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LabVIEW software per driver Technosoft IDS-IDM 240-640

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Abstract

Di seguito verrano spiegate le principali funzioni utilizzate nel sistema di controllo di SPARC per movimentare i motori stepper con i driver della Technosoft IDS-IDM 240 e 640.

1. Introduzione

I driver della Technosoft sono dei controllori di movimento molto performanti in grado di comunicare con PC e PLC in RS232. Ogni driver ha una sua memoria programmabile e un indirizzo fisico configurabile per la comunicazione in CANopen la quale, una volta stabilita la comunicazione con il driver principale (detto MASTER) si può accedere alla catena di driver formata dal CANopen.

Fig.1 Driver Technosoft IDM

2. Installazione librerie e funzioni LabVIEW

Per poter comunicare tramite un PC con un driver della Technosoft è necessario installare il programma "Easy Motion studio" il quale installerà (in un sistema operativo Windows) nella cartella "C:\WINDOWS\system32" la libreria "tmlcomm.dll". Le funzioni necessarie per comunicare e comandare attraverso le funzioni LabVIEW, sono contenute e installate dal programma "TML_Lib Lybrary for Labview", la sua installazione creerà una cartella chiamata "TML_LIB_LabVIEW" dove al suo interno troveremo le funzioni, gli esempi e i vari file di configurazione. Tutti i VI installati sono proprietari della Technosoft, in quanto non è possibile modificarli perché costituiti da una "Call Library Function Node" che non può è essere in alcun modo alterata, perché ogni VI richiama la libreria "tmlcomm.dll".

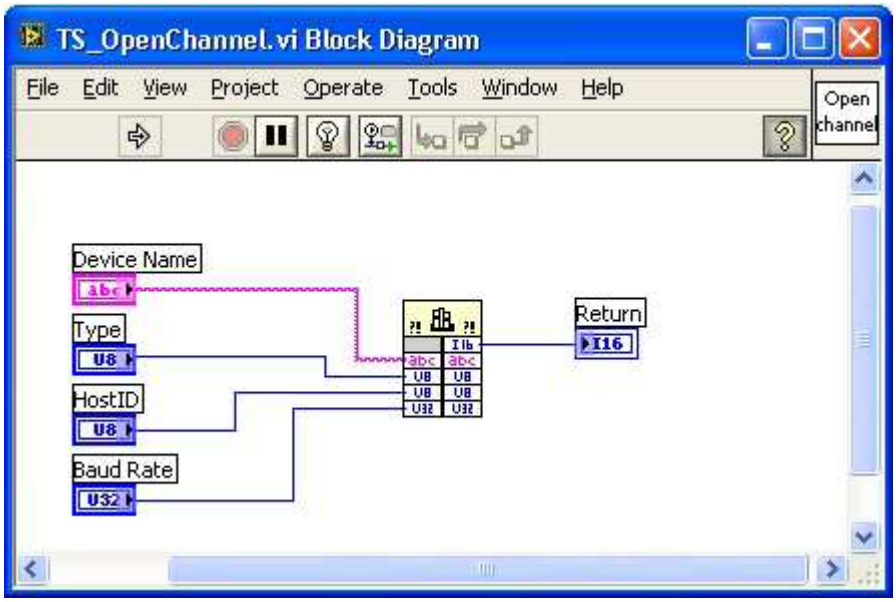


Fig.2 Block Diagram del VI "TS_OpenChannel.vi"

3. Inizializzazione driver e VI di lettura errore.

Per inizializzare la porta di comunicazione, come primo VI viene utilizzato "\TML_LIB_LabVIEW\Functions\TS_OpenChannel.vi"

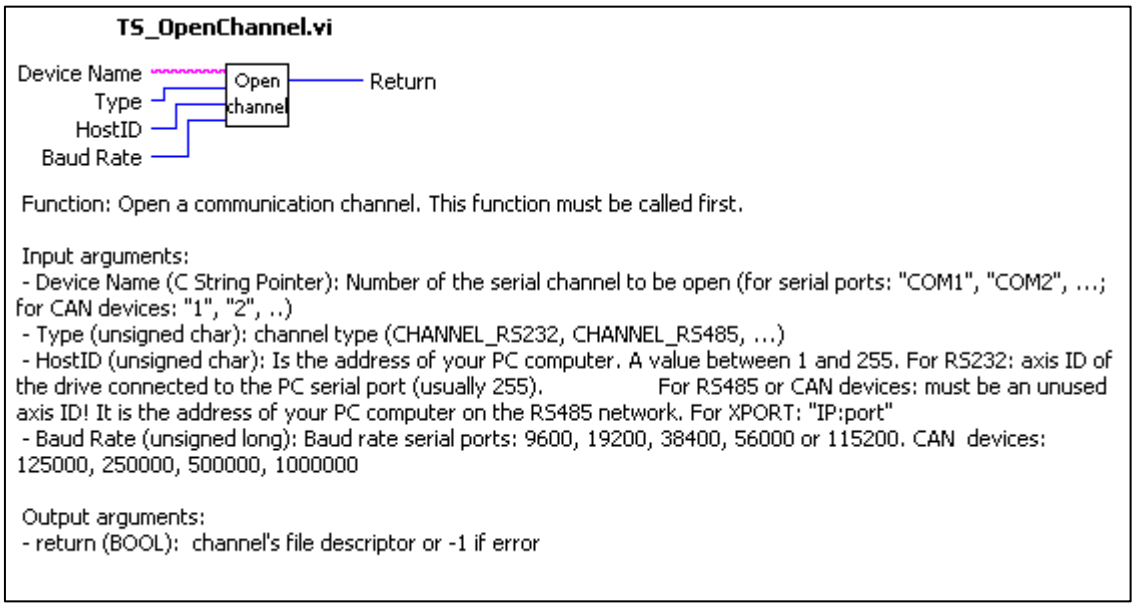


Fig.3 Spiegazione VI "TS_OpenChannel.vi"

Come spiegato in figura 3, il "Device name" è una stringa dove scrivere il numero della porta seriale, il "Type" definisce il tipo di protocollo seriale (0 = RS232 | 1 = RS485), "HostID" definisce l'ID del driver (MASTER) al quale il PC è collegato direttamente (da 1 a 255) e nella voce "Baud Rate" verrà passato il numero di caratteri al secondo.

Dopo l'apertura del canale, è necessario caricare le impostazioni di sistema dal file "\TML_LIB_LabVIEW\Setups\IBL2403 - CAN - ID1.t.zip" passando il percorso del file direttamente nella funzione "TS_LoadSetup.vi"

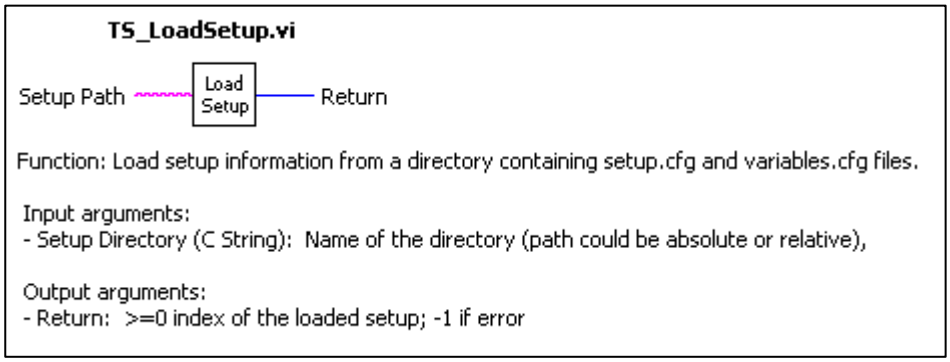


Fig.4 Spiegazione VI "TS_LoadSetup.vi"

Dopo aver carico in memoria le informazione contenenti nei file "setup.cfg" e "variables.cfg", si devono associare al driver che vogliamo movimentare, quindi utilizzeremo la funzione "TS_SetupAxis.vi" al quale passeremo il numero ID del driver da controllare.

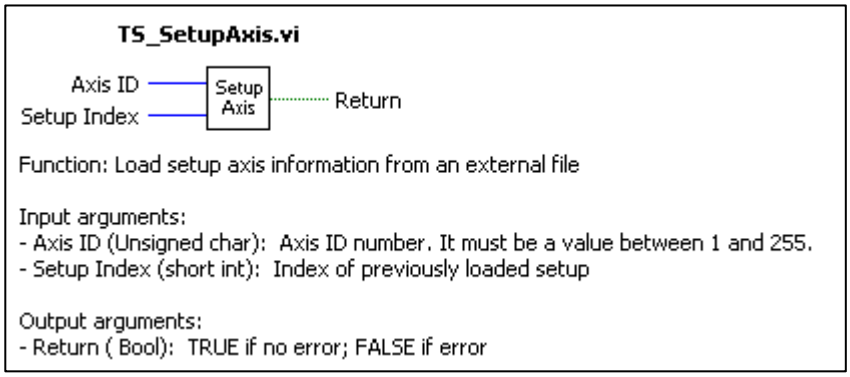


Fig.5 Spiegazione VI "TS_SetupAxis.vi"

In figura 6 è rappresentata la funzione "TS_SelectAxis.vi" la quale seleziona il driver che andremmo a controllare. Tramite l'input "Axis ID" (da 1 a 255) viene richiamato il driver "Master" o uno qualsiasi dei driver collegati in catena tramite CANopen.

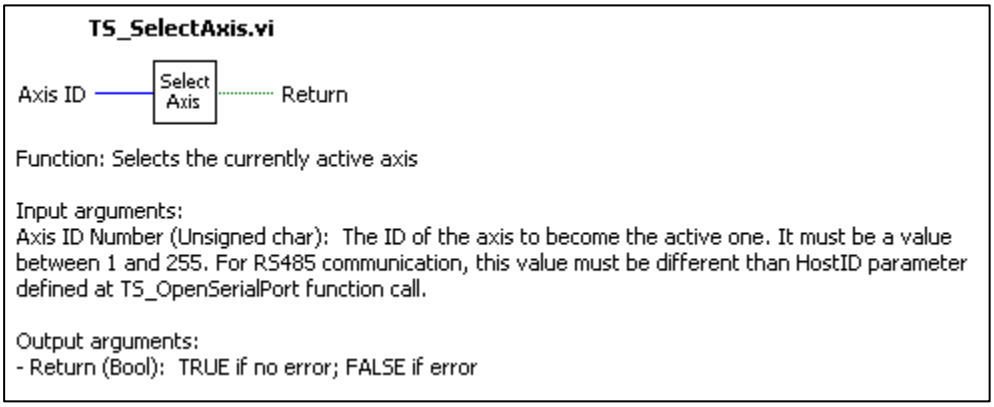


Fig.6 Spiegazione VI "TS_SelectAxis.vi"

Per verificare se tutte le funzioni di inizializzazione sono andate a buon fine, utilizziamo la funzione "TS_DriveInitialisation.vi" che esegue il comando ENDINIT e verifica se il driver è stato inizializzato correttamente, restituendo un Output di conferma.

Fig.7 Spiegazione VI "TS_DriveInitialisation.vi"

Ogni funzione possiede un output di "Return" dove il VI restituisce un valore di tipo numerico o booleano. Per sapere che tipo di errore è stato rilevato, dobbiamo utilizzare la funzione di "TS_GetLastErrorText.vi" che semplicemente restituirà l'ultimo messaggio di errore rilevato sottoforma di una stringa.

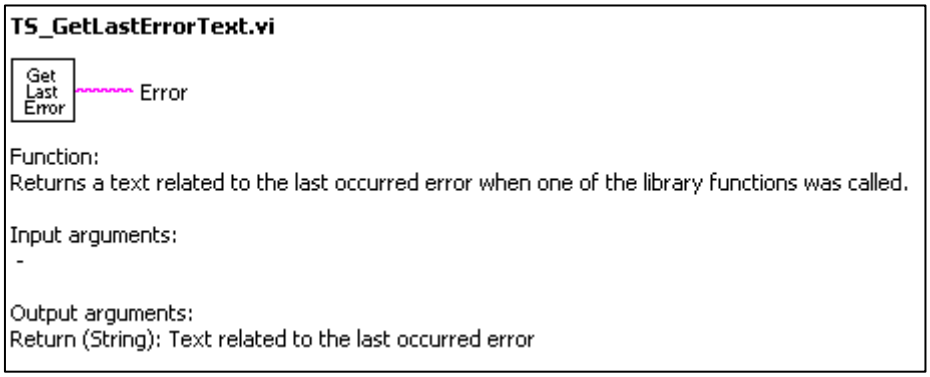


Fig.8 Spiegazione VI "TS_GetLastError.vi"

4. Funzioni di controllo dello stato del driver

Le funzioni che la Technosoft mette a disposizioni, sono più di 90. Di seguito elencherò solo le funzioni utilizzate dal sistema di controllo che necessitano di una più dettagliata spiegazione.

La funzione "TS_ReadStatus.vi" permette di leggere i registri interni al driver, in particolar caso noi abbiamo bisogni di leggere lo stato di funzionamento del motore. Grazie ai registri "REG_SRH" "REG_SRL" e "REG_MER" possiamo accedere a delle word di 16bit che rilevano lo status del driver e del motore. Oltre ai registri di errore, è molto importante lo status dei bit presenti nel registro "SRL" i quali rilevano se il motore è ON (bit 15) o se il motore è in stato di attesa o di running (bit 10).

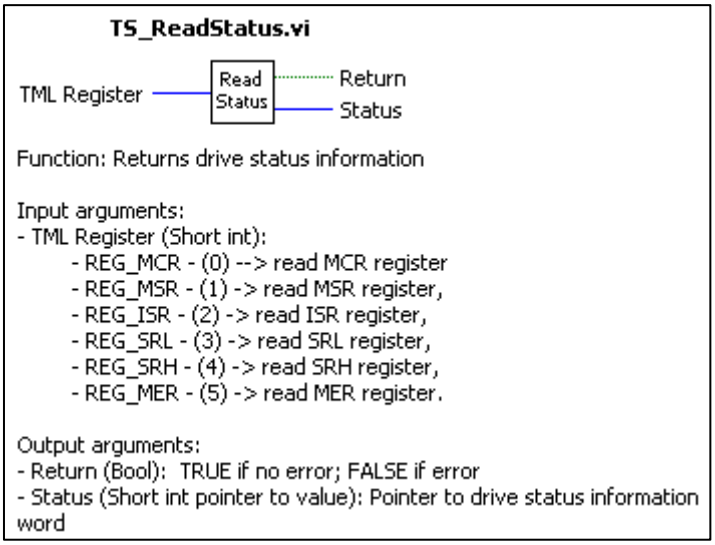


Fig.9 Spiegazione VI "TS_ReadStatus.vi"

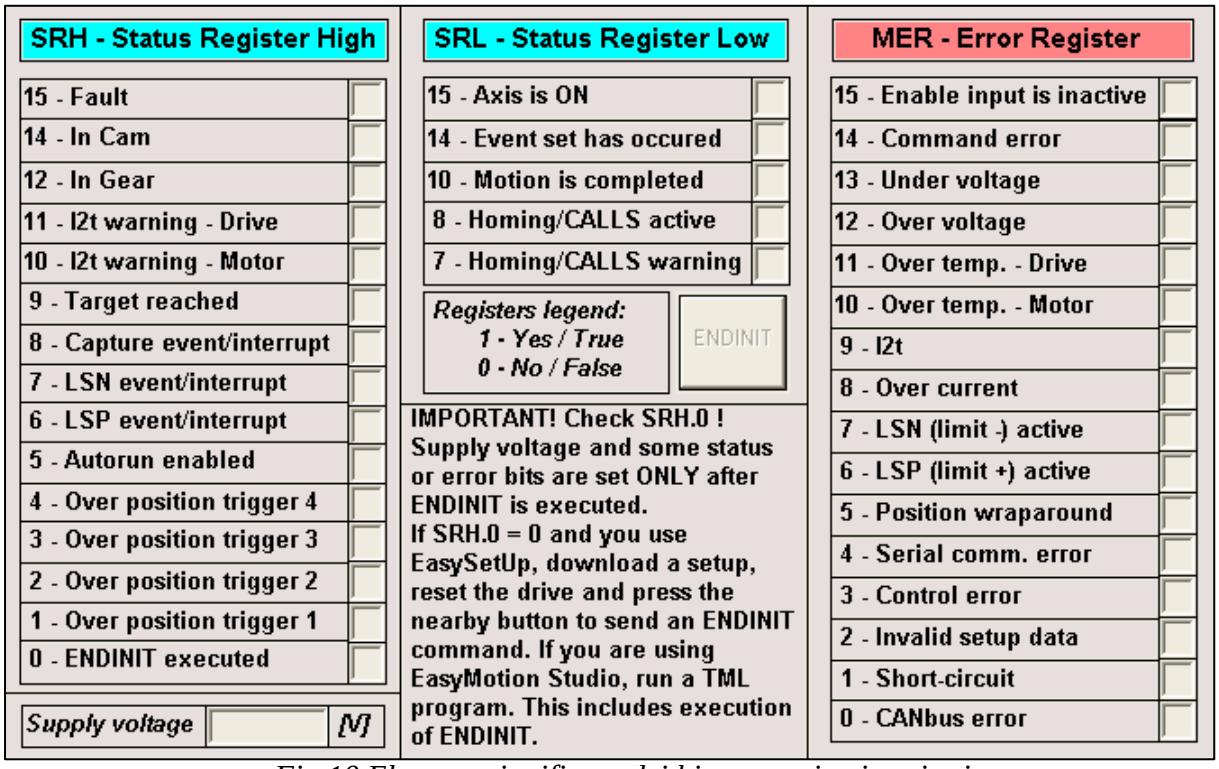


Fig.10 Elenco e significato dei bit presenti nei registri

Per rilevare lo stato dei fine corsa, oltre a poterli leggere dallo stato dei registri, usiamo la funzione "TS_GetInput.vi", la quale restituisce lo stato degli input presenti sulla scheda.

Elenco input:
Port[2] = IN INVERT "2/LSP"
Port[5] = IN "5/CAPI"
Port[16] = IN INVERT "16/ENABLE"
Port[24] = IN INVERT "24/LSN"
Port[29] = IN INVERT "29/GPIN1"
Port[30] = IN INVERT "30/GPIN2"
Port[34] = IN "34/H1"
Port[35] = IN "35/H2"
Port[36] = IN "36/H3"
Port[37] = IN "37/DIR"
Port[38] = IN "38/PULSE"

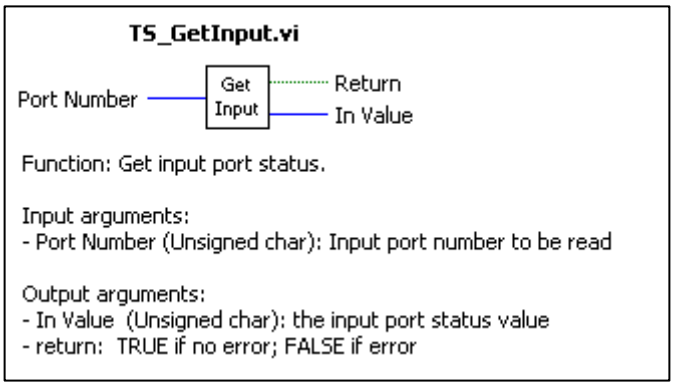


Fig.11 Spiegazione VI "TS_GetInput.vi"

Le funzioni "TS_GetIntVariable.vi" , "TS_GetLongVariable.vi" e "TS_GetFixedVariable.vi" restituiscono tutte quelle variabili che necessitano di word da 16 o 32 bit. Nel manuale (sezione TML Variables) sono descritte molteplici variabili, quelle da noi più utilizzate sono "TPOS" (Long) che rileva la posizione relativa ai passi eseguiti dal motore, e le due variabili AD2 e AD5 (Int) che restituiscono i valori "reference e feedback" corrispondenti alle tensioni del potenziometro esterno.

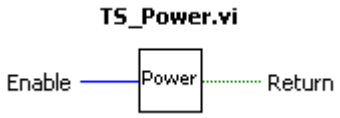
Type	Format	Representation	Range
Int	Signed integer	16 bits	-32768 ¸ 32767 (0x8000 ¸ 0x7FFF)
Long	Signed long integer	32 bits	-2147483648 ¸ 2147483647 (0x80000000 ¸ 0x7FFFFFFF)
Fixed	(Integer part).(fractional part)	32 bits	-32768.999969 ¸ 32767.999969 (0xFFFF.FFFF ¸ 0x7FFF.FFFF)

Fig.12 Tabella dei formati di rappresentazione variabili.

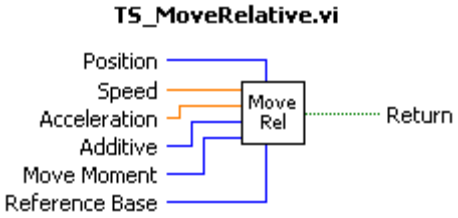
5. Funzioni di comando motore

Anche le funzioni di comando e di configurazione del driver sono molteplici. Si può, oltre a comandare il motore, gestire lo stato degli output digitali (con il VI "TS_SetOutput.vi") e settare le variabili per la movimentazione del motore. Le funzioni essenziali per movimentare un motore sono tre.

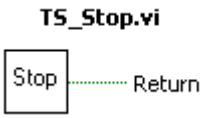
- TS_Power.vi
  Questa funzione abilita il passaggio di corrente verso il motore (1 = ON | 0 = OFF)



- TS_MoveRelative.vi
  Questa funzione permette di muovere il motore passandogli come parametri principali, il valore dei passi da compiere (Position) la velocità (Speed) l'accelerazione (Acceleration) e varie variabili settabili a seconda del caso e delle necessità.



- TS_Stop.vi
  Questa funzione ferma immediatamente il motore



Nel caso della funzione di stop, esistono 4 varianti. Queste varianti possono essere attivate con un "TML command" LSACT STOPx, dove la x è uguale a 0,1,2 o 3.
STOP0 ferma il motore con il tasso di decelerazione preventivamente programmato
STOP1 imposta la velocità a 0
STOP2 imposta la corrente a 0
STOP3 imposta la tensione del motore a 0.

Per inviare un qualsiasi comando (TML command) al driver, si utilizza il VI "TS_Execute.vi" che, come mostrato in figura 13, deve essere inviato sotto forma di stringa.

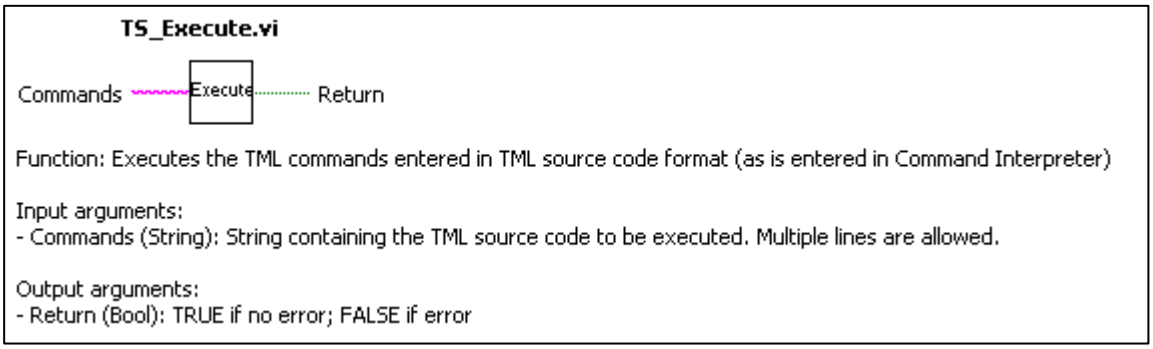


Fig.13 Spiegazione VI "TS_Execute.vi"

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IDM240_640-User-Manual
http://www.google.it/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CFMQFjAA&url=http%3A%2F%2Fftp.ruigongye.com%2Fdownloadfile.aspx%3Fpath%3D%252F200808%252FIDM240_640-User-Manual.pdf&ei=OwjfT7uMC-mk4gTF8aCvCg&usg=AFQjCNErIwdAdl1Uftdls35-qGssk6O9hA

IDM240
IDM640

Version 1.1

Intelligent Servo Drive for DC, Brushless DC and AC Motors

TECHNOSOFT

Intelligent Servo Drives

Technical Reference

TECHNOSOFT

IDM240/640 v1.1
Technical Reference

P091.048.051.IDM.UM.0803
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Read This First

About This Manual

This book is a technical reference manual for the **IDM240/640** intelligent servo drive. It describes the IDM240/640 operation and provides basic information needed to program the IDM240/640 in the Technosoft Motion Language (**TML**) environment.

Notational Conventions

This document uses the following conventions:

- The **Technosoft Motion Language** will be referred to as **TML**
- TML variables, parameters or instructions are shown in special italic typeface. Here is a sample:

  SETIO#4 IN;
  UPD;

Information about Cautions

This book may contain caution statements.

> **CAUTION ! This is an example of a caution statement.**
> **A caution statement describes a situation that could potentially cause harm to you or to the IDM240/640 intelligent servo drive unit**

Related Documentation from Technosoft

Technosoft MotionChip™ User Manual, parts 1 and 2 (parts no. UMMCp1, UMMCp2), describes in detail the Technosoft Motion Language and how to use it to program motion applications on products like IDM240/640 supporting this high-level language interface

IPM Motion Studio User Manual (part no. UMMS) describes how to use the IPM Motion Studio – the complete development platform for IDM240/640 including: motion system setup & tuning wizard, motion sequence programming wizard, testing and debugging tools like: data logging, watch, control panels, on-line viewers of TML registers, parameters and variables, etc.

If you Need Assistance …

If you want to …	Contact Technosoft at …
Visit Technosoft online	World Wide Web: http://www.technosoftmotion.com/
Receive general information or assistance (see Note)	World Wide Web: http://www.technosoftmotion.com/ Email: contact@technosoftmotion.com
Ask questions about product operation or report suspected problems (see Note)	Fax: (41) 32 732 55 04 Email: hotline@technosoftmotion.com
Make suggestions about, or report errors in documentation.	Mail: Technosoft SA Case postale 52 Rue des Courtils 8A CH-2035 Corcelles - NE Switzerland

Note: You need to **register your IDM240 or IDM640** system in order to get free assistance and support. Use the License no. of your IPM Motion Studio.

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1. IDM240/640 Overview

This chapter describes the IDM240/640 key features along with a block diagram and provides a functional overview.

The IDM240/640 is a fully digital intelligent servo drive based on the latest DSP controller technology. Embedded with the high level Technosoft Motion Language (**TML**) the IDM240/640 offers a flexible, compact and easy to implement solution for single or multi-axis applications with

- brushless DC motors
- permanent magnet synchronous motors (PMSM)
- DC brush motors

The IDM240/640 can operate stand-alone, with the motion sequences stored in the internal E^2ROM, or under the supervision of a master controller that can send motion commands through RS-232, RS-485 or CAN communication channels. Limit switches; capture inputs or general purpose I/Os may also be used to trigger the execution of pre-stored motion sequences.

The powerful TML offers the possibility of programming various motion modes, like position or speed profiles, contouring, electronic gearing, electronic cam, external references, including 2 test modes for hardware setup validation.

The configuration, tuning and programming of the IDM240/640 intelligent servo drive can be easily done using the Technosoft **IPM Motion Studio** - an integrated development platform for digital motion control applications that offers a set of high level graphical tools:

- Setup Wizard that provides a quick way to:
  - Describe the system structure like motor and sensors types, control mode, etc.
  - Enter the basic system parameters
  - Perform tests to validate the system hardware
  - Identify the motor and load parameters
  - Tune the controllers
- Motion Wizard for motion application programming
- Data logging and watch facilities enabling the graphical or numerical display of the status of various motion system variables during tests.

1.1 Key Features

- Fully digital servo drive with embedded intelligence
- Suitable for brushless DC, PMSM and DC brush motors
- Vector (field-oriented) control of AC motors (PMSM)
- High level quick setup, tuning and motion programming with Technosoft IPM Motion Studio
- Powerful TML instruction set for definition and execution of motion sequences, enabling:
  - Single or multi axis control
  - Standalone operation with motion sequences stored in E^2ROM
  - Different control modes: open-loop, torque, speed or position close-loop control
  - External variables control capabilities (pressure, flow, temperature, …)
  - Various motion modes:
    - Electronic cam, gearing, contouring, profiling: position or speed (jogging)
    - External digital or analogue reference inputs
    - Test modes for hardware setup validation
  - 18 programmable event triggers when motion modes can be changed on-the-fly
  - Automatic subroutines (TML interrupts) for monitoring up to 12 conditions like protections triggered, communication or control error, etc.
  - Motion sequences triggered by digital inputs
  - On-line motion parameterization and adjustment using analogue inputs
  - Precise position capture on CAPI encoder Index input
- Emergency shutdown
- RS-232 and RS-485 serial interface
- CAN interface
- 32K×16 zero-wait state SRAM memory
- 4K×16 E^2ROM to store TML programs (16Kx16 optional)
- Compact design: 136 x 95 x 26mm
- Nominal PWM switching frequency: 20kHz[1]
- Nominal update frequency for torque loop: 10kHz[1]
- Nominal update frequency for speed/position loop: 1kHz[1]
- Minimal load inductance: 50µH @12V, 200µH @48V, 330µH @80V
- Operating ambient temperature: 0-50°C

[1] Nominal values cover all cases. Higher values may be programmed for configurations with brushless DC and with DC brush motors

1.2 Functional Overview

1.2.1. Block Diagram

Figure 1.1 presents the block diagram of the IDM240/640 intelligent servo drive with its main components.

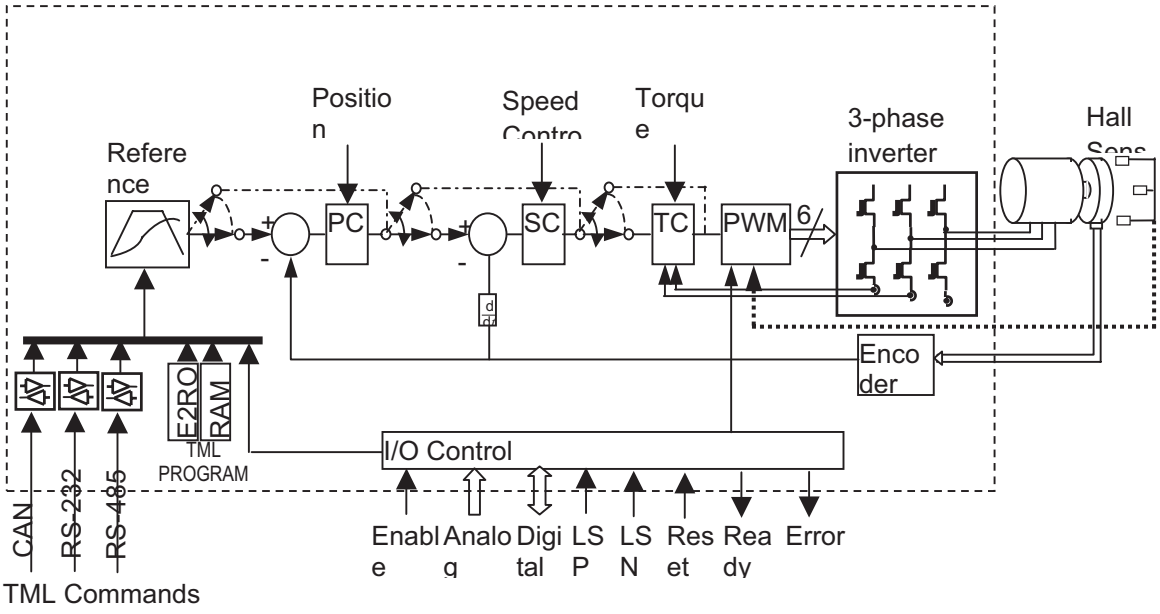


Figure 1.1. The block diagram of the IDM240/640 intelligent servo drive

1.2.2. Motion Application Configurations

Tables 1.1 and 1.2 show the motion application configurations selectable with the IDM240/640.

In bold typeface are the recommended configurations, for the available sensors. In normal typeface are the possible configurations. These may be covered by a recommended one. In italic typeface are technically possible configurations. In these cases the performances have to be evaluated prior to selection.

Table 1.1. *Motion application configurations with DC brush and brushless DC motors*

No	Application Configuration	Controlled Loops			Sensors Required			
		Pos	Spd	Crt	User	Pos	Spd	Crt
1	Open loop, Voltage mode							
2	Torque control			√				√
3	Speed control, Voltage mode *		√			Anyone		
4	Speed control, Current loop		√	√		Anyone		√
5	Position control, Speed & Current loop	√	√	√		√		√
6	Position control, Voltage mode *	√				√		
7	Position control, Current loop *	√		√		√		√
8	Position control, Speed mode *	√	√			√		
9	User specific control, Voltage mode *	√			√			
10	User specific control, Current loop *	√		√	√			√
11	User specific control, Speed loop, Voltage mode *	√	√		√	Anyone		
12	User specific control, Speed & Current loop	√	√	√	√	Anyone		√

Table 1.2. *Motion application configurations with brushless AC motors (PMSM)*

No	Application Configuration	Controlled Loops			Sensors Required			
		Pos	Spd	Crt	User	Pos	Spd	Crt
1	Open loop, Voltage mode					(√)		
2	Torque control, FOC			√		√		√
3	Speed Control, Voltage mode *		√			√		
4	Speed control, Current loop, FOC		√	√		√		√
5	Position control, Speed & Current loop, FOC	√	√	√		√		√
6	Position control, Voltage mode *	√				√		
7	Position control, Current loop, FOC*	√		√		√		√
8	Position control, Speed mode *	√	√			√		
9	User specific control, Voltage Mode *	√			√	(√)		
10	User specific control, Current loop, FOC *	√			√	√		√
11	User specific control, Speed loop, Voltage mode *	√	√		√	√		
12	User specific control, Speed & Current loop, FOC	√	√	√	√	√		√

Legend:

* – Special mode, an outer loop is closed in the absence of an inner one. Lower performances may be expected than in the case when the inner loop is closed

(√) – Sensor is optional. 2 different approaches: a) sensor present, b) sensor not present

Controlled Loops: Pos – Position or user external, Spd – Speed, Crt – Current/Torque

1.2.3. Sensors

Table 1.3 presents the categories of sensors accepted by the IDM240/640, and their connections.

Table 1.3. IDM240/640 accepted sensors

Cat	Usage	Type	Connections
Position	Position feedback	Incremental encoder single-ended or differential	A1+ for A, (A1- for $\overline{A}$) B1+ for B, (B1- for $\overline{B}$) Z1+ for Z, (Z1- for $\overline{Z}$)
		Analogue sensor	+Tach, -Tach
		Sent on-line by a host	RS-232/RS-485 communication channel
Speed	Speed feedback	Computed from position	The position sensor connections
		Tachometer (analogue)	+Tach, -Tach
		Computed from time between Hall edges, single-ended or differential Hall	H1/B2/DT+ for Hall1, (H1/B2/DT- for $\overline{\textbf{Hall1}}$) H2/Z2+ for Hall2, (H2/Z2- for $\overline{\textbf{Hall2}}$) H3/A2/CK+ for Hall3, (H3/A2/CK- for $\overline{\textbf{Hall3}}$)
		Sent on-line by a host	RS-232 / RS-485 / CAN communication channel
Current	Current feedback	2 shunts in inverter legs	On-board
Torque	Torque feedforward	Sent on-line by a host	RS-232 / RS-485 / CAN communication channel
User specific	External-loop sensor feedback	Analogue sensor	+Tach, -Tach
		Sent on-line by a host	RS-232 / RS-485 / CAN communication channel
Hall sensors	Commutation	120° apart, single-ended or differential	H1/B2/DT+ for Hall1, (H1/B2/DT- for $\overline{\textbf{Hall1}}$) H2/Z2+ for Hall2, (H2/Z2- for $\overline{\textbf{Hall2}}$) H3/A2/CK+ for Hall3, (H3/A2/CK- for $\overline{\textbf{Hall3}}$)
Voltage	Over and under- voltage protection V_{DC} compensation	Analogue sensor	On-board
Temp.	Drive over-temperature protection	Analogue sensor	On-board
	Motor over-temperature protection	Analogue sensor	Therm, GND

1.2.4. Controlled Loops

As Figure 1.1 shows, the IDM240/640 control unit includes 3 control loops.

The outer loop is used for motor position control. It can be also used to control an external signal if user specific control mode is selected. In this case, the IDM240/640 can perform for example a temperature, pressure or flow control. The outer loop controller is a PID with filter on the derivative term. The PID output can be used as speed, torque or voltage command for the motor.

The middle loop implements the speed control. The speed loop controller is a PI with speed, acceleration and torque feedforward. The speed loop controller output can be used as torque or voltage command for the motor. A limit for torque command can be set from an analogue input.

The inner loop performs the current/torque control. For AC motors, torque control is performed using a field oriented control (FOC) scheme. The inner loop uses 2 PI controllers one for torque control (Q axis controller) and the other for flux control (D axis controller). The inner loop provides a voltage vector command, which is translated into PWM commands.

1.2.5. Special Features

The IDM240/640 control unit includes a set of programmable special features. These offer the possibility to select different strategies according with the application specific. The next table summarizes these features.

Table 1.4. Special features of the IDM240/640 control unit

Function	Options
Current Offset Detection	Automatic, with motor supplied (PWM outputs active)
	Automatic, without motor supplied (PWM outputs inactive)
	Automatic detection is disabled. User provides the offset
Start method for the brushless AC (PMSM) motors	Motor is aligned on phase A, by injecting a current in phases B and A
	Motor is aligned on phase A, by applying a voltage on phases B and A
	Motor starts as a brushless DC using Hall commutation. After first Hall transition, commutes to brushless AC mode (FOC, sinusoidal currents)
	Motor is moved with a rotary current vector, till encoder index pulse is reached. Index offset to motor position when aligned on phase A should be known
	Motor is moved with a rotary voltage vector, till encoder index pulse is reached. Index offset to motor position when aligned on phase A should be known
	Motor is aligned on phase A, by injecting a currents in phases in a way that moves the motor only in the programmed direction
	Motor is aligned on phase A, by applying voltages on phases in a way that moves the motor only in the programmed direction
	Direct, using an absolute position sensor. The sensor offset to motor position aligned on phase A should be known.

	Automatic detection of an absolute position sensor offset. Motor is aligned on phase A with one of the above methods and computes the offset.
PWM command Techniques	With compensation of DC-bus voltage variation
	With compensation of dead-time
	With 3rd harmonic injection to increase maximum applicable voltage
	With PWM frequency wobbling around programmed value to reduce EMI (electromagnetic interference)

1.2.6. PWM Frequency and Sampling Rates

The IDM240/640 uses a fast loop for current/torque control and a slow loop for position/speed sampling. The sampling rates of these loops are synchronized and linked in a fixed ratio with the PWM frequency in order to eliminates the beat-frequency problems. The maximum sampling frequency on the fast loop can be half of the PWM frequency. The PWM frequency and the divider ratios for fast and slow loops are user programmable in a wide range. The maximum values for PWM frequency and sampling rate frequencies depend on the application configuration. Table 1.5 shows the typical (default) values, which cover all motion application configurations.

Table 1.5. Typical values for PWM frequency and sampling rates

PWM	Fast loop (current/torque)	Slow loop (position/speed)
20kHz	10kHz	1kHz

1.2.7. Motion modes

The IDM240/640 provides 35 motion modes. Each motion mode designates a reference mode and a control structure. Table 1.6 summarizes for each type of control the reference modes accepted.

Table 1.6. Motion Modes

1.1.1.1.1 Reference Modes	**1.1.1.1.2 Control Type**			
	Position / User Specific	**Speed**	**orque**	**oltage**
Profiles (trapezoidal speed)	√	√		
Contouring (point to point with linear interpolation)	√	√	√	√
Electronic Gearing Master	√	√		
Electronic Gearing Slave	√			
Electronic Cam Master	√	√		
Electronic Cam Slave	√			
External, reference read	√	√	√ SL	√ SL

from the analogue input (+Ref, -Ref)			√ FL	√ SL
External, reference sent on-line through RS-232/RS-485 communication channel	√	√	√ SL	√ SL
			√ FL	√ FL
Test (limited ramp)			√ FL	√ FL
Stop	√	√	√	√

Legend

SL – Reference update is done on the slow (position/speed) loop

FL – Reference update is done on the fast (current/torque) loop

In all the cases where SL or FL is not mentioned, the reference update is done on the slow loop

1.2.8. Operating Modes

The IDM240/640 can operate in 2 modes: **Autorun** (stand-alone) and **External** (slave).

In Autorun (stand-alone) mode, the IDM240/640 executes motion sequences, stored in the E^2ROM. There are no restrictions to motion modes or application configurations. The IDM240/640 enters in this operation mode automatically if:

Auto / Ext position of DIP Switch is ON immediately after power-on

The code of the TML instruction BEGIN is detected in first location from the E^2ROM at the address 4000h (see Par. 1.2.9. Memory)

In **External** (slave) mode, the IDM240/640 wait commands from an external device (PC or master controller) through communication channels. There are no restrictions to motion modes or application configurations. The IDM240/640 enters in slave mode if **Auto / Ext** position of DIP Switch is OFF immediately after power-on.

In **External** mode, the commands sent by the master have higher priority, acting like “interrupts” if in the moment of reception a TML program is executing from the local memory.

The possibility to execute both commands sent by a master and TML programs or functions from the local memory with or without automatic execution after power-on, offer the flexibility required for multiple-axis applications with distributed intelligence. For example, each axis can store in the local memory the start-up initialization procedure plus a set of functions performing different motion sequences. After power-up, with Auto / Ext position of DIP Switch in ON state, the axis automatically executes the initialization sequence, and then waits for master commands. These can resume to “call homing procedure”, “call motion sequence no. 1” etc. Once the command issued it is the slave axis job to execute it.

1.2.9. Memory Map

The IDM240/640 has 2 types of memory: a 32K×16 zero-wait-state SRAM and an 8K×8 serial E^2ROM.

The SRAM memory is mapped both in the program space and in the data space in the address range 8000h to 0FFFFh. The data memory can be used for real-time data acquisition and to temporary save variables during a TML program execution. The program space can be used to download and execute TML programs. It is at user choice to decide how to split the 32K SRAM in data and program memory.

The E^2ROM is seen as 4K×16 program memory mapped in the address range 4000h to 4FFFh. It offers the possibility to keep TML programs in a non-volatile memory. Read and write accesses to the E^2ROM locations as well as TML programs downloading and execution are done from the user point of view similar with those in the SRAM program memory. The E^2ROM SPI serial access is completely transparent for the user.

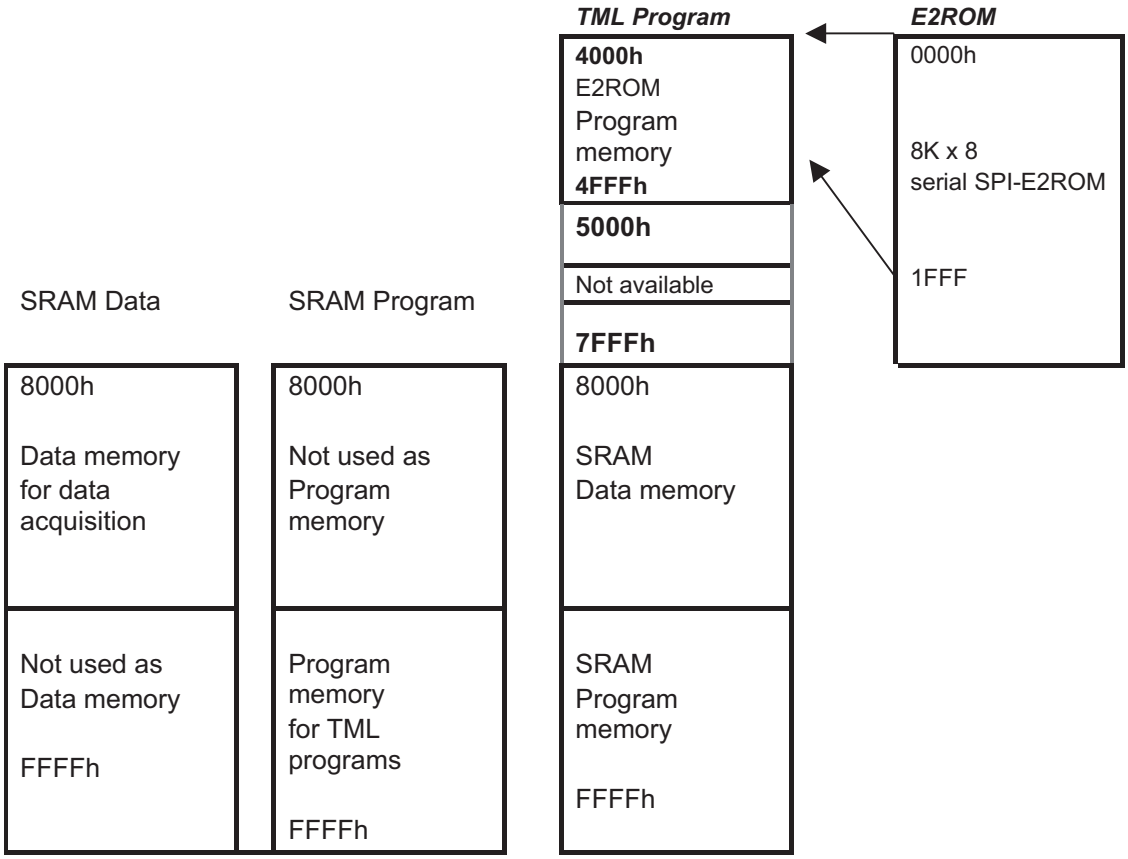


Figure 1.2. IDM240/640 Memory Map

2. Technical specifications

The following paragraphs present in detail all the technical specifications of the IDM240 / 640 family of Intelligent Servo Drives.
Please read this chapter **before** starting to work with the drive. Carefully observe the specifications and compare them with your motor / sensor specifications.

2.1 Key Features

- Single-ended, open-collector or differential encoder interface (IDM240-5EI
- and IDM640-8EI) [1]
- Resolver interface (IDM240-5RI and IDM640-8RI) [2] :
    - Differential outputs for resolver excitation
    - Excitation signal: sinusoidal, f = 10KHz
    - Amplitude of the output signal, adjustable in 0-8V_{pp}
    - Output current: max 50 mA_{RMS}
    - Differential inputs (from resolver Sin & Cos)
    - Input voltage: V_{in} = 4 V_{pp}
- Single-ended, open collector or differential Hall sensor interface
- Second encoder input (single-ended, open-collector or differential) used for master reference
- 24V opto-isolated IO:
    - 8 digital inputs: 6 general purpose, RESET and ENABLE
        - All digital inputs active high (24V): connected to 24V => DSP pin = 1
        - 2 digital inputs available as 24V and 5V:
        - Maximum input frequency signal = 5MHz
    - 6 digital outputs 24V compatible:
        - All 6 digital outputs at 24V and 80mA
        - All active low: 0 on DSP pin => IO in 24V; 1 on DSP pin or HighZ => IO in HighZ
        - Maximum output frequency signal = 30KHz
    - 2 differential analog inputs+/-10V (reference and tacho)
- Compact design: 136 x 95 x 26 mm
- RS-232, RS-485 serial communication
- CAN-Bus 2.0B up to 1Mbit/s

[1] The IDM240-5EI and IDM640-8EI can support the SSI and EnDat position sensors. For more information, please contact Technosoft.
[2] The IDM240-5RI and IDM640-8RI can support the SSI, EnDat, SinCos and Linear Hall position sensors. For more information, please contact Technosoft.

- Hardware Axis ID selection
- Motor sensor thermal interface
- On-board temperature sensor
- Nominal PWM switching frequency: 20kHz[1]
- Nominal update frequency for torque loop: 10kHz[1]
- Nominal update frequency for speed/position loop: 1kHz[1]
- Logic power supply: 12-48V$_{DC}$
- Motor power supply:
  - (IDM240 – 5EI and IDM240 – 5RI): 12-48V; 5A; 16A peak
  - (IDM640 – 8EI and IDM640 – 8RI): 12-80V; 8A; 16A peak
- Minimal load inductance: 50µH @12V, 200µH @48V, 330µH @80V
- Operating ambient temperature: 0-50°C

[1] Nominal values cover all cases. Higher values may be programmed for configurations with brushless DC and DC brush motors.

2.2 *Drive Drawings*

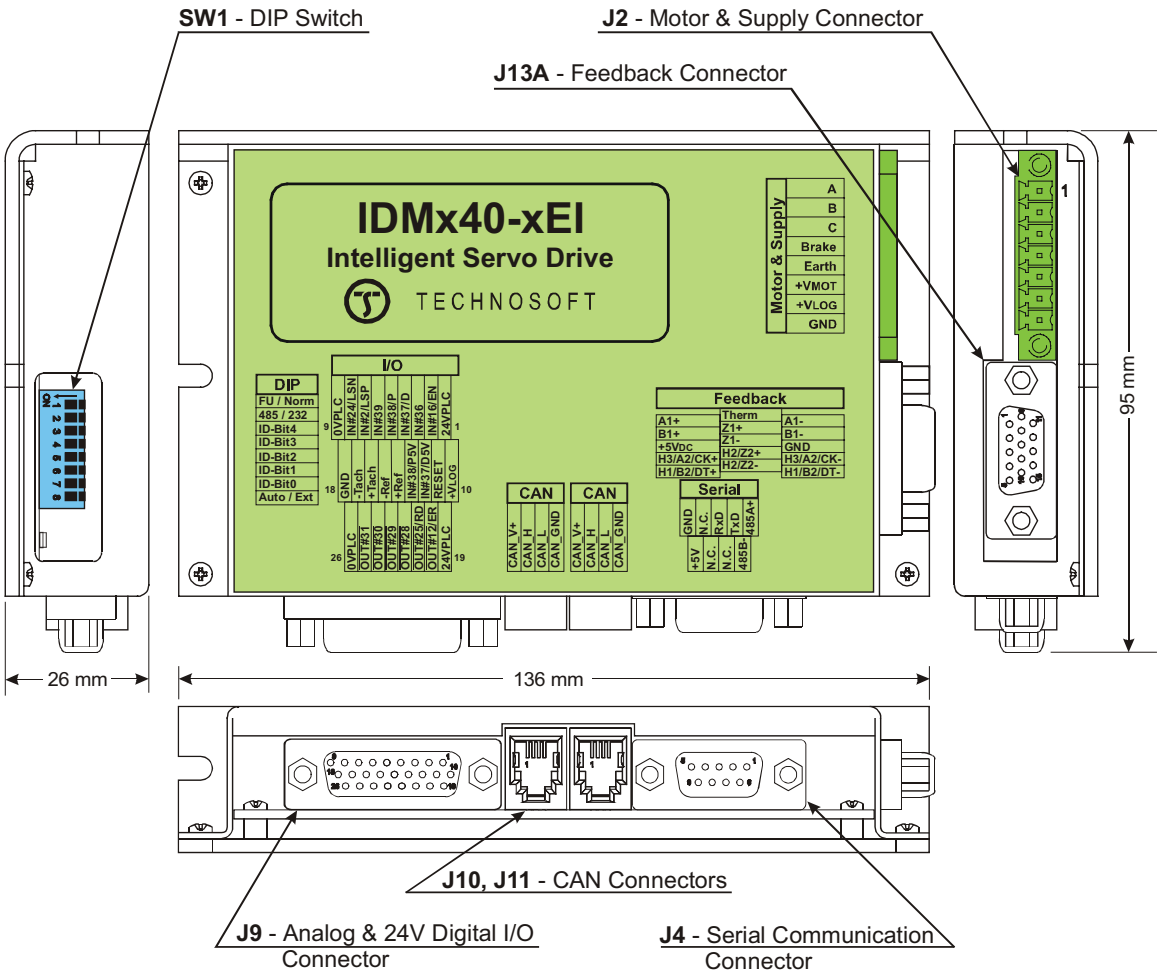


Figure 2.1. IDM240-5EI and IDM640-8EI drawings

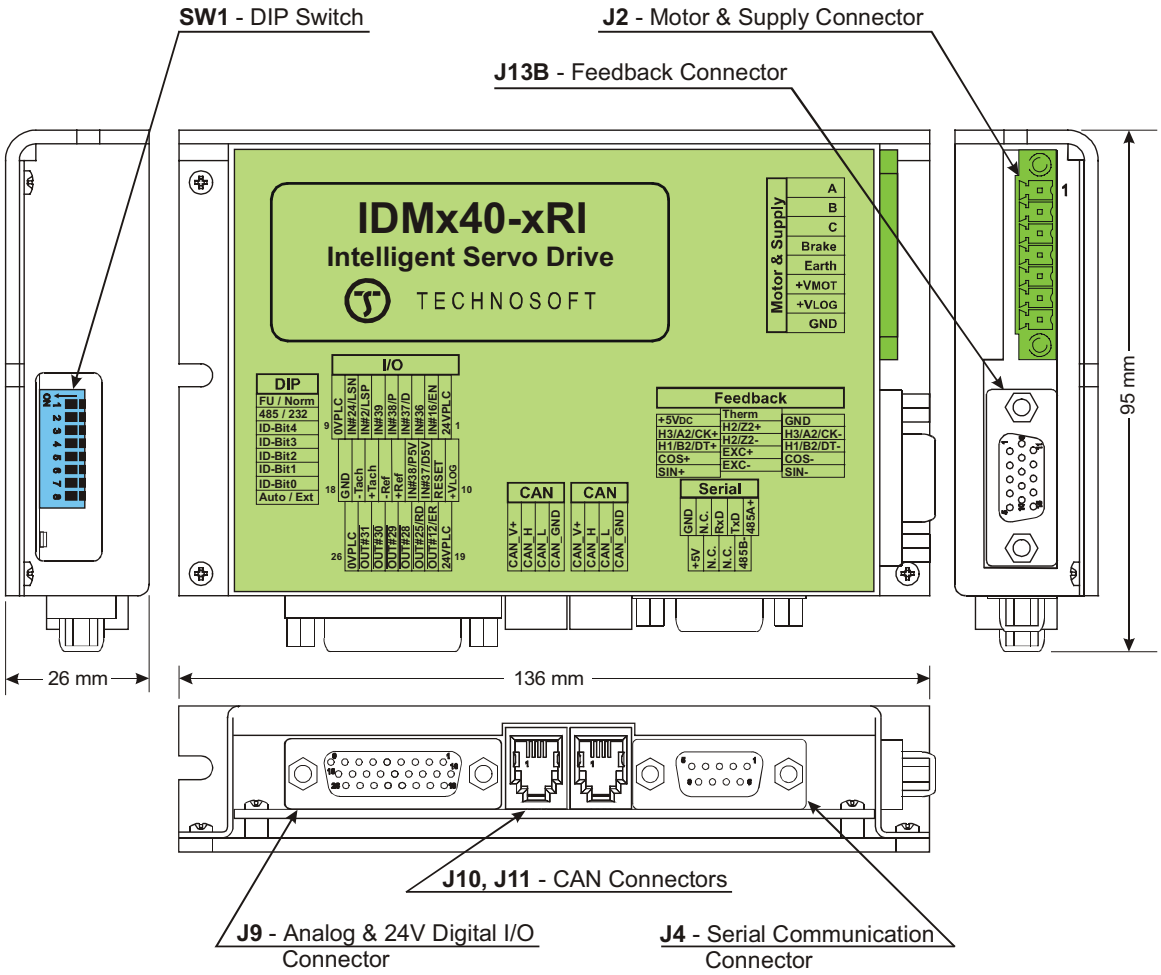


Figure 2.2. IDM240-5RI and IDM640-8RI drawings

2.3 *Connector's Specifications*

2.3.1. Analog & 24V Digital I/O – J9 Connector

Pin	Name on the Drive cover	TML name	Type	Function / Alternate function / Comments
1	*24VPLC*	-	I	24 V power supply (+) terminal for all opto-isolated I/O
2	*IN#16/EN*	*IN#16 / ENABLE*	I	24V compatible input. Opto-isolated Connect to +24V to disable the PWM outputs
3	*IN#36*	*IN#36*	I	24V compatible input. Opto-isolated.
4	*IN#37/D*	*IN#37 / DIR*	I	24V compatible input. Opto-isolated. Shared with pin 12 (IN#37/D5V) Can be used as DIRECTION input in Pulse & Direction motion mode
5	*IN#38/P*	*IN#38 / PULSE*	I	24V compatible input. Opto-isolated. Shared with pin 13 (IN#38/P5V) Can be used as PULSE input in Pulse & Direction motion mode
6	*IN#39*	*IN#39*	I	24V compatible input. Opto-isolated
7	*IN#2/LSP*	*IN#2 / LSP*	I	24V compatible input. Opto-isolated Positive limit switch
8	*IN#24/LSN*	*IN#24 / LSN*	I	24V compatible input. Opto-isolated Negative limit switch
9	*0VPLC*	-	I	24 V power supply (-) terminal for all opto-isolated I/O
10	$+V_{LOG}$	-	O	$+V_{LOG}$. Logic supply voltage (as applied on J2, pin 7)
11	*RESET*	-	I	**RESET** pin – connect to +24V for reset the board
12	*IN#37/D5V*	*IN#37 / DIR*	I	5V compatible input. Opto-isolated. Shared with pin 4 (IN#37/D) Can be used as DIRECTION input in Pulse & Direction motion mode
13	*IN#38/P5V*	*IN#38 / PULSE*	I	5V compatible input. Opto-isolated. Shared with pin 5 (IN#38/P) Can be used as PULSE input in Pulse & Direction motion mode
14	*+Ref*	*AD5*	I	+/-10V differential analog input. May be used as analogue position, speed or torque reference
15	*-Ref*		I	
16	*+Tach*	*AD2*	I	+/-10V differential analog input. May be used as analog position or speed feedback (from a tachometer). Internally filtered (3.4KHz).
17	*-Tach*		I	
18	*GND*	-	O	Ground of the $+5V_{DC}$.power supply output
19	*24VPLC*	-	I	24 V power supply (+) for all opto-isolated I/O

20	**$\overline{\text{OUT\#12}}$** */ER*	*OUT#12 / ERROR*	O	24V compatible output. Opto-isolated TML instruction ROUT#12 force this pin to +24V and set light to the red LED
21	**$\overline{\text{OUT\#25}}$** */RD*	*OUT#25 / READY*	O	24V compatible output. Opto-isolated TML instruction ROUT#25 force this pin to +24V and set light to the green LED
22	**$\overline{\text{OUT\#28}}$**	*OUT#28*	O	24V compatible output. Opto-isolated TML instruction ROUT#28 force this pin to +24V
23	**$\overline{\text{OUT\#29}}$**	*OUT#29*	O	24V compatible output. Opto-isolated TML instruction ROUT#29 force this pin to +24V
24	**$\overline{\text{OUT\#30}}$**	*OUT#30*	O	24V compatible output. Opto-isolated TML instruction ROUT#30 force this pin to +24V
25	**$\overline{\text{OUT\#31}}$**	*OUT#31*	O	24V compatible output. Opto-isolated TML instruction ROUT#31 force this pin to +24V
26	*0VPLC*	-	I	24 V power supply (-) for all opto-isolated I/O
case	*SHIELD*	-	-	Shield

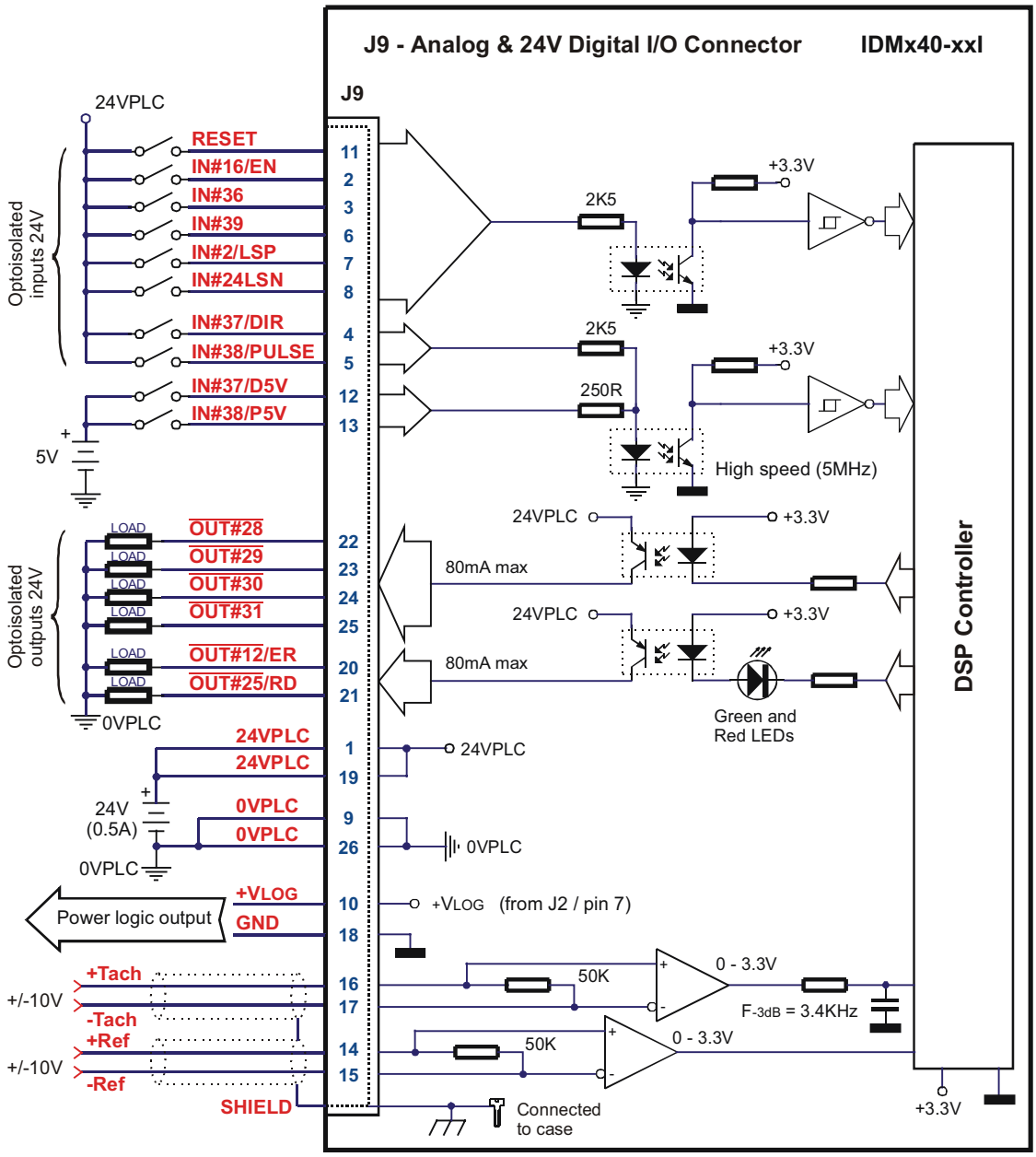


Figure 2.3. J29 – I/O connections

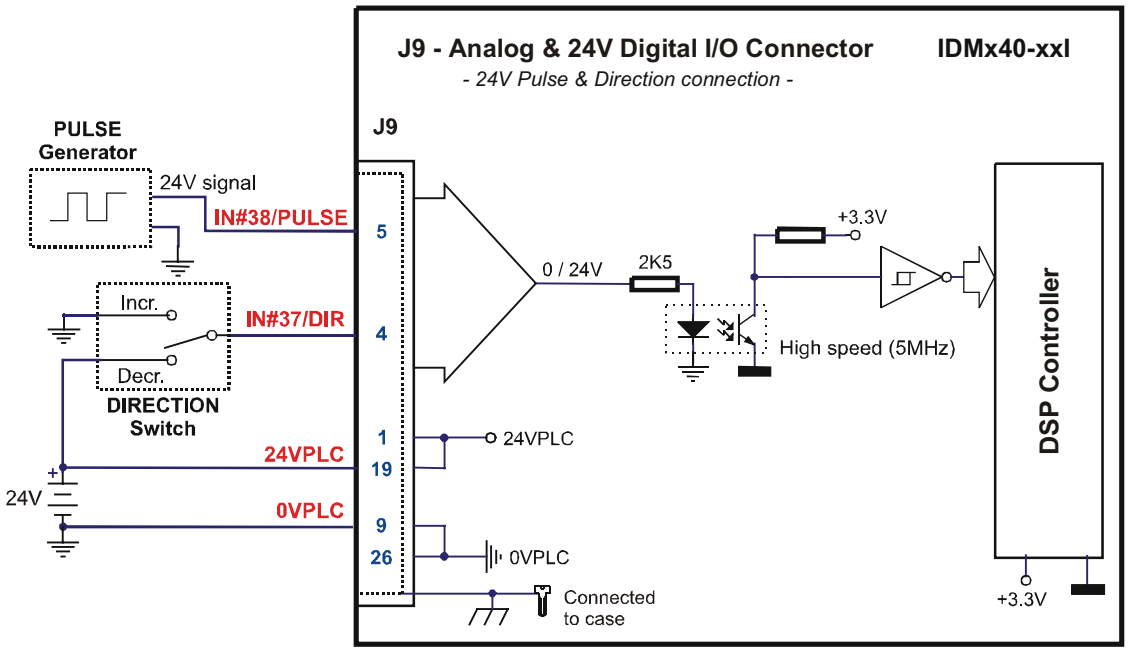


Figure 2.4. J9 – 24V Pulse & Direction connection

Note1: When using 24V Pulse & Direction connection, leave open pins 12 *(IN#37/D5V)* and 13 *(IN#38/P5V).*

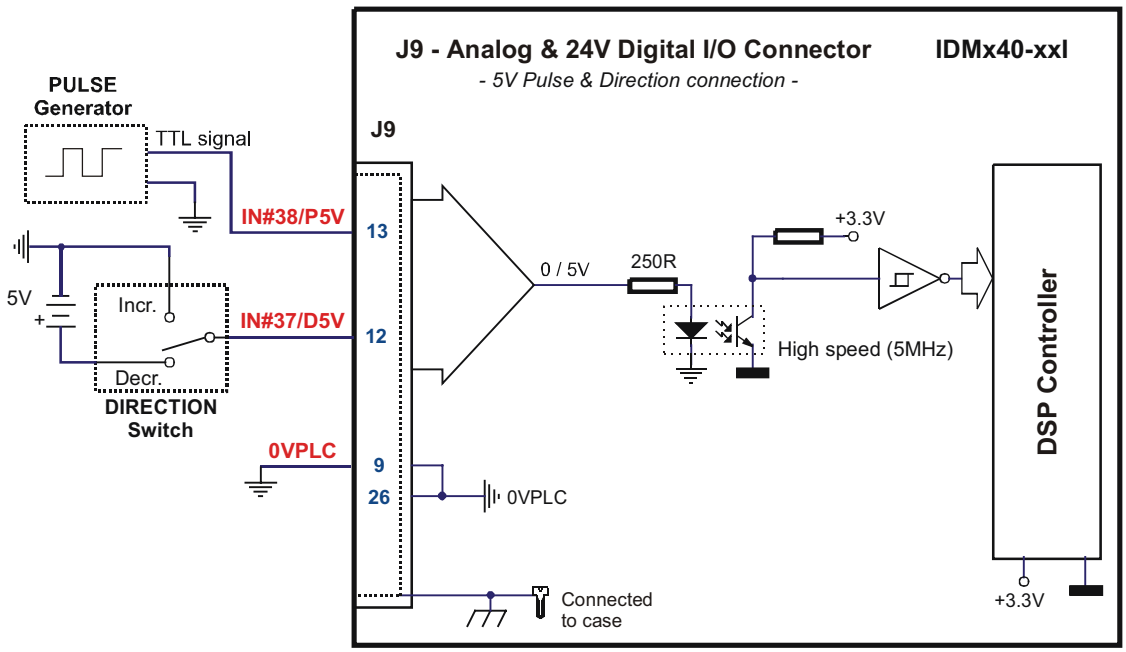


Figure 2.5. J9 – 5V Pulse & Direction connection

Note1: When using 5V Pulse & Direction connection, leave open pins 4 *(IN#37/D)* and 5 *(IN#38/P).*

Note2: When *IN#38/P* or *IN#38/P5V* is used as PULSE input in Pulse & Direction motion mode, on each rising edge the reference (or feedback) is incremented / decremented.

Note3: When *IN#37/D* or *IN#37/D5V* is used as DIRECTION input in Pulse & Direction motion mode, the reference (or feedback) is incremented if this pin is pulled low.

2.3.2. *Motor & Supply – J2 Connector*

Pin	Name	Type	Function
1	A	O	Phase A for 3-phase motors, Motor+ for DC brush motors
2	B	O	Phase B for 3-phase motors, Motor- for DC brush motors
3	C	O	Phase C for 3-phase motors, unconnected for DC brush motors
4	Brake	O	Brake output for external brake resistor
5	Earth	-	Earth connection
6	$+V_{MOT}$	I	Positive terminal of the motor supply: 12 to $48V_{DC}$ for IDM240-5EI 12 to $80V_{DC}$ for IDM640-8EI
7	$+V_{LOG}$	I	Positive terminal of the logic supply: 12 to $48V_{DC}$
8	GND	-	Negative terminal of the $+V_{MOT}$ and $+V_{LOG}$ external power supplies

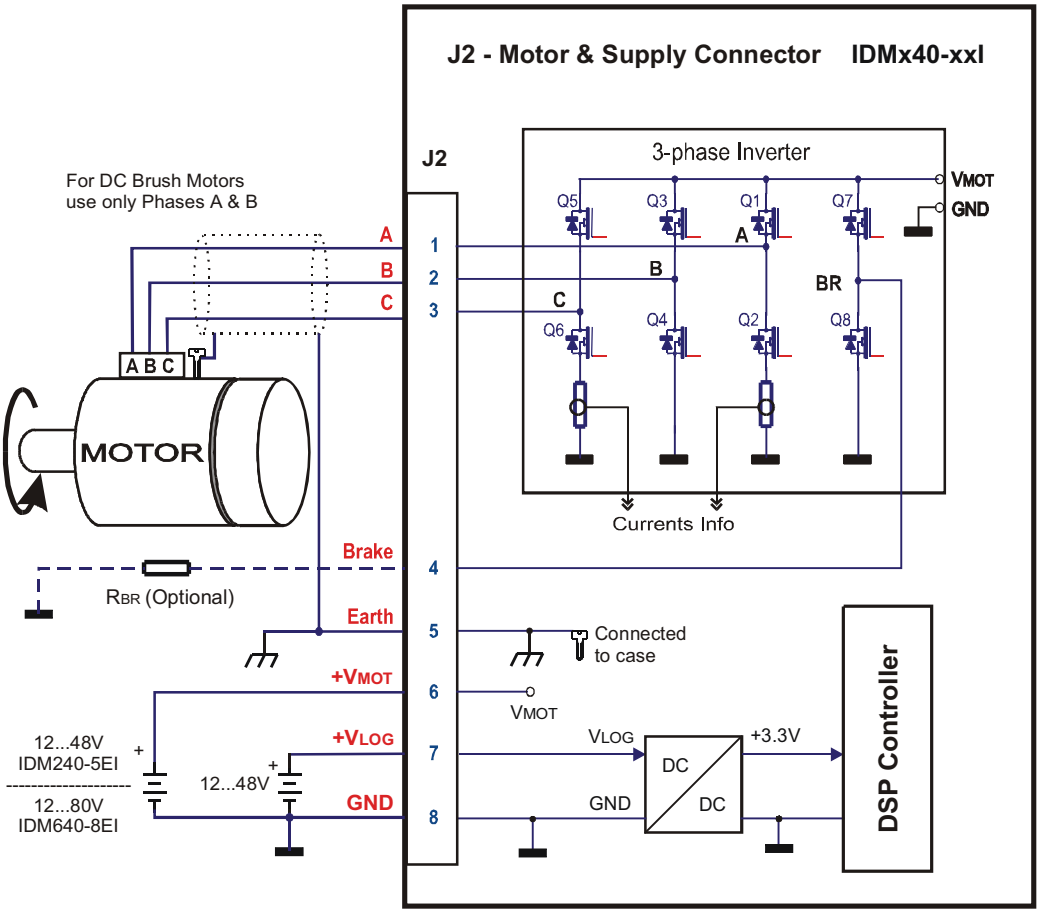


Figure 2.6. J2 – Motor and supply connection

Note: EARTH signal is internally connected to the metal case and to all SHIELD signals, but completely isolated from all electric signals of IDM240/640. This feature may facilitate avoiding ground loops. It is recommended to connect Earth with GND at only 1 point, preferably close to the V_{DC} supply output.

2.3.3. Serial – J4 Connector

Pin	Name	Type	Function
1	485A+	I/O	RS-485 line A (positive during stop bit)
2	TxD	O	RS-232 Data Transmission
3	RxD	I	RS-232 Data Reception
4	N.C.		Not Connected
5	GND		Ground
6	485B-	I/O	RS-485 line B (negative during stop bit)
7	N.C.		Not Connected
8	N.C.		Not Connected
9	+5V	O	Supply for RS-485 terminator and/or supply for handheld terminal (internally generated)

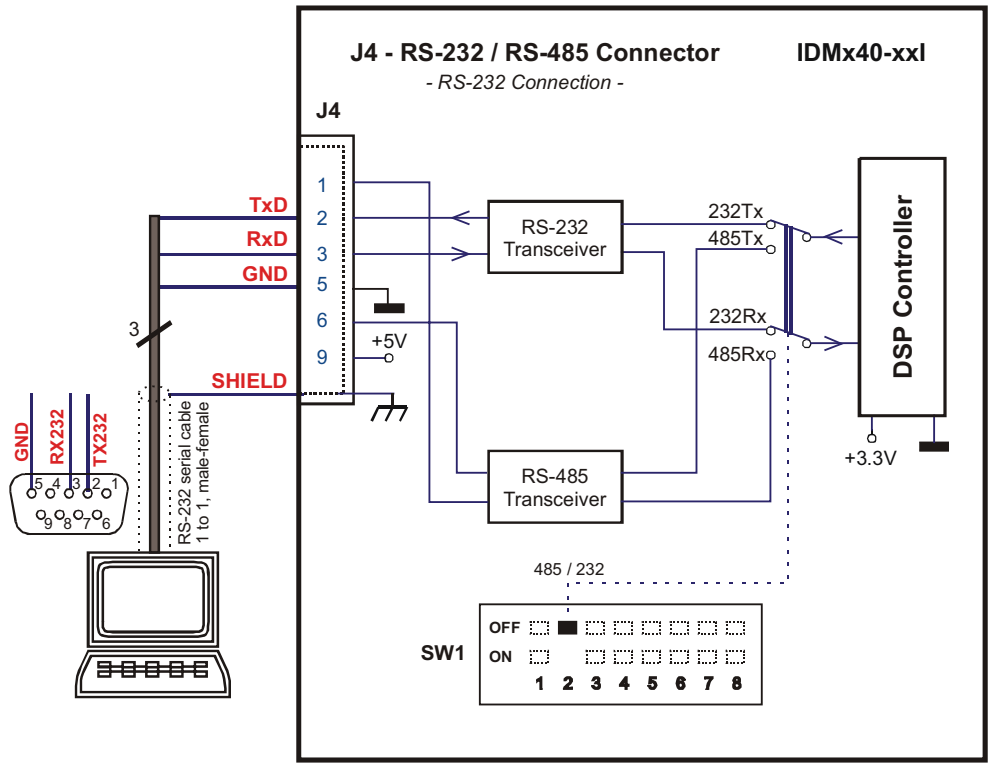


Figure 2.7. *J4 – Serial RS-232 connection*

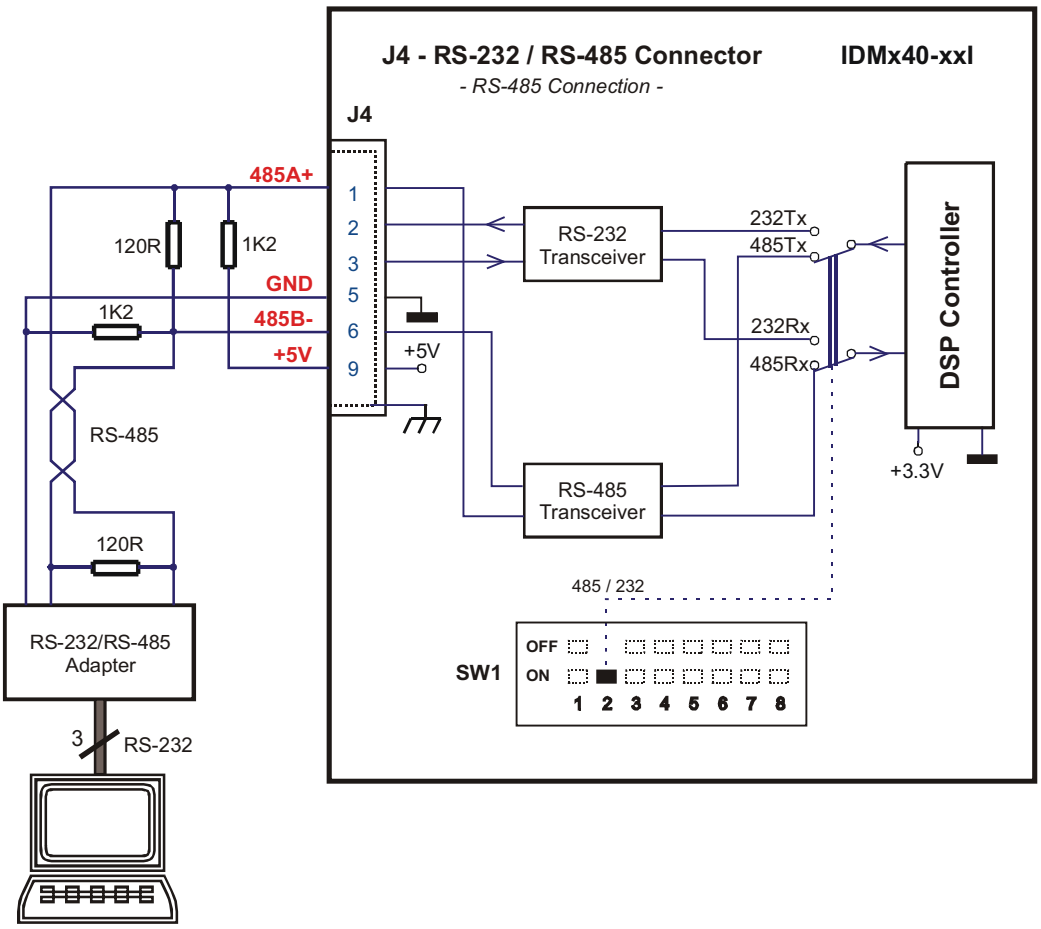


Figure 2.8. *J4 – Serial RS-485 connection*

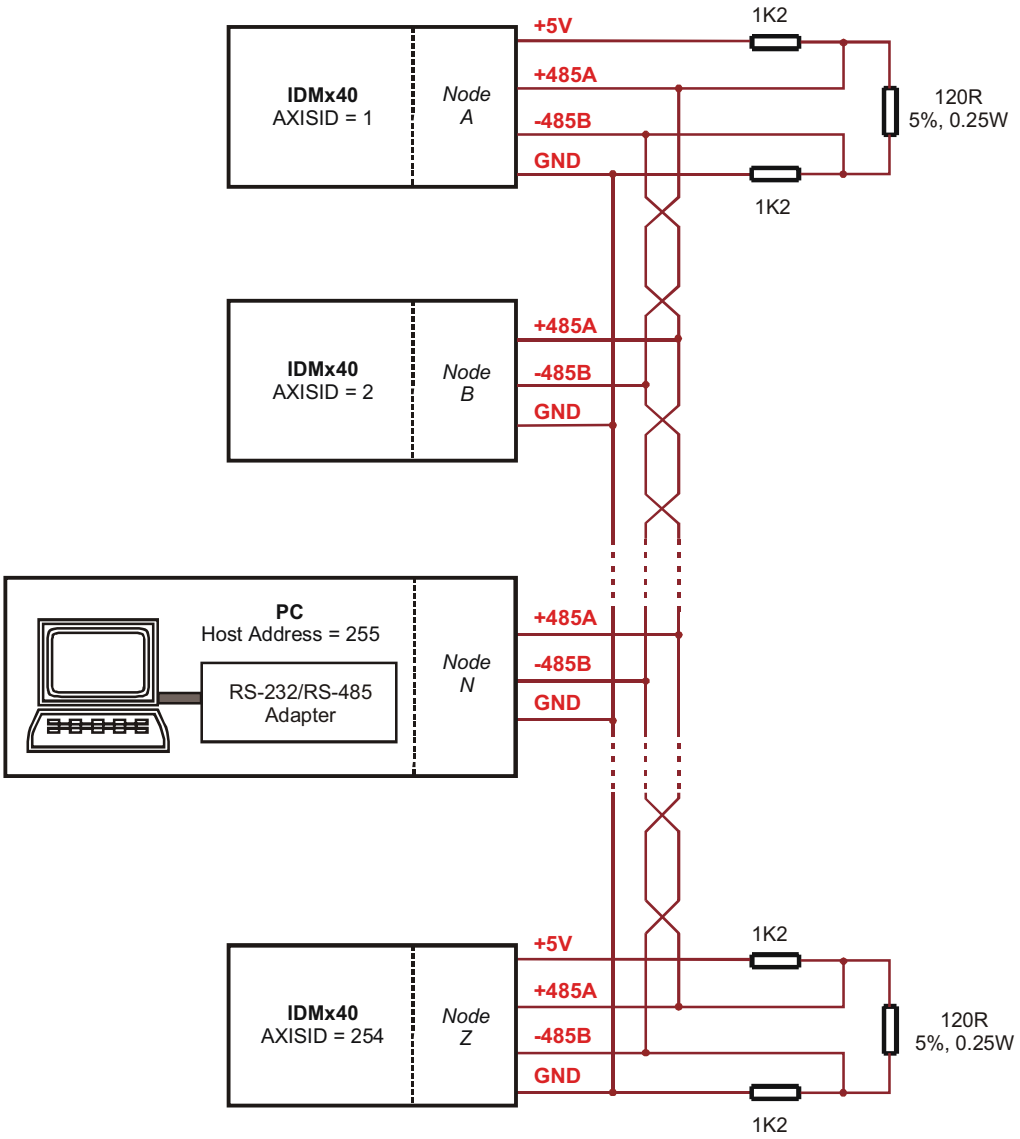


Figure 2.9. *Multiple-Axis RS-485 Network connection*

Note1: For the PC, parameter Host Address can have values between 1 and 255 and this value must be different from parameter Axis ID for the IDMs in the network. For example, if the Host Address is set to 255, then none of the IDMs in the network can have Axis ID set to 255.

Note2: The PC can be placed in any position in the network.

2.3.4. CAN – J10, J11 Connectors

Pin	Name	Type	Function
1	CAN_V+	I	+24V_{DC} (optional +5V_{DC}) isolated supply input
2	CAN_H	I/O	CAN-Bus positive line (positive during dominant bit) (see Notes)
3	CAN_L	I/O	CAN-Bus negative line (negative during dominant bit) (see Notes)
4	CAN_GND	-	Reference ground for CAN_L, CAN_H and CAN_V+ signals

Note1: The CAN network require a 120 Ohms terminator. This is not included on-board.
Note2: All 4 CAN signals are fully isolated from all other IDM's circuits (system ground - GND, IO ground – 0VPLC and Earth).

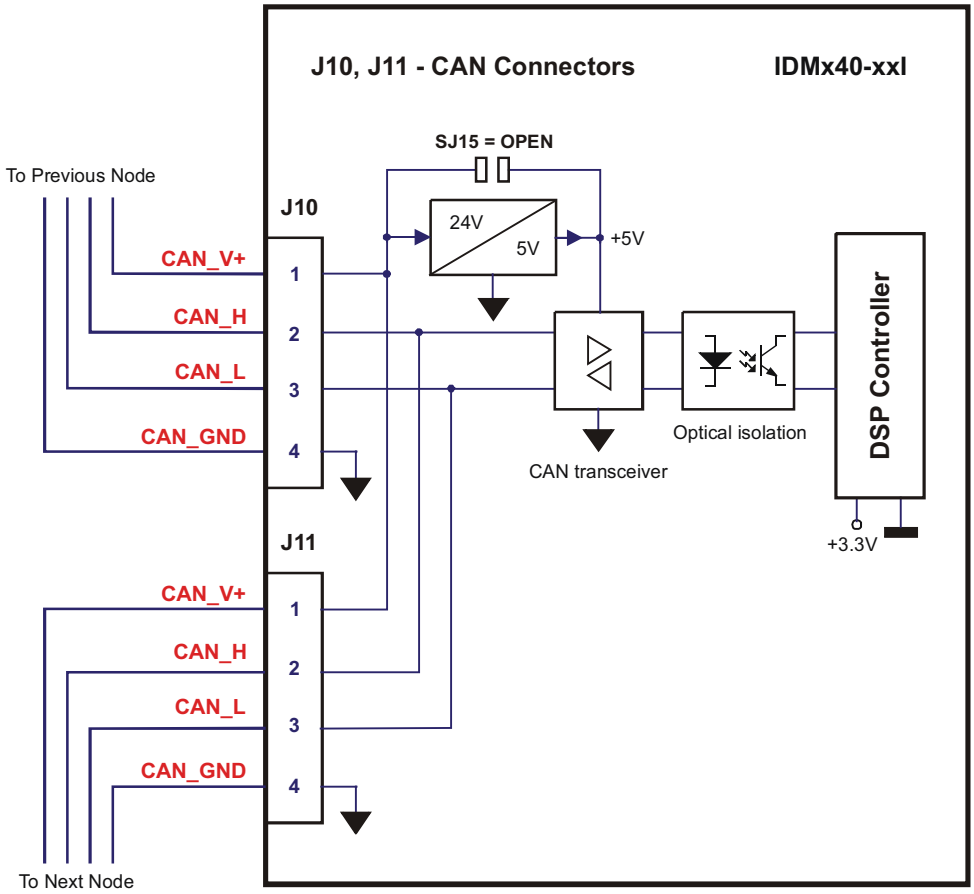


Figure 2.10. *J10, J11 – CAN Connectors*

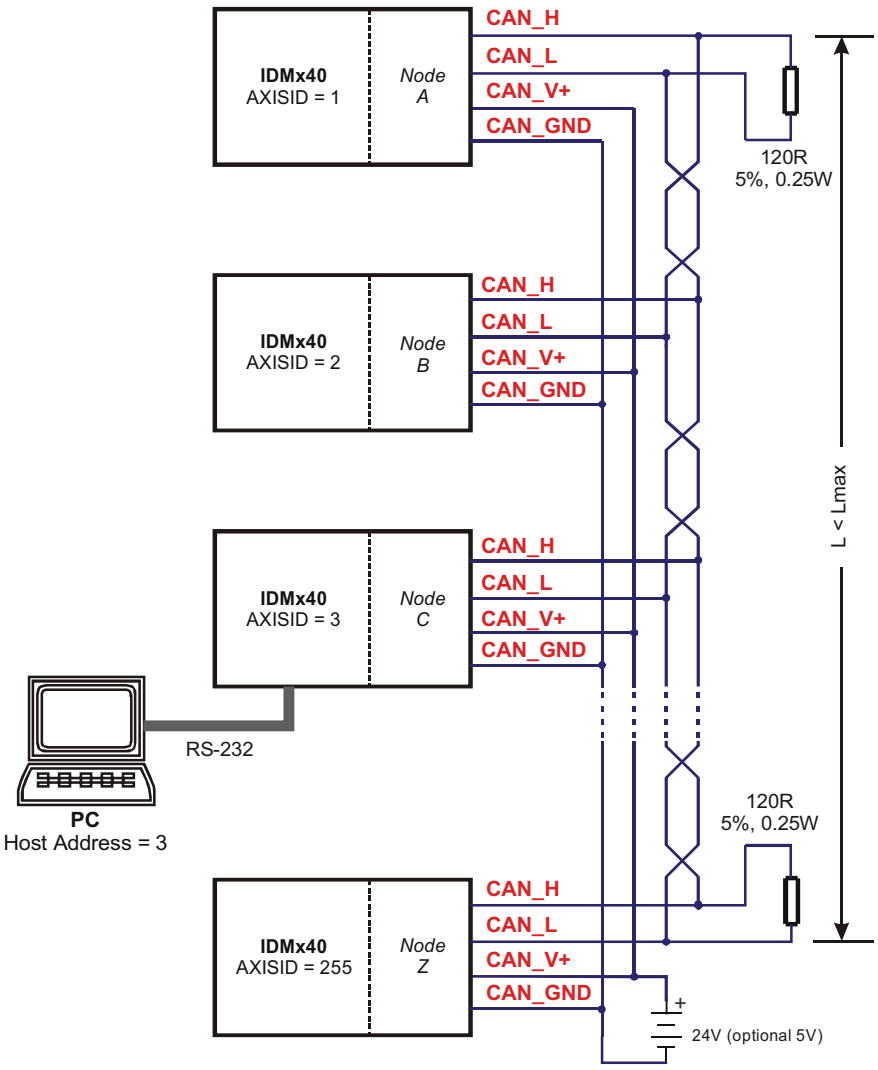


Figure 2.11. *Multiple-Axis CAN network*

2.3.5. SW1 – DIP-Switch

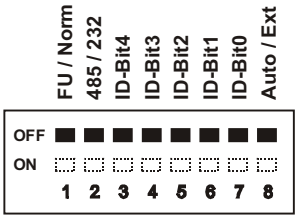


Figure 2.12. SW1 – DIP Switch

- **Position 1**: FU / Norm

ON: Enable firmware update

- OFF: Normal operation

- **Position 2**: 485 / 232

ON: IDM240/640 drive communicates in RS-485 mode

OFF: IDM240/640 drive communicates in RS-232 mode

The state of 485 / 232 switch is sampled during power-up, and the communication protocol is configured accordingly.

- **Position 3 … 7**: ID-Bitx

These switches are sampled during power-up, and the Axis ID is configured accordingly. See *Table 2.1*.

- **Position 8**: Auto / Ext

ON: IDM240/640 in Autorun (stand-alone) mode. After reset, automatically executes a program from the internal E2ROM.

OFF: IDM240/640 in External (slave) mode. After reset, waits for commands from an external device.

Table 2.1. Axis ID / Address configuration

DIP Switch position					Axis ID
3	4	5	6	7	
ID – Bit4	ID – Bit3	ID – Bit2	ID – Bit1	ID – Bit0	
OFF	OFF	OFF	OFF	OFF	255
OFF	OFF	OFF	OFF	ON	1
OFF	OFF	OFF	ON	OFF	2
OFF	OFF	OFF	ON	ON	3
OFF	OFF	ON	OFF	OFF	4
OFF	OFF	ON	OFF	ON	5
OFF	OFF	ON	ON	OFF	6
OFF	OFF	ON	ON	ON	7
OFF	ON	OFF	OFF	OFF	8
OFF	ON	OFF	OFF	ON	9
OFF	ON	OFF	ON	OFF	10
OFF	ON	OFF	ON	ON	11
OFF	ON	ON	OFF	OFF	12
OFF	ON	ON	OFF	ON	13
OFF	ON	ON	ON	OFF	14
OFF	ON	ON	ON	ON	15
ON	OFF	OFF	OFF	OFF	16
ON	OFF	OFF	OFF	ON	17
ON	OFF	OFF	ON	OFF	18
ON	OFF	OFF	ON	ON	19
ON	OFF	ON	OFF	OFF	20
ON	OFF	ON	OFF	ON	21
ON	OFF	ON	ON	OFF	22
ON	OFF	ON	ON	ON	23
ON	ON	OFF	OFF	OFF	24
ON	ON	OFF	OFF	ON	25
ON	ON	OFF	ON	OFF	26
ON	ON	OFF	ON	ON	27
ON	ON	ON	OFF	OFF	28
ON	ON	ON	OFF	ON	29
ON	ON	ON	ON	OFF	30
ON	ON	ON	ON	ON	31

Note1: Others Axis ID values (32 - 255) can be set by software with *AXISID* instruction.

2.3.6. Feedback – J13A Connector (IDM240-5EI and IDM640-8EI)

Pin	Name on the Drive cover	Type	Function / Comments
1	A1+	I	Positive A for differential encoder or A for single-ended encoder [1]*)
2	B1+	I	Positive B for differential encoder or B for single-ended encoder [1]*)
3	+5V_{DC}	O	+5V_{DC} Supply (generated internally)
4	H3/A2/CK+	I	Positive Hall 3 for differential Hall or Hall 3 for single-ended Hall [2]*) Second encoder positive A for differential encoder or A for single-ended encoder
5	H1/B2/DT+	I	**Positive Hall 1** for differential Hall or **Hall 1** for single-ended Hall [2]*) Second encoder **positive B** for differential encoder or **B** for single-ended encoder
6	Therm	I	Analog input from motor thermal sensor
7	Z1+	I	**Positive Z** for differential encoder or **Z** for single-ended encoder [1]*)
8	Z1-	I	Negative Z for differential encoder
9	H2/Z2+	I	**Positive Hall 2** for differential Hall or **Hall 2** for single-ended Hall [2]*) Second encoder **positive Z** for differential encoder or **Z** for single-ended encoder
10	H2/Z2-	I	**Negative Hall 2** for differential Hall Second encode: negative Z for differential encoder
11	A1-	I	**Negative A** for differential encoder
12	B1-	I	Negative B for differential encoder
13	GND	-	Ground of the encoder supply
14	H3/A2/CK-	I	Negative Hall 3 for differential Hall Second encoder negative A for differential encoder
15	H1/B2/DT-	I	Negative Hall 1 for differential Hall Second encoder negative B for differential encoder
case	SHIELD	-	Shield

[1]*) In application configurations without encoder feedback, this input may be used as general-purpose inputs.

[2]*) In application configurations without Hall or second encoder feedback, this input may be used as general-purpose inputs.

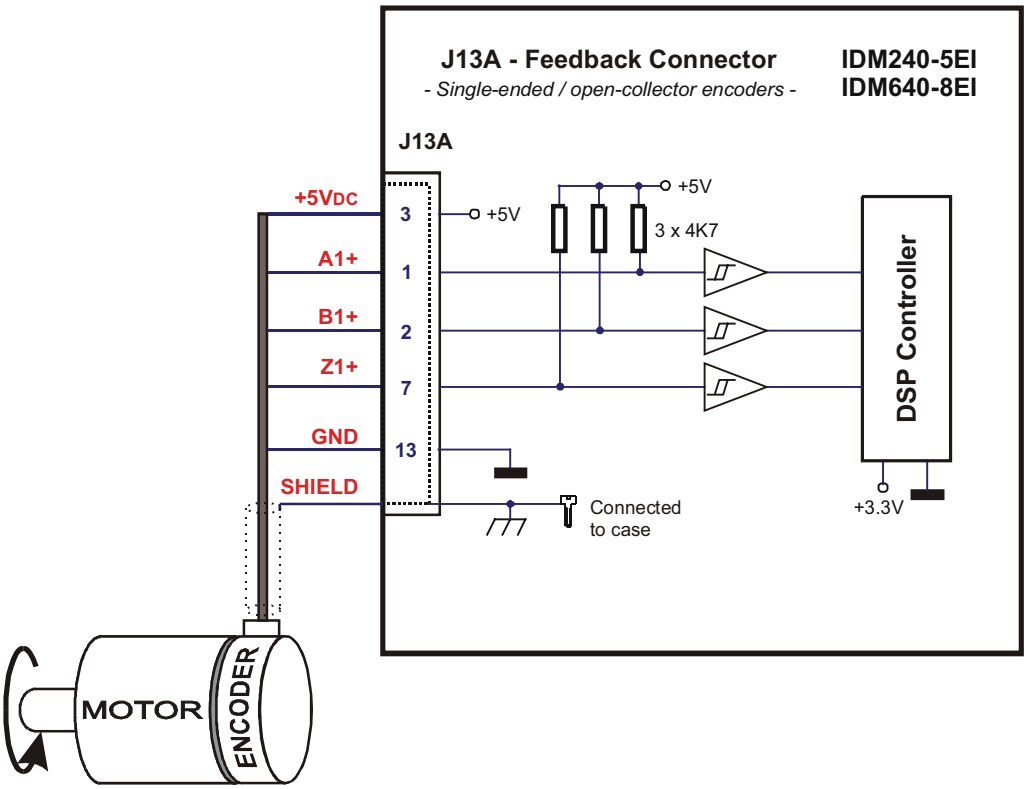


Figure 2.13. *J13A – Single-ended / open-collector encoder connection*

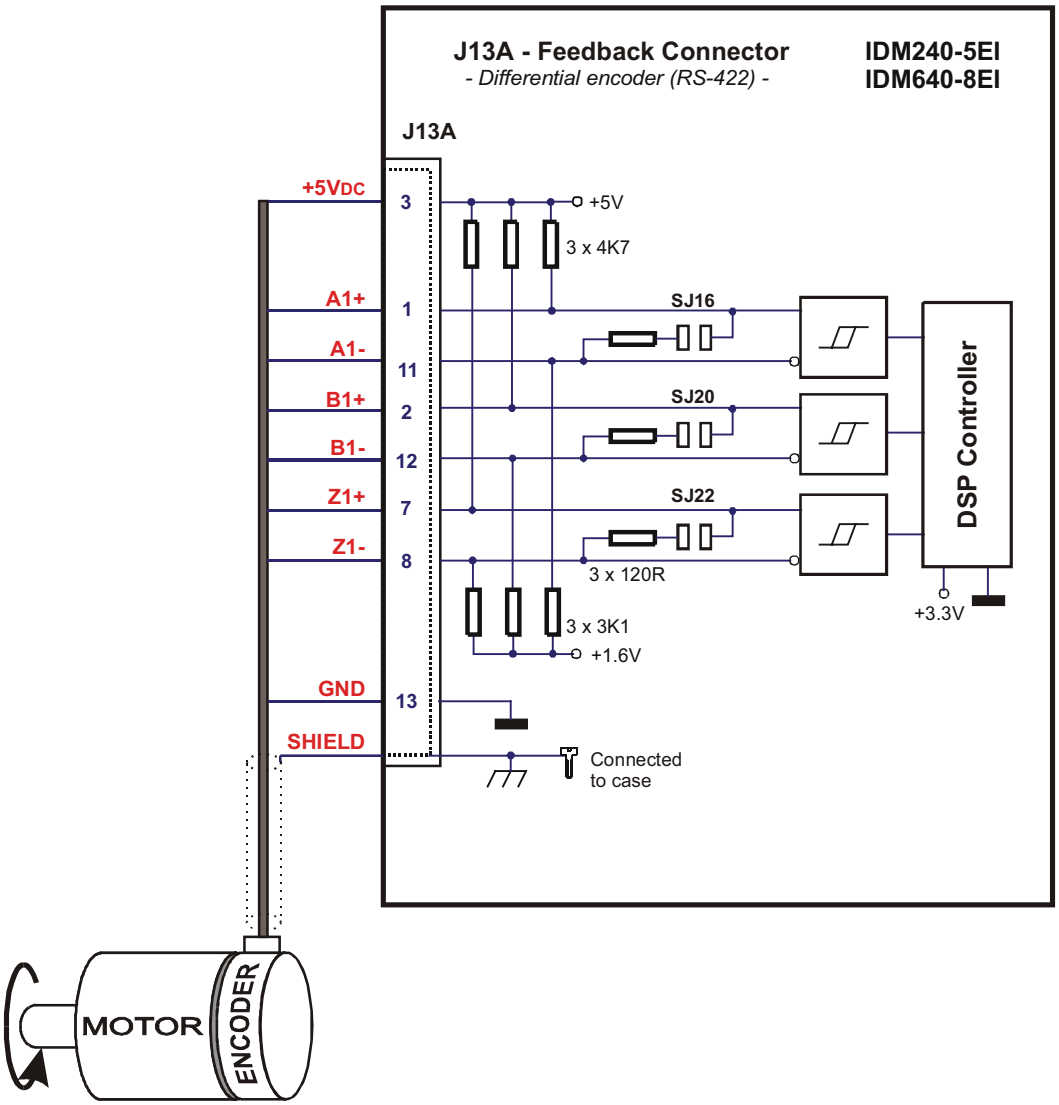


Figure 2.14. *J13A – Differential (RS-422) encoder connection*

Note1: For differential encoders with long cables, the solder-joints SJ16, SJ20 and SJ22 must be strapped, else these straps are optional.

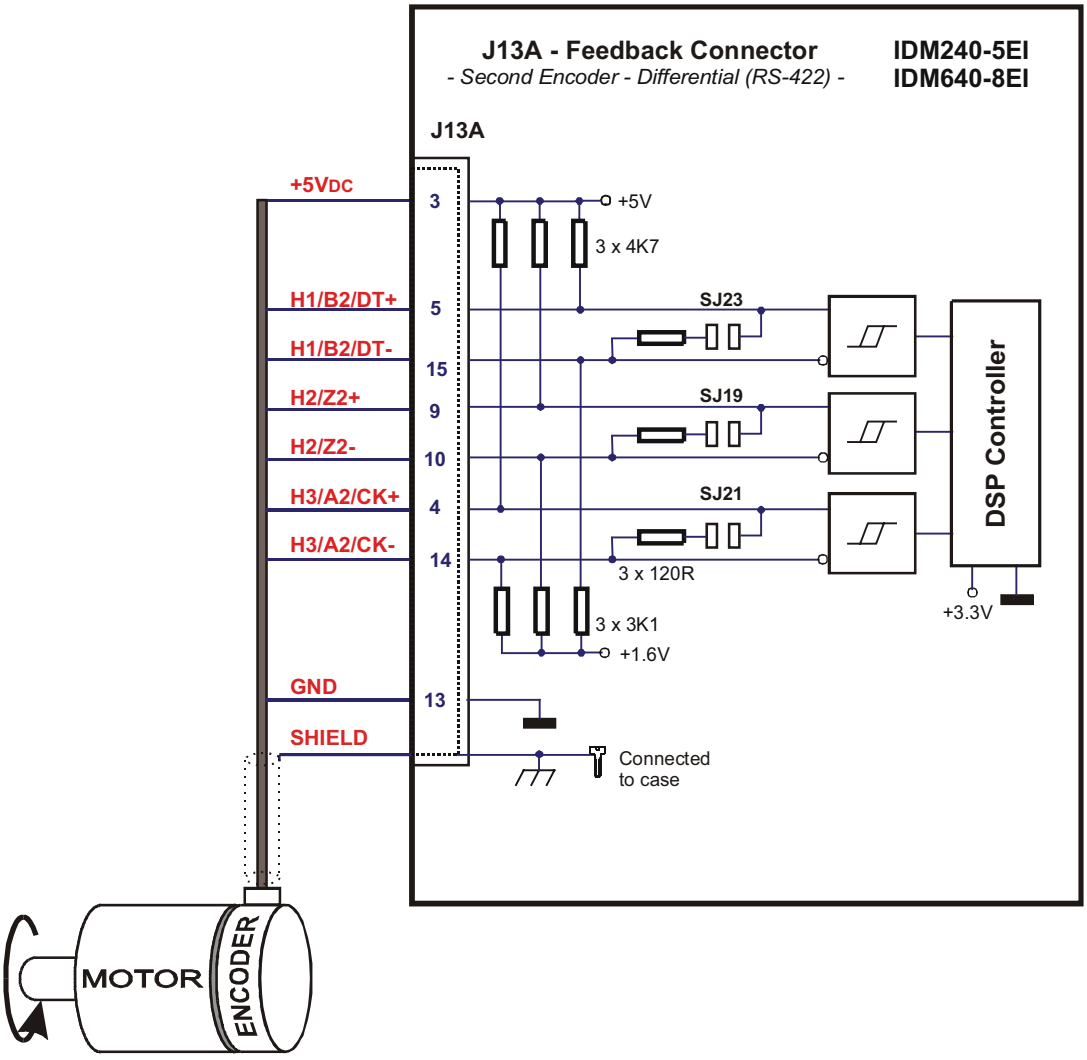


Figure 2.15. *J13A – Second encoder - differential (RS-422) connection*

Note1: For differential encoders with long cables, the solder-joints SJ19, SJ21 and SJ23 must be strapped, else these straps are optional.

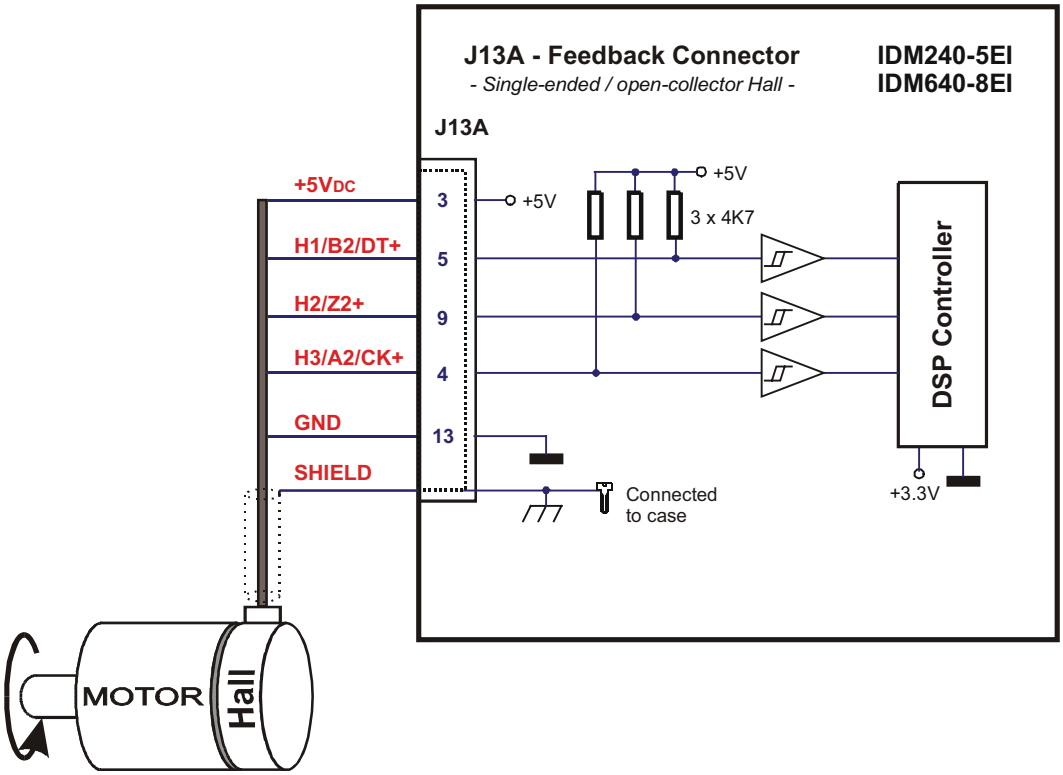


Figure 2.16. *J13A – Single-ended / open-collector Hall connection*

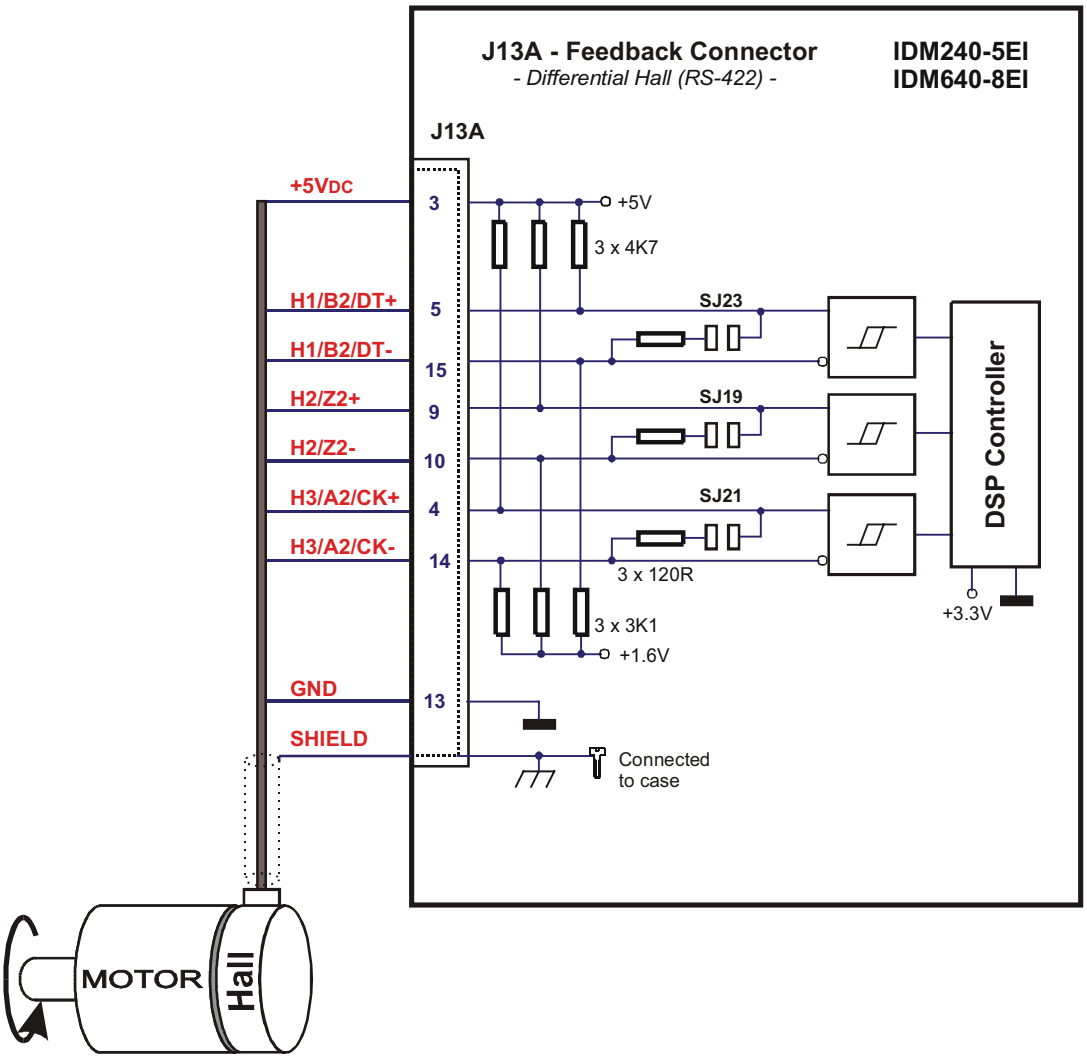


Figure 2.17. *J13A – Differential (RS-422) Hall connection*

Note1: For differential encoders with long cables, the solder-joints SJ19, SJ21 and SJ23 must be strapped, else these straps are optional.

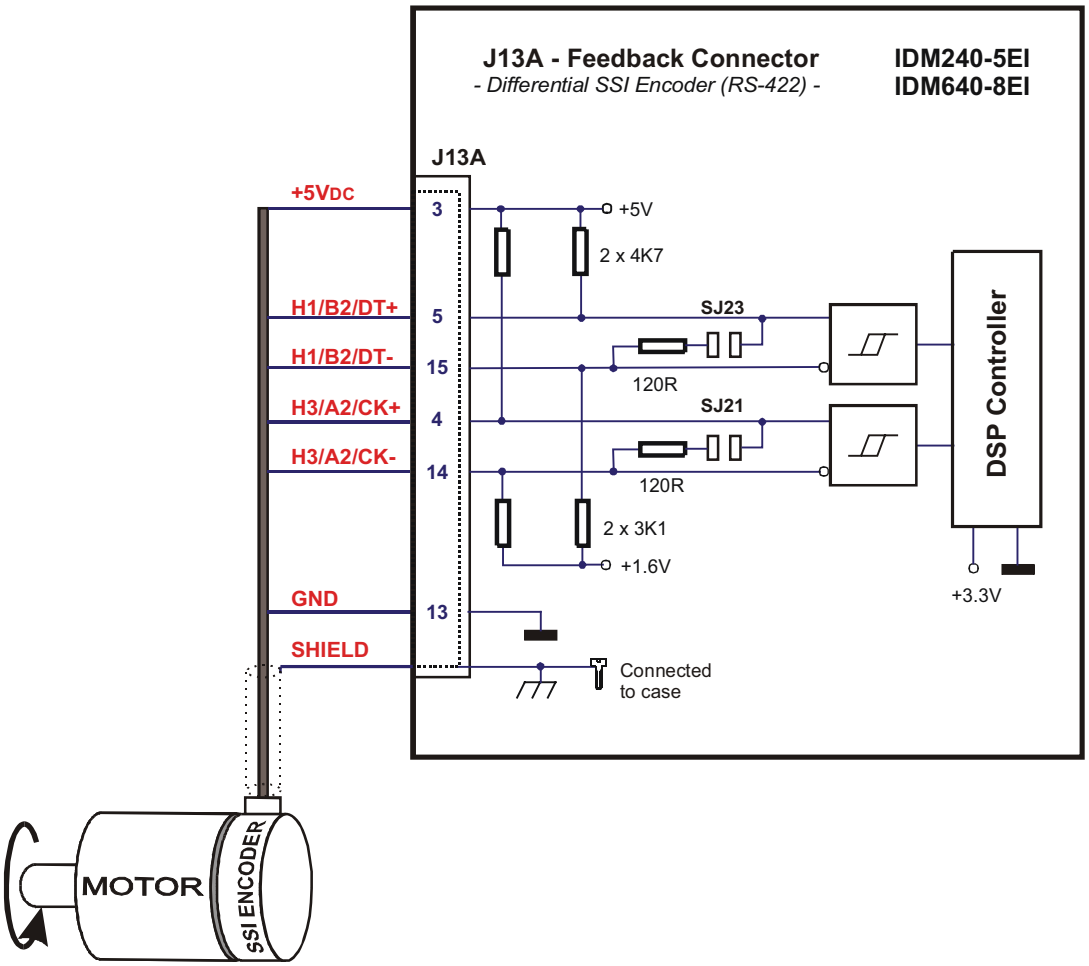


Figure 2.18. *J13A – Differential (RS-422) SSI encoder connection*

Note1: For differential encoders with long cables, the solder-joints SJ21 and SJ23 must be strapped; otherwise, these straps are optional.

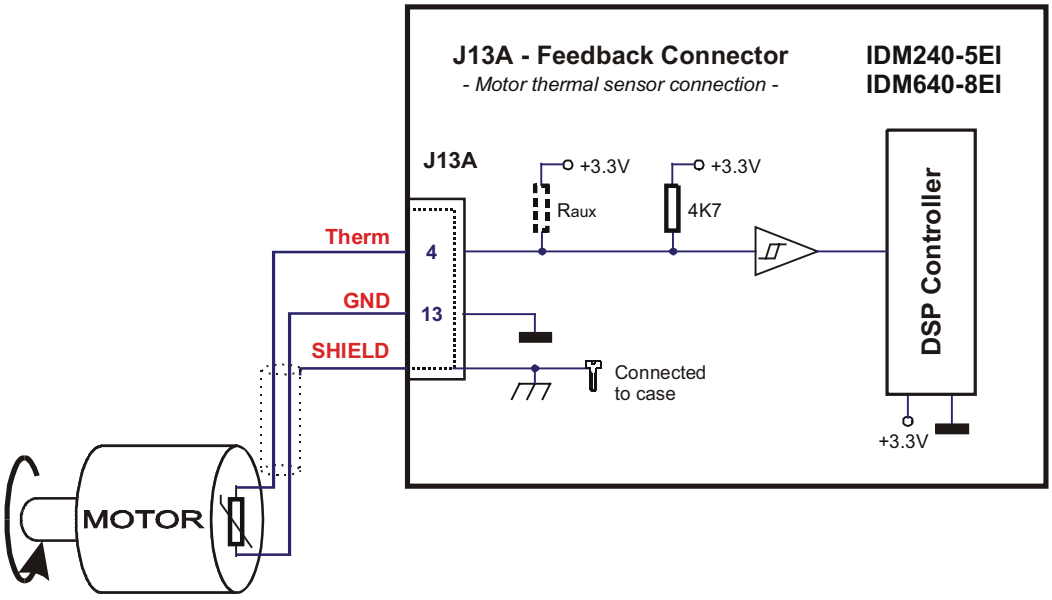


Figure 2.19. *J13A – Motor thermal sensor connection*

2.3.7. Feedback – J13B Connector (IDM240-5RI and IDM640-8RI)

Pin	Name on the Drive cover	Type	Function / Comments
1	$+5V_{DC}$	O	$+5V_{DC}$ Supply (generated internally)
2	H3/A2/CK+	I	Positive Hall 3 for differential Hall or Hall 3 for single-ended Hall [1]*) Second encoder positive A for differential encoder or A for single-ended encoder
3	H1/B2/DT+	I	**Positive Hall 1** for differential Hall or **Hall 1** for single-ended Hall [1]*) Second encoder **positive B** for differential encoder or **B** for single-ended encoder
4	COS+	I	Resolver input for Cosines (+)
5	SIN+	I	Resolver input for Sinus (+)
6	Therm	I	Analog input from motor thermal sensor
7	H2/Z2+	I	**Positive Hall 2** for differential Hall or **Hall 2** for single-ended Hall [1]*) Second encoder **positive Z** for differential encoder or **Z** for single-ended encoder
8	H2/Z2-	I	**Negative Hall 2** for differential Hall Second encoder: negative Z for differential encoder
9	EXC+	O	Excitation output signal (+)
10	EXC-	O	Excitation output signal (-)
11	GND	-	Ground of the $5V_{DC}$ supply
12	H3/A2/CK-	I	Negative Hall 3 for differential Hall Second encoder negative A for differential encoder
13	H1/B2/DT-	I	Negative Hall 1 for differential Hall Second encoder negative B for differential encoder
14	COS-	I	Resolver input for Cosines (-)
15	SIN-	I	Resolver input for Sinus (-)
case	SHIELD		Shield

Note: The symbols + and – means the phase for the differential signals. To be observed when the resolver would be connected.

[1] *) In application configurations without Hall or second encoder feedback, this input may be used as general-purpose inputs.

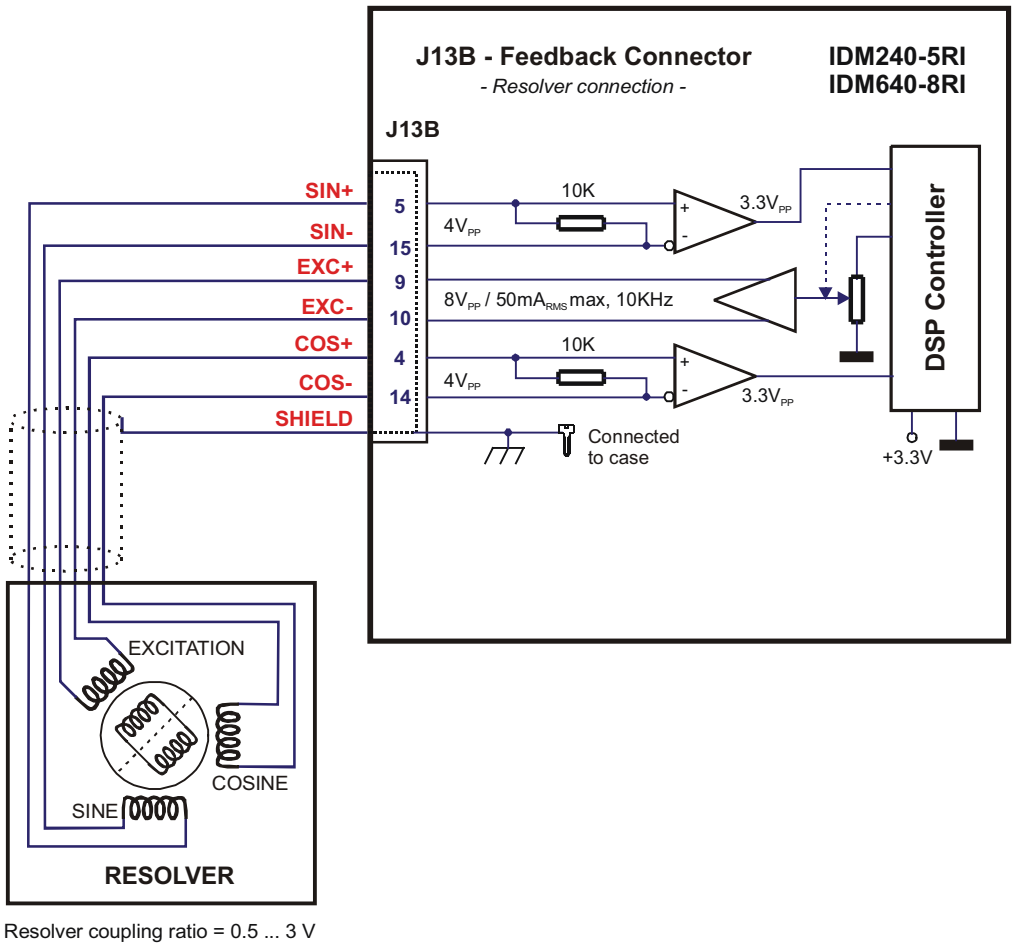


Figure 2.20. *J13B – Resolver connection*

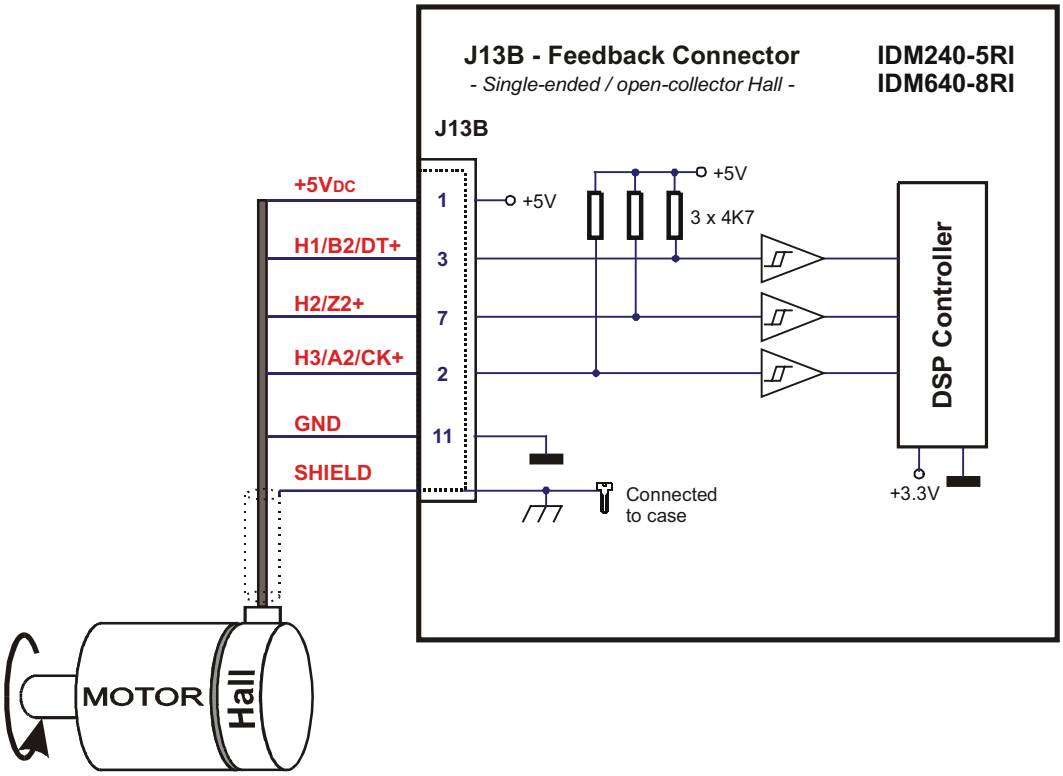


Figure 2.21. *J13B – Single-ended / open-collector Hall connection*

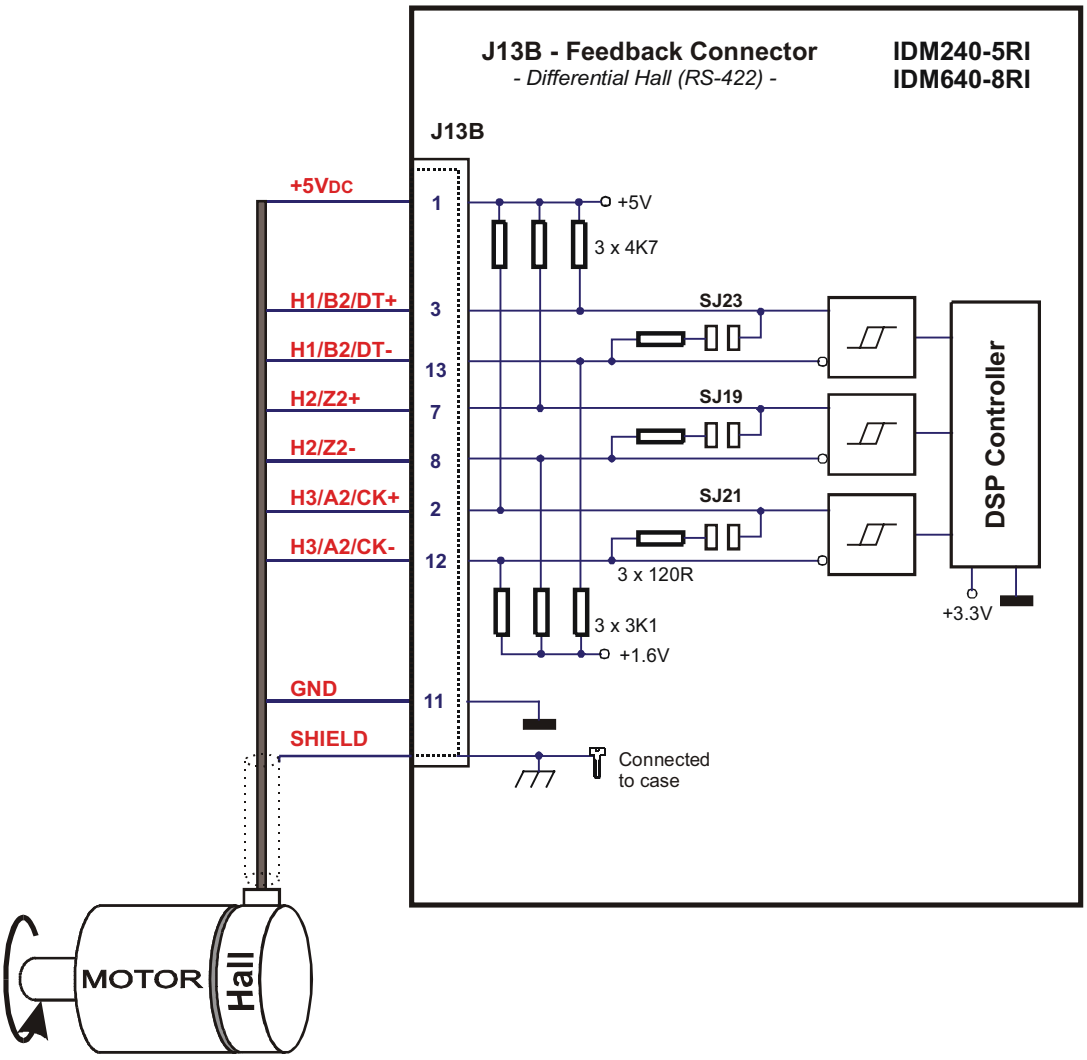


Figure 2.22. *J13B – Differential (RS-422) Hall connection*

Note1: For differential encoders with long cables, the solder-joints SJ19, SJ21 and SJ23 must be strapped; otherwise, these straps are optional.

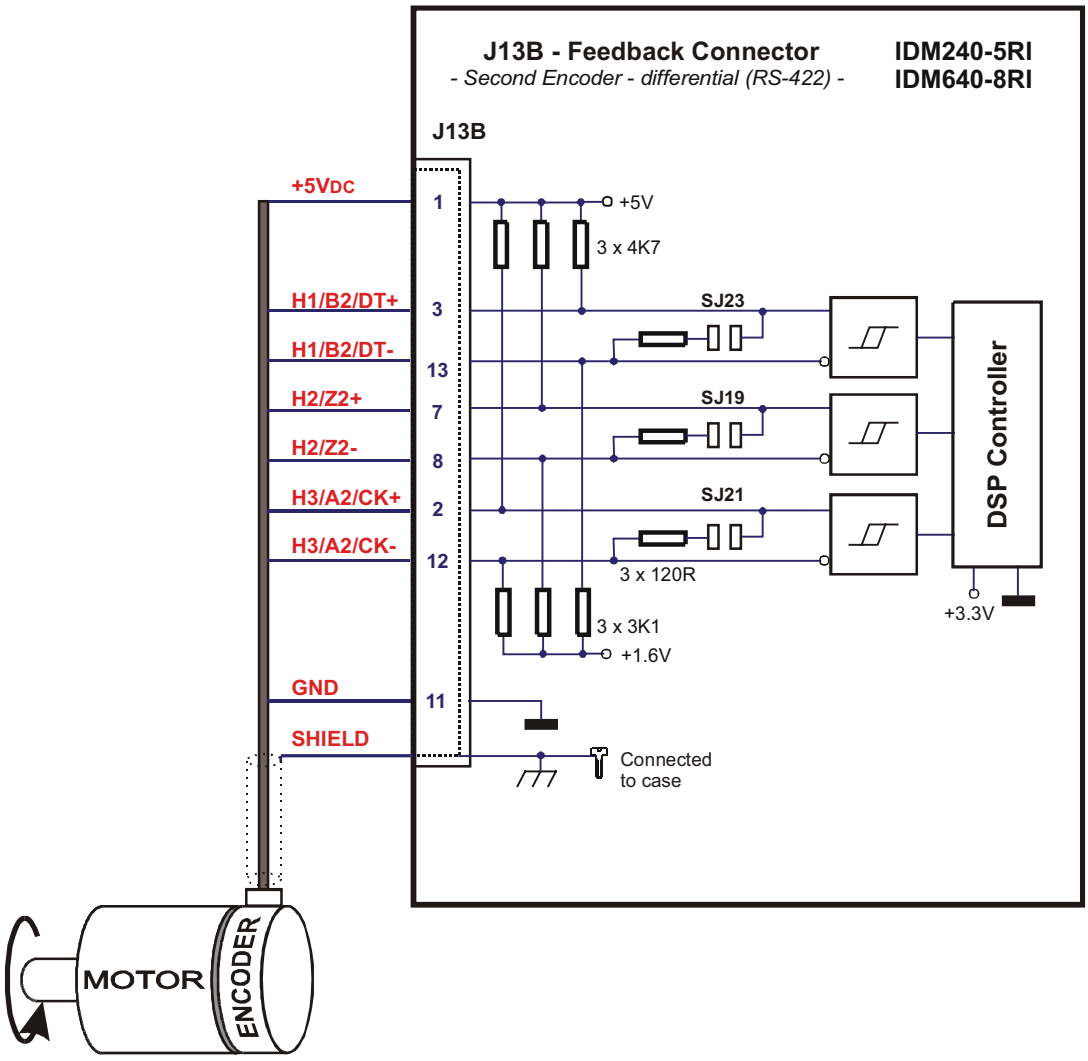


Figure 2.23. *J13B – Second encoder - differential (RS-422) connection*

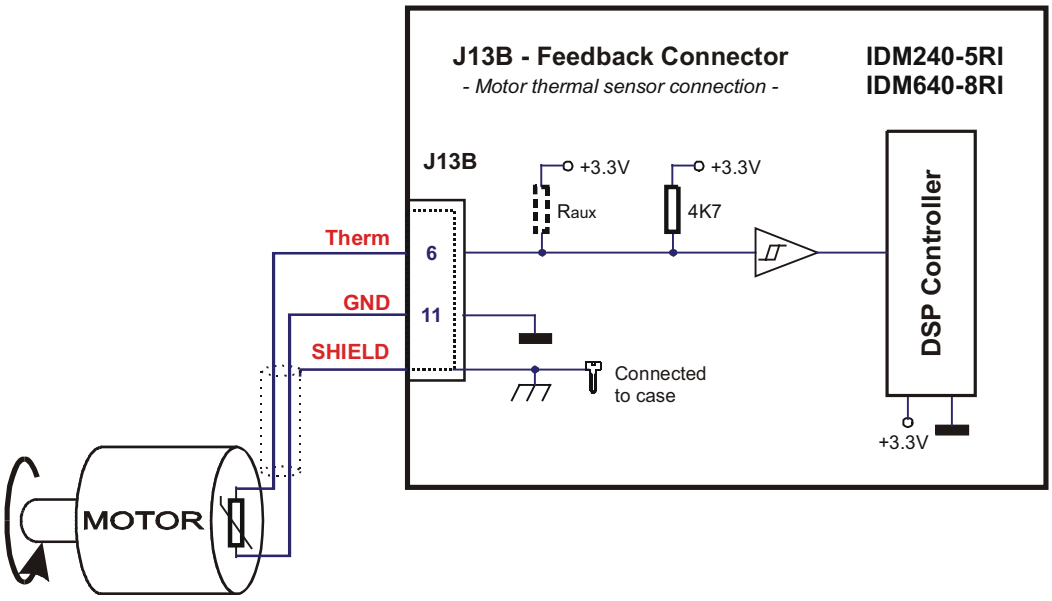


Figure 2.24. *J13B – Motor thermal sensor connection*

2.4 Electrical Specifications

Electrical characteristics:

All parameters measured under the following conditions (unless otherwise noted):
T_{amb} = 0…50°C, V_{LOG} = 24V_{DC}, V_{24VPLC} = 24V_{DC}, CAN_V+ = 24V_{DC};
V_{MOT} = 48V_{DC} (IDM240-5EI) or 80V_{DC} (IDM640-8EI);
Supplies start-up / shutdown sequence: *-any-* ;
Load current 5A_{RMS} (IDM240-5EI) or 8A_{RMS} (IDM640-8EI)

Logic Supply Input

	Measured between +V_{LOG} and GND.	Min.	Typ.	Max.	Units
Supply voltage	Nominal values, including ripple up to ±25%	12	24	48	V_{DC}
	Absolute maximum values, continuous	8		60	V_{DC}
	Absolute maximum values, surge (duration ≤ 10mS) †	-0.5		63	V
Supply current	+V_{LOG} = 12V		250	400	mA
	+V_{LOG} = 24V		100	250	mA
	+V_{LOG} = 48V		50	150	mA

Motor Supply Input

	Measured between +V_{MOT} and GND.	Min.	Typ.	Max.	Units
Supply voltage IDM240	Nominal values, including ripple & braking-induced over-voltage up to ±25%	12		48	V_{DC}
	Absolute maximum values, continuous	0		63	V_{DC}
	Absolute maximum values, surge (duration ≤ 10mS) †	-0.5		65	V
Supply voltage IDM640	Nominal values, including ripple & braking-induced over-voltage up to ±25%	12		80	V_{DC}
	Absolute maximum values, continuous	0		100	V_{DC}
	Absolute maximum values, surge (duration ≤ 10mS) †	-0.5		105	V
Supply current	Idle		1.5	4	mA
	Operating			16	A
	Power-up surge (duration ≤ 10mS)			30	A_{PEAK}

I/O Supply Input (isolated)

	Measured between +24V_{PLC} and 0V_{PLC}.	Min.	Typ.	Max.	Units
Supply voltage	Nominal values	8	24	30	V_{DC}
	Absolute maximum values, surge (duration ≤ 10mS) †	-0.5		32	V
Supply current	All inputs and outputs disconnected		20	30	mA
	All inputs tied to +24V_{PLC}; all outputs sourcing 80mA each into external load(s)		600	650	mA
Isolation voltage rating	Between 0V_{PLC} and GND			200	V_{RMS}

CAN-Bus Supply Input (isolated)

	Measured between CAN_V+ and CAN_GND.	Min.	Typ.	Max.	Units
Supply voltage, default config.	Nominal values	8	24	30	V_{DC}
	Absolute maximum values, surge (duration ≤ 10mS) †	-0.5		32	V
Supply voltage, SJ15 strapped	Nominal values	4.75	5	5.25	V_{DC}
	Absolute maximum values, surge (duration ≤ 10mS) †	-0.5		7.5	V
Supply current	CAN-Bus idle		12	25	mA
	CAN-Bus operating at 1Mbit/s		60	180	mA
Isolation voltage rating	Between CAN_GND and GND			200	V_{RMS}

Motor Outputs

	All voltages referenced to GND.	Min.	Typ.	Max.	Units
Motor output current IDMx40-5	Continuous operation	-5		+5	A_{RMS}
Motor output current IDMx40-8	Continuous operation	-8		+8	A_{RMS}
Motor output current, peak		-16.5		+16.5	A
Short-circuit protection threshold		±20	±22	±24	A
Short-circuit protection delay		10	20	40	µS
On-state voltage drop	Output current = ±5A (IDMx40-5)	-800	±150	+250	mV
	Output current = ±8A (IDMx40-8)	-900	±200	+350	mV
Off-state leakage current		-1	±0.1	+1	mA
Motor inductance	F_{PWM} = 20kHz, $+V_{MOT}$ = 12V	50			µH
	F_{PWM} = 20kHz, $+V_{MOT}$ = 48V	200			µH
	F_{PWM} = 20kHz, $+V_{MOT}$ = 80V (IDM640)	400			µH

24V Digital Inputs (opto-isolated)

	All voltages referenced to $0V_{PLC}$.	Min.	Typ.	Max.	Units
Input voltage	Logic "LOW"	-5	0	1.2	V
	Logic "HIGH"	18	24	30	
	Absolute maximum, surge (duration ≤ 1S) †	-30		+80	
Input current	Logic "HIGH"	2.5	10	15	mA
	Logic "LOW"	0		0.2	
Input frequency		0		5	KHz
Minimum pulse width	Pulse "LOW"-"HIGH"-"LOW"	10			µS
	Pulse "HIGH"-"LOW"-"HIGH"	100			µS

5V Digital Inputs (opto-isolated)

	All voltages referenced to $0V_{PLC}$.	Min.	Typ.	Max.	Units
Input voltage	Logic "LOW"	-0.5	0	0.8	V
	Logic "HIGH"	2.4	5	5.5	
	Absolute maximum, surge (duration ≤ 1S) †	-5		+7.5	
Input current	Logic "HIGH"	4	10	20	mA
	Logic "LOW"	0		0.1	
Input frequency		0		5	MHz
Minimum pulse width		150			nS

24V Digital Outputs (opto-isolated)

	All voltages referenced to $0V_{PLC}$.	Min.	Typ.	Max.	Units
Output voltage	Logic "HIGH"; $+24V_{PLC} = 24V_{DC}$; External load = 330Ω	22	23	24.5	V
	Absolute maximum, surge (duration ≤ 1S) †	-0.5		35	
Output current	Logic "HIGH"; $[+24V_{PLC} – V_{OUT}] \leq 2V$			80	mA
	Logic "LOW" (leakage crt.)		0.05	0.2	
	Absolute maximum, surge (duration ≤ 1S) †	-350		350	

Resolver Interface

Applicable to IDM240-5RI and IDM640-8RI		Min.	Typ.	Max.	Units
Excitation frequency			10		KHz
Excitation voltage	Software adjustable	0		8	V_{PP}
Excitation current				50	mA_{RMS}
Resolver coupling ratio	$U_{SIN/COS} : U_{EXC}$	1:2		2:1	-
Sin / Cos Input voltage			4		V_{PP}
Sin / Cos Input impedance			10		KΩ

Encoder / Hall Inputs

		Min.	Typ.	Max.	Units
Single-ended mode compliance	Leave negative inputs disconnected	TTL / CMOS / open-collector			
Input threshold voltage	Single-ended mode	1.4	1.5	1.6	V
Differential mode compliance	For full RS422 compliance, see 1	TIA/EIA-422			
Input hysteresis	Differential mode	±0.1	±0.2	±0.5	V
Input common mode range	Referenced to GND	-7		+12	V
	Absolute maximum, surge (duration ≤ 1S) †	-25		+25	
Input impedance	Single-ended mode		4.7		KΩ
	Differential mode (see 1)		120		Ω

Analog Inputs

	Min.	Typ.	Max.	Units

Differential voltage range		±9.5	±10	±10.5	V
Common-mode voltage range	Referenced to GND	-12	0…10	+50	V
Input impedance	Differential, Tach input		60		KΩ
	Differential, Ref input		44		KΩ
Common-mode impedance	Referenced to GND; Tach input		30		KΩ
	Referenced to GND; Ref input		44		KΩ
Resolution			10		bits
Differential linearity	Guaranteed 10-bits no-missing-codes			0.09	% FS[2]
Offset error	Common-mode voltage = 0…10V		±0.1	±0.3	% FS[2]
Gain error	Common-mode voltage = 0…10V		±0.5	±1	% FS[2]
Bandwidth (-3dB)	Ref input (depending on software settings)		5		KHz
	Tach input		3.4		KHz

RS-232

		Min.	Typ.	Max.	Units
Standards compliance		TIA/EIA-232-C			
Bit rate	Depending on software settings	9600		115200	Baud
ESD Protection	Human Body Model			±15	KV

RS-485

		Min.	Typ.	Max.	Units
Standards compliance		TIA/EIA-485			
Recommended transmission line impedance	Measured at 1MHz	90	120	150	Ω
Bit rate	Depending on software settings	9600		115200	Baud
Number of network nodes	Depending on software settings			64	-
ESD Protection	Human Body Model			±15	KV

CAN-Bus

All voltages referenced to CAN_GND		Min.	Typ.	Max.	Units
Standards compliance		CAN-Bus 2.0B error active; ISO 11898-2			
Recommended transmission line impedance	Measured at 1MHz	90	120	150	Ω
Bit rate	Depending on software settings	125K		1M	Baud
Number of network nodes	Depending on software settings			64	-
ESD Protection	Human Body Model			±15	KV

Supply Outputs

		Min.	Typ.	Max.	Units
+5V_{DC} voltage	Current sourced = 350mA	4.75	5	5.25	V
+5V_{DC} available current		350			mA

Others

		Min.	Typ.	Max.	Units
Operating temperature		0		50	°C
Dimensions	Length x Width x Height	136 x 91.5 x 26.5			mm
Weight			0.28		Kg
Frame Insulation voltage withstand	GND to SHIELD (connected to frame)			250	V
Storage temperature	Not powered	-40		85	°C
Humidity	Non-condensing	0		90	%RH

[1] To connect 120Ω RS-422 terminators, strap solder-joints SJ16, SJ20, SJ22 (encoder) and/or SJ21, SJ23, SJ19 (Hall or second encoder).

[2] "FS" stands for "Full Scale"

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

2.5 *IDM240/640 LEDs*

LED Color	Function
Green	**Turned on when OUT#25 output is set low**
Red	**Turned on when the power stage error signal is generated or when OUT#12 is set low**

3. IDM240/640 Programming in the TML Environment

3.1 How to Access IDM240/640 I/O pins from TML

3.1.1. General-purpose Digital Inputs

The IDM240/640 general-purpose digital input pins are named IN#n where n can be: 2, 24, 36, 37, 38 or 39. Some of the input pins have also an alternate function. For example pin A1+/IN#3 is IN#3 with alternate function A1+ – encoder A input. After reset, all the input pins with an alternate function like A1+/IN#3 have the input function enabled and the alternate function disabled. The alternate function may be enabled after execution of the TML command *ENDINIT* (end of initialization), function of the application configuration set through the previous commands. For example, if the application configuration is with encoder feedback, at *ENDINIT* the pin A1+/IN#3 function will switch automatically from general-purpose IN#3 to encoder input A1+.
In order to read a digital input use TML command

var = IN#n;

where var is a 16-bit integer variable. After execution, *var* is set as follows:

var = 0, if IN#n = 0
var != 0, if IN#n = 1

In order to use a digital input after the alternate function is enabled, 2 more steps are necessary before reading the input.
Disable the alternate function and enable the I/O function using the TML command:

ENIO#n; where *n* is the input pin number (0 for IN#0, 1 for IN#1, etc.)

Specify that the I/O pin is input using TML command:

SETIO#n IN; where *n* is the input pin number

Now the input can be read with the TML command *var = IN#n*. It is not necessary to repeat the *ENIO#n* and *SETIO#n IN* commands next times the input is read. Once the pin function is set as input it remains in this state until the input function is specifically disabled with TML command

DISIO#n; where *n* is the input number

or the alternate function is enabled with a specific command. For example the TML command ENCAPI 0 enables capture function of the Z1+/IN#5 pin and disables the IN#5.

State of inputs IN#36, IN#37, IN#38 and IN#39 can be read all together using TML command

var = IN2, bitmask;

which puts in *var* the result of an AND logic between the state of inputs/outputs and the value of the *bitmask*. The state of the *IN2* is read as follows:

Bits 15-8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	X	IN#39	IN#38	IN#37	IN#36	IN#35/ H3+	IN#34/ H2+	IN#33/ H1+

The state of an input pin is 1 if the input signal is high and 0 if the input signal is low.

3.1.2. General-purpose Digital Outputs

The IDM240/640 has 5 general-purpose digital output pins are named OUT#n where n can be 25, 28, 29, 30, 31 and a special output OUT#12/ER to signalize the power stage error.

In order to set an output high (1 logic) use TML command

SOUT#n; set OUT#n (1 logic)

In order to set an output low (0 logic) use TML command

ROUT#n; reset OUT#n (0 logic)

After reset, the digital outputs must be first declared as outputs using TML command

SETIO#n OUT; where *n* is the output pin number

After an output pin is declared as output it can be set high or low with *SOUT#n* or *ROUT#n*. It is not necessary to repeat the *SETIO#n OUT* command next times the output is used. Once the pin function set as output it remains in this state.

CAUTION ! You should not set as outputs other IDM240/640 pins. Use the TML command SETIO#n OUT only for n = 12, 25, 28, 29, 30 and 31! SETTING AS AN OUTPUT OF ONE OF THE INPUT PINS CAN DAMAGE THE DRIVE!

Remark: The state of an output pin is 0 if the output is set high and 1 if the output is set low.

3.1.3. Encoder Signals

In application configurations with encoder feedback, A1+/IN#3 and B1+/IN#4 inputs are automatically setup as encoder inputs when the TML command *ENDINIT* is executed. The motor position is computed by the on-board encoder interface and provided in the TML variable *APOS* (actual motor position).

If the encoder has an index pulse connected to Z1+/IN#5, the capture input can be enabled (see 3.1.8 for details) and used to capture the actual motor position on rising or falling edge of the encoder index pulse.

In application configurations without encoder feedback, A1+/IN#3 and B1+/IN#3 inputs may be used as general-purpose inputs IN#3 and IN#4. The Z1+I/IN#5 input may also be used as

general-purpose input IN#5 if the application doesn't need to capture actual motor position on using Z1+ input.

3.1.4. Hall Signals

In application configurations requiring Hall signals feedback, H1+/IN#33, H2+/IN#34 and H3+/IN#35 pins are setup as Hall inputs. The actual state of the Hall signals is provided in the TML variable *HALL*, which can take values from 1 to 6. The *HALL* variable has on bits 2-0 the values of the H3+, H2+, H1+ signals applied on J13A/J13B connector.

In application configurations without Hall signals feedback, Hall inputs may be used as general-purpose inputs IN#33, IN#34 and IN#35.

3.1.5. Analog Inputs

IDM240/640 Pins	TML Environment
+Ref -Ref	The 10-bit A/D conversion result, left-shifted by 6 is provided in TML variable *AD5*. The position or speed reference can be read from TML variables *TPOS* or *TSPD*. These are computed as (*AD5 – AD5OFF*) x *CADIN* / $2^{16\text{-SFTADIN}}$, where *AD5OFF* is a programmable offset and *CADIN*, *SFTADIN* are 2 TML parameters.
+Tach -Tach	The 10-bit A/D conversion result, left-shifted by 6 is provided in TML variable *AD2*. In applications where position feedback is read from this input, TML variable *APOS* contains (*AD2* >> 6). In applications where speed feedback is read from this input, TML variable *ASPD* contains (*AD2OFF – AD2*)>>6, where *AD2OFF* is a programmable offset.

3.1.6. Limit Switch Inputs LSP, LSN

The IDM240/640 has 2 dedicated inputs for limit switches: LSP (positive direction) and LSN (negative direction). The inputs can be programmed to sense rising of falling transitions. The following actions can be programmed when a transition is detected on a limit switch input:

Automatically stop the motor. This feature can be activated with TML command *LSACT STOPx* where *x* = 0,1,2 or 3. *STOP3* to *STOP0* indicate 4 different ways to stop a motor: a) smooth with a programmed deceleration rate; b) by setting speed reference to 0; c) by setting current reference to 0; d) by setting motor voltage command to 0;

Generate a TML interrupt. The TML interrupt service routine accepts any TML command, hence when a limit switch is reached, any desired action can be programmed;

Generate a TML event. On event occurrence, the motion mode and/or parameters can be automatically changed. This feature is useful if the motor is on-purpose moved towards a limit switch to execute a specific motion sequence when the limit switch is reached.

The edge-detection feature of a limit switch input must be enabled using the TML commands

ENLSP 0; enable LSP to sense a falling edge
ENLSP 1; enable LSP to sense a rising edge
ENLSN 0; enable LSN to sense a falling edge
ENLSN 1; enable LSN to sense a rising edge

The edge-detection is automatically disabled after the transition is sensed, to avoid the potential problems caused by multiple transitions. Hence, after each transition sensed, the capture input must be enabled again in order to detect the next transition. The edge-detection can also be disabled using TML commands *DISLSN* or *DISLSP*.

3.1.7. ENABLE Input

The IN#16/EN input can be used as an emergency stop. When asserted high, the following events happen:

The IDM240/640 executes automatically the TML command *AXISOFF* that has the following effects:

the controllers are disabled;

the power-stage transistors are turned off;

Generate a TML interrupt. The TML interrupt service routine accepts any TML command, hence when a Enable input is triggered, any desired action can be programmed;

The IN#16/EN input acts like a non-maskable interrupt, which is always executed, no matter of the IDM240/640 operation context. If the TML command *AXISON* is executed while IN#16/EN pin is held low, the command has no effect. By default, in order to applying a voltage to motor, the IN#16/EN input must be held low or left open.

3.1.8. CAPI Capture Input

The actual motor position can be captured when rising or falling transitions occur on the capture input Z1+. The latency from the time a transition happens on a capture input to the time the motor position is read is maximum 63ns. This feature offers the possibility to perform precise motor positioning relative to its position at the time when the capture input was triggered. For example, connecting the encoder index pulse to Z1+ can do accurate homing. When a transition is detected on a capture input, the motor position is saved in the TML variable *CAPPOS*. In the same time, the following actions may be programmed:

Generate a TML interrupt. The TML interrupt service routine accepts any TML command, hence when a capture input is triggered, any desired action can be programmed;

Generate a TML event. On event occurrence, the motion mode and/or parameters can be automatically changed. This feature may be used to pre-program next motor move after the capture input was triggered.

The edge-detection feature of a the capture inputs must be enabled using the TML commands

ENCAPI 0 enable CAPI to sense a falling edge
ENCAPI 1 enable CAPI to sense a rising edge

The edge-detection is automatically disabled after the transition is sensed, to avoid the potential problems caused by multiple transitions. Hence, after each transition sensed, the capture input must be enabled again in order to detect the next transition. The edge-detection can also be disabled using TML commands *DISCAPI*. When capture inputs are disabled their alternate function as general-purpose inputs IN#5 is enabled.

3.1.9. READY Output

The $\overline{\text{OUT\#25}}$ /RD output is set high immediately after reset. It goes low after the IDM240/640 internal initialization ends. This output can be used to signal to an external device that the IDM240/640 is powered and it is ready to receive and execute TML commands. When is low the IDM240/640 green LED is turned on. The state of the output may be changed with TML commands

SOUT#25; set $\overline{\text{OUT\#25}}$ /RD high and turn off green LED

ROUT#25; set $\overline{\text{OUT\#25}}$ /RD low and turn on green LED

3.2 PWM Voltage Command Scaling

In the TML environment all PWM voltage commands are normalized as 16-bit signed integers. The following table presents the how these commands are translated into voltages

TML Voltage Command [bits]	Voltage Applied [Volts]
+32767	+Vmax[1]
0	0
-32768	-Vmax

Vmax is the maximum voltage applicable defined as Vmax = $V_{MOT} - V_D - V_{DT}$, where

V_{MOT} is the IDM240/640 motor supply / DC-bus voltage
V_D is the voltage drop on inverter transistors
V_{DT} is the voltage drop due to dead-time (if dead-time compensation is not activated)

Hence the scaling factor for the voltage commands is:

$$\text{Voltage [V]} = \frac{\text{V max[V]}}{\text{32768[bits]}} \times \text{TML Voltage [bits]}$$

Remark: The resolution of the PWM voltage commands depends on the PWM frequency, set by default at 20KHz. At this value PWM resolution is 1:1000. This means that a modification of the voltage applied occurs only if the 10MSB of the TML command voltage are changed.

3.3 Error Signal

The IDM240/640 power stage generates an error signal in case of short-circuit and/or earth-fault. When the error signal is set, the following events happen:
The inverter transistors are turned off as long as the error state is set

[1] A positive voltage determines in the motor a current that is measured as positive

The $\overline{\text{OUT\#12}}$ /ER output is set high and the IDM240/640 red led is turned on

Generate a TML interrupt. The TML interrupt service routine accepts any TML command, hence when power-stage protection is triggered, any desired action can be programmed

If the error condition has disappeared, it is possible to resume the moving through executing the *AXISON* instruction, and optionally, setting low the $\overline{\text{OUT\#12}}$ /ER signal and turn off the red led using the *SOUT#12* instruction.

3.4 Supply / DC-bus Voltage Measurement Scaling

The IDM240/640 includes a supply / DC-bus voltage feedback. In the TML environment, the A/D converted value of the supply / DC-bus voltage feedback can be read as the TML variable *AD4*.

The scaling factor for the DC-bus voltage measurement is:

$$\text{DC-bus [V]} = \frac{108.5[V]}{65472[bits]} \times \text{AD4 [bits]}$$

where 108.5 V is the maximum measurable DC-bus voltage

65472 is the AD4 value for DC-bus voltage = 108.5 V

Remark: AD4 value is the result of a 10-bit A/D conversion, left-shifted by 6. The 6LSB of *AD6* are always 0. If the A/D conversion result varies with 1LSB this translates into a variation of the *AD4* value with $2^6 = 64$.

3.5 Motor Currents Scaling

The IDM240/640 measures motor currents through shunts placed in the lower-legs of the inverter. Only currents measured on phases A and B are connected to 2 A/D inputs with a current gain factor of 0.1V/A. The shunt from phase C is used only to sense a short-circuit. In applications with 3-phase AC motors, the TML variables *IA* and *IB* provide the motor currents in phases A and B. In applications with DC or brushless DC motors, TML variable *IQ* gives the motor current. The scaling factor for the motor currents is:

$$\text{Motor current [A]} = \frac{1.65[V]}{32704[bits] \times 0.1[V/A]} \times \text{TML current [bits], or}$$

$$\text{Motor current [A]} = \frac{16.5[A]}{32704[bits]} \times \text{TML current [bits]}$$

Remark: The A/D conversion result has 10-bit resolution and is used left-shifted by 6. The 6LSB of TML currents are always 0. If the A/D conversion result varies with 1LSB this translates into a variation of the TML current value with $2^6 = 64$.

3.6 Motor Speed Scaling

TML variable ASPD gives the motor speed. The scaling factor depends on the speed sensor.

When the motor has a position sensor like an encoder, the speed can be estimated as position increment per speed-loop sampling period (set by default at 1ms). In this case the scaling factor is

$$\text{Motor speed [rpm]} = \frac{60}{4 \times \text{N [lines]} \times \text{T[s]}} \times \text{ASPD [bits]}$$

where N is the number of encoder lines
T is the speed-loop sampling period in seconds
4 is the multiplication ratio of the position resolution done in the encoder interface

Example: If T = 1ms, and N = 500 lines, motor speed [rpm] = 30 × ASPD [bits]

When the motor has a position sensor like a resolver, the speed can be estimated as position increment per speed-loop sampling period. In this case the scaling factor is

$$\text{Motor speed [rpm]} = \frac{1}{P_{RES}\ \text{[bits/rev]} \times \text{T[s]}} \times \text{ASPD [bits]}$$

where P_{RES} is the resolver interface resolution
T is the speed-loop sampling period in seconds

If the speed feedback is provided by a tachometer, connected to IDM240/640 connector J9 on analogue input Tach, the scaling factor is

$$\text{Motor speed [rpm]} = \frac{3.3[V]}{1024[bits] \times 0.165[V/V] \times K_T\,[V/rpm]} \times ASPD\ \text{[bits]}$$

where K_T is the tachometer constant
0.165 [V/V] is the IDM240/640 feedback gain factor

Remark: In speed control motion modes, the speed reference should be provided in the same units as ASPD i.e. based on the same scaling as for the speed measurement.

3.7 Motor Position Scaling

TML variable *APOS* gives the motor position. When encoder feedback is used, *APOS* is measured in encoder counts (1 encoder count = 1 bit). The scaling factor is:

$$\text{Motor position [revolutions]} = \frac{1}{4 \times \text{N [lines]}} \times \text{APOS [bits]}$$

where N is the number of encoder lines
4 is the multiplication ratio of the position resolution done in the encoder interface
If the position feedback is read from the resolver analogue inputs, the scaling factor is

$$\text{Motor position [revolutions]} = \frac{1}{P_{RES}\ [\text{bits/rev}]} \times \text{APOS [bits]}$$

where P_{RES} is the resolver interface resolution

If the position feedback is read from the analogue input TACH, the scaling factor is

$$\text{Motor position [revolutions]} = \frac{3.3[V]}{1024[bits] \times 0.165[V/V] \times K_P[V/rpm]} \times APOS \text{ [bits]}$$

where K_P is the analogue position sensor constant.

3.8 Drive Temperature Scaling

The IDM240/640 includes a temperature sensor. TML variable *AD7* gives the drive temperature. The scaling factor is:

$$\text{Drive temperature [°C]} = \frac{3.3[V]}{1024[bits] \times 0.01[V/°C]} \times AD7 \text{ [bits]} - 50[°C]$$

4. Technosoft Motion Language

The Technosoft Motion Language (TML) consists of a high-level set of instructions allowing to:

- Set up the Intelligent drive for a particular motion application configuration
- Program and execute motion sequences

For the setup phase the TML enables the user to:

- Describe the basic system configuration (as motor and sensors type)
- Perform specific settings (as motor start mode, PWM mode, sampling rates, etc.)
- Setup the controllers (current, speed, position, external user specific loop), etc.

For motion programming and execution the TML permits to:

- Select the motion mode (profiles, contouring, gearing in multiple axes structures, etc.)
- Setup events and change on-the-fly the motion mode and/or parameters when the events occur
- Detect transitions and program specific actions for external signals as limit switches, captures
- Execute homing sequences
- Compute motion parameters using the built-in ALU
- Synchronize multiple-axis structures, by sending group commands, etc.

The ultimate goal of the TML instruction set is to implement complex motion applications based on high-level motor-independent motion sequencing commands.

4.1 TML Environment

The TML environment includes 3 basic components:

- the “motion processor”
- the trajectory generator
- the motor control kernel

The software implemented “motion processor” represents the core of the TML environment. It decodes and executes the TML commands. Like any processor, it includes specific elements as program counter, stack, ALU, interrupt management and registers.

The trajectory generator computes function of the motion mode selected, the target position, speed, torque or voltage in order to reach the commanded values.

The motor-control kernel implements the control loops including acquisition of feedback sensors, the controllers, the coordinate transformations for FOC, the motor protections, etc.

When the “motion processor” executes motion configuration or command instructions, it translates them into actions upon the trajectory generator and/or the motor control kernel.

The TML works with 3 data types:

int/uint	–	16-bit signed/unsigned integers
long	–	32-bit signed integers
fixed	–	32-bit fixed-point where the 16 MSB represent the integer part and the 16 LSB the fractional part

4.2 Motion Modes

The Intelligent drive offers the 8 reference modes, i.e. 8 modes to provide the target reference:

- profiles
- contouring
- pulse & direction
- external
- electronic gearing
- electronic cam
- test
- stop

Each reference mode can be applied to several control structures. From this combination results 40 motion modes, where each motion mode designates a reference mode and a specific control structure.

4.2.1. Position Profile Modes

In position profile modes, a position control is performed using a trapezoidal speed profile. The user specifies the desired position (absolute or relative), the slew speed and the acceleration/deceleration ramp. The reference generator computes the position trajectory corresponding to a trapezoidal or triangular speed profile. Depending on the control structure used, 4 position profile modes are possible:

Table 4.1. Position Profile - Motion Modes

Position Profile Motion Modes	Controlled Loops		
	Position / User	Speed	Torque
PP3	√	√	√
PP2	√	√	
PP1	√		√
PP0	√		

Related Parameters

`CPOS` Command position (long) – desired position (absolute or relative) in position units[1]

`CSPD` Command speed (fixed)– desired slew speed in speed units[2]

`CACC` Command acceleration (fixed) – desired acceleration / deceleration in acceleration units[3]

[1] Position units can be: a) counts of encoder (1 count = 1/(4 * no. of encoder lines); b) 1 LSB if position feedback is read from an analogue input or parallel port; c) one micro-step for steppers

[2] Speed units can be: a) position units/slow-loop sampling if speed is estimated as position difference; b) 1LSB if speed feedback is read from an analogue input or parallel port;

[3] Acceleration units are speed units / slow-loop sampling

Related Instructions

`MODE PPx`	Set position profile mode x (x = 0, 1, 2, 3)
`CPR`	Command position is relative
`CPA`	Command position is absolute
`UPD`	Update – updates motion parameters. Start command if no motion

`STOP0, STOP1, STOP2 or STOP3` – Stop motion using methods 0 to 3

In all position profile modes, the motion parameters `CPOS, CSPD, CACC` can be changed any time during motion. The reference generator automatically re-computes the position trajectory in order to reach the new commanded position using the new values for slew speed and acceleration. Figure 4.1 shows an example when slew speed and acceleration rate are changed, while commanded position is kept the same.

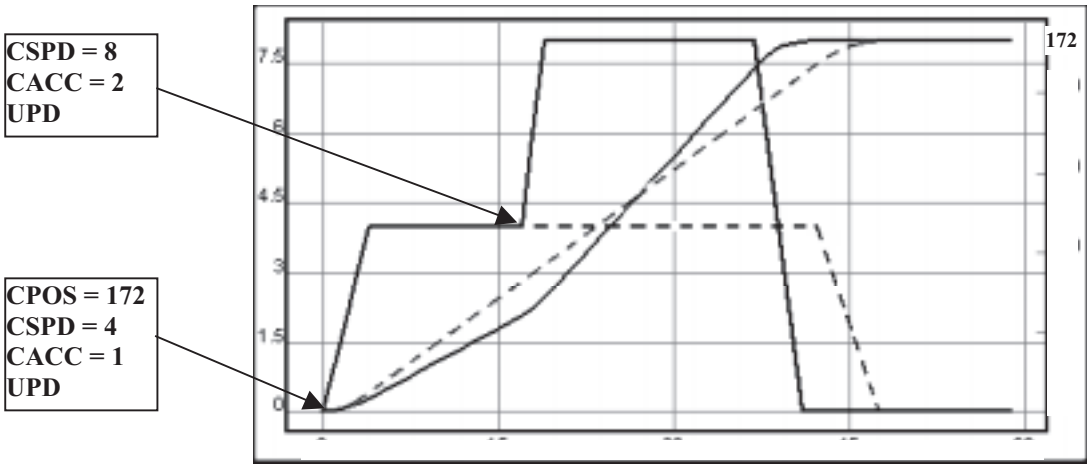


Figure 4.1. *Position profile. On-the-fly change of motion parameters*

There is no restriction for the commanded position. If during motion a new position command is issued that require to reverse the motor, the reference generator does automatically the following operations:

- stops the motor with the programmed deceleration rate
- accelerates the motor in the opposite direction till the slew speed is reached or till the motor has to decelerate
- stops the motor on the commanded position

In position profile modes, the reference generator automatically eliminates the round-off errors, which may appear when the commanded position can't be reached with the programmed slew speed and acceleration/deceleration rate. This situation is illustrated by the example below.

Example:

Commanded position is 258 counts, with the slew speed 18 counts/sampling and the acceleration rate 4 counts/sampling[1]. To reach the slew speed 2 options are available:

Accelerate at 16 in 4 steps, then from 16 to 18 in a 5th step. Acceleration space is 49 counts

Accelerate from 0 to 2 in 1st step, then from 2 to 18 in 4 steps. Acceleration space is 41 counts

For the deceleration phase the options and spaces are the same. But, no matter what option is used for acceleration and deceleration phase, the space that remains to be done at constant speed is not a multiple of 18 i.e. the position increment at each step. Hence when to start the deceleration phase? Table 4.2, presents the possible options and the expected errors.

Table 4.2. Round-off error example. Options and expected errors.

Acceleration Space [counts]	Deceleration Space [counts]	Space to do at constant speed [counts]	Time to go at constant speed [sampling steps]	Deceleration starts after [samplings]	Target position Error [counts]
49 counts	49 counts	258 – 2 * 49 = 160 counts	160/18 = 8.8	5 + 8 = 13	- 16
				5 + 9 = 14	+ 2
49 counts	41 counts	258 – 49 – 41 = 168 counts	168/18 = 9.3	5 + 9 = 14	- 6
				5 + 10 = 15	+ 12
41 counts	49 counts	258 – 41 – 49 = 168 counts	168/18 = 9.3	5 + 9 = 14	- 6
				5 + 10 = 15	+12
41 counts	41 counts	258 – 2 * 41 = 176 counts	176/18 = 9.7	5 + 9 = 14	-14
				5 + 10 = 15	+4

The Intelligent drive comes with a different approach. It monitors the round-off errors and automatically eliminates them by introducing during deceleration phase short periods where target speed is kept constant. Hence, the target position is always reached exactly without errors.

CPOS=258
CSPD=18
CACC=4

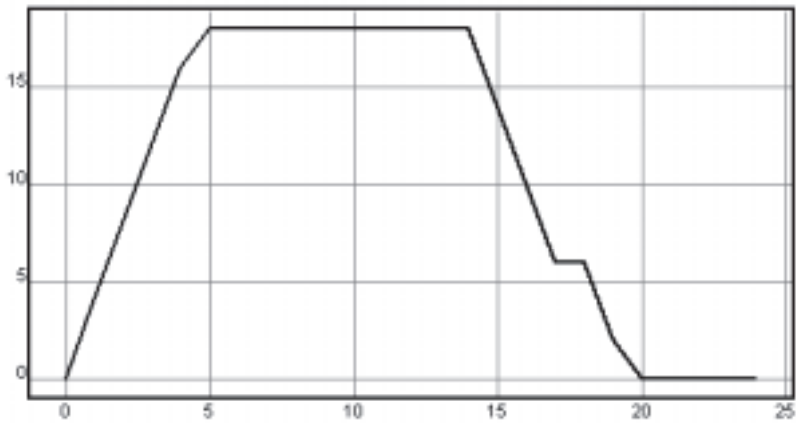


Figure 4.2. *Position profile. Automatic elimination of round-off errors*

Figure 4.2 shows the target speed generated by the Intelligent drive for the above example. During the deceleration phase the target speed:

- decelerates from 18 to 6 in 3 steps (target position advances with 36 counts)
- is kept constant for 1 step (target position advances with 6 counts)
- decelerates from 6 to 2 in one step (target position advances 4 counts)
- decelerates from 2 to 0 in the last step (target position advances 1 count)

Hence deceleration space is 47 counts which added to 49 counts for acceleration phase and 162 counts for constant speed gives exactly the 258 counts commanded position.

Programming Example

```
MODE PP3;          // set position profile mode 3
CACC = 1.5;        // command acceleration = 1.5 counts/sampling^2
CSPD = 20.;        // command speed = 20 counts/sampling
CPOS = 20000;      // command position = 2000counts
CPA;               // command position is absolute
UPD;               // update - start the motion
```

4.2.2. Speed Profile Modes

In speed profile modes, a speed control is performed using a trapezoidal profile. The user specifies the jog speed and the acceleration/deceleration ramp. When motion starts, the motor accelerates up to the specified speed and continues to jog at this speed until a new speed or a stop command is issued. Speed, direction and acceleration can be changed any time during motion. Depending on the control structure used, 2 speed profile modes are possible:

Table 4.3. Speed Profile - Motion Modes

Speed Profile Motion Modes	**Controlled Loops**		
	Position / User	Speed	Torque
SP1		√	√
SP0		√	

Related Parameters

`CSPD` Command speed (fixed) – desired jog speed in speed units. Sign gives direction.

`CACC` Command acceleration (fixed) – desired acceleration / deceleration in acceleration units

Related Instructions

`MODE SPx` Set speed profile mode x (x = 0, 1)

`UPD` Update – updates motion parameters. Start command if no motion

`STOP0, STOP1, STOP2 or STOP3` – Stop motion using methods 0 to 3

Programming Example

```
MODE SP1;              // set speed profile mode 1
CACC = 1.;             // command acceleration = 1.0 counts/sampling^2
CSPD = -25.5;  // command speed = -25.5 counts/sampling
                       // negative command speed = negative direction
UPD;                   // update - start the motion
```

4.2.3. Position/Speed/Torque/Voltage Contouring Modes

In contouring mode, an arbitrary profile can be prescribed. The profile contour is described by reference increments per sampling over a time interval (see Figure 4.3). The contour profile is:

- a position reference in position contouring mode;
- a speed reference in speed contouring mode;
- a torque reference in torque contouring mode;
- a voltage reference in voltage contouring mode;

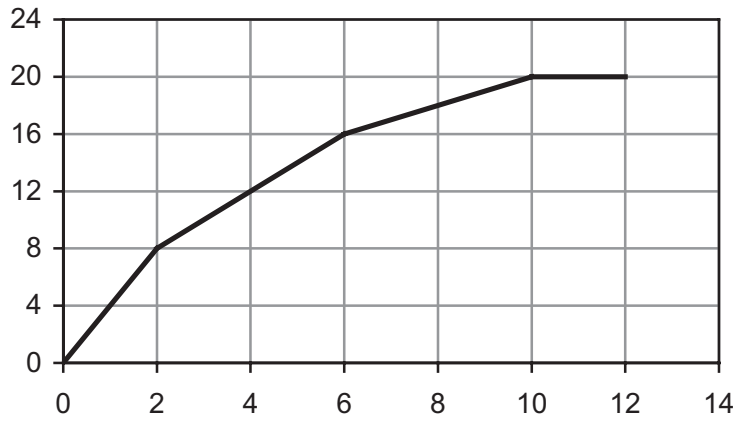


Figure 4.3. Reference generation in contouring modes

In position/speed contouring, the starting point is either the current value of the target position/speed, or the actual value of the motor position/speed (see par. Motion Mode Changing). In torque/voltage contouring, the starting value is settable by the user (default value is 0).

The contouring modes require a local memory where to place the sequence of contour segments to be executed. First the contouring mode must be set and first segment should be provided. Then contouring mode can be activated with the `UPD` command. Once a contouring mode is activated, the rest of the segments are automatically executed. The sequence of contour segments must end with a segment where the time interval is 0. When the reference generator works with one segment, the next segment is already fetched waiting in a local buffer. This procedure permits to immediately start the following segment when the current one ends. Each

time the reference generator starts a new segment, the parameters of the next segment are transferred into the local buffer.

A host may also send through any communication channel contouring segments. But these segment commands are treated differently. Each time a segment command is sent by the host, it starts to execute immediately, canceling previous segment processing.

Table 4.4, presents the possible contouring modes.

Table 4.4. Contouring Modes

Category	Motion Modes	Controlled Loops		
		Position / User	Speed	Torque
Position Contouring	PP3	√	√	√
	PP2	√	√	
	PP1	√		√
	PP0	√		
Speed Contouring	SC1		√	√
	SC0		√	
Torque Contouring	TC			√
Voltage Contouring	VC			

Related Parameters

REF0(H)[1]	Starting value (int) – torque/voltage contouring in torque/voltage units[2]
`Time`	Value or variable (int) – represents time interval in samplings of a segment
`Increment`	Value or variable (fixed) – represents reference increment per sampling

Related Instructions

`MODE PCx`	Set position contouring mode x (x = 0, 1, 2, 3)
`MODE SCx`	Set speed contouring mode x (x = 0, 1)
`MODE TC`	Set torque contouring
`MODE VC`	Set voltage contouring. Voltage reference represents motor voltage for DC motor quadrature component (Q-axis) of the voltage vector for AC motors
`SEG Time, Increment`	Set a contour segment with parameters `Time` and `Increment`
`UPD`	Update – updates motion parameters. Start if no motion

`STOP0, STOP1, STOP2 or STOP3` – Stop motion using methods 0 to 3

[1] (H) means high part (16MSB) of a 32-bit variable

[2] Torque unit. Torque [torque units] = Torque [Nm] * 2^{10} / (V_{REF}HI - V_{REF}LO) * 64 * K_I / (K_T * 2^{SFTCRT}) where: V_{REF}HI - V_{REF}LO = analogue input range, K_I – current measurement gain [V/A], K_T – motor torque constant [Nm/A], SFTCRT – a TML parameter set by default at 0)

Voltage unit. Voltage [voltage unit] = Voltage [V] * 32768/ U_{DC} where U_{DC} – DC-bus voltage [V]

Programming Example (see Figure 4.3)

```
MODE PC3;          // set position contouring mode 3
SEG 2, 4.;         // set 1st segment. Increment position reference
                   // with 4 counts/sampling in the next 2 samplings
UPD;               // update – start motion
SEG 4, 2.;         // set 2nd segment
SEG 4, 1.;         // set 3rd segment
SEG 2, 0.;         // set 4th segment
SEG 0, 0.;         // end contour sequence
```

4.2.4. Position/Speed Pulse & Direction Modes

In pulse & direction modes, the position or speed reference is provided by an external device, which gives 2 digital signals:

Pulse – a sequence of pulses. Each pulse represents a position unit. The sum of the pulses indicates the position displacement to be performed. The variation of number of pulses during one sampling period represents a speed reference.

Direction - a digital signal which indicates the reference sign (motion direction)

The external device *Pulse* signal must be connected to the intelligent drive input *IN#38/P* or *IN#38/P5V*. The external device *Direction* signal must be connected to the intelligent drive input *IN#37/D* or *IN#37/D5V*.

Table 4.5, presents the possible pulse & direction modes.

Table 4.5. Pulse & Direction Modes

Category	Motion Modes	Controlled Loops		
		Position / User	Speed	Torque
Position Pulse & Direction	PPD3	√	√	√
	PPD2	√	√	
	PPD1	√		√
	PPD0	√		
Speed Pulse & Direction	SPD1		√	√
	SPD0		√	

Related Instructions

`MODE PPDx` Set position pulse & direction mode x (x = 3, 2, 1, 0)

`MODE SPDx` Set speed pulse & direction mode x (x = 1, 0)

`UPD` Update – updates motion parameters. Start command if no motion

`STOP0, STOP1, STOP2 or STOP3` – Stop motion using methods 0 to 3

Programming Example

```
MODE PPD3;         // set pulse & dir mode 3
UPD;               // update – activate new mode. Motion starts
```

// when external device provides pulses

4.2.5. External Position/Speed/Torque/Voltage Modes

In the external modes, an external device provides the target reference in one of the following ways:

- using TML on-line commands sent through any communication channel;
- as an analogue voltage connected to Ref input;
- as a 16-bit value which can be read from the an input port mapped in the I/O space;
- as a 32-bit value which can be read from two input port mapped in the I/O space;

Table 4.6, presents the possible external modes. Torque and voltage external modes include 2 options:

- torque/voltage slow – reference is read at each slow-loop (position/speed) sampling period
- torque/voltage fast – reference is read at each fast-loop (torque/current) sampling period

Related Parameters

`EREF` (long) where the external device writes the position reference when it is provided on-line. The speed, torque or voltage reference should be written in **`EREF(H)`** which seen as an integer

Related Instructions

`MODE PEx`	Set external position mode x (x = 3, 2, 1, 0)
`MODE SEx`	Set external speed mode x (x = 1, 0)
`MODE TES`	Set external torque mode slow
`MODE TEF`	Set external torque mode fast
`MODE VES`	Set external voltage mode slow
`MODE VES`	Set external voltage mode fast
`EXTREF 0`	Set external reference type: provided on-line
`EXTREF 1`	Set external reference type: read from analogue input (+Ref, -Ref)
`EXTREF 2`	Set external reference type: read from a 16-bit I/O port
`EXTREF 3`	Set external reference type: read from a 32-bit I/O port
`UPD`	Update – updates motion parameters. Start command if no motion

`STOP0, STOP1, STOP2 or STOP3` – Stop motion using methods 0 to 3

The external reference should be in position units for position external modes; speed units for speed external modes; torque units for torque external modes; and voltage units for voltage external modes.

Table 4.6. External Modes

Category	Motion Modes	Controlled Loops		
		Position / User	Speed	Torque
Position External	PE3	√	√	√
	PE2	√	√	
	PE1	√		√
	PE0	√		
Speed External	SE1		√	√
	SE0		√	
Torque External Slow	TES			√
Torque External Fast	TEF			√
Voltage External Slow	VES			
Voltage External Fast	VEF			

Programming Example

```
EXTREF 1;          // external reference read from analogue input
MODE SE1;          // set speed external mode 1
UPD;               // update – activate new mode
```

4.2.6. Torque/Voltage Test Modes

The torque and voltage test modes are intended for performing preliminary tests during the setup phase. The test reference is a limited ramp (see Figure 4.4). In application configurations with brushless AC motors, the test modes also give the possibility to drive the motor by setting up the electrical angle variation (see Figure 4.5)

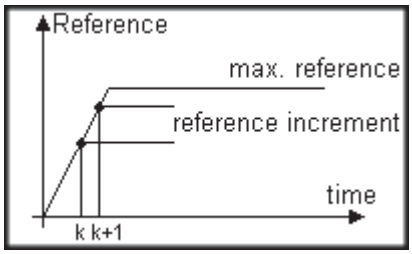
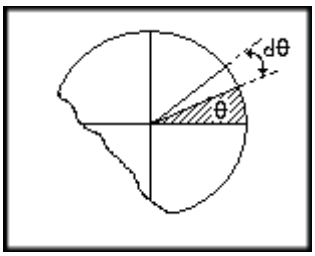


Figure 4.4. *Reference profile in test modes*



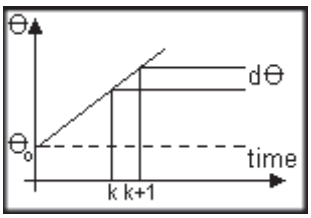


Figure 4.5. *Electrical angle setup in test modes with brushless AC motors*

Related Parameters

REFTST	maximum value of the test reference in torque or voltage units (int)
RINCTST	reference increment at each slow-loop sampling period (int)
THTST	initial value for the electrical angle in electrical angle units[1] (int)
TINCTST	electrical angle increment at each fast-loop sampling period (int)

Related Instructions

MODE TT	Set torque test mode
MODE VT	Set voltage test mode

4.2.7. Electronic Gearing Modes

In electronic gearing mode one axis set as master transmits its position to one or several axes set as slaves. The slaves can receive the master position through CAN communication channel or from second encoder input, and follow the master position with a programmable ratio. The master position can be the actual motor position (default) or the current target position. If actual position is sent, the master can work in any motion mode. If target position is sent, the master should work in a mode that generates a target position. The master sends its position once at each slow-loop sampling. Slave axes perform a position control. The master reference increment multiplied by the gear ratio is added to their actual position. Depending on the control structure the following 4 motion modes are possible for the slaves

Table 4.7. Electronic Gearing Slave - Motion Modes

Electronic Gearing Slave Motion Modes	Controlled Loops		
	Position	Speed	Torque
GS3	√	√	√
GS2	√	√	
GS1	√		√
GS0	√		

Related Parameters

SLAVEID	the axis or group ID to which master sends its position
GEAR	slave(s) gear ratio (fixed). Negative values means opposite direction
MREF	(long) slave location where the master sends its position

Related Instructions

MODE GSx	Set electronic gear slave mode x (x = 3, 2, 1, 0)
SGM	Set electronic gearing master mode

1 Electrical angle [electrical angle units] = electrical angle [degrees] * 32767 / 180 in the range – 32768 to +32767 i.e. +/- 180 degrees

RGM	Reset electronic gearing master mode

Programming Example

```
                  // On slave axis (Axis ID = 1):
MODE GS3;         // set electronic gearing slave mode 3
      GEAR = -0.5;// slave gear ratio is 0.5 opposite direction
UPD;              // update – activate new mode

                  // On master axis:
      SAVEID 1;   // slave axis has Axis ID = 1
      SGM;        // set electronic gearing master mode
UPD;              // update – activate new mode. Master starts to send
                  // its position
```

4.2.8. Electronic Cam Modes

In electronic cam mode one axis set as master transmits its position to one or several axes set as slaves. The slaves can receive the master position through CAN communication channel or from second encoder input. A cam table specifies the slaves position function of the master position. Between master points linear interpolation is performed. The master position can be the actual motor position (default) or the current target position. If actual position is sent, the master can work in any motion mode. If target position is sent, the master should work in a mode that generates a target position. The master sends its position once at each slow-loop sampling. Slave axes perform a position control. The master reference increment multiplied by the gear ratio is added to their actual position. Depending on the control structure the following 4 motion modes are possible for the slaves.

Table 4.8. Electronic Cam Slave - Motion Modes

Electronic Cam Slave Motion Modes	Controlled Loops		
	Position	Speed	Torque
CS3	√	√	√
CS2	√	√	
CS1	√		√
CS0	√		

Related Parameters

SLAVEID	the Axis or Group ID to which master sends its position
MREF	(long) slave location where the master sends its position
MPOS0	(long) slave location where is master position after correction
CAMOFF	cam offset

Related Instructions

`MODE CSx`	Set electronic cam slave mode x (x = 3, 2, 1, 0)
`SGM`	Set electronic cam master mode
`RGM`	Reset electronic cam master mode
`INITCAM LoadAddress, RunAddress`	Copy cam table from E^2ROM to RAM

Programming Example

```
                        // On slave axis (Axis ID = 1):
INITCAM 0x4500,0xF000;  // copy cam table from E2ROM to RAM
MODE CS3;               // set electronic cam slave mode 3
UPD;                    // update – activate new mode

                        // On master axis:
      SAVEID 1;         // slave axis has Axis ID = 1
      SGM;              // set master mode for electronic cam
UPD;        // update – activate new mode. Master starts to send
                        // its position
```

4.2.9. Stop Modes

The Intelligent drive offers 4 modes to stop the motor. These are presented in Table 4.9.

Table 4.9. Stop Modes

Stop Modes	Action
STOP3	Smoothly decelerates the motor till speed is 0
STOP2	Forces target speed to 0
STOP1	Forces target torque to 0
STOP0	Forces motor voltage to 0

In order to start a new the motion after a STOP command, the motion mode has to be set again. This operation disables the stop mode and allows motor to move.

Related Instructions

`STOPx`	Set stop mode x (x = 3, 2, 1, 0)

Programming Example

```
STOP3;          // smooth stop
MODE PP3;       // set position profile mode 3
UPD;            // update – restart motion after a STOP command
```

4.2.10. Motion Mode Changing

The intelligent drive allows switching on the fly all the motion modes except the test modes. This feature is especially useful for position/speed control applications where the target reference is provided by the internal trajectory generator using position/speed profile modes, position/speed contouring modes, electronic gearing, electronic cam and stop modes.

On the fly change of the motion modes is possible because the target reference is updated each time the motion mode changes. Whenever a new motion mode is set, the target position/speed reference is set to the actual values of the motor position/speed. This default target update mode (*TUM0*) is particularly useful to perform precise relative positioning triggered by an external event, because the input data for the relative position profile computation are the real motor position and speed.

For open-loop applications where there is no position/speed feedback, the intelligent drive offers also the possibility cancel the target position/speed update with the actual motor values. In this case (set with *TUM1* command) the target reference is preserved when motion modes are changed. In speed profile or speed contouring modes the trajectory generator continues to integrate the target position allowing thus on the fly transition from these modes to position profile or position contouring modes, even in the absence of the motor feedback.

4.3 Application Programming

Motion Command Categories

Basically, there are two categories of motion commands:

- immediate
- sequential, which can only reside in the local memory (if present)

The immediate motion commands don't require a wait loop to complete the execution. These commands can be send to the Intelligent drive via the communication channels, or can reside in the local memory.

The sequential motion commands require a wait loop to complete. In this category enter the following 2 commands:

`WAIT!`	Wait a programmed event to occur
`SEG Time, Increment`	Set a contour segment with parameters `Time` and `Increment` to be executed when the previous one ends

The sequential commands can reside only in a local memory. If these commands are sent via the communication channels are immediately executed as if the wait loop condition is always true.

TML Program Structure

A TML program starts with instruction BEGIN and ends with instruction END. It is divided into 2 sections:

- the initialization section
- the motion application programming section

The initialization section starts after BEGIN and lasts until the ENDINIT command, which means end of initialization section. In this section, the intelligent drive is setup for a particular motion

application configuration. This involves setup of the TML configuration registers for the application motor and sensors types, the PWM and sampling rates settings, the parameterization of the controllers, protections and other special features like: motor start method, PWM mode, etc. When ENDINIT command is executed, it uses the information from the initialization section to setup the intelligent drive for a particular motion application configuration. After ENDINIT execution, the basic configuration involving the motor and sensors types, the sampling rates, can't be changed unless the intelligent drive is reset.

The motion application programming section contains the motion sequences to be executed. The section starts after ENDINIT and lasts until the TML program ends. In many cases, the first instruction to be executed in this section is AXISON which activates the PWM commands for the default motion mode after reset: external voltage, reference provided on-line in EREF(H). Default value of EREF(h) is 0.

Structure of a TML Program

```
BEGIN;              // TML program start
 ...
                    // Intelligent drive setup for a particular application configuration
 ...
ENDINIT;            // end of initialization
 ...
                    // Motion Sequences
 ...
END;                // TML program end
```

4.4 Event Triggers

The IDM240/640 can be programmed to monitor an event and do actions on the event occurrence. A typical example is the situation when the parameters and/or the motion mode have to be changed (updated) at a precise moment, when a certain event happens. The TML recognizes a set of 18 events, which can be programmed, one at a time, for monitoring (Table 4.10).

Table 4.10. Programmable Event Triggers

No.	**Mnemonic**	**Event Description**
1	!MC	Set event when motion complete
2	!CAP	Set event when a capture input is triggered
3	!LSP	Set event when positive limit switch (LSP input) is triggered
4	!LSN	Set event when negative limit switch (LSN input) is triggered
5	!IN#n 0	Set event when digital input #n is reset;
6	!IN#n 1	Set event when digital input #n is set;
7	!RT value32 !RT var32	Set event after a time period (relative to event setting) = a 32-bit long value or variable. Time unit is slow-loop period
8	!AT value32	Set event when absolute time = a 32-bit long value or variable

	!AT var32	
9	!SU value32 !SU var32	Set event when actual (motor) speed <= a 32-bit fixed value or variable
10	!SO value32 !SO var32	Set event when actual (motor) speed >= a 32-bit fixed value or variable
11	!RPU value32 !RPU var32	Set event when actual (motor) relative position (from current motion start or `POS0` value) <= a 32-bit long value or variable
12	!RPO value32 !RPO var32	Set event when actual (motor) relative position (from current motion start or `POS0` value) >= a 32-bit long value or variable;
13	!APU value32 !APU var32	Set event when actual (motor) absolute position <= 32-bit long value or variable
14	!APO value32 !APO var32	Set event when actual (motor) absolute position >= 32-bit long value or variable
15	!RU value32 !RU var32	Set event when target reference <= 32-bit long/fixed value or variable
16	!RO value32 !RO var32	Set event when target reference >= 32-bit long/fixed value or value
17	!VU var32a, value32 !VU var32a, var32b	Set event when a 32-bit long/fixed variable (`var32a`) <= 32-bit long/fixed value or variable
18	!VO var32a, value32 !VO var32a, var32b	Set event when a 32-bit long/fixed variable (`var32a`) >= 32-bit long/fixed value or variable

After an event is programmed, the user has the following options:

- wait until the event occurs, then do a certain action
- set a new motion mode and/or set of motion parameters, to be automatically activated when the event occurs
- stop motion when the event occurs

Programming Examples

1)

```
!RT 100;      // set relative time event: after 100 slow-loop periods
              // i.e. after 100ms for default sampling values
WAIT!;        // wait event to occur
```

2)

```
!CAP;         // set event when a capture input is triggered
STOP3!;       // smooth stop when event occurs
```

3)

```
!IN#4 0       // set event when input IO#4 goes low
MODE PP3      // set position profile mode 3
CPR;          // command position is relative
CPOS=2000;    // command position is 2000
```

```
!UPD;          // when event occurs, move 2000 from actual position
```

4.5 Conditional Jumps and Functions

TML offers 2 powerful instructions for program control:

- conditional GOTO;
- conditional CALL of a TML function

A TML function starts with a label and ends with RET instruction. The function can contain any TML command. When a conditional GOTO or CALL instruction is encountered, the condition is checked and, if it is true, a jump or call to the specified label is executed. If condition is false, the next TML instruction is executed.

The condition to check is a comparison of a given parameter or variable with 0. The possible conditions are: < 0, <= 0, >0, >=0, =0, != 0.

Programming Examples

```
GOTO label1, i_var2, LT;       // jump to label1 if i_var2 < 0
GOTO label2, i_var2, LEQ;      // jump to label2 if i_var2 <= 0
GOTO label3, i_var2, GT;       // jump to label3 if i_var2 > 0
GOTO label4;                   // unconditional jump to label4
CALL fct1, i_var1, GEQ;        // call function fct1, if i_var1 >= 0
CALL fct1, i_var1, EQ;         // call function fct1, if i_var1 = 0
CALL fct1, i_var1, NEQ;        // call function fct1, if i_var1 != 0
CALL fct1;                     // unconditional call of
                               // function fct1

fct1:
…
…
RET
```

4.6 TML Interrupts – Automatic Functions for Monitoring Conditions

The TML interrupts offer the possibility to select up to 12 interrupt conditions that can be monitored. On the contrary to the event triggers where the programmed event is expected to occur and it is waited, the TML interrupts main goal is to provide a way to react to unexpected events as are most of the conditions from Table 4.11. The TML interrupt service routine is like a TML function except the RET instruction which is replaced by RETI (return from interrupt). In order to generate a TML interrupt 3 conditions are necessary:

- the TML interrupts should be globally enabled (with TML command EINT)
- one or more interrupt conditions should be individually unmasked
- the monitored condition should occur

The TML interrupts use, requires to define an interrupt table with the addresses (starting labels) of the TML interrupt service routines.

Table 4.11. TML Interrupt Conditions

TML Interrupt No.	Condition Description
0	ENABLE input is set low or left open
1	Power-stage protection (short-circuit and/or earth-fault) is triggered
2	At least one software-monitored protection: over-current, I^2t, TEMP1 input over limit, TEMP2 input over limit, over-voltage, under-voltage) is triggered
3	Control error. The difference between the target and actual value is over a programmed limit
4	Communication error
5	32-bit position wraps-around
6	Positive Limit Switch (LSP input) is triggered
7	Negative Limit Switch (LSN input) is triggered
8	A capture input (CAPI) was triggered
9	When motion is completed
10	When a new contour segment can be provided
11	When a programmable event trigger occurs

Programming Example

```
      INTTABLE = IntVect;     // set interrupt table
      ICR = 0x4;              // unmask INT2
      EINT;                   // global enable for TML interrupts
      …
      …

Int2_SoftProtection:          // INT2 Interrupt service routine
      STOP3;                  // stop motion
      RETI;                   // return from interrupt

IntVect:                      // interrupt vector table
      @Int0_Disable;
      @Int1_PDPINT;
      @Int2_SoftProtection;
      @Int3_ControlError;
      @Int4_CommError;
      @Int5_WrapAround;
      @Int6_LimitSwitchP;
      @Int7_LimitSwitchM;
```

```
@Int8_Capture;
@Int9_MotionComplete;
@Int10_UpdateContourSeg;
@Int11_EventReached;
```

4.7 Arithmetic and Logic Operations

The TML “motion processor” ALU permits the following operations:

- addition
- subtraction
- multiplication
- left and right shift
- logic AND and OR

The operands, TML variables or parameters are treated always as signed numbers. Right shift is performed with sign-extension.

Addition. The right-side operand (variable or value) is added to the left-side operand

Examples:

```
i_var1 += 10;     // i_var1 = i_var1 + 10
i_var1 += i_var2; // i_var1 = i_var1 + i_var2
```

Subtraction. The right-side operand (variable or value) is subtracted from the left-side operand

Examples:

```
i_var1 -= 10;     // i_var1 = i_var1 - 10
i_var1 -= i_var2; // i_var1 = i_var1 - i_var2
```

Arithmetic Shift. Can be performed with one or 2 operands. In shift instructions, with a single operand, its value is left or right shifted. At right shifts, high order bits are sign-extended and the low order bits are lost. At left shifts, high order bits are lost and the low order bits are zeroed. The shift value is between 0 and 15.

Examples:

```
i_var1 <<= 2;     // i_var1 = i_var1 left shifted by 2
l_var1 >>= 7;     // l_var1 = l_var1 right shifted by 7
```

In shift operations with 2 operands, the destination operand is a 32-bit variable (long or fixed) and the source operand is a 16-bit integer. The destination operand takes the value of the source operand left shifted between 0 and 16. The high order bits of the shifted value are sign-extended.

Examples:

```
i_var1 = 16;            // integer i_var1 = 16 (0x10)
```

```
l_var1 = i_var1 <<3;    // long l_var1 = 128 (0x80)
i_var1 = -10;           // integer i_var1 = -10 (0xFFF6)
l_var1 = i_var1 <<0;    // long l_var1 = -10 (0xFFFFFFF6)
```

The last example shows how shift instruction can be used to assign to a long variable the value of an integer variable, preserving the sign.

Shift operations can also be done with the 48-bit PROD Register, which keeps the result of the last performed multiply operation.

Example:

```
PROD >>= 1; // right shift by 1 the contents of PROD register,
            // in order to divide by 2 the last
```

Multiplication. The multiply instructions, include 2 source operands. The first operand can be any parameter or a variable (integer, long or fixed). The 2nd operand can be only an integer variable or a 16-bit immediate value. The 48-bit result is automatically saved in a dedicated register named PROD. The multiplication result can be saved in PROD, left or right shifted with a value between 0 and 15.

Examples:

```
l_var1 * -200 <<0;      // PROD = 48-bit result of l_var1 * (-200)
i_var1 * i_var2 >>1;    // PROD = (i_var1 * i_var2)/2
l_var1 = PROD;          // save in l_var1 the 32LSB of PROD
l_var1 * i_var2 >>2;    // PROD = (l_var1 * i_var2)/4
```

Logic AND and OR. Bit manipulation can be done using TML instruction

```
SRB var16, ANDmask, ORmask
```

This command performs a logic-AND between var16 value and the ANDmask value and afterwards a logic-OR with the ORrmask value. The result is saved in var16.

4.8. Multiple-axis Programming

For multiple-axis application the TML offers 3 categories of instructions:

a) write a data to a remote axis or group of axes

Example:

```
[2]i_var1 = i_var2;// i_var1 from axis 2 = i_var2 from local axis
```

b) read a data from a remote axis

Example:

```
i_var1 = [1]i_var2;// i_var1 from local axis = i_var2 from axis 1
```

c) send a TML command to a remote axis or group of axes

Example:

```
[3]{UPD};          // send command UPD to axis 3
```

Appendix A. Serial Communication Protocol

TML Instruction Format

The TML instruction code consists of 1 to 5, 16-bit words (see Figure A.1). The first word is the operation code. The rest of words (if present) represent the instruction data words. The operation code is divided into 2 fields: Bits 15-9 represent the code for the operation category. For example all TML instructions that perform addition of 2 integer variables share the same operation category code. The remaining bits 8-0 represent the operand ID that is specific for each instruction.

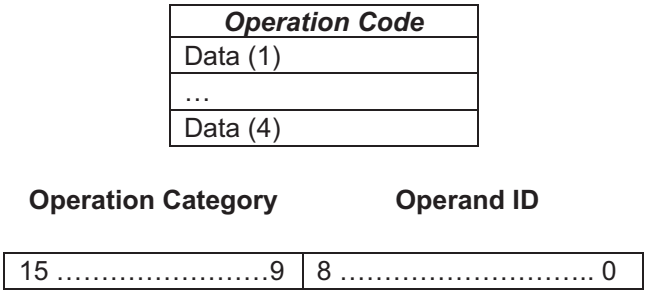


Figure A.1. TML Instruction Format

Axis Identification in a Multiple-axis Network

Another information that has to be included in a serial message is the axis or group ID. The axis ID is a unique number between 0 and 255 through which an axis is identified. After power-on, the Axis ID is set by default at 255. It can be changed using the TML command *AXISID*. This command may se sent by a host or may be included in a TML program that is automatically executed after power-on. This program may set for example the Axis ID according with the value read from the IDM240/640 J6 connector, which is dedicated for this purpose.

Each axis also includes a group ID. When a TML command is sent to a group, all axes sharing the same group ID will receive the command. This feature allows a host to send a command simultaneously to several axes, for example to start or stop the axes motion in the same time. The group ID is like the Axis ID an 8-bit value. A TML command can be sent to 8 different groups. Each group is defined as having one of the 8 bits of the group ID value set to 1 (see Table A.1)

The group ID of an axis can have any value between 0 and 255. If for example the group ID is 11 (1011b) this means that the axis will receive all messages sent to groups 1, 2 and 4

Table A.1. Definition of the groups

Group No.	Group ID value
1	1 (0000 0001b)
2	2 (0000 0010b)
3	4 (0000 0100b)
4	8 (0000 1000b)
5	16 (0001 0000b)
6	32 (0010 0000b)
7	64 (0100 0000b)
8	128 (1000 0000b)

When a TML Instruction is sent through the serial channel, the body of the message consists of the axis or group ID followed by the instruction code (see Figure A.2).

Axis/Group ID
Operation Code
Data (1)
…
Data (4)

Figure A.2. Message Structure

The axis or group ID is sent as a 16-bit word with the following structure:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	G	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0	0	0	0	H

Figure A.3. Structure of the axis or group ID in a communication message

Where:

Bit 0 – HOST bit. When a host is connected with an IDM240/640 through the RS-232 protocol, both host and IDM240/640 must have the same ID (same value for bits ID7 to ID0). The difference is done through the HOST bit: 0 – IDM240/640, 1 – host. When RS-485 protocol is used, the host and the IDM240/640 board(s) must have different ID (different values for bits ID7 to ID0) and HOST bit should be 0

Bits 11-8 – ID7-ID0: the 8-bit value of an axis or group ID

Bit 12 – GROUP bit: 0 – ID7-ID0 value is an Axis ID, 1 – ID7-ID0 value is a group ID

Message Types

The serial communication protocol is based on 2 types of messages:

- Type A: Messages that don't require an answer (a return message). In this category enter for example the messages containing commands for parameter settings, commands that start or stop motion execution, etc.
- Type B: Messages that require an answer. In this category enter the messages containing commands that ask to return data, for example the value of TML parameters, registers, or variables.

The type B message has 2 components:

- A request message with the TML command "Give Me Data".
- An answer message with the TML command "Take Data"

All messages, type A or type B have the structure presented in Figure A.3.

The "`Give Me Data`" request message includes the following information:

Axis ID (destination axis)
Operation Code: 0B004 for 16-bit data **0B005 for 32-bit data**
Data(1): Sender Axis ID
Data(2): Requested Data Address

Figure A.4 "Give Me Data" Message Contents

The "`Take Data`" answer message includes the following information:

Axis ID (destination axis)
Operation Code: 0B404 for 16-bit data **0B405 for 32-bit data**
Data(1): Sender Axis ID
Data(2): Requested Data Address
Data(3): Data Requested 16LSB
Data(4): Data Requested 16MSB (for 32-bit data)

Figure A.5. "Take Data" Message Contents

Serial RS232/RS485 Communication Protocol

The IDM240/640 serial communication interface works with 8 data bits, 2 stop bits, no parity at the following baud rates: 9600 (default after reset), 19200, 38400, 56600 and 115200. The messages exchanged through serial communication are packed in the following format:

Byte 1: Message length
Byte 2: Axis/Group ID – high byte
Byte 3: Axis/Group ID – low byte
Byte 4: Operation code – high byte
Byte 5: Operation code – low byte
Byte 6: Data (1) – high byte
Byte 7: Data (1) – low byte
Byte 8: Data (2) – high byte
…
Byte13: Data (4) – low byte
Last byte: Checksum

Figure A.6. Serial communication message format

The message length byte contains the total number of bytes of the message minus 2. Put in over words, the length byte value is the number of bytes of the: axis/group ID (2bytes), the operation code (2 bytes) and the data words (variable from 0 to 8 bytes). The checksum byte is the sum modulo 256 of all the bytes of the message except the checksum itself.

Example1: The TML instruction "`kpp = 5`" (set proportional part of the position controller), has the instruction code:

Operation Code = 205Eh
Data (1) = 0005h

A host connected on RS-232 with an IDM240/640 with Axis ID = 255 = 0FFh (default after reset) wants to send the TML instruction "`kpp = 5`". The serial message must have the following contents:

Byte 1: 06h – length: ID=2,Opcode=2,Data=2
Byte 2: 0Fh – high byte of ID = 0FF0h
Byte 3: F0h – low byte of ID = 0FF0h
Byte 4: 20h – high byte of OpCode = 205Eh
Byte 5: 5Eh – low byte of OpCode = 205Eh
Byte 6: 00h – high byte of Data(1) = 0005h
Byte 7: 05h – low byte of Data(1) = 0005h)
Byte 8: 88h – checksum

Figure A.7. Serial message contents when TML instruction "kpp = 5" is sent

Example2:

The host connected on RS-232 wants to get the value of the kpp parameter from an IDM240/640 with Axis ID = 255 = 0FFh. The kpp value to be returned is 120h. The host has to send a “Give Me Data” TML command with the following instruction code:

Operation Code = B004h (16-bit value)
Data (1) = 0FF1h (sender ID = destination ID + HOST bit set)
Data(2) = 025Eh (kpp variable address)

The” Take Data” answer will have the following instruction code:

Operation Code = B404h (16-bit value)
Data (1) = 0FF0h (sender ID)
Data(2) = 025Eh (kpp variable address)
Data(3) = 0120h (kpp variable value)

The serial message send by the host with “Give Me Data” command must have the following contents:

Byte 1: 08h – length ID=2,Opcode=2,Data=4
Byte 2: 0Fh – high byte of ID = 0FF0h
Byte 3: F0h – low byte of ID = 0FF0h
Byte 4: B0h – high byte of OpCode = B004h
Byte 5: 04h – low byte of OpCode = B004h
Byte 6: 0Fh – high byte of Data(1) = 0FF1h
Byte 7: F1h – low byte of Data(1) = 0FF1h
Byte 8: 02h – high byte of Data(2) = 025Eh
Byte 9: 5Eh – low byte of Data(2) = 025Eh
Byte 8: 1Bh – checksum

Figure A.8. Serial message contents for “Give Me Data” value of kpp

The serial message received by the host with “Take Data” command must have the following contents:

Byte 1: 0Ah – length ID=2,Opcode=2,Data=6
Byte 2: 0Fh – high byte of ID = 0FF1h
Byte 3: F1h – low byte of ID = 0FF1h
Byte 4: B4h – high byte of OpCode = B404h
Byte 5: 04h – low byte of OpCode = B404h
Byte 6: 0Fh – high byte of Data(1) = 0FF0h
Byte 7: F0h – low byte of Data(1) = 0FF0h
Byte 8: 02h – high byte of Data(2) = 025Eh
Byte 9: 5Eh – low byte of Data(2) = 025Eh
Byte 10: 01h – high byte of Data(3) = 0120h
Byte 11: 20h – low byte of Data(3) = 0120h
Byte 12: 42h – checksum

Figure A.9. Serial message contents for "Take Data" value of kpp

RS-232 Protocol

The RS-232 communication can be used to connect a host with one IDM240/640 working in slave mode. The RS-232 protocol is full duplex, allowing simultaneous transmission in both directions. After each command (Type A or B) sent by the host, the IDM240/640 will confirm the reception by sending one acknowledge-**O**k byte. This byte is' O' (ASCII code of capital o, 0x4F). If the host receives the 'O' byte, this means that the IDM240/640 has received correctly (checksum verification was passed) the last message sent, and now is ready to receive the next message.

If the checksum computed by the IDM240/640 doesn't match with the one sent by the host, the IDM240/640 will send one acknowledge-**N**ot-ok byte. This is 'N' (ASCII code of capital n, 0x4E). If the host receives the 'N' byte, it can start immediately to send again the last message.

If after a message sent, the host doesn't receive any acknowledge byte (after the programmed timeout period), this means that at some point during the last message transmission, one byte was lost and the synchronization between the host and the IDM240/640 is gone. In order to restore the synchronization the host should do the following:

1. send a SYNC byte having value 0x0d
2. wait a programmed timeout period for an answer;
3. if the IDM240/640 sends back the same SYNC byte, the synchronization is restored and the host can again the last message, else go to step 1
4. repeat steps 1 to 3 until IDM240/640 answers or 15 SYNC bytes are sent. If after 15 SYNC bytes there is no answer from the IDM240/640, then there is a serious communication problem and the serial link must be checked

When a host sends a type A message through RS-232 it has to:

a) Send the SCI message (as in Example 1);

b) Wait the acknowledge-OK byte 'O' from the IDM240/640;

When a host sends a type B message through RS-232 it has to:

a) Send a message with "Give Me Data" command (as in Example 2)
b) Wait the acknowledge-OK byte 'O' from the IDM240/640;
c) Wait the response message from the IDM240/640, which contains the command "Take Data".

When the IDM240/640 returns a "Take Data" message it doesn't expect to receive an acknowledge byte from the host. It is the host task to monitor the communication. If the host gets the response message with a wrong checksum, it is the host duty to send again the "Give Me Data" request.

RS-485 Protocol

The RS-485 communication can be used to connect up to 255 IDM240/640 in a multi-axis network. The master is also one of the network nodes. The RS-485 protocol is semi-duplex. If at one moment one network node transmits – it has the transmission enabled and the reception disabled – all the other nodes must listen – their transmission is disabled and the reception is enabled.

This procedure imposes certain limitations:

An acknowledge byte is sent back to the master after receiving a message on RS-485, ONLY if the message was sent to an individual axis.

No acknowledge byte is sent back after receiving a group message on RS-485 by a group of several axes. This avoids conflicting messages on the RS-485 bus, if more slave axes try to send the acknowledge byte at the same time. Hence it is the master job to request data from each axis in order to check that sent group messages were received correctly by each axis.

An IDM240/640 device can't send a message to itself. This situation may occur if for example the message is sent to a group and the sender is included in the group

It is not recommended to program a slave axis to send a message when a certain event happens. The correct approach is to program the master to periodically interrogate each axis about its status

If after a message sent to one axis, the host doesn't receive the acknowledge byte (after the programmed timeout period), in order to restore the synchronization the host should do the following:

1. Send 15 SYNC bytes (value 0x0d)
2. Send again the message

Appendix B. CAN Communication Protocol

TML Instruction Format

The TML instruction code consists of 1 to 5, 16-bit words (see Figure B.1). The first word is the operation code. The rest of words (if present) represent the instruction data words. The operation code is divided into 2 fields: Bits 15-9 represent the code for the operation category. For example all TML instructions that perform addition of 2 integer variables share the same operation category code. The remaining bits 8-0 represent the operand ID that is specific for each instruction.

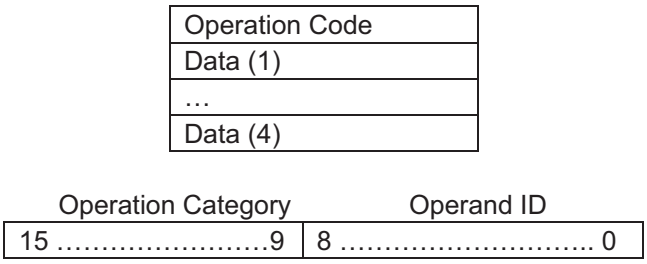


Figure B.1. TML Instruction Format

Axis Identification in a Multiple-axis Network

In multiple-axis configurations, each axis needs to be identified through a unique number – the Axis ID. The Axis ID is set hardware from SW1 and is sampled at power-on. It can be later changed using the TML command *AXISID*. This command may se sent by a host or may be included in a TML program that is automatically executed after power-on with the Intelligent drive set in stand-alone mode.

The Technosoft Motion Language allows several axis to be assigned to a group. When a TML command is sent to a group, all axes sharing the same group ID, will receive the command. This feature allows a host to send a command simultaneously to several axes, for example to start or stop the axes motion in the same time. The Group ID is like the Axis ID an 8-bit value. A TML command can be sent to 8 different groups. Each group is defined as having one of the 8 bits of the group ID value set to 1 (see Table B.1)

Table B.1. Definition of the groups

Group No.	Group ID value
G1	1 (0000 0001b)
G2	2 (0000 0010b)
G3	4 (0000 0100b)
G4	8 (0000 1000b)
G5	16 (0001 0000b)
G6	32 (0010 0000b)
G7	64 (0100 0000b)
G8	128 (1000 0000b)

The Group ID of an axis can have any value between 0 and 255. If for example the group ID is 11 (1011b) this means that the axis will receive all messages sent to groups 1, 2 and 4.
When a TML Instruction is send through the CAN-bus channel, the Axis/Group ID and the operation code are included in the CAN Message Identifier Words (see Figure B.2).

CAN Message Identifier Word1 (contains part of the Operation Code and Axis/Group ID)
CAN Message Identifier Word2 (contains rest of the Operation Code and Axis/Group ID)
Data (1)
…
Data (4)

Figure B.2. Message Structure

In a serial or CAN message, the axis or group ID is a 16-bit word with the following structure:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	G	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0	0	0	0	H

Where:

Bit 0 – HOST bit.

In a network configuration like in Figure B.3, the HOST bit indicates the destination axis for messages received by the relay axis: 0 – relay axis, 1 – host. Messages received by the relay axis with HOST bit set to 1, will be retransmitted through RS-232 to the host. Messages received by the relay axis with HOST bit set to 0, will be interpreted as commands for this axis and will be executed.

In a network configuration like in Figure B.4, the HOST bit must always be 0.

Bits 11-4 – ID7-ID0: the 8-bit value of an axis or group ID
Bit 12 – GROUP bit: 0 – ID7-ID0 value is an Axis ID, 1 – ID7-ID0 value is a group ID

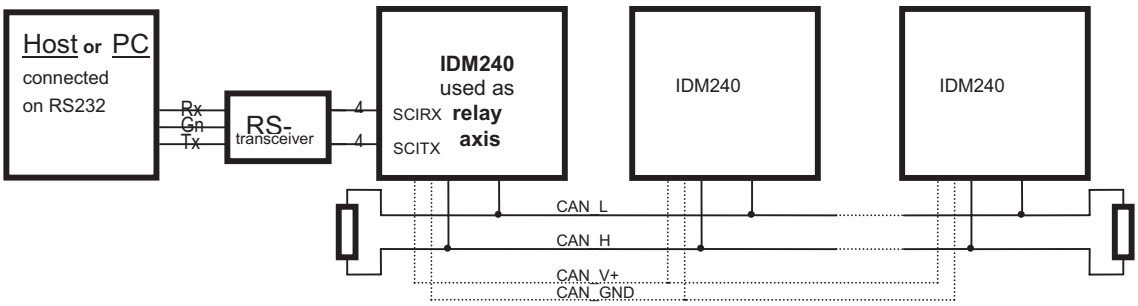


Figure B.3. Multiple-axis network using CAN-bus communication with host connected through RS-232 to an axis used as communication relay

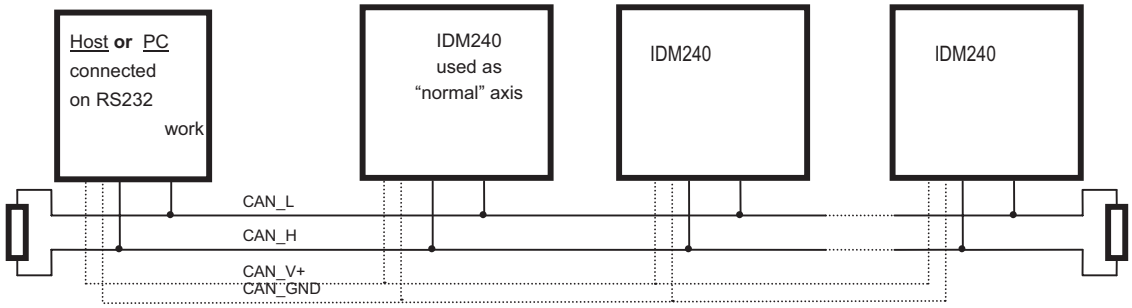


Figure B.4. Multiple-axis network using CAN-bus communication with host connected directly to the CAN network

CAN Message Types

The communication protocol is based on 2 types of messages:

Type A: Messages that don’t require an answer (a return message). In this category enters for example the messages containing commands for parameter settings, commands that start or stop motion execution, etc. These messages have the structure presented in Figure B.2.

Type B: Messages that require an answer. In this category enter the messages containing commands that ask to return data, for example the value of TML parameters, registers, or variables.

The type B message has 2 components:

A request message with the TML command “Give Me Data”

An answer message with the TML command “Take Data”

The “Give Me Data” request message has the following content:

CAN Message Identifier Word1 (contains part of the Operation Code and Axis/Group ID)
CAN Message Identifier Word2 (contains rest of the Operation Code and Axis/Group ID)
Data(1): Sender Axis ID
Data(2): Requested Data Address

Figure B.5. "Give Me Data" Message Contents

The Operation Code for the "Give Me Data" request is 0B004 for 16-bit data and 0B005 for 32-bit data.

The "Take Data" answer message includes the following information:

CAN Message Identifier Word1 (contains part of the Operation Code and Axis/Group ID)
CAN Message Identifier Word2 (contains rest of the Operation Code and Axis/Group ID)
Data(1): Sender Axis ID
Data(2): Requested Data Address
Data(3): Data Requested 16LSB
Data(4): Data Requested 16MSB (for 32-bit data)

Figure B.6. "Take Data" Message Contents

The Operation Code for the "Take Data" request is 0B404 for 16-bit data and 0B405 for 32-bit data.

CAN-bus Communication Protocol – Frames Description

The Intelligent drive implements the CAN 2.0B protocol that uses 29 bits for the identifier. Figure B.7 presents how the standard TML Instruction from Figure B.2 is packed and transmitted on the CAN-bus: the CAN message identifier format and the CAN data bytes correspondence with the instruction code data words.

CAN Message Identifier Word 1

x	x	x	Operation Code (7MSB) (Operation Category)	GROUP Bit	Axis/Group ID (5MSB) ID7-ID3

CAN Message Identifier Word 2

Axis/Group ID (3LSB) ID7-ID3	0	0	0	HOST bit	Operation code (9LSB) (Operation ID)

CAN Message Data Byte No.	TML Data Word
1	Data(1) – high byte
2	Data(1) – low byte

3	Data(2) – high byte
4	Data(2) – low byte
5	Data(3) – high byte
6	Data(3) – low byte
7	Data(4) – high byte
8	Data(4) – low byte

Figure B.7. CAN message frame

The CAN-bus communication offers the possibility to work on a semi-duplex network like in a full-duplex one. The CAN controller automatically solves the conflicts that occur while 2 axes try to transmit messages in the same time. For example, in an RS-485 network, such an event usually corrupts both messages, while in a CAN-bus the higher priority message always wins. The lower priority message is automatically sent after the transmission of the first message ends.

Any Intelligent drive from a CAN-bus network may also be connected through RS-232 with a host (see Figure B.3). In this structure, the axis connected to the host, apart from executing the commands received from host or other axes, acts also as a retransmission relay which:

receives through RS-232, commands from host for another axis and retransmits them to the destination through CAN-bus

receives through CAN-bus data requested by host from another axis and retransmits them to the host through RS-232

This flexibility enables a host to program and monitor a CAN-bus network of Intelligent drives using only one RS-232 connection to any axis, without the need to have a CAN-bus interface. In this case the CAN-bus protocol is completely transparent for the host.

By default, the CAN baud-rate is set at 125Kbps. The maximum baud-rate is 1Mbps. It can be changed at any value supported by the CAN transceiver.

CAN-bus Communication Protocol – Examples

Example 1: Suppose the host wants to send on the CAN bus to an IDM240/640 the message containing the TML instruction "`KPP = 0x1234`" (set proportional part of the position controller). As this is a type A message (no answer required), the instruction (see extracts from Table D.2 and C.6 below) has the following code:

Operation Code = 205Eh
Data (1) = 1234h

(Extract from Table D.2. TML Instruction Set. Assignment Group)

Syntax	Description	TML Instruction Format				
		Operation Code	Data(1)	Data(2)	Data(3)	Data(4)
V16 = val16	V16 = val16	0x2000 | 9LSB(&V16)	val16			

(Extract from Table C.6. Controllers Parameters)

Name	Address	Type	Description
KPP	0x025E	int	Proportional term coefficient for position controller

If the destination IDM240/640 has the Axis ID = 5, the CAN Message Identifier Words have the following content:

CAN Message Identifier Word 1

x	x	x	Operation Code (7MSB from 205Eh)	GROUP Bit	Axis/Group ID (5MSB) ID7-ID3	= 04 00 h
0	0	0	0 0 1 0 0 0 0	0	0 0 0 0 0	

CAN Message Identifier Word 2

Axis/Group ID (3LSB) ID7-ID3	0	0	0	HOST bit	Operation code (9LSB from 205E)	= A0 5E h
1 0 1	0	0	0	0	0 0 1 0 1 1 1 1 0	

Consequently, the CAN message for "`kpp = 0x1234`" is:

Byte no.	Value	Description
1	04	high byte of CAN Message Identifier Word1 = 0400h
2	00	low byte of CAN Message Identifier Word1 = 0400h
3	A0	high byte of CAN Message Identifier Word2 = A05Eh
4	5E	low byte of CAN Message Identifier Word2 = A05Eh
5	12	high byte of Data(1) = 1234h
6	34	low byte of Data(1) = 1234h

Figure B.8. CAN message contents when TML instruction "kpp = 0x1234" is sent

Example 2: Suppose the host connected directly on the CAN bus wants to get the value of the local position error from an IDM240/640. The position error is a 16-bit TML variable named POSERR situated at the 0x022A internal memory address (see extract from Table 39 below).

(Extract from Table 39. Controllers Variables)

Name	Address	Type	Description
POSERR	0x022A	int	Position error

Suppose the host CAN bus address is 3 and that the questioned IDM240/640 has 5 as CAN bus address. As this is a type B message (an answer is required), it has 2 components: the request command "Give Me Data" and the answer "Take Data".
The request command "Give Me Data" has the following content:

CAN Message Identifier Word1 (Op. Code = B004h and ID = 5)	1600h
CAN Message Identifier Word2 (Op. Code = B004h and ID = 5)	A004h
Data(1): Sender Axis ID	0030h
Data(2): Requested Data Address	022Ah

Supposing that the `POSERR` value is 2, the "Take Data" answer will have the following content:

CAN Message Identifier Word1 (Op. Code = B404h and ID = 3)	1680h

CAN Message Identifier Word2 (Op. Code = B404h and ID = 3)	6004h
Data(1): Sender Axis ID	0050h
Data(2): Requested Data Address	022Ah
Data(3): Value Existing at Requested Data Address	0002h

The request CAN Message Identifier Words for the CAN message "?POSERR" are:

CAN Message Identifier Word 1

x	x	x	Operation Code (7MSB from B004h)	GROUP Bit	Axis/Group ID (5MSB) ID7-ID3	
0	0	0	1 0 1 1 0 0 0	0	0 0 0 0 0	= 16 00 h

CAN Message Identifier Word 2

Axis/Group ID (3LSB) ID7-ID3	0	0	0	HOST bit	Operation code (9LSB from B004h)	
1 0 1	0	0	0	0	0 0 0 0 0 0 1 0 0	= A0 04 h

Consequently, the request CAN message for "?POSERR" is:

Byte no.	Value	Description
1	16	high byte of CAN Message Identifier Word1 = 1600h
2	00	low byte of CAN Message Identifier Word1 = 1600h
3	A0	high byte of CAN Message Identifier Word2 = A004h
5	04	low byte of CAN Message Identifier Word2 = A004h
5	00	high byte of Data(1) = 0030h
6	30	low byte of Data(1) = 0030h
7	02	high byte of Data(2) = 022Ah
8	2A	low byte of Data(2) = 022Ah

Figure B.9. CAN message contents when TML instruction "?POSERR" is sent

The answer CAN Message Identifier Words for the CAN message answer to "?POSERR" are:

CAN Message Identifier Word 1

x	x	x	Operation Code (7MSB from B404h)	GROUP Bit	Axis/Group ID (5MSB) ID7-ID3	
0	0	0	1 0 1 1 0 1 0	0	0 0 0 0 0	= 16 80 h

CAN Message Identifier Word 2

Axis/Group ID (3LSB) ID7-ID3	0	0	0	HOST bit	Operation code (9LSB from B004h)	
0 1 1	0	0	0	0	0 0 0 0 0 0 1 0 0	= 60 04 h

Consequently, the CAN message answered to the request "?POSERR" is:

Byte no.	Value	Description

1	16	high byte of CAN Message Identifier Word1 = 1680h
2	80	low byte of CAN Message Identifier Word1 = 1680h
3	60	high byte of CAN Message Identifier Word2 = 6004h
5	04	low byte of CAN Message Identifier Word2 = 6004h
5	00	high byte of Data(1) = 0050h
6	50	low byte of Data(1) = 0050h
7	02	high byte of Data(2) = 022Ah
8	2A	low byte of Data(2) = 022Ah
9	00	high byte of Data(2) = 0002h
10	02	low byte of Data(2) = 0002h

Figure B.10. *CAN message contents for "Take Data" value of POSERR*

Appendix C. TML Data Components

TML Registers

The TML environment works with *configuration, command* and *status* registers.
The *configuration* registers contain essential configuration information like motor and sensors type, or basic operation settings like PWM mode, motor start method, etc. The configuration registers must be setup during the initialization phase.
The *command* registers hold configuration settings that can be changed during motion. These settings refer to the activation/deactivation of software protections, use of TML interrupts and communication options.
The *status* registers, provide information about the status of different motion system elements like communication, motion mode, active control loops, system protections, TML interrupts. The status registers can be used to detect events and to take decisions in a TML program.

Configuration registers (R/W):
SCR – System Configuration Register. Used to define the basic application configuration: motor and sensors types, brake circuit presence, external user loop existence
OSR – Operating Settings Register. Used to define specific system operating settings, as current offset detection mode, Brushless AC motor start procedure, PWM special features, stepper control type, how to read the sensor of the external user loop, which pin to use for brake command

Command registers (R/W):
CCR – Communication Control Register. Contains settings for SPI and parallel I/O channels.
ICR – Interrupt Control Register. Used to define the masks for TML interrupts
PCR - Protections Control Register. Used to activate different protections in the system, as maximum current, I^2t, over and under voltage and over-temperature (TEMP1,2 inputs over limits)

Status registers (RO):
AAR - Axis Address Register. Keeps the Axis ID and the group ID
CBR – CAN Baud rate Register. Keeps the current settings for CAN-bus baud-rate
CER – Communication Error Register. Contains error flags for the communication channels
CSR – Communication Status Register. Contains status flags for the communication channels
ISR - Interrupt Status Register. Contains interrupt flags set by the TML interrupt conditions
MCR – Motion Command Register. Contains information about the motion modes: reference mode, active control loops, positioning type: absolute or relative, etc.
MSR – Motion Status Register. Mainly used internally by the TML kernel, the register bits give indications about motion progress and specific motion events as software protections, control error, wrap-around, limit switches, captures, contour segments, events, axis status, etc.

PCR - Protections Control Register. Used to examine the status of different protections in the system, as over-current, I^2t, over and under voltage and TEMP1, TEMP2 inputs over limits

The TML registers have reserved mnemonics, but no specially dedicated instructions. Hence, in a TML program, registers are treated like any other TML parameter or variable. The configuration and command registers can be read or written. The status registers can only be read. Table C.1 presents the TML registers, their mnemonic, type and the corresponding data memory addresses.

Table C.1. TML Registers

Mnemonic	Register Name	Type	Address
SCR	System Configuration Register	Configuration	0x300
OSR	Operating Settings Register	Configuration	0x302
CCR	Communication Control Register	Command	0x30A
ICR	Interrupt Control Register	Command	0x304
PCR	Protections Control Register	Cmd/status	0x303
AAR	Axis Address Register	Status	0x30C
CBR	CAN Baud rate Register	Status	0x30D
CER	Communication Error Register	Status	0x301
CSR	Communication Status Register	Status	0x30B
ISR	Interrupt Status Register	status	0x306
MCR	Motion Command Register	Status	0x309
MSR	Motion Status Register	status	0x308

TML Parameters

TML programs use some specific data information structured through the TML parameters. Having reserved TML mnemonics, the TML parameters allow setup and/or examine the parameters of the different motion system components.

Some of the TML parameters share the same memory address. They are used in application configurations that exclude one each other, and thus are not needed at the same time.

A part of the TML parameters must be setup during the initialization phase. They are used to define the real-time kernel including the PWM frequency and the control loops sampling periods and should not be changed after the execution of the *ENDINIT* command. The other parameters can be initialized, used and changed any time before or after *ENDINIT* command.

The following tables present the TML parameters, grouped by functionality.

Table C.2. Real-time Kernel Parameters

Parameter Name	Address	Data Type	Significance
CLPER	0x0250	uint	Current loop sampling time
SLPER	0x0251	uint	Speed loop sampling time

Table C.3. Motors Parameters

Parameter Name	Address	Data Type	Significance
BOOST	0x027D	int	Boost voltage
CORDDTH	0x028E	int	Acceleration correction factor
CORDTH	0x028D	int	Speed correction factor
CWEAK	0x0257	int	Weak factor
GUARD	0x027E	int	Stepper guard factor
IDMAX	0x027B	int	D axis maximum current
IDMIN	0x027C	int	D axis minimum current
IDRSTEP	0x027B	int	D axis reference current
IQRSTEP	0x027C	int	Q axis reference current
KSLIP	0x0279	int	Slip factor
KSPD	0x0277	int	Speed factor
KVOLT	0x0279	int	Voltage factor
POSTRGG	0x0289	uint	Position trigger for controlled start
SCL2H	0x0281	int	Scaling factor 2 - high part
SCL2L	0x0282	uint	Scaling factor 2 - low part
SCL3	0x0283	int	Scaling factor 3
SCL4	0x0286	int	Scaling factor 4
SENSE	0x0288	int	PMSM start sense
SFTCWEAK	0x0258	int	Shift for weak factor
SFTKSLIP	0x027A	int	Shift slip factor
SFTKSPD	0x0278	int	Shift for speed factor
SFTKVOLT	0x027A	int	Shift voltage factor
SFTSCL1	0x0280	int	Scaling factor shift
SGCODTH	0x0289	int	Speed sign correction factor
SIN2REC	0x0287	int	Sinusoidal to rectangular transition level
SRCOR	0x027F	int	Sinusoidal to rectangular transition correction
SRECTCOMP	0x028F	int	Device correction term
T1ONA	0x0284	uint	Time on A phase
T1ONB	0x0285	uint	Time on B phase
TIMELIM	0x0286	uint	Time limit for controlled start
WEAKINC	0x0259	int	Weak increment

Table C.4. Sensors Parameters

Parameter Name	Address	Data Type	Significance
AD0OFF	0x0244	uint	Offset for AD0 channel
AD1OFF	0x0245	uint	Offset for AD1 channel
AD2OFF	0x0246	uint	Offset for AD2 channel
AD3OFF	0x0247	uint	Offset for AD3 channel
AD4OFF	0x0248	uint	Offset for AD4 channel
AD5OFF	0x0249	uint	Offset for AD5 channel
AD6OFF	0x024A	uint	Offset for AD6 channel
AD7OFF	0x024B	uint	Offset for AD7 channel
CADIN	0x025C	int	Analog feedback scaling factor
CI0	0x028D	int	Static friction current factor
CIQ	0x028E	int	Motor torque current factor
ELRES	0x0279	uint	Encoder increments / electrical resolution
FILTER1	0x029D	int	Coefficient for the first order filter for analogue reference
HALLCASE	0x0259	int	Hall sensors configuration parameter
HALLDIR	0x028F	int	Speed estimate from time (Hall pulse length) parameter
MECRES	0x0277	uint	Position sensor increments / mechanical revolution
PFOVF	0x029C	uint	Position feedback overflow value (analogue, parallel I/O or on-line position sensor)
POSOKLIM	0x036A	uint	Position accepted error band to lock control
SETAD01	0x024C	int	Specific AD channels assignment (IA, IB) for the selected power stage
SETAD23	0x024D	int	specific AD channels assignment (ANALOG_FDBK, IC) for the selected power stage
SETAD45	0x024E	int	specific AD channels assignment (VDC, REF) for the selected power stage
SETAD67	0x024F	int	specific AD channels assignment (TEMP1/TQLIM, TEMP2/TQFFW) for the selected power stage
SFTADIN	0x025D	int	Shift for analog feedback scaling factor
SFTCRT	0x0290	int	Current measurement shift factor
TONPOSOK	0x036B	uint	Trigger time for control lock after positioning
VDCN	0x025A	uint	DC bus voltage nominal value (V_dc compensation)
ZAOFF	0x0289	uint	Offset between encoder Z

Table C.5. Power Converters Parameters

Parameter Name	Address	Data Type	Significance
BRAKEDC	0x028B	uint	Brake duty cycle
BRAKELIM	0x028A	uint	Brake activation level
BRAKEOFF	0x028C	uint	Brake inactive state set value (default active Lo)
DBT	0x0253	uint	Power stage dead-time
DBTLIM	0x027E	int	Dead band compensation parameter
DBTTH	0x027F	int	Dead band threshold
PWMPER	0x0252	uint	PWM period
SATPWM	0x0254	int	Saturation limit for voltage command
NEWPERWOB	0x0287	uint	Central PWM period for wobbling
MAXPWMWOB	0x028F	uint	Maximum PWM frequency variation during wobbling

Table C.6. Controllers Parameters

Parameter Name	Address	Data Type	Significance
ENC2TH	0x0278	uint	Scaling constant for electrical angle computation
IMAXP	0x0266	int	Saturation limit for integral part for position controller
IMAXS	0x026C	int	Saturation limit for integral part for speed controller
KDFP	0x0264	int	Derivative term filter coefficient for position controller
KDP	0x0262	int	Derivative term coefficient for position controller
KFFA	0x026E	int	Acceleration feedforward factor
KFFL	0x026F	int	Load torque feedforward factor
KFFS	0x026D	int	Speed feedforward factor
KII	0x0273	int	Integrative term coefficient for current controller
KIP	0x0260	int	Integrative term coefficient for position controller
KIS	0x0269	int	Integrative term coefficient for speed controller
KPI	0x0271	int	Proportional term coefficient for current controller
KPP	0x025E	int	Proportional term coefficient for position controller
KPS	0x0267	int	Proportional term coefficient for speed controller
SATID	0x0275	int	Saturation limit for ud command
SATIQ	0x0276	int	Saturation limit for uq command
SATP	0x0265	int	Saturation limit for speed command
SATS	0x026B	int	Saturation limit for current command
SFTAFFW	0x0291	int	Shift feedforward acceleration
SFTKDP	0x0263	int	Derivative term shift for position controller
SFTKFF	0x0270	int	Feedforward shift
SFTKII	0x0274	int	Integrative term shift for current controller
SFTKIP	0x0261	int	Integrative term shift for position controller
SFTKIS	0x026A	int	Integrative term shift for speed controller
SFTKPI	0x0272	int	Proportional term shift for current controller
SFTKPP	0x025F	int	Proportional term shift for position controller
SFTKPS	0x0268	int	Proportional term shift for speed controller
SFTSFFW	0x0292	int	Shift feedforward speed

Table C.7. Reference Generator Parameters

Parameter Name	Address	Data Type	Significance
CACC	0x02A2	fixed	Acceleration command for position/speed profile modes
CPOS	0x029E	long	Position command for position profile mode
CSPD	0x02A0	fixed	Speed command for position/speed profile modes
GEAR	0x02AC	fixed	Gearing factor for slave axis
POS0	0x02B8	long	Position origin for relative position event
REF0	0x02A8	fixed	Initial reference in voltage test mode (fixed)
REF0	0x02A8	long	Initial reference in torque test mode (long)
REFTST	0x0281	int	Test reference saturation value
RINCTST	0x0280	int	Test reference increment value
SLAVEID	0x0311	int	Axis / group ID for slave in electronic gearing
THTST	0x0282	int	Test reference electric angle
TIME0	0x02BE	long	Time origin for relative time event
TINCTST	0x0283	int	Test reference electric angle increment

Table C.8. Protections Parameters

Parameter Name	Address	Data Type	Significance
ALPHA	0x0295	long	I2t cooling coefficient
BETA	0x0293	long	I2t heating
EFLEVEL	0x02C7	int	Earth fault - protection limit
ERRMAX	0x02C5	uint	Control error limit
IMAXPROT	0x0297	int	Maximum current - protection limit
NI2T	0x0255	long	I2t computation interval
T1MAXPROT	0x0298	uint	Temp1. maximum - protection value
T2MAXPROT	0x0299	uint	Temp2. maximum - protection value
TERRMAX	0x02C6	uint	Trigger time for control error
TIMAXPROT	0x02C4	uint	Trigger time for maximum current protection
UMAXPROT	0x029A	uint	DC bus voltage maximum - protection value
UMINPROT	0x029B	uint	DC bus voltage minimum - protection value

Table C.9. Motion Language Parameters

Parameter Name	Address	Data Type	Significance
INITABLE	0x0307	int	Start address of TML interrupts vector table

TML Variables

TML programs use some specific data information structured through the TML variables. Having reserved TML mnemonics, the TML variables are used in the control module of the program. Their values can be read at any time during the execution of the program. Activating the on-chip logger module, real-time data tracing can also be implemented for any of these variables.

The TML variables are internally initialized before activating the motion system real time structure (before

the ENDINIT TML command), or before activating the motion control functions (before the execution of the AXISON TML command).

Majority of TML variables is read only (RO). Modifying their value during motion execution may cause improper operation of the motion system. In specific situations, some of the TML variables can also be written (are R/W variables).

The following tables present the TML variables, grouped by functionality.

Table C.10. Motors Variables

Name	Address	Type	Description
APOS	0x0228	Long	actual position
ASPD	0x022C	Fixed	actual speed
IA	0x0239	Int	A phase current
IB	0x023A	int	B phase current
IC	0x023B	int	C phase current
STATE	0x0288	int	Sinusoidal/rectangular actual stepper control mode
UAREF	0x0236	int	A phase reference voltage
UBREF	0x0237	int	B phase reference voltage
UCREF	0x0238	int	C phase reference voltage

Table C.11. Sensors Variables

Name	Address	Type	Description
ACCPL	0x02FF	int	Estimated acceleration between tow Hall/encoder pulses
AD0	0x023C	uint	1st AD channel (current i_A)
AD1	0x023D	uint	2nd AD channel (current i_B)
AD2	0x023E	uint	3rd AD channel (reference)
AD3	0x023F	uint	4th AD channel (current i_C)
AD4	0x0240	uint	5th AD channel (DC link voltage)
AD5	0x0241	uint	6th AD channel (feedback)
AD6	0x0242	uint	7th AD channel (Temperature 1 / Limit torque)
AD7	0x0243	uint	8th AD channel (Temperature 2 / Feedforward torque)
CAPPOS	0x02BC	long	Captured position
COSTH	0x0226	int	Cosine theta
ELPOS	0x0221	int	Absolute electrical position

FFL	0x0223	int	Feedforward load torque
POSINC	0x0222	int	On-line incremental position feedback
SSPL	0x02FE	int	Speed samples between tow Hall/encoder pulses
THETAINC	0x020E	int	Electrical angle increment

Table C.12. Controllers Variables

Name	Address	Type	Description
CRTERR	0x0231	int	Q axis current error
HALL	0x0227	int	Hall sensors information
ID	0x0234	int	D axis current
IDREF	0x0233	int	D axis reference current
IQ	0x0230	int	Q axis current
IQREF	0x022F	int	Q axis reference current
POSERR	0x022A	int	Position error
SINTH	0x0225	int	Sinus theta
SPDERR	0x022E	int	Speed error
SPDREF	0x022B	int	Reference speed
THETA	0x0224	int	Field position angle
UDREF	0x0235	int	D axis reference voltage
UQREF	0x0232	int	Q axis reference voltage

Table C.13. Power Converter Variables

Name	Address	Type	Description
CVDC	0x025B	int	DC bus compensation ratio

Table C.14. Motion Language Variables

Name	Address	Type	Description
PROD	0x030E	48 bits	Result of a TML multiply operation

Table C.15. Reference Generator Variables

Name	Address	Type	Description
ATIME	0x02C0	Long	Absolute system time
CDREF	0x02A4	Fixed	Reference increment for a contour segment
CTIME	0x02A6	Int	No. of samplings for a contour segment
EREF	0x02A8	fixed/long	External reference for all external modes
MREF	0x02AA	Long	Reference send from master
RPOS	0x02BA	Long	Relative position for event tests
RTIME	0x02C2	Long	Relative time for event tests
TACC	0x02B6	Fixed	Target acceleration
TPOS	0x02B2	Long	Target position
TREF	0x02AE	fixed/long	Target reference
TSPD	0x02B4	Fixed	Target speed

TML User variables

Besides the TML pre-defined variables, the users of TML environment can define their own variables, which can be used in all the TML instructions that manipulate variables of the same types. The on-chip data memory offers the possibility to work with up to 32 integer / 16 long or fixed user-defined variables (see Table C.17). The address of the user variables is automatically set in order of declaration starting with 0x03E0. Apart from these variables the Intelligent drive also provides 3 pre-defined variables for general-purpose use (see Table C.16)

Table C.16. General-purpose Pre-defined Variables

Name	Address	Type	Description
VAR_I1	0x0366	Int	Predefined user variable
VAR_I2	0x0367	Int	Predefined user variable
VAR_LF	0x0368	Fixed/long	Predefined user variable

Table C.17. User-defined Variables

Type	Format	Representation	Range
Int	Signed integer	16 bits	-32768 ¸ 32767 (0x8000 ¸ 0x7FFF)
Long	Signed long integer	32 bits	-2147483648 ¸ 2147483647 (0x80000000 ¸ 0x7FFFFFFF)
Fixed	(Integer part).(fractional part)	32 bits	-32768.999969 ¸ 32767.999969 (0xFFFF.FFFF ¸ 0x7FFF.FFFF)

Appendix D. TML Instruction Set Summary

This paragraph describes the complete set of TML instructions, grouped by functionality. Within each group, the instructions are ordered alphabetically and contain the mnemonic syntax, a short description and the instruction code. The next table presents the symbols used.

Table D.1. TML Instructions Code Symbols

Symbols	Description
&Label	Address of TML program label
&V16	Address of a 16-bit integer variable
&V32	Address of a 32-bit long or fixed variable
(V16)	Memory location at address equal with V16 value
(la)	Long addressing. Source/destination operand provided with 16-bit address. Some TML instructions using 9-bit short addressing are doubled with their long addressing equivalent
9LSB(&V16)	The 9 LSB (less significant bits) of the address of a 16-bit integer
9LSB(&V32)	The 9 LSB (less significant bits) of the address of a 32-bit long or fixed
A	Axis ID
A/G	Axis ID or Group ID
ANDdis	16-bit AND mask. See Table MCRx & AND/OR masks for DISIO#n and Table MCRx & PxDIR addresses
ANDen	16-bit AND mask. See Table MCRx & AND/OR masks for ENIO#n and Table MCRx & PxDIR addresses
ANDin	16-bit AND mask. See Table AND/OR masks for SETIO#n IN
ANDm	16-bit user-defined AND mask
ANDout	16-bit AND mask. See Table AND/OR masks for SETIO#n OUT
ANDrst	16-bit AND mask. See Table AND/OR masks for ROUT#n
ANDset	16-bit AND mask. See Table AND/OR masks for SOUT#n
Bit_msk	16-bit AND mask. See Tables PxDIR & Bit_msk for V16=IN#n and table MCRx & PxDIR addresses
BitMskIO	16-bit AND mask. See Table BitMskIO for V16=INPORT#n
D_ref	32-bit fixed value
D_time	16-bit value
Flag	See Table Condition Flag for GOTO/CALL
LengthMLI	Length of a TML instruction code in words – 1
MCRx	See Tables MCRx & AND/OR masks for ENIO#n / DISIO#n and Table MCRx & PxDIR addresses
ORdis	16-bit OR mask. See Table MCRx & AND/OR masks for DISIO#n and Table MCRx & PxDIR addresses
OREn	16-bit OR mask. See Table MCRx & AND/OR masks for ENIO#n and Table MCRx & PxDIR addresses
ORin	16-bit OR mask.. See Table AND/OR masks for SETIO#n IN
ORm	16-bit user-defined OR mask

ORout	16-bit OR mask. See Table AND/OR masks for SETIO#n OUT
ORrst	16-bit OR mask. See Table AND/OR masks for ROUT#n
ORset	16-bit OR mask. See Table AND/OR masks for SOUT#n
PxDIR	See Table PxDIR & Bit_msk for V16=IN#n and Table MCRx & PxDIR addresses
pm	Data memory space: 200 – 3FFh (internal), 8000 – 0FFFFh (external)
dm	Program memory space: 8000 – 0FFFFh (external)
dpi	SPI-E2ROM memory space: 4000h – 7FFFh (external)
TM	Type of memory. When used in syntax TM should be replaced by *dm* or *pm* or *spi*. When used in code, see Table TM values.
V16	16-bit integer variable
V16D	16-bit integer variable used as destination
V16S	16-bit integer variable used as source
V32	32-bit long or fixed variable
V32(L)	16LSB of a 32-bit long or fixed variable (seen as a 16-bit integer)
V32(H)	16MSB of a 32-bit long or fixed variable (seen as a 16-bit integer)
V32D	32-bit long or fixed variable used as destination
V32S	32-bit long or fixed variable used as source
Val16	16-bit integer value
Val32	32-bit long or fixed value
Val32(L)	16LSB of a 32-bit long or fixed value
Val32(H)	16MSB of a 32-bit long or fixed value

Table D.2. TML Instruction Set. Assignment Group

Syntax	Description	Code			
		0	1	2	3
(V16D), TM = V16S	(V16D) from TM = V16S	0x90B0 | TM	&V16D	&V16S	
(V16D), TM = V32S	(V16D) from TM = V32S	0x90B1 | TM	&V16D	&V32S	
(V16D), TM = val16	(V16D) from TM = val16	0x90A0 | TM	&V16D	val16	
(V16D), TM = val32	(V16D) from TM = val32	0x90A1 | TM	&V16D	val32(L)	val32(H)
(V16D+), TM = V16S	(V16D) from TM = V16S then V16D += 1	0x9030 | TM	&V16D	&V16S	
(V16D+), TM = V32S	(V16D) from TM = V32S thenV16D += 1	0x9031 | TM	&V16D	&V32S	
(V16D+), TM = val16	(V16D) from TM = val16 then V16D += 1	0x9020 | TM	&V16D	val16	
(V16D+), TM = val32	(V16D) from TM = val32 then V16D += 1	0x9021 | TM	&V16D	val32(L)	val32(H)
SRB V16,ANDm,ORm	Set / Reset Bits of a V16	0x5800 | 9LSB(&V16)	ANDm	ORm	
SRBL V16,ANDm,ORm	Set / Reset Bits of a V16 (la)	0x5C00	&V16	ANDm	Orm
V16 = label	V16 = address of a TML label	0x2000 | 9LSB(&V16)	&label		
V16 = val16	V16 = val16	0x2000 | 9LSB(&V16)	val16		
V16D = (V16S), TM	V16D = (&V16S) from TM	0x9180 | TM	&V16S	&V16D	
V16D = (V16S+), TM	V16D = (&V16S) from TM then V16S += 1	0x9100 | TM	&V16S	&V16D	
V16D = IN#n	Read input #n	0x6000 | 9LSB(&V16D)	PxDIR	Bit_msk	
V16D = IN1, ANDm	Read IN#25 to IN#32 with ANDm	0x6000 | 9LSB(&V16D)	PEDIR	ANDm	
V16D = IN2, ANDm	Read IN#33 to IN#39 with ANDm	0x6000 | 9LSB(&V16D)	PFDIR	ANDm	
V16D = INPORT#n	Read input #n from IO space port	0x6800 | 9LSB(&V16D)	BitMskIO		
V16D = INPORT,ANDm	Read all inputs from IO space port	0x6800 | 9LSB(&V16D)	ANDm		
V16D = V16S	V16D = V16S	0x2800 | 9LSB(&V16D)	&V16S		
V16D = -V16S	V16D = -V16S	0x3000 | 9LSB(&V16D)	&V16S		
V16D = V32S(H)	V16D = V32S(H)	0x2800 | 9LSB(&V16D)	&V32S+1		
V16D = V32S(L)	V16D = V32S(L)	0x2800 | 9LSB(&V16D)	&V32S		
V16D, dm = V16S	V16D from dm = V16S (la)	0x9014	&V16D	&V16S	
V16D, dm = val16	V16 from dm = val16 (la)	0x9004	&V16D	val16	
V32 = val32	V32 = val32	0x2400 | 9LSB(&V32)	val32(L)	val32(H)	
V32(H) = val16	V32(H) = val16	0x2000 | 9LSB(&V32+1)	val16		
V32(L) = val16	V32(H) = val16	0x2000 | 9LSB(&V32)	val16		
V32D = (V16S), TM	V32D = (V16S) from TM	0x9181 | TM	&V16S	&V32D	
V32D = (V16S+), TM	V32D = (V16S) from TM then V16D += 1	0x9101 | TM	&V16S	&V32D	
V32D = V32S	V32D = V32S	0x2C00 | 9LSB(&V32D)	&V32S		
V32D = -V32S	V32D = -V32S	0x3400 | 9LSB(&V32D)	&V32S		
V32D =V16S << N	V32D = V16S left-shifted by N	0x8960 | N (N=0-16)	&V32D	&V16S	
V32D(H) = V16S	V32D(H) = V16	0x2800 | 9LSB(&V32D+1)	&V16S		
V32D(L) = V16S	V32D(L) = V16	0x2800 | 9LSB(&V32D)	&V16S		
V32D, dm = V32S	V32D from dm = V32S (la)	0x9015	&V32D	&V32S	
V32D, dm = val32	V32 from dm = val32 (la)	0x9005	&V32D	val32(L)	val32(H)

Table D.3. TML Instruction Set. Arithmetic Group

Syntax	Description	Code			
		0	1	2	3
PROD <<= N	Left shift PROD by N	0x88A0 | N (N=0-15)	0x030e		
PROD >>= N	Right shift PROD by N	0x8880 | N (N=0-15)	0x030e		
V16 <<= N	Left shift V16 by N	0x8820 | N (N=0-15)	&V16		
V16 >>= N	Right shift V16 by N	0x8800 | N (N=0-15)	&V16		
V16 += val16	Add val16 to V16	0x3800 | 9LSB(&V16)	val16		
V16 -= val16	Subtract val16 from V16	0x4800 | 9LSB(&V16)	val16		
V16 * val16 << N	PROD = (V16 * val16) >> N	0x8C20 | N (N=0-15)	&V16	val16	
V16 * val16 >> N	PROD = (V16 * val16) >> N	0x8C00 | N (N=0-15)	&V16	val16	
V16A * V16B << N	PROD = (V16A * V16B) << N	0x8CA0 | N (N=0-15)	&V16A	&V16B	
V16A * V16B >> N	PROD = (V16A * V16B) >> N	0x8C80 | N (N=0-15)	&V16A	&V16B	
V16D += V16S	Add V16S to V16D	0x4000 | 9LSB(&V16D)	&V16S		
V16D -= V16S	Subtract V16S from V16D	0x5000 | 9LSB(&V16D)	&V16S		
V32 * V16 << N	PROD = (V32 * V16) << N	0x8DA0 | N (N=0-15)	&V32	&V16	
V32 * V16 >> N	PROD = (V32 * V16) >> N	0x8D80 | N (N=0-15)	&V32	&V16	
V32 * val16 << N	PROD = (V32 * val16) << N	0x8D20 | N (N=0-15)	&V32	val16	
V32 * val16 >> N	PROD = (V32 * val16) >> N	0x8D00 | N (N=0-15)	&V32	val16	
V32 >>= N	Right shift V32 by N	0x8900 | N (N=0-15)	&V32		
V32 <<= N	Left shift V32 by N	0x8920 | N (N=0-15)	&V32		
V32 += val32	Add val32 to V32	0x3C00 | 9LSB(&V32)	val32(L)	val32(H)	
V32 -= val32	Subtract val32 from V32	0x4C00 | 9LSB(&V32)	val32(L)	val32(H)	
V32D += V32S	Add V32S to V32D	0x4400 | 9LSB(&V32D)	&V32S		
V32D -= V32S	Subtract V32S from V32D	0x5400 | 9LSB(&V32D)	&V32S		

Table D.4. TML Instruction Set. Program Flow Decision Group

Syntax	Description	Code			
		0	1	2	3
CALL Label	Unconditional CALL of a function	0x7401	&Label		
CALL Label, V16, Flag	CALL function if V16 Flag 0	0x7401 | Flag	&V16	&Label	
CALL Label, V32, Flag	CALL function if V32 Flag 0	0x7501 | Flag	&V32	&Label	
GOTO Label	Unconditional GOTO to label	0x7400	&Label		
GOTO Label, V16, Flag	GOTO label if V16 Flag 0	0x7400 | Flag	&V16	&Label	
GOTO Label, V32, Flag	GOTO label if V32 Flag 0	0x7500 | Flag	&V32	&Label	
RET	Return from TML function	0x0404			
RETI	Return from TML Interrupt SR	0x0504			

Table D.5. TML Instruction Set. Motion Mode Setting Group

Syntax	Description	Code			
		0	1	2	3
MODE CS0	Set MODE Cam Slave 0 ()	0x5909	0xB4C6	0x8406	
MODE CS1	Set MODE Cam Slave 1 (T)	0x5909	0xB5C6	0x8506	
MODE CS2	Set MODE Cam Slave 2 (S)	0x5909	0xB6C6	0x8606	
MODE CS3	Set MODE Cam Slave 3 (S,T)	0x5909	0xB7C6	0x8706	
MODE GS0	Set MODE Gear Slave 0 ()	0x5909	0xB4C5	0x8405	
MODE GS1	Set MODE Gear Slave 1 (T)	0x5909	0xB5C5	0x8505	
MODE GS2	Set MODE Gear Slave 2 (S)	0x5909	0xB6C5	0x8605	
MODE GS3	Set MODE Gear Slave 3 (S,T)	0x5909	0xB7C5	0x8705	
MODE PC0	MODE Position Contouring 0 ( )	0x5909	0xBCC2	0x8402	
MODE PC1	MODE Position Contouring 1 (T)	0x5909	0xBDC2	0x8502	
MODE PC2	MODE Position Contouring 2 (S)	0x5909	0xBEC2	0x8602	
MODE PC3	MODE Position Contouring 3 (S,T)	0x5909	0xBFC2	0x8702	
MODE PE0	MODE Position External 0 ( )	0x5909	0xBCC0	0x8400	
MODE PE1	MODE Position External 1 (T)	0x5909	0xBDC0	0x8500	
MODE PE2	MODE Position External 2 (S)	0x5909	0xBEC0	0x8600	
MODE PE3	MODE Position External 3 (S,T)	0x5909	0xBFC0	0x8700	
MODE PP0	MODE Position Profile 0 ( )	0x5909	0xBCC1	0x8401	
MODE PP1	MODE Position Profile 1 (T)	0x5909	0xBDC1	0x8501	
MODE PP2	MODE Position Profile 2 (S)	0x5909	0xBEC1	0x8601	
MODE PP3	MODE Position Profile 3 (S,T)	0x5909	0xBFC1	0x8701	
MODE PPD0	MODE Position Pulse & Dir 0 ( )	0x5909	0xBCC4	0x8404	
MODE PPD1	MODE Position Pulse & Dir 1 (T)	0x5909	0xBDC4	0x8504	
MODE PPD2	MODE Position Pulse & Dir 2 (S)	0x5909	0xBEC4	0x8604	
MODE PPD3	MODE Position Pulse & Dir 3 (S,T)	0x5909	0xBFC4	0x8704	
MODE SC0	MODE Speed Contouring 0 (T)	0x5909	0xBAC2	0x8202	
MODE SC1	MODE Speed Contouring 1 (T)	0x5909	0xBBC2	0x8302	
MODE SE0	MODE Speed External 0 (T)	0x5909	0xB2C0	0x8200	
MODE SE1	MODE Speed External 1 (T)	0x5909	0xB3C0	0x8300	
MODE SP0	MODE Speed Profile 0 ( )	0x5909	0xBAC1	0x8201	
MODE SP1	MODE Speed Profile 1 (T)	0x5909	0xBBC1	0x8301	
MODE SPD0	MODE Speed Pulse & Dir 0 ( )	0x5909	0xBAC4	0x8204	
MODE SPD1	MODE Speed Pulse & Dir 1 (T)	0x5909	0xBBC4	0x8304	
MODE TC	MODE Torque Contouring	0x5909	0xB1C3	0x8103	
MODE TEF	MODE Torque External Fast loop	0x5909	0xB1E0	0x8120	
MODE TES	MODE Torque External Slow loop	0x5909	0xB1C0	0x8100	
MODE TT	MODE Torque Test	0x5909	0xB1C8	0x8108	
MODE VC	MODE Voltage Contouring	0x5909	0xB0C3	0x8003	
MODE VEF	MODE Voltage External Fast loop	0x5909	0xB0E0	0x8020	
MODE VES	MODE Voltage External Slow loop	0x5909	0xB0C0	0x8000	
MODE VT	MODE Voltage Test	0x5909	0xB0C8	0x8008	

Table D.6. TML Instruction Set. Configuration and Command Group

Syntax	Description	Code			
		0	1	2	3
AXISOFF	AXIS is OFF (deactivate control)	0x0002			
AXISON	AXIS is ON (activate control)	0x0102			
BEGIN	BEGIN of a TML program	0x649C			
BREAK	BREAK TML program execution	0x0010			
CHECKSUM, TM Start, Stop, V16D	V16D = Checksum between Start and Stop addresses from TM	0xD910 | (TM<<3)	&V16D	Start	Stop
CONTINUE	Resume TML program execution	0x0110			
CPA	Command Position is Absolute	0x5909	0xFFFF	0x2000	
CPR	Command Position is Relative	0x5909	0xDFFF	0x0000	
DINT	Disable TML Interrupts	0x0410			
EINT	Enable TML Interrupts	0x0510			
END	END of a TML program	0x0001			
ENDINIT	END of Initialization	0x0020			
EXTREF 0	External Reference read from EREF updated on-line	0x5909	0xFF3F	0x0000	
EXTREF 1	External Reference read from REFERNCE input	0x5909	0xFF7F	0x0040	
EXTREF 2	External Reference read from a16-bit IO port	0x5909	0xFFBF	0x0080	
EXTREF 3	External Reference read from a 32=bit IO port	0x5909	0xFFFF	0x00C0	
INITCAM addrS, addrD	Copy CAM table from SPI (addrS address) to RAM (addrD address)	0xD840	addrS	addrD	
LSACT NONE	Limit Switch Action = NONE	0x20A7	0x0000		
LSACT STOP0	Limit Switch Action = STOP0	0x20A7	0x0001		
LSACT STOP1	Limit Switch Action = STOP1	0x20A7	0x0002		
LSACT STOP2	Limit Switch Action = STOP2	0x20A7	0x0004		
LSACT STOP3	Limit Switch Action = STOP3	0x20A7	0x0008		
NOP	No Operation	0x0000			
RAOU	Reset Automatic Origin Update	0x5909	0xEFFF	0x0000	
RESET	RESET DSP controller	0x0402			
SAOU	Set Automatic Origin Update	0x5909	0xFFFF	0x1000	
SAP V32	Set Actual Position = V32	0x8000 | 9LSB(&V32)			
SAP val32	Set Actual Position = val32	0x8400	val32(L)	val32(H)	
SEG D_time, D_ref	Segment D_time, D_ref	0x7800	D_time	D_ref(L)	D_ref(H)
SEG V16, V32	Segment V16, V32	0x7C00 | 9LSB(&V16)	&V32		
SETWS val16	SET Wait-States for PS,DS,IS	0xD802	val16		
STA	Set Target pos. = Actual pos.	0x2CB2	0x0228		
STOP0	STOP motion in mode 0	0x0104			

STOP0!	STOP0 when ! (event occurs)	0x0004			
STOP1	STOP motion in mode 1	0x0144			
STOP1!	STOP1 when ! (event occurs)	0x0044			
STOP2	STOP motion in mode 2	0x0184			
STOP2!	STOP2 when ! (event occurs)	0x0084			
STOP3	STOP motion in mode 3	0x01C4			
STOP3!	STOP3 when ! (event occurs)	0x00C4			
TUM0	Set Target Update Mode 0	0x5909	0xBFFF	0x0000	
TUM1	Set Target Update Mode 1	0x5909	0xFFFF	0x4000	
UPD	Update motion immediate	0x0108			
UPD!	Update when ! (event occurs)	0x0008			

Table D.7. TML Instruction Set. Event group

Syntax	Description	Code			
		0	1	2	3
!APO V32	! if Relative Position Over V32	0x7192	0x0228	&V32	
!APO val32	! if Relative Position Over val32	0x7092	0x0228	val32(L)	val32(H)
!APU V32	! if Relative Position Under V32	0x7183	0x0228	&V32	
!APU val32	! if Relative Position Under val32	0x7083	0x0228	val32(L)	val32(H)
!AT V32	! if Absolute Time >= V32	0x7198	0x02C0	&V32	
!AT val32	! if Absolute Time >= val32	0x7098	0x02C0	val32(L)	val32(H)
!CAP	! if Capture triggered	0x700E			
!IN#n 0	! if Input #n is 0	0x70DB	PxDIR	Bit_msk	
!IN#n 1	! if Input #n is 1	0x70DA	PxDIR	Bit_msk	
!LSN	! if Limit Switch Negative active	0x700C			
!LSP	! if Limit Switch Positive active	0x700D			
!MC	!(set event) if Motion Complete	0x700F			
!RO V32	! if Reference Over V32	0x7190	0x02AE	&V32	
!RO val32	! if Reference Over val32	0x7090	0x02AE	val32(L)	val32(H)
!RPO V32	! if Relative Position Over V32	0x7194	0x02BA	&V32	
!RPO val32	! if Relative Position Over val32	0x7094	0x02BA	val32(L)	val32(H)
!RPU V32	! if Relative Position Under V32	0x7185	0x02BA	&V32	
!RPU val32	! if Relative Position Under val32	0x7085	0x02BA	val32(L)	val32(H)
!RT V32	! if Relative Time >= V32	0x71B9	0x02C2	&V32	
!RT val32	! if Relative Time >= val32	0x70B9	0x02C2	val32(L)	val32(H)
!RU V32	! if Reference Under V32	0x7181	0x02AE	&V32	
!RU val32	! if Reference Under val32	0x7081	0x02AE	val32(L)	val32(H)
!SO V32	! if Speed Over V32	0x7196	0x022C	&V32	
!SO val32	! if Speed Over val32	0x7096	0x022C	val32(L)	val32(H)
!SU V32	! if Speed Under V32	0x7187	0x022C	&V32	
!SU val32	! if Speed Under val32	0x7087	0x022C	val32(L)	val32(H)
!VO V32A, V32B	! if V32A >= V32B	0x7190	&V32A	&V32B	
!VO V32A, val32	! if V32A >= val32	0x7090	&V32A	val32(L)	val32(H)
!VU V32A, V32B	! if V32A <= V32B	0x7181	&V32A	&V32B	
!VU V32A, val32	! if V32A <= val32	0x7081	&V32A	val32(L)	val32(H)
WAIT!	Wait until event occurs	0x0408			

Table D.8. TML Instruction Set. I/O Group

Syntax	Description	Code			
		0	1	2	3
DIS2CAPI	Disable 2nd CAPI capture	0x04A0			
DISCAPI	Disable CAPI capture	0x0481			
DISIO#n	Disable IO#n	0x5C00	MCRx	ANDdis	ORdis
DISLSN	Disable LSN limit switch	0x5C00	0x7070	0xFFFE	0x0000
DISLSP	Disable LSP limit switch	0x5C00	0x7071	0xFFFE	0x0000
EN2CAPI0	Enable 2nd CAPI capture for 1->0	0x0420			
EN2CAPI1	Enable 2nd CAPI capture for 0->1	0x0520			
ENCAPI0	Enable CAPI capture for 1->0	0x0401			
ENCAPI1	Enable CAPI capture for 0->1	0x0501			
ENIO#n	Enable IO#n	0x5C00	MCRx	ANDen	OREn
ENLSN0	Enable LSN limit switch for 1->0	0x5C00	0x7070	0x7FFB	0x0001
ENLSN1	Enable LSN limit switch for 0->1	0x5C00	0x7070	0x7FFF	0x0005
ENLSP0	Enable LSP limit switch for 1->0	0x5C00	0x7071	0x7FFB	0x0001
ENLSP1	Enable LSP limit switch for 0->1	0x5C00	0x7071	0x7FFF	0x0005
OUTPORT V16	OUT V16 value to IO space port	0x6C00 | 9LSB(&V16)			
ROUT#n	Reset IO#n output to 0	0x5C00	PxDIR	ANDrst	ORrst
SETIO#n IN	Set IO#n as input	0x5C00	PxDIR	ANDin	ORin
SETIO#n OUT	Set IO#n as output	0x5C00	PxDIR	ANDout	ORout
SOUT#n	Set IO#n output to 1	0x5C00	PxDIR	ANDset	ORset

Table D.9. TML Instruction Set. Communication and Multiple axis group

Syntax	Description	Code			
		0	1	2	3
[A/G] { Instr1; Instr2; …}	Send a series of TML instructions to [A/G]	0x9400 | LengthMLI	A/G	MLI code 1-4 words	
[A/G] (V16D),TM = V16S	[A/G] (V16D),TM = local V16S	0x9830 | TM	A/G	& V16D	& V16S
[A/G] (V16D),TM = V32S	[A/G] (V16D),TM = local V32S	0x9831 | TM	A/G	& V16D	& V32S
[A/G] V16D = V16S	[A/G] V16D = local V16S	0xB800 | 9LSB(&V16D)	A/G	& V16S	
[A/G] V16D,dm = V16S	[A/G] V16D,dm = local V16S (Ia)	0x9814	A/G	& V16D	& V16S
[A/G] V32D = V32S	[A/G] V32D = local V32S	0xBC00 | 9LSB(&V32D)	A/G	& V32S	
[A/G] V32D,dm = V32S	[A/G] V32D,dm= local V32S (Ia)	0x9815	A/G	& V32D	& V32S
ADDGRID V16	Add Group ID = V16	0x0940	&V16		
ADDGRID val16	Add Group ID = val16	0x0840	val16		
AXISID val16	AXIS ID = val16	0x0801	val16		
CANBR val16	Set CAN-bus Baud-Rate	0x0804	val16		
GROUPID val16	GROUP ID = val16	0x0802	val16		
REMGRID V16	Remove Group ID = V16	0x0980	&V16		
REMGRID val16	Remove Group ID = val16	0x0880	val16		
RGM	Reset axis as Gear/Cam Master	0x5909	0xF7FF	0x0000	
SCIBR V16	Set SCI Baud Rate	0x0920	&V16		
SCIBR val16	Set SCI Baud Rate	0x0820	val16		
SGM	Set axis as Gear/Cam Master	0x5909	0xFFFF	0x8800	
SPIBR V16	Set SPI Baud Rate	0x0910	&V16		
SPIBR val16	Set SPI Baud Rate	0x0810	val16		
V16D = [A] (V16S),TM	Local V16D = [A] (V16S), dm	0x9D00 | TM	A/G	& V16S	& V16D
V16D = [A] V16S	Local V16D = [A] V16S	0xD800 | 9LSB(&V16S)	A/G	& V16D	
V16D = [A] V16S,dm	Local V16D = [A] V16S, dm (Ia)	0x9C00	A/G	& V16S	& V16D
V32D = [A] V32S,dm	Local V32D = [A] V32S, dm (Ia)	0x9C01	A/G	& V32S	& V32D
V32D = [A] (V16S),TM	Local V32D = [A] (V16S),TM	0x9D01 | TM	A/G	& V16S	& V16D
V32D = [A] V32S	Local V32D = [A] V32S	0xDC00 | 9LSB(&V32S)	A/G	& V32D	

The following tables explicit the symbols used in the TML instruction set.

Table D.10. AND/OR for masks SETIO#n IN

#n	ANDin	ORin	Function
#0	0xFEFF	0x0000	R 8
#1	0xFDFF	0x0000	R 9
#2	0xFBFF	0x0000	R 10
#3	0xF7FF	0x0000	R 11
#4	0xEFFF	0x0000	R 12
#5	0xDFFF	0x0000	R 13
#6	0xBFFF	0x0000	R 14
#7	0x7FFF	0x0000	R 15
#8	0xFEFF	0x0000	R 8
#9	0xFDFF	0x0000	R 9
#10	0xFBFF	0x0000	R 10
#11	0xF7FF	0x0000	R 11
#12	0xEFFF	0x0000	R 12
#13	0xDFFF	0x0000	R 13
#14	0xBFFF	0x0000	R 14
#15	0x7FFF	0x0000	R 15
#16	0xFEFF	0x0000	R 8
#17	0xFDFF	0x0000	R 9
#18	0xFBFF	0x0000	R 10
#19	0xF7FF	0x0000	R 11
#20	0xEFFF	0x0000	R 12
#21	0xDFFF	0x0000	R 13
#22	0xBFFF	0x0000	R 14
#23	0x7FFF	0x0000	R 15
#24	0xFEFF	0x0000	R 8
#25	0xFEFF	0x0000	R 8
#26	0xFDFF	0x0000	R 9
#27	0xFBFF	0x0000	R 10
#28	0xF7FF	0x0000	R 11
#29	0xEFFF	0x0000	R 12
#30	0xDFFF	0x0000	R 13
#31	0xBFFF	0x0000	R 14
#32	0x7FFF	0x0000	R 15
#33	0xFEFF	0x0000	R 8
#34	0xFDFF	0x0000	R 9
#35	0xFBFF	0x0000	R 10
#36	0xF7FF	0x0000	R 11
#37	0xEFFF	0x0000	R 12
#38	0xDFFF	0x0000	R 13
#39	0xBFFF	0x0000	R 14

Table D.11. AND/OR masks for SETIO#n OUT

#n	ANDout	ORout	Function
#0	0xFFFF	0x0100	S 8
#1	0xFFFF	0x0200	S 9
#2	0xFFFF	0x0400	S 10
#3	0xFFFF	0x0800	S 11
#4	0xFFFF	0x1000	S 12
#5	0xFFFF	0x2000	S 13
#6	0xFFFF	0x4000	S 14
#7	0xFFFF	0x8000	S 15
#8	0xFFFF	0x0100	S 8
#9	0xFFFF	0x0200	S 9
#10	0xFFFF	0x0400	S 10
#11	0xFFFF	0x0800	S 11
#12	0xFFFF	0x1000	S 12
#13	0xFFFF	0x2000	S 13
#14	0xFFFF	0x4000	S 14
#15	0xFFFF	0x8000	S 15
#16	0xFFFF	0x0100	S 8
#17	0xFFFF	0x0200	S 9
#18	0xFFFF	0x0400	S 10
#19	0xFFFF	0x0800	S 11
#20	0xFFFF	0x1000	S 12
#21	0xFFFF	0x2000	S 13
#22	0xFFFF	0x4000	S 14
#23	0xFFFF	0x8000	S 15
#24	0xFFFF	0x0100	S 8
#25	0xFFFF	0x0100	S 8
#26	0xFFFF	0x0200	S 9
#27	0xFFFF	0x0400	S 10
#28	0xFFFF	0x0800	S 11
#29	0xFFFF	0x1000	S 12
#30	0xFFFF	0x2000	S 13
#31	0xFFFF	0x4000	S 14
#32	0xFFFF	0x8000	S 15
#33	0xFFFF	0x0100	S 8
#34	0xFFFF	0x0200	S 9
#35	0xFFFF	0x0400	S 10
#36	0xFFFF	0x0800	S 11
#37	0xFFFF	0x1000	S 12
#38	0xFFFF	0x2000	S 13
#39	0xFFFF	0x4000	S 14

Table D.12.AND/OR masks for ROUT#n

#n	ANDrst	Orrst	Function
#0	0xFFFE	0x0000	R 0
#1	0xFFFD	0x0000	R 1
#2	0xFFFB	0x0000	R 2
#3	0xFFF7	0x0000	R 3
#4	0xFFEF	0x0000	R 4
#5	0xFFDF	0x0000	R 5
#6	0xFFBF	0x0000	R 6
#7	0xFF7F	0x0000	R 7
#8	0xFFFE	0x0000	R 0
#9	0xFFFD	0x0000	R 1
#10	0xFFFB	0x0000	R 2
#11	0xFFF7	0x0000	R 3
#12	0xFFEF	0x0000	R 4
#13	0xFFDF	0x0000	R 5
#14	0xFFBF	0x0000	R 6
#15	0xFF7F	0x0000	R 7
#16	0xFFFE	0x0000	R 0
#17	0xFFFD	0x0000	R 1
#18	0xFFFB	0x0000	R 2
#19	0xFFF7	0x0000	R 3
#20	0xFFEF	0x0000	R 4
#21	0xFFDF	0x0000	R 5
#22	0xFFBF	0x0000	R 6
#23	0xFF7F	0x0000	R 7
#24	0xFFFE	0x0000	R 0
#25	0xFFFE	0x0000	R 0
#26	0xFFFD	0x0000	R 1
#27	0xFFFB	0x0000	R 2
#28	0xFFF7	0x0000	R 3
#29	0xFFEF	0x0000	R 4
#30	0xFFDF	0x0000	R 5
#31	0xFFBF	0x0000	R 6
#32	0xFF7F	0x0000	R 7
#33	0xFFFE	0x0000	R 0
#34	0xFFFD	0x0000	R 1
#35	0xFFFB	0x0000	R 2
#36	0xFFF7	0x0000	R 3
#37	0xFFEF	0x0000	R 4
#38	0xFFDF	0x0000	R 5
#39	0xFFBF	0x0000	R 6

Table D.13. AND/OR masks for SOUT#n

#n	ANDset	ORset	Function
#0	0xFFFF	0x0001	S 0
#1	0xFFFF	0x0002	S 1
#2	0xFFFF	0x0004	S 2
#3	0xFFFF	0x0008	S 3
#4	0xFFFF	0x0010	S 4
#5	0xFFFF	0x0020	S 5
#6	0xFFFF	0x0040	S 6
#7	0xFFFF	0x0080	S 7
#8	0xFFFF	0x0001	S 0
#9	0xFFFF	0x0002	S 1
#10	0xFFFF	0x0004	S 2
#11	0xFFFF	0x0008	S 3
#12	0xFFFF	0x0010	S 4
#13	0xFFFF	0x0020	S 5
#14	0xFFFF	0x0040	S 6
#15	0xFFFF	0x0080	S 7
#16	0xFFFF	0x0001	S 0
#17	0xFFFF	0x0002	S 1
#18	0xFFFF	0x0004	S 2
#19	0xFFFF	0x0008	S 3
#20	0xFFFF	0x0010	S 4
#21	0xFFFF	0x0020	S 5
#22	0xFFFF	0x0040	S 6
#23	0xFFFF	0x0080	S 7
#24	0xFFFF	0x0001	S 0
#25	0xFFFF	0x0001	S 0
#26	0xFFFF	0x0002	S 1
#27	0xFFFF	0x0004	S 2
#28	0xFFFF	0x0008	S 3
#29	0xFFFF	0x0010	S 4
#30	0xFFFF	0x0020	S 5
#31	0xFFFF	0x0040	S 6
#32	0xFFFF	0x0080	S 7
#33	0xFFFF	0x0001	S 0
#34	0xFFFF	0x0002	S 1
#35	0xFFFF	0x0004	S 2
#36	0xFFFF	0x0008	S 3
#37	0xFFFF	0x0010	S 4
#38	0xFFFF	0x0020	S 5
#39	0xFFFF	0x0040	S 6

Table D.17. MCRx & AND/OR masks for ENIO#n

#n	MPCRx	ANDen	ORen	Function
#0	MCRA	0xFFFE	0x0000	R 0
#1	MCRA	0xFFFD	0x0000	R 1
#2	MCRA	0xFFFB	0x0000	R 2
#3	MCRA	0xFFF7	0x0000	R 3
#4	MCRA	0xFFEF	0x0000	R 4
#5	MCRA	0xFFDF	0x0000	R 5
#6	MCRA	0xFFBF	0x0000	R 6
#7	MCRA	0xFF7F	0x0000	R 7
#8	MCRA	0xFEFF	0x0000	R 8
#9	MCRA	0xFDFF	0x0000	R 9
#10	MCRA	0xFBFF	0x0000	R 10
#11	MCRA	0xF7FF	0x0000	R 11
#12	MCRA	0xEFFF	0x0000	R 12
#13	MCRA	0xDFFF	0x0000	R 13
#14	MCRA	0xBFFF	0x0000	R 14
#15	MCRA	0x7FFF	0x0000	R 15
#16	MCRB	0xFFFE	0x0000	R 0
#17	MCRB	0xFFFD	0x0000	R 1
#18	MCRB	0xFFFB	0x0000	R 2
#19	MCRB	0xFFF7	0x0000	R 3
#20	MCRB	0xFFEF	0x0000	R 4
#21	MCRB	0xFFDF	0x0000	R 5
#22	MCRB	0xFFBF	0x0000	R 6
#23	MCRB	0xFF7F	0x0000	R 7
#24	MCRB	0xFEFF	0x0000	R 8
#25	MCRC	0xFFFE	0x0000	R 0
#26	MCRC	0xFFFD	0x0000	R 1
#27	MCRC	0xFFFB	0x0000	R 2
#28	MCRC	0xFFF7	0x0000	R 3
#29	MCRC	0xFFEF	0x0000	R 4
#30	MCRC	0xFFDF	0x0000	R 5
#31	MCRC	0xFFBF	0x0000	R 6
#32	MCRC	0xFF7F	0x0000	R 7
#33	MCRC	0xFEFF	0x0000	R 8
#34	MCRC	0xFDFF	0x0000	R 9
#35	MCRC	0xFBFF	0x0000	R 10
#36	MCRC	0xF7FF	0x0000	R 11
#37	MCRC	0xEFFF	0x0000	R 12
#38	MCRC	0xDFFF	0x0000	R 13
#39	MCRC	0xFFFF	0x0000	-

Table D.18. MCRx & AND/OR masks for DISIO#n

#n	MCRx	ANDdis	ORdis	Function
#0	MCRA	0xFFFF	0x0001	S 0
#1	MCRA	0xFFFF	0x0002	S 1
#2	MCRA	0xFFFF	0x0004	S 2
#3	MCRA	0xFFFF	0x0008	S 3
#4	MCRA	0xFFFF	0x0010	S 4
#5	MCRA	0xFFFF	0x0020	S 5
#6	MCRA	0xFFFF	0x0040	S 6
#7	MCRA	0xFFFF	0x0080	S 7
#8	MCRA	0xFFFF	0x0100	S 8
#9	MCRA	0xFFFF	0x0200	S 9
#10	MCRA	0xFFFF	0x0400	S 10
#11	MCRA	0xFFFF	0x0800	S 11
#12	MCRA	0xFFFF	0x1000	S 12
#13	MCRA	0xFFFF	0x2000	S 13
#14	MCRA	0xFFFF	0x4000	S 14
#15	MCRA	0xFFFF	0x8000	S 15
#16	MCRB	0xFFFF	0x0001	S 0
#17	MCRB	0xFFFF	0x0002	S 1
#18	MCRB	0xFFFF	0x0004	S 2
#19	MCRB	0xFFFF	0x0008	S 3
#20	MCRB	0xFFFF	0x0010	S 4
#21	MCRB	0xFFFF	0x0020	S 5
#22	MCRB	0xFFFF	0x0040	S 6
#23	MCRB	0xFFFF	0x0080	S 7
#24	MCRB	0xFFFF	0x0100	S 8
#25	MCRC	0xFFFF	0x0001	S 0
#26	MCRC	0xFFFF	0x0002	S 1
#27	MCRC	0xFFFF	0x0004	S 2
#28	MCRC	0xFFFF	0x0008	S 3
#29	MCRC	0xFFFF	0x0010	S 4
#30	MCRC	0xFFFF	0x0020	S 5
#31	MCRC	0xFFFF	0x0040	S 6
#32	MCRC	0xFFFF	0x0080	S 7
#33	MCRC	0xFFFF	0x0100	S 8
#34	MCRC	0xFFFF	0x0200	S 9
#35	MCRC	0xFFFF	0x0400	S 10
#36	MCRC	0xFFFF	0x0800	S 11
#37	MCRC	0xFFFF	0x1000	S 12
#38	MCRC	0xFFFF	0x2000	S 13
#39	MCRC	0xFFFF	0x0000	-

Table D.14. PxDIR & Bit_msk for V16=IN#n; !IN#n 0; and !IN#n 1;

#n	PxDIR	Bit_msk	Function
#0	PADIR	0x0001	1<<n
#1	PADIR	0x0002	1<<n
#2	PADIR	0x0004	1<<n
#3	PADIR	0x0008	1<<n
#4	PADIR	0x0010	1<<n
#5	PADIR	0x0020	1<<n
#6	PADIR	0x0040	1<<n
#7	PADIR	0x0080	1<<n
#8	PBDIR	0x0001	1<<(n-8)
#9	PBDIR	0x0002	1<<(n-8)
#10	PBDIR	0x0004	1<<(n-8)
#11	PBDIR	0x0008	1<<(n-8)
#12	PBDIR	0x0010	1<<(n-8)
#13	PBDIR	0x0020	1<<(n-8)
#14	PBDIR	0x0040	1<<(n-8)
#15	PBDIR	0x0080	1<<(n-8)
#16	PCDIR	0x0001	1<<(n-16)
#17	PCDIR	0x0002	1<<(n-16)
#18	PCDIR	0x0004	1<<(n-16)
#19	PCDIR	0x0008	1<<(n-16)
#20	PCDIR	0x0010	1<<(n-16)
#21	PCDIR	0x0020	1<<(n-16)
#22	PCDIR	0x0040	1<<(n-16)
#23	PCDIR	0x0080	1<<(n-16)
#24	PDDIR	0x0001	1<<(n-24)
#25	PEDIR	0x0001	1<<(n-25)
#26	PEDIR	0x0002	1<<(n-25)
#27	PEDIR	0x0004	1<<(n-25)
#28	PEDIR	0x0008	1<<(n-25)
#29	PEDIR	0x0010	1<<(n-25)
#30	PEDIR	0x0020	1<<(n-25)
#31	PEDIR	0x0040	1<<(n-25)
#32	PEDIR	0x0080	1<<(n-25)
#33	PFDIR	0x0001	1<<(n-33)
#34	PFDIR	0x0002	1<<(n-33)
#35	PFDIR	0x0004	1<<(n-33)
#36	PFDIR	0x0008	1<<(n-33)
#37	PFDIR	0x0010	1<<(n-33)
#38	PFDIR	0x0020	1<<(n-33)
#39	PFDIR	0x0040	1<<(n-33)

Condition Flags for GOTO/CALL

Flag	Value
LT	0x0090
LEQ	0x0088
EQ	0x00C0
NEQ	0x00A0
GT	0x0084
GEQ	0x0082

MCRx and PxDIR Addresses

Register	Address
MCRA	0x7090
MCRB	0x7092
MCRC	0x7094
PADIR	0x7098
PBDIR	0x709A
PCDIR	0x709C
PDDIR	0x709E
PEDIR	0x7095
PFDIR	0x7096

TM (Type Memory) values

TM	Value
pm	0x0000
dm	0x0004
spi	0x0008

Appendix E. IDM240/640 Dimensions

The next figures present the IDM240/640 dimensions.

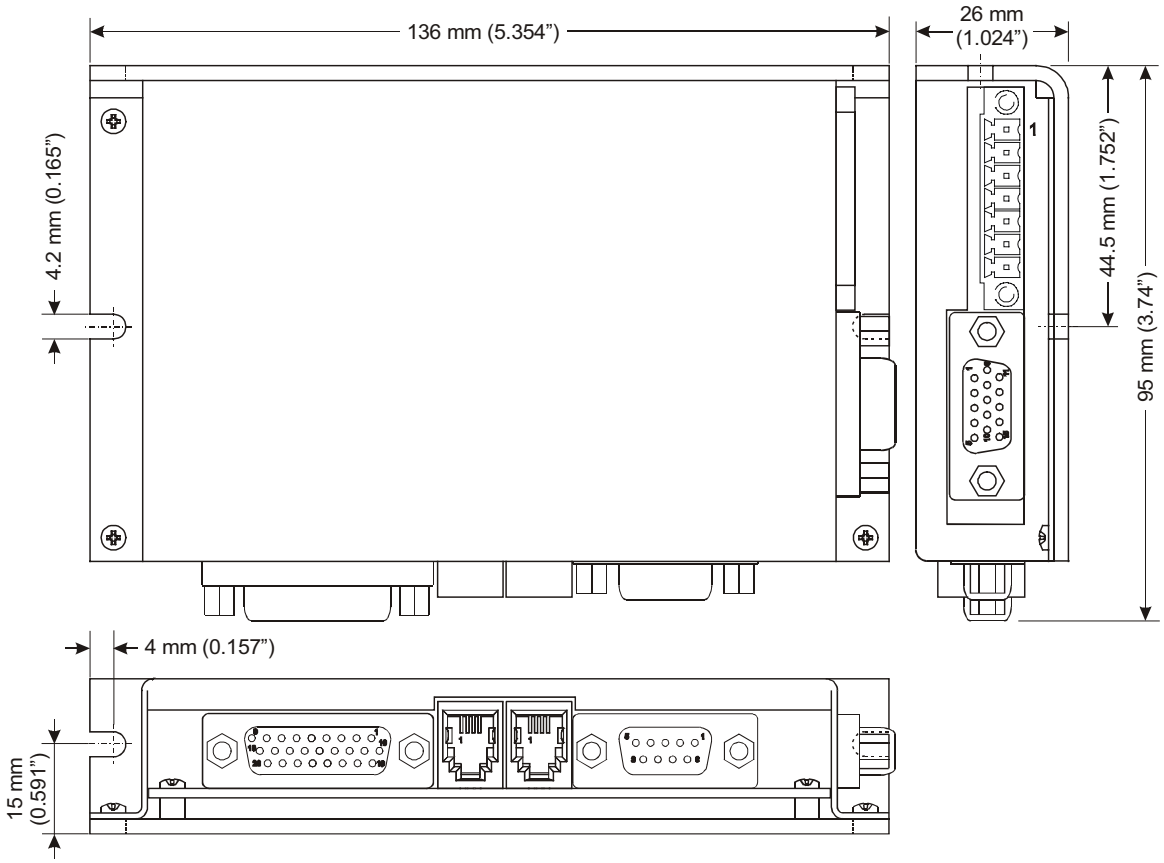


Figure E.1. IDM240-5EI and IDM640-8EI dimensions

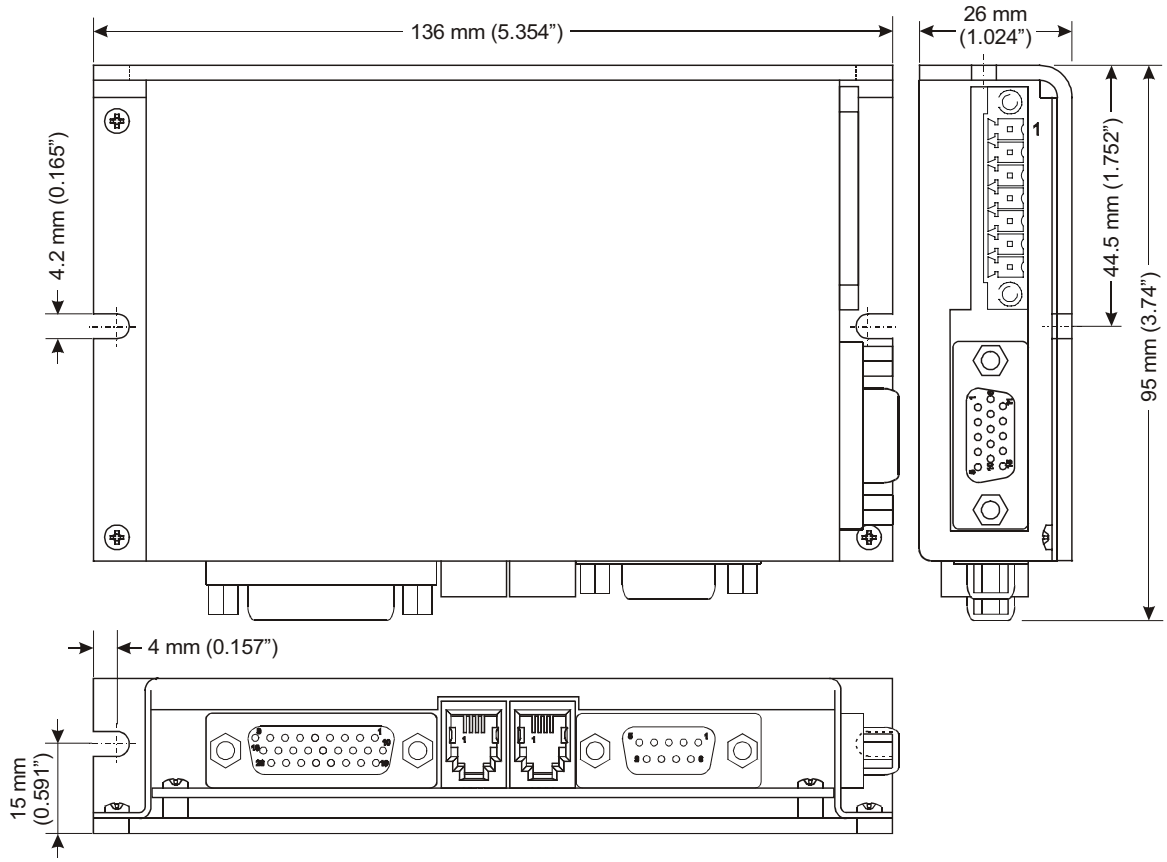


Figure E.2. IDM240-5RI and IDM640-8RI dimensions

Appendix F. Connectors Type and Mating Connectors

Table below presents the IDM240/640 connectors type and the mating connectors

Connector	Function	Version 1.1 Mating connector Technosoft specification feedback to customer	included with the IDM240/640
J2	Motor & supply	Phoenix Contact MC 1.5/8-STF-3.5	YES
J4	Serial	generic RS232, 9-pin Sub-D male	NO
J10 & J11	CAN	generic RJ11-4/4 phone plug	YES
J13A / J13B	Feedback	generic 15-pin High Density Sub-D male	YES
J9	Analog & 24V digital I/O	generic 26-pin High Density Sub-D male	YES

TECHNOSOFT

TML_LIB_LabVIEW

v2.0

Motion Control Library for Technosoft Intelligent Drives

TECHNOSOFT

User Manual

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TML_LIB_LabVIEW
v2.0
User Manual

P091.040.LABVIEW.v20.UM.0406
April 2006

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Read This First

Whilst Technosoft believes that the information and guidance given in this manual is correct, all parties must rely upon their own skill and judgment when making use of it. Technosoft does not assume any liability to anyone for any loss or damage caused by any error or omission in the work, whether such error or omission is the result of negligence or any other cause. Any and all such liability is disclaimed.

About This Manual

This book describes the motion library **TML_LIB_LabVIEW v2.0.** TML_LIB_LabVIEW is a collection of functions, which can be integrated in a PC application developed in LabVIEW environment. With TML_LIB_LabVIEW motion library, you can quickly program the desired motion and control the Technosoft intelligent drives and motors (with the drive integrated in the motor case) from a PC. The TML_LIB_LabVIEW allows you to communicate with Technosoft drive/motors via serial RS-232, RS-485, CAN-bus or Ethernet protocols.

Scope of This Manual

This manual applies to the following Technosoft intelligent drives and motors:

- **IDM240 / IDM640** (models IDM240-5EI, IDM240-5LI, IDM640-8EI and IDM640-8LI), with firmware **F000H** or later (revision letter must be equal or after H i.e. I, J, etc.)
- **IDM240 CANopen/ IDM640 CANopen** (models IDM240-5EI CANopen, IDM240-5LI CANopen, IDM640-8EI CANopen and IDM640-8LI CANopen) with firmware version **F500A**.
- **IDS240 / IDS640** (all models), with firmware **F000H** or later
- **IDS640 CANopen** with firmware **F500A** or later
- **ISCM4805 / ISCM8005** (all models), with firmware **F000H** or later
- **IBL2403** (all models), with firmware **F020H** or later
- **IPS110** (all models), with firmware **F005H** or later
- **IM23x** (models IS and MA), with firmware **F900H** or later

IMPORTANT! *For correct operation, these drives/motors must be programmed with firmware revision H.* ***EasySetUp***[1] *- Technosoft IDE for drives/motors setup, includes a firmware*

[1] **EasySetUp** is included in **TML_LIB_LabVIEW** installation package as a component of **EasyMotion Studio Demo version**. It can also be downloaded free of charge from Technosoft web page

programmer with which you can check your drive/motor firmware version and revision and if needed, update your drive/motor firmware to revision H.

Notational Conventions

This document uses the following conventions:

- **Drive/motor** - an *intelligent drive* or an *intelligent motor* having the drive part integrated in the motor case
- **TML** – Technosoft Motion Language
- **IU** – drive/motor internal units
- **ACR.5** – bit 5 of ACR data
- **FAxx** – firmware versions F000H, F020H, F005H, F900H or later
- **FBxx** – firmware versions F500A or later

Related Documentation

TML_LIB v2.0 User Manual (part no. P091.040.UM.xxxx) describes in detail the TML_LIB Technosoft Motion Language Library and how to use it to program motion applications in Visual C++, Visual Basic or Delphi environments.

MotionChip™ II TML Programming (part no. P091.055.MCII.TML.UM.xxxx) describes in detail TML basic concepts, motion programming, functional description of TML instructions for high level or low level motion programming, communication channels and protocols. Also give a detailed description of each TML instruction including syntax, binary code and examples.

MotionChip II Configuration Setup (part no. P091.055.MCII.STP.UM.xxxx) describes the MotionChip II operation and how to setup its registers and parameters starting from the user application data. This is a technical reference manual for all the MotionChip II registers, parameters and variables.

Help of the EasyMotion Studio software platform – describes how to use the EasyMotion Studio, which support all new features added to revision H of firmware. It includes: motion system setup & tuning wizard, motion sequence programming wizard, testing and debugging tools like: data logging, watch, control panels, on-line viewers of TML registers, parameters and variables, etc.

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1 Introduction

The programming of Technosoft intelligent drives/motors involves 2 steps:

1) Drive/motor setup
2) Motion programming

For **Step 1 – drive/motor setup**, Technosoft provides **EasySetUp**. EasySetUp is an integrated development environment for the setup of Technosoft drives/motors. The output of EasySetUp is a set of *setup data*, which can be downloaded to the drive/motor EEPROM or saved on your PC for later use. The setup data is copied at power-on into the RAM memory of the drive/motor and is used during runtime. The reciprocal is also possible i.e. to retrieve the complete setup data from a drive/motor EEPROM previously programmed. EasySetUp can be downloaded free of charge from Technosoft web page. It is also provided on the TML_LIB_LabVIEW installation CD.

For **Step 2 – motion programming**, Technosoft offers multiple options, like:

1) Use the drives/motors embedded motion controller and do the motion programming in Technosoft Motion Language (TML). For this operation Technosoft provides **EasyMotion Studio**, an IDE for both drives setup and motion programming. The output of EasyMotion Studio is a set of setup data and a TML program to download and execute on the drive/motor.
2) Use a **.DLL** with high-level motion functions which can be integrated in a host application written in C/C++, Delphi Pascal, Visual Basic or LabVIEW
3) Use a **PLCopen** compatible library with motion function blocks which can be integrated in a PLC application based on one of the IEC 61136 standard languages
4) Combine option 1) with options 2) or 3) to really distribute the intelligence between the master/host and the drives/motors in complex multi-axis applications. Thus, instead of trying to command each step of an axis movement, you can program the drives/motors using TML to execute complex tasks and inform the master when these are done.

TML_LIB_LabVIEW is part of option 2) – a collection of functions allowing you to implement motion control applications on a PC computer. The link between the Technosoft drives/motors and the PC can be done via serial link, via CAN-bus using a CAN interface or via Ethernet using an adapter/bridge between Ethernet and RS-232. Realized as a collection of high-level functions, the library allows you to focus on the main aspects related to your application specific implementation, and to simply use the drive and execute motion commands by calling appropriate functions from the library.

This manual presents how to install and use the components of the **TML_LIB_LabVIEW** library version 2.0.

Remarks:

- *Option 4) requires using EasyMotion Studio instead of EasySetUp. With EasyMotion Studio you can create high-level motion functions in TML, to be called from your PC*
- *EasyMotion Studio is also recommended if your application includes a homing as it comes with 32 predefined homing procedures to select from, with possibility to adapt them*

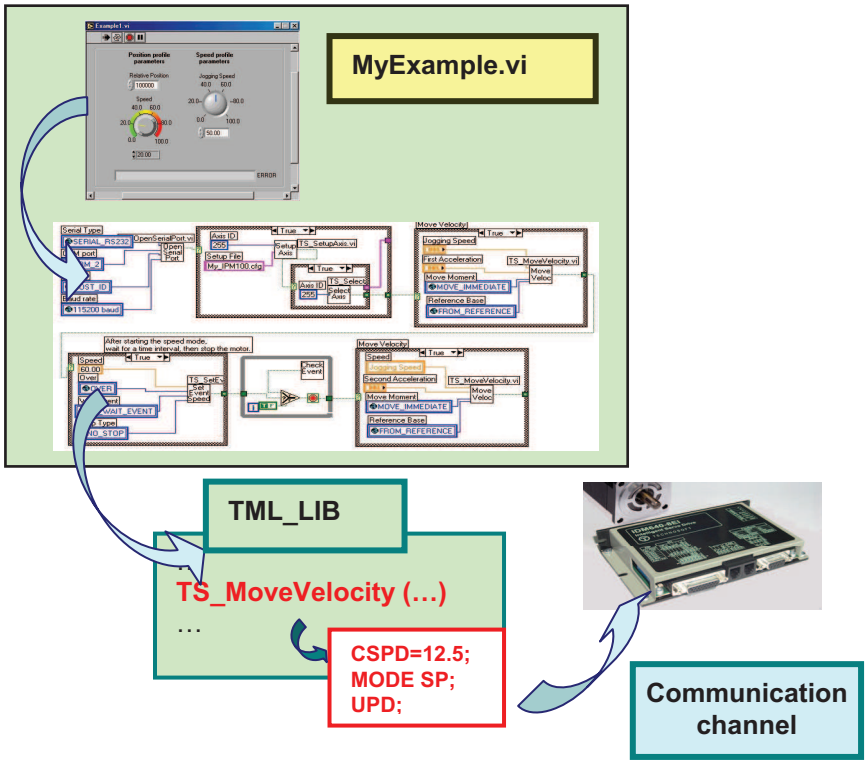


Figure 1.1. *Using TML_LIB_LabVIEW to control a Technosoft intelligent drive from the PC computer*

2 Getting started

2.1 Hardware installation

For the hardware installation of the Technosoft drives/motors see their user manual.

For drives/motors setup, you can connect your PC to any drive/motor using an RS232 serial link. Through this serial link you can access all the drives/motors from the network. Alternately, you can connect your PC directly on the CAN bus network if it is equipped with one of the CAN interfaces supported by EasySetUp.

2.2 Software installation

In order to perform successfully the following software installations, make sure that you have the "Administrator" rights.

2.2.1 Installing EasySetUp

On the TML_LIB_LabVIEW installation CD you'll find the setup for EasyMotion Studio Demo version. This application includes a fully functional version of EasySetUp and a demo version of EasyMotion Studio. Start the setup and follow the installation instructions.

2.2.2 Installing TML_LIB_LabVIEW library

Start the TML_LIB_LabVIEW setup and follow the installation instructions. After library installation open the LabVIEW environment and add in the list **VI Search Path,** the installation path of the library, by default **C:\Program Files\Technosoft\TML_LIB_LabVIEW.**.Table 2.1 details the package contents.

Table 2.1 *TML_LIB_LabVIEW package contents*

Directory	Files	Description
Root directory	TML_lib.dll	TML_LIB DLL library file
	TMLcomm.dll	TML communication DLL file
	P091.040.UM.xxxx.PDF	The PDF file of the TML_LIB user manual (this document)
Examples Files	Ex25TML.txt	TML source file for Example 25
	Ex29RAM.out	COFF file for Example 29
	Ex30.out	COFF file for Example 30
	Ex32_MyCam.cam	A cam file for example 32, in Technosoft cam file format
	Ex32_MyCam.txt	A cam file for example 32, in text file format
Examples	Example diagrams	A complete Visual C project implementing the examples from Chapter 4.
Functions	VI functions	Contains the sub VIs of the library which implement the functions from TML_LIB.dll
GlobalVIs	sub VIs with global variables	Sub VIs containing the declaration of global variables used in examples
Setups	Setup data directories	Sample setup data of the drives used in examples. For your configurations generate the setup data (see paragraph 2.3)

2.3 Drive/motor setup

Before starting to send motion commands from the PC, you need to do the drive/motor setup according with your application needs. For this operation you'll use **EasySetUp**.

EasySetUp is an integrated development environment for the setup of Technosoft drives and motors (with the drive integrated in the motor case). The output of **EasySetUp** is a set of setup data, which can be downloaded to the drive/motor EEPROM or saved on your PC for later use.

A setup contains all the information needed to configure and parameterize a Technosoft drive/motor. This information is preserved in the drive/motor EEPROM in the setup table. The setup table is copied at power-on into the RAM memory of the drive/motor and is used during runtime. The reciprocal is also possible i.e. to retrieve the complete setup data from a drive/motor EEPROM previously programmed

Steps to follow for commissioning a Technosoft drive/motor

Step 1. Start EasySetUp

From Windows Start menu execute: "Start | Programs | EasySetUp | EasySetUp" or "Start | Programs | EasyMotion Studio | EasySetUp" depending on which installation package you have used.

Step 2. Establish communication

EasySetUp starts with an empty window from where you can create a **New** setup, **Open** a previously created setup which was saved on your PC, or **Upload** the setup from the drive/motor.

Before selection one of the above options, you need to establish the communication with the drive/motor you want to commission. Use menu command **Communication | Setup** to check/change your PC communication settings. Press the **Help** button of the dialogue opened. Here you can find detailed information about how to setup your drive/motor and do the connections. Power on the drive/motor and then close the **Communication | Setup** dialogue with OK. If the communication is established, EasySetUp displays in the status bar (the bottom line) the text "**Online**" plus the axis ID of your drive/motor and its firmware version. Otherwise the text displayed is "**Offline**" and a communication error message tells you the error type. In this case, return to the Communication | Setup dialogue, press the Help button and check troubleshoots.

Remark: *When first started, EasySetUp tries to communicate with your drive/motor via RS-232 and COM1 (default communication settings). If your drive/motor is powered and connected to your PC port COM1 via an RS-232 cable, the communication can be automatically established.*

Step 3. Setup drive/motor

Press **New** button and select your drive/motor type. Depending on the product chosen, the selection may continue with the motor technology (for example: brushless motor, brushed motor) or the control mode (for example stepper – open-loop or stepper – closed-loop) and type of feedback device (for example: incremental encoder, SSI encoder)

This opens 2 setup dialogues: for **Motor Setup** and for **Drive setup** through which you can configure and parameterize a Technosoft drive/motor, plus several predefined control panels customized for the product selected.

In the **Motor setup** dialogue you can introduce the data of your motor and the associated sensors. Data introduction is accompanied by a series of tests having as goal to check the

connections to the drive and/or to determine or validate a part of the motor and sensors parameters. In the **Drive setup** dialogue you can configure and parameterize the drive for your application. In each dialogue you will find a **Guideline Assistant**, which will guide you through the whole process of introducing and/or checking your data. Close the Drive setup dialogue with **OK** to keep all the changes regarding the motor and the drive setup.

Step 4. Download setup data to drive/motor

Press the **Download to Drive/Motor** button to download your setup data in the drive/motor EEPROM memory in the *setup table*. From now on, at each power-on, the setup data is copied into the drive/motor RAM memory that is used during runtime. It is also possible to **Save** the setup data on your PC and use it in other applications.

Step 5. Reset the drive/motor to activate the setup data

Step 6. Create the setup data for TML_LIB_LabVIEW. The TML_LIB_LabVIEW requires drive/motor setup information for proper execution of the application. The setup data is generated with the **Setup | Export to TML_LIB…** command if you are in **EasySetUp**, or the **Application | Export to TML_LIB…** command if you are using EasyMotion Studio. The information is generated in the form of an archive file with the **.t.zip** extension and is saved in the **Archives** folder from EasySetUp/EasyMotion Studio installation folder (by default C:\Program Files\Technosoft\ESM\).

2.4 Build an application with TML_LIB_LabVIEW

The library TML_LIB_LabVIEW is a collection of high level functions, grouped in several categories and provided as the **TML_LIB.dll** file. To simplify the functions usage, each function has a subVi associated.

Most of these subVIs are of Boolean type, and return a '**True'** value if the execution of the function is performed without any error (at PC level). If the function returns a '**False'** value, you can interrogate the error type by calling the function **TS_GetLastErrorText.vi**.

Steps to build an application with TML_LIB_LabView:

1. **Create a new VI.** Launch LabVIEW and press the button **New VI**. For details read the LabView online help.
2. **Setup the communication.** The application developed is based on the communication between PC and Technosoft drives/motors thus it should begin with the communication channel setup. The communication channel is opened with the **TS_OpenChannel.vi** subVI. At the end of the application you must close the communication channel with subVI **TS_CloseChannel.vi**.
3. **Load setup configurations.** The setup information is required by the library functions in order to check if there are incompatibilities between the drive and the operation to be executed (as an example, avoiding issuing an "Output port" command to a port which is an input port on that drive). EasySetUp/EasyMotion Studio generates the setup information in the form of an archive file with the **.t.zip** extension. The archives are saved in the **Archives** folder from EasyMotion Studio/ EasySetUp installation folder. The drive's/motor's setup data are declared in the PC application with function **TS_LoadSetup.vi**. The subVI must be called for each configuration setup used.

4. **Setup axes.** Each axis defined at PC level requires the setup information. The configuration setup is associated to an axis with subVI **TS_SetupAxis.vi**.
5. **Select the active axis/group.** The messages sent from the PC address to one axis. Use subVI **TS_SelectAxis.vi** to choose the messages destination. All further function calls, which send TML messages on the communication channel, will address the messages to this active axis.
6. **Program the motion for current axis.** Use the TML_LIB_LabVIEW functions to program the motions required.

3 TML_LIB_LabVIEW description

3.1 Basic concept

The Technosoft intelligent drives are programmable using the Technosoft Motion Language (TML). TML consists of a high-level set of codes allowing the user to parameterize and execute specific motion operations.

TML allows to:

- Configure the motion mode (profiles, contouring, gearing in multiple axes structures, etc.)
- Detect / specifically treat external signals as limit switches, captures
- Execute homing sequences
- Setup / start specific action on pre-defined motion events
- Synchronize multiple axes structures, by sending group commands
- etc.

The **TML_LIB_LabVIEW** library is the tool that helps you to handle the process of motion control application implementation on a PC computer, at a high level, without the need to write / compile TML code.

A central element of the library is the communication kernel, which is responsible of correct opening of the communication channel (serial RS-232 or RS-485, CAN-bus or Ethernet), as well as of TML messages handling. This includes handling of the specific communication protocol, for each of these channels.

Consequently, each application you'll develop starts with the opening of the communication, i.e. calling the **TS_OpenChannel.vi** subVI. The application must end with the **TS_CloseChannel.vi** subVI execution.

You'll be able to handle multiple-axis applications from the PC. Besides the drive/motor setup with EasySetUp or EasyMotion Studio, you'll also need to indicate some basic drive information for correct usage of the library functions. Thus, for each drive that is installed in the system, you'll need to execute the **TS_SetupAxis.vi** subVI, indicating the axis ID and configuration setup. Such information will be used for some functions of the library, in order to check if there are incompatibilities between the drive and the operation to be executed (as an example, avoiding issuing an "Output port" command to a port which is an input port on that drive).

Note that besides setting-up individual axes, it is also possible to setup groups of axes (with the **TS_SetupGroup.vi** subVI). This will allow you to issue commands, which will be received and executed simultaneously on all the axes initialized as belonging to that group.

Once all the axes are defined, the library allows you to select the so-called 'active axis or group', using the **TS_SelectAxis**, or **TS_SelectGroup** subVI respectively. Consequently, all future commands that you'll execute after the selection of one axis or group will be addressed to that axis or group. You can change at any time in your program the active axis/group.

3.2 Internal units and scaling factors

Technosoft drives/motors work with parameters and variables represented in internal units (IU). The parameters and variables may represent various signals: position, speed, current, voltage, etc. Each type of signal has its own internal representation in IU and a specific scaling factor. In order to easily identify each type of IU, these have been named after the associated signals. For example the **position units** are the internal units for position, the **speed units** are the internal units for speed, etc.

The scaling factor of each internal unit shows the correspondence with the international standard units (SI). The scaling factors are dependent on the product, motor and sensor type. Put in other words, the scaling factors depend on the setup configuration.

In order to find the internal units and the scaling factors for a specific case, select the application in the project window and then execute menu command **Help | Setup Data Management | Internal Units and Scaling Factors**.

Important: *The **Help | Setup Data Management | Internal Units and Scaling Factors** command provides customized information, function of the application setup. If you change the drive, the motor technology or the feedback device, check again the scaling factors with this command. It may show you other relations!*

3.3 Axis Identification

The data exchanged on the communication channel is done using messages. Each message contains one TML instruction to be executed by the receiver of the message. Apart from the binary code of the TML instruction attached, any message includes information about its destination: an axis (drive/motor) or group of axes. This information is grouped in the **Axis/Group ID Code**. Each drive/motor has its own 8-bit Axis ID and Group ID.

Remarks:

1. *The Axis ID of a drive/motor must be **unique** and is set during the drive/motor setup phase with **EasySetUp**.*
2. *The Axis ID and Group ID of a drive/motor are stored in TML variable **AAR**. Use TS_GetIntVariable.vi to read the value of the Axis ID and Group ID.*

The Group ID represents a way to identify a group of axes, for a multicast transmission. This feature allows to send a command simultaneously to several axes, for example to start or stop the axes motion in the same time. When a function block sends a command to a group, all the axes members of this group will receive the command. For example, if the axis is member of group 1 and group 3, it will receive all the messages that in the group ID include group 1 and group 3.

Remark: *A drive/motor belongs, by default, to the group ID = 1.*

Each axis can be programmed to be member of one or several of the 8 possible groups.

Table 3.1*Definition of the groups*

Group No.	Group ID value
1	1 (0000 0001b)
2	2 (0000 0010b)
3	4 (0000 0100b)
4	8 (0000 1000b)
5	16 (0001 0000b)
6	32 (0010 0000b)
7	64 (0100 0000b)
8	128 (1000 0000b)

3.4 Functions descriptions

The section presents the functions implemented in the **TML_LIB_LabVIEW** library. The functions are classified as follows:

- **Motion programming –** functions for motion programming on the selected axis.
- **Motor commands –** functions to enable/disable the motor power stage, start/stop the motion, change the value of the motor position and current
- **Events** – functions for events programming and test
- **TML jumps and function calls** – functions which allows you to execute code downloaded in the drive/motor memory
- **I/O handling** – functions for read/write operations with drive/motor I/O ports
- **Data transfer** – functions for read/write operations from/to the drive/motor memory
- **Drive/motor monitoring** – functions for monitoring the drive/motor status
- **Miscellaneous –** functions for FAULT state reset and drive reset
- **Data logger** – functions for logger setup and data upload
- **Drive setup** – functions for axis setup in the PC application
- **Drive administration** – functions that control the destination axis of the message sent via communication channels
- **Communication setup** – functions that manage the PC communication channel

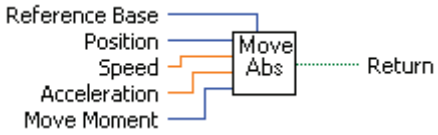
For each function you will find the following information:

- The subVi symbol
- The function C prototype
- SubVI parameters description
- A functional description
- Name of the related subVIs
- Examples reference. The examples that illustrate the correct use of the functions (subVIs) are listed in chapter 4.

3.4.1 Motion programming

3.4.1.1 TS_MoveAbsolute.vi

Symbol:



Prototype:

LONG _TS_MoveAbsolute@28(LONG Position, DOUBLE Speed, DOUBLE Acceleration, SHORT INT Move Moment, SHORT INT Reference Base);

Parameters:

	Name	Description
Input	Position	Position to reached expressed in drive/motor position units
	Speed	Slew speed expressed in TML speed units. If the value is zero the drive/motor will use the previously value set for speed
	Acceleration	Acceleration/deceleration rate expressed in TML acceleration units. If its value is zero the drive/motor will use the previously value set for acceleration
	Move Moment	Defines the moment when the motion is started
	Reference Base	Specifies how the motion reference is computed: from actual values of position and speed reference or from actual values of load/motor position and speed
Output	return	TRUE if no error, FALSE if error

Description: The function programs an absolute positioning with trapezoidal speed profile. The motion is described through **Position** parameter for position to reach, **Speed** for slew speed and **Acceleration** for acceleration/deceleration rate. The position to reach can be positive or negative. The **Speed** and **Acceleration** can be **only** positive.

Once set, the motion parameters are memorized on the drive/motor. If you intend to use values previously defined for the acceleration rate and/or the velocity you don't need to send their values again in the following trapezoidal profiles. Set to zero the value of speed and/or acceleration and the drive/motor will use the values previously defined (this option reduces the TML code generated by this function).

The motion is executed:

- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Set **Reference Base** = **FROM_REFERENCE** if you want the reference generator to compute the motion profile starting from the actual values of the position and speed reference. Set **Reference**

Base = **FROM_MEASURE** if you want the reference generator to compute the motion profile starting from the actual values of the load/motor position and speed. When this option is used, at the beginning of each new motion profile, the position and speed reference are updated with the actual values of the load/motor position and speed.

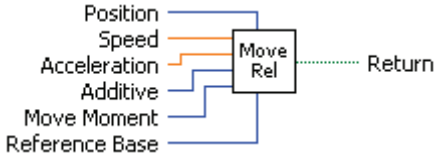
Remark: *In open loop control of steppers, this option is ignored because there is no position and/or speed feedback.*

Related functions: TS_MoveRelative.vi, TS_MoveSCurveAbsolute.vi, TS_MoveSCurveRelative.vi, TS_MoveVelocity.vi

Associated examples: Example 6, Example 11, Example 12, Example 14, Example 27, Example 28, Example 29, Example 37, Example 39

3.4.1.2 TS_MoveRelative.vi

Symbol:



Prototype:

LONG _TS_MoveRelative@32(LONG Position, DOUBLE Speed, DOUBLE Acceleration, UNSIGNED CHAR Additive, SHORT INT Move Moment, SHORT INT Reference Base);

Parameters:

	Name	Description
Input	Position	Position increment expressed in TML position units
	Speed	Slew speed expressed in TML speed units. If its value is zero the drive/motor will use the previously value set for speed
	Acceleration	Acceleration/deceleration rate expressed in the TML acceleration units. If its value is zero the drive/motor will use the previously value set for acceleration
	Additive	Specifies how is computed the position to reach
	Move Moment	Defines the moment when the motion is started
	Reference Base	Specifies how the motion reference is computed: from actual values of position and speed reference or from actual values of load/motor position and speed
Output	return	TRUE if no error, FALSE if error

Description: The function programs a relative positioning with trapezoidal speed profile. The motion is described through **Position** for position increment, **Acceleration** for acceleration/deceleration rate and **Speed** for slew speed. The position increment can be positive or negative; the sign gives the motion direction. The speed and acceleration can be **only** positive.

Once set, the motion parameters are memorized on the drive/motor. If you intend to use values previously defined for the acceleration rate and/or the velocity you don't need to send their values again in the following trapezoidal profiles. Set to zero the value of speed and/or acceleration if you want the drive/motor to use the values previously defined with other commands (this option reduces the TML code generated by this function).

The position to reach can be computed in 2 ways: standard (default) or additive. In standard mode, the position to reach is computed by adding the position increment to the instantaneous position in the moment when the command is executed. In the additive mode, the position to reach is computed by adding the position increment to the previous position to reach, independently of the moment when the command was issued. The additive mode is activated with **Additive = IsAdditive**.

The motion is executed:

- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**

- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Set **Reference Base** = **FROM_REFERENCE** if you want the reference generator to compute the motion profile starting from the actual values of the position and speed reference. Use this option for example if successive standard relative moves must be executed and the final target position should represent exactly the sum of the individual commands. Set **Reference Base** = **FROM_MEASURE** if you want the reference generator to compute the motion profile starting from the actual values of the load/motor position and speed. When this option is used, at the beginning of each new motion profile, the position and speed reference are updated with the actual values of the load/motor position and speed.

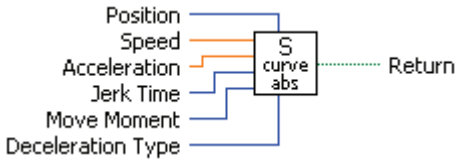
Remark: *In open loop control of steppers, this option is ignored because there is no position and/or speed feedback.*

Related functions: TS_ MoveAbsolute.vi, TS_MoveSCurveAbsolute.vi, TS_MoveSCurveRelative.vi, TS_MoveVelocity.vi

Associated examples: Example 1, Example 2, Example 4, Example 5, Example 7, Example 8, Example 16, Example 20, Example 24, Example 26, Example 29, Example 31, Example 32, Example 33, Example 36, Example 38, Example 40, Example 42

3.4.1.3 TS_MoveSCurveAbsolute.vi

Symbol:



Prototype:

LONG _TS_MoveSCurveAbsolute@32(LONG Position, DOUBLE Speed, DOUBLE Acceleration, LONG Jerk Time, SHORT INT Move Moment, SHORT INT Deceleration Type);

Parameters:

	Name	Description
Input	Position	Position to reach expressed in TML position units
	Speed	The slew speed expressed in TML speed units.
	Acceleration	Acceleration/deceleration rate expressed in TML acceleration units.
	Jerk Time	Represents the time interval for acceleration to reach the programmed value. It is expressed in TML time units.
	Move Moment	Defines the moment when the motion is started
	Deceleration Type	Specifies the speed profile used when the motion is stopped with TS_Stop
Output	Return	TRUE if no error, FALSE if error

Description: The function block programs an absolute positioning with an S-curve shape of the speed. This shape is due to the jerk limitation, leading to a trapezoidal or triangular profile for the acceleration and an S-curve profile for the speed. The motion is described through **Position** parameter for position to reach, **Speed** for slew speed, **Acceleration** for acceleration/deceleration rate and **Jerk Time**. The position to reach can be positive or negative. The **Speed**, **Acceleration** and **Jerk Time** can be **only** positive.

An S-curve profile must begin when load/motor is not moving. During motion the parameters should not be changed. Therefore when executing successive S-curve commands, you should wait for the previous motion to end before setting the new motion parameters and starting next motion.

When the motion is stopped with function TS_Stop.vi, the deceleration phase can be done in 2 ways:

- Smooth, using an S-curve speed profile, when **Deceleration Type = S_CURVE_SPEED_PROFILE**
- Fast, using a trapezoidal speed profile, when **Deceleration Type** = **TRAPEZOIDAL_SPEED_PROFILE**

The motion can be executed:

- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **MoveMoment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of

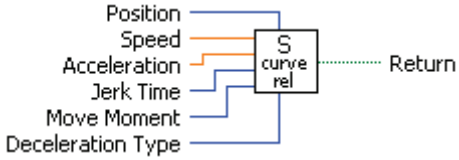
the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Related functions: TS_MoveAbsolute.vi, TS_MoveRelative.vi, TS_MoveSCurveRelative.vi TS_MoveVelocity.vi, TS_QuikStopDecelerationRate.vi

Associated examples: Example 35

3.4.1.4 TS_MoveSCurveRelative.vi

Symbol:



Prototype:

LONG _TS_MoveSCurveRelative@32(LONG Position, DOUBLE Speed, DOUBLE Acceleration, LONG Jerk Time, SHORT INT Move Moment, SHORT INT Deceleration Type);

Parameters:

	Name	Description
Input	Position	Position increment expressed in drive/motor position units
	Speed	Slew speed expressed in drive/motor speed units.
	Acceleration	Acceleration/deceleration rate expressed in drive/motor acceleration units.
	Jerk Time	Represents the time interval for acceleration to reach the programmed value. It is expressed in drive/motor time units.
	Move Moment	Defines the moment when the motion is started
	Deceleration Type	Specifies the speed profile used when the motion is stopped with TS_Stop.vi
Output	Return	TRUE if no error, FALSE if error

Description: The function block programs a relative positioning with an S-curve shape of the speed. This shape is due to the jerk limitation, leading to a trapezoidal or triangular profile for the acceleration and an S-curve profile for the speed. The motion is described through **Position** parameter for position increment, **Speed** for slew speed, **Acceleration** for acceleration/deceleration rate and **Jerk Time**. The position to reach can be positive or negative. The **Speed**, **Acceleration** and **Jerk Time** can be **only** positive.

An S-curve profile must begin when load/motor is not moving. During motion the parameters should not be changed. Therefore when executing successive S-curve commands, you should wait for the previous motion to end before setting the new motion parameters and starting next motion.

When the motion is stopped with function TS_Stop.vi, the deceleration phase can be done in 2 ways:

- Smooth, using an S-curve speed profile, when **Deceleration Type = S_CURVE_SPEED_PROFILE**
- Fast, using a trapezoidal speed profile, when **Deceleration Type** = **TRAPEZOIDAL_SPEED_PROFILE**

The motion can be executed:

- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of

the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Related functions: TS_MoveAbsolute.vi, TS_MoveRelative.vi, TS_MoveSCurveAbsolute.vi TS_MoveVelocity.vi

Associated examples: Example 35

3.4.1.5 TS_MoveVelocity. vi

Symbol:

Prototype:

LONG _TS_MoveVelocity@24(DOUBLE Speed, DOUBLE Acceleration, SHORT INT Move Moment, SHORT INT Reference Base);

Parameters:

	Name	Description
Input	Speed	Jog speed expressed in TML speed units
	Acceleration	Acceleration rate expressed in TML acceleration units. If the value is zero the drive/motor will use the previously value set for acceleration.
	Move Moment	Defines the moment when the motion is started
	Reference Base	Specifies how the motion reference is computed: from actual values of position and speed reference or from actual values of load/motor position and speed
Output	return	TRUE if no error, FALSE if error

Description: The function programs a trapezoidal speed profile. You specify the jog **Speed**. The load/motor accelerates until the jog speed is reached. The jog speed can be positive or negative; the sign gives the direction. The **Acceleration** can be **only** positive.

Once set, the motion parameters are memorized on the drive/motor. If you intend to use values previously defined for the acceleration rate you don't need to send its value again in the following speed profiles. Set to zero the value of acceleration if you want the drive/motor to use the value previously defined with other commands (this option reduces the TML code generated by this function).

The motion is executed:

- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Set **Reference Base** = **FROM_REFERENCE** if you want the reference generator to compute the motion profile starting from the actual values of the position and speed reference. Use this option for example if successive standard relative moves must be executed and the final target position should represent exactly the sum of the individual commands. Set **Reference Base** = **FROM_MEASURE** if you want the reference generator to compute the motion profile starting from the actual values of the load/motor position and speed. When this option is used, at the beginning of each new motion profile, the position and speed reference are updated with the actual values of the load/motor position and speed.

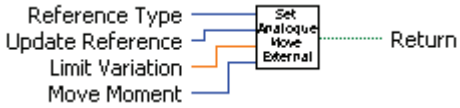
Remark: *In open loop control of steppers, this option is ignored because there is no position and/or speed feedback.*

Related functions: TS_MoveRelative.vi, TS_MoveAbsolute.vi, TS_MoveSCurveAbsolute.vi, TS_MoveSCurveRelative.vi

Associated examples: Example 1, Example 2, Example 3, Example 4, Example 5, Example 7, Example 9, Example 10, Example 12, Example 15, Example 16, Example 17, Example 18, Example 19, Example 24, Example 27, Example 28, Example 29, Example 30, Example 31, Example 39, Example 40

3.4.1.6 TS_SetAnalogueMoveExternal.vi

Symbol:



Prototype:

LONG _TS_SetAnalogueMoveExternal@20(SHORT INT Reference Type, UNSIGNED CHAR Update Reference, DOUBLE Limit Variation, SHORT INT Move Moment);

Parameters:

	Name	Description
Input	Reference Type	Specifies how the analogue signal is interpreted
	Update Reference	Specifies how often the analogue reference is read when torque control is performed
	Limit Variation	Speed/acceleration limit value for position/speed control expressed in TML internal units
	Move Moment	Defines the moment when the motion is started
Output	Return	TRUE if no error, FALSE if error

Description: The function block programs the drive/motor to work with an external analogue reference read via a dedicated analogue input (10-bit resolution). The analogue signal can be interpreted as a position, speed or torque analogue reference. Through parameter **ReferenceType** you specify how the analogue signal is interpreted:

- Position reference when **Reference Type = REFERENCE_POSITION**. The drive/motor performs position control.
- Speed reference when **Reference Type = REFERENCE_SPEED**. The drive/motor performs speed control.
- Torque reference when **Reference Type = REFERENCE_TORQUE**. The drive/motor performs torque control.

Remark: *During the drive/motor setup, in the* ***Drive setup*** *dialogue, you have to:*

1. *Select the appropriate control type for your application at Control Mode.*
2. *Perform the tuning of controllers associated with the selected control mode.*
3. *Setup the analogue reference. Specify the reference values corresponding to the upper and lower limits of the analogue input. In addition, a dead-band symmetrical interval and its center point inside the analogue input range may be defined.*

In position control you can limit the maximum speed at sudden changes of the position reference and thus to reduce the mechanical shocks. In speed control you can limit the maximum acceleration at sudden changes of the speed reference and thus to get a smoother transition. These features are activated by setting the **Limit Variation** parameter to a positive value and disabled when the **Limit Variation** is zero.

In torque control you can choose how often to read the analogue input: at each slow loop sampling period (**Update Reference = UPDATE_FAST**) or at each fast loop sampling period (**Update Reference = UPDATE_SLOW**).

The motion is executed:

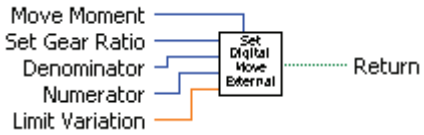
- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the motion parameters are set, but does not execute. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Related functions: TS_SetDigitalMoveExternal.vi, TS_SetOnlineMoveExternal.vi

Associated examples: Example 13

3.4.1.7 TS_SetDigitalMoveExternal

Symbol:



Prototype:

LONG _TS_SetDigitalMoveExternal@24(UNSIGNED CHAR Set Gear Ratio, SHORT INT Denominator, SHORT INT Numerator, DOUBLE Limit Variation, SHORT INT Move Moment);

Parameters:

	Name	Description
Input	Set Gear Ratio	Specifies if the digital reference is followed by the drive with a gear ratio
	Denominator	Gear ratio denominator
	Numerator	Gear ratio numerator
	Limit Variation	Acceleration limit value
	Move Moment	Defines the moment when the motion is started
Output	Return	TRUE if no error, FALSE if error

Description: The function block programs the drive/motor to work with an external digital reference provided as pulse & direction or quadrature encoder signals. In either case, the drive/motor performs a position control with the reference computed from the external signals.

Remarks: *The option for the input signals: pulse & direction or quadrature encoder is established during the drive/motor setup.*

The drive/motor follows the external reference with a gear ratio different than 1:1 when **Set Gear Ratio = YES**. The gear ratio is specified as a ratio of 2 integer values: **Numerator** / **Denominator**. The **Numerator** value is signed, while the **Denominator** is unsigned. The sign indicates the direction of movement: positive – same as the external reference, negative – reversed to the external reference.

You can limit the maximum acceleration at sudden changes of the external reference and thus to get a smoother transition. This feature is activated when the parameter **Limit Value** has a positive value and disabled when its value is zero.

The motion is executed:

- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the motion parameters are set, but the motion is not activated. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Related functions: TS_SetAnalogueMoveExternal, TS_SetOnlineMoveExternal

Associated examples: Example 21

3.4.1.8 TS_SetOnlineMoveExternal.vi

Symbol:

Prototype:

LONG _TS_SetOnlineMoveExternal@24(SHORT INT Reference Type, DOUBLE Limit Variation, DOUBLE Initial Value, SHORT INT Move Moment);

Parameters:

	Name	Description
Input	Reference Type	Specifies how the analogue signal is interpreted
	Limit Variation	Speed/acceleration limit value for position/speed control expressed in drive/motor internal units
	Initial Value	The initial value of the reference received on-line
	Move Moment	Defines the moment when the motion is started
Output	Return	TRUE if no error, FALSE if error

Description: The function programs the drive/motor to work with a reference received via a communication channel from an external device. Depending on the control mode chosen, the external reference is saved in one of the TML variables:

- **EREFP**, which becomes the position reference if the **Reference Type = REFERENCE_POSITION**
- **EREFS**, which becomes the speed reference if the **Reference Type = REFERENCE_SPEED**
- **EREFT**, which becomes the torque reference if the **Reference Type = REFERENCE_TORQUE**
- **EREFV**, which becomes voltage reference if the **Reference Type = REFERENCE_VOLTAGE**

Remark: *During the drive/motor setup, in the* ***Drive setup*** *dialogue, you have to:*

1. *Select the appropriate control type for your application in* ***Drive Setup*** *dialogue.*
2. *Perform the tuning of controllers associated with the selected control mode.*

In position control you can limit the maximum speed at sudden changes of the position reference and thus to reduce the mechanical shocks. In speed control you can limit the maximum acceleration at sudden changes of the speed reference and thus to get a smoother transition. These features are activated by setting the **Limit Variation** parameter to a positive value and disabled when the **Limit Variation** is zero.

The motion is executed:

- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of

the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

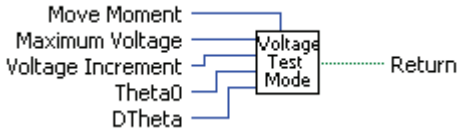
If the external device starts sending the reference AFTER the motion mode is activated, it may be necessary to initialize EREFP, EREFS, EREFT or EREFV. The desired starting value is set through **Initial Value** parameter.

Related functions: TS_SetAnalogueMoveExternal.vi, TS_SetDigitalMoveExternal.vi

Associated examples: Example 13

3.4.1.9 TS_VoltageTestMode.vi

Symbol:



Prototype:

LONG _TS_VoltageTestMode@20(SHORT INT MaxVoltage, SHORT INT IncrVoltage, SHORT INT Theta0, SHORT INT Dtheta, SHORT INT MoveMoment);

Parameters:

	Name	Description
Input	MaxVoltage	Maximum test voltage expressed in drive/motor voltage command units
	IncrVoltage	Voltage increment expressed in drive/motor internal units
	Theta0	Initial value of electrical angle expressed in drive/motor electrical angle units
	Dtheta	Electric angle increment expressed in drive/motor electrical angle increment units
	Move Moment	Defines the moment when the motion is started
Output	return	TRUE if no error, FALSE if error

Description: The function allows you to set the drives/motors in voltage test mode. In the test mode a saturated ramp voltage is applied to the motor, i.e. the voltage will increase with the **IncrVoltage** increment at each slow sampling period up to the **MaxVoltage** value.

Remark: *This is a test mode to be used only in some special cases for drives setup. The test mode is not supposed to be used during normal operation*

For AC motors (like for example the brushless motors), you have the possibility to rotate a voltage reference vector with a programmable speed. As a result, these motors can be moved in an “open-loop” mode without using the position sensor. The main advantage of this test mode is the possibility to conduct in a safe way a series of tests, which can offer important information about the motor parameters, drive status and the integrity of the its connections.

The voltage reference vector initial position is set through parameter **Theta0** and its speed through **Dtheta**. For DC motors set these parameters to zero.

The motion is executed:

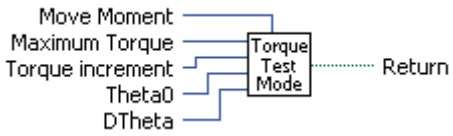
- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You’ll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Related functions: TS_TorqueTestMode.vi

Associated examples: Example 22

3.4.1.10 TS_TorqueTestMode.vi

Symbol:



Prototype:

LONG _TS_TorqueTestMode@20(SHORT INT MaxTorque, SHORT INT IncrTorque, SHORT INT Theta0, SHORT INT Dtheta, SHORT Move Moment);

Parameters:

	Name	Description
Input	MaxTorque	Maximum test torque expressed in TML current units
	IncrTorque	Torque increment expressed in TML internal units
	Theta0	Initial value of electrical angle expressed in TML electrical angle units
	Dtheta	Electric angle increment expressed in TML electrical angle increment units
	Move Moment	Defines the moment when the motion is started
Output	return	TRUE if no error, FALSE if error

Description: The function allows you to set the drives/motors in torque test mode. In the test mode a saturated ramp current is applied to the motor, i.e. the current will increase with the **IncrTorque** increment at each slow sampling period up to the **MaxTorque** value.

Remark: *This is a test mode to be used only in some special cases for drives setup. The test mode is not supposed to be used during normal operation*

For AC motors (like for example the brushless motors), you have the possibility to rotate a current reference vector with a programmable speed. As a result, these motors can be moved in an "open-loop" mode without using the position sensor. The main advantage of this test mode is the possibility to conduct in a safe way a series of tests, which can offer important information about the motor parameters, drive status and the integrity of the its connections.

The current reference vector initial position is set through parameter **Theta0** and its speed through **Dtheta**. For DC motors set these parameters to zero.

The motion is executed:

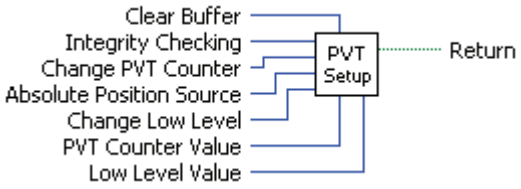
- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Related functions: TS_VoltageTestMode.vi

Associated examples: Example 23

3.4.1.11 TS_PVTSetup.vi

Symbol:



Prototype:

LONG _TS_PVTSetup@28(SHORT INT Clear Buffer, SHORT INT Integrity Checking, SHORT INT Change PVT Counter, SHORT INT Absolute Position Source, SHORT INT Change Low Level, SHORT INT PVT Counter Value, SHORT INT Low Level Value);

Parameters:

	Name	Description
Input	Clear Buffer	Specifies if the PVT buffer is cleared
	Integrity Checking	Enable/disable PVT counter integrity checking
	Change PVT Counter	Specifies if the integrity counter is updated with the value of PVTCounterValue parameter
	Absolute Position Source	Selects the source for initial position for absolute PVT mode
	Change Low Level	Specifies if the level for BufferLow signaling is updated with the value of LowLevelValue parameter
	PVT Counter Value	The new value for the drive/motor PVT integrity counter
	Low Level Value	The new value for the level of the BufferLow signal
Output	return	TRUE if no error, FALSE if error

Description: The function programs a drive/motor to work in PVT motion mode. In PVT motion mode the drive/motor performs a positioning path described through a series of points. Each point specifies the desired **P**osition, **V**elocity and **T**ime, i.e. contains a PVT data. Between the points the built-in reference generator performs a 3rd order interpolation.

Remark: *The function block just programs the drive/motor for PVT mode. The motion mode is activated with function TS_SendPVTFirstPoint.vi and the PVT points are sent to the drive with function TS_SendPVTPoint.vi.*

A key factor for getting a correct positioning path in PVT mode is to set correctly the distance in time between the points. Typically this is 10-20ms, the shorter the better. If the distance in time between the PVT points is too big, the 3rd order interpolation may lead to important variations compared with the desired path.

The PVT motion mode can be started only when the previous motion is complete. However, you can switch at any moment to another motion mode.

The PVT mode can be relative or absolute. In the absolute mode, each PVT point specifies the position to reach. The initial position may be either the current position reference TML variable TPOS (**Absolute Position Source = 1**) or a preset value read from the TML parameter PVTPOS0 (**Absolute Position Source = 0**). In the relative mode, each PVT point specifies the position increment relative to the previous point. In both cases, the time is relative to the previous

point i.e. represents the duration of a PVT segment. For the first PVT point, the time is measured from the starting of the PVT mode.

Remark: *The PVT mode, absolute or relative, is set with function TS_SendPVTFirstPoint.vi.*

Each time when the drive receives a new PVT point, it is saved into the PVT buffer. The reference generator empties the buffer as the PVT points are executed. The PVT buffer is of type FIFO (first in, first out). The default length of the PVT buffer is 7 PVT points. Each entry in the buffer is made up of 9 words, so the default length of the PVT buffer in terms of how much memory space is reserved is 63 (3Fh) words. The drive/motor automatically sends messages to the host when the buffer is full, low or empty. The messages contain the PVT status (TML variable **PVTSTS**). The buffer full condition occurs when the number of PVT points in the buffer is equal with the buffer size. The buffer low condition occurs when the number of PVT points in the buffer is less or equal with a programmable value. The level for BufferLow signaling is updated when **Change Low Level = YES** with the value of parameter **Low Level Value**. The buffer empty condition occurs when the buffer is empty and the execution of the last PVT point is over.

When the PVT buffer becomes empty the drive/motor:

- Remains in PVT mode if the velocity of last PVT point executed is zero and waits for new points to receive
- Enters in quick stop mode if the velocity of last PVT point executed is not zero

Therefore, a correct PVT sequence must always end with a last PVT point having velocity zero.

Remarks:

1. *The PVT and PT modes share the same buffer. Therefore the TML parameters and variables associated with the buffer management are the same.*
2. *Both the PVT buffer size and its start address are programmable via TML parameters (int@0x0864) and PVTBUFLEN (int@0x0865). Therefore if needed, the PVT buffer size can be substantially increased. Use TS_SetIntegerVariable.vi to change the PVT buffer parameters.*

Each PVT point also includes a 7-bit integrity counter. The integrity counter value must be incremented by the host by one, each time a new PVT point is sent to the drive/motor. If the integrity counter error checking is activated (**Integrity Checking = YES)**, the drive compares its integrity counter value with the one sent with the PVT point. This comparison is done every time a PVT point is received. If the values of the two integrity counters do not match, the integrity check error is triggered, the drive/motor sends messages with PVTSTS to the host and the received PVT point is discarded. Each time a PVT point is accepted (the integrity counters match or the integrity counter error checking is disabled), the drive automatically increments its internal integrity counter.

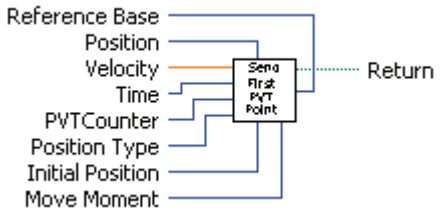
The default value of the internal integrity counter after power up is 0. Set **Change PVT Counter = YES** to change its value with **PVT Counter Value** parameter. The integrity counter checking is disabled when parameter **Integrity Checking = NO**.

Related functions: TS_SendPVTFirstPoint.vi, TS_SendPVTPoint.vi

Associated examples: –

3.4.1.12 TS_SendPVTFirstPoint.vi

Symbol:



Prototype:

LONG _TS_SendPVTFirstPoint@36(LONG Position, DOUBLE Velocity, WORD Time, SHORT INT PVT Counter, SHORT INT PositionType, LONG InitialPosition, SHORT INT Move Moment, SHORT INT Reference Base);

Parameters:

	Name	Description
Input	Position	Position value for first PVT point expressed in drive/motor internal position units
	Velocity	Speed at the end of the first PVT segment expressed in drive/motor internal speed units
	Time	Represents the time interval of the PVT segment expressed in drive/motor internal time units. The maximum time interval is 511 IU.
	PVT Counter	Integrity counter for first PVT point.
	Position Type	Specifies the type of PVT mode
	Initial Position	The initial position at the start of an absolute PVT movement
	Move Moment	Defines the moment when the motion is started
	Reference Base	Specifies how the motion reference is computed: from actual values of position and speed reference or from actual values of load/motor position and speed
Output	return	TRUE if no error, FALSE if error

Description: The function sends the first PVT point and activates the PVT motion mode.

Parameter **Position Type** sets the PVT mode: absolute or relative. In the absolute mode (**Position Type = ABSOLUTE_POSITION**), each PVT point specifies the position to reach. The initial position may be either the current position reference TML variable TPOS or a preset value read from the TML parameter PVTPOS0. In the relative mode (**Position Type = RELATIVE_POSITION**), each PVT point specifies the position increment relative to the previous point.

Remark: *The source for initial position, TPOS or PVTPOS0, is set with function TS_PVTSetup.vi.*

The motion is executed:

- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of

the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

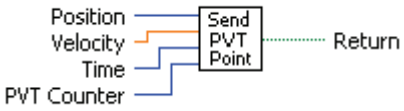
Set **Reference Base** = **FROM_REFERENCE** if you want the reference generator to compute the motion profile starting from the actual values of the position and speed reference. Set **Reference Base** = **FROM_MEASURE** if you want the reference generator to compute the motion profile starting from the actual values of the load/motor position and speed. When this option is used, at the beginning of each new motion profile, the position and speed reference are updated with the actual values of the load/motor position and speed.

Related functions: TS_PVTSetup.vi, TS_SendPVTPoint.vi

Associated examples: –

3.4.1.13 TS_SendPVTPoint.vi

Symbol:



Prototype:

LONG _TS_SendPVTPoint(LONG Position, DOUBLE Velocity, WORD Time, SHORT INT PVT Counter);

Parameters:

	Name	Description
Input	Position	Position at the end of the PVT segment expressed in TML position units
	Velocity	Velocity at the end of the PVT segment expressed in TML speed units
	Time	Time interval for the current PVT segment expressed in TML time units
	PVT Counter	The integrity counter for the current PVT point
Output	return	TRUE if no error, FALSE if error

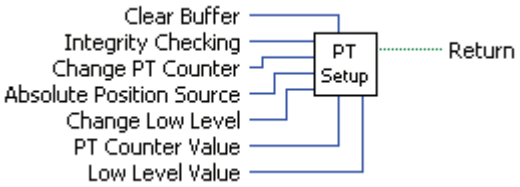
Description: The function sends a PVT point to the drive/motor. Each point specifies the desired **Position**, **Velocity** and **Time**, i.e. contains a **PVT** data. Between the PVT points the reference generator performs a 3rd order interpolation. The PVT point also includes a 7-bit integrity counter read from **PVT Counter**. The integrity counter value must be incremented by the host by one, each time a new PVT point is sent to the drive/motor.

Related functions: TS_PVTSetup.vi, TS_SendPVTFirstPoint.vi

Associated examples: –

3.4.1.14 TS_PTSetup.vi

Symbol:



Prototype:

LONG _TS_PTSetup@28(SHORT INT Clear Buffer, SHORT INT Integrity Checking, SHORT INT Change PT Counter, SHORT INT Absolute Position Source, SHORT INT Change Low Level, SHORT INT PT Counter Value, SHORT INT Low Level Value);

Parameters:

	Name	Description
Input	Clear Buffer	When TRUE the PT buffer is cleared
	Integrity Checking	Enable/disable PT counter integrity checking
	Change PT Counter	Specifies if the integrity counter is updated with the value of PT Counter Value parameter
	Absolute Position Source	Selects the source for initial position for absolute PVT mode
	Change Low Level	Specifies if the level for BufferLow signaling is updated with the value of LowLevelValue parameter
	PT Counter Value	The new value for the drive/motor PVT integrity counter
	Low Level Value	The new value for the level of the BufferLow signal
Output	Return	TRUE if no error, FALSE if error

Description: The function programs a drive/motor to work in PT motion mode. In PT motion mode the drive/motor performs a positioning path described through a series of points. Each point specifies the desired **P**osition and **T**ime, i.e. contains a PT data. Between the points the built-in reference generator performs a linear interpolation.

Remark: *The function block just programs the drive/motor for PT mode. The motion mode is activated with function TS_SendPTFirstPoint.vi and the PT points are sent to the drive with function TS_SendPTPoint.vi.*

The PT motion mode can be started only when the previous motion is complete. However, you can switch at any moment to another motion mode.

The PT mode can be relative or absolute. In the absolute mode, each PT point specifies the position to reach. The initial position may be either the current position reference TML variable TPOS (**Absolute Position Source = 1**) or a preset value read from the TML parameter PVTPOS0 (**Absolute Position Source = 0**). In the relative mode, each PT point specifies the position increment relative to the previous point. In both cases, the time is relative to the previous point i.e. represents the duration of a PT segment. For the first PT point, the time is measured from the starting of the PT mode.

Remark: *The PT mode, absolute or relative, is set with function TS_SendPTFirstPoint.vi.*

Each time when the drive receives a new PT point, it is saved into the PT buffer. The reference generator empties the buffer as the PT points are executed. The PT buffer is of type FIFO (first in, first out). The default length of the PT buffer is 7 PT points. Each entry in the buffer is made up of 9 words, so the default length of the PVT buffer in terms of how much memory space is reserved is 63 (3Fh) words. The drive/motor automatically sends messages to the host when the buffer is full, low or empty. The messages contain the PVT status (TML variable **PVTSTS**). The buffer full condition occurs when the number of PVT points in the buffer is equal with the buffer size. The buffer low condition occurs when the number of PVT points in the buffer is less or equal with a programmable value. Set **Change Low Level = YES** to change the level for BufferLow signaling with the value of parameter **Low Level Value**. The buffer empty condition occurs when the buffer is empty and the execution of the last PT point is over. When the PT buffer becomes empty the drive/motor keeps the position reference unchanged.

Remarks:

3. *The PT and PVT modes share the same buffer. Therefore the TML parameters and variables associated with the buffer management are the same.*
4. *Both the PT buffer size and its start address are programmable via TML parameters (int@0x0864) and PVTBUFLEN (int@0x0865). Therefore if needed, the PT buffer size can be substantially increased. Use TS_SetIntegerVariable.vi to change the PT buffer parameters.*

Each PT point also includes a 7-bit integrity counter. The integrity counter value must be incremented by the host by one, each time a new PT point is sent to the drive/motor. If the integrity counter error checking is activated (**Integrity Checking = YES)**, the drive compares its integrity counter value with the one sent with the PT point. This comparison is done every time a PT point is received. If the values of the two integrity counters do not match, the integrity check error is triggered, the drive/motor sends messages with PVTSTS to the host and the received PT point is discarded. Each time a PT point is accepted (the integrity counters match or the integrity counter error checking is disabled), the drive automatically increments its internal integrity counter.

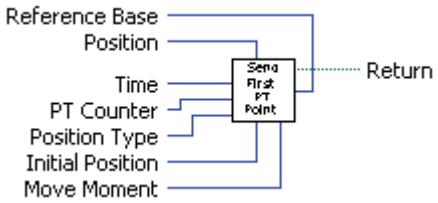
The default value of the internal integrity counter after power up is 0. Set **Change PT Counter = YES** to change the value of integrity counter with **PT Counter Value** parameter. The integrity counter checking is disabled when parameter **Integrity Checking = NO**.

Related functions: TS_SendPTFirstPoint.vi, TS_SendPTPoint.vi

Associated examples: –

3.4.1.15 TS_SendPTFirstPoint.vi

Symbol:



Prototype:

LONG _TS_SendPTFirstPoint@28(LONG Position, WORD Time, SHORT PT Counter, SHORT Position Type, LONG Initial Position, SHORT Move Moment SHORT Reference Base);

Arguments:

	Name	Description
Input	Position	Position value for first PT point expressed in TML position units
	Time	Time interval of the PT segment expressed in TML time units.
	PT Counter	Integrity counter for first PT point.
	Position Type	Specifies the type of PT mode
	Initial Position	The initial position at the start of an absolute PT movement
	Move Moment	Defines the moment when the motion is started
	Reference Base	Specifies how the motion reference is computed: from actual values of position and speed reference or from actual values of load/motor position and speed
Output	Return	TRUE if no error, FALSE if error

Description: The function sends the first PT point and activates the PT motion mode.

Parameter **Position Type** sets the PT mode: absolute or relative. In the absolute mode (**Position Type = ABSOLUTE_POSITION**), each PT point specifies the position to reach. The initial position may be either the current position reference TML variable TPOS or a preset value read from the TML parameter PVTPOS0. In the relative mode (**Position Type = RELATIVE_POSITION**), each PT point specifies the position increment relative to the previous point.

Remark: *The initial position source, TPOS or PVTPOS0, is set with function TS_PTSetup.vi.*

The motion is executed:

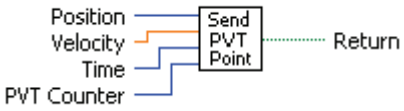
- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate** or the **TS_UpdateOnEvent** functions in order to activate the movement.

Related functions: TS_PTSetup.vi, TS_SendPTPoint.vi

Associated examples: –

3.4.1.16 TS_SendPTPoint.vi

Symbol:



Prototype:

LONG _TS_SendPTPoint@12(LONG Position, UNSIGNED SHORT INT Time, SHORT INT PT Counter);

Parameters:

	Name	Description
Input	Position	Position at the end of the PT segment expressed in TML position units
	Time	Time interval for the current PT segment expressed in TML time units
	PT Counter	The integrity counter for the current PT point
Output	return	TRUE if no error, FALSE if error

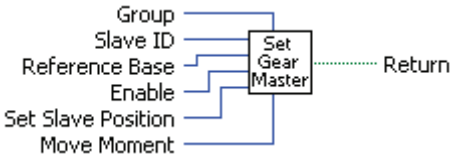
Description: The function sends a PT point to the drive/motor. Each point specifies the desired **Position**, and **Time**. Between the PT points the reference generator performs a linear interpolation. The PT point also includes a 7-bit integrity counter read from parameter **PT Counter**. The integrity counter value must be incremented by the host by one, each time a new PT point is sent to the drive/motor.

Related functions: TS_PTSetup.vi, TS_SendPTFirstPoint.vi

Associated examples: –

3.4.1.17 TS_SetGearingMaster.vi

Symbol:



Prototype:

LONG _TS_SetGearingMaster@24(SHORT INT Group, UNSIGNED CHAR Slave ID, SHORT INT Reference Base, SHORT INT Enable, UNSIGNED CHAR Set Slave Pos, SHORT INT Move Moment);

Parameters:

	Name	Description
Input	Group	Specifies if the master sends its position to one slave or a group of slaves
	Slave ID	The axis ID of the slave or group ID of group of slaves
	Reference Base	Specifies if the master sends its load position or its position reference
	Enable	Enable/disables the master in electronic gearing
	Set Slave Pos	Specify if the master is initializing the slave(s)
	Move Moment	Defines the moment when the settings are activated
Output	Return	TRUE if no error, FALSE if error

Description: The function programs the active axis as master in electronic gearing. Once at each slow loop sampling time interval, the master sends either its load position APOS (**Reference Base = FROM_MEASURE**) or its position reference TPOS (**Reference Base = FROM_REFERENCE**) to the axis or the group of axes specified in the parameter **Slave ID**.

Remark: *The Reference Base = FROM_MEASURE option is not valid if the master operates in open loop. It is meaningless if the master drive has no position sensor.*

The **Slave ID** is interpreted either as the Axis ID of one slave (**Group = NO**) or the value of a Group ID i.e. the group of slaves to which the master should send its data (**Group = YES**).

The master operation is enabled with **Enable = ENABLE** and is disabled when **Enable = DISABLE**. In both cases, these operations have no effect on the motion executed by the master.

If the master activation is done AFTER the slaves are set in electronic gearing mode, set **Set Slave Pos = INITIALIZE** to determine the master to send an initialization message to the slaves.

The commands are executed:

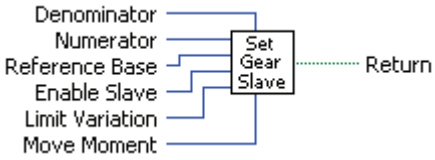
- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Related functions: TS_SetGearingSlave, TS_SendSynchronization

Associated examples: Example 31

3.4.1.18 TS_SetGearingSlave.vi

Symbol:



Prototype:

LONG _TS_SetGearingSlave@28(SHORT INT Denominator, SHORT INT Numerator, SHORT INT Reference Base, SHORT INT Enable, DOUBLE Limit Variation, SHORT INT Move Moment);

Parameters:

	Name	Description
Input	Denominator	Gear ratio denominator (always positive)
	Numerator	Gear ratio numerator (positive or negative)
	Reference Base	Specifies how the motion reference is computed: from actual values of position and speed reference or from actual values of load/motor position and speed
	Enable Slave	Enables the electronic gearing slave mode
	Enable Superposition	Enables/disables motion superposition
	Limit Variation	Acceleration limit when the slave is coupling
	Move Moment	Defines the moment when the settings are activated
Output	return	TRUE if no error, FALSE if error

Description: The function programs the active axis to operate as slave in electronic gearing. In electronic gearing slave mode the drive/motor performs a position control. At each slow loop sampling period, the slave computes the master's position increment and multiplies it with its programmed gear ratio. The result is the slave's position reference increment, which added to the previous slave position reference gives the new slave position reference.

The gear ratio is the result of the division **Numerator** / **Denominator**. **Numerator** is a signed integer, while the **Denominator** is unsigned integer. The **Numerator** sign indicates the direction of movement: positive – same as the master, negative – reversed to the master. **Numerator** and **Denominator** are used by an automatic compensation procedure that eliminates the round off errors, which occur when the gear ratio is an irrational number like: 1/3 (Slave = 1, Master = 3).

The slave can get the master position in two ways:

1. Via a communication channel (**Enable Slave = SLAVE_COMMUNICATION_CHANNEL**), from a drive/motor set as master with function block TS_SetGearingMaster
2. Via an external digital reference of type pulse & direction or quadrature encoder (**Enable Slave = SLAVE_2ND_ENCODER**)

Remark: *Set* ***Enable Slave = SLAVE_NONE*** *if you want to program the motion mode parameters without enabling it.*

When master position is provided via the external digital interface, the slave computes the master position by counting the pulse & direction or quadrature encoder signals. The initial value of the master position is set by default to 0. Use function TS_SetLongVariable to change its value by writing the desired value in the TML variable APOS2.

You can smooth the slave coupling with the master, by limiting the maximum acceleration on the slave. This is particularly useful when the slave must couple with a master running at high speed. This feature is activated when the parameter **Limit Value** has a positive value and disabled when its value is zero.

Set **Reference Base** = **FROM_REFERENCE** if you want the reference generator to compute the slave position starting from the actual values of the position and speed reference. Set **Reference Base** = **FROM_MEASURE** if you want the reference generator to compute the slave position starting from the actual values of the load/motor position and speed. When this option is used, at the beginning of each new motion profile, the position and speed reference are updated with the actual values of the load/motor position and speed.

Remarks:

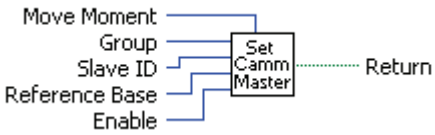
1. *The function requires drive/motor position loop to be closed. During the drive/motor setup select **Position** at Control Mode and perform the position controller tuning.*
2. *Use function block **TS_SetGearingMaster.vi** to program a drive/motor as master in electronic gearing*
3. *When the reference is read from second encoder or pulse & direction inputs you don't need to program a drive/motor as master in electronic gearing*

Related functions: TS_SetGearingMaster.vi, TS_SetMasterResolution.vi

Associated examples: Example 31

3.4.1.19 TS_SetCammingMaster.vi

Symbol:



Prototype:

LONG _TS_SetCammingMaster@20(SHOT INT Group, UNSIGNED CHAR Slave ID, SHORT INT Reference Base, SHORT INT Enable, SHORT INT Move Moment);

Parameters:

	Name	Description
Input	Group	Specifies if the master sends its position to one slave or a group of slaves
	Slave ID	The axis ID of the slave or group ID of group of slaves
	Reference Base	Specifies if the master sends its load position or its position reference
	Enable	Enable/disables the master in electronic camming
	Move Moment	Defines the moment when the settings are activated
Output	Return	TRUE if no error, FALSE if error

Description: The function programs the active axis as master in electronic camming. Once at each slow loop sampling time interval, the master sends either its load position APOS (**Reference Base = FROM_MEASURE**) or its position reference TPOS (**Reference Base = FROM_REFERENCE**) to the axis or the group of axes specified in the parameter **Slave ID**.

Remark: *The Reference Base = FROM_MEASURE option is not valid if the master operates in open loop. It is meaningless if the master drive has no position sensor.*

The **SlaveID** is interpreted either as the Axis ID of one slave (**Group = SET_SLAVE**) or the value of a Group ID i.e. the group of slaves to which the master should send its data (**Group = SET_GROUP**).

The master operation is enabled with **Enable = ENABLE** and is disabled when **Enable = DISABLE**. In both cases, these operations have no effect on the motion executed by the master.

The commands are executed:

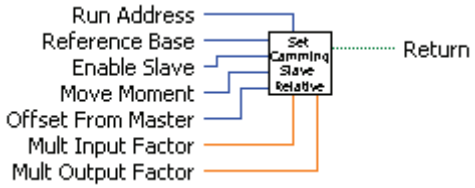
- Immediately when **Move Moment** = **UPDATE_IMMEDIATE**
- When a programmed event occurs if **Move Moment** = **UPDATE_ON_EVENT**
- If you select **Move Moment** = **UPDATE_NONE**, the movement is parameterized, but does not execute. You'll need to issue an update command to determine the execution of the movement. Use the **TS_UpdateImmediate.vi** or the **TS_UpdateOnEvent.vi** functions in order to activate the movement.

Related functions: TS_CamDownload.vi, TS_CamInitialization.vi
TS_SetCammingSlaveRelative.vi, TS_SetCammingSlaveAbsolute.vi,
TS_SendSynchronization.vi

Associated examples: Example 32

3.4.1.20 TS_SetCammingSlaveRelative.vi

Symbol:



Prototype:

LONG _TS_SetCammingSlaveRelative@36(UNSIGNED SHORT INT RunAddress, SHORT INT Reference Base, SHORT INT Enable Slave, SHORT INT Move Moment, LONG Offset From Master, DOUBLE Mult Input Factor, DOUBLE Mult Output Factor);

Parameters:

	Name	Description
Input	Run Address	Drive/motor RAM address where the cam table is copied with function TS_CamInitialization
	Reference Base	Specifies how the motion reference is computed: from actual values of position and speed reference or from actual values of load/motor position and speed
	Enable Slave	Enable the electronic camming slave mode
	Move Moment	Defines the moment when the settings are activated
	Offset From Master	Cam table offset expressed in TML position units
	Mult Input Factor	CAM table input scaling factor
	Mult Output Factor	CAM table output scaling factor
Output	Return	TRUE if no error, FALSE if error

Description: The function block programs the active axis to operate as slave in electronic camming relative mode. The slave drive/motor executes a cam profile function of the master drive/motor position. The cam profile is defined by a cam table – a set of (X, Y) points, where X is cam table input i.e. the master position and Y is the cam table output i.e. the corresponding slave position. Between the points the drive/motor performs a linear interpolation. In electronic camming relative mode the output of the cam table is added to the slave actual position.

The cam tables are previously stored in drive/motor EEPROM memory with function **TS_CamDownload.vi**. After download, previously starting the camming slave, you have to initialize the cam table, i.e. to copy it from EEPROM memory to RAM memory. Use function **TS_CamInitialization.vi** to initialize a cam table. The active cam table is selected through parameter **Run Address**. The **Run Address** must contain the drive/motor RAM address where the cam table was copied.

The slave can get the master position in two ways:

1. Via a communication channel (**Enable Slave = SLAVE_COMM_CH**), from a drive/motor set as master with function block TS_SetGearingMaster
2. Via an external digital reference of type pulse & direction or quadrature encoder (**Enable Slave = SLAVE_2ND_ENCODER**)

Remark:

1. *Set **Enable Slave = SLAVE_NONE** if you want to program the motion mode parameters without enabling it.*
2. *Use function block **TS_SetCammingMaster.vi** to program a drive/motor as master in electronic camming. When the reference is read from second encoder or pulse & direction inputs you don't need to program a drive/motor as master in electronic camming*

When master position is provided via the external digital interface, the slave computes the master position by counting the pulse & direction or quadrature encoder signals. The initial value of the master position is set by default to 0. Use function block TS_SetLongVariable to change its value by writing the desired value in the TML variable APOS2.

With parameter **Offset From Master** you can shift the cam profile versus the master position, by setting an offset for the slave. The cam table input is computed as the master position minus the cam offset. For example, if a cam table is defined between angles 100 to 250 degrees, a cam offset of 50 degrees will make the cam table to execute between master angles 150 and 300 degrees.

You can compress/extend the cam table input. Set the parameter **Mult Input Factor** with the correction factor by which the cam table input is multiplied. For example, an input correction factor of 2, combined with a cam offset of 180 degrees, will make possible to execute a cam table defined for 360 degrees of the master in the last 180 degrees.

You can also compress/extend the cam table output. Specify through input **Mult Output Factor** the correction factor by which the cam table output is multiplied. This feature addresses the applications where the slaves must execute different position commands at each master cycle, all having the same profile defined through a cam table. In this case, the drive/motor is programmed with a unique normalized cam profile and the cam table output is multiplied with the relative position command updated at each master cycle.

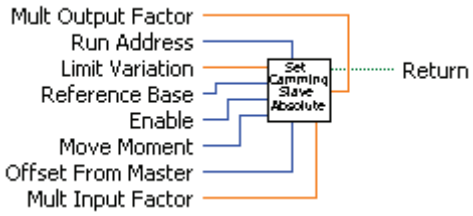
If you intend to use the default or previously defined values for the **Mult Input Factor**, **Mult Output Factor** and/or **Offset From Master**, you don't need to send their values. Set to zero their values if you want the drive/motor to use the values previously defined with other commands (this option reduces the TML code generated by this function).

Related functions: TS_CamDownload.vi, TS_CamInitialization.vi, TS_SetCammingSlaveAbsolute.vi, TS_SetCammingMaster.vi, TS_SetMasterResolution.vi

Associated examples: Example 32

3.4.1.21 TS_SetCammingSlaveAbsolute.vi

Symbol:



Prototype:

LONG _TS_SetCammingSlaveAbsolute@44(UNSIGNED SHORT INT Run Address, DOUBLE Limit Variation, SHORT INT Reference Base, SHORT INT Enable Slave, SHORT INT Move Moment, LONG Offset From Master, DOUBLE Mult Input Factor, DOUBLE Mult Output Factor);

Parameters:

	Name	Description
Input	Run Address	Drive/motor RAM address where the cam table is copied with function TS_CamInitialization
	Limit Variation	Slave speed limit value expressed in TML speed units
	Reference Base	Specifies how the motion reference is computed: from actual values of position and speed reference or from actual values of load/motor position and speed
	Enable Slave	Enable the electronic camming slave mode
	Move Moment	Defines the moment when the settings are activated
	Offset From Master	Cam table offset expressed in TML position units
	Mult Input Factor	CAM table input scaling factor
	Mult Output Factor	CAM table output scaling factor
Output	Return	TRUE if no error, FALSE if error

Description: The function block programs the active axis to operate as slave in electronic camming absolute mode. The slave drive/motor executes a cam profile function of the master drive/motor position. The cam profile is defined by a cam table – a set of (X, Y) points, where X is cam table input i.e. the master position and Y is the cam table output i.e. the corresponding slave position. Between the points the drive/motor performs a linear interpolation. In electronic camming absolute mode the output of the cam table represents the position to reach.

The electronic camming absolute mode may generate abrupt variations on the slave position reference, mainly at entry in the camming mode. Set parameter **Limit Variation** to limit the speed of the slave during travel towards the position to reach. The limitation is disabled if the **Limit Variation** is set to zero.

The cam tables are previously stored in drive/motor EEPROM memory with function TS_CamDownload.vi. After download, previously starting the camming slave, you have to initialize the cam table, i.e. to copy it from EEPROM memory to RAM memory. Use function TS_CamInitialization.vi to initialize a cam table. The active cam table is selected through

parameter **Run Address**. The **Run Address** must contain the drive/motor RAM address where the cam table was copied.

The slave can get the master position in two ways:

1. Via a communication channel (**Enable Slave = SLAVE_COMM_CH**), from a drive/motor set as master with function block TS_SetGearingMaster
2. Via an external digital reference of type pulse & direction or quadrature encoder (**Enable Slave = SLAVE_2ND_ENCODER**)

Remark:

1. *Set **Enable Slave = SLAVE_NONE** if you want to program the motion mode parameters without enabling it.*
2. *Use function block **TS_SetCammingMaster.vi** to program a drive/motor as master in electronic camming. When the reference is read from second encoder or pulse & direction inputs you don't need to program a drive/motor as master in electronic camming*

When master position is provided via the external digital interface, the slave computes the master position by counting the pulse & direction or quadrature encoder signals. The initial value of the master position is set by default to 0. Use function block TS_SetLongVariable to change its value by writing the desired value in the TML variable APOS2.

Set the parameter **Offset From Master** to shift the cam profile versus the master position, by setting an offset for the slave. The cam table input is computed as the master position minus the cam offset. For example, if a cam table is defined between angles 100 to 250 degrees, a cam offset of 50 degrees will make the cam table to execute between master angles 150 and 300 degrees.

You can compress/extend the cam table input. Set the parameter **Mult Input Factor** with the correction factor by which the cam table input is multiplied. For example, an input correction factor of 2, combined with a cam offset of 180 degrees, will make possible to execute a cam table defined for 360 degrees of the master in the last 180 degrees.

You can also compress/extend the cam table output. Specify through input **Mult Output Factor** the correction factor by which the cam table output is multiplied. This feature addresses the applications where the slaves must execute different position commands at each master cycle, all having the same profile defined through a cam table. In this case, the drive/motor is programmed with a unique normalized cam profile and the cam table output is multiplied with the relative position command updated at each master cycle.

***Remark:** If the Offset From Master, Mult Input Factor and/or Mult Output Factor are set to zero the drive/motor will use the value previously set for the parameter or the default value. With this option the TML code generated by this function is reduced.*

Related functions: TS_CamDownload.vi, TS_CamInitialization.vi, TS_SetCammingSlaveRelative.vi, TS_SetCammingMaster.vi, TS_SetMasterResolution.vi

Associated examples: –

3.4.1.22 TS_CamDownload.vi

Symbol:

Prototype:

LONG _TS_CamDownload@20(CSTR Cam File, UNSIGNED SHORT INT Load Address, UNSIGNED SHORT INT Run Address, UNSIGNED SHORT INT *Next Load Address, UNSIGNED SHORT INT *Next Load Address);

Parameters:

	Name	Description
Input	Cam File	The name of the file containing the cam table description
	Load Address	The EEPROM memory address where the cam table is downloaded
	Run Address	The RAM address where the cam table is copied at initialization
Output	Next Load Address	Next available EEPROM address from where a cam table can be downloaded
	Next Run Address	Next available RAM address where a cam table can be copied
	Return	TRUE if no error, FALSE if error

Description: The function downloads a cam table in the drive/motor EEPROM memory starting with address **Load Address**. The **Run Address** parameter is required to compute the **Next Run Address**. The function returns the next valid memory addresses for cam tables trough output parameters **Next Load Address** respectively **Next Run Address**. If the values returned by the function are 0 then there is no memory available.

The **Load Address** and **Run Address** for the **first** cam table downloaded are computed by **EasyMotion Studio** and displayed in the dialogue **Memory Settings**. To open the dialogue **Memory Settings** select the appropriate application and in **Application General Information** press the button **Memory Settings**. For the next cam tables, if available, the **Load Address** and **Run Address** are the values returned by the previous call function TS_CamDownload (parameters **Next Load Address** and **Next Run Address**).

The cam table description is read from the file **Cam File**. The file is generated from **EasyMotion Studio** and has the extension ***.cam**.

Steps to follow when using cam tables:

1. Create or import a cam table in **EasyMotion Studio**. The cam table is saved by EasyMotion Studio in the application's directory.
2. Download the cam table in the drive/motor EEPROM memory with **TS_CamDownload.vi**
3. Initialize the cam table with function **TS_CamInitialization.vi**
4. Program the drive/motor to operate as slave in electronic camming mode with **TS_SetCammingSlaveAbsolute.vi** or **TS_SetCammingSlaveRelative.vi**. Select the cam table used with the parameter RunAddress.

Related functions: TS_SetCammingSlaveRelative.vi, TS_SetCammingSlaveAbsolute.vi, TS_CamInitialization.vi

Associated examples: Example 32

3.4.1.23 TS_CamInitialization.vi

Symbol:

Prototype:

LONG _TS_CamInitialization(UNSIGNED SHORT INT Load Address, UNSIGNED SHORT INT Run Address);

Parameters:

	Name	Description
Input	Load Address	EEPROM memory address where the cam table is downloaded
	Run Address	RAM address where the cam table is copied at run time
Output	Return	TRUE if no error, FALSE if error

Description: The function copies a cam table from drive/motor EEPROM memory in the RAM memory at address **Run Address**. The cam table was previously downloaded with function **TS_CamDownload.vi** at EEPROM address **Load Address**.

The function must be called for each cam table used by the application.

Related functions: TS_SetCammingSlaveRelative.vi, TS_SetCammingSlaveAbsolute.vi, TS_CamDownload.vi

Associated examples: Example 32

3.4.1.24 TS_SetMasterResolution

Symbol:

Prototype:

LONG _TS_SetMasterResolution@4(LONG Master Resolution);

Parameters:

	Name	Description
Input	Master Resolution	Number of encoder counts per one revolution of the master position sensor.
Output	Return	TRUE if no error, FALSE if error

Description: The function sets the TML parameter **MASTERRES** with the value **Master Resolution**.

The master resolution is needed by the electronic gearing or camming slaves to compute correctly the master position and speed (i.e. the position increment). If master position is not cyclic (i.e. the resolution is equal with the whole 32-bit range of position), set master resolution to **FULL_RANGE**.

Remark: *Call function **TS_SetMasterResolution.vi** before activating the electronic gearing or camming slave mode with function **TS_SetGearingSlave.vi** respectively **TS_SetCammingSlaveAbsolute/Relative.vi**.*

Related functions: TS_SetGearingSlave.vi, TS_SetCammingSlaveAbsolute.vi, TS_SetCammingSlaveRelative.vi

Associated examples: Example 32

3.4.1.25 TS_SendSynchronization

Symbol:

Prototype:

LONG _TS_SendSynchronization@4(LONG Period);

Parameters:

	Name	Description
Input	Period	Time period between two synchronization messages. It is expressed in drive/motor internal time units
Output	return	TRUE if no error, FALSE if error

Description: The function enables/disables the synchronization procedure between axes. The synchronization process is activated when the parameter **Period** has a non-zero value. The active axis is set as the synchronization master and the other axes become synchronization slaves. To disable the synchronization procedure set the **Period** to zero.

The synchronization process is performed in two steps. First, the master sends a synchronization message to all axes, including to itself. When this message is received, all the axes read their own internal time. Next, the master sends its internal time to all the slaves, which compare it with their own internal time. If there are differences, the slaves correct slightly their sampling periods in order to keep them synchronized with those of the master. As effect, when synchronization procedure is active, the execution of the control loops on the slaves is synchronized with those of the master within a 10µs time interval. Due to this powerful feature, drifts between master and slave axes are eliminated. The **Period** represents the time interval in internal units between the synchronization messages sent by the master. Recommended value is 20ms.

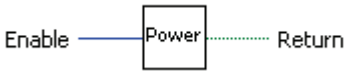
Related functions: TS_SetGearingMaster.vi, TS_SetGearingSlave.vi, TS_SetCammingMaster.vi, TS_SetCammingSlave.vi

Associated examples: –

3.4.2 Motor commands

3.4.2.1 TS_Power.vi

Symbol:



Prototype:

LONG _TS_Power@4(SHORT INT Enable);

Parameters:

	Name	Description
Input	Enable	Enables/disables the power stage of the active axis
Output	return	TRUE if no error; FALSE if error

Description: The function enables/disables the power stage of the active axis. If **Enable = POWER_ON** the power stage is enabled (executes the TML command **AxisON**). The power stage is disabled (executes the TML command **AxisOFF**) when **Enable = POWER_OFF**.

Related functions: TS_ResetFault.vi, TS_Reset.vi

Associated examples: all examples

3.4.2.2 TS_UpdateImmediate.vi

Symbol:

Prototype:

LONG _TS_UpdateImmediate@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	TRUE if no error, FALSE if error

Description: The function updates the motion mode immediately. It allows you to start a motion previously programmed. This can be useful for example if you already defined a motion and you want to start it in a specific context (after testing a condition, event, input port, etc.). The command can also be useful to repeat the last motion that was already defined and eventually executed (as for example a relative move).

Related functions: TS_UpdateOnEvent.vi

Associated examples: Example 5, Example 19

3.4.2.3 TS_UpdateOnEvent.vi

Symbol:

Prototype:

LONG _TS_UpdateOnEvent@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	TRUE if no error, FALSE if error

Description: The function updates the motion mode on next event occurrence. It allows you to start a motion that was previously programmed at the occurrence of the active event. This can be useful for example if you already defined a motion and you want to start it when an event occurs. The command can also be used to repeat the last motion that was already defined and eventually executed (as for example a relative move), when the event will occur.

Related functions: TS_UpdateImmediate.vi

Associated examples: Example 6, Example 38

3.4.2.4 TS_Stop.vi

Symbol:

Prototype:

LONG _TS_Stop@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	TRUE if no error, FALSE if error

Description: The functions stops the motor with the deceleration rate set in TML parameter CACC. The drive/motor decelerates following a trapezoidal speed profile. If the function is called during the execution of an S-curve profile, the deceleration profile may be chosen between a trapezoidal or an S-curve profile. You can detect when the motor has stopped by setting a motion complete event with function **TS_SetEventOnMotionComplete.vi** and waiting until the event occurs (**Wait Event** = **WAIT_EVENT**). When the drive performs torque control the drive is set in torque external mode with current reference = 0.

Remarks:

- *In order to restart after a TS_Stop.vi call you need to set again the motion mode. This operation disables the stop mode and allows the motor to move*
- *When TS_Stop.vi is executed it will automatically stop any TML program execution, to avoid overwriting the command from the TML program*
- *During abrupt stops an important energy may be generated. If the power supply can't absorb the energy generated by the motor, it is necessary to foresee an adequate surge capacitor in parallel with the drive supply to limit the over voltage.*

Related functions: TS_QuickStopDecelerationRate.vi

Associated examples: Example 10, Example 13, Example 16, Example 18, Example 21, Example 22, Example 24, Example 25, Example 26, Example 27 Example 29, Example 30, Example 31, Example 32, Example 34, Example 40

3.4.2.5 TS_SetPosition.vi

Symbol:

Prototype:

LONG _TS_SetPosition@4(LONG Position);

Parameters:

	Name	Description
Input	Position	The value used to set the position, expressed in TML position units
Output	return	TRUE if no error, FALSE if error

Description: The function sets/changes the referential for position measurement by changing simultaneously the load position (TML variable APOS) and the target position values (TML variable APOS), while keeping the same position error. Future motion commands will then be related to the absolute value, as updated at this point to **Position**.

Related functions: –

Associated examples: Example 6, Example 12, Example 14, Example 28, Example 32, Example 35, Example 39

3.4.2.6 TS_SetTargetPositionToActual.vi

Symbol:

Prototype:

LONG _TS_SetTargetPositionToActual@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	TRUE if no error, FALSE if error

Description: The function sets the value of the target position (the position reference) to the value of the actual load position i.e. TPOS = APOS_LD. The command may be used in closed loop systems when the load/motor is still following a hard stop, to reposition the target position to the actual load position.

Remark: *The command is automatically done if the next motion mode is set with Reference Base = FROM_MEASURE. In this case the target position and speed are both updated with the actual values of the load position and respectively load speed: TPOS = APOS_LD and TSPD = ASPD_LD.*

Related functions: –

Associated examples: Example 28

3.4.2.7 TS_SetCurrent.vi

Symbol:

Prototype:

LONG _TS_SetCurrent@4(SHORT INT Current Value);

Parameters:

	Name	Description
Input	Current Value	Value at which the motor current reference is set expressed in drive/motor internal current units
Output	Return	TRUE if no error, FALSE if error

Description: The function sets the motor run current with **Current Value**. The run current is used by the drive to control the step motor in open loop.

Remark: *The command is valid only for configurations with step motor operating in open loop.*

Related functions: –

Associated examples: Example 8

3.4.2.8 TS_QuickStopDecelerationRate.vi

Symbol:

Prototype:

LONG _TS_QuickStopDecelerationRate@8(DOUBLE Deceleration);

Parameters:

	Name	Description
Input	Deceleration	The value written in TML parameter CDEC
Output	return	TRUE if no error, FALSE if error

Description: The function sets on the active axis the TML parameter **CDEC** with the value **Deceleration**. The drive/motor uses the deceleration rate when:

- The function TS_Stop is executed during a positioning set with TS_MoveSCurveRelative/Absolute and option **Deceleration Type = TRAPEZOIDAL_SPEED_PROFILE**
- Enters in **quick stop mode.** The drive enters in quick stop mode if an error requiring the immediate stop of the motion occurs (like triggering a limit switch or following a command error), the drive/motor enters automatically

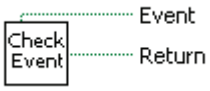
Related functions: TS_Stop.vi, TS_MoveSCurveRelative.vi, TS_MoveSCurveAbsolute.vi

Associated examples: Example 34

3.4.3 Events

3.4.3.1 TS_CheckEvent.vi

Symbol:



Prototype:

LONG _TS_CheckEvent@4(SHORT INT *event);

Parameters:

	Name	Description
Input	–	–
Output	Event	Signal if event occurred
	return	TRUE if no error, FALSE if error

Description: The function checks if the actually active event occurred. If an event was defined using one of the **SetEvent…** functions with **WaitEvent = NO_WAIT_EVENT** then you can check if the event occurred using the **TS_CheckEvent.vi** function.

This is an interesting alternative to the case when **WaitEvent** parameter was set to **WAIT_EVENT** in one of the **SetEvent…** functions. In that case, if the event will not occur, due to some unexpected problems, the program will hang-up in an internal loop of the **SetEvent…** function waiting for the event to occur.

Thus, in order to avoid such a problem, set the **WaitEvent** parameter to **NO_WAIT_EVENT**, in the **SetEvent…** function, and then call the **TS_CheckEvent.vi** function from your application. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

Related functions: all SetEvent… functions

Associated examples: Example 24, Example 27

3.4.3.2 TS_SetEventOnMotionComplete.vi

Symbol:

Prototype:

LONG _TS_SetEventOnMotionComplete@8(SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	On motion complete stop the motion
Output	return	TRUE if no error, FALSE if error

Description: The function sets an event when the motion is completed. You can use, for example, this event to start your next move only after the actual move is finalized.

The motion complete condition is set in the following conditions:

- During position control:
  - If UPGRADE.11=1, when the position reference arrives at the position to reach (commanded position) and the position error remains inside a settle band for a preset stabilize time interval. The settle band is set with TML parameter POSOKLIM and the stabilize time with TML parameter TONPOSOK. This is the default condition.
  - If UPGRADE.11=0, when the position reference arrives at the position to reach (commanded position)
- During speed control, when the speed reference arrives at the commanded speed

The motion complete condition is reset when a new motion is started i.e. when the update command – UPD is executed.

Remark:

1. *Use function TS_SetIntVariable.vi to change the settle band and/or the stabilize time.*
2. *In case of steppers controlled open-loop, the motion complete condition for positioning is always set when the position reference arrives at the position to reach independently of the UPGRADE.11 status.*

If the **Wait Event** = **WAIT_EVENT**, the function will continuously test the status of the drive event, and will wait until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnMotionComplete.vi** waiting for the event to occur.

If the parameter **Wait Event = NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

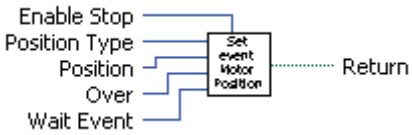
At event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 1, Example 2, Example 4, Example 7, Example 14, Example 20, Example 24, Example 28, Example 29, Example 31, Example 32, Example 33, Example 35, Example 37, Example 39, Example 40

3.4.3.3 TS_SetEventOnMotorPosition.vi

Symbol:



Prototype:

LONG _TS_SetEventOnMotorPosition@20(SHORT INT Position Type, LONG Position, SHORT INT Over, SHORT INT WaitEvent, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Position Type	Specifies the motor position type: absolute or relative
	Position	The position value that triggers the event expressed in TML position units.
	Over	Specifies the condition tested
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of motor position. The events can be: when the absolute (**Position Type** = **ABSOLUTE_POSITION)** or relative (**Position Type = ABSOLUTE_RELATIVE**) motor position is equal or over/under **Position**.

The absolute motor position is the measured position of the motor. The relative position is the load displacement from the beginning of the actual movement. For example if a position profile was started with the absolute load position 50 revolutions, when the absolute load position reaches 60 revolutions, the relative motor position is 10 revolutions.

The condition monitored for the event is set with parameter **Over.** For **Over = OVER** the event is set when the motor position is equal or over the **Position**. When **Over = BELOW** the event is set if the motor position becomes equal or under **Position**.

If the **Wait Event** = **WAIT_EVENT**, the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnMotorPosition.vi** waiting for the event to occur.

If the parameter **Wait Event = NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

At event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent, and all other SetEvent… functions

Associated examples: Example 11, Example 12, Example 14

3.4.3.4 TS_SetEventOnLoadPosition.vi

Symbol:

Prototype:

LONG _TS_SetEventOnLoadPosition@20(LONG Position, SHORT INT Over, SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Position Type	Specifies the load position type: absolute or relative
	Position	The position value that triggers the event expressed in TML position units.
	Over	Specifies the condition tested
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of load position. The events can be: when the absolute (**Position Type** = **ABSOLUTE_POSITION)** or relative (**Position Type = ABSOLUTE_RELATIVE**) load position is equal or over/under **Position**.

The absolute load position is the measured position of the load. The relative position is the load displacement from the beginning of the actual movement.

The condition monitored for the event is set with parameter **Over.** For **Over = OVER** the event is set when the load position is equal or over the **Position**. When **Over = BELOW** the event is set if the load position becomes equal or under **Position**.

If the **Wait Event** = **WAIT_EVENT**, the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnLoadPosition.vi** waiting for the event to occur.

If the parameter **Wait Event = NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

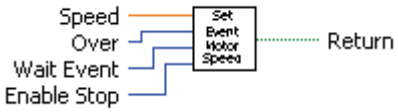
At event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 42

3.4.3.5 TS_SetEventOnMotorSpeed.vi

Symbol:



Prototype:

LONG _TS_SetEventOnMotorSpeed@20(DOUBLE Speed, SHORT INT Over, SHORT INT WaitEvent, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Speed	The speed value that triggers the event expressed in drive/motor internal speed units.
	Over	Specifies the condition tested
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	Return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of motor speed. The events can be: when the motor speed is over (**Over** = **OVER**) or under (**Over** = **BELOW**) the **Speed** parameter.

If the **Wait Event** = **WAIT_EVENT**, the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnMotionComplete.vi** waiting for the event to occur.

If the parameter **Wait Event = NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

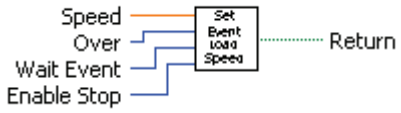
At event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 3, Example 6, Example 12

3.4.3.6 TS_SetEventOnLoadSpeed.vi

Symbol:



Prototype:

LONG _TS_SetEventOnLoadSpeed@20(DOUBLE Speed, SHORT INT Over, SHORT INT Wait Event, SHORT INT EnableStop);

Parameters:

	Name	Description
Input	Speed	The speed value that triggers the event expressed in drive/motor internal speed units.
	Over	Specifies the condition tested
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of load speed. The events can be: when the load speed is over (**Over** = **OVER**) or under (**Over** = **BELOW**) the **Speed** parameter.

If the **Wait Event** = **WAIT_EVENT**, the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnLoadSpeed.vi** waiting for the event to occur.

If the parameter **Wait Event = NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

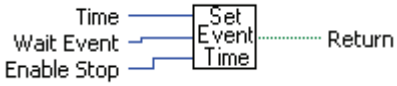
At event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 42

3.4.3.7 TS_SetEventOnTime.vi

Symbol:



Prototype:

LONG _TS_SetEventOnTime@12(UNSIGNED SHORT INT Time, SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Time	Time delay expressed in TML time units
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	On event stop the motion
Output	return	TRUE if no error, FALSE if error

Description: The function programs an event after a time period equal to the value of the **Time** parameter.

If the parameter **Wait Event** = **WAIT_EVENT** the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnTime.vi** function, waiting for the event to occur.

If the parameter **Wait Event** = **NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

At the event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Remark: *The timers start ONLY after the execution of the ENDINIT (end of initialization) command. Therefore you should not set wait events before executing this command.*

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 1, Example 2, Example 4, Example 7, Example 13, Example 17, Example 19

3.4.3.8 TS_SetEventOnPositionRef.vi

Symbol:

Prototype:

LONG _TS_SetEventOnPositionRef@16(LONG Position, SHORT INT Over, SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Position	The position reference value that triggers the event expressed in TML position units.
	Over	Specifies the condition tested
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of position reference. Setting this event you can detect when the position reference is over (**Over** = **OVER**) or under (**Over** = **BELOW**) the value of parameter **Position**.

If the parameter **Wait Event** = **WAIT_EVENT** the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnPositionRef.vi** function, waiting for the event to occur.

If the parameter **Wait Event** = **NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

At the event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 12, Example 32

3.4.3.9 TS_SetEventOnSpeedRef.vi

Symbol:

Prototype:

LONG _TS_SetEventOnSpeedRef@20(DOUBLE Speed, SHORT INT Over, SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Speed	The speed reference value that triggers the event expressed in TML speed units.
	Over	Specifies the condition tested
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	Return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of speed reference. Setting this event you can detect when the speed reference is over (**Over** = **OVER**) or under (**Over** = **BELOW**) the value of parameter **Speed**.

If the parameter **Wait Event** = **WAIT_EVENT** the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnSpeedRef.vi** function, waiting for the event to occur.

If the parameter **Wait Event** = **NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

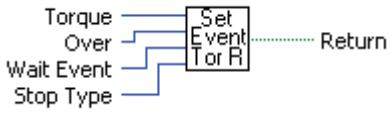
At the event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 12, Example 42

3.4.3.10 TS_SetEventOnTorqueRef.vi

Symbol:



Prototype:

LONG _TS_SetEventOnTorqueRef@16(SHORT INT Torque, SHORT INT Over, SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Torque	The torque reference value that triggers the event expressed in TML current units.
	Over	Specifies the condition tested
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	Return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of torque reference. Setting this event you can detect when the torque reference is over (**Over** = **OVER**) or under (**Over** = **BELOW**) the value of parameter **Torque**.

If the parameter **Wait Event** = **WAIT_EVENT** the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnTorqueRef.vi** function, waiting for the event to occur.

If the parameter **WaitEvent** = **NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

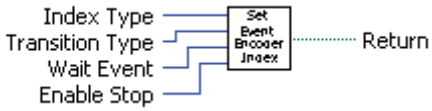
At the event occurrence the motion is stopped if the parameter **Enable Stop = STOP.** Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 23

3.4.3.11 TS_SetEventOnEncoderIndex.vi

Symbol:



Prototype:

LONG _TS_SetEventOnEncoderIndex@16(SHORT INT Index Type, SHORT INT Transition Type, SHORT INT WaitEvent, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Index Type	Specifies the index monitored for transition
	Transition Type	Specifies the input transition monitored
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	Return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of drive/motor encoder index inputs. You can monitor the first encoder index (**Index Type = Index_1**) or the second encoder index (**Index Type = Index_2**). The event is trigger by encoder index transition low to high when **Transition Type = TRANSITION_LOW_TO_HIGH** or by the transition high to low when **Transition Type = TRANSITION_ HIGH_TO_LOW.**

If the parameter **Wait Event** = **WAIT_EVENT** the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnEncoderIndex.vi** function, waiting for the event to occur.

If the parameter **WaitEvent** = **NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

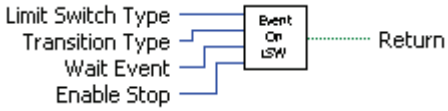
At the event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi, and all other SetEvent… functions

Associated examples: Example 27

3.4.3.12 TS_SetEventOnLimitSwitch.vi

Symbol:



Prototype:

LONG _TS_SetEventOnLimitSwitch@16(SHORT INT Limit Switch Type, SHORT INT Transition Type, SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Limit Switch Type	Specifies the limit switch monitored for transition
	Transition Type	Specifies the input transition monitored
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	Return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of drive/motor limit switch inputs. The event is set:

- when a transition occurs on limit switch negative if parameter **Limit Switch Type = LSW_NEGATIVE**
- when a transition occurs on limit switch negative if parameter **Limit Switch Type = LSW_POSITIVE**

You can monitor the limit switch transition low to high when **Transition Type = TRANSITION_LOW_TO_HIGH** or the transition high to low when **Transition Type = TRANSITION_ HIGH_TO_LOW.**

If the parameter **Wait Event** = **WAIT_EVENT** the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnLimitSwitch.vi** function, waiting for the event to occur.

If the parameter **Wait Event** = **NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

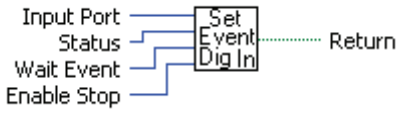
At the event occurrence the motion is stopped if the parameter **Enable Stop = TRUE.** Set **Enable Stop = FALSE** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi and all other SetEvent… functions

Associated examples: Example 9, Example 17

3.4.3.13 TS_SetEventOnDigitalInput.vi

Symbol:



Prototype:

LONG _TS_SetEventOnDigitalInput@16(UNSIGNED CHAR Input Port, UNSIGNED CHAR Status, SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Input Port	Specifies the digital input monitored
	Status	The input status that trigger the event
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	Return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of drive/motor general purpose digital inputs. The event is set when a transition occurs on digital input **Input Port**.

You can monitor when the digital input goes high (**Status = IO_HIGH)** or the digital input goes low (**Status = IO_LOW**).

If the parameter **Wait Event** = **WAIT_EVENT** the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnDigitalInput.vi** function, waiting for the event to occur.

If the parameter **WaitEvent** = **NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

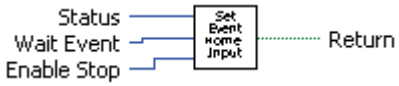
At the event occurrence the motion is stopped if the parameter **Enable Stop = STOP.** Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi and all other SetEvent… functions

Associated examples: Example 5, Example 8, Example 15

3.4.3.14 TS_SetEventOnHomeInput.vi

Symbol:



Prototype:

LONG _TS_SetEventOnHomeInput@12(UNSIGNED CHAR Status, SHORT INT Wait Event, SHORT INT Enable Stop);

Parameters:

	Name	Description
Input	Status	Input port status (High/low)
	Wait Event	Specifies if the function waits the event occurrence
	Enable Stop	Stop the motion when at event occurrence
Output	Return	TRUE if no error, FALSE if error

Description: It allows you to program an event function of drive/motor general purpose digital input assigned as home input. The home input is specific for each product and based on the setup data. The event is set when a transition occurs on home input.

You can monitor when the home input goes high (**Status = IO_HIGH**) or the home input goes low (**Status = IO_LOW**).

If the parameter **Wait Event** = **WAIT_EVENT** the function tests continuously the event status, and waits until the event occurs. There is a drawback of this situation, if the event will not occur, due to some unexpected problems. In such a case, the program hangs-up in an internal loop of the **TS_SetEventOnHomeInput.vi** function, waiting for the event to occur.

If the parameter **Wait Event** = **NO_WAIT_EVENT** you can check if the event occurred using the **TS_CheckEvent.vi** function. In this way, you can detect if the event does not occur and eventually exit from the test loop after a given time period.

At the event occurrence the motion is stopped if the parameter **Enable Stop = STOP**. Set **Enable Stop = NO_STOP** if you do not want to stop the motion at event occurrence.

Related functions: TS_CheckEvent.vi and all other SetEvent… functions

Associated examples: Example 28, Example 38 Example 39

3.4.4 TML jumps and function calls

3.4.4.1 TS_GOTO.vi

Symbol:

Prototype:

LONG _TS_GOTO@4(UNSIGNED SHORT INT address);

Parameters:

	Name	Description
Input	address	The memory address where the jump is made
Output	return	TRUE if no error, FALSE if error

Description: The function commands the active axis to execute the TML code beginning from the **address** until TML instruction **END** is encountered. The TML code can be stored in the drive/motor EEPROM memory or in the TML program memory.

Prior calling the **TS_GOTO.vi** function you have to:

- Create a TML sequence using **EasyMotion Studio**
- Download the TML code in the drive/motor memory with EasyMotion Studio or subVI TS_DownloadProgram.vi
- Make sure that a valid instruction is found at **address**. Otherwise, unpredictable effects can occur, which can affect the correct operation of the drive/motor.

Remark:

1. *For more details about drive/motor memory structure see the "Memory Map" topic from EasyMotion Studio help.*
2. *During the execution of a local TML program on the drive, any TML command sent on-line from the PC is treated with higher priority, and will be executed before executing the local TML code.*

Related functions: TS_DownloadProgram.vi, TS_GOTO_Label.vi, TS_CALL.vi, TS_CALL_Label.vi

Associated examples: Example 29, Example 30

3.4.4.2 TS_GOTO_Label.vi

Symbol:

Prototype:

LONG _TS_GOTO_Label@4(CSTR Label);

Parameters:

	Name	Description
Input	Label	TML program label where the jump is made
Output	return	TRUE if no error, FALSE if error

Description: The function commands the active axis to execute the TML code beginning from label **Label** until TML instruction **END** is encountered. The TML code can be stored in the drive/motor EEPROM memory or in the TML program memory. The selection of the memory type used for the program is done from Memory Settings.

The string **Label** must be a valid TML label, defined in EasyMotion Studio prior generating the setup information.

Prior calling the **TS_GOTO_Label.vi** function you have to:

- Create a TML sequence using **EasyMotion Studio**. The commands sequence must start with **Label** declaration.
- Select, in the **Memory Setting** dialogue, from where you want to run the TML program: TML program or EEPROM.
- Create the COFF file (***.out**) with the menu command **Application | Motion | Build**
- Generate the configuration setup with the menu command **Application | Export to TML_lib…** to include the new **Label** in the setup data
- Download the TML code in the drive/motor memory with EasyMotion Studio or with function **TS_DownloadProgram.vi**.

Remark:

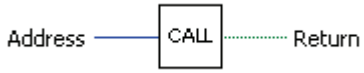
1. *For more details about drive/motor memory structure see the "Memory Map" topic from EasyMotion Studio help.*
2. *During the execution of a local TML program on the drive, any TML command sent on-line from the PC is treated with higher priority, and will be executed before executing the local TML code.*

Related functions: TS_DownloadProgram.vi, TS_GOTO_Label.vi, TS_CALL.vi, TS_CALL_Label.vi

Associated examples: Example 29

3.4.4.3 TS_CALL.vi

Symbol:



Prototype:

LONG _TS_CALL@4(UNSIGNED SHORT INT address);

Parameters:

	Name	Description
Input	address	The memory address where the jump is made
Output	return	TRUE if no error, FALSE if error

Description: The function commands the active axis to execute the TML function stored at **address**. The TML functions can be stored in the drive/motor EEPROM memory or in the TML program memory. The function execution ends when the TML instruction **RET** is encountered.

Prior using the **TS_CALL.vi** function you have to:

- Create at least one TML function using **EasyMotion Studio**
- Download the TML code in the drive/motor memory with EasyMotion Studio or function TS_DownloadProgram
- In the Command Interpreter type the command **?Function_name** to retrieve the function address. Repeat the procedure above for all the functions
- Make sure that a valid TML code subroutine begins at **address**. Otherwise, unpredictable effects can occur, which can affect the correct operation of the drive/motor.

Remark:

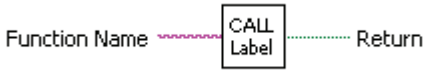
1. *For more details about drive/motor memory structure see the "Memory Map" topic from EasyMotion Studio help.*
2. *During the execution of a local TML program on the drive, any TML command sent on-line from the PC is treated with higher priority, and will be executed before executing the local TML code.*

Related functions: TS_DownloadProgram.vi, TS_CALL_Label.vi, TS_CancelableCALL.vi, TS_CancelableCALL_Label.vi

Associated examples: Example 30

3.4.4.4 TS_CALL_Label.vi

Symbol:



Prototype:

LONG _TS_CALL_Label@4(CSTR Function Name);

Arguments:

	Name	Description
Input	Function Name	Name of the TML function
Output	Return	TRUE if no error, FALSE if error

Description: The function commands the active axis to execute the TML function **Function Name**. The TML functions can be stored in the drive/motor EEPROM memory or in the TML program memory. The function execution ends when the TML instruction **RET** is encountered.

The string **Function Name** must be a valid TML function name, defined in EasyMotion Studio prior generating the setup information.

Prior using the **TS_CALL_Label.vi** function you have to:

- Create at least one TML function using **EasyMotion Studio**
- Generate the configuration setup
- Download the TML code in the drive/motor memory with EasyMotion Studio or function TS_DownloadProgram

Remark:

1. *For more details about drive/motor memory structure see the "Memory Map" topic from EasyMotion Studio help.*
2. *During the execution of a local TML program on the drive, any TML command sent on-line from the PC is treated with higher priority, and will be executed before executing the local TML code.*

Related functions: TS_DownloadProgram.vi, TS_CALL.vi, TS_CancelableCALL.vi, TS_CancelableCALL_Label.vi

Associated examples: Example 30

3.4.4.5 TS_CancelableCALL.vi

Symbol:

Prototype:

LONG _TS_CancelableCALL@4(UNSIGNED SHORT INT address);

Parameters:

	Name	Description
Input	address	Name of the TML function
Output	return	TRUE if no error, FALSE if error

Description: The function commands the active axis to execute the TML function stored at **address**. Use this command if the exit from the called TML function depends on conditions that may not be reached. In this case, using function **TS_Abort.vi** you can terminate the function execution and return to the next instruction after the call. The TML functions can be stored in the drive/motor EEPROM memory or in the TML program memory.

Prior using the **TS_CancelableCALL.vi** function you have to:

- Create at least one TML function using **EasyMotion Studio**
- Download the TML code in the drive/motor memory with EasyMotion Studio or function TS_DownloadProgram
- Make sure that a valid TML code subroutine begins at **address**. Otherwise, unpredictable effects can occur, which can affect to correct operation of the drive/motor.

Remark:

1. *You can call only one function at a time using the TS_CancelableCALL. Any cancelable call issued during the execution of a function called with TS_CancelableCALL is ignored. This situation is signaled with bit SRL.7.*
2. *For more details about drive/motor memory structure see the "Memory Map" topic from EasyMotion Studio help.*
3. *During the execution of a local TML program on the drive, any TML command sent on-line from the PC is treated with higher priority, and will be executed before executing the local TML code.*

Related functions: TS_DownloadProgram.vi, TS_CALL.vi, TS_CALL_Label.vi, TS_CancelableCALL_Label.vi

Associated examples: -

3.4.4.6 TS_CancelableCALL_Label.vi

Symbol:

Prototype:

LONG _TS_CancelableCALL_Label@4(CSTR Function Name);

Parameters:

	Name	Description
Input	Function Name	Name of the TML function
Output	return	TRUE if no error, FALSE if error

Description: The function commands the active axis to execute the TML function named **Function Name**. Use this command if the exit from the called TML function depends on conditions that may not be reached. In this case, using function **TS_Abort.vi** you can terminate the TML function execution and return to the next instruction after the call. The TML functions can be stored in the drive/motor EEPROM memory or in the TML program memory.

Prior using the **TS_CancelableCALL_Label.vi** function you have to:

- Create at least one TML function using **EasyMotion Studio**
- Select, in the **Memory Setting** dialogue, from where you want to run the TML program: TML program or EEPROM.
- Create the COFF file (***.out**) with the menu command **Application | Motion | Build**.
- Generate the configuration setup with the menu command **Application | Export to TML_lib…** to include the new **function names** in the setup data
- Download the TML code in the drive/motor memory with EasyMotion Studio or function **TS_DownloadProgram.vi**

Remark:

1. *You can call only one function at a time using the TS_CancelableCALL.vi. Any cancelable call issued during the execution of a function called with TS_CancelableCALL.vi is ignored. This situation is signaled with bit x from SRL.*
2. *For more details about drive/motor memory structure see the "Memory Map" topic from EasyMotion Studio help.*
3. *During the execution of a local TML program on the drive, any TML command sent on-line from the PC is treated with higher priority, and will be executed before executing the local TML code.*

Related functions: TS_DownloadProgram.vi, TS_CALL.vi, TS_CALL_Label.vi, TS_CancelableCALL .vi

Associated examples: Example 34

3.4.4.7 TS_ABORT.vi

Symbol:

Prototype:

LONG _TS_Abort@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	TRUE if no error, FALSE if error

Description: The function aborts the execution of a TML function launched with a cancelable call.

Related functions: TS_CancelableCALL.vi, TS_CancelableCALL_Label.vi

Associated examples: Example 34

3.4.5 IO handling

3.4.5.1 TS_SetupInput.vi

Symbol:

Prototype:

LONG _TS_SetupInput@4(UNSIGNED CHAR Port Number);

Parameters:

	Name	Description
Input	Port Number	Port number to be set as input
Output	return	TRUE if no error, FALSE if error

Description: The function sets the I/O **Port Number** of the drive/motor as an input port.

Use the function only if the input selected may also be used as an output. **Check the drive/motor user manual to find what inputs are available**. Do this operation only once, first time when you use the input. If the drive/motor has the inputs separated from the outputs (i.e. none of the input line can be used as output) you don't have to use the function.

Remark: *Depending on the firmware version programmed on the drive/motor, FAxx or FBxx, the digital inputs and outputs are numbered as follows:*

- *from #0 to #39 for firmware **FAxx**[1]. The list is unordered, for example, a product with 4 inputs and 4 outputs can use the inputs: #36, #37, #38 and #39 and the outputs #28, #29, #30 and #31.*
- *From 0 to 15 for firmware version **FBxx**[2]. The list is ordered, for example, a product with 5 inputs and 3 outputs can use the inputs: 0, 1, 2, 3 and 4 and the outputs 0, 1, and 2.*

Each intelligent drive/motor has a specific number of inputs and outputs, therefore only a part of the maximum number of I/Os is used.

Related functions: TS_GetInput.vi, TS_SetupOutput.vi, TS_SetOutput.vi

Associated examples: Example 5, Example 8, Example 10, Example 15, Example 16, Example 18, Example 30

[1] Represents the firmware versions: F000H, F020H, F005H, F900H or later programmed on Technosoft drives/motors: IDM240/IDM640, IDS240/IDS640, ISCM4805/ISCM8005, IBL2403, IM23x (models IS and MA)

[2] Represents the firmware versions F500A or later programmed on Technosoft drives: IDM240 CANopen/IDM640 CANopen, IDS640 CANopen

3.4.5.2 TS_GetInput.vi

Symbol:

Prototype:

LONG _TS_GetInput@4(UNSIGNED CHAR Port Number, UNSIGNED CHAR *In Value);

Parameters:

	Name	Description
Input	Port Number	Input port number read
	In Value	Pointer to the variable where the port status is stored
Output	return	TRUE if no error, FALSE if error

Description: The function returns the status of digital input **Port Number**. When the function is executed, the variable **In Value,** where the input line status is saved, becomes:

- Zero if the input line was low
- Non-zero if the input line was high

If the IO port selected can be used as input or an output, prior to call **TS_GetInput.vi**, you need to call **TS_SetupInput** and configure IO port as input. **Check the drive/motor user manual to find what inputs are available**.

Remark: *Depending on the firmware version programmed on the drive/motor, FAxx or FBxx, the digital inputs and outputs are numbered as follows:*

- *From #0 to #39 for firmware **FAxx**[1]. The list is unordered, for example, a product with 4 inputs and 4 outputs can use the inputs: #36, #37, #38 and #39 and the outputs #28, #29, #30 and #31.*
- *From 0 to 15 for firmware version **FBxx**[2]. The list is ordered, for example, a product with 5 inputs and 3 outputs can use the inputs: 0, 1, 2, 3 and 4 and the outputs 0, 1, and 2.*

Each intelligent drive/motor has a specific number of inputs and outputs, therefore only a part of the maximum number of I/Os is used.

Related functions: TS_SetupInput.vi, TS_SetupOutput.vi, TS_SetOutput.vi

Associated examples: Example 10, Example 15, Example 16, Example 18, Example 30

[1] Represents the firmware versions: F000H, F020H, F005H, F900H or later on Technosoft drives/motors: IDM240/IDM640, IDS240/IDS640, ISCM4805/ISCM8005, IBL2403, IM23x (models IS and MA)

[2] Represents the firmware versions F500A or later on Technosoft drives: IDM240 CANopen/IDM640 CANopen, IDS640 CANopen

3.4.5.3 TS_SetupOutput.vi

Symbol:

Prototype:

LONG _TS_SetupOutput@4(UNSIGNED CHAR Port Number);

Parameters:

	Name	Description
Input	Port Number	Port number to be set as output
Output	Return	TRUE if no error, FALSE if error

Description: The function configures the digital I/O port **Port Number** of the drive/motor as an output port.

Use the function only if the selected output may also be used as an input. **Check the drive/motor user manual to find what outputs are available.** Do this operation only once, first time when you use the output. If the drive/motor has the outputs separated from the inputs (i.e. none of the output line can be used as an input) you don't have to use the function.

Remark: *Depending on the firmware version programmed on the drive/motor, FAxx or FBxx, the digital inputs and outputs are numbered as follows:*

- *from #0 to #39 for firmware **FAxx**[1]. The list is unordered, for example, a product with 4 inputs and 4 outputs can use the inputs: #36, #37, #38 and #39 and the outputs #28, #29, #30 and #31*
- *From 0 to 15 for firmware version **FBxx**[2]. The list is ordered, for example, a product with 5 inputs and 3 outputs can use the inputs: 0, 1, 2, 3 and 4 and the outputs 0, 1, and 2.*

Each intelligent drive/motor has a specific number of inputs and outputs, therefore only a part of the maximum number of I/Os is used.

Related functions: TS_GetInput.vi, TS_SetupOutput.vi, TS_SetOutput.vi

Associated examples: Example 14

[1] Represents the firmware versions: F000H, F020H, F005H, F900H or later on Technosoft drives/motors: IDM240/IDM640, IDS240/IDS640, ISCM4805/ISCM8005, IBL2403, IM23x (models IS and MA)

[2] Represents the firmware versions F500A or later on Technosoft drives: IDM240 CANopen/IDM640 CANopen, IDS640 CANopen

3.4.5.4 TS_SetOutput.vi

Symbol:

Prototype:

LONG _TS_SetOutput@8(UNSIGNED CHAR Port Number, UNSIGNED CHAR Out Value);

Parameters:

	Name	Description
Input	Port Number	Output port number to be written
	Out Value	Output status value to be set
Output	return	TRUE if no error, FALSE if error

Description: The function set/resets the status of digital output port **Port Number** of the drive/motor.

The port status **IO_LOW** or **IO_HIGH** is set corresponding to the value of the **Out Value** parameter.

If the IO port selected may also be used as input or an output, prior to call **TS_SetOutput.vi**, you need to call **TS_SetupOutput.vi** and configure IO port as output.

Remark: *Depending on the firmware version programmed on the drive/motor, FAxx or FBxx, the digital inputs and outputs are numbered as follows:*

- *from #0 to #39 for firmware **FAxx**[1]. The list is unordered, for example, a product with 4 inputs and 4 outputs can use the inputs: #36, #37, #38 and #39 and the outputs #28, #29, #30 and #31*
- *From 0 to 15 for firmware version **FBxx**[2]. The list is ordered, for example, a product with 5 inputs and 3 outputs can use the inputs: 0, 1, 2, 3 and 4 and the outputs 0, 1 and 2.*

Each intelligent drive/motor has a specific number of inputs and outputs, therefore only a part of the maximum number of I/Os is used.

Related functions: TS_SetupOutput.vi, TS_SetupInput.vi, TS_GetInput.vi

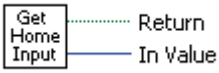
Associated examples: Example 14

[1] Represents the firmware versions: F000H, F020H, F005H, F900H or later on Technosoft drives/motors: IDM240/IDM640, IDS240/IDS640, ISCM4805/ISCM8005, IBL2403, IM23x (models IS and MA)

[2] Represents the firmware versions F500A or later on Technosoft drives: IDM240 CANopen/IDM640 CANopen, IDS640 CANopen

3.4.5.5 TS_GetHomeInput.vi

Symbol:



Prototype:

LONG _TS_GetHomeInput@4(UNSIGNED CHAR *In Value);

Parameters:

	Name	Description
Input	In Value	Pointer to the variable where the port status is stored
Output	Return	TRUE if no error, FALSE if error

Description: The function returns the status of the general purpose digital input assigned as home input. **Check the drive/motor user manual to find the IO configuration.**

When the function is executed, the variable **In Value** where the input line status is saved becomes:

- Zero if the input line was low
- Non-zero if the input line was high

If the input port may also be used as output, prior to call **TS_GetInput.vi**, you need to call **TS_SetupInput.vi** and configure it as input.

Related functions: TS_SetupInput.vi, TS_SetupOutput.vi, TS_SetOutput.vi

Associated examples: Example 32, Example 38

3.4.5.6 TS_GetMultipleInputs.vi

Symbol:

Prototype:

LONG _TS_GetMultipleInputs(CSTR Variable Name, SHORT INT *Status);

Parameters:

	Name	Description
Input	Variable Name	TML variable where the inputs status is saved on the drive
Output	Status	Pointer to variable where the value of Variable Name is stored
	Return	TRUE if no error, FALSE if error

Description: The function reads simultaneously the status of more inputs and save their status in TML variable **Variable Name** on the drive/motor. The value of **Variable Name** is then uploaded and stored in the **Status** variable.

For drives/motors programmed with firmware version **FAxx**[1] the digital inputs read are:

- Enable input – saved in bit 15 of **pszVarName**
- Limit switch input for negative direction (LSN) – saved in bit 14 of **pszVarName**
- Limit switch input for positive direction (LSP) – saved in bit 13 of **pszVarName**
- General-purpose inputs #39, #38, #37 and #36 – saved in bits 3, 2, 1 and 0 of **pszVarName**

If the drive/motor is programmed with firmware version **FBxx**[2] then the function reads all the input lines available of the drive/motor. The digital inputs are numbered from 0 to 15. The input's number represents also the position of the corresponding bit from the **pszVarName**, i.e. input number **x** has associated bit **x** from the **pszVarName**.

The bits corresponding to these inputs are set as follows: 0 if the input is low and 1 if the input is high. The other bits of the variable are set to 0.

Remark: *If one of these inputs is inverted inside the drive/motor, the corresponding bit from the variable is inverted too. Hence, these bits always show the inputs status at connectors level (0 if input is low and 1 if input is high) even when the inputs are inverted.*

The variable **Variable Name** is of type integer and must be defined with EasyMotion Studio before generating the setup files.

Related functions: TS_SetIndexCapture.vi, TS_SetNegativeLimitSwitch.vi, TS_SetPositiveLimitSwitch.vi

Associated examples: Example 37

[1] Represents the firmware versions: F000H, F020H, F005H, F900H or later on Technosoft drives/motors: IDM240/IDM640, IDS240/IDS640, ISCM4805/ISCM8005, IBL2403, IM23x (models IS and MA)

[2] Represents the firmware versions F500A or later on Technosoft drives: IDM240 CANopen/IDM640 CANopen, IDS640 CANopen

3.4.5.7 TS_SetMultipleOutputs.vi

Symbol:

Prototype:

BOOL TML_EXPORT TS_SetMultipleOutputs(CSTR Variable Name, SHORT INT Status);

Parameters:

	Name	Description
Input	Variable Name	Intermediary TML variable necessary to store the outputs status to be set on the drive/motor
	Status	The value with which the outputs are set
Output	return	TRUE if no error, FALSE if error

Description: The function sets simultaneous more outputs of the drive/motor with the value of parameter **Status**. Its value is transferred and stored on the drive in **pszVarName** TML variable and from there is used to set the outputs.

Remark: *The function is designed for drives/motors programmed with firmware version* ***FAxx***[1]*. For drives/motors programmed with firmware version* ***FBxx***[2] *use the TS_SetMultipleOutputs2 function.*

The outputs are:

- Ready output – set by bit 15 of pszVarName
- Error output – set by bit 14 of pszVarName
- General-purpose outputs: #31, #30, #29, #28 – set by bits 3, 2, 1, and 0 of pszVarName

The outputs are set as follows: low if the corresponding bit in the variable is 0 and high if the corresponding bit in the variable is 1. The other bits of the variable are not used.

Remark: *If one of these outputs is inverted inside the drive/motor, its command is inverted. Hence, the outputs are always set at connectors level according with the bits values (low if bit is 0 and high if bit is 1) even when the outputs are inverted.*

CAUTION: *Do not use* ***TS_SetMultipleOututs.vi*** *if any of the 6 outputs mentioned is not on the list of available outputs of your drive/motor. There are products that use some of these outputs internally for other purposes. Attempting to change these lines status may harm your product.*

Related functions: TS_SetIndexCapture.vi, TS_SetNegativeLimitSwitch.vi, TS_SetPositiveLimitSwitch.vi

Associated examples: Example 37

[1] Represents the firmware versions: F000H, F020H, F005H, F900H or later on Technosoft drives/motors: IDM240/IDM640, IDS240/IDS640, ISCM4805/ISCM8005, IBL2403, IM23x (models IS and MA)

[2] Represents the firmware versions F500A or later on Technosoft drives: IDM240 CANopen/IDM640 CANopen, IDS640 CANopen

3.4.5.8 TS_SetMultipleOutputs2.vi

Symbol:

Prototype:

BOOL TML_EXPORT TS_SetMultipleOutputs2(CSTR Variable Name, SHORT INT Status);

Parameters:

	Name	Description
Input	SelectedPorts	Mask for selecting the outputs controlled. Each bit of the parameter represents an output port.
	Status	Parameter containing the outputs status to be set
Output	return	TRUE if no error, FALSE if error

Description: The function sets simultaneous the digital outputs of the drive/motor selected with the **SelectedPorts** mask using the value of the **Status** parameter.

Remark: *The function is designed for drives/motors programmed with firmware version* ***FBxx***[1]*. For drives/motors programmed with firmware version* ***FAxx***[2] *use the TS_SetMultipleOutputs function.*

The digital outputs are numbered from 0 to 15 and they form an ordered list, for example, a product with 3 outputs will have 0, 1 and 2. The input's number represents also the position of the corresponding bit from the **SelectedPorts** mask, i.e. input number **x** has associated bit **x** from the **SelectedPorts**.

The outputs are set as follows:

- **low** if the corresponding bit from the **SelectedPorts** is 1 and the corresponding bit from **Status** variable is 0.
- **high** if it's the corresponding bit from **SelectedPorts** is 1 and the corresponding bit from SelectedPorts is 1.

Related functions: TS_SetIndexCapture.vi, TS_SetNegativeLimitSwitch.vi, TS_SetPositiveLimitSwitch.vi

Associated examples: –

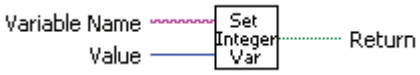
[1] Represents the firmware versions F500A or later on Technosoft drives: IDM240 CANopen/IDM640 CANopen, IDS640 CANopen

[2] Represents the firmware versions: F000H, F020H, F005H, F900H or later on Technosoft drives/motors: IDM240/IDM640, IDS240/IDS640, ISCM4805/ISCM8005, IBL2403, IM23x (models IS and MA)

3.4.6 Data transfer

3.4.6.1 TS_SetIntVariable.vi

Symbol:



Prototype:

LONG _TS_SetIntVariable@8(CSTR Variable Name, SHORT INT Value);

Parameters:

	Name	Description
Input	Variable Name	TML parameter name
	Value	The value to be written
Output	return	TRUE if no error; FALSE if error

Description: The function writes the **Value** in the TML data **Variable** on the active axis. The TML data (parameter, variable or user defined variable) is of type long (16-bit).

Remarks:

1. *The available TML data is configuration dependent and is listed in the variables.cfg file*
2. *The user defined variables are set with EasyMotion Studio prior generating the setup information*

Related functions: TS_GetIntVariable.vi, TS_SetLongVariable.vi, TS_GetLongVariable.vi, TS_SetFixedVariable.vi, TS_GetFixedVariable.vi

Associated examples: Example 18

3.4.6.2 TS_GetIntVariable.vi

Symbol:

Prototype:

LONG _TS_GetIntVariable@8(CSTR Variable Name, SHORT INT *Read Value);

Parameters:

	Name	Description
Input	Variable Name	Name of the TML parameter, variable or used defined variable
Output	Read Value	Pointer to the variable where the value is stored
	return	TRUE if no error, FALSE if error

Description: The function reads the value of TML data **Variable Name**. The TML data (parameter, variable or user defined variable) is of type integer (16-bit). The value read is saved in the variable pointed by **Read Value**.

Remarks:

1. *The available TML data is configuration dependent and is listed in the **variables.cfg** file.*
2. *The user defined variables are set with EasyMotion Studio prior generating the setup information*

Related functions: TS_SetIntVariable.vi, TS_SetLongVariable.vi, TS_SetFixedVariable.vi, TS_GetLongVariable.vi, TS_GetFixedVariable.vi

Associated examples: Example 18, Example 20, Example 36, Example 38

3.4.6.3 TS_SetLongVariable.vi

Symbol:

Prototype:

LONG _TS_SetLongVariable@8(CSTR Variable Name, LONG value);

Parameters:

	Name	Description
Input	Variable Name	Name of the parameter
	Value	The value to be written
Output	return	TRUE if no error, FALSE if error

Description: The function writes the **Value** in the TML data **Variable Name** on the active axis. The TML data (parameter, variable or user defined variable) is of type long (32-bit).

Remarks:

3. *The available TML data is configuration dependent and is listed in the variables.cfg file*
4. *The user defined variables are set with EasyMotion Studio prior generating the setup information*

Related functions: TS_GetIntVariable.vi, TS_SetIntVariable.vi, TS_GetLongVariable.vi, TS_SetFixedVariable.vi, TS_GetFixedVariable.vi

Associated examples: Example 20, Example 34

3.4.6.4 TS_GetLongVariable.vi

Symbol:

Prototype:

LONG _TS_GetLongVariable@8(CSTR Variable Name, LONG *Read Value);

Parameters:

	Name	Description
Input	Variable	Name of the parameter
Output	Read Value	Pointer to the variable where the parameter value is stored
	Return	TRUE if no error, FALSE if error

Description: The function reads the value of TML data **Variable**. The TML data (parameter, variable or user defined variable) is of type long (32-bit). The value read is saved in the variable pointed by **Read Value**.

Remarks:

1. *The available TML data is configuration dependent and is listed in the **variables.cfg** file.*
2. *The user defined variables are set with EasyMotion Studio prior generating the setup information*

Related functions: TS_SetIntVariable.vi, TS_SetLongVariable.vi, TS_SetFixedVariable.vi, TS_GetIntVariable.vi, TS_GetFixedVariable.vi

Associated examples: Example 20, Example 24, Example 27, Example 28, Example 34, Example 35, Example 42

3.4.6.5 TS_SetFixedVariable.vi

Symbol:

Prototype:

LONG _TS_SetFixedVariable@12(CSTR Variable Name, DOUBLE Value);

Parameters:

	Name	Description
Input	Variable Name	Name of the parameter
	Value	The value to be written
Output	return	TRUE if no error, FALSE if error

Description: The function converts the **Value** to type fixed and writes it in the TML data **Variable Name** on the active axis. The TML data (parameter, variable or user defined variable) is of type fixed (16 bits integer part, 16 bits fractional part).

Remarks:

1. *The available TML data is configuration dependent and is listed in the **variables.cfg** file.*
2. *The user defined variables are set with EasyMotion Studio prior generating the setup information*

Related functions: TS_SetIntVariable.vi, TS_GetIntVariable.vi, TS_SetLongVariable.vi, TS_GetLongVariable.vi, TS_GetFixedVariable.vi

Associated examples: Example 19, Example 34

3.4.6.6 TS_GetFixedVariable.vi

Symbol:

Prototype:

LONG _TS_GetFixedVariable@8(CSTR Variable Name, DOUBLE *value);

Parameters:

	Name	Description
Input	Variable Name	Name of the parameter
Output	Read Value	Pointer where the parameter value is stored
	Return	TRUE if no error, FALSE if error

Description: The function reads the value of TML data **Variable Name** from the active axis. The TML data (parameter, variable or user defined variable) is of type fixed (16 bits integer part, 16 bits fractional part). The value read is converted to double and saved in the variable pointed by **Read Value**.

Remarks:

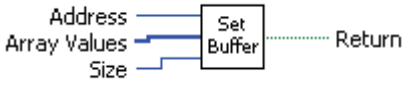
1. *The available TML data is configuration dependent and is listed in the **variables.cfg** file.*
2. *The user defined variables are set with EasyMotion Studio prior generating the setup information*

Related functions: TS_SetIntVariable.vi, TS_SetLongVariable.vi, TS_SetFixedVariable.vi, TS_GetIntVariable.vi, TS_GetLongVariable.vi

Associated examples: Example 19

3.4.6.7 TS_SetBuffer.vi

Symbol:



Prototype:

LONG _TS_SetBuffer@12(UNSIGNED SHORT INT Address, LONG *Array Values, SHORT INT Size);

Parameters:

	Name	Description
Input	Address	Start address where to download the data buffer
	Array Values	Pointer to the array with data to be downloaded
	Size	The number of words to download
Output	return	TRUE if no error, FALSE if error

Description: The function downloads a data buffer on the active axis. The parameter **Array Values** points to the beginning of the array from where the data will be downloaded. The length of the buffer is set with parameter **Size**. The data is stored on the drive/motor starting with **Address**. The **Address** can belong to drive/motor EEPROM memory or TML data memory.

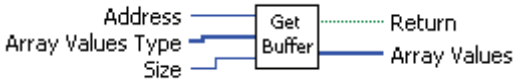
Remark: *For details about drive/motor memory structure see the "Memory Map" topic from EasyMotion Studio on line help.*

Related functions: TS_GetBuffer.vi

Associated examples: Example 20, Example 39

3.4.6.8 TS_GetBuffer.vi

Symbol:



Prototype:

LONG _TS_GetBuffer@12(UNSIGNED SHORT INT Address, LONG *Array Values, SHORT INT Size);

Parameters:

	Name	Description
Input	Address	Start address from where the data will be uploaded
	Array Values	Pointer to the array where the uploaded data will be stored
	Size	The number of words to upload
Output	return	TRUE if no error, FALSE if error

Description: The function uploads a data buffer from the active axis. The start address of the buffer is set with parameter **Address** and its length is **Size.** The **Address** can belong to drive/motor EEPROM memory or TML data memory. The parameter **Array Values** points to the beginning of the array where the uploaded data is stored.

Remark: *For details about drive/motor memory structure see the "Memory Map" topic from EasyMotion Studio on line help.*

Related functions: TS_SetBuffer.vi

Associated examples: Example 20, Example 39

3.4.7 Drive/motor monitoring

3.4.7.1 TS_ReadStatus.vi

Symbol:

Prototype:

LONG _TS_ReadStatus@8(SHORT INT TML Register, SHORT INT *Status);

Parameters:

	Name	Description
Input	TML Register	Registers selection
Output	Status	Pointer of the variable where the status is saved
	return	TRUE if no error; FALSE if error

Description: The function returns drive/motor status information. Depending on the value of **TML Register** parameter, you can examine the contents of the Motion Control Register (**TML Register = REG_MCR**), Motion Status Register (**TML Register = REG_MSR**), Interrupt Status Register (**TML Register = REG_ISR**), Status Register Low (**TML Register** = **REG_SRL**), Status Register High (**TML Register = REG_SRH**) or Motion Error Register (**TML Register = REG_MER**) of the drive/motor.

Related functions: –

Associated examples: –

3.4.7.2 TS_OnlineChecksum.vi

Symbol:

Prototype:

LONG _TS_OnlineChecksum@12(UNSIGNED SHORT INT Start Address, SHORT INT End Address, SHORT INT *Checksum);

Parameters:

	Name	Description
Input	Start Address	The memory range start address
	End Address	The memory range end address
	Checksum	Pointer to the variable where the checksum is stored
Output	return	TRUE if no error, FALSE if error

Description: The function requests from the active axis the checksum of a memory range. The memory range is defined with parameters **Start Address** and **End Address**. The function stores the checksum received from the drive in variable **Checksum**.

With function TS_OnlineChecksum.vi you can check the integrity of the data saved in a drive/motor EEPROM or RAM memory. The memory type is selected automatically function of the **Start Address** and the **End Address**.

Related functions: TS_SetBuffer.vi

Associated examples: Example 39

3.4.8 Miscellaneous

3.4.8.1 TS_DownloadProgram

Symbol:

Prototype:

LONG _TS_DownloadProgram@8(CSTR File Name, UNSIGNED SHORT INT *Entry Point);

Parameters:

	Name	Description
Input	pszOutFile	The name of the out file generated with EasyMotion Studio
Output	wEntryPoint	Start address of downloaded file
	return	TRUE if no error, FALSE if error

Description: The function downloads a COFF formatted file to the drive/motor, and returns the entry point of that file. Parameter **File Name** specifies the name of the object file to be downloaded. If the operation is successful, the function will return the entry point (start address) of the downloaded code in the **Entry Point** parameter. You can use this address to launch the execution of the downloaded code, by using it as the input argument of the **TS_GOTO.vi** or **TS_CALL.vi** functions.

The COFF file is generated from EasyMotion Studio with menu command **Application | Motion | Build** and is saved in the application directory. You can download several such applications in different locations of the drive internal memory, and execute them according to your application status, with the **TS_GOTO.vi** or **TS_CALL.vi** functions.

Related functions: TS_GOTO.vi, TS_CALL.vi

Associated examples: Example 29, Example 30

3.4.8.2 TS_Execute.vi

Symbol:

Prototype:

LONG _TS_Execute@4(CSTR Commands);

Parameters:

	Name	Description
Input	Commands	String containing the TML source code to be executed.
Output	return	TRUE if no error, FALSE if error

Description: The function executes the TML commands entered in TML source code format (as is entered in the Command Interpreter), from a string containing that code. Use this function if you want to send a specific motion sequence, directly written in TML language.

Build a string **Commands** containing the source TML code and then call the **TS_Execute.vi** function in order to compile the code and to send on-line the associated TML object commands.

If a compile error occurs, the function returns a FALSE, otherwise it returns TRUE.

Related functions: TS_ExecuteScript.vi

Associated examples: Example 9, Example 10, Example 11, Example 13, Example 20, Example 25, Example 39, Example 41

3.4.8.3 TS_ExecuteScript.vi

Symbol:

Prototype:

LONG _TS_ExecuteScript@4(CSTR File Name);

Parameters:

	Name	Description
Input	File Name	The name of the file containing the TML source code to be executed.
Output	Return	TRUE if no error, FALSE if error

Description: The function executes TML commands entered in TML source code format (as is entered in the Command Interpreter) from a script file. Use this function if you want to send a specific motion sequence, directly written in TML language.

Define a data file **File Name** containing the source TML code you want to send to the drive and then call the **TS_ExecuteScript.vi** function in order to compile the code and to send on-line the associated TML object commands.

If a compile error occurs, the function returns a FALSE, otherwise it returns TRUE.

Related functions: TS_Execute.vi

Associated examples: Example 25

3.4.8.4 TS_GetOutputOfExecute.vi

Symbol:

Prototype:

LONG _TS_GetOutputOfExecute@8(CSTR Output, SHORT INT Max Chars);

Parameters:

	Name	Description
Input	Output	String containing the TML source code generated at the last library function call.
	Max Chars	The maximum numbers of characters to return in the string
Output	return	TRUE if no error, FALSE if error

Description: The function returns the TML output source code of the last previously executed TML_LIB_LabVIEW library function call. Use this function if you want to examine the TML code that is generated when you call one of the functions of the TML_LIB_LabVIEW library.

The code is returned in the **Output** string. Set the maximum number of characters to be returned as the value of the **Max Chars** parameter.

Related functions: TS_Execute.vi

Associated examples: Example 41

3.4.8.5 TS_Save.vi

Symbol:

Prototype:

LONG _TS_Save@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	TRUE if no error; FALSE if error

Description: The function saves the actual values of all the TML parameters with setup data from the active data RAM memory into the EEPROM memory, in the setup table. Through this command, you can save all the setup modifications done, after the power on initialization.

Related functions: TS_Reset.vi, TS_Save.vi

Associated examples: Example 20

3.4.8.6 TS_ResetFault.vi

Symbol:

Prototype:

LONG _TS_ResetFault@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	TRUE if no error; FALSE if error

Description: The function gets out the active axis from the FAULT status in which it enters when an error occurs. After a TS_ResetFault.vi execution, most of the errors bits from **M**otion **E**rror **R**egister are cleared (set to 0), the Ready output (if present) is set to the ready level, the Error output (if present) is set to the no error level and the drive/motor returns to normal operation.

Remarks:

- *The TS_ResetFault.vi execution does not change the status of MER.15 (enable input on disabled level), MER.7 (negative limit switch input active), MER.6 (positive limit switch input active) and MER.2 (invalid setup table)*
- *The drive/motor will return to FAULT status if there are errors when the function is executed*

Related functions: TS_Power.vi

Associated examples: Example 36

3.4.8.7 TS_Reset.vi

Symbol:

Prototype:

LONG _TS_Reset@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	TRUE if no error; FALSE if error

Description: The function resets the active axis. After reset the drive/motor will load the values of TML parameters set during setup phase. If the drive/motor is configured to run in the '**Autorun'** mode, it will automatically execute after reset the TML code stored in the E2ROM memory (if there is such a program).

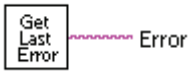
Remark: *If during drive/motor operation you have changed the setup parameters and want to use them after the reset, call function TS_Save.vi prior TS_Reset.vi. The function TS_Save.vi stores in the drive/motor EEPROM memory the actual values of all TML parameters.*

Related functions: TS_Power.vi, TS_DownloadProgram.vi, TS_GOTO.vi, TS_Save.vi

Associated examples: Example 20, Example 36

3.4.8.8 TS_GetLastErrorText.vi

Symbol:



Prototype:

CSTR _TS_GetLastErrorText@0(void);

Parameters:

	Name	Description
Input	–	–
Output	return	A text related to the last occurred error

Description: The function returns a text related with the last occurred error during a TML_LIB_LabVIEW function execution. You can visualize this text in order to see what the problem was.

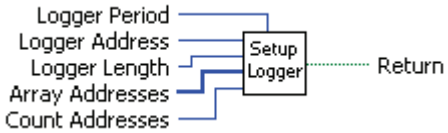
Related functions: –

Associated examples: all

3.4.9 Data logger

3.4.9.1 TS_SetupLogger.vi

Symbol:



Prototype:

LONG _TS_SetupLogger@20(UNSIGNED SHORT INT Logger Address, UNSIGNED SHORT INT Logger Length, UNSIGNED SHORT INT *Array Addresses, UNSIGNED SHORT INT Count Address, UNSIGNED SHORT INT Logger Period);

Parameters:

	Name	Description
Input	Logger Address	The address of the logger buffer in drive/motor memory, where data will be stored during logging
	Logger Length	The length in words of the logger buffer
	Array Addresses	Pointer to the array containing the drive/motor memory addresses to be logged
	Count Address	The number of memory addresses to be logged
	Logger Period	Time interval between two consecutive data logging expressed in drive/motor time units
Output	return	TRUE if no error, FALSE if error

Description: The function sets the parameters of the data logger on the active axis. Use this function if you want to perform data logging at the drive/motor level during the motion execution and analyze it at the PC level.

Set the **Logger Address** parameter with the starting address of the drive/motor data memory buffer where a number of **Logger Length** data points of logged data will be stored.

The addresses of TML data logged are stored in an array of length **Count Address**. Parameter **Array Addresses** points to the beginning of the array where the uploaded data will be stored.

Remark *The number of data sets which can be stored will be determined as the integer part of the ratio Logger Length / Count Address.*

The parameter **Logger Period** sets how often the TML data is logged. The period can have any value between 1 and 7FFF.

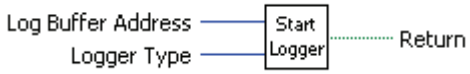
Remark*: Be careful when using the data logger functions! Incorrect settings related to data logger buffer location and size may lead to improper operation of the drive, with unpredictable results.*

Related functions: TS_StartLogger.vi, TS_UploadLoggerResults.vi, TS_CheckLoggerStatus.vi

Associated examples: Example 33

3.4.9.2 TS_StartLogger.vi

Symbol:



Prototype:

LONG _TS_StartLogger@8(UNSIGNED SHORT INT Logger Address, UNSIGNED CHAR Logger Type);

Parameters:

	Name	Description
Input	Logger Address	The address of the logger buffer in drive/motor memory, where data will be stored during logging
	Logger Type	Specifies when the logging occurs
Output	Return	TRUE if no error, FALSE if error

Description: The function starts the data logger on the active axis. The function may be called only after the initialization of the data logger with the **TS_SetupLogger.vi** function.

Use the parameter **Logger Type** to set if the data logging process must be done in the slow control loop (**Logger Type** = **LOGGER_SLOW**), or in the fast control loop (**Logger Type** = **LOGGER_FAST**).

Related functions: TS_SetupLogger.vi, TS_UploadLoggerResults.vi, TS_CheckLoggerStatus.vi

Associated examples: Example 33

3.4.9.3 TS_CheckLoggerStatus.vi

Symbol:

Prototype:

LONG _TS_CheckLoggerStatus@8(UNSIGNED SHORT INT Logger Address, UNSIGNED SHORT INT *Logger Status);

Parameters:

	Name	Description
Input	Logger Address	The address of the logger buffer in drive/motor memory, where data will be stored during logging
Output	Logger Status	Number of points still remaining to capture; if it is 0, the logging is completed
	Return	TRUE if no error, FALSE if error

Description: The function checks the data logger status on the active axis. Use this function in order to check if the data logging process is still running, or if the data logging process was ended. The function returns the **Logger Status** parameter, whose value indicates how many points are still to be captured. If **Logger Status = 0** the data logging process is finished.

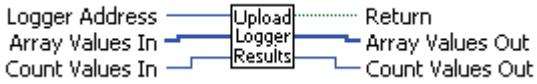
The function may be called only after the start of the logging process with the **TS_StartLogger.vi** function.

Related functions: TS_ SetupLogger.vi, TS_StartLogger.vi, TS_UploadLoggerResults.vi

Associated examples: Example 33

3.4.9.4 TS_UploadLoggerResults.vi

Symbol:



Prototype:

LONG _TS_UploadLoggerResults(WORD wLogBufferAddr, WORD* arrayValues, WORD& countValues);

Parameters:

	Name	Description
Input	Logger Address	The address of the logger buffer in drive/motor memory, where data will be stored during logging
	Array Values	Pointer to the array where the uploaded data is stored on the PC
	Count Values	The size of **Array Values**, expressed in WORDs
Output	Count Values	The number of uploaded data
	return	TRUE if no error, FALSE if error

Description: The function uploads the data logged from the active axis. Use this function to upload the data stored during the data logger execution. Before calling the function, you must declare a data buffer in the PC program, starting at the **Array Values** address, with a size equal to the **Count Values** parameter.

The **TS_UploadLoggerResults.vi** function will fill the **Array Values** data buffer with the data transferred from the drive, and will also return the actual number of transferred data words, in the **Count Values** parameter. Once the data is transferred, you can use it for data analysis, graphical representation.

Remark:

1. *Prior uploading the data logged, call function TS_CheckLoggerStatus.vi to test the end of data logging.*
2. *The number of data sets which were stored will be determined as the integer part of the ratio [**length** / **Count Address**] where **length** and **Count Address** are setup parameters defined when calling the **TS_SetupLogger.vi** function*

The uploaded data is stored in consecutive data sets, i.e. the first set of ***Count Address*** words will contain the first logged point for the selected variables, the second set of ***Count Address*** words will contain the second logged point for the selected variables, and so on. The following table illustrates this data structure for an example of **4 logged variables**.

Data WORD	Meaning
1	**Variable 1, point 1**
2	Variable 2, point 1
3	Variable 3, point 1
4	Variable 4, point 1
5	**Variable 1, point 2**
6	Variable 2, point 2
7	Variable 3, point 2
…	…

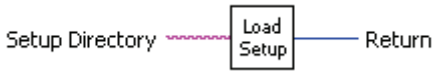
Related functions: TS_ SetupLogger, TS_StartLogger, TS_ CheckLoggerStatus

Associated examples: Example 33

3.4.10 Drive setup

3.4.10.1 TS_LoadSetup.vi

Symbol:



Prototype:

SHORT INT _TS_LoadSetup@4(CSTR Setup Directory);

Parameters:

	Name	Description
Input	Setup Directory	Name of the directory where are the setup files
Output	Return	The index associated to the setup

Description: The function loads a drive/motor configuration setup in the PC application. The configuration setup is generated from EasyMotion Studio or EasySetUp and stored in two files: setup.cfg and variables.cfg. With string **Setup Directory** you specify the absolute or relative path of the directory with the setup files. The function returns an index associated to the configuration setup. Use the value returned to associate the configuration setup with the corresponding axis.

Remark: *The function must be called for each configuration setup only once in your program, in its initialization part.*

Related functions: TS_SetupAxis.vi, TS_SetupGroup.vi, TS_SetupBroadcast.vi

Associated examples: all examples

3.4.10.2 TS_SetupAxis.vi

Symbol:

Prototype:

LONG _TS_SetupAxis@8(UNSIGNED CHAR Axis ID, SHORT INT Setup Index);

Parameters:

	Name	Description
Input	Axis ID	Axis ID of the drive/motor
	Setup Index	Configuration index generated by TS_LoadSetup
Output	return	TRUE if no error, FALSE if error

Description: The function associates a configuration setup to the drive/motor having **Axis ID**. The configuration setup is identified through **Setup Index**.

The function must be called for each axis of the motion system, only once in your program, in the initialization part, before any attempt to send messages to that axis.

Remarks:

1. *The **Axis ID** parameter must be identical with the value set during drive/motor setup.*
2. *Use function TS_LoadSetup.vi to obtain the configuration setup identifier.*

Related functions: TS_LoadSetup.vi, TS_SetupGroup.vi, TS_SetupBroadcast.vi

Associated examples: all examples

3.4.10.3 TS_SetupGroup.vi

Symbol:

Prototype:

LONG _TS_SetupGroup@8(UNSIGNED CHAR Group ID, SHORT INT Setup Index);

Arguments:

	Name	Description
Input	Group ID	Group ID number. It must be a value between 1 and 8
	Setup Index	Name of the data file storing the setup axis information
Output	return	TRUE if no error, FALSE if error

Description: The function associates to the group of drives/motors a configuration setup identified through **Setup Index**. The configuration setup is used by TML_LIB when sends commands towards axes that have the **Group ID**.

The function must be called for each group defined in the motion system, only once in your program, in the initialization part, before any attempt to send messages to that group.

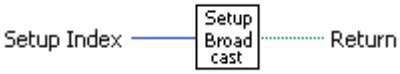
Remarks: *Use function TS_LoadSetup.vi to obtain the configuration setup identifier.*

Related functions: TS_LoadSetup.vi, TS_SetupAxis.vi, TS_SetupBroadcast.vi

Associated examples: all examples

3.4.10.4 TS_SetupBroadcast

Symbol:



Prototype:

LONG _TS_SetupBroadcast@4(SHORT INT Setup Index);

Parameters:

	Name	Description
Input	Setup Index	Name of the data file storing the setup axis information
Output	return	TRUE if no error, FALSE if error

Description: The function sets the configuration setup used by TML_LIB when issuing broadcast commands. The configuration setup is identified through **Setup Index**.

Remarks: *Use function TS_LoadSetup.vi to obtain the configuration setup identifier.*

Related functions: TS_LoadSetup.vi, TS_SetupAxis.vi, TS_SetupGroup.vi

Associated examples: –

3.4.10.5 TS_DriveInitialization.vi

Symbol:

Prototype:

LONG _TS_DriveInitialization@0(void);

Parameters:

	Name	Description
Input	–	–
Output	Return	TRUE if no error, FALSE if error

Description: The function initializes the active axis. It must be executed when the drive/motor is powered or after a reset with function TS_Reset.vi. The function call should be placed after the functions TS_SetupAxis.vi and TS_SelectAxis.vi and before any functions that send messages to the axis.

Related functions: TS_LoadSetup.vi, TS_SetupAxis.vi, TS_SelectAxis.vi

Associated examples: all examples

3.4.11 Drive administration

3.4.11.1 TS_SelectAxis.vi

Symbol:

Prototype:

LONG _TS_SelectAxis@4(UNSIGNED CHAR Axis ID);

Parameters:

	Name	Description
Input	Axis ID	The Axis ID where the commands are sent
Output	return	TRUE if no error, FALSE if error

Description: The function selects the currently active axis. All further function calls, which send TML messages on the communication channel, will address the messages to this active axis.

Call the function only after the setup of the axis (after calling the **TS_SetupAxis.vi** function) for the same axis (with the same **Axis ID**).

In a single axis motion system, call this function only once in your program. In a multiple axis configuration, call this function each time you want to redirect the communication to another axis of the system.

Related functions: TS_SelectGroup.vi

Associated examples: all examples

3.4.11.2 TS_SelectGroup.vi

Symbol:

Prototype:

LONG _TS_SelectGroup(UNSIGNED CHAR Group ID);

Parameters:

	Name	Description
Input	Group ID	The Group ID where the commands are sent
Output	Return	TRUE if no error, FALSE if error

Description: The function selects the currently active group. All further function calls, which send TML messages on the communication channel, will address these messages to this active group. The active group is set with parameter **Group ID**. It must be a value between 1 and 8.

Remark: *The function must be called after the group setup i.e. after calling the* ***TS_SetupGroup.vi*** *function.*

Related functions: TS_SelectAxis.vi

Associated examples: Example 26

3.4.11.3 TS_SelectBroadcast.vi

Symbol:

Prototype:

LONG _TS_SelectBroadcast@0(void);

Parameters:

	Name	Description
Input	–	–
Output	Return	TRUE if no error, FALSE if error

Description: The function enables TML_LIB to issue the broadcast messages, i.e. all further function calls, which send TML messages on the communication channel, will address these messages to all the axes.

Remark: *The function must be called after the broadcast setup i.e. after calling the* ***TS_SetupBroadcast.vi*** *function.*

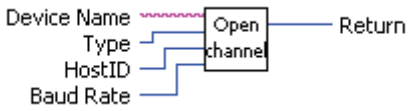
Related functions: TS_SelectAxis.vi, TS_SelectGroup.vi

Associated examples: -

3.4.12 Communication setup

3.4.12.1 TS_OpenChannel.vi

Symbol:



Prototype:

SHORT INT _TS_OpenChannel@16(CSTR Device Name, UNSIGNED CHAR Type, UNSIGNED CHAR HostID, UNSIGNED LONG Baud rate);

Parameters:

	Name	Description
Input	Device Name	The communication channel to be opened
	Type	The type of the communication channel
	HostID	Axis ID for the PC
	Baud Rate	Communication baud rate
Output	Return	The file descriptor of the or -1 if error

Description: The function opens the communication channel specified with parameter **Device Name**.

The communication channel type is set with parameter **Type**. The TML_LIB_LabVIEW supports the following communication types:

- serial RS-232
  - **Type = CHANNEL_RS232** for PC serial port
  - **Type = CHANNEL_VIRTUAL_SERIAL** for virtual serial interface[1]
- serial RS-485
  - **Type = CHANNEL_RS485** for an RS-485 interface board or an RS-232/RS-485 converter
- CAN-bus
  - **Type** = **CHANNEL_IXXAT_CAN** for **IxxAT** PC to CAN interface
  - **Type = CHANNEL_SYS_TEC_USBCAN** for **Sys Tec** USB to CAN interface
  - **Type = CHANNEL_PEAK_SYS_PCAN_PCI** for **ESD** PC to CAN interface
  - **Type = CHANNEL_ESD_CAN** for **PEAK System** PCAN-PCI interface
  - **Type = CHANNEL_PEAK_SYS_PCAN_ISA** for **PEAK System** PCAN-ISA
  - **Type = CHANNEL_PEAK_SYS_PCAN_PC104** for **PEAK System** PC/104
  - **Type = CHANNEL_PEAK_SYS_PCAN_USB**
  - **Type = CHANNEL_PEAK_SYS_PCAN_DONGLE** for **PEAK System** Dongle interfaces

[1] Contact Technosoft for more details regarding the virtual serial channel.

- Ethernet
    - **Type = CHANNEL_XPORT_IP** for XPort adapter/bridge between Ethernet and RS-232 from Lantronix.

Depending on the communication channel type, the parameter **Device Name** can be:

- For serial communication: ‘COM1’, ‘COM2’, ‘COM3’….
- For virtual serial interface is the name of the dll file that implements the serial interface
- For CAN-bus communication: ‘1’, ‘2’, ‘3’…
- For Ethernet communication: ‘192.168.19.52’, ‘technosoft.masterdrive.ch’…

The **HostID** parameter represents the Axis ID of the PC in the system. The value of **HostID** is set as follows:

- For serial RS-232 the **HostID** is equal with the axis ID of the drive connected to the PC serial port
- For serial RS-485 and CAN-bus the **HostId** must be a unique value. ***Attention!*** *Make sure that all the drives/motors from the network have a different address*
- For Ethernet communication the **HostID** is equal with the axis ID of the drive connected to the serial port of the Ethernet adapter.

Set the communication speed with the ***Baud Rate*** parameter. The accepted values are:

- For serial communication and Ethernet: 9600, 19200, 38400, 56000 or 115200 kbps.
- For CAN-bus: 125, 250, 500, 1000 kbps

Remark: *You can open several communication channels but only one can be active in an application at one moment. You can switch between the communication channels with function TS_SelectChannel.vi.*

Related functions: TS_SelectChannel.vi, TS_CloseChannel.vi

Associated examples: all examples

3.4.12.2 TS_SelectChannel.vi

Symbol:

Prototype:

LONG _TS_SelectChannel@4(SHORT INT fd);

Parameters:

	Name	Description
Input	fd	The communication channel file descriptor
Output	return	TRUE if no error, FALSE if error

Description: The function selects as active the communication channel described by parameter **fd**. All commands send towards the drives/motors will use the selected communication channel.

Remarks:

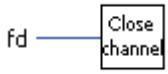
1. *Use function TS_OpenChannel.vi to open the communication channels*
2. *The function TS_SelectChannel.vi is not required in application with only one communication channel*

Related functions: TS_OpenChannel.vi, TS_CloseChannel.vi

Associated examples: all examples

3.4.12.3 TS_CloseChannel.vi

Symbol:



Prototype:

void _TS_CloseChannel@4(SHORT INT fd);

Parameters:

	Name	Description
Input	fd	The communication channel file descriptor
Output	–	–

Description: The function closes the communication channel described by parameters **fd**. With **fd = -1** the function closes the channel previously selected with function **TS_SelectChannel.vi**. This function must be called at the end of the application. It will release the communication channel resources, as it was allocated to the program when the **TS_OpenChannel.vi** function was called.

Related functions: TS_OpenChannel.vi, TS_SelectChannel.vi

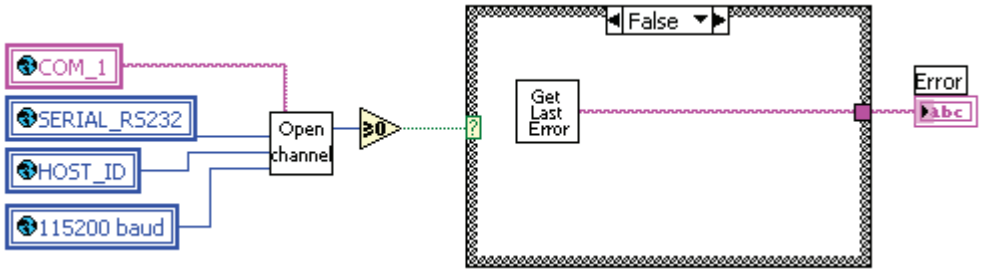
Associated examples: all examples

4 Examples

This chapter presents a collection of applications implemented in LabVIEW, which use the functions of the **TML_LIB_LabVIEW** library. The examples are intended to provide you a first, basic insight about using the **TML_LIB_ LabVIEW** library to implement your motion control applications.

The examples are based on the hypothesis that the drive is already initialized, i.e. the setup code is already downloaded into the drive (see section 2.3 for details), so that you'll directly start sending motion commands from the PC to the drive.

Remark: *Most TML_LIB_LabVIEW subVIs return a Boolean TRUE if they execute correctly, and a FALSE if any error occurred (incorrect parameters, failed operation at PC level). You should check after each function call if there was an error or not. In case of error use the subVI TS_GetLastTextError.vi to obtain a description of the error occurred. Thus, a VI implemented with TML_LIB_LabVIEW subVIs should look like this:*



The examples automatically launch at run control panels which display the status of some drive variables (as speed, position, current, etc.).

Remark: *The examples and the control panels are built for configurations with Technosoft drive **IBL2403-CAN**. For other drives/motors generate the setup data and modify the examples and the control panels to accommodate the IO configuration of your drive/motor.*

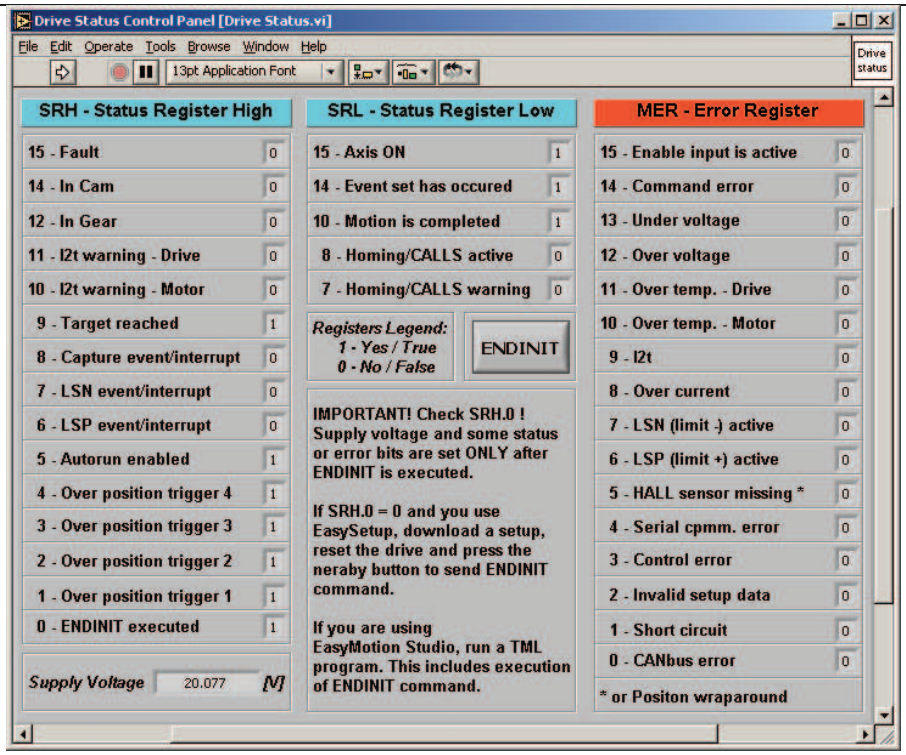


Figure 4.1. *Drive status control panel*

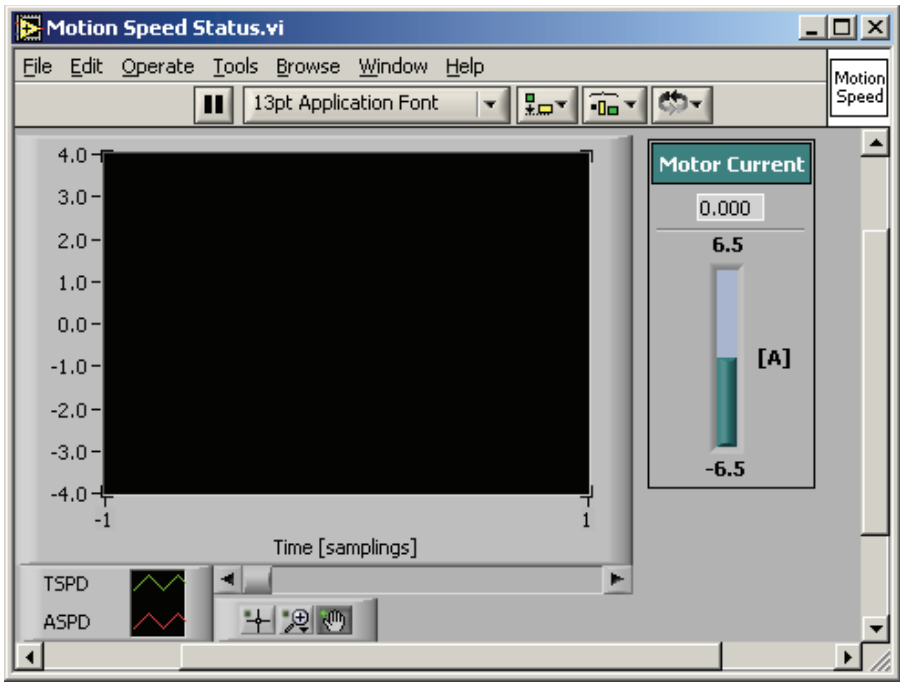


Figure 4.2 *Motion speed control panel*

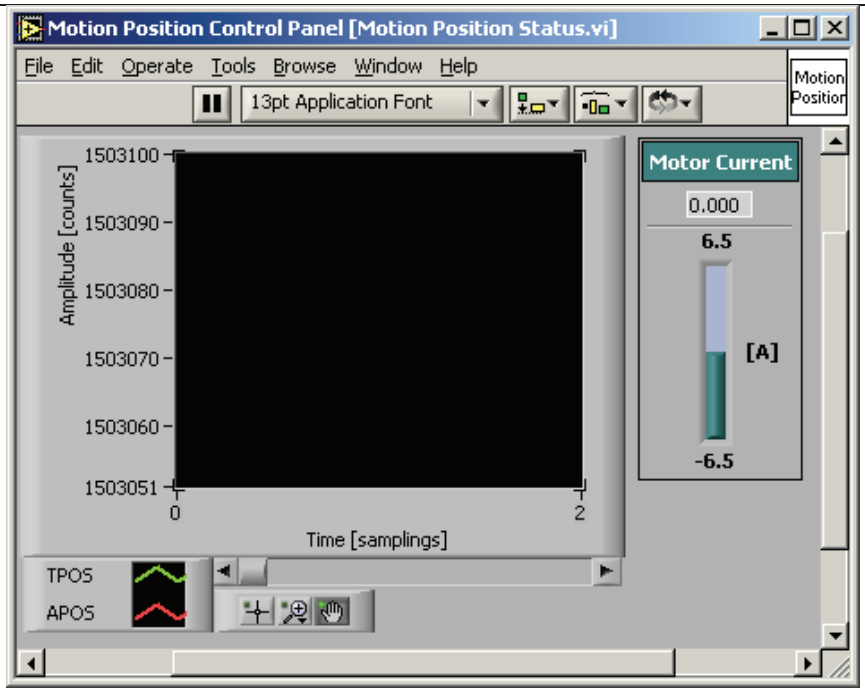


Figure 4.3 *Motion position control panel*

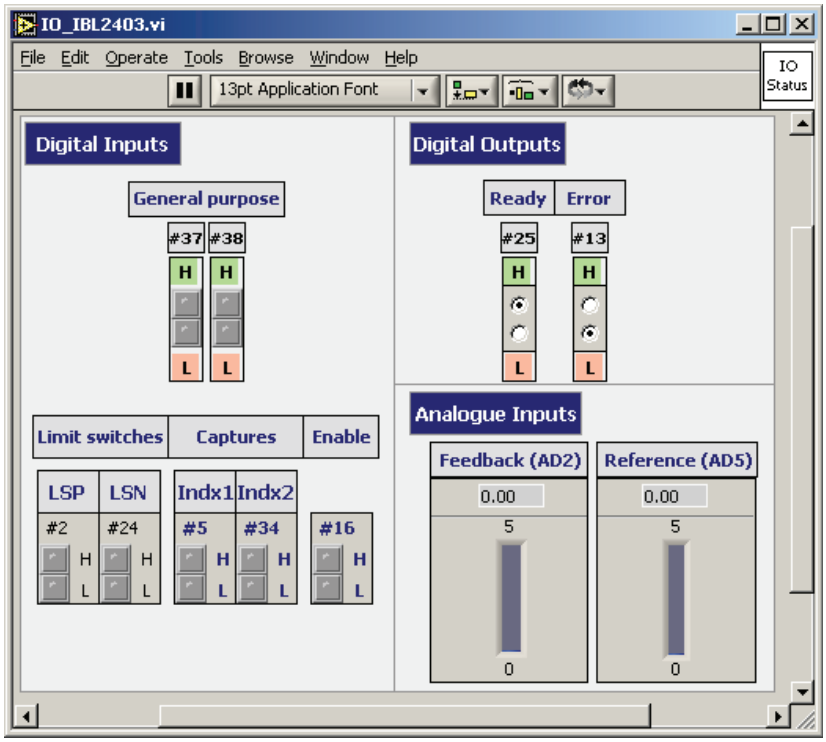


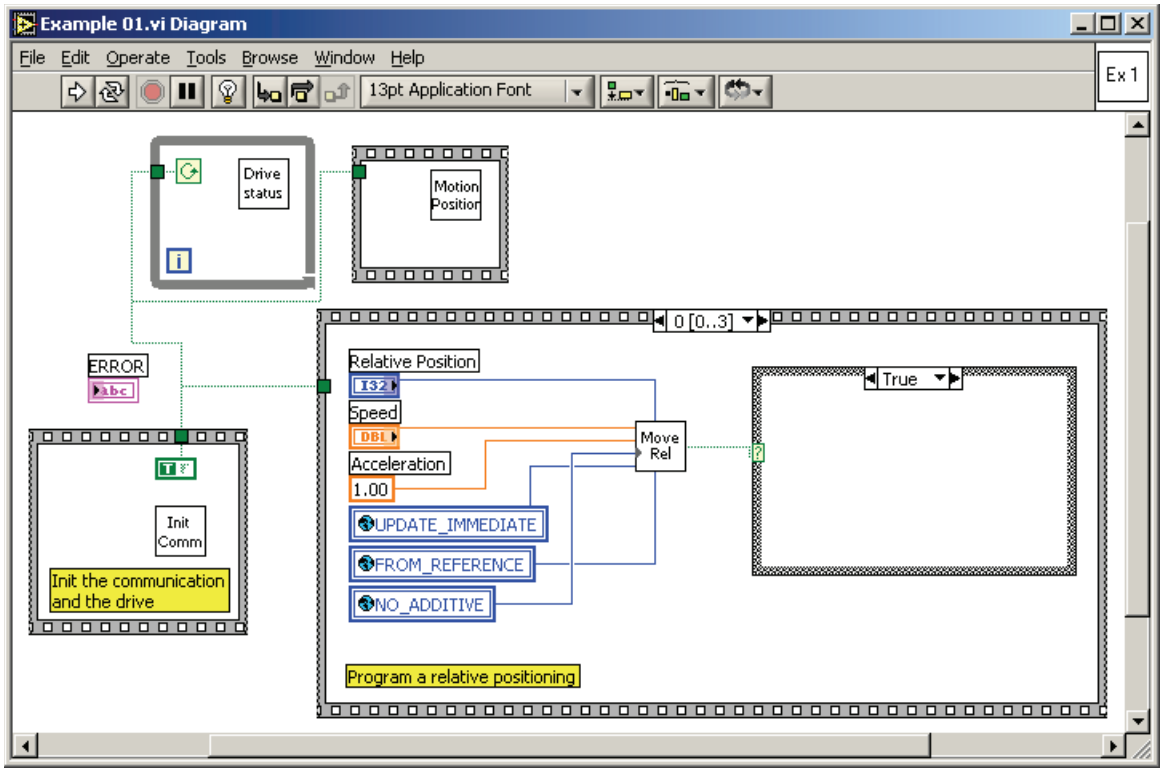
Figure 4.4 *IO control panel for IBL2403 - CAN*

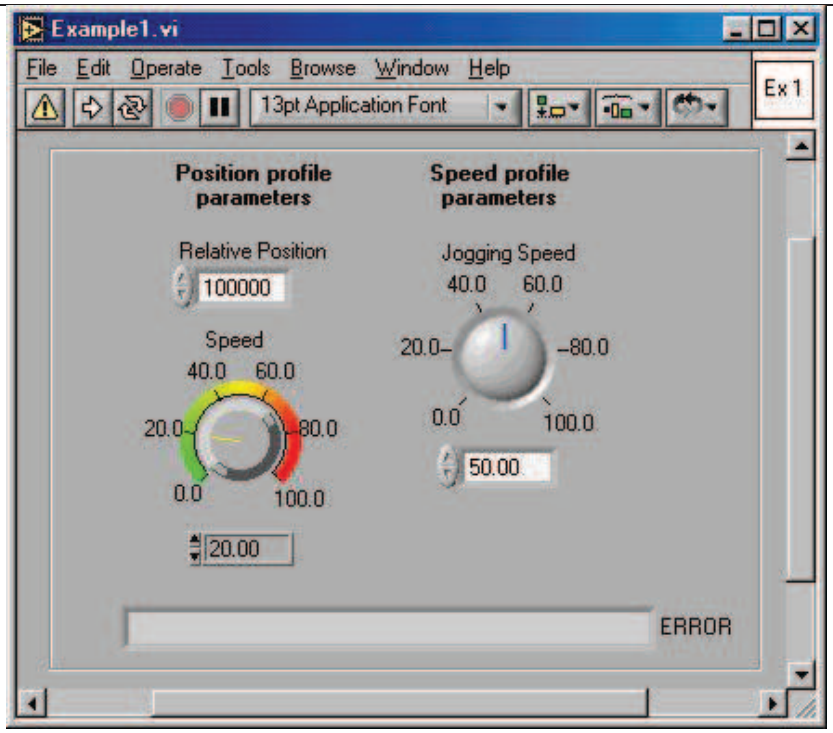
4.1 Example 1. Profiled positioning movement followed by a speed profile jogging

This example implements a relative positioning movement, waits until the motion is finished, then starts moving the motor with a constant speed.

The VI front panel allows you to setup the parameters for the position profile and speed profile. If an error occurs, you'll see the error message in the ERROR text box.

***Remark:**. For a better readability of the other examples, the error message field was introduced in the VI screen only for this example. You can add it if needed for the other examples, too.*

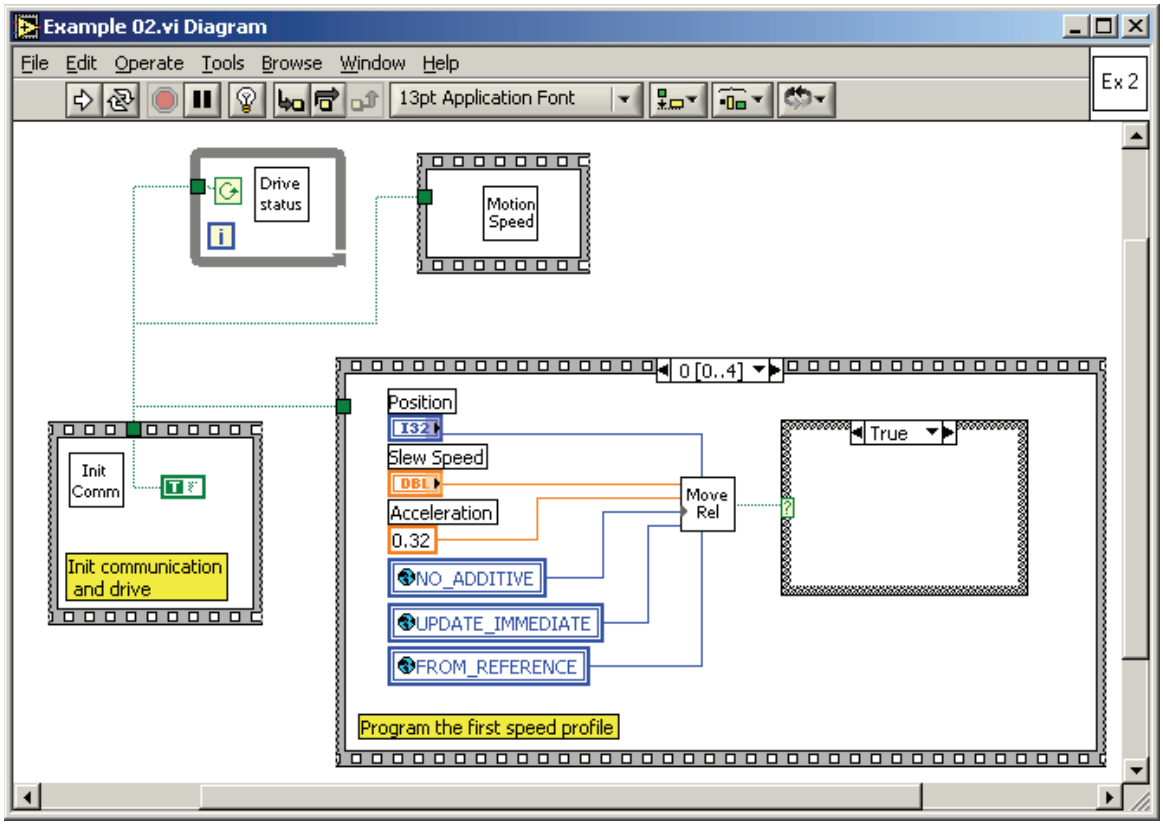


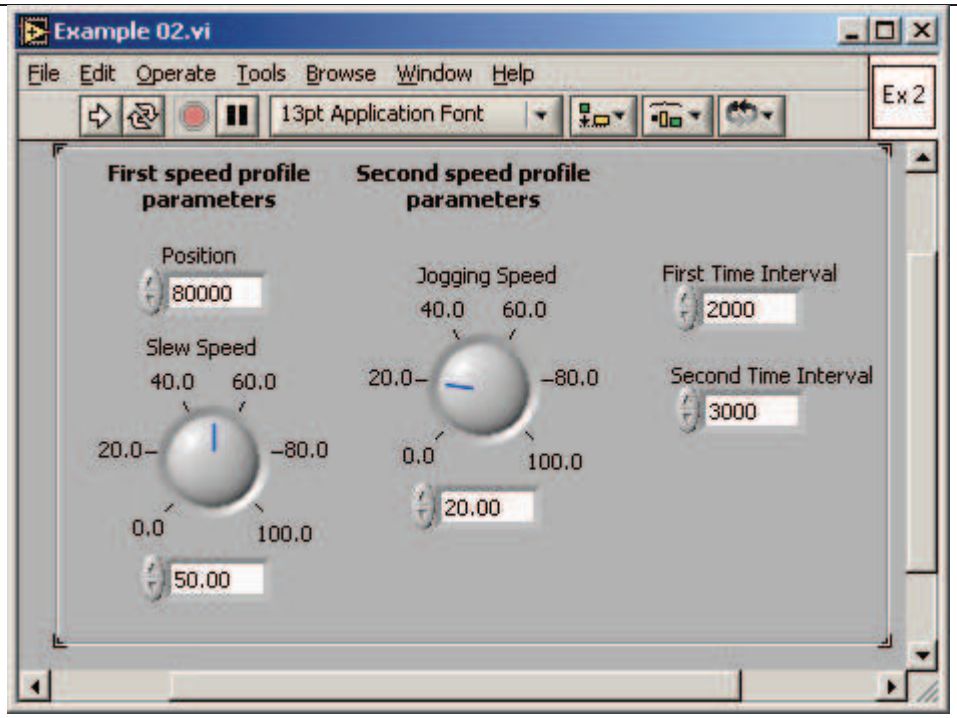

Example1.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 1
Position profile parameters
Speed profile parameters
Relative Position
100000
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
50.00
Speed
40.0
60.0
20.0
80.0
0.0
100.0
20.00
ERROR

4.2 Example 2. Positioning movement; wait a while; speed jogging; stop after a time period

This example implements a relative positioning movement, waits until the motion is finished, then stays stopped for a given time interval. After this time interval, the motor starts moving with a constant speed. After another time interval, the motor is stopped.

The VI front panel allows you to setup the parameters of the first speed profile, second speed profile, the time interval for which the motor remains stopped and the time interval after which the motor is stopped.

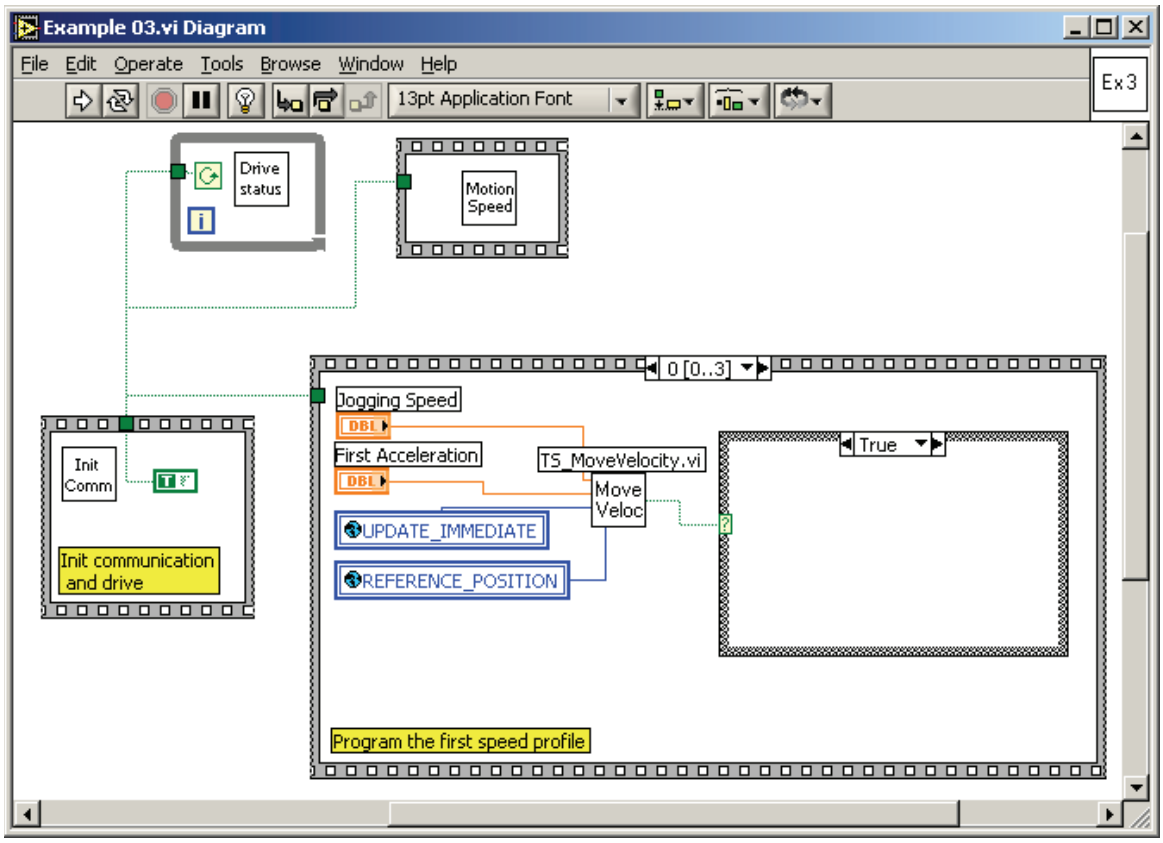


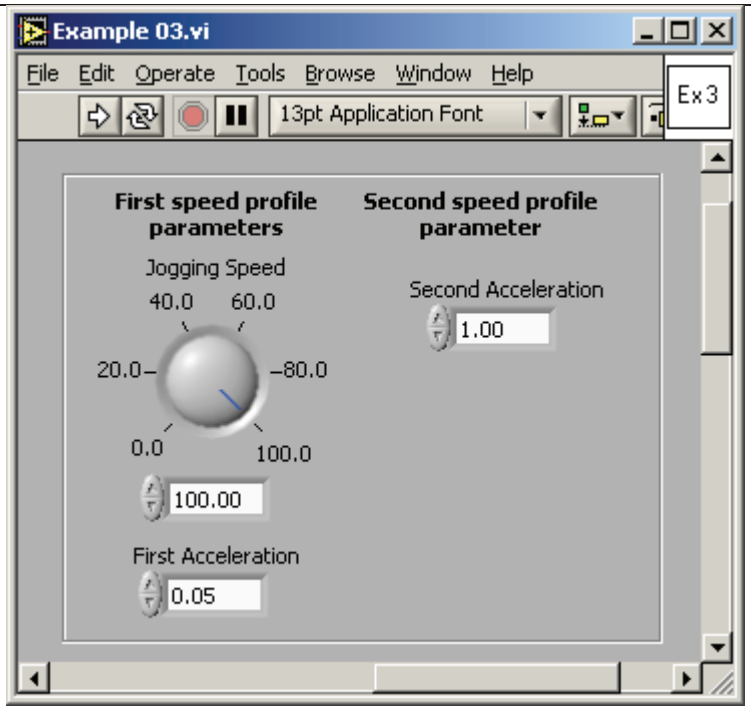

Example 02.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 2
First speed profile parameters
Second speed profile parameters
Position
80000
Slew Speed
40.0 60.0
20.0 -80.0
0.0 100.0
50.00
Jogging Speed
40.0 60.0
20.0 -80.0
0.0 100.0
20.00
First Time Interval
2000
Second Time Interval
3000

4.3 Example 3. Speed profile with two acceleration values

This example implements a speed movement having two different acceleration values during motor start: one acceleration value for speeds below a given level, and another acceleration value for speeds greater than the speed level. The motor is stopped after a time interval.

The VI front panel allows you to setup the parameters of the first speed profile and to set the acceleration for the second speed profiles.

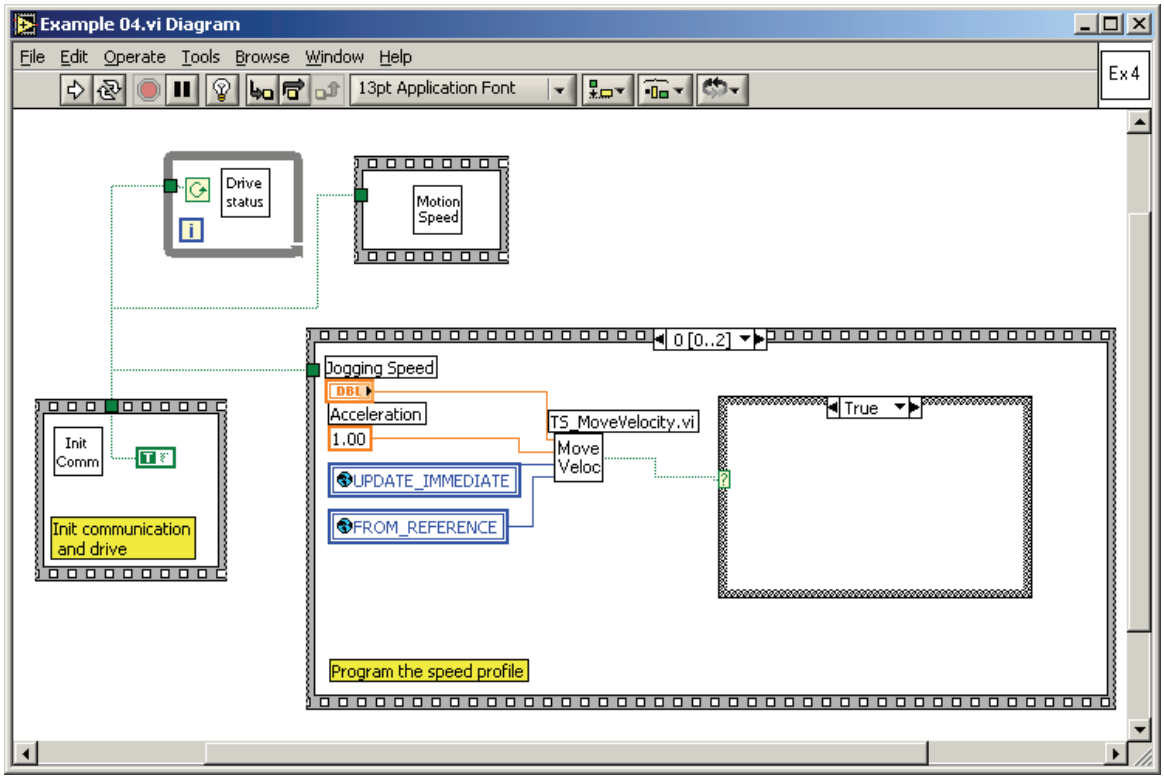


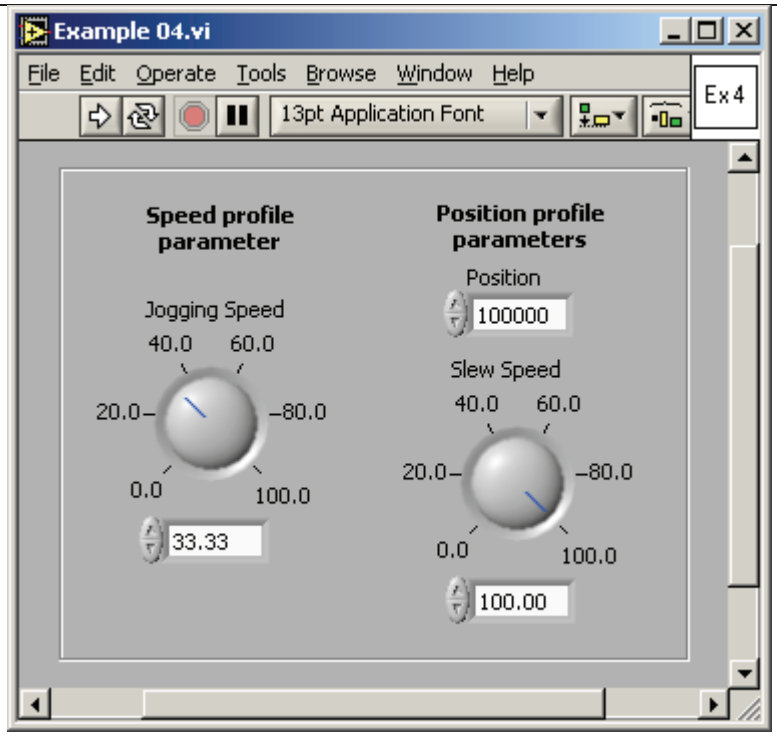

Example 03.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex3
First speed profile parameters
Second speed profile parameter
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
100.00
First Acceleration
0.05
Second Acceleration
1.00

4.4 Example 4. Speed jogging; wait a time period; positioning movement

This example implements a speed movement for a given time period, followed by a relative positioning. The VI allows you to setup the parameters of the speed and position profile.

The VI front panel allows you to setup the parameters of the speed and position profiles.

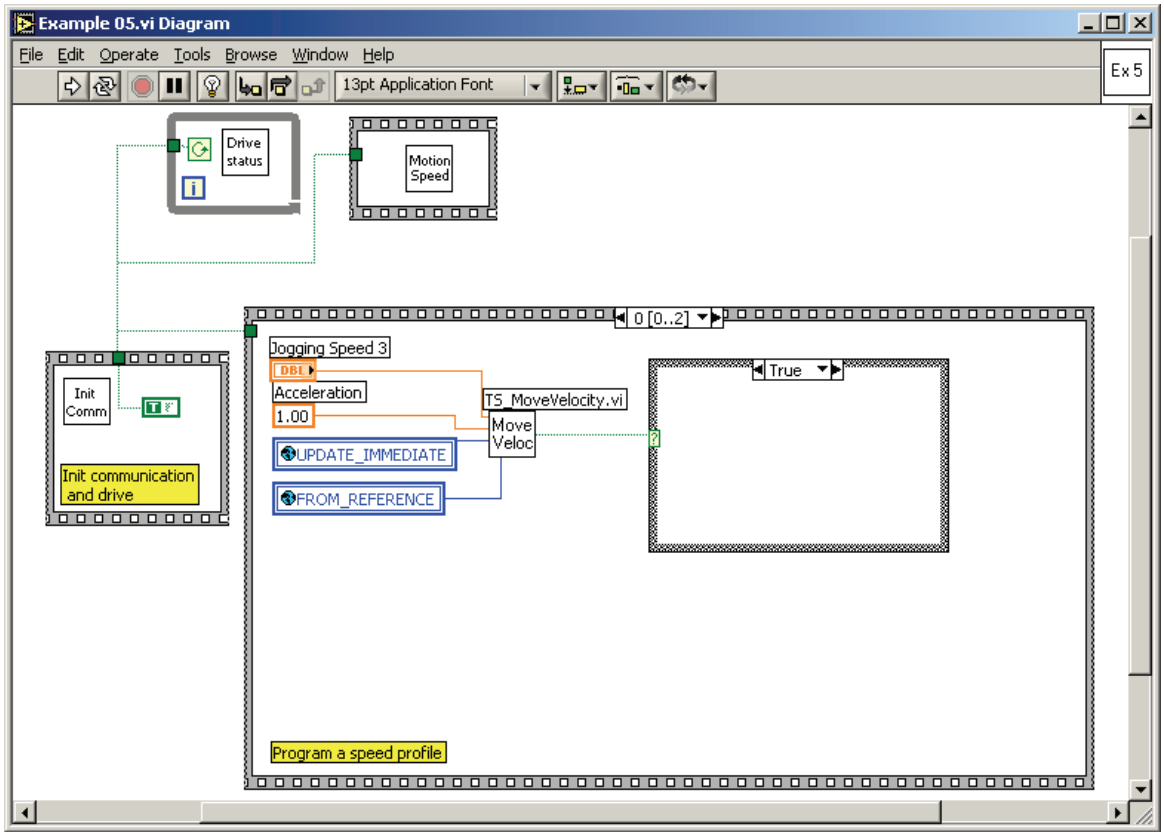


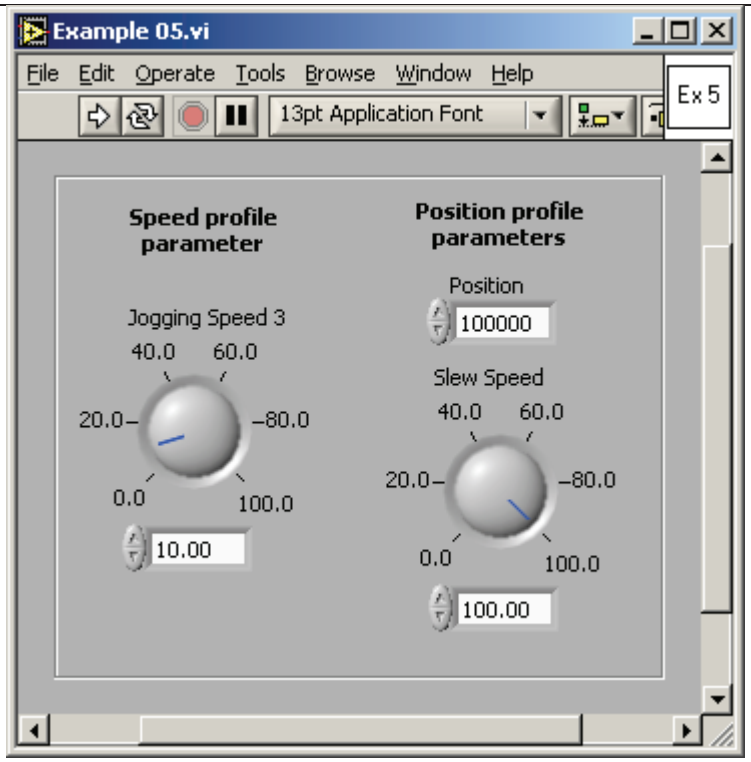

Example 04.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex4
Speed profile parameter
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
33.33
Position profile parameters
Position
100000
Slew Speed
40.0
60.0
20.0
80.0
0.0
100.0
100.00

4.5 Example 5. Speed jogging; wait for an input port to be triggered; positioning movement

This example implements a speed movement until a digital input of the drive is set to low. At that moment, a positioning movement with a different maximum speed is executed. The VI allows you to setup the parameters of the speed and position profiles. While the application is running, set to low the IN#37 digital input of the drive, in order to stop the motion.

The VI front panel allows you to setup the parameters of the speed and position profiles.




Example 05.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 5
Speed profile parameter
Jogging Speed 3
40.0 60.0
20.0 80.0
0.0 100.0
10.00
Position profile parameters
Position
100000
Slew Speed
40.0 60.0
20.0 80.0
0.0 100.0
100.00

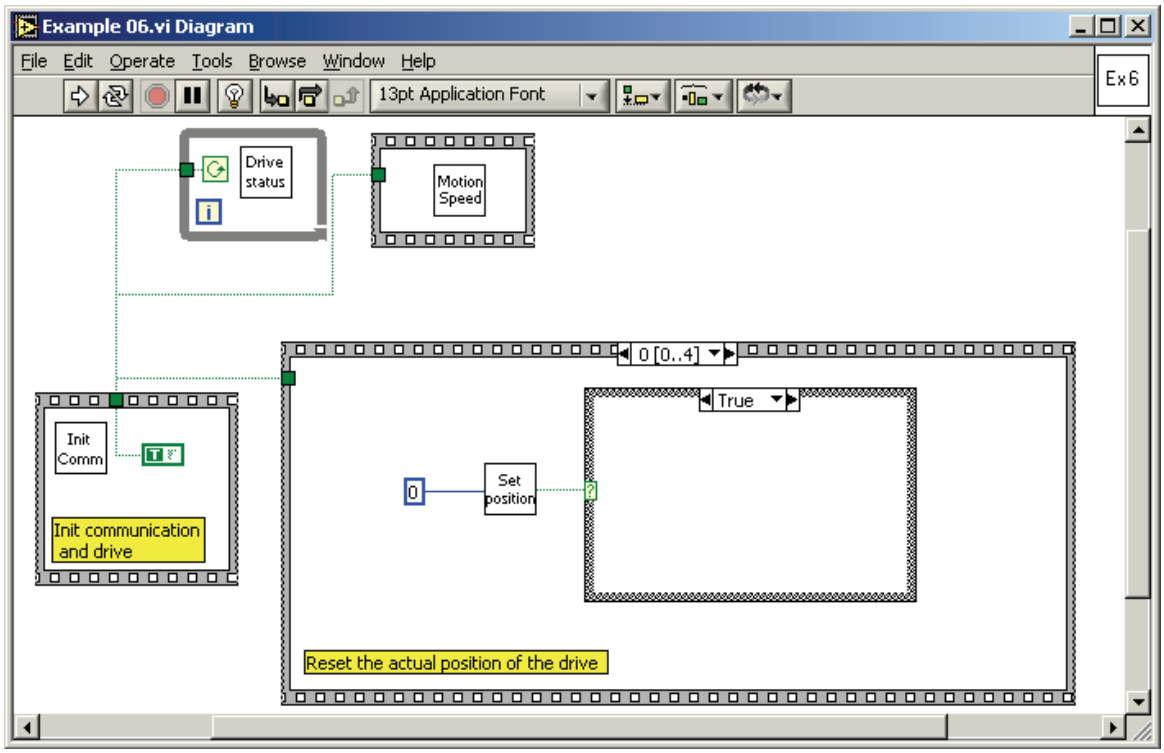
4.6 Example 6. Absolute position motion profile with different acceleration / deceleration rate

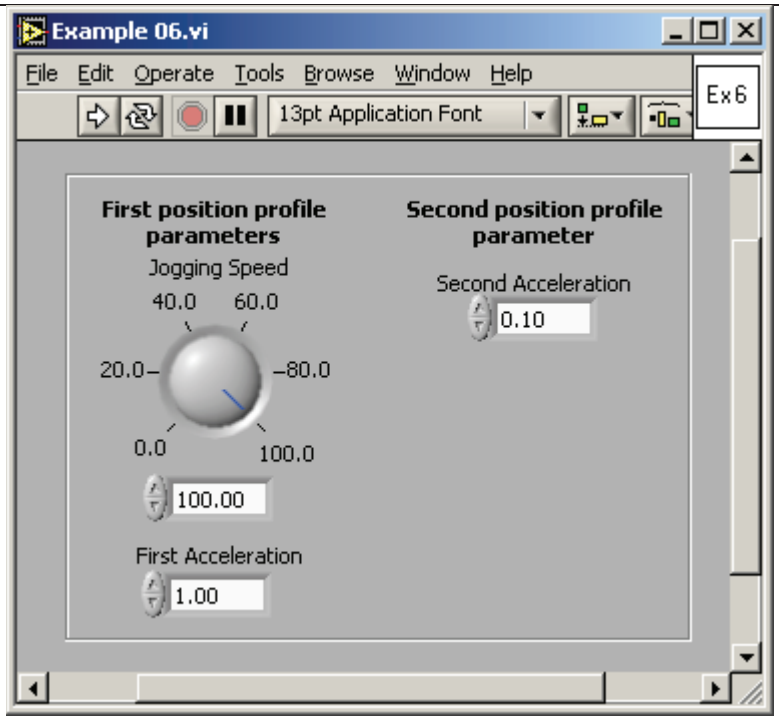
This example implements a position profile movement having different acceleration and deceleration values. One acceleration value is used at motor start. As the slew speed is reached, another acceleration value is set, thus the deceleration will be executed with the new value.

Note that in order to get this behavior, two conditions must be observed:

- The reference position must be big enough, so that the reference speed is a trapezoidal one (reaches the slew speed)
- The motor must reach slew speed during the acceleration part of the motion profile

The VI front panel allows you to setup the parameters of the first and of the second position profiles.

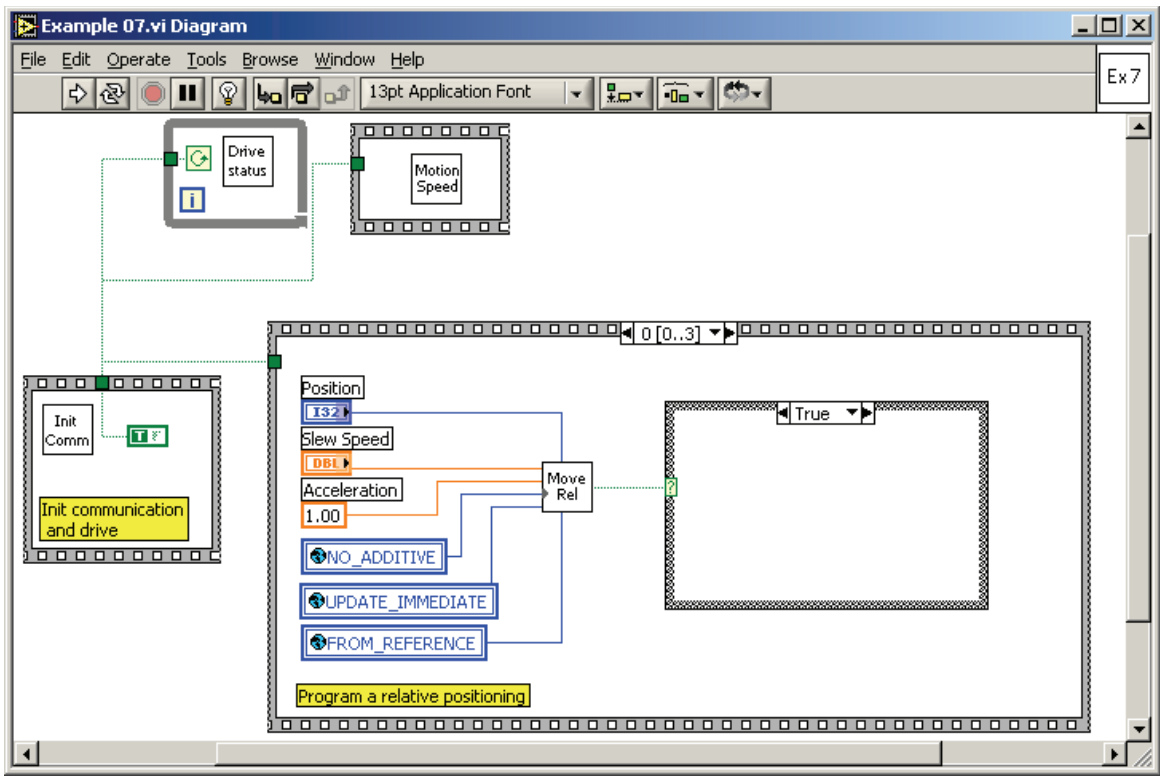


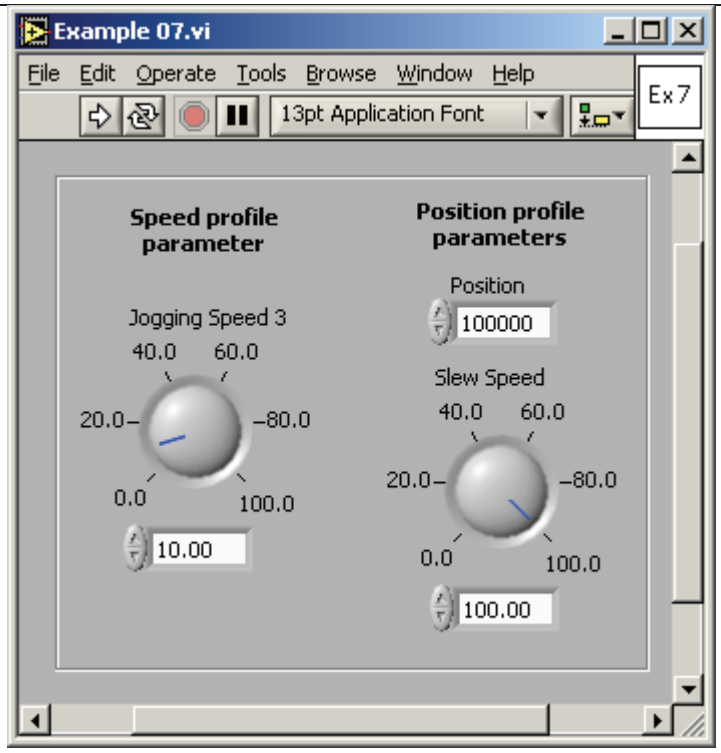

Example 06.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex6
First position profile parameters
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
100.00
First Acceleration
1.00
Second position profile parameter
Second Acceleration
0.10

4.7 Example 7. Positioning movement; speed jogging; wait a time period, then stop

This example implements a position profile movement followed by a speed profile jogging. After a time interval of movement on the speed profile, the motion is stopped.

The VI front panel allows you to setup the parameters of the first speed profile, the second speed profile and the second speed profile travel time interval.



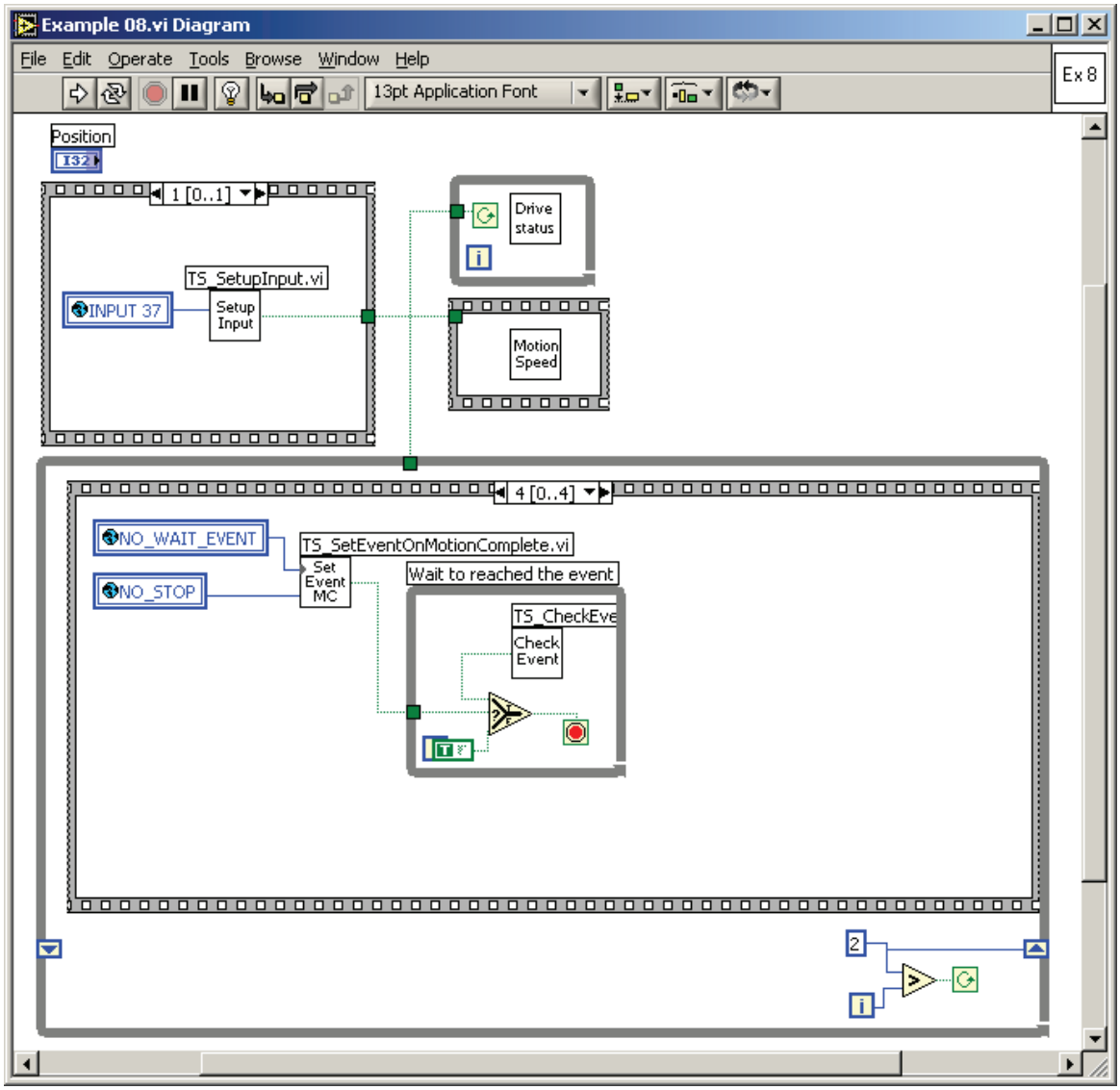

Example 07.vi
File Edit Operate Tools Browse Window Help
Ex7
13pt Application Font
Speed profile parameter
Jogging Speed 3
40.0
60.0
20.0
80.0
0.0
100.0
10.00
Position profile parameters
Position
100000
Slew Speed
40.0
60.0
20.0
80.0
0.0
100.0
100.00

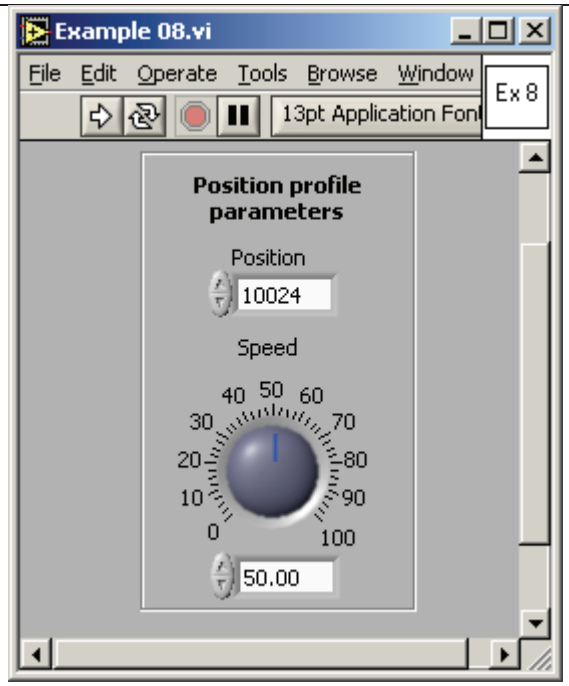
4.8 Example 8. Repeat a motion at input port set, with current reduction between motions

This example implements a repetitive position profile movement. The motion is repeated for a given number of times, each time when a digital input port is set to low level. Between the motions, while waiting for a new start, the motor current is set to a low, stand-by value. At motion start (when the digital input port level is set to low), the current is set to a run-time value. Each time the position is doubled as compared with the previous value.

***Remark**: This example can be used only with stepper open loop configuration.*

The VI front panel allows you to setup the parameters of the position profile.

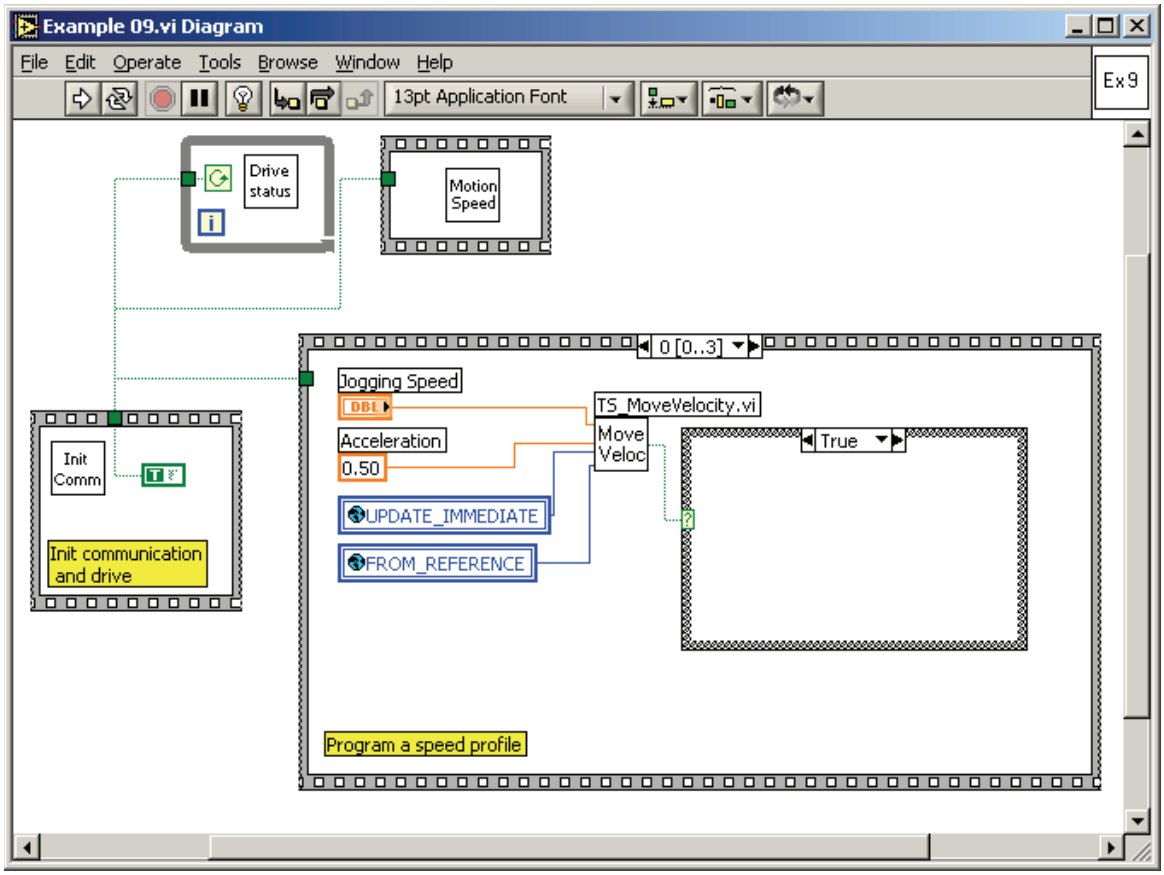


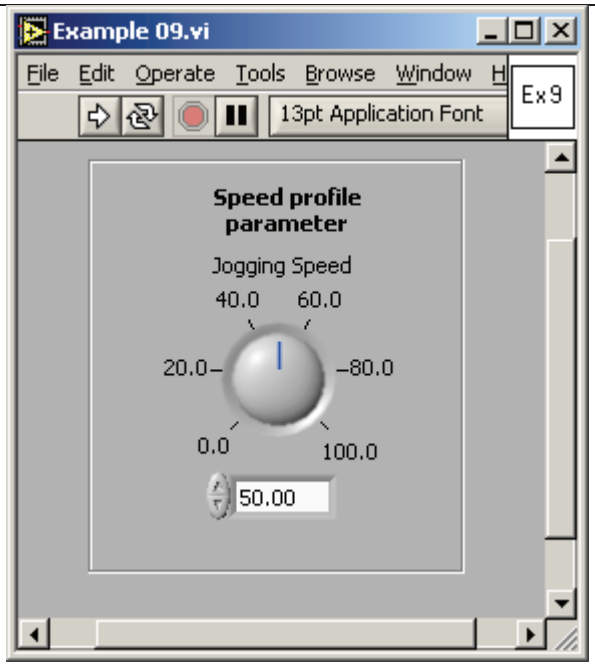

Example 08.vi
File Edit Operate Tools Browse Window
Ex 8
13pt Application Font
Position profile parameters
Position
10024
Speed
0 10 20 30 40 50 60 70 80 90 100
50.00

4.9 Example 9. Move to the positive limit switch, reverse to the negative limit switch

This example activates the limit switches of the drive, and then implements a jogging movement in the positive direction, until the positive limit switch is reached. At that moment, the motor is stopped, and a jogging movement is started in the negative direction (at negative speed) until the negative limit switch is reached. There the motor is stopped again.

The VI front panel allows you to setup the parameters of the speed profile.

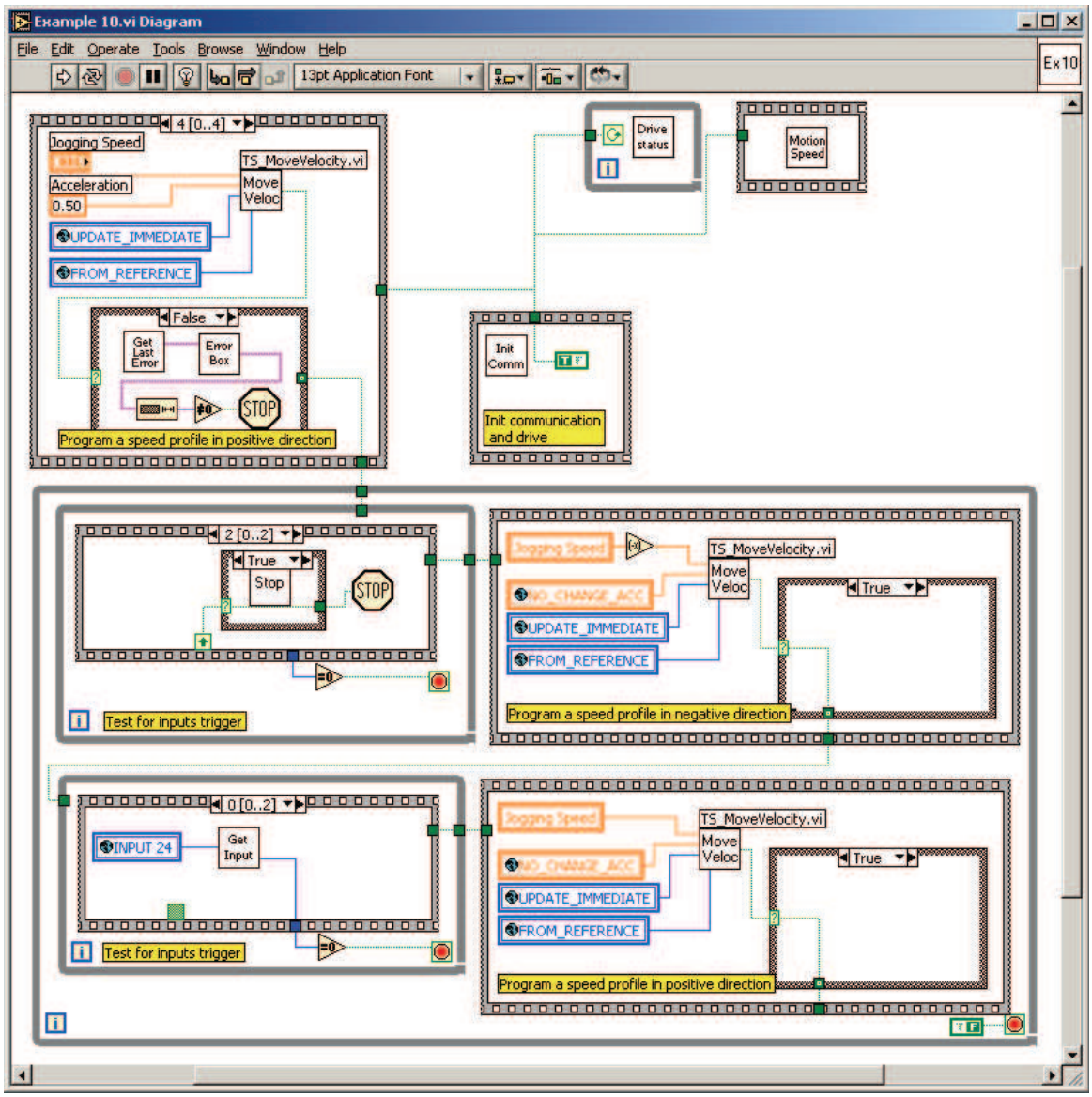


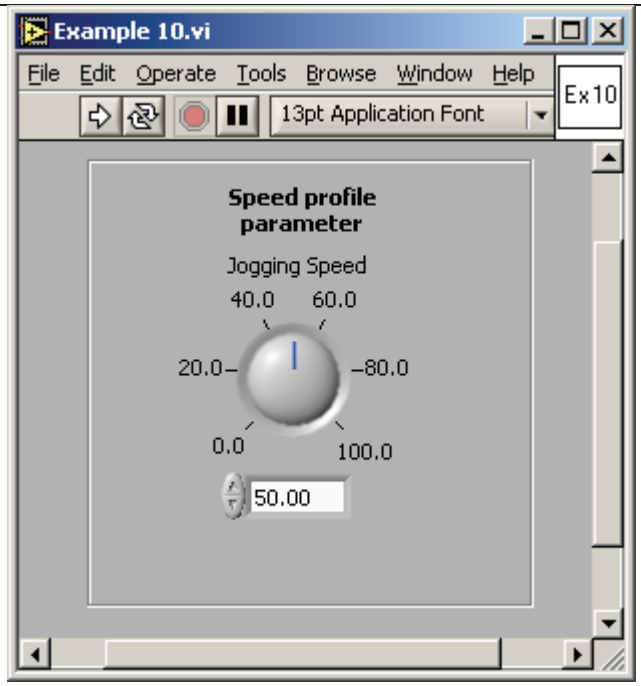

Example 09.vi
File Edit Operate Tools Browse Window H
Ex9
13pt Application Font
Speed profile parameter
Jogging Speed
40.0
60.0
20.0
-80.0
0.0
100.0
50.00

4.10 Example 10. Move between limit switches until an input port changes its status

This example implements a jogging movement between the positive and the negative limit switches, until a digital input changes its status. At that moment, the movement is stopped.

The VI front panel allows you to setup the parameter of the speed profile.

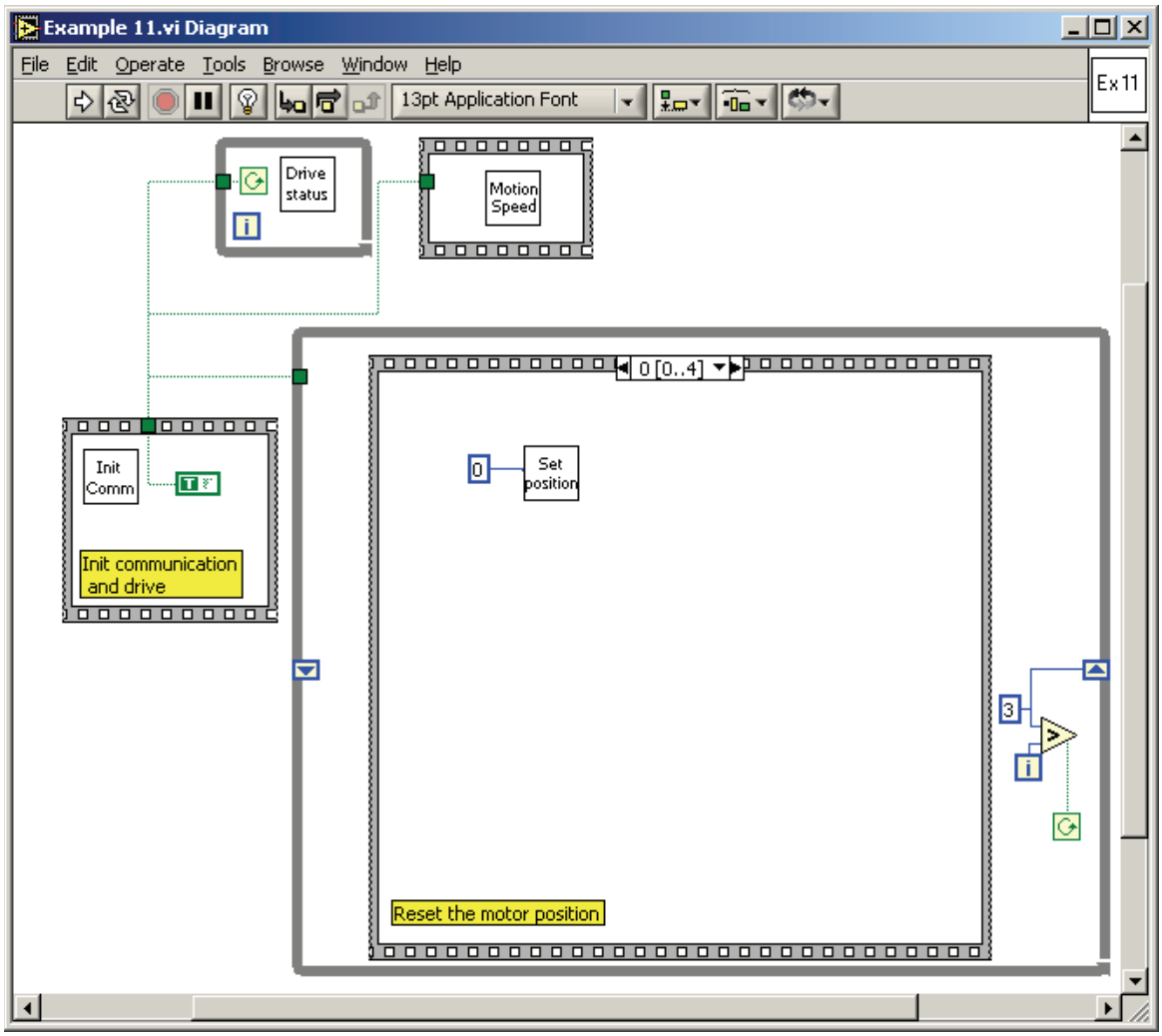


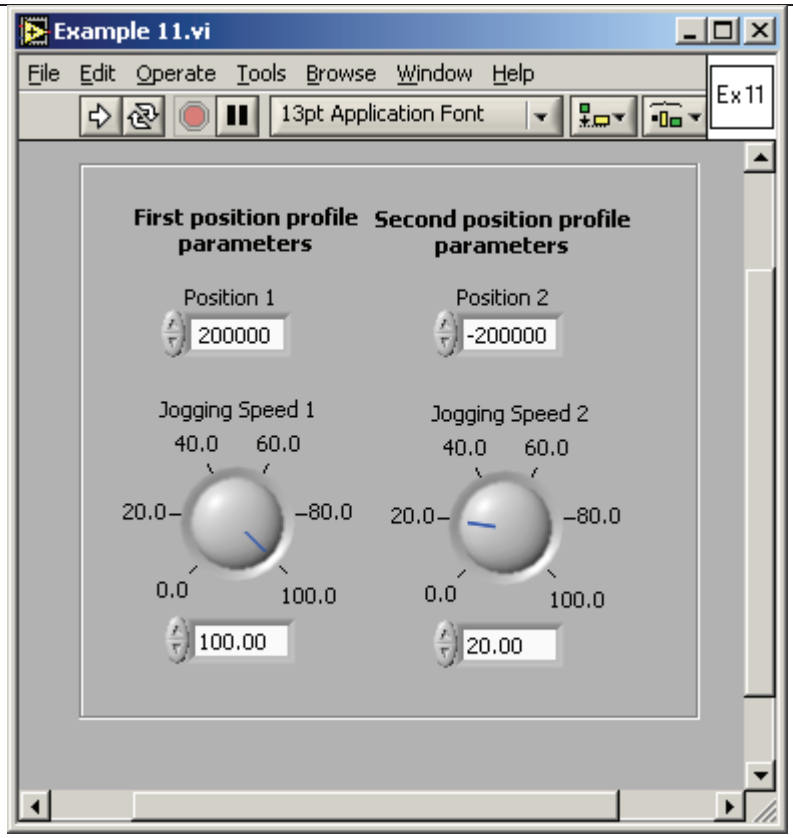

Example 10.vi
File Edit Operate Tools Browse Window Help
Ex10
13pt Application Font
Speed profile parameter
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
50.00

4.11 Example 11. Move forward and backward at 2 different speeds, for a given distance

This example implements a forward jogging movement, over a given relative distance, followed by a movement in the opposed direction, over the same relative distance, with a different jogging speed. The movement is repeated for a given number of times.

The VI front panel allows you to setup the parameters of the first and second speed profiles.

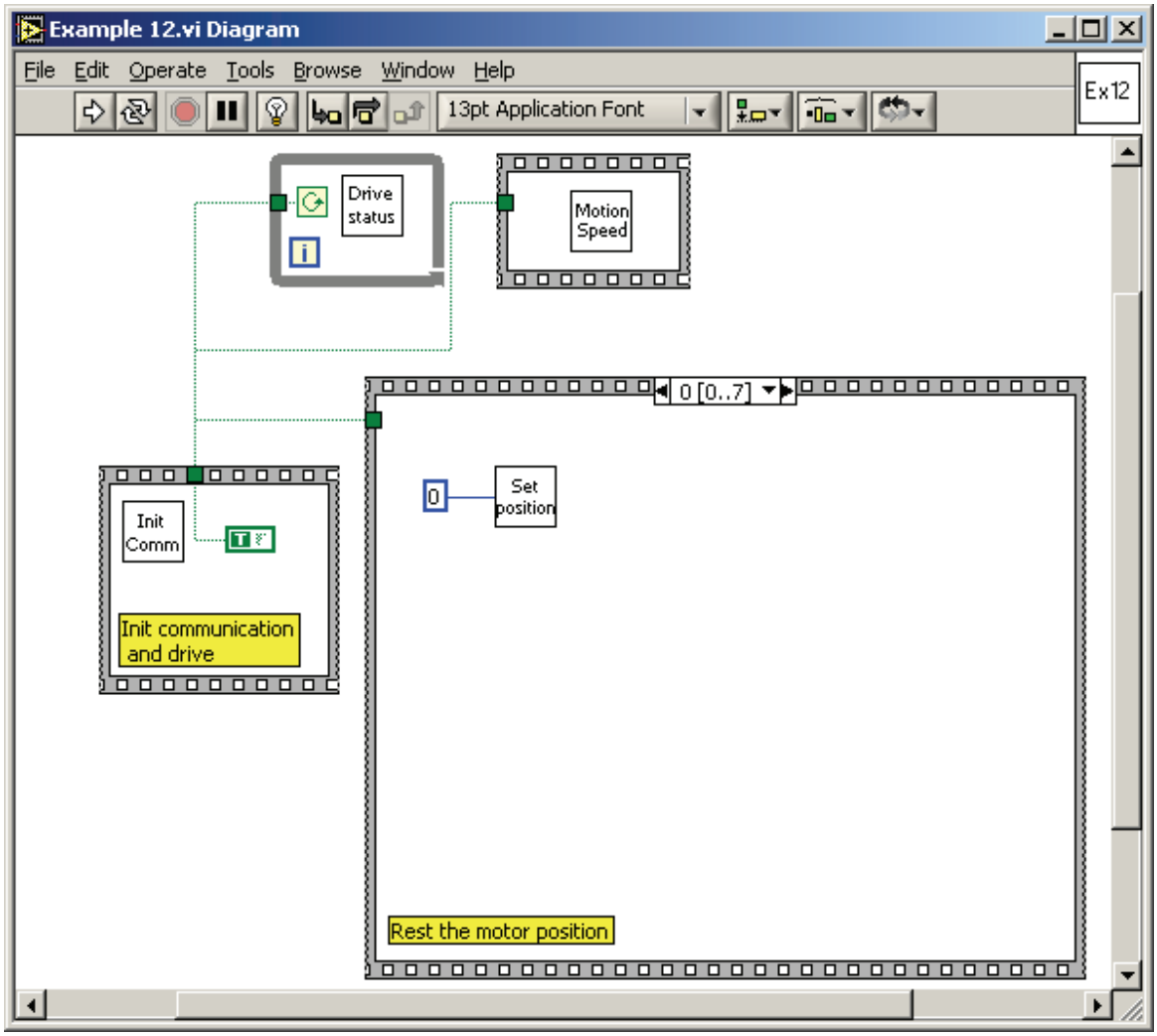


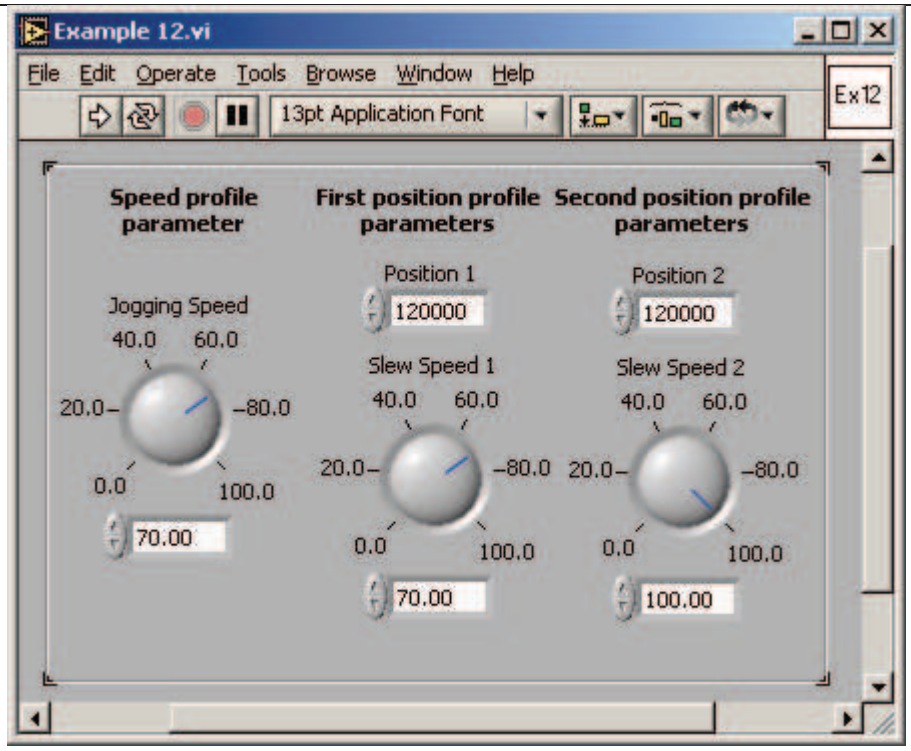

Example 11.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex11
First position profile parameters
Second position profile parameters
Position 1
200000
Position 2
-200000
Jogging Speed 1
40.0
60.0
20.0
-80.0
0.0
100.0
100.00
Jogging Speed 2
40.0
60.0
20.0
-80.0
0.0
100.0
20.00

4.12 Example 12. Speed profile, followed by profiled positioning at a given speed

This example implements a jogging movement, until a given speed reference, when an absolute positioning is started. During this positioning motion, the position profile is changed at a given value of the reference.

The VI allows you to setup the parameters of the speed profile, the first position profile and the second position profile.

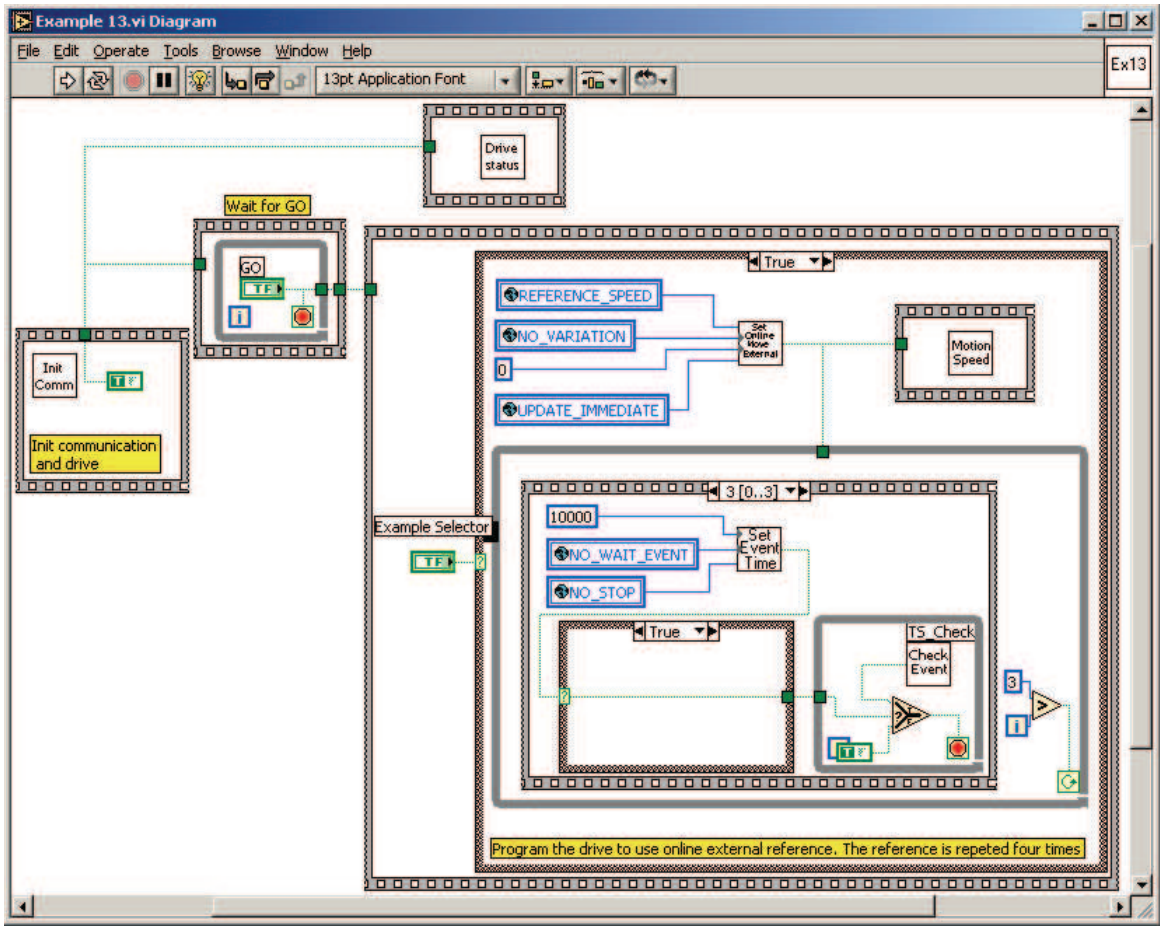


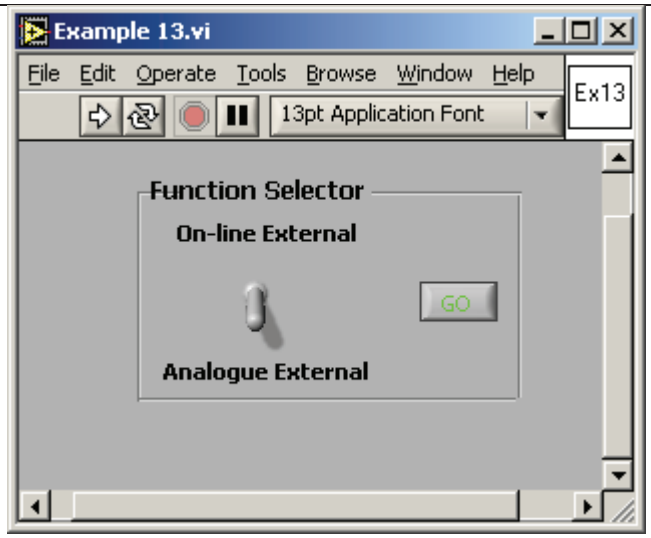

Example 12.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex12
Speed profile parameter
First position profile parameters
Second position profile parameters
Jogging Speed
40.0 60.0
20.0 -80.0
0.0 100.0
70.00
Position 1
120000
Slew Speed 1
40.0 60.0
20.0 -80.0
0.0 100.0
70.00
Position 2
120000
Slew Speed 2
40.0 60.0
20.0 -80.0
0.0 100.0
100.00

4.13 Example 13. Speed control with external reference

This example implements a speed control or position control function of user selection. When the user selects **Analogue** the drive uses the values read from analogue input Reference for positioning. With selection **Online** the drive is programmed to use the reference received online from the PC.

In the VI front panel select the reference type used and then press the GO button.

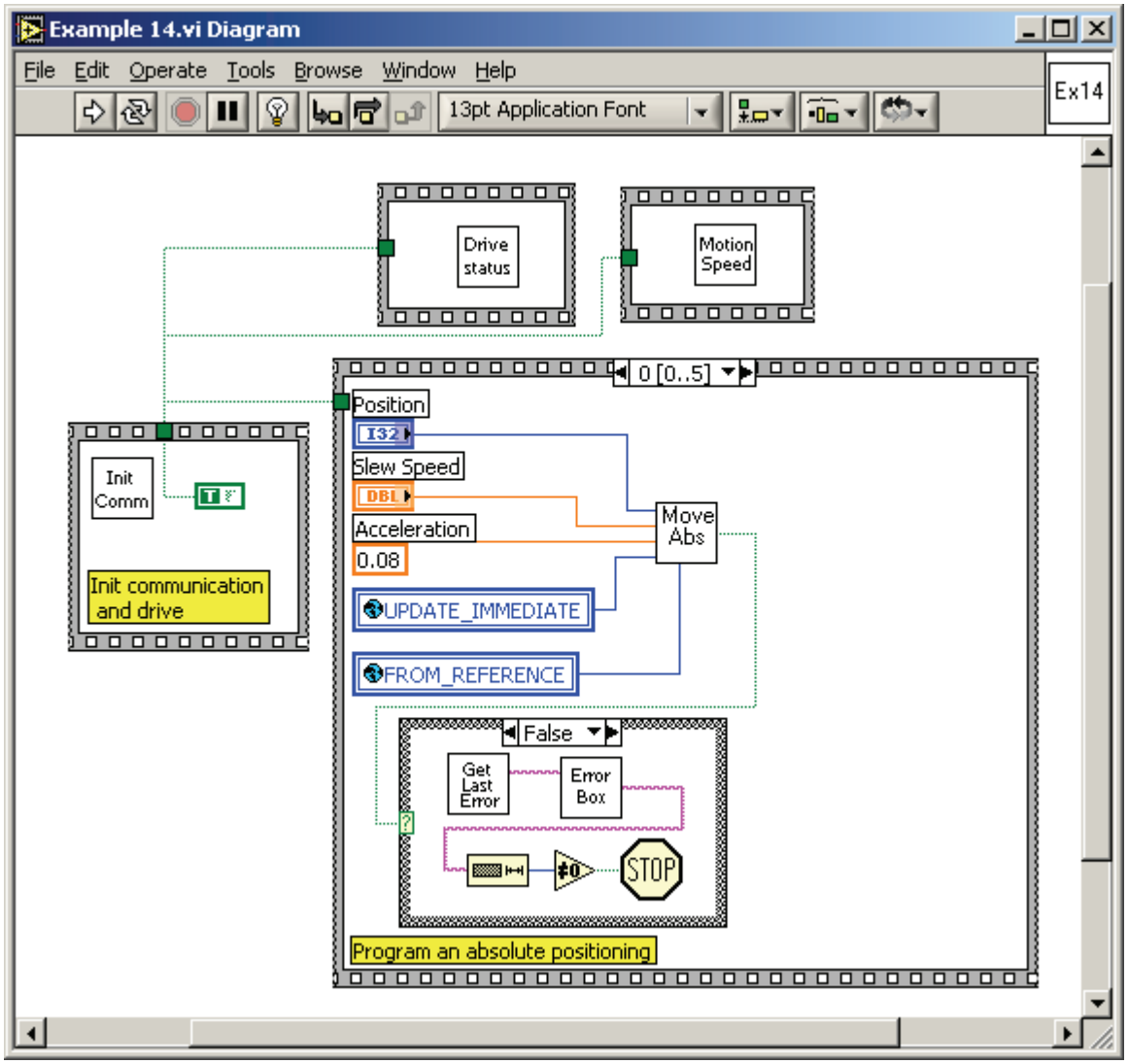


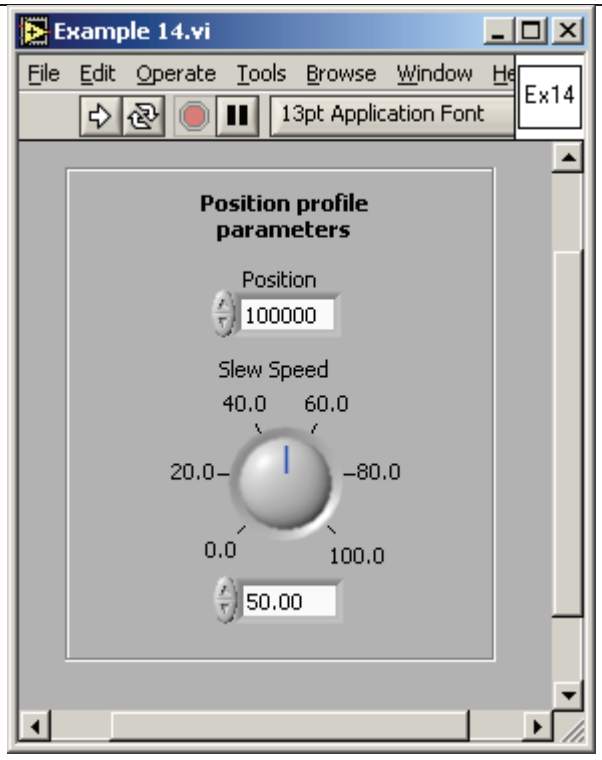

Example 13.vi
File Edit Operate Tools Browse Window Help
Ex13
13pt Application Font
Function Selector
On-line External
GO
Analogue External

4.14 Example 14. Profiled positioning, with output port status changing at a given position

This example implements a profiled positioning movement, and commutes the status of a digital output port of the drive, at a given motor position value.

The VI front panel allows you to setup the parameters of the position profile.

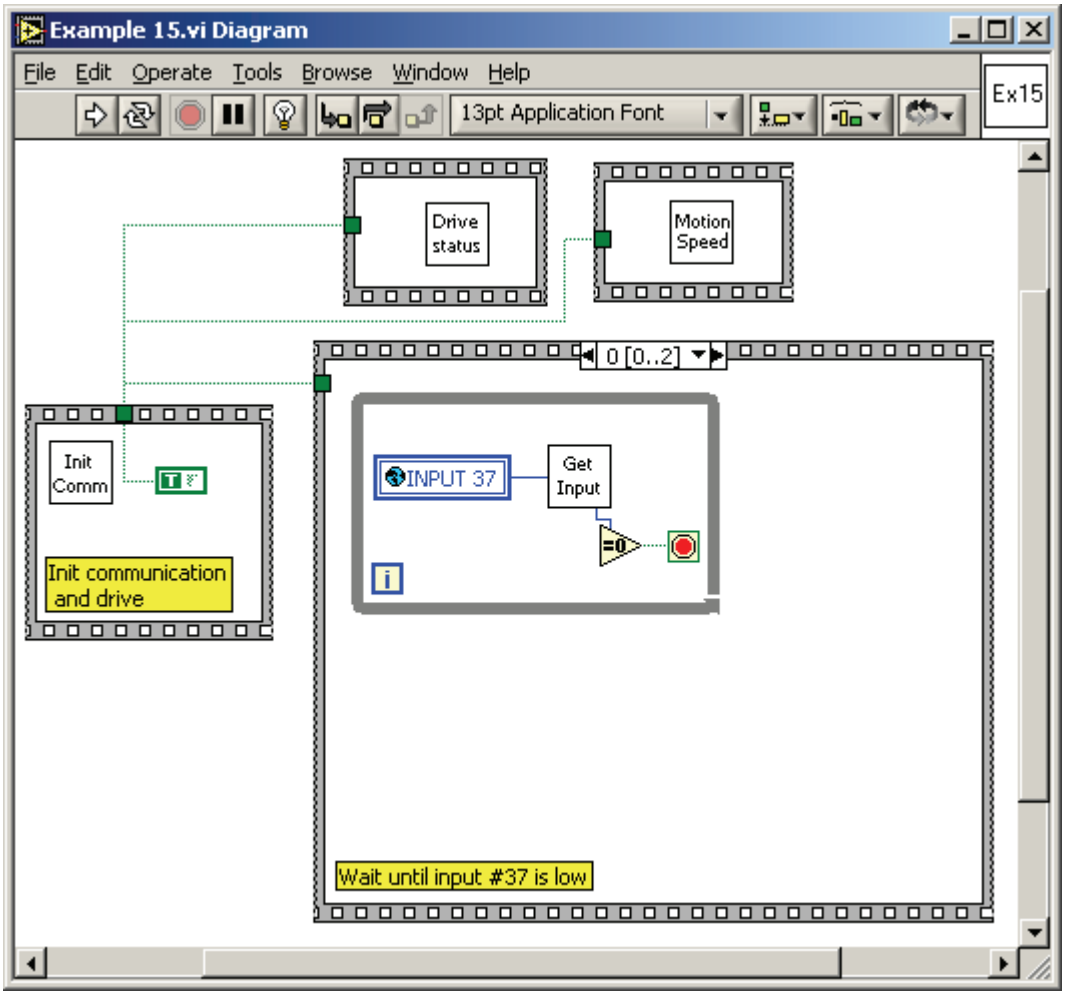


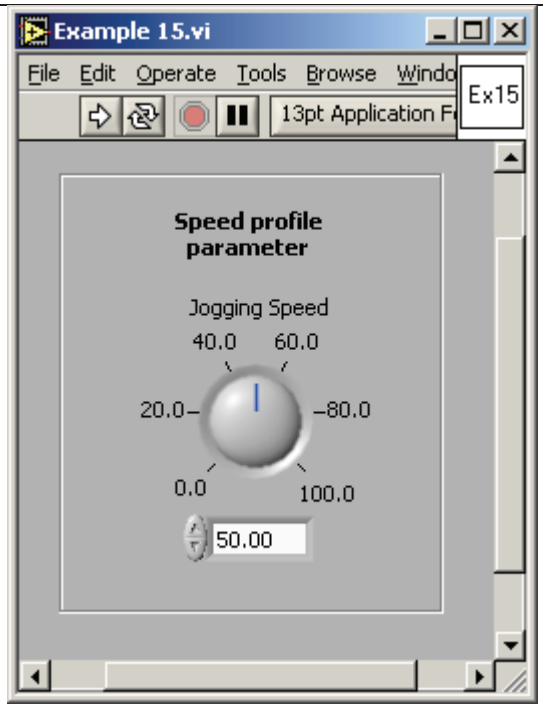

Example 14.vi
File Edit Operate Tools Browse Window He
Ex14
13pt Application Font
Position profile parameters
Position
100000
Slew Speed
40.0
60.0
20.0
80.0
0.0
100.0
50.00

4.15 Example 15. Execute a jogging speed motion, until the home input is captured

This example implements a profiled speed movement, until the home input capture is detected. At that moment, the motion is stopped.

The VI front panel allows you to setup the parameters of the speed profile. While the application is running, set the digital input port IN#38 to low, in order to stop the motor.

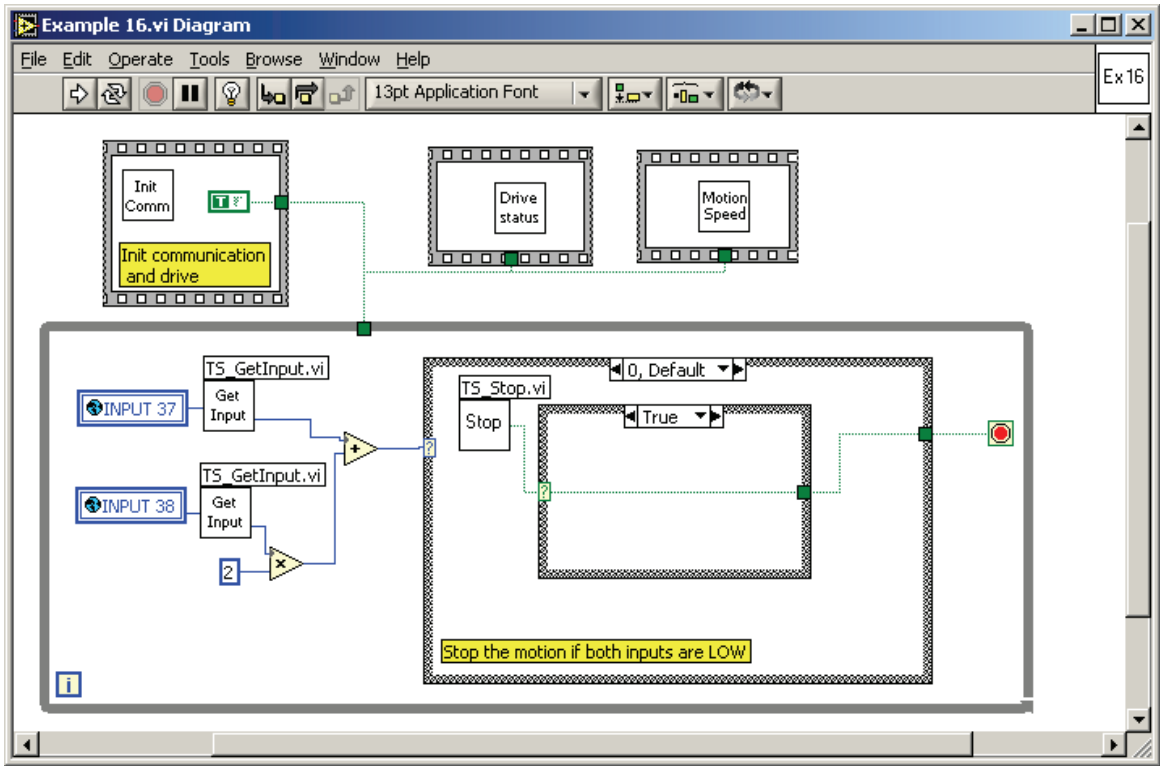


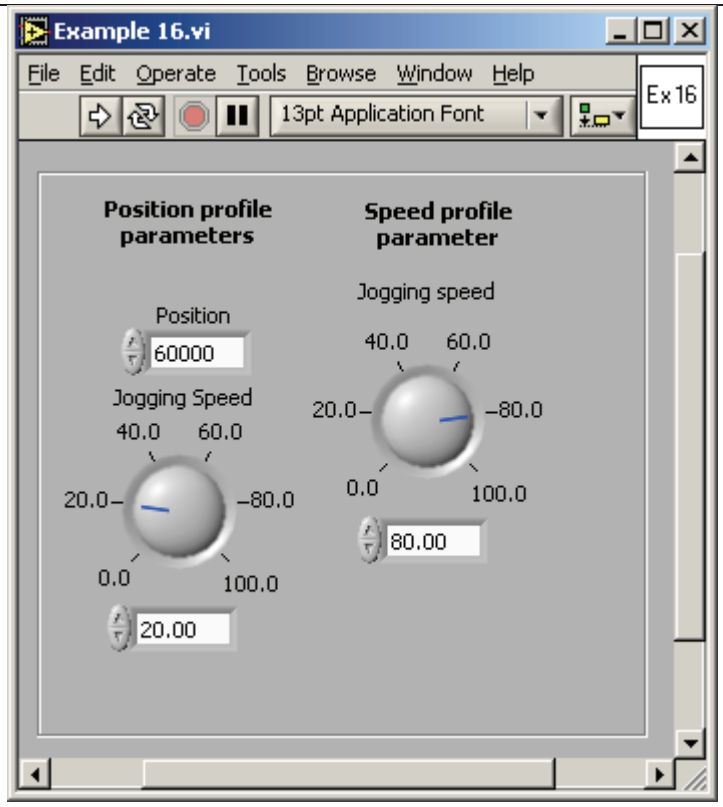

Example 15.vi
File Edit Operate Tools Browse Windo
Ex15
13pt Application F
Speed profile parameter
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
50.00

4.16 Example 16. Different motions based on the status of two digital inputs of the drive

This example implements different movements, based on the status of two digital input ports of the drive. The code continuously read the status of these ports and based on their values executes a speed profile (if first input is set to low), a position profile (if second input is set to low), or stops the motion and exit (if both inputs are set to low at the same time).

The VI front panel allows you to setup the parameters of the position profile and speed profile. While the application is running, set to low IN#37, in order to execute a position profile, or set to low the IN#38, in order to execute a speed profile. Then set to low both the IN#37 and IN#38 at the same time, in order to stop the motion.

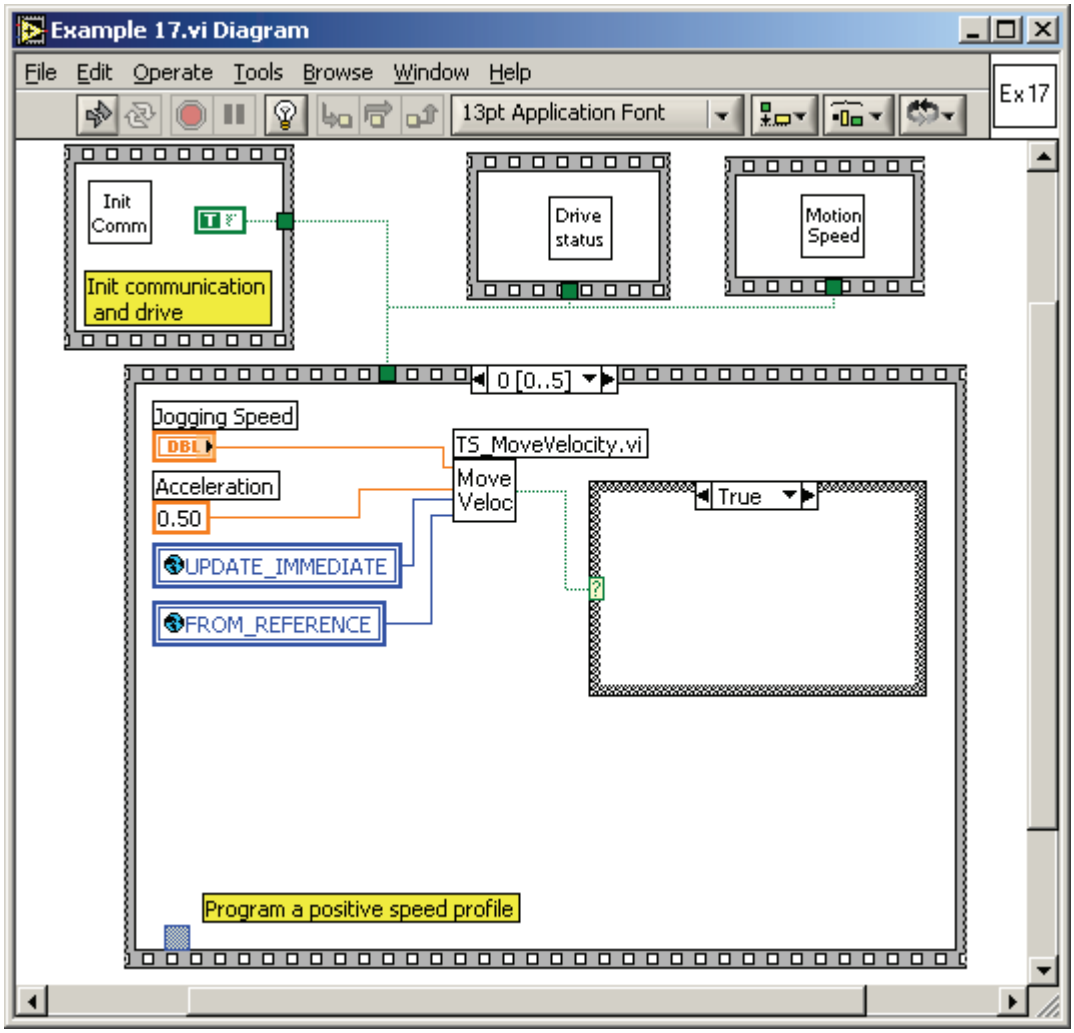


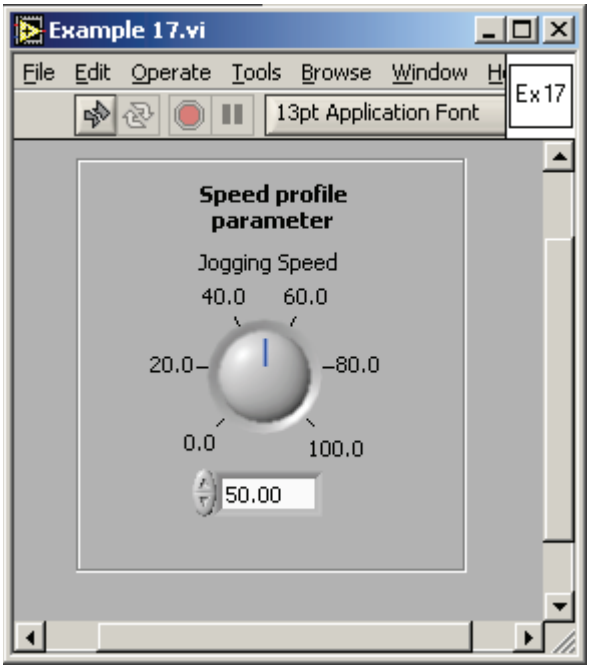

Example 16.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex16
Position profile parameters
Speed profile parameter
Position
60000
Jogging Speed
40.0
60.0
20.0
-80.0
0.0
100.0
20.00
Jogging speed
40.0
60.0
20.0
-80.0
0.0
100.0
80.00

4.17 Example 17. Move between limit switches. Power-off if blocked on a limit switch

This example implements a jogging movement, until the positive limit switch is reached. At that point, the motion is reversed, until the negative limit switch is reached, then the motion is stopped. The program checks if, after reversing the motion at positive limit switch reach, this limit switch continues to be ON, after a given time period. In this case, the drive is powered-OFF, as this can represent an emergency situation.

The VI front panel allows you to setup the parameters of the speed profile. Set to low the LSP input in order to reverse the motion. During the reverse motion, set to low the LSN input, in order to stop the motor. If the LSP input is set to low for a longer time, at its reach, the drive is powered-OFF.

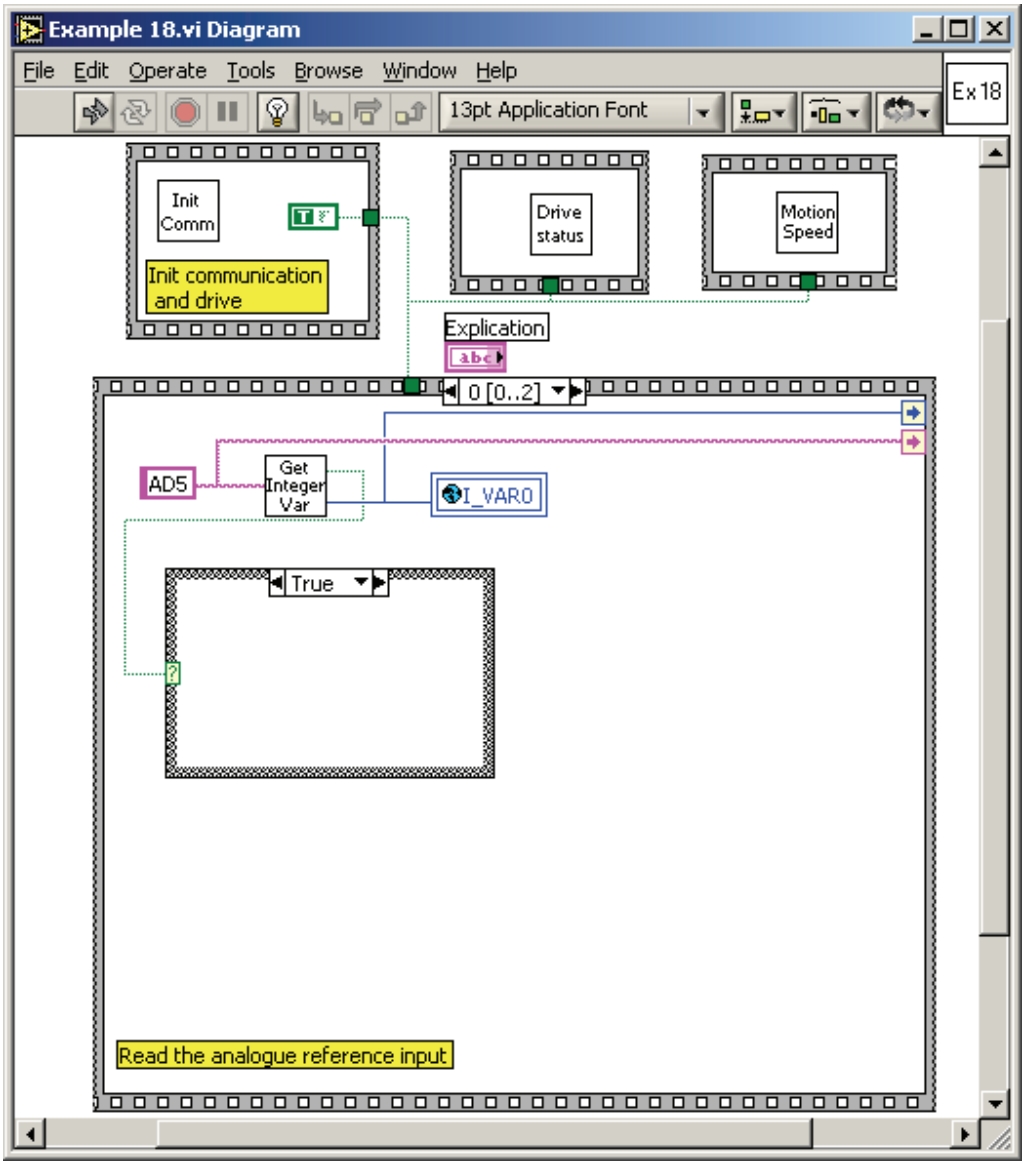


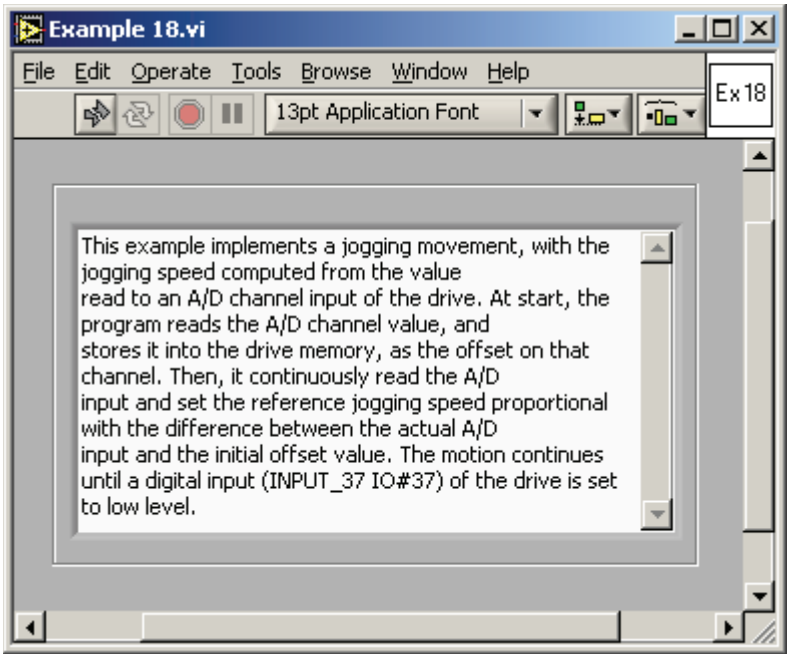

Example 17.vi
File Edit Operate Tools Browse Window
Ex17
13pt Application Font
Speed profile parameter
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
50.00

4.18 Example 18. Jog at a speed computed from an A/D signal, until a digital input is reset

This example implements a jogging movement, with the jogging speed computed from the value read to an A/D channel input of the drive. At start, the program reads the A/D channel value, and stores it into the drive memory, as the offset on that channel. Then, it continuously read the A/D input and set the reference jogging speed proportional with the difference between the actual A/D input and the initial offset value. The motion continues until a digital input of the drive is set to low.

Run the application. Change the value of the AD5 channel in order to modify the speed reference value. Set the status of the digital input port IN#37 to low, in order to stop the motion.

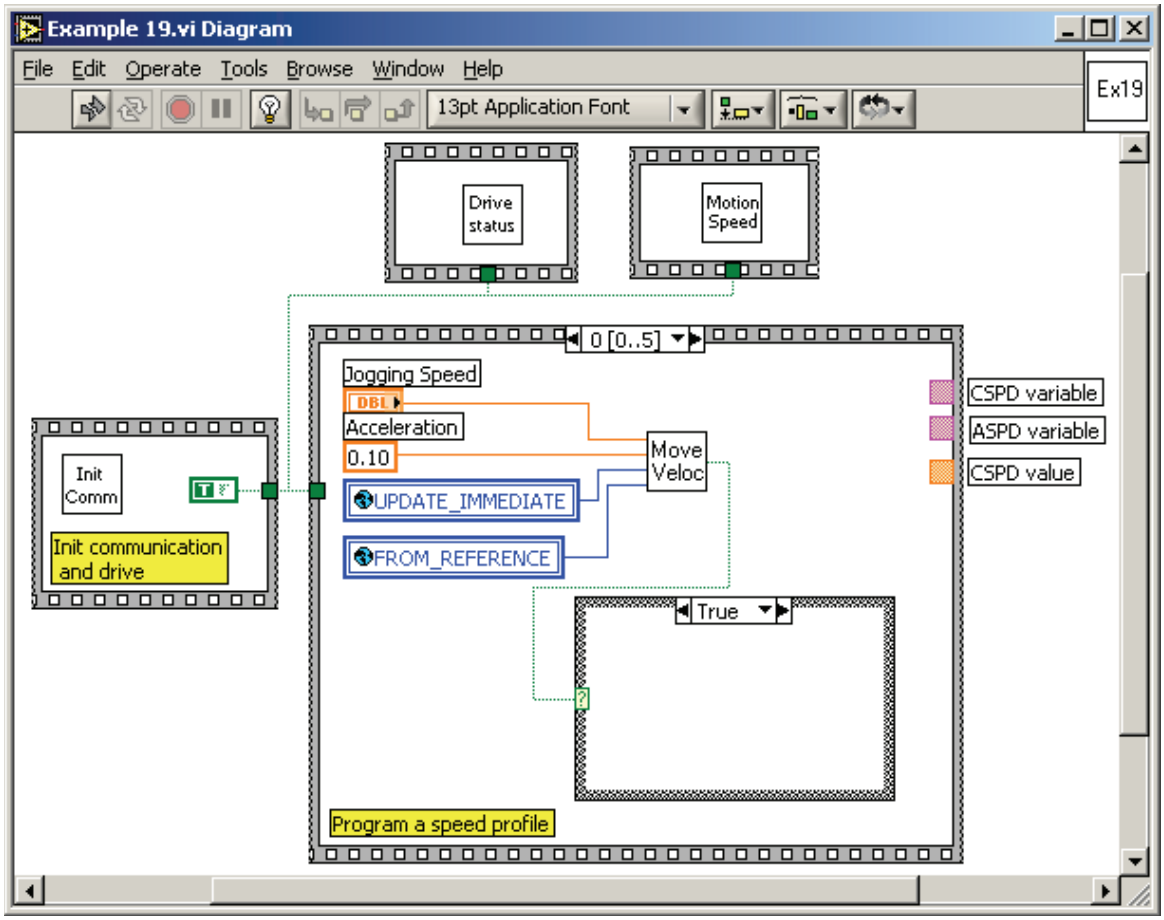


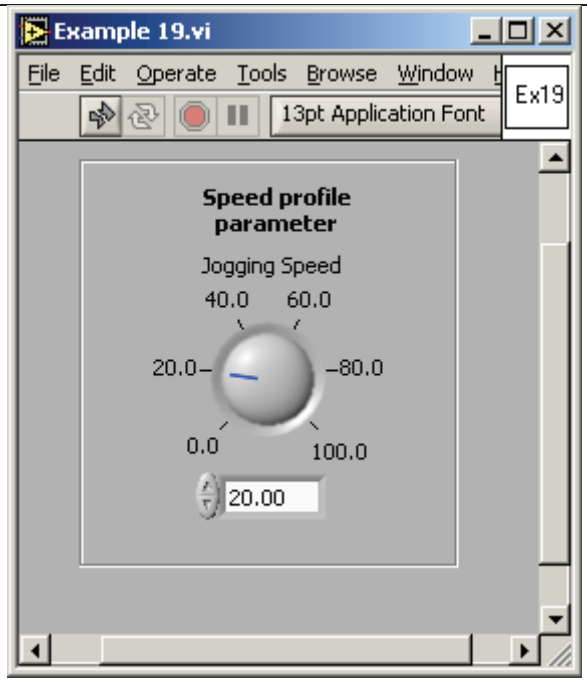

Example 18.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex18
This example implements a jogging movement, with the jogging speed computed from the value read to an A/D channel input of the drive. At start, the program reads the A/D channel value, and stores it into the drive memory, as the offset on that channel. Then, it continuously read the A/D input and set the reference jogging speed proportional with the difference between the actual A/D input and the initial offset value. The motion continues until a digital input (INPUT_37 IO#37) of the drive is set to low level.

4.19 Example 19. Speed control, with drive interrogation / setup of TML speed parameters

This example implements a jogging movement with two levels of speed reference. The program directly reads the TML speed reference and measured values, and decides the moments when to change the speed reference. The change is done also directly at the level of TML variables into the drive memory.

The VI front panel allows you to setup the parameters of the speed profile.




Example 19.vi
File Edit Operate Tools Browse Window
13pt Application Font
Ex19
Speed profile parameter
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
20.00

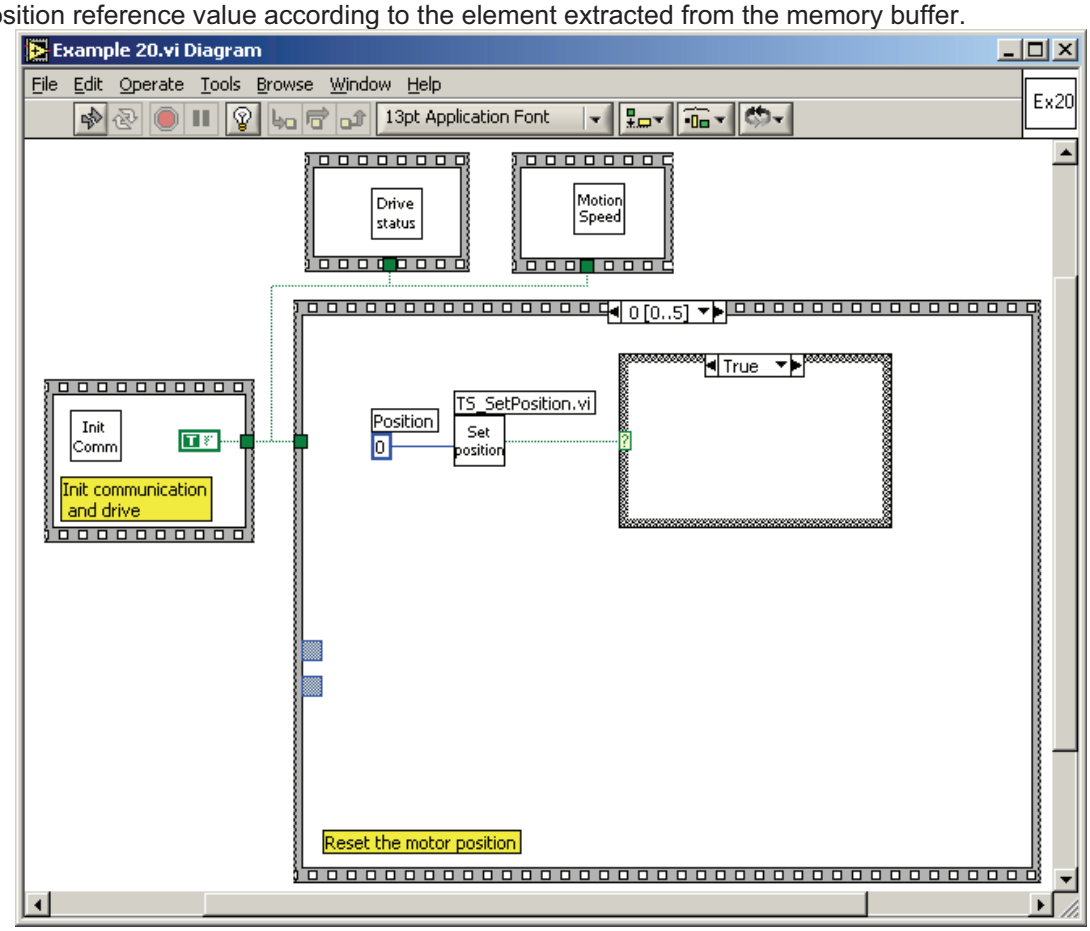
4.20 Example 20. Setup positioning motion, using tables stored into drive memory

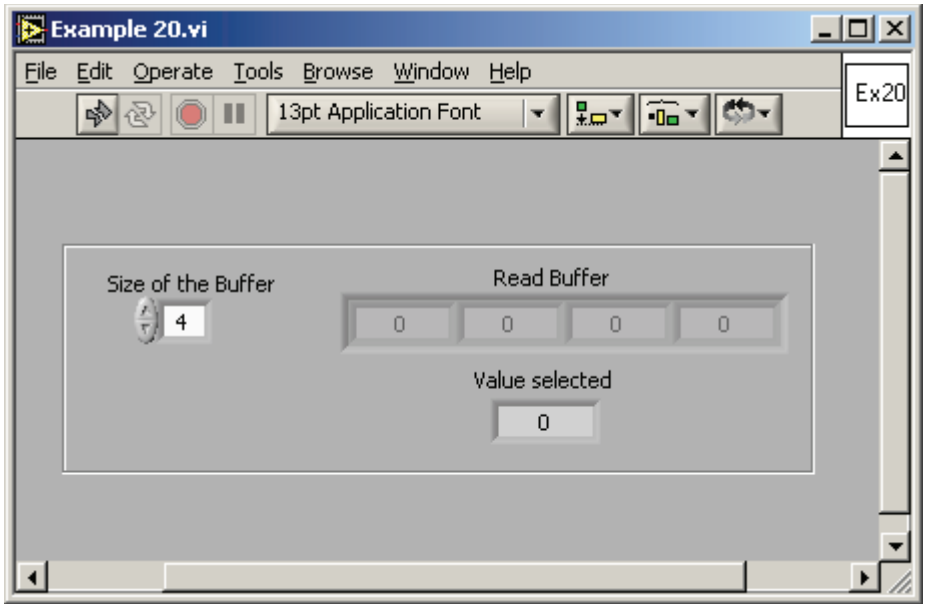
This example uses information locally stored in the drive internal memory, in order to set up motion parameters. Initially, the program stores 2 tables containing different values for reference positions. Then, as an example of using this information, it reads the value of an A/D channel of the drive and, based on the read value, selects one of the tables. The selected table is read from memory, and the motion is imposed based on a value read from that table at an internal location where the reference is stored.

Remarks:

1. *The tables' write operation should be done only once if the tables are stored into the EEPROM memory of the drive*
2. *Be careful when selecting the tables' memory location, as writing at incorrect addresses can affect the correct operation of the drive.*

Change the AD5 channel level, in order to set a value that will choose which element to extract from the memory buffer. Then run the application. The motor will start a position profile with a position reference value according to the element extracted from the memory buffer.



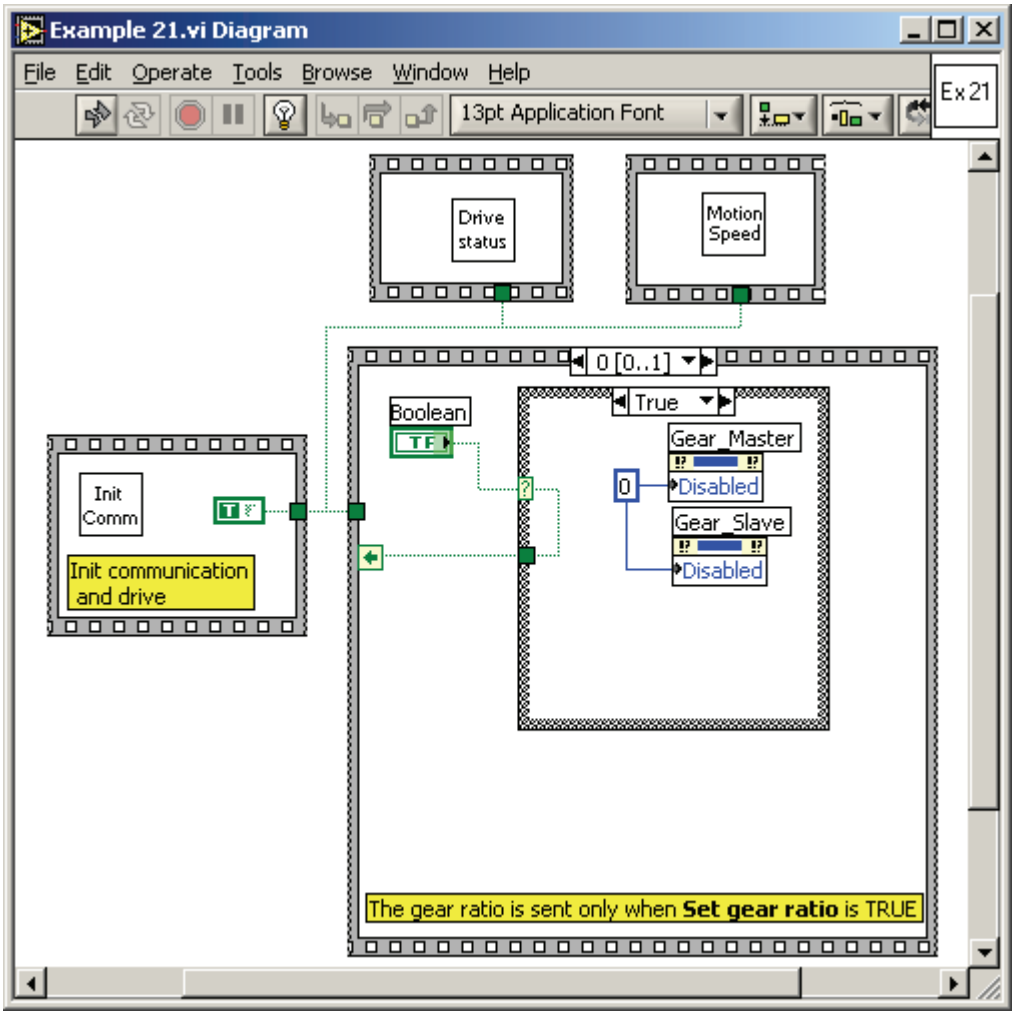

Example 20.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex20
Size of the Buffer
4
Read Buffer
0 0 0 0
Value selected
0

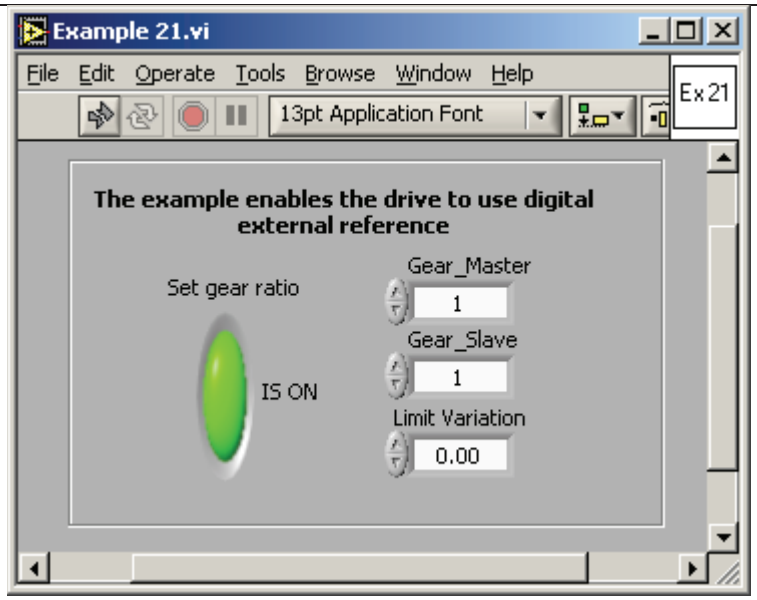
4.21 Example 21. Setting the Digital External motion mode

This example programs the drive to operate with external digital reference. The external position reference is computed from pulse & direction signals.

Run the application. While the application is running, apply pulses to the '**Pulse'** input of the drive (IN#38). Set the '**Direction'** input (IN#37) to low or high level, in order to change motion direction.

Remark: *For this example you have to setup the drive to read the digital external reference from pulse & direction inputs.*

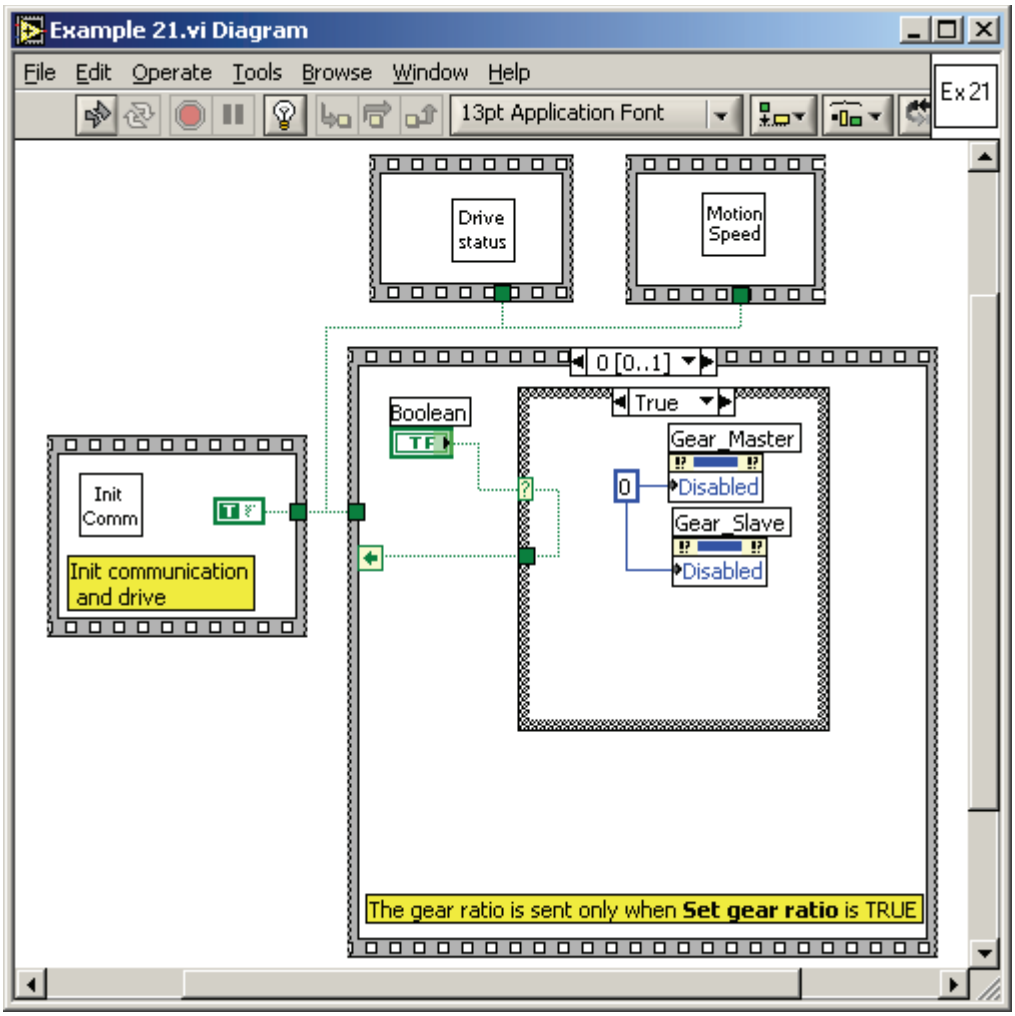


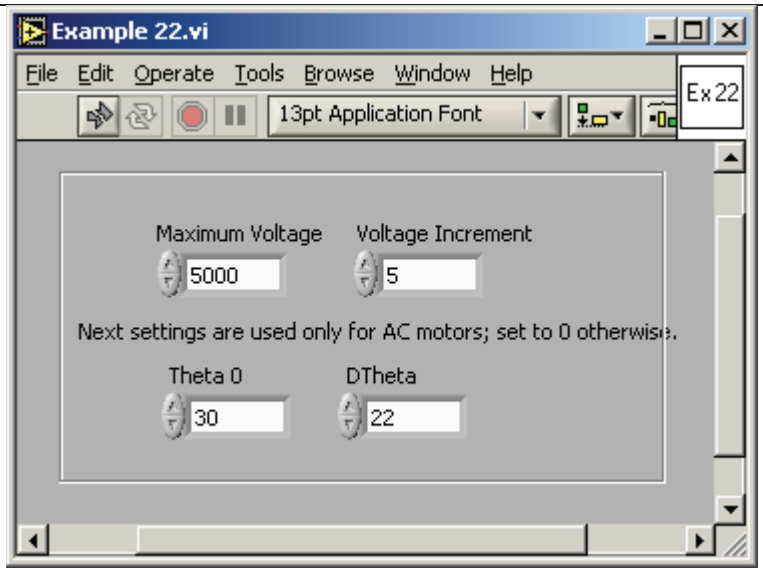

Example 21.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex21
The example enables the drive to use digital external reference
Set gear ratio
IS ON
Gear_Master
1
Gear_Slave
1
Limit Variation
0.00

4.22 Example 22. Test the voltage mode, with event on voltage reference

This example activates the test voltage mode on a drive. A variable voltage vector is generated on motor phases, with prescribed increment and maximum value. For AC motor configurations, the voltage vector can also be rotated, with a prescribed initial and increment angle.

Setup the maximum voltage and the voltage increment parameters. If the drive controls an AC motor, set the **Theta0**, **Dtheta** parameters, else set them to 0. Then run the application.

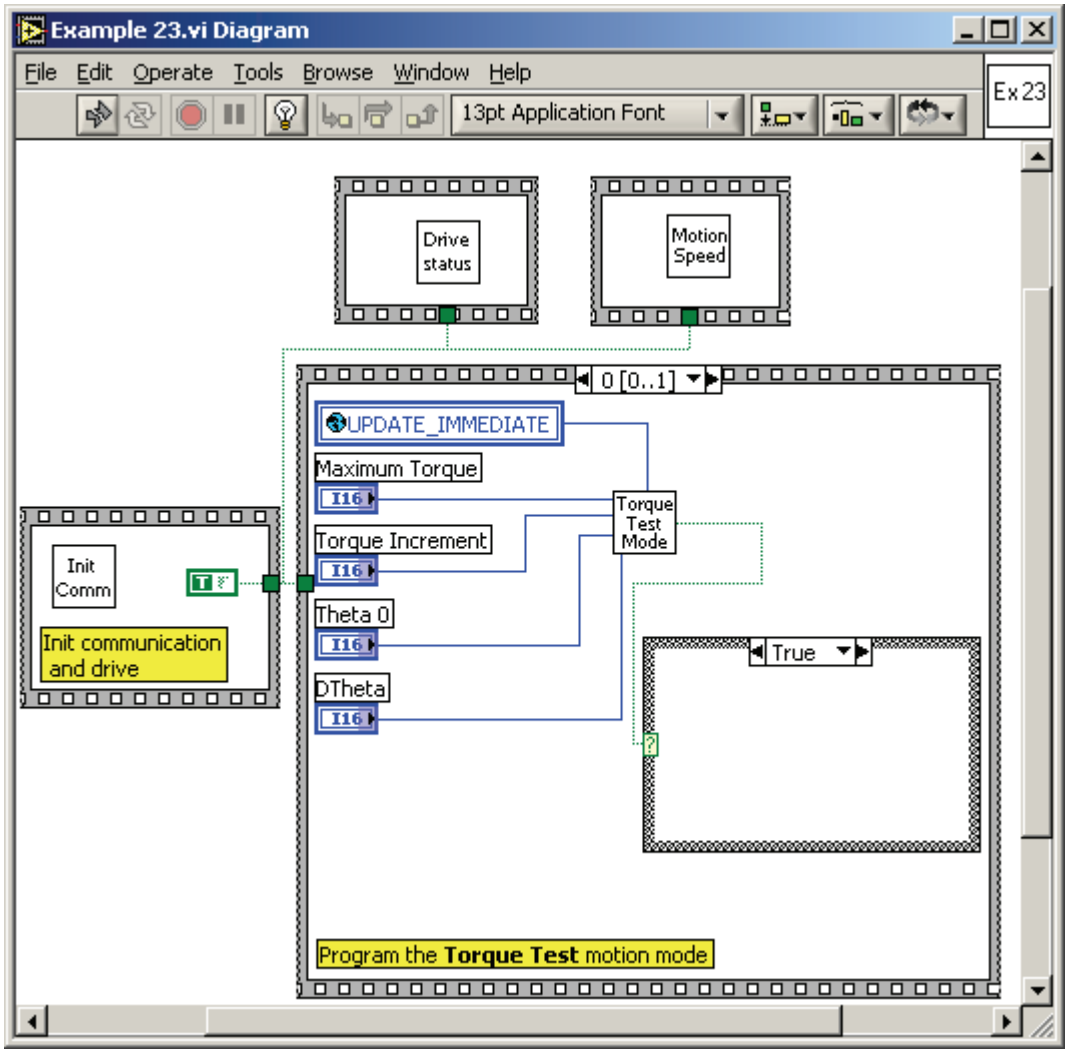


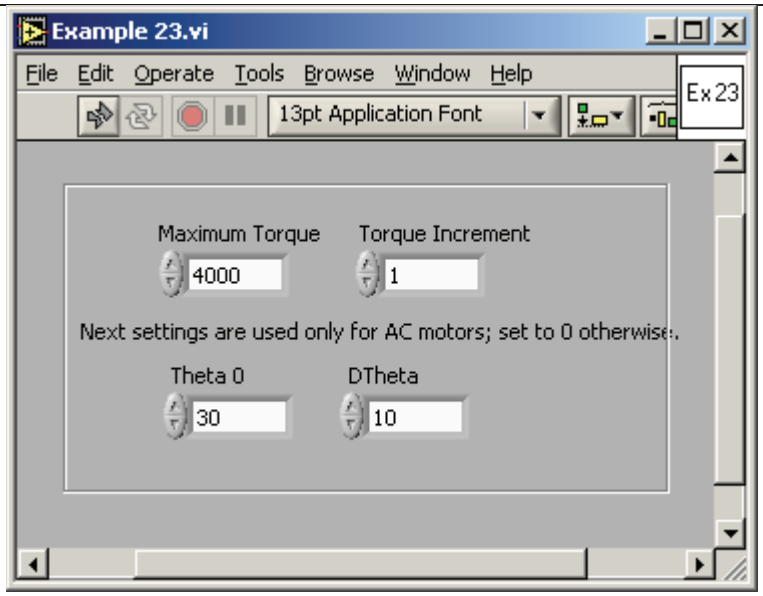

Example 22.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex22
Maximum Voltage
5000
Voltage Increment
5
Next settings are used only for AC motors; set to 0 otherwise.
Theta 0
30
DTheta
22

4.23 Example 23. Test torque mode, with event on torque reference

This example activates the test torque mode on a drive. A variable current vector is generated on motor phases, with prescribed increment and maximum value. For AC motor configurations, the current vector can also be rotated, with a prescribed initial and increment angle.

Setup the maximum torque and the torque increment parameters. If the drive controls an AC motor, set the **Theta0**, **Dtheta** parameters, else set them to 0. Then run the application.




Example 23.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex23
Maximum Torque
4000
Torque Increment
1
Next settings are used only for AC motors; set to 0 otherwise.
Theta 0
30
DTheta
10

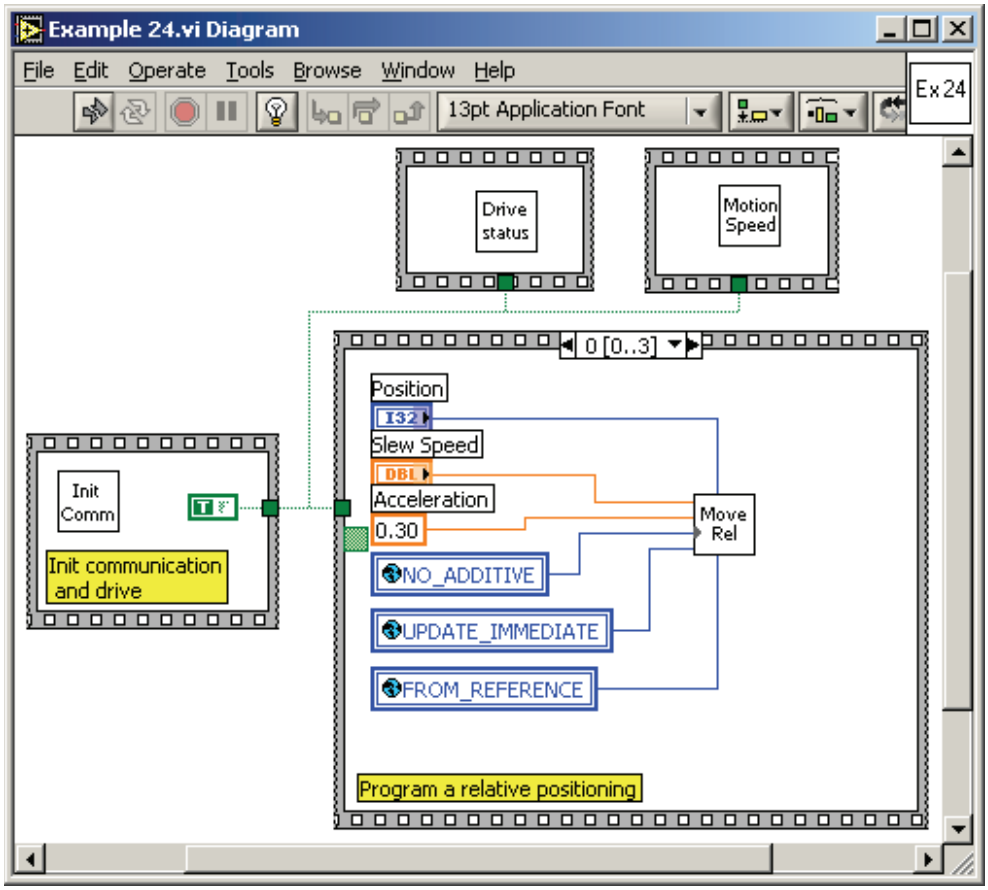
4.24 Example 24. Profiled positioning and speed movement, with event test from PC side

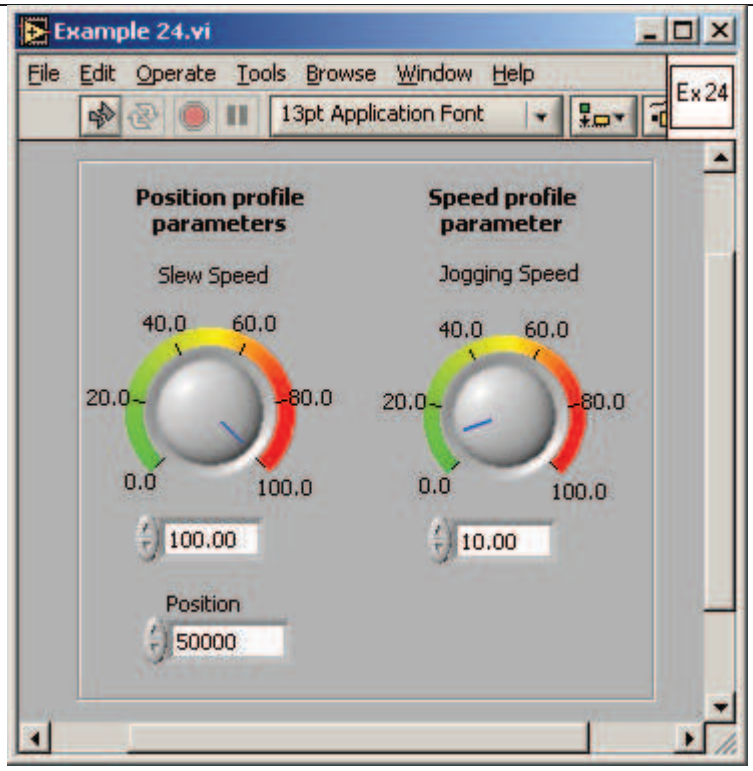
This example starts a profiled positioning, and performs testing of motion complete event by drive interrogation from the PC. It also checks if the position value does not exceed some critical reverse value. Once the positioning is completed, the motor begins a speed profile movement. If an error has occurred during positioning (i.e., a wrong position value is reached, instead of a motion complete event), the motor is stopped.

Such an approach can be very useful in order to avoid entering an infinite waiting loop. All event-related TML_LIB functions can be set to wait until the programmed event occurs. If the event does not occur, due to an error, then the PC program will not return any longer from the event function, and will be blocked.

If such a case appears, use the approach from this example instead, i.e. program an event without waiting for it to occur inside the event programming function. Instead, check the event using the **TS_CheckEvent** function, as well as perhaps other drive variables, etc. Thus, you can decide if an error has occurred, and the PC program will not be blocked anymore.

The VI front panel allows you to set the parameters for positioning profile and speed profile.

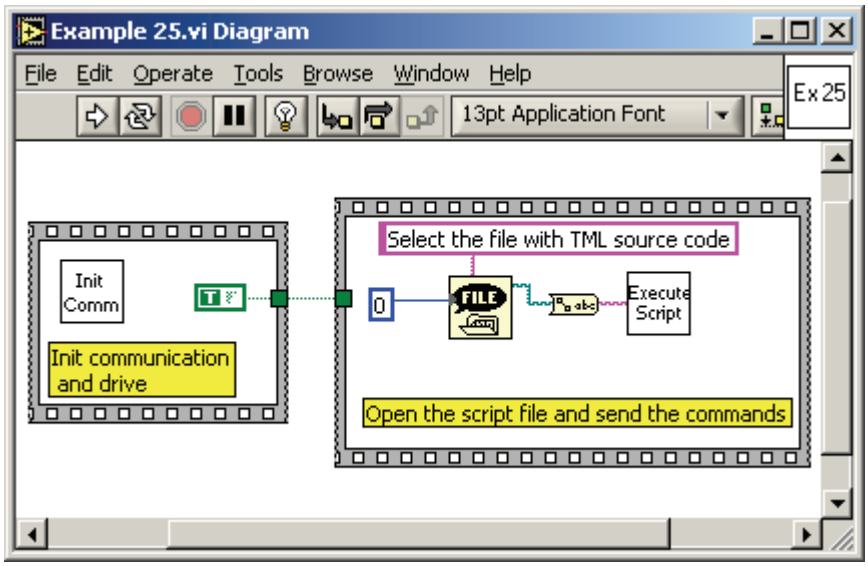


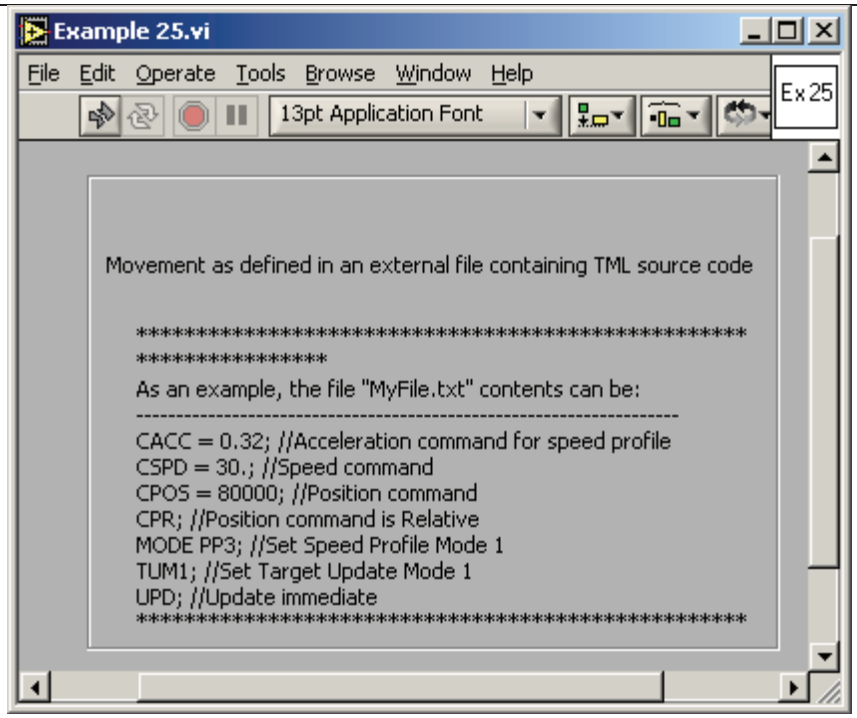

Example 24.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 24
Position profile parameters
Slew Speed
40.0
60.0
20.0
80.0
0.0
100.0
100.00
Position
50000
Speed profile parameter
Jogging Speed
40.0
60.0
20.0
80.0
0.0
100.0
10.00

4.25 Example 25. Movement as defined in an external file containing TML source code

This example opens an external TML source code file, compile each instruction and send it on-line to the drive. Such an approach can be very useful in order to send a fixed sequence of several TML instructions, eventually implementing some specific functionality.

The application requires a file containing valid TML source code. For this example you can use the sample file, **Ex25TML.txt**, provided with the library. The file is installed in the sub-directory **Example Files** of the TML_LIB_LabView installation directory.

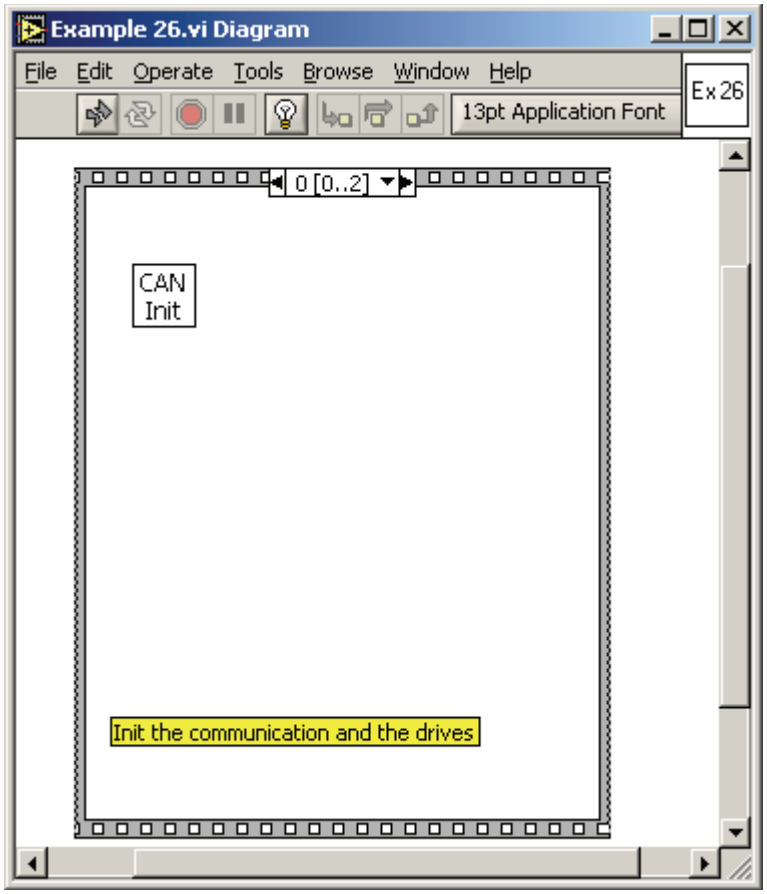


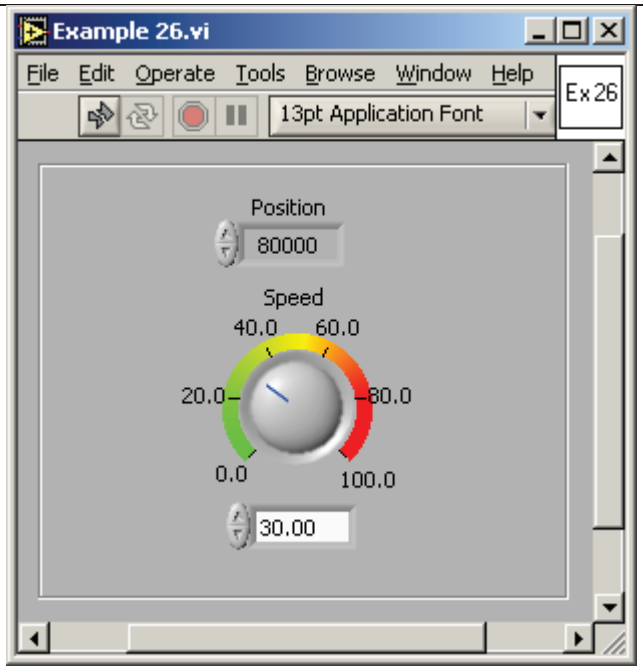

Example 25.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 25
Movement as defined in an external file containing TML source code
****
As an example, the file "MyFile.txt" contents can be:
CACC = 0.32; //Acceleration command for speed profile
CSPD = 30.; //Speed command
CPOS = 80000; //Position command
CPR; //Position command is Relative
MODE PP3; //Set Speed Profile Mode 1
TUM1; //Set Target Update Mode 1
UPD; //Update immediate
****

4.26 Example 26. Positioning command to a group of axes

This example shows how to send commands to a group of drives. The example programs a group of drives to execute a relative positioning. The group has two drives with Axis ID = 1 respectively Axis ID = 2 and are connected in a CAN-bus network. The drive with Axis ID = 1 is connected to PC via RS232 link.

The VI front panel allows you to setup the parameters of the position profile.

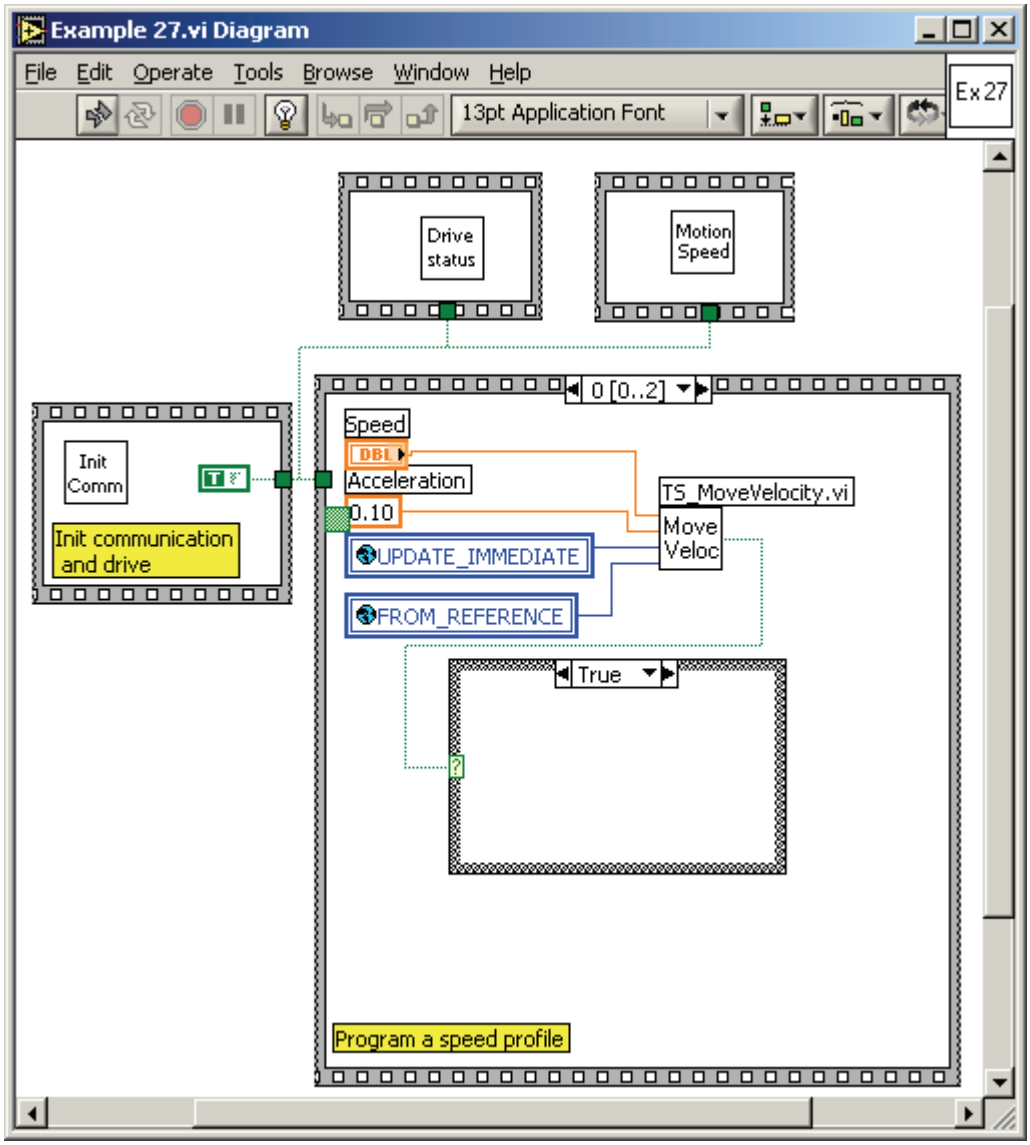


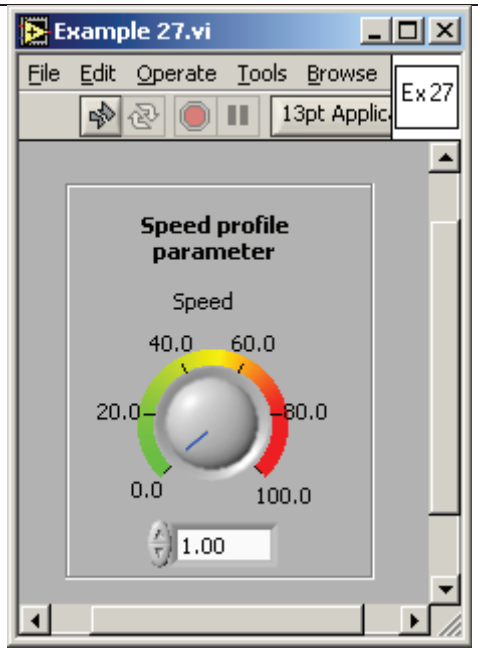

Example 26.vi
File Edit Operate Tools Browse Window Help
Ex 26
13pt Application Font
Position
80000
Speed
40.0
60.0
20.0
80.0
0.0
100.0
30.00

4.27 Example 27. Jogging motion until the index capture is detected, then position on index

This example programs an axis to move with a jog speed until index capture is detected. When the index input transition is detected the motor is stopped and then positioned to the captured position. If the capture index is not detected and the position limit is reached the motor is stopped.

Power on the drive, modify the speed profile parameter in the VI dialog, rotate manually the motor shaft, then run the application.

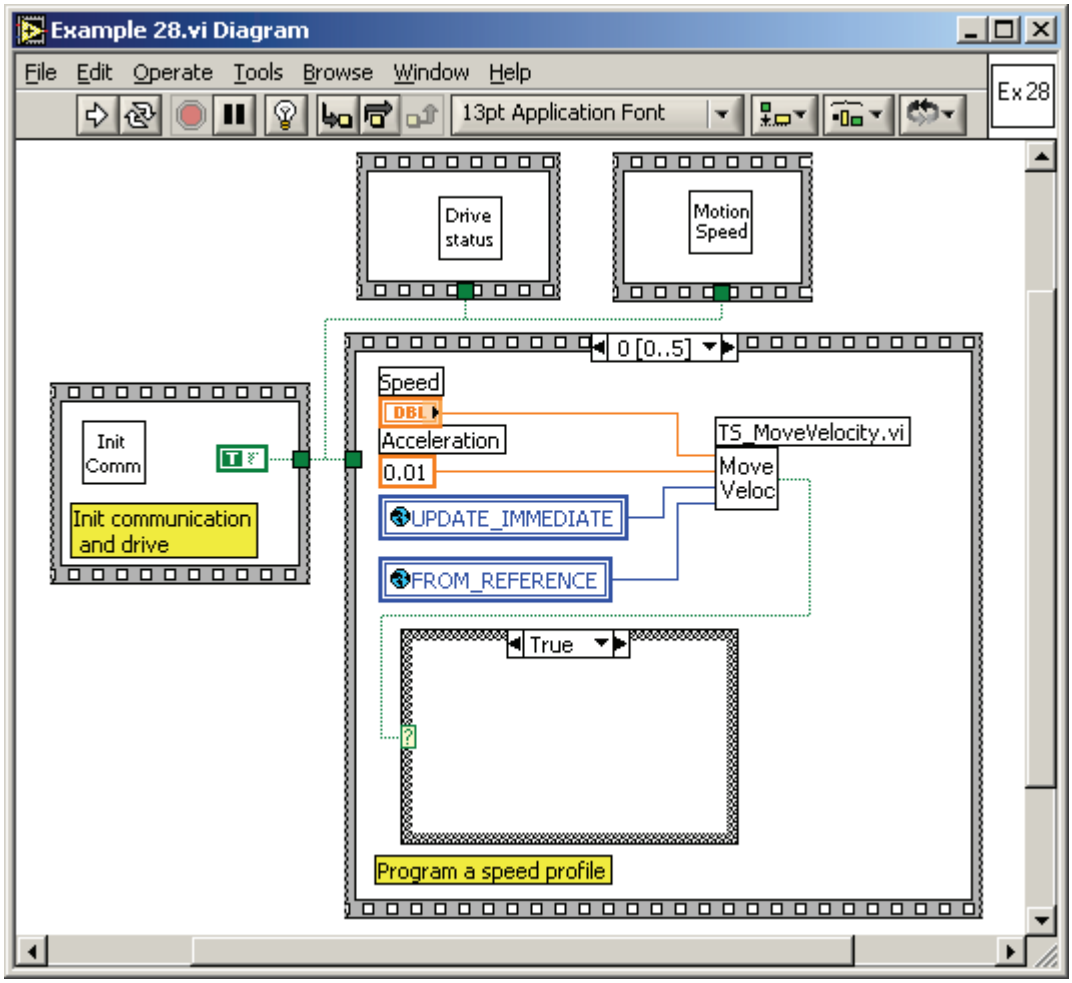


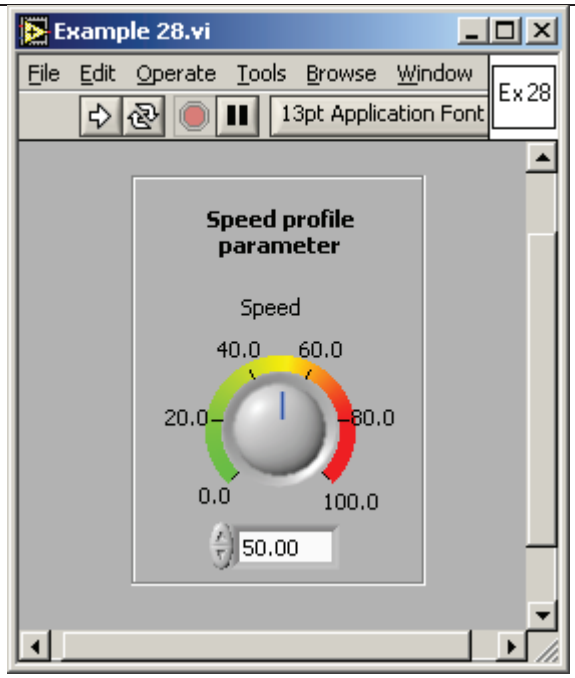

Example 27.vi
File Edit Operate Tools Browse
Ex27
13pt Applic
Speed profile parameter
Speed
40.0
60.0
20.0
80.0
0.0
100.0
1.00

4.28 Example 28. Speed jogging until home found, position to home, and set position to zero

This example can be used to detect the system home position and to set the absolute position to 0 at the home point. It moves the motor at constant speed until the home capture is detected. Then the motor is positioned at the home position and the absolute and the reference position values are reset.

First modify the speed profile parameter, and then run the application. While the application is running, set to low the IN#38 digital input in order to generate the home position capture.

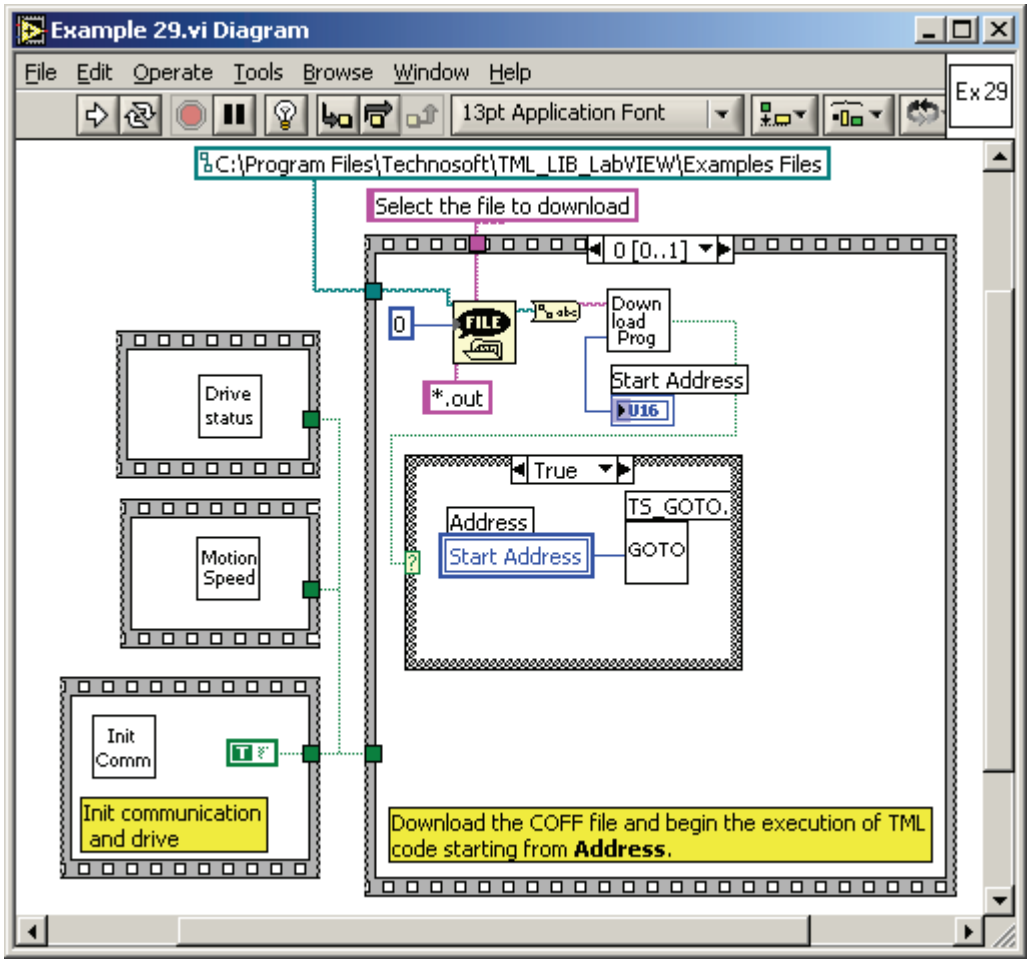


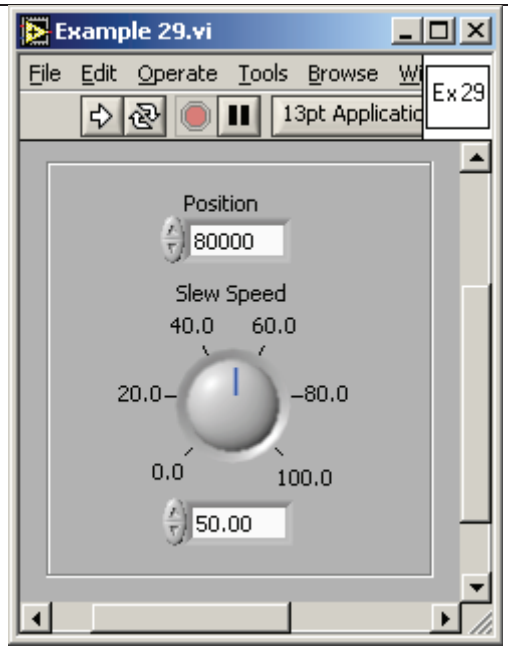

Example 28.vi
File Edit Operate Tools Browse Window
Ex 28
13pt Application Font
Speed profile parameter
Speed
40.0
60.0
20.0
80.0
0.0
100.0
50.00

4.29 Example 29. Download a COFF format file & send a positioning command on-line

This example can be used to download a COFF format file containing a TML application generated from EasyMotion Studio to the drive. This allows you to distribute the intelligence between the PC and the drives/motors in complex multi-axis applications. Thus, instead of trying to command each step of an axis movement, you can program the drives/motors using TML to execute complex tasks and inform the master when these are done.

The application requires a COFF file containing valid TML code. For this example you can use the sample file, **Ex29RAM.out**, provided with the library. The file is installed in the sub-directory **Example Files** of the TML_LIB_LabView installation directory.



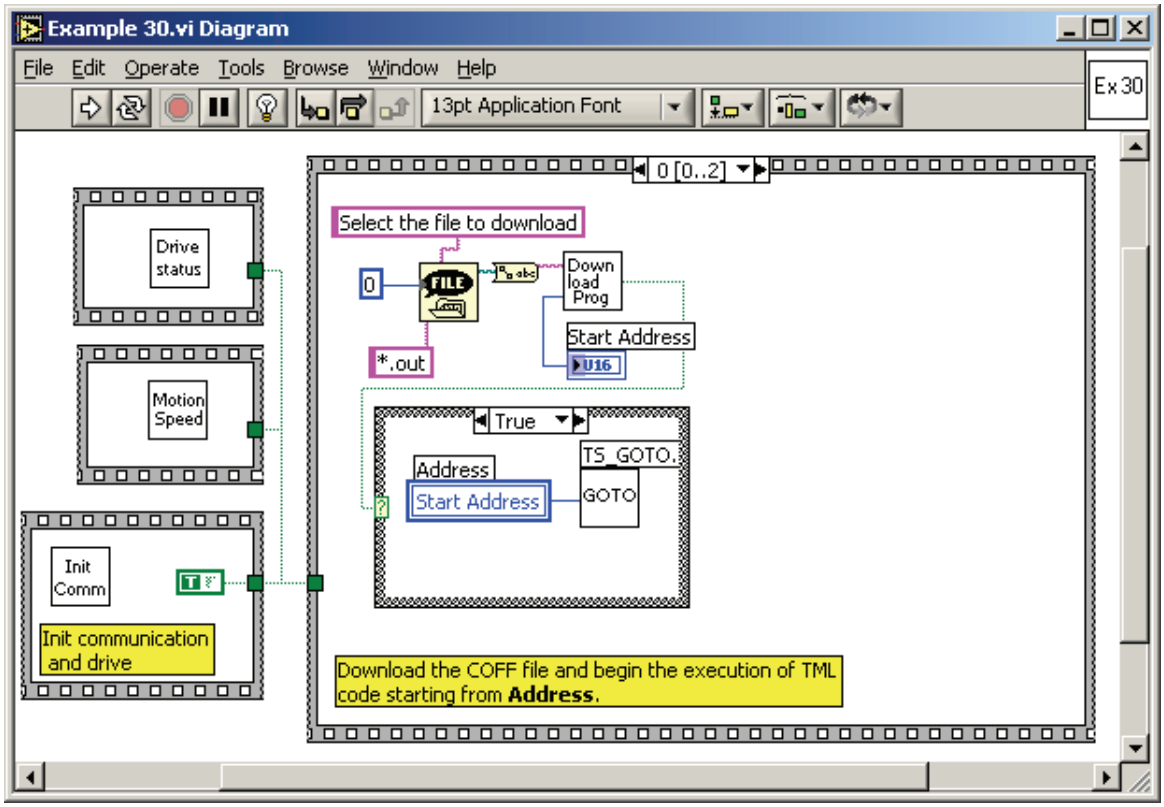

Example 29.vi
File Edit Operate Tools Browse
Ex 29
13pt Applicatio
Position
80000
Slew Speed
40.0
60.0
20.0
-80.0
0.0
100.0
50.00

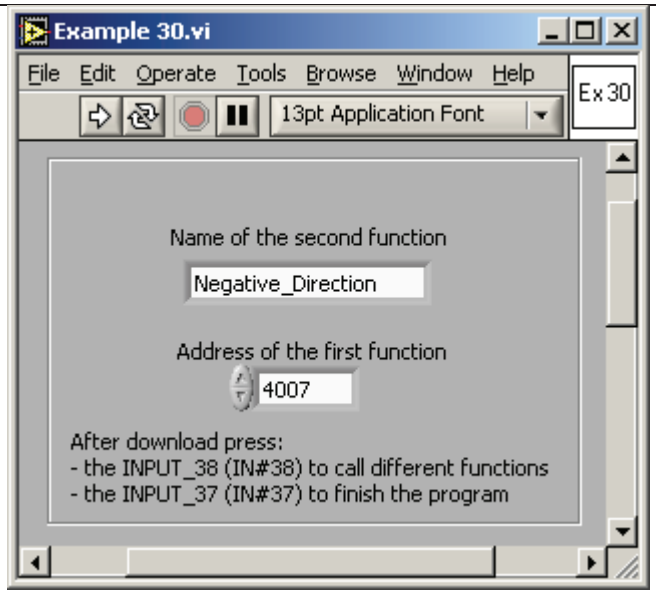
4.30 Example 30. Download a COFF format file, then call TML functions

The example downloads a COFF format file (***.out**) in the drive memory, then execute the TML code included in the downloaded code. The COFF file is generated with EasyMotion Studio based on a TML application. The addresses and the names of the functions are listed in the **variables.cfg** .

The example first downloads the `*.out` file containing this code and then, based on the status of a digital input port – selects which function to execute, and launches it using the function **TS_CALL**.

Note that, when you call a function stored in the drive memory, it executes until a **RET**urn TML instruction is found. At that moment, the drive enters the waiting loop executed prior to the launch of the **CALL** command. Meanwhile, any command sent on-line from the PC will have a higher execution priority.

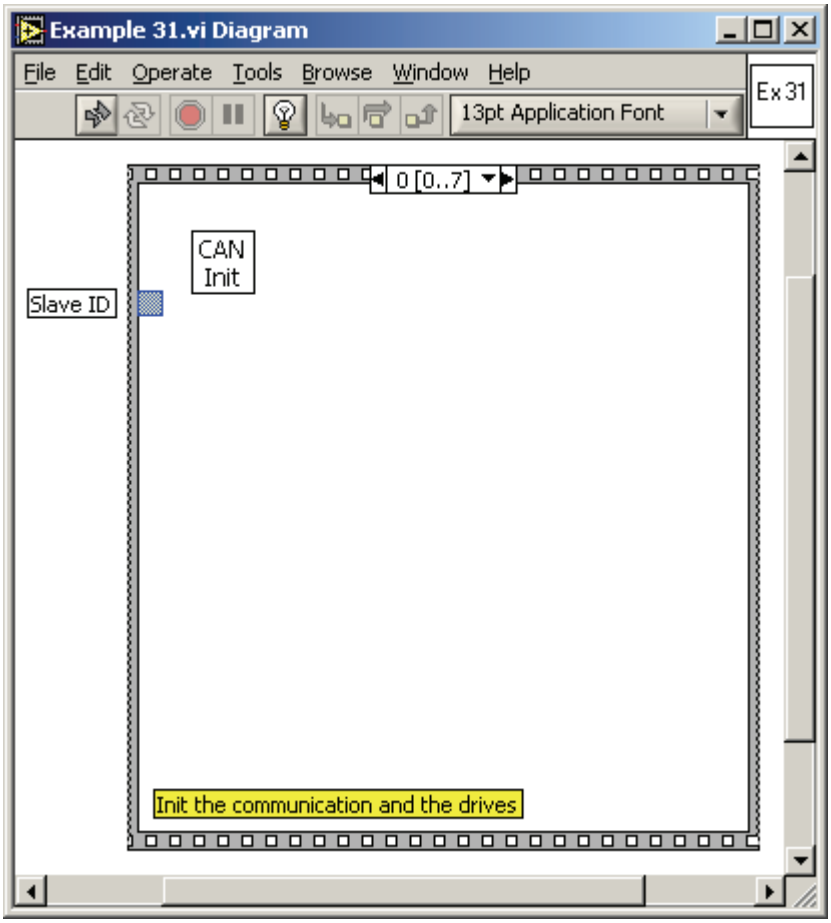


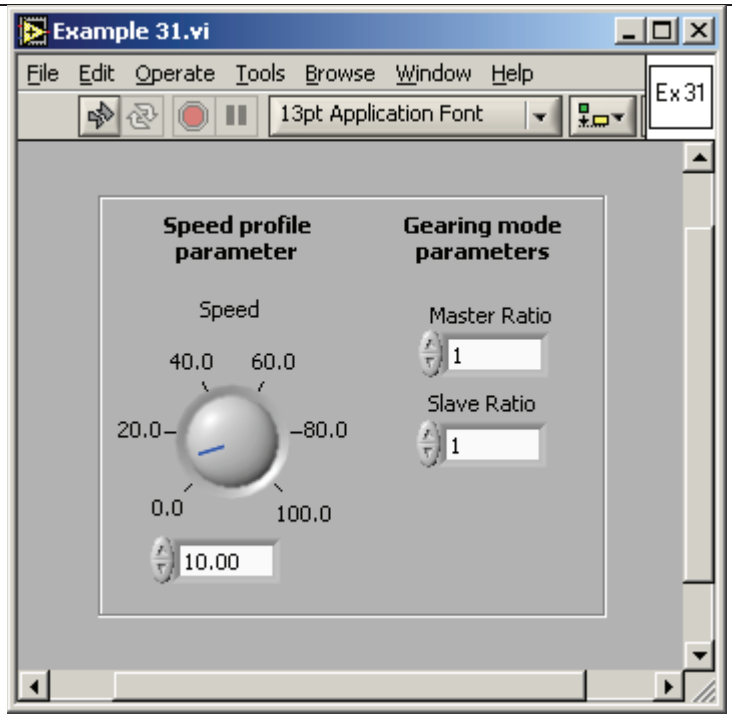

Example 30.vi
File Edit Operate Tools Browse Window Help
Ex 30
13pt Application Font
Name of the second function
Negative_Direction
Address of the first function
4007
After download press:
- the INPUT_38 (IN#38) to call different functions
- the INPUT_37 (IN#37) to finish the program

4.31 Example 31. Set up the Master and Slave Gearing Mode; use the drives in gearing mode

This example programs the drive with Axis ID = 2 as master and the drive with Axis ID = 1 as slave in electronic gearing mode. It initializes the master and the slave with the appropriate parameters, and then it starts a motion on the master. At the end of the gearing mode operation, it disables both the master and the slave from this operation mode.

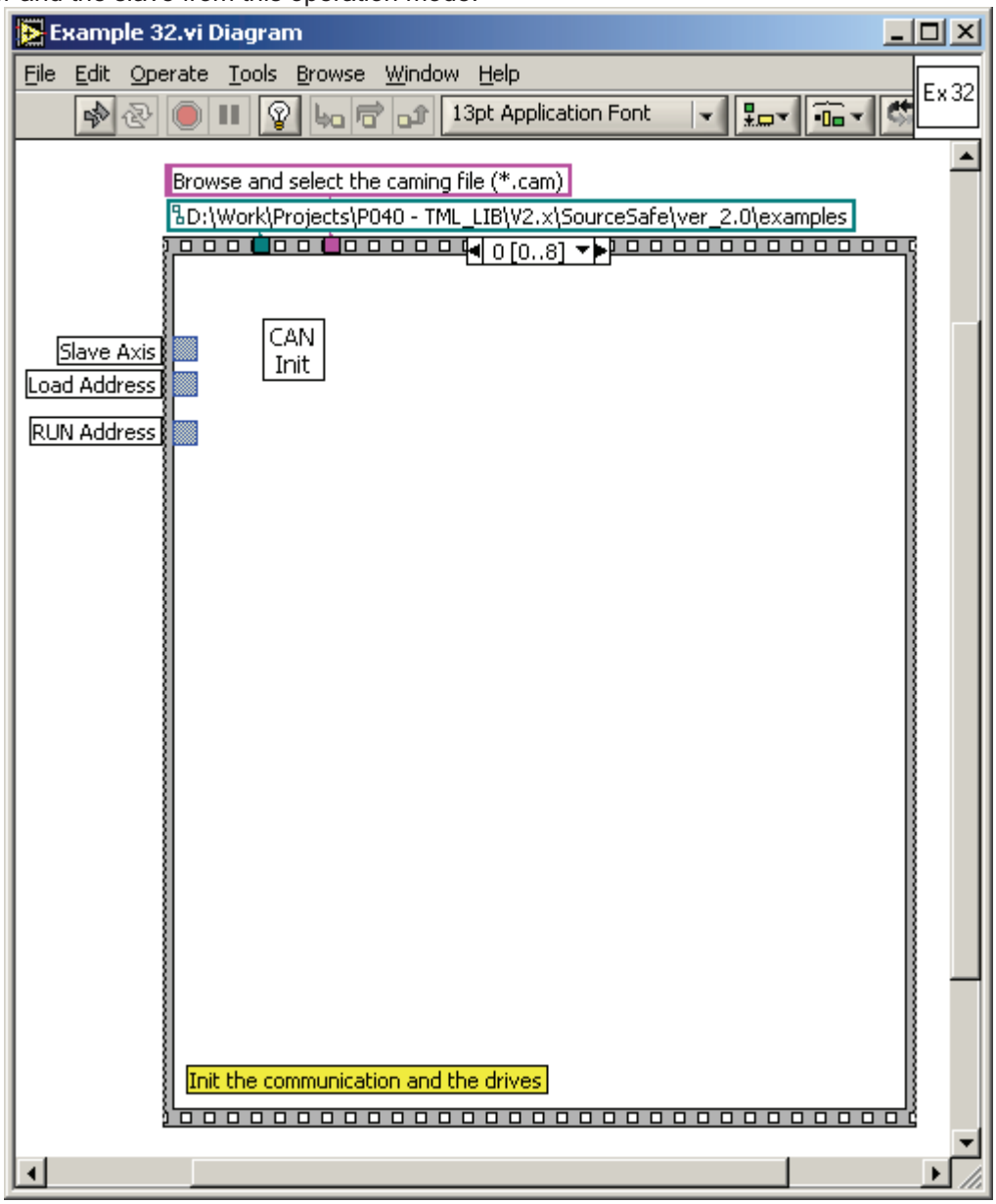
The VI front panel allows you to set for the master drive the parameters of the speed profile and the gear ratio for the slave drive.



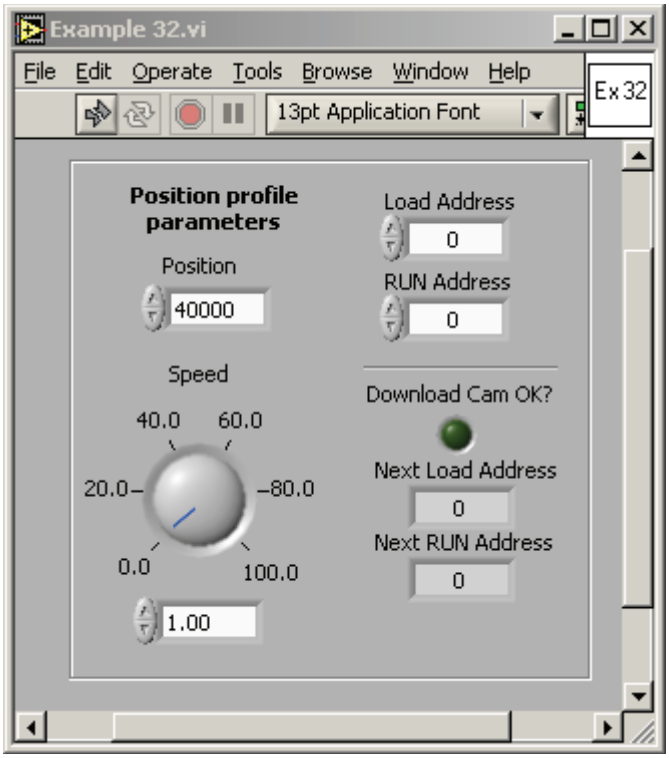

Example 31.vi
File Edit Operate Tools Browse Window Help
Ex 31
13pt Application Font
Speed profile parameter
Gearing mode parameters
Speed
40.0
60.0
20.0
80.0
0.0
100.0
10.00
Master Ratio
1
Slave Ratio
1

4.32 Example 32. Set up Master and Slave in electronic cam Mode; use the drives in cam mode

This example shows how to set up the electronic cam mode on the master, as well as on the slave axes, in a multiple-axis structure. It initializes the master and the slave with the appropriate parameters. It also downloads an electronic cam table file on the slave axis drive. Then it starts a motion on the master. At the end of the electronic cam mode operation, it disables both the master and the slave from this operation mode.

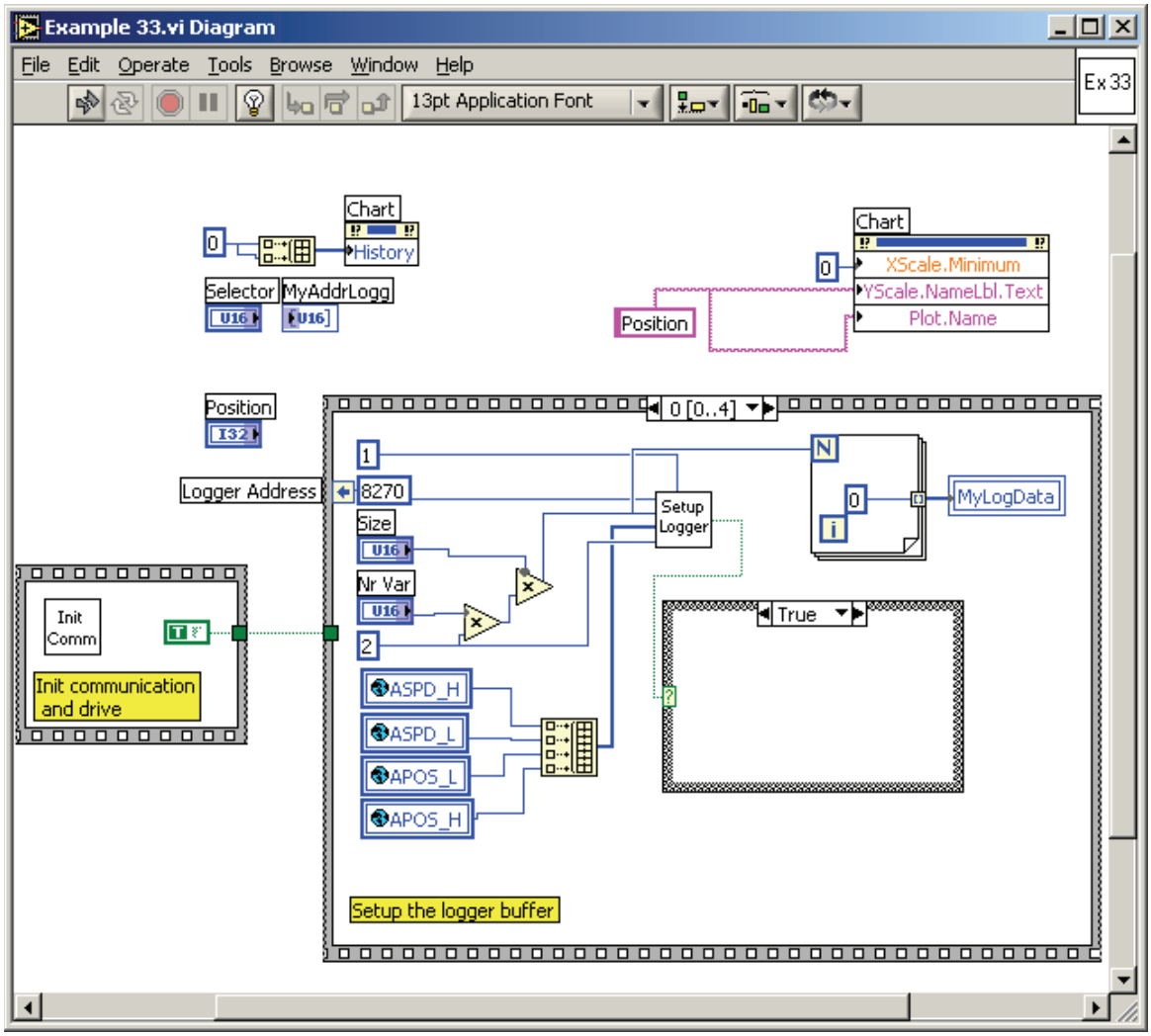


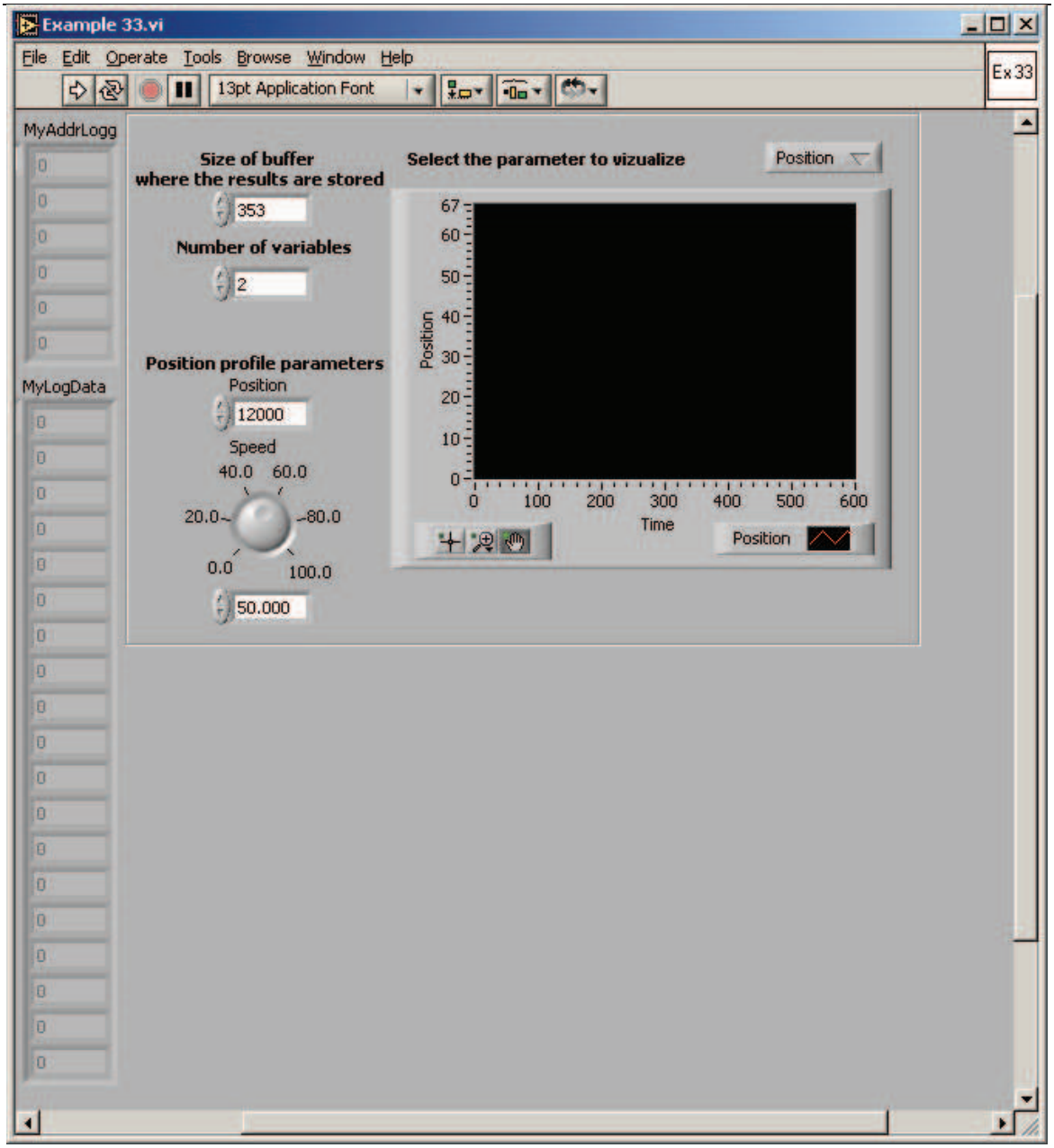
The VI front panel allows to set the for the master axis the parameters of the position profile and to select the for slave axis the load address and the run address for the cam table.



4.33 Example 33. Usage of data logger to upload real-time stored data from the drive

This example shows how to setup the data logger on a drive, to start data logging, check its end and upload the logged data from the drive to the PC.




Example 33.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 33
MyAddrLogg
MyLogData
Size of buffer where the results are stored
353
Number of variables
2
Position profile parameters
Position
12000
Speed
40.0 60.0
20.0 80.0
0.0 100.0
50.000
Select the parameter to vizualize
Position
Position
Time
Position

4.34 Example 34. Homing procedures based on pre-stored TML sequences on the drive

This example shows you how to execute a homing motion, based on the existence on the drive of a specific motion sequence containing the TML code needed to implement the homing.

The search for the home position can be done in numerous ways. In order to offer maximum flexibility, the TML does not impose the homing procedures but lets you define your own, according with your application needs.

Basically a homing procedure is a TML function and by calling it you start executing the homing procedure. The call must be done using the function **TS_CancelableCALL_Label**. This command offers the possibility to abort at any moment the homing sequence execution (with function **TS_Abort**). Therefore, if the homing procedure can't find the home position, you have the option to cancel it.

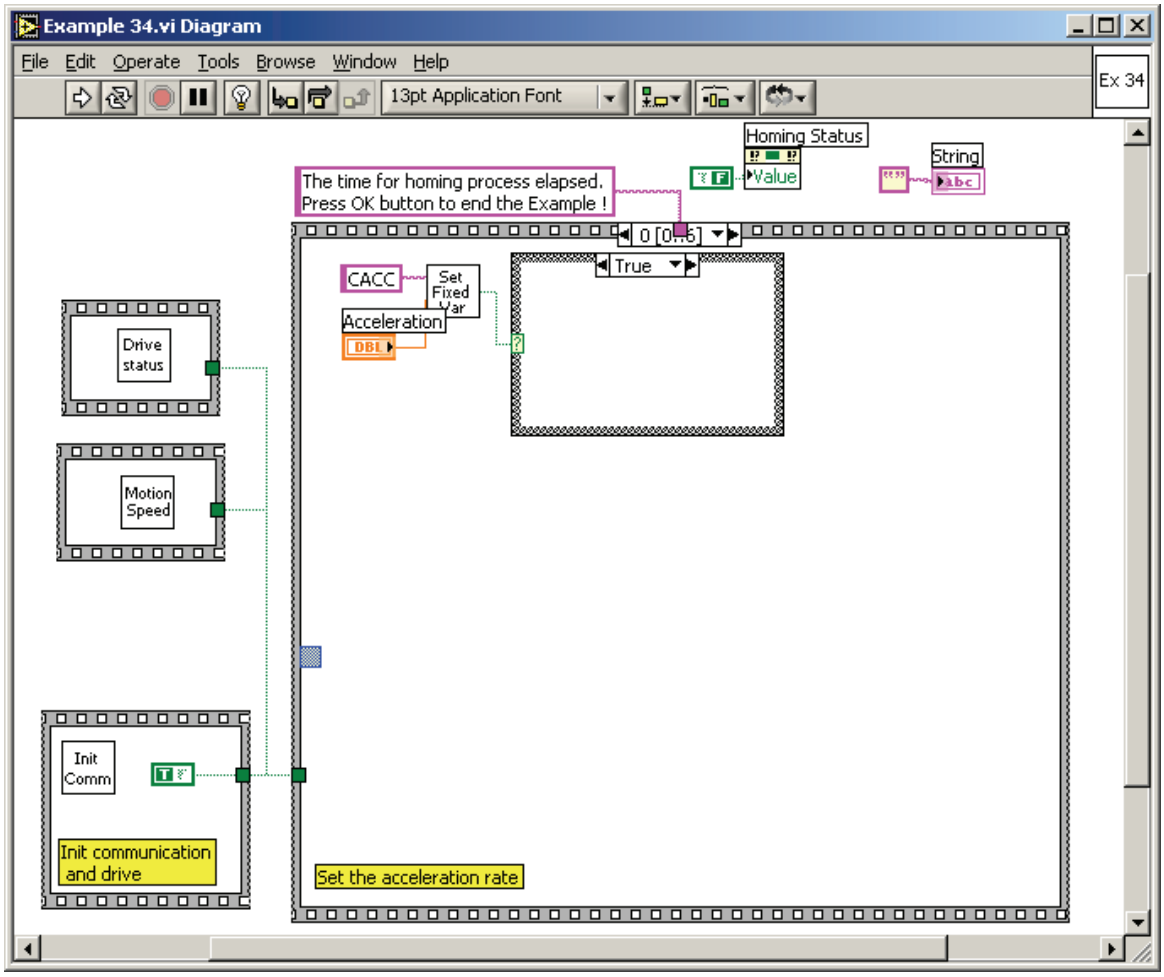
During the execution of a homing procedure bit 8 of Status Register Low part is set. Hence you can find when a homing sequence ends, either by monitoring the bit 8 from **SRL** or by programming the drive/motor to send a message to your host when the bit changes. As long as a homing sequence is in execution, you should not start another one. If this happens, the last homing is aborted and a warning is generated by setting bit 7 from **SRL**

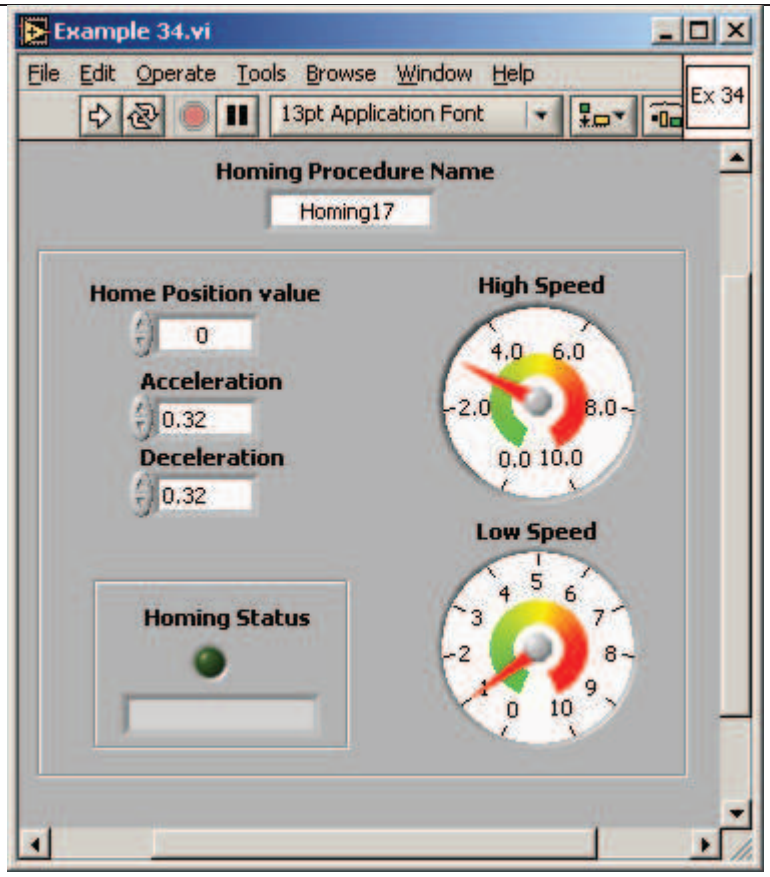
Remark: *In motion programming tools like EasyMotion Studio, Technosoft provides for each intelligent drive/motor a collection of up to 32 homing procedures. These are predefined TML functions, which you may call after setting the homing parameters. You may use any of these homing procedures as they are, or use them as a starting point for your own homing routines.*

Before using any homing method from the TML_LIB environment you need to perform the following steps:

- Create in EasyMotion Studio a project for your drive/motor
- Setup the drive/motor and download the setup table. After the download reset the drive/motor to activate
- Select **Homing Modes** view. In this view you can see all the homing procedures defined for your drive/motor, together with a short description of how it works. In order to select a homing procedure, check its associated button. You may choose more then homing procedure, if you intend to use execute different homing operations in the same application.
- Download the homing procedure with menu command **Application | Motion | Download Program**
- Generate the configuration setup for TML_LIB with menu command **Application | Export to TML_LIB**

You are now prepared to build your PC application, which will call one of the homing methods from the drive memory. The idea is that you'll set up, from the PC, some of the parameters needed during the homing procedure, then you'll call one of the homing functions stored on the drive, and eventually you'll test the status of the homing process until it will be finished.

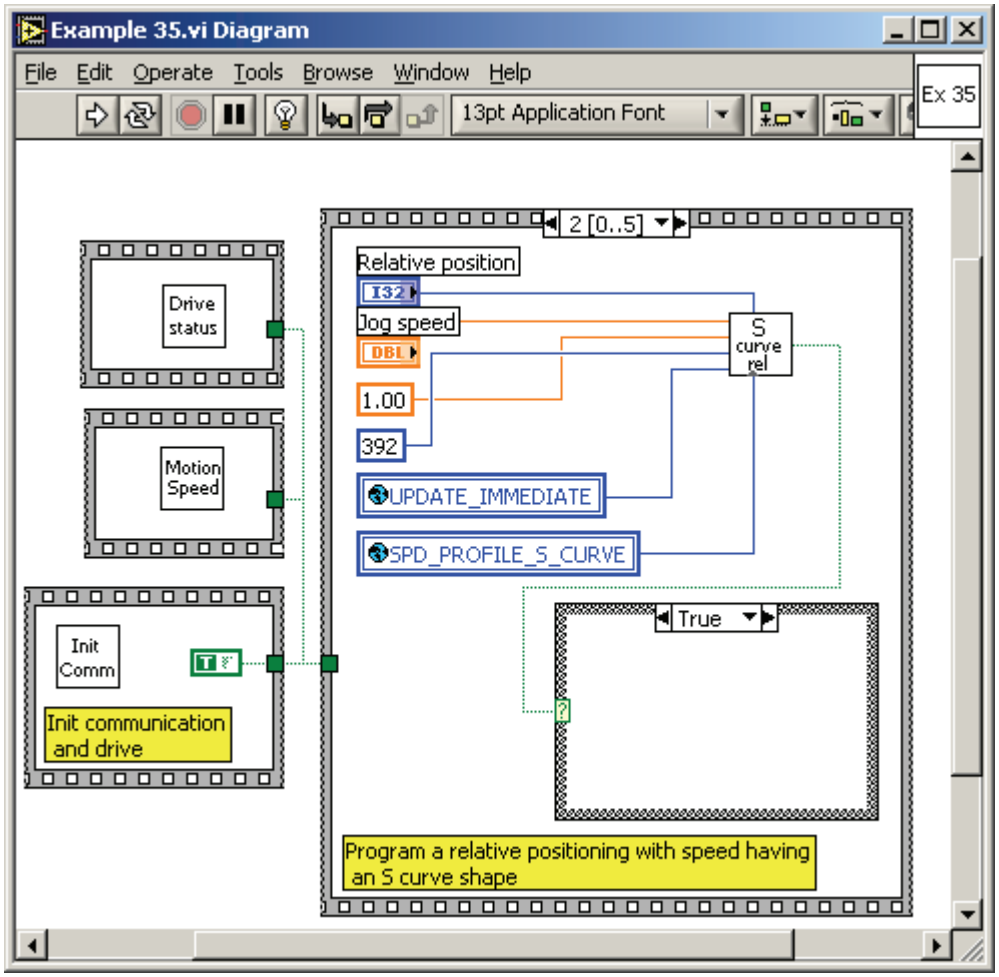

Example 34.vi Diagram
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 34
Homing Status
Value
String
The time for homing process elapsed.
Press OK button to end the Example !
0 [0..5]
True
CACC
Set Fixed Var
Acceleration
DBL
Drive status
Motion Speed
Init Comm
Init communication and drive
Set the acceleration rate

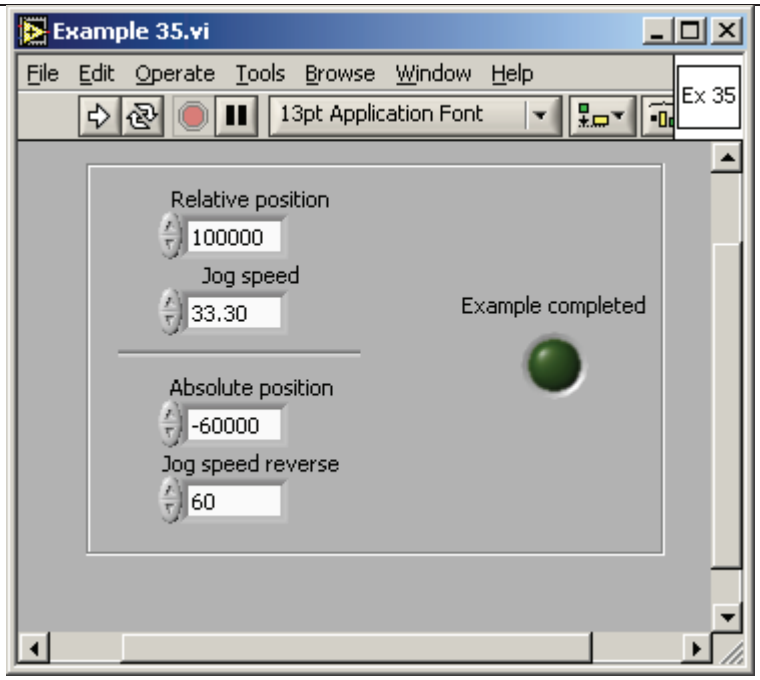

Example 34.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 34
Homing Procedure Name
Homing17
Home Position value
0
Acceleration
0.32
Deceleration
0.32
High Speed
4.0 6.0
2.0 8.0
0.0 10.0
Low Speed
5
4 6
3 7
2 8
1 9
0 10
Homing Status

4.35 Example 35. Positioning with S-Curve profile for speed; speed jogging

The example shows how to program a relative position followed by an absolute positioning. The speed has an S-Curve shape for both motions.

The VI front panel allows you to set the parameters for the relative and absolute positioning.




Example 35.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 35
Relative position
100000
Jog speed
33.30
Example completed
Absolute position
-60000
Jog speed reverse
60

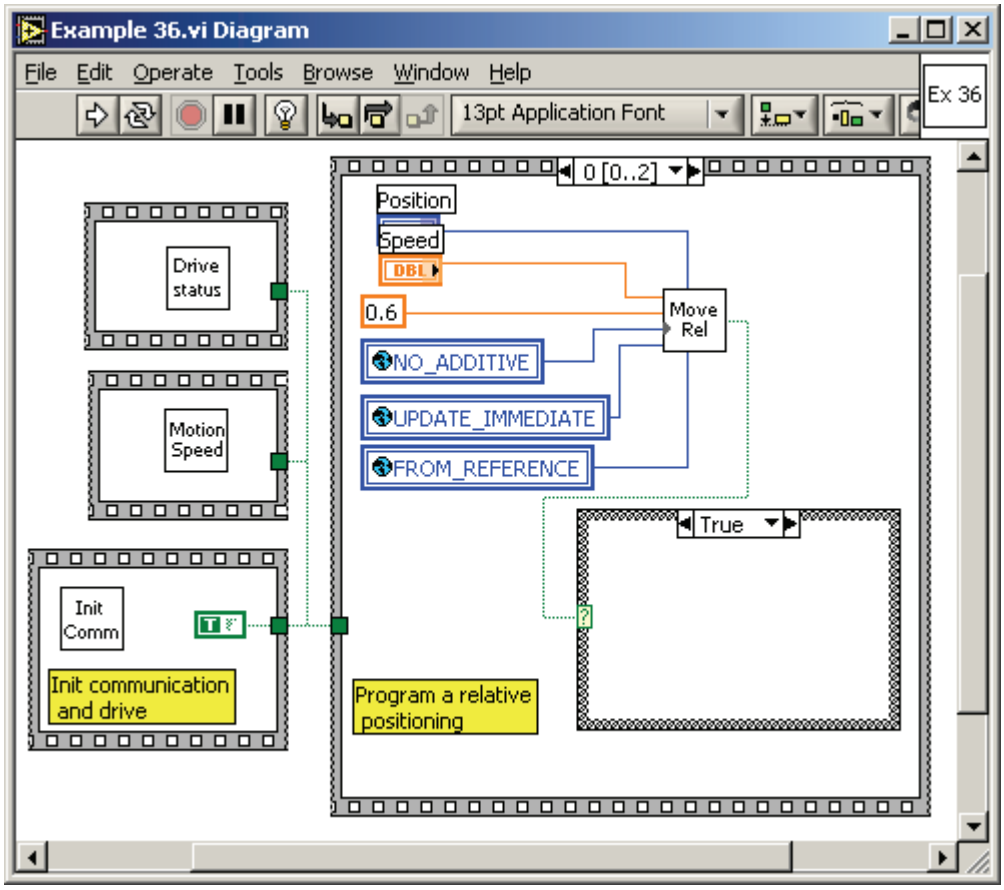
4.36 Example 36. Reset FAULT state

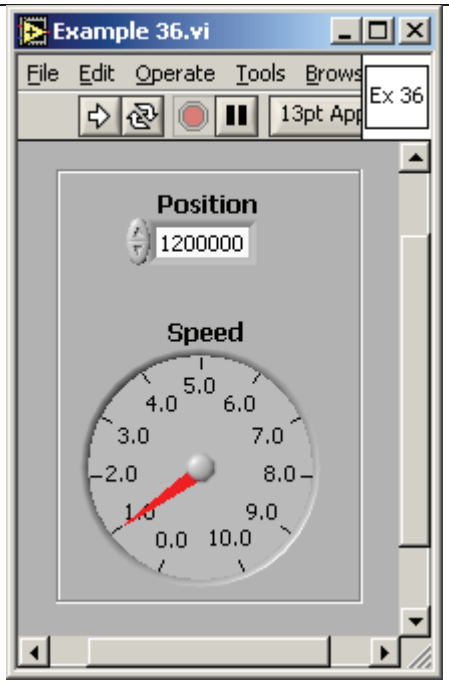
The example shows how to restore the drive normal operation from FAULT state. The drive is programmed to do a relative positioning. The drive enters in FAULT state when you block the motor shaft during the motion. In the FAULT state:

- The drive/motor is in AXISOFF with the control loops and the power stage deactivated
- Ready and error outputs (if present) are set to the not ready level, respectively to the error active level. When available, ready greed led is turned off and error red led is turned on

The FAULT state is reset when you press a key; the drive power stage remains disabled.

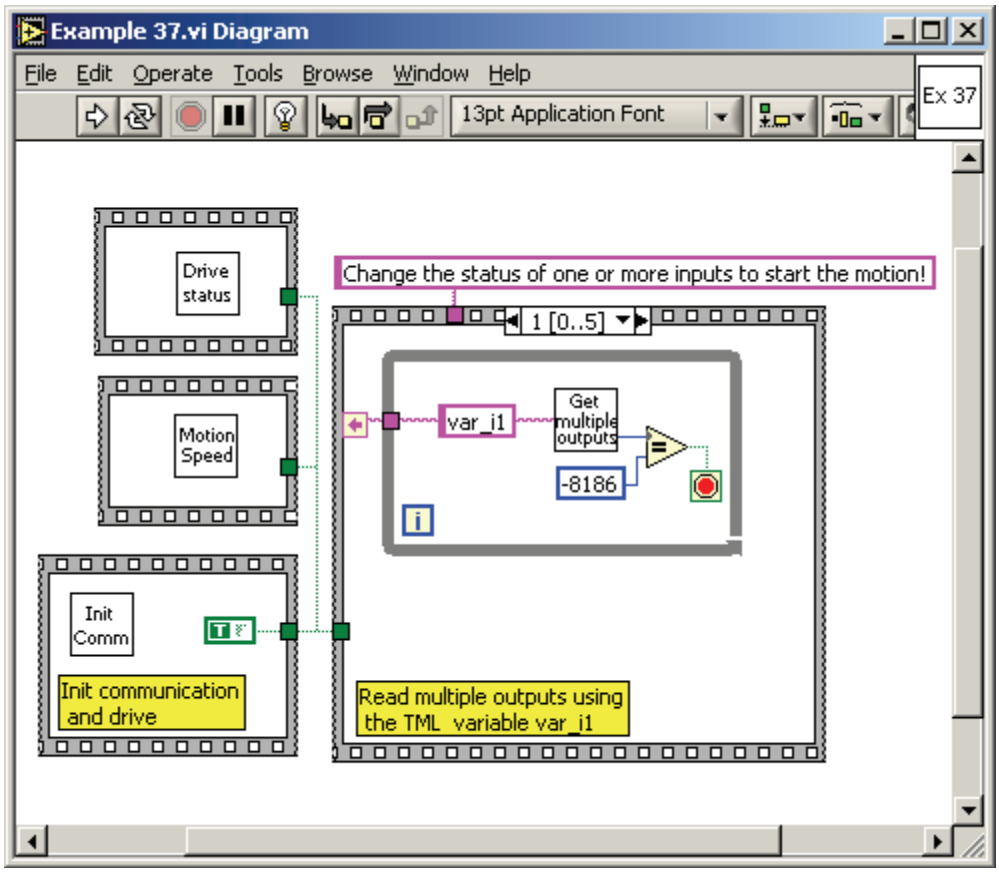
The VI front panel allows you to Run the example and block the motor shaft to trigger the **Control error** protection and the FAULT status.

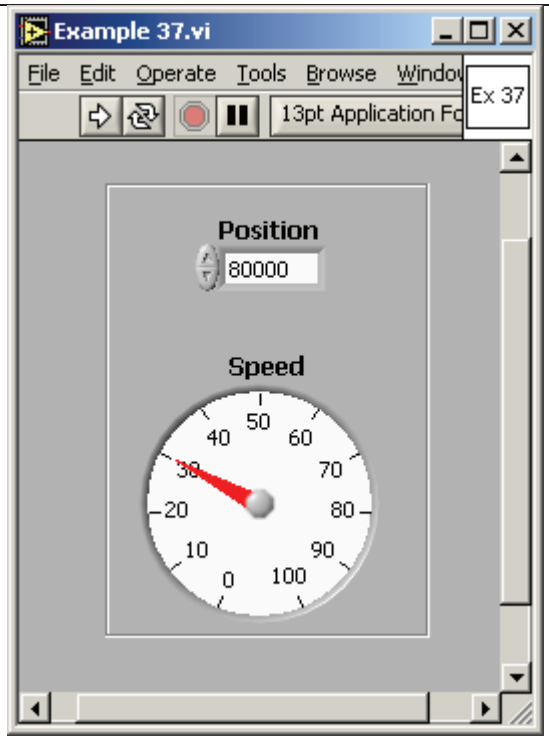



Example 36.vi
File Edit Operate Tools Brows
Ex 36
13pt App
Position
1200000
Speed
5.0
4.0
6.0
3.0
7.0
2.0
8.0
1.0
9.0
0.0
10.0

4.37 Example 37. Read multiple inputs/set multiple outputs

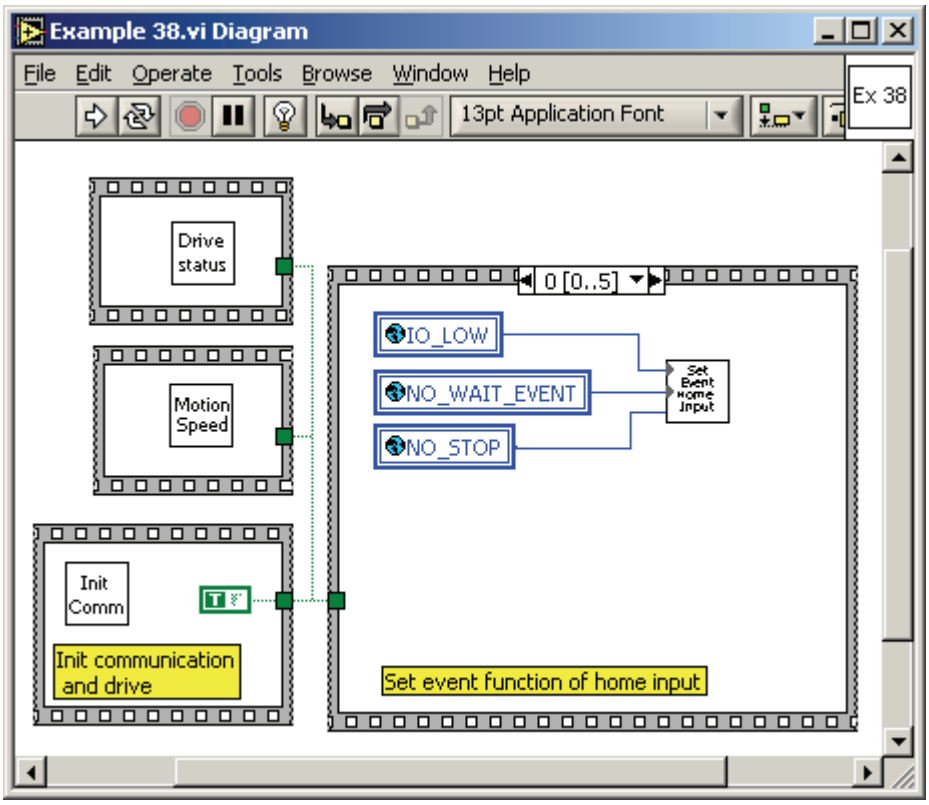
The example shows how to read multiple outputs from the drive. The program remains in a loop until one of the inputs changes its status moment when the motor begins an absolute positioning. When the motion is complete the state of several outputs is set.

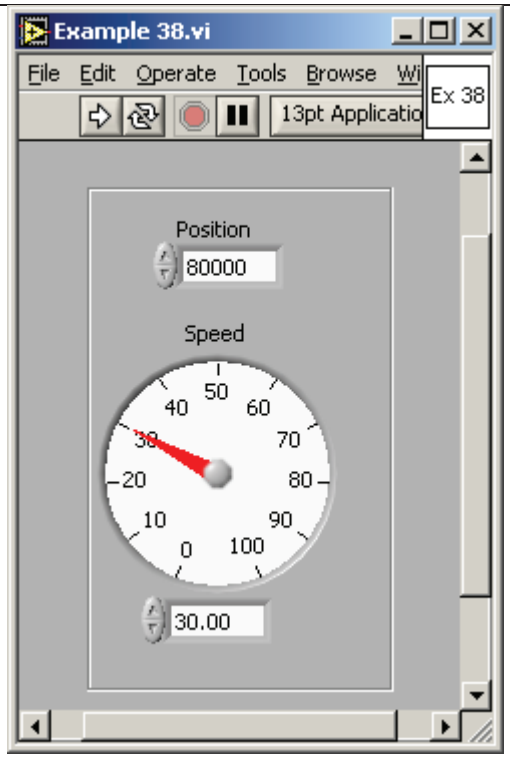



Example 37.vi
File Edit Operate Tools Browse Windo
Ex 37
13pt Application Fo
Position
80000
Speed
0
10
20
30
40
50
60
70
80
90
100

4.38 Example 38. Positioning when an event on home input occurs

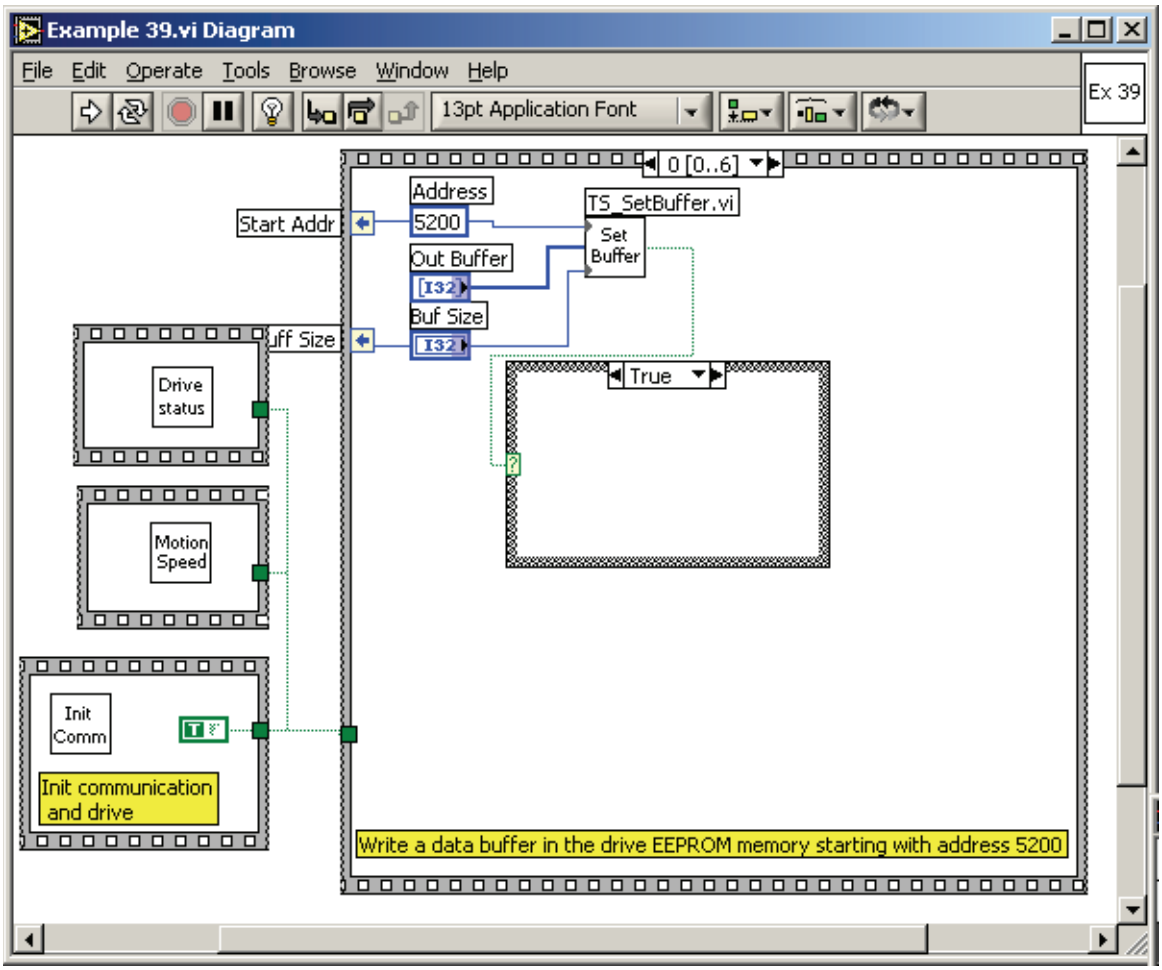
The example shows how to program a positioning triggered by an event on home input. The event is set when the home input goes low.

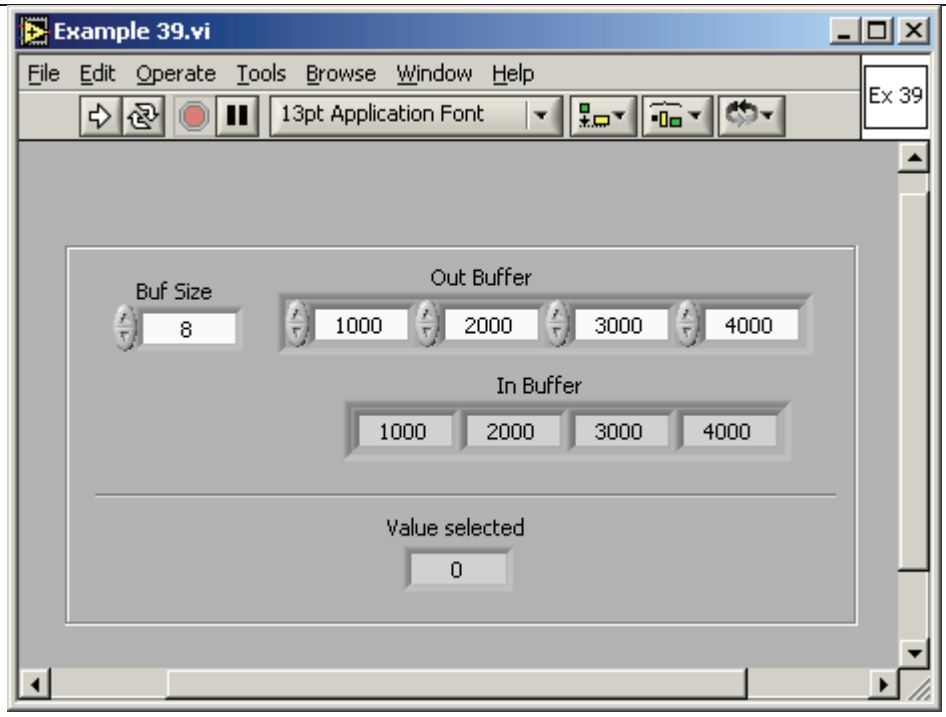



Example 38.vi
File Edit Operate Tools Browse Wi
Ex 38
13pt Applicatio
Position
80000
Speed
50
40
60
30
70
20
80
10
90
0
100
30.00

4.39 Example 39. Write/read in the drive memory

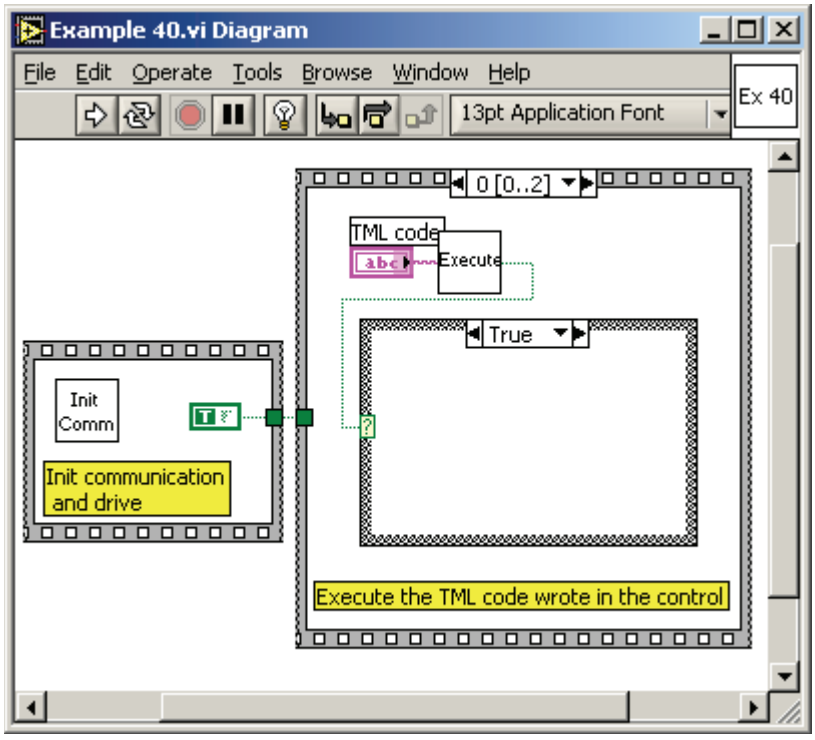
The example writes/reads a data block in the drive EEPROM memory. The write operation is verified with a checksum. After the homing procedure the drive makes a positioning with the position command read from the EEPROM.

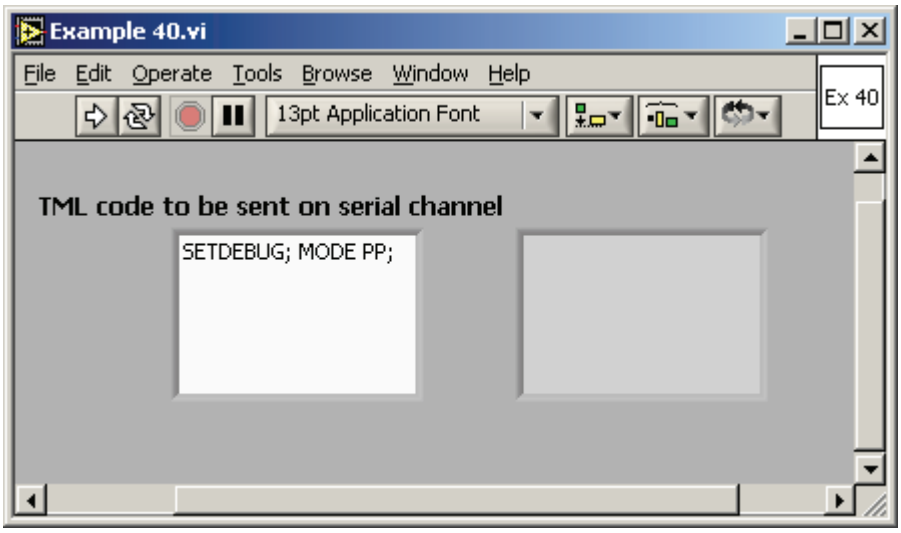



Example 39.vi
File Edit Operate Tools Browse Window Help
13pt Application Font
Ex 39
Buf Size
8
Out Buffer
1000
2000
3000
4000
In Buffer
1000
2000
3000
4000
Value selected
0

4.40 Example 40. View binary code of a TML command

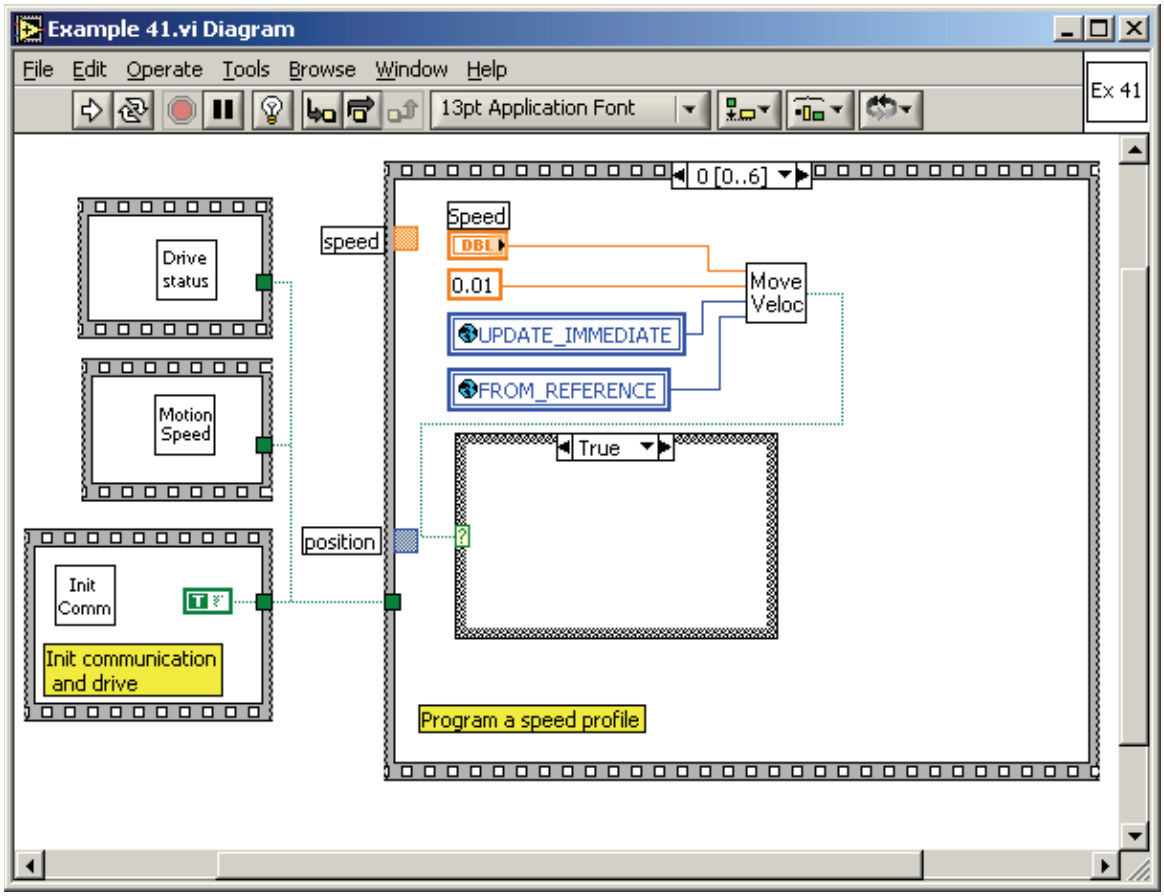
The example returns the binary code of a TML command **MODE PP**.

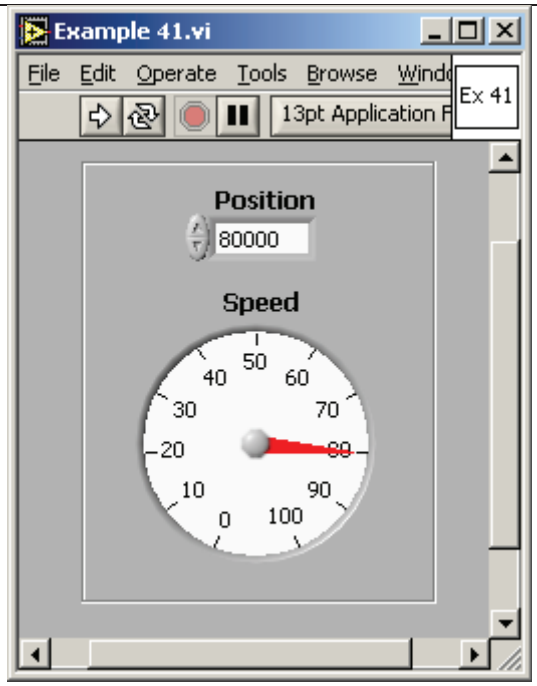




4.41 Example 41. Speed jog and positioning with direction change

The example programs a speed profile followed by a position profile. The drive switches from speed control to position control when the event function of reference speed is set. When the event set function of motor position is triggered the motion is stopped and restarted in the opposite direction with a speed profile. The motion ends when the event set function of load speed is set.




Example 41.vi
File Edit Operate Tools Browse
Ex 41
13pt Application
Position
80000
Speed
50
40
60
30
70
20
80
10
90
0
100

This page is empty

TECHNOSOFT