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LabVIEW software per Chiller PC200

Sandro Fioravanti

INFN-LNF

Abstract

Il Chiller PC200 della Thermo Scientific, regola la temperatura sulla seconda e la terza sezione acceleratrice di SPARC.

1. Introduzione

Di seguito sono elencati tutti i passaggi per programmare in LabVIEW un Chiller PC200. Il tipo di PC200 da noi utilizzato comunica tramite porta USB, per questo ha bisogno di una configurazione manuale dei driver che emulano una porta seriale (com port) su una porta USB. In appendice ci sono i link e i manuali per configurarla.

2. Inizializzazione interfaccia seriale e descrizione pacchetto dati

L'interfaccia seriale è di tipo RS232/RS485 con parametri di default 9600 Baud, 8 data bits, 1 stop bit, no parity e nessun handshaking. Tutti i dati sono inviati e ricevuti in forma binaria e rappresentati in esadecimale. Non si deve usare il codice ASCII.
Il pacchetto dati è composto da 6 byte + n data bytes:

	Checksum region						
Lead char CA or CC	Addr-MSB 0	Addr-LSB 1	Command	n d-bytes	d-byte 1 ...	d-byte n	Checksum

Fig. 1 Composizione comando

Lead char	0xCA (RS-232) 0xCC (RS-485)
Addr-msb	Byte significativo dell'indirizzo
Addr-lsb	Byte meno significavo dell'indirizzo
Command	Byte che corrisponde alla funzione da eseguire
n d-bytes	Numero di byte che seguono, di cui è composto il dato richesto o inviato
d-byte 1	Primo numero "data byte" che compone il dato
...	
d-byte n	n byte di cui il comando è composto
Checksum	Byte di controllo errore

3. Checksum

Il controllo degli errori è indispensabile per verificare la correttezza del comando trasmesso o ricevuto. I byte da verificare, come raffigurato il figura 1, sono 4 + n byte, quindi tutti i byte compresi tra il "Lead char" e il "Checksum". Il Checksum è l'inverso del risultato della somma di tutti i numeri presenti nella regione del checksum.

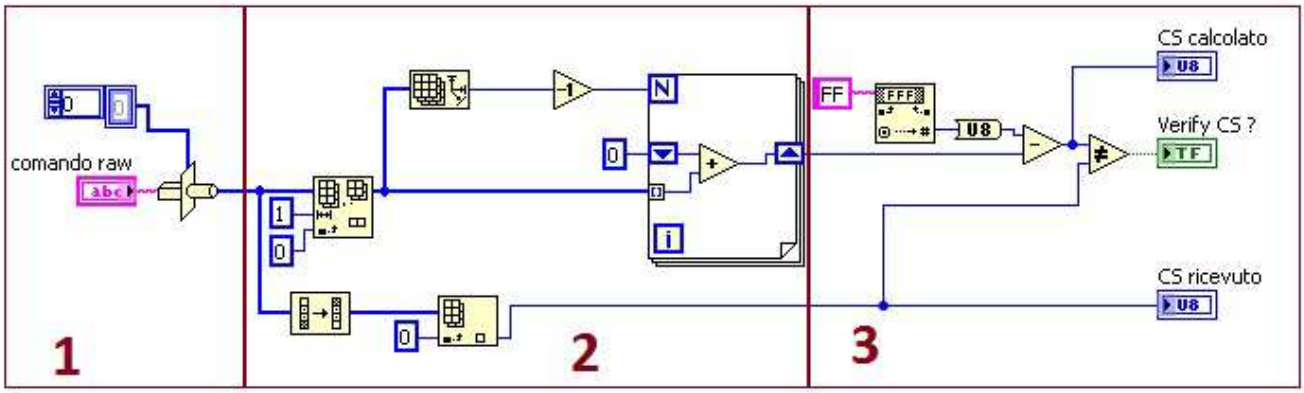

Fig. 2 Calcolo e verifica del Checksum LabVIEW

Nella figura 2 sono raffigurati i passaggi per verificare se il dato è corretto. Il comando viene trasmesso dal PC200 in formato string, ed è per questo motivo che nel primo blocco la stringa viene trasformata in un array di tipo U8. Nel secondo blocco viene eliminato dall'array il primo numero (Lead char) e passato al "for" il numero dell'indice dell'array meno uno, così da far sommare al ciclo "for" tutti i numeri tranne l'ultimo che è proprio il valore di checksum originale. Per prelevare il numero di checkseum originale, dato che siamo a conoscenza che l'ultimo numero è il checksum, possiamo tranquillamente capovolgere l'array e prelevare il primo numero. Nel terzo blocco calcoliamo il checksum, il quale si ricava con la differenza del valore massimo di un byte (FF) meno il byte meno significativo della somma dei byte

presenti nella regione del checksum. Dopo di ché possiamo fare il confronto tra il checksum calcolato e quello ricevuto dal PC200.

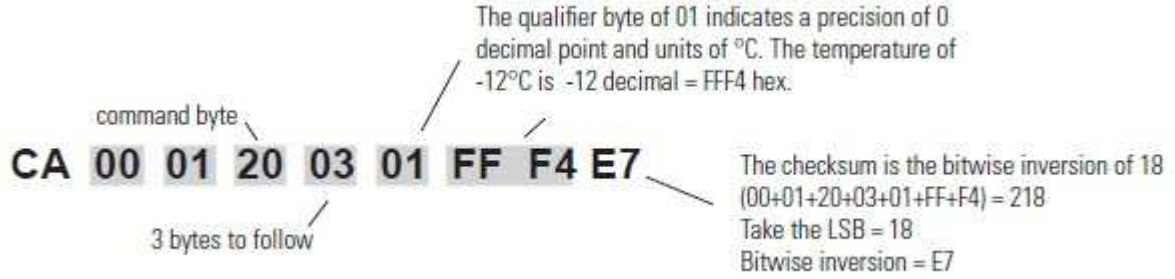

Fig. 3 Spiegazione del manuale di come interpretare un comando

4. Invio e ricezione di un comando

Ogni comando, che sia di lettura che di setting, ha sempre una stringa di ritorno che ne verifica il corretto invio. Di seguito, spiego come programmare correttamente l'invio e la ricezione di un comando in esadecimale.

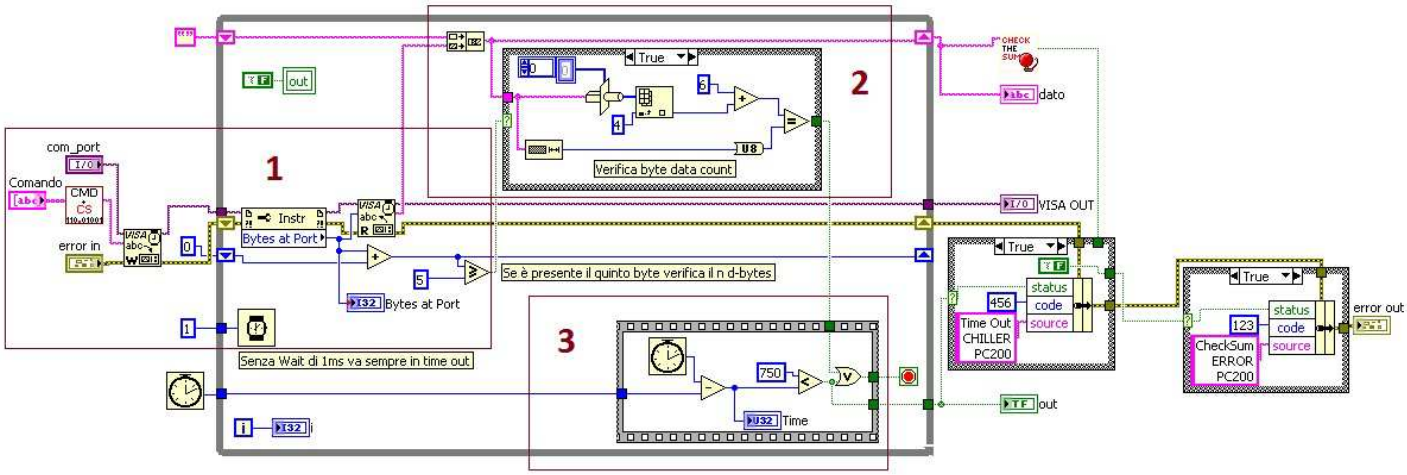

Fig.4 Raffigurazione del vi di invio e comando

In figura 5 sono raffigurate le varie fasi che compongono il programma. Nel primo blocco viene prima di tutto calcolato il cheacksum e aggiunto in coda al comando da inviare. Dopo aver inviato il comando con il vi "VISA Write" entriamo nella struttura loop dove andiamo a leggere la stringa di risposta con il vi "VISA Read". Quando i byte letti sono maggiori o uguali a 5, significa che possiamo verifica il quinto byte (n d-byte) per conoscere l'esatta grandezza del comando ricevuto che sarà uguale a 6 + il valore del quinto byte.
Nel terzo blocco é predisposto un tickcount che, se il secondo blocco non raggiunge le caratteristiche richieste entro 750ms, disattiva il loop e invia un flag di error "Time Out".

5. Read Status

Attraverso la funzione "Read Status", il PC200 ci restituisce lo stato del chiller compresi i vari allarmi. Questa funzione restituisce 40 bit di stato suddivisi in 5 byte. Una volta ricavati i bit dalla funzione, basta associare il numero del bit alla tabella come in figura.

BIT	d1	d2	d3	d4	d5
b.7	RTD1 Open Error	RTD2 Open Error	High temp fixed fault	Beeper on	External Sensor controlling
b.6	RTD1 Short Error	RTD2 Short Error	Low temp fixed fault	0	Heat icon flashing
b.5	RTD1 Open Fault	RTD2 Open Warn	High temp fault	Fault	Heat icon on
b.4	RTD1 Short Fault	0	Low temp fault	Unit stopping	Cool icon flashing
b.3	0	RTD2 Open*	Low level fault	Unit on	Cool icon on
b.2	0	RDT2 Short*	High temp warn	Pump on	HPC fault
b.1	0	High RA temp fault	Low temp warn	Compressor on	MOL fault
b.0	0	HTC fault	Low level warn	Heat output > 0	Pump speed fault

*Ignore this display

Fig.5 Tabella di corrispondeza bit

6. Elenco funzioni

Di seguito tutte le funzioni a 16 bit in gradi Celsius:

FUNCTION MASTER SENDS UNIT RESPONDS

Read Acknowledge	CA 00 01 **00** 00 FE	CA 00 01 **00** 02(v1)(v2)(cs)
Read Status (see Table 3)	CA 00 01 **09** 00 F5	CA 00 01 **09** 05(d1)(d2)(d3)(d4)(d5)(cs)
Read Internal Temperature (RTD1)	CA 00 01 **20** 00 DE	CA 00 01 **20** 03(qb)(d1)(d2)(cs)
Read External Temperature (RTD2)	CA 00 01 **21** 00 DD	CA 00 01 **21** 03(qb)(d1)(d2)(cs)
Read Currently Selected Setpoint	CA 00 01 **70** 00 8E	CA 00 01 **70** 03(qb)(d1)(d2)(cs)
Read Low Temperature Warning	CA 00 01 **40** 00 BE	CA 00 01 **40** 03(qb)(d1)(d2)(cs)
Read Low Temperature Fault	CA 00 01 **41** 00 BD	CA 00 01 **41** 03(qb)(d1)(d2)(cs)
Read High Temperature Warning	CA 00 01 **60** 00 9E	CA 00 01 **60** 03(qb)(d1)(d2)(cs)
Read High Temperature Fault	CA 00 01 **61** 00 9D	CA 00 01 **61** 03(qb)(d1)(d2)(cs)
Read Cool Proportional Band (P)	CA 00 01 **74** 00 8A	CA 00 01 **74** 03(qb)(d1)(d2)(cs)
Read Cool Integral (I)	CA 00 01 **75** 00 89	CA 00 01 **75** 03(qb)(d1)(d2)(cs)
Read Cool Derivative (D)	CA 00 01 **76** 00 88	CA 00 01 **76** 03(qb)(d1)(d2)(cs)
Read Heat Proportional Band (P)	CA 00 01 **71** 00 8D	CA 00 01 **71** 03(qb)(d1)(d2)(cs)
Read Heat Integral (I)	CA 00 01 **72** 00 8C	CA 00 01 **72** 03(qb)(d1)(d2)(cs)
Read Heat Derivative (D)	CA 00 01 **73** 00 8B	CA 00 01 **73** 03(qb)(d1)(d2)(cs)
Set Currently Selected Setpoint*	CA 00 01 **F0** 02(d1)(d2)(cs)	CA 00 01 **F0** 03(qb)(d1)(d2)(cs)
Set Low Temp Warning	CA 00 01 **C0** 02(d1)(d2)(cs)	CA 00 01 **C0** 03(qb)(d1)(d2)(cs)
Set Low Temp Fault	CA 00 01 **C1** 02(d1)(d2)(cs)	CA 00 01 **C1** 03(qb)(d1)(d2)(cs)
Set High Temp Warning	CA 00 01 **E0** 02(d1)(d2)(cs)	CA 00 01 **E0** 03(qb)(d1)(d2)(cs)
Set High Temp Fault	CA 00 01 **E1** 02(d1)(d2)(cs)	CA 00 01 **E1** 03(qb)(d1)(d2)(cs)
Set Cool Proportional Band (P = 0.1 - 99.9)	CA 00 01 **F4** 02(d1)(d2)(cs)	CA 00 01 **F4** 03(qb)(d1)(d2)(cs)
Set Cool Integral (I = 0 - 9.99)	CA 00 01 **F5** 02(d1)(d2)(cs)	CA 00 01 **F5** 03(qb)(d1)(d2)(cs)
Set Cool Derivative (D = 0 - 5.0)	CA 00 01 **F6** 02(d1)(d2)(cs)	CA 00 01 **F6** 03(qb)(d1)(d2)(cs)
Set Heat Proportional Band (P = 0.1 - 99.9)	CA 00 01 **F1** 02(d1)(d2)(cs)	CA 00 01 **F1** 03(qb)(d1)(d2)(cs)

Set Heat Integral (I = 0 - 9.99)	CA 00 01 **F2** 02(d1)(d2)(cs)	CA 00 01 **F2** 03(qb)(d1)(d2)(cs)
Set Heat Derivative (D = 0 - 5.0)	CA 00 01 **F3** 02(d1)(d2)(cs)	CA 00 01 **F3** 03(qb)(d1)(d2)(cs)

command bytes shown in **bold** v1, v2 = protocol version

(qb)	determina la precisione della lettura e l'unità di misura
00	0 precision (1), no units of measure
10	1 precision (0.1), no units of measure
20	2 precision (0.01), no units of measure
11	1 precision (0.1), °C
21	2 precision (0.01), °C
12	1 precision (0.1), °F
22	2 precision (0.01), °F
1D	1 precision (0.1), °K
2D	2 precision (0.01), °K

d1,d2 = 16 bit signed integer of the value being en (error number) 01 = Bad command,
sent or received 02 = Bad checksum
cs = the checksum of the string (see text) xx = no valid data, include in checksum
d1,d2,d3,d4 = 32 bit signal integer of the value
being sent or received
* = limited to the range of the head, bath and fluid combination

Bibliografia

Manuale di installazione Chiller PC200
U01047 PREMIUM Immersion Circulator Manual.pdf

Guida di Installazione Windows 7
AN_119_FTDI_Drivers_Installation_Guide_for_Windows7.pdf

Guida di Installazione Windows XP
AN_104_FTDI_Drivers_Installation_Guide_for_WindowsXP(FT_000093).pdf

Thermo Scientific
Laboratory Temperature Control Products

Manual Part Number U01047
Rev. 09/21/2011

Premium Series Heated Immersion Circulators

PC 200

PC 201

PC 300

ARCTIC Series Refrigerated/Heated Bath Circulators

A 24B

A 28

A 28F

A 25

A 40

GLACIER Refrigerated Bath Circulator

G 50

SAHARA Series Heated Bath Circulators

S 7

S 13

S 15

S 30

S 45

S 49

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Thermo Fisher Scientific

25 Nimble Hill Road
Newington, NH 03801
Tel : (800) 258-0830 or
(603) 436-9444
Fax : (603) 436-8411
www.thermoscientific.com/tc

Sales, Service, and Customer Support

25 Nimble Hill Road
Newington, NH 03801
Tel: (800) 258-0830
Sales: 8:00 am to 5:00 pm
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Fax: (603) 436-8411
service.tc.us@thermofisher.com

Dieselstrasse 4
D-76227 Karlsruhe, Germany
Tel : +49 (0) 721 4094 444
Fax : +49 (0) 721 4094 300
info.tc.de@thermofisher.com

Table of Contents

PREMIUM Quick Start Guide

Safety Precautions:

The unit is designed for indoor use only.

Never place unit in a location where excessive heat, moisture, inadequate ventilation, or corrosive materials are present.

Never use flammable or corrosive fluids with this unit.

Ensure the tubing you select will meet your maximum temperature and pressure requirements.

Before using any fluid or performing maintenance where contact with the fluid is likely refer to the manufacturer's MSDS for handling precautions.

What you need to get started:

- An adjustable wrench
- Appropriate hose or plumbing
- Appropriate size clamps or connection type

1 Electrical/Communications Connections

The unit is intended for use on a dedicated outlet. All units are equipped with automatic thermally-triggered 20 Amp circuit protector.

The circuit protection is designed to protect the controller, and is not intended as a substitute for branch circuit protection. It is the user's responsibility to provide a disconnect device. Position the unit so it is not difficult to operate your disconnecting device.

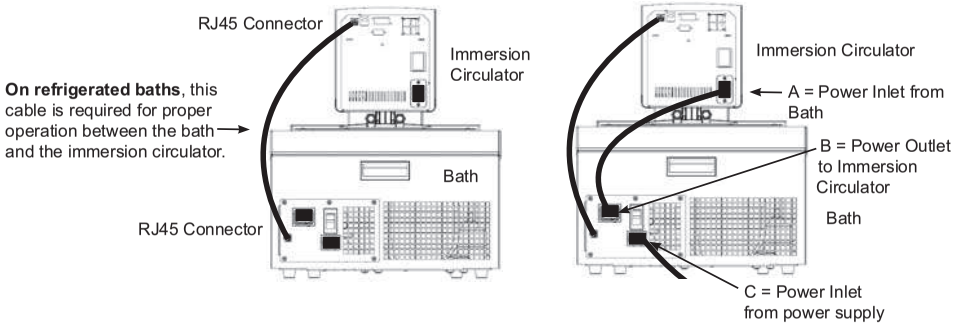
Refer to the bath nameplate on the rear, upper-left-hand corner of the bath for specific electrical requirements. Voltage deviations of ± 10% are permissible. The outlet must be rated as suitable for the total power consumption of the unit.

For refrigerated baths:
Ensure all communication and electrical connections are made prior to starting the unit.

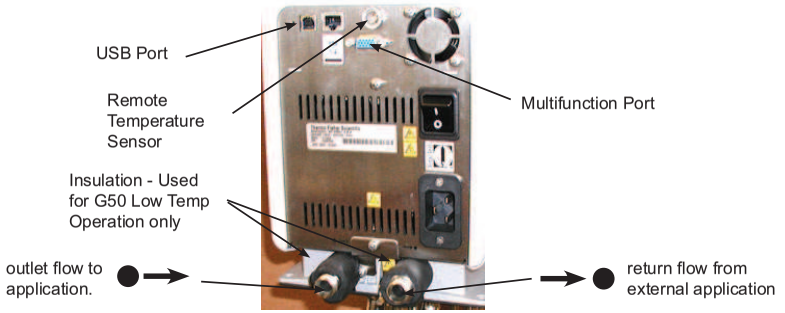
- Install the supplied RJ45 shielded cable between the immersion circulator and the bath RJ45 connectors (similar to Ethernet). **This is required for proper operation.**
- Install the power cord from the connector on the rear of the controller, A, to the connector on the rear of the refrigerated bath, B.
- Connect the bath's power cord, C, to a grounded power outlet.

For refrigerated baths, never connect controller power inlet, A, to a power outlet. Never connect power outlet, B, to anything but an immersion circulator.

Ensure the electrical cords do not come in contact with any of the plumbing connections or tubing.



2 Connections and External Flow



Immersion Circulator Connections (Typical)

Tubing is normally used to connect the pump to an external application.

The plumbing connections for external circulation are located on the rear of the immersion circulator. Remove the union nuts and shields to install the 8 mm or 12 mm hose barbs and clamps supplied with the unit.

Ensure the reservoir drain port on the front of the unit is *closed* and that all plumbing connections are secure.

To avoid spilling, place your application containers into the bath before filling.

Fill the bath work area from 2.0 cm (3/4") to 5.0 cm (2") below the top, see acceptable fluids below.

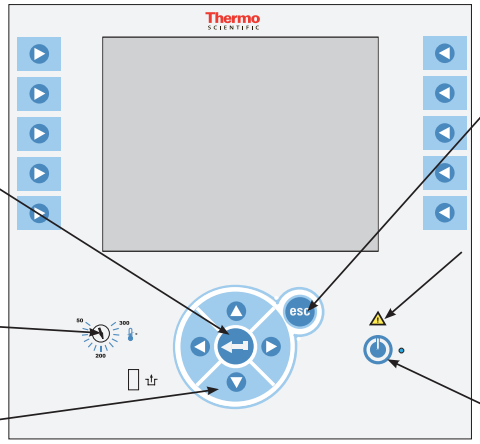
Avoid overfilling, oil-based fluids expand when heated.

When pumping to an external system, keep extra fluid on hand to maintain the proper level in the circulating lines and the external system. Monitor the fluid level whenever heating the fluid.

Acceptable Fluids:

Fluid	High °C	Low °C:
Water	+100/+100	+5/+5
Glycol-Water	+100/+100	-30/-30
SIL 100	+75/+75	-75/-25
SIL 180	+200/+150	-40/-25
SIL 300	+200/+150	+80/+80
SYNTH 60	+45/+45	-50/-25
SYNTH 200	+200/+150	+30/+30
SYNTH 260	+200/+150	+45/+45
Other	+200/+150	-90/-90

Start Up



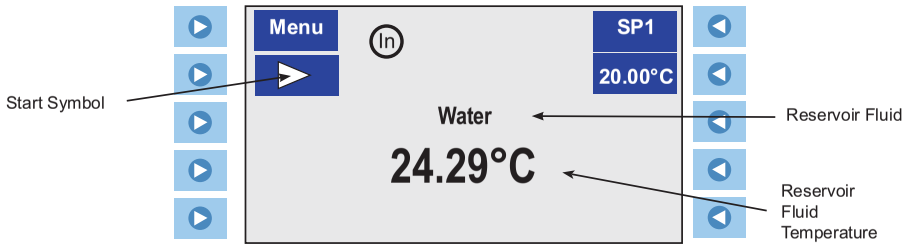
Refrigerated units should be left in an upright position at room temperature (~25°C) for 24 hours before starting. This will ensure the lubrication oil has drained back into the compressor.

Before starting the unit, double check all USB (optional), electrical and plumbing connections.

Do not run the unit until fluid is added to the unit. Have extra fluid on hand. If the unit will not start refer to the manual.

- For refrigerated baths, place the circuit breaker located on the rear of the bath to the **I** position.

- For all units, place the circuit protector located on the rear of the immersion circulator to the **I** position, the unit will enter the standby mode.
- Press , the controller will momentarily display **Thermo Scientific** and then the Start Display will appear.



Start Display

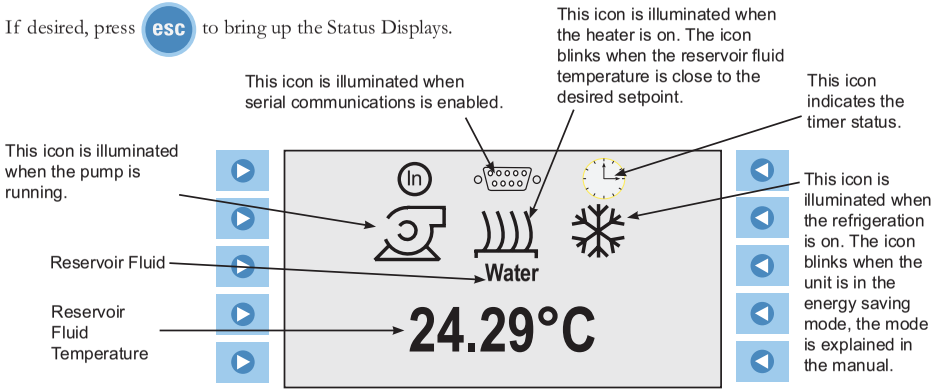
- Press to the left of the start symbol, . The unit will start and the start symbol will turn into a stop symbol, .

After start up, check all the plumbing connections for leaks.

The **Menu** and **SP1** portions on the top of the display are used to view and/or change the immersion circulator's settings. These features are explained in detail in the manual.

In indicates the controller is using its internal sensor for temperature control. Ex is displayed when the external sensor is selected for temperature control.

If desired, press esc to bring up the Status Displays.



Status Display

If desired, press esc to toggle between the Start and Status Displays.

Shut Dowm

- Press to the left of the stop symbol, . The unit will stop and the stop symbol will turn into a start symbol, .
- Press . The controller's display will go blank and the blue LED will illuminate indicating the unit is in the standby mode.
- Place the circuit protector on the rear of the immersion circulator to the **O** position. The blue LED will extinguish.

PREMIUM Kurzanleitung

Sicherheitsvorkehrungen:

Das Gerät darf nur in geschlossenen Räumen betrieben werden.

Stellen Sie das Gerät niemals an Orten auf, wo es übermäßiger Hitze, Feuchtigkeit, unzureichender Belüftung oder korrosiven Stoffen ausgesetzt ist.

Verwenden Sie niemals brennbare oder korrosive Flüssigkeiten in diesem Gerät.

Stellen Sie sicher, dass die von Ihnen ausgewählten Schläuche die Höchstgrenzen für Temperatur und Druck nicht unterschreiten.

Bevor Sie Flüssigkeiten einsetzen oder eine Wartung durchführen, bei denen Sie möglicherweise mit Flüssigkeiten in Berührung kommen, beachten Sie die im Sicherheitsdatenblatt des Flüssigkeitsherstellers beschriebenen Vorsichtsmaßnahmen.

Sie benötigen für die Inbetriebnahme:

- Einen verstellbaren Schraubenschlüssel
- Passende Schläuche bzw. Leitungen
- Passende Klemmen oder Anschlussstücke

1 Elektrische Anschlüsse/Kommunikationsanschlüsse

Das Gerät ist für die Verwendung an einer dafür vorgesehenen Steckdose bestimmt. Alle Thermostate sind mit einem automatischen thermischen 20 A Schutzschalter ausgestattet.

Der Stromkreisschutz dient zum Schutz des Reglers und ersetzt nicht den Abzweigschutz. Die Bereitstellung einer Trennvorrichtung unterliegt der Verantwortung des Benutzers. Stellen Sie das Gerät so auf, dass die Bedienung der Trennvorrichtung keine Schwierigkeiten bereitet.

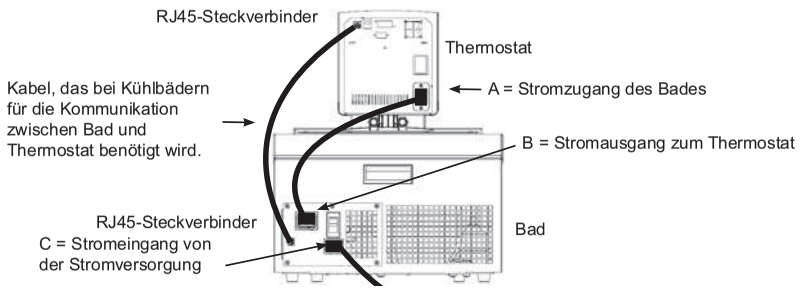
Die spezifischen elektrischen Anforderungen finden Sie auf dem Bad-Typenschild in der linken oberen Ecke auf der Rückseite des Bades. Es sind Spannungsschwankungen von ± 10 % zulässig. Die Steckdose muss als geeignet für den Gesamtenergieverbrauch des Geräts ausgeführt sein.

Bei Kühlbädern:
Stellen Sie sicher, dass vor Inbetriebnahme des Geräts alle Kommunikations- und Stromverbindungen hergestellt sind.

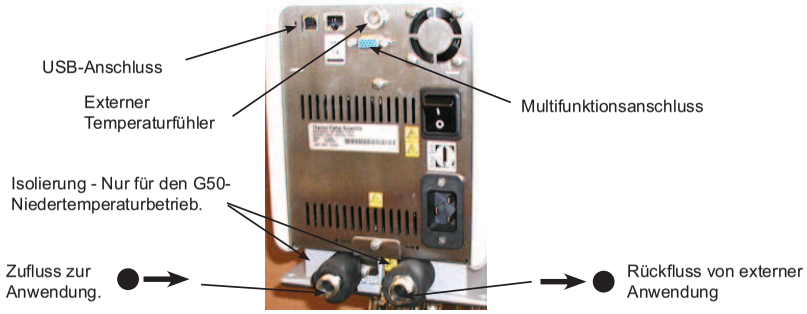
- Schließen Sie das Netzkabel von der Buchse auf der Rückseite des Reglers, A, zur Buchse auf der Rückseite des Kühlbads, B, an.
- Schließen Sie das Stromkabel des Bades, C, an eine geerdete Steckdose an.
- Installieren Sie das mitgelieferte Kommunikationskabel zwischen dem Thermostat und den RJ45-Steckverbindern des Bades (ähnlich wie Ethernet).

Bei Kühlbädern darf der Stromeingang des Reglers, A, niemals an einen separaten Stromausgang angeschlossen werden. Schließen Sie den Stromausgang, B, ausschließlich an einen Thermostat an.

Achten Sie darauf, dass die Stromkabel nicht mit einem der Wasseranschlüsse oder Schläuche in Kontakt geraten.



2 Anschlüsse und externer Kreislauf



Thermostatanschlüsse (typisch)

Schläuche dienen normalerweise dazu, die Pumpe an eine externe Anwendung anzuschließen.

Die Wasseranschlüsse für die externe Umwälzung befinden sich auf der Rückseite des Thermostats. Entfernen Sie die Überwurfmuttern und Verschlussplättchen, um die mit dem Gerät mitgelieferten 8 mm bzw. 12 mm Schlauchtüllen und -klemmen zu montieren.

Achten Sie darauf, dass der Ablaufhahn des Behälters an der Vorderseite des Geräts *geschlossen* ist und alle Wasseranschlüsse fest sitzen.

Um ein Überlaufen zu vermeiden, stellen Sie die Behälter vor dem Befüllen in das Bad.

Befüllen Sie das Bad so, dass ein Arbeitsbereich von 2,0 cm (3/4") bis 5,0 cm (2") von der Oberkante erhalten wird (siehe zulässige Flüssigkeiten weiter unten).

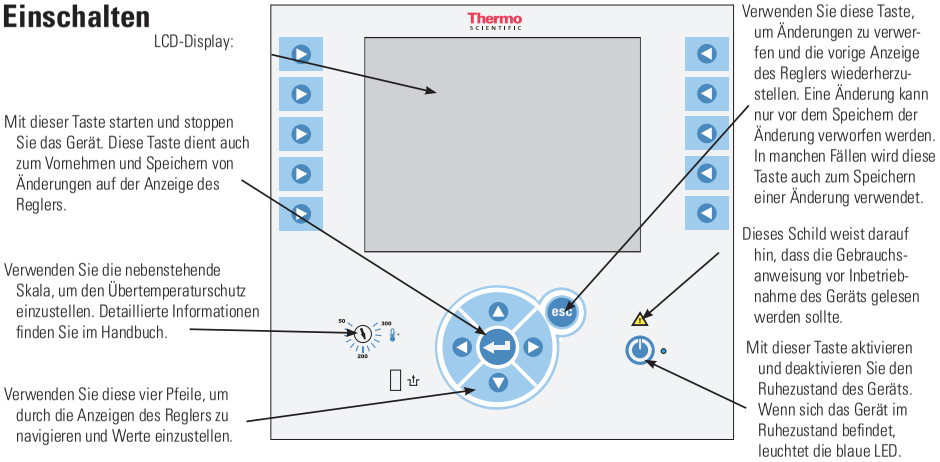
Vermeiden Sie ein Überfüllen, da Flüssigkeiten auf Ölbasis sich unter Erwärmung ausdehnen.

Wenn Sie Flüssigkeit in ein externes System pumpen, halten Sie zusätzliche Flüssigkeit griffbereit, um den ordnungsgemäßen Füllstand in den Umwälzleitungen und im externen System aufrecht zu erhalten. Überwachen Sie den Füllstand, wenn Sie die Flüssigkeit erhitzen.

Zulässige Flüssigkeiten:

Flüssigkeit	Max. °C	Min. °C
Wasser	+100/+100	+5/+5
Glykol/Wasser-Gemisch	+100/+100	-30/-30
SIL 100	+75/+75	-75/-75
SIL 180	+200/+200	-40/-40
SIL 300	+300/+300	+80/+80
SYNTH 60	+45/+45	-50/-50
SYNTH 200	+210/+210	+20/+20
SYNTH 260	+250/+250	+40/+40
Sonstige	+200/+150	-90/-90

Einschalten



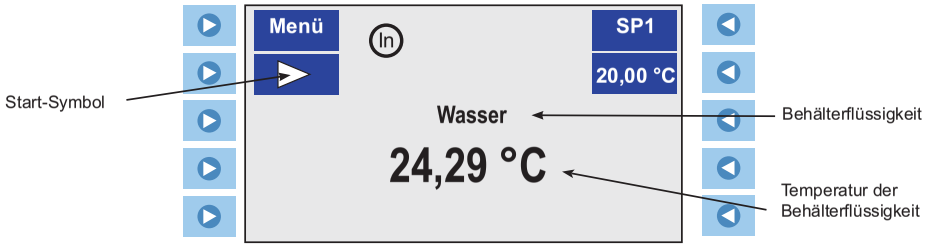
Kühlgeräte müssen vor Inbetriebnahme 24 Stunden bei Raumtemperatur (~25 °C) aufrecht stehen. Dadurch wird gewährleistet, dass das Schmieröl zurück in den Kompressor fließt.

Kontrollieren Sie vor dem Start des Geräts alle USB- (optional), Flüssigkeits- und elektrischen Anschlüsse.

Lassen Sie das Gerät erst laufen, nachdem Sie die Flüssigkeit zugegeben haben.. Halten Sie zusätzliche Flüssigkeit griffbereit. Wenn das Gerät nicht startet, sehen Sie das Handbuch ein.

- Bei Kühlbädern stellen Sie den Schalter auf der Rückseite des Bades auf die Position **I**.

- Stellen Sie den Schalter auf der Rückseite bei allen Geräten auf die Position **I**; das Gerät wechselt in den Ruhemodus.
- Drücken Sie auf ; der Regler zeigt vorübergehend Thermo Scientific und dann die Startanzeige an.



Startanzeige

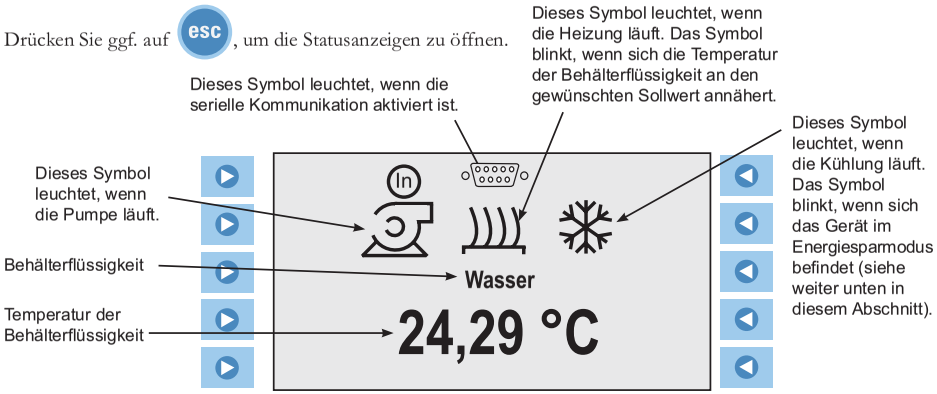
- Drücken Sie links vom Start-Symbol auf . Das Gerät startet und das Start-Symbol verwandelt sich in ein Stopp-Symbol .

Überprüfen Sie nach Inbetriebnahme alle Leitungsanschlüsse auf undichte Stellen.

Die Bereiche **SP1** und **Menü** im oberen Teil der Anzeige dienen zur Ansicht und/oder Änderung der Thermostateinstellungen. Eine detaillierte Beschreibung dieser Funktionen finden Sie im Handbuch.

In Zeigt an, dass der Thermostat seinen integrierten Fühler zur Temperatursteuerung verwendet. Ex Wird angezeigt, wenn der externe Fühler für die Temperaturregelung ausgewählt wurde.

Drücken Sie ggf. auf esc, um die Statusanzeigen zu öffnen.



Statusanzeige

Drücken Sie bei Bedarf auf esc, um zwischen den Start- und Statusanzeigen zu wechseln.

Ausschalten

- Drücken Sie links vom Stopp-Symbol auf . Das Gerät stoppt und das Stopp-Symbol verwandelt sich in ein Start-Symbol ( ).

- Drücken Sie auf . Die Anzeige des Thermostats wird gelöscht und die blaue LED leuchtet auf, um anzuzeigen, dass sich das Gerät im Ruhezustand befindet.

Stellen Sie den Schalter auf der Rückseite des Thermostats auf die Position **O**. Die blaue LED erlischt.

- Bei Kühlgeräten stellen Sie den Schalter auf der Rückseite des Bads auf die Position **O**.

Preface

Compliance

Products tested and found compliant with the requirements defined in the EC Directives as well as Low Voltage Directive (LVD) can be identified by the CE Mark on the rear of the unit. The Declaration of Conformity can be found in the appendix of this manual.

The conformity assessment were performed following defined procedures according to each applicable directive.

The council decision 93/465/EEC shall be authoritative concerning the modules of the various phases of the conformity assessment procedures and the rules for the affixing and use of the CE Mark), which are intended to be used in the technical harmonization directives.

To confirm compliance with the EC-Directive 2004/108/EC Electromagnetic Compatibility (EMC) our products were tested according to the EMC requirements for emission and immunity for electrical equipment for measurement, control and laboratory use.

Some electrical equipment displaying the CE Mark, e.g., monitors or analytical instruments, can be affected if their manufacture accepts interference, e.g., flickering of a monitor, as a minimum operating quality with electromagnetic compatibility. We recommend a minimum distance of approximately one meter from this type of equipment.

For any additional information, refer to the Declaration of Conformity.

Visit **www.ul.com/global/eng/pages** to view the UL listings for Thermo Fisher Scientific. Reference file #E164214 for these products.

WEEE

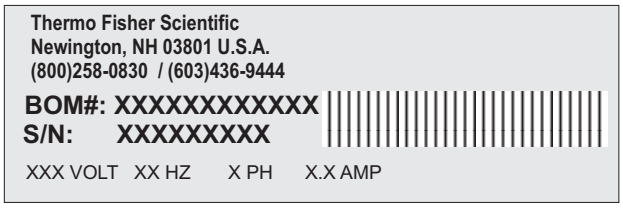
This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with this symbol.

Thermo Fisher Scientific has contracted with one or more recycling/ disposal companies in each EU Member State, dispose of or recycle this product through them. Further information on Thermo Fisher Scientific's compliance with these Directives is available at:

www.thermoscientific.com/WEEERoHS

After-sale Support

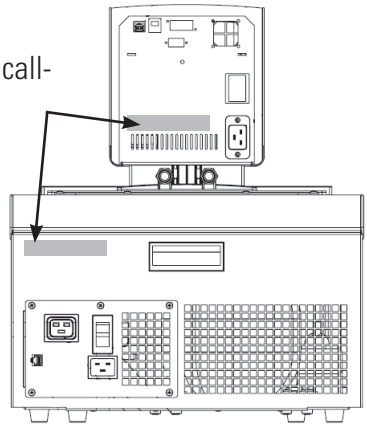
Thermo Fisher Scientific is committed to customer service both during and after the sale. If you have questions concerning the unit operation, or questions concerning spare parts or Service Contracts, call our Sales, Service and Customer Support phone number, see this manual's inside cover for contact information.



Sample Nameplate

Before calling, please obtain the serial number printed on the **system nameplates** on the rear of the unit.

Nameplate
Refer to nameplate when calling for after-sale support



Nameplates (Typical Locations)

Feedback

We appreciate any feedback you can give us on this manual. Please e-mail us at thermoscientificmanuals@thermofisher.com. Be sure to include the manual part number and the revision date listed on the front cover.

Warranty

Thermo Scientific Laboratory Temperature Control Products have a warranty against defective parts and workmanship for 36 months from date of shipment. See back page of this manual for more details.

Unpacking

Retain all cartons and packing material until the unit is operated and found to be in good condition. If the unit shows external or internal damage contact the transportation company and file a damage claim. Under ICC regulations, this is your responsibility.

⚠ CAUTION

Refrigerated units should be left in an upright position for 24 hours at room temperature before starting. This will ensure the lubrication oil has drained back into the compressor. ▲

Section 1 Safety

Safety Warnings

Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions concerning the operation of your unit or the information in this manual, please contact us. See inside cover for contact information.

DANGER indicates an imminently hazardous situation which, if not avoided, *will* result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, *could* result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It is also be used to alert against unsafe practices.

The lightning flash with arrow symbol, within an equilateral triangle, is intended to alert the user to the presence of non-insulated "dangerous voltage" within the unit's enclosure. The voltage magnitude is significant enough to constitute a risk of electrical shock.

This label indicates the presence of hot surfaces.

This label indicates read the manual.

Observe all warning labels. ▲

Never remove warning labels. ▲

Refrigerated units should be left in an upright position for 24 hours before starting. This will ensure the lubrication oil has drained back into the compressor. ▲

The unit construction provides protection against the risk of electrical shock by grounding appropriate metal parts. The protection will not function unless the power cord is connected to a properly grounded outlet. It is the user's responsibility to assure a proper ground connection is provided. ▲

The circuit protector located on the rear of the unit is not intended to act as a disconnecting means. ▲

Never operate the unit with the immersion circulator removed from the bath. ▲

Do not mount the immersion circulator backwards on the bath; the line cord could contact the reservoir fluid. Ensure the electrical cords do not come in contact with any of the plumbing connections or tubing. ▲

Operate the unit using only the supplied line cord. If the unit's power cord is used as the disconnecting device, it must be easily accessible at all times. ▲

Never place the unit in a location or atmosphere where excessive heat, moisture, or corrosive materials are present. ▲

Ensure the tubing you select will meet your maximum temperature and pressure requirements. ▲

Ensure all communication and electrical connections are made prior to starting the unit. ▲

Many refrigerants which may be undetectable by human senses are heavier than air and will replace the oxygen in an enclosed area causing loss of consciousness. Refer to the unit's nameplate and the manufacturer's most current MSDS for additional information. ▲

Never operate the unit without fluid in the reservoir. ▲

Other than water, before using any fluid, or when performing maintenance where contact with the fluid is likely, refer to the manufacturer's MSDS and EC Safety Data sheet for handling precautions. ▲

Ensure, that no toxic gases can be generated by the fluid. Flammable gases can build up over the fluid during usage. ▲

Never use corrosive or flammable fluids with this unit. Use of these fluids will void the manufacturer's warranty. ▲

When using ethylene glycol and water, check the fluid concentration and pH on a regular basis. Changes in concentration and pH can impact system performance. ▲

Ensure the fluid is at a safe temperature (20°C to 55°C) before handling or draining. ▲

Never operate damaged or leaking equipment, or with any damaged cords. ▲

Never operate the unit or add fluid to the reservoir with panels removed. ▲

Do not clean the unit with solvents, only use a soft cloth and water. ▲

Drain the unit before it is transported and/or stored in, near or below freezing temperatures.

Always turn the unit off and disconnect the supply voltage from its power source before moving the unit or before performing any service or maintenance procedures. ▲

Transport the unit with care. Sudden jolts or drops can damage the unit's components. ▲

Refer service and repairs to a qualified technician. ▲

Section 2 General Information

Description

The Thermo Scientific PREMIUM Series of Heated Immersion Circulators are used with refrigerated and heated baths. All circulators can pump to an external system. All controllers have a digital display and easy-to-use touch pad, five programmable setpoint temperatures, acoustic and optical alarms, and offer adjustable high temperature protection.

PREMIUM Heated Immersion Circulator

	PC 200	PC 201	PC 300
Temperature Range	Ambient +13°C to +200°C Ambient +23°F to +392°F	Ambient +13°C to +200°C Ambient +23°F to +392°F	Ambient +13°C to +300°C Ambient +23°F to +572°F
Temperature Stability	±0.01°C	±0.01°C	±0.01°C
Heater Capacity 230V/115V	2000/1200 Watts	3000/NA Watts	3000/NA Watts
Immersion Depth mm inches	75 to 145 3.0 to 5.7	75 to 145 3.0 to 5.7	75 to 145 3.0 to 5.7
Dimensions (H x W x D) mm inches	421 x 189 x 233 16.6 x 7.4 x 9.2	421 x 189 x 233 16.6 x 7.4 x 9.2	421 x 189 x 233 16.6 x 7.4 x 9.2
Net Weight kg lb	4.7 10.4	4.7 10.4	4.7 10.4
Pumping Capacity Max flow rate lpm/gpm Max pressure (mbar/psi) Max suction (mbar/psi) Pump speed	 24/6.3 560/8.1 380/5.5 Variable (0% - 100%)	 24/6.3 560/8.1 380/5.5 Variable (0% - 100%)	 24/6.3 560/8.1 380/5.5 Variable (0% - 100%)
Electrical Requirements (Voltage ±10%)	100 V/50 Hz 100 V/60 Hz or 115 V/60 Hz or 200-230 V/50..60 Hz	200-230 V/50..60 Hz	200-230 V/50..60 Hz
Connectivity Remote sensor port USB port Multi function port RS232 RS485 Ethernet/LAN Analog I/O	 Yes Yes Yes Optional Optional Optional Optional	 Yes Yes Yes Optional Optional Optional Optional	 Yes Yes Yes Optional Optional Optional Optional

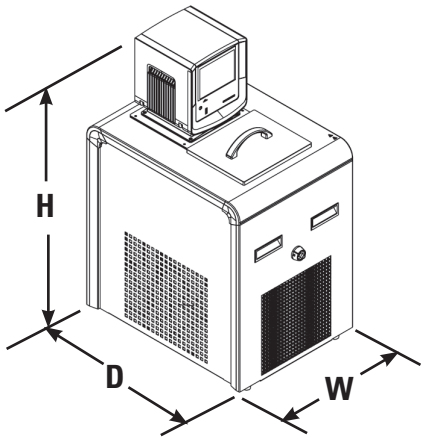
- Performance specifications established in accordance with DIN 12 876 (using water at 70°C).
- Lower temperature ranges available with supplemental cooling.
- The maximum bath wall thickness for circulators that have a factory installed clamp is 26 mm.
- Communication options require an accessory box.
- Thermo Fisher Scientific reserves the right to change specifications without notice.

ARCTIC Refrigerated/Heated Bath Circulator Specifications

Stainless Steel Refrigerated/Heated Bath Circulators					
	A24B	**A25**	**A28**	**A28F**	**A40**
Temperature Range	-24 to 200°C -11 to 392°F	-25 to 200°C -13 to 392°F	-28 to 200°C -18 to 392°F	-28 to 200°C -18 to 392°F	-40 to 200°C -40 to 392°F
Bath Volume liters gallons	16 - 27 4.2 - 7.1	7 - 12 1.8 - 3.2	6 - 10 1.6 - 2.6	6 - 10 1.6 - 2.67	7 - 12 1.8 - 3.2
Cooling Capacity watts	700	500	320	320	800
Refrigerant	R404	R134a	R134a	R134a	R404
Dimensions (H x W x D)* mm inches	612 x 765 x 610 24.1 x 30.1 x 24.0	749 x 273 x 483 29.5 x 10.7 x 19.0	749 x 273 x 483 29.5 x 10.7 x 19.0	558 x 514 x 426 22.0 x 20.2 x 16.8	787 x 385 x 519 31.0 x 15.1 x 20.4
Net Weight kg lb	58.6 128.9	36.1 79.5	36.0 79.1	35.6 78.3	55.2 121.5
Electrical Requirements** (Voltage ±10%)	100 V/50 Hz 100 V/60 Hz or 115 V/60 Hz or 230 V/50 Hz				

GLACIER Refrigerated Bath Circulator Specifications

G 50 Ultra-Low Refrigerated Bath Circulator	
Temperature Range	-50° to 200°C -58°F to 392°F
Bath Volume liters gallons	7 - 12 1.8 - 3.2
Cooling Capacity at 20°C	1000 watts
Dimensions (H x W x D)* mm inches	851 x 419 x 554 33.5 x 16.5 x 21.8
Net Weight kg/lb	62/136
Electrical Requirements** (Voltage ±10%)	200 V/50 Hz or 208-230 V/60 Hz or 230 V/50 Hz



*Add ~26 mm (1 inch) to D for drain fitting.

**See Section 3 for additional information.

• Thermo Fisher Scientific reserves the right to change specifications without notice.

SAHARA Heated Bath Circulator Specifications

Stainless Steel Heated Bath Circulators			
	S7	**S13**	**S15**
Temperature Range*	Ambient +13 to 300°C Ambient +23 to 572°F	Ambient +13 to 300°C Ambient +23 to 572°F	Ambient +13 to 200°C Ambient +23 to 392°F
Bath Volume liters gallons	4 - 7 1.1 - 1.8	7 - 11 1.8 - 2.9	7 - 17 1.8 - 4.5
Dimensions** (H x W x D) mm inches	494 x 235 x 428 19.5 x 9.2 x 16.7	494 x 321 x 428 19.5 x 12.6 x 16.7	494 x 381 x 457 19.5 x 15.0 x 18.0
Net Weight kg lb	10.6 23.4	12.3 27.0	13.7 30.1

Stainless Steel Heated Bath Circulators			
	S30	**S45**	**S49**
Temperature Range*	Ambient +13 to 200°C Ambient +23 to 392°F	Ambient +13 to 200°C Ambient +23 to 392°F	Ambient +13 to 200°C Ambient +23 to 392°F
Bath Volume liters gallons	14 - 24 3.7 - 6.3	30 - 41 7.9 - 10.8	29 - 51 7.7 - 13.5
Dimensions** (H x W x D) mm inches	494 x 381 x 628 19.5 x 15.0 x 24.7	594 x 381 x 628 23.4 x 15.0 x 24.7	494 x 579 x 746 19.5 x 22.8 x 29.4
Net Weight kg lb	16.5 36.2	20.3 44.7	24.3 53.4

Specifications achieved with bath cover removed.

*Lower temperature ranges available with supplemental cooling.

**Add ~26 mm (1 inch) to D for drain fitting.

- Thermo Fisher Scientific reserves the right to change specifications without notice.

Wetted Materials

PREMIUM Immersion Circulator

Viton

EPDM

Ryton

Ultem

Vectra

Stainless Steel

Stainless Steel Baths/Circulators

Stainless Steel Series

Ryton (drain fitting)

Zotek-N (cover seal)

Section 3 Installation

Ambient Conditions

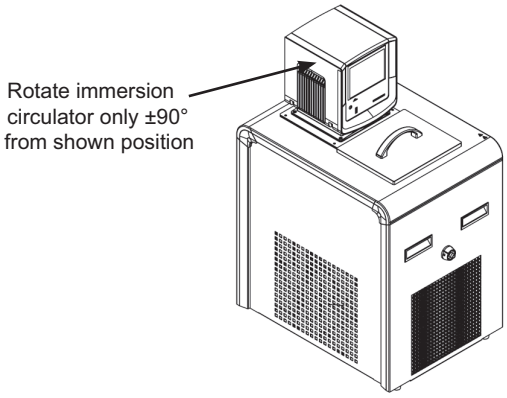
Ambient Temperature Range	5°C to 40°C (41°F to 104°F)
Maximum Relative Humidity	80% at 31°C (88°F)
Operating Altitude	Sea Level to 2000 meters (6560 feet)
Overvoltage Category	II
Pollution Degree	2
Degree of Protection	IP 20

The unit is designed for continuous operation and for indoor use.

The units normally ships with the immersion circulator mounted facing the reservoir. You may change the position ±90° by removing thumb screws, no tools are required.

⚠ CAUTION

Do not mount it backwards; the line cord could contact the reservoir fluid. ▲



⚠ CAUTION

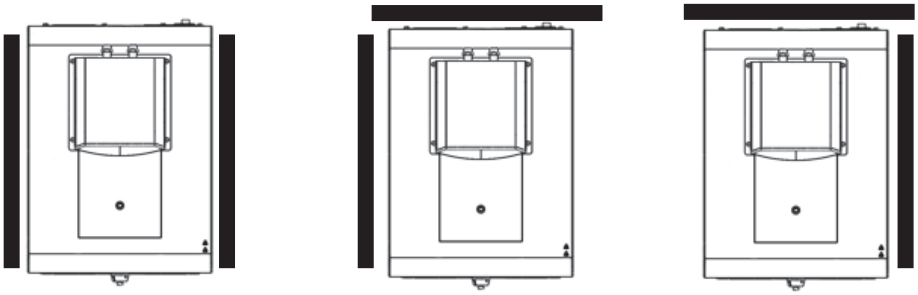
Never place the unit in a location where excessive heat, moisture, inadequate ventilation, or corrosive materials are present. ▲

⚠ CAUTION

Refrigerated units should be left in an upright position for 24 hours at room temperature before starting. This will ensure the lubrication oil has drained back into the compressor. ▲

Ventilation

The unit can operate with 0 clearance on two exhaust sides as long as the third exhaust side has unrestricted air flow. Blocked ventilation will increase the unit's temperature, reduce its cooling capacity and, on refrigerated units, eventually lead to premature compressor failure.



Ventilation Options

Electrical Requirements

DANGER

The unit construction provides protection against the risk of electrical shock by grounding appropriate metal parts. The protection will not function unless the power cord is connected to a properly grounded outlet. It is the user's responsibility to assure a proper ground connection is provided. ▲

The unit is intended for use on a dedicated outlet. All units are equipped with automatic thermally-triggered 20 Amp circuit protector.

NOTE If the circuit protector activates allow the unit to cool before resetting. Restart the unit. Contact us if it activates again. ▲

The circuit protection is designed to protect the controller, and is not intended as a substitute for branch circuit protection. Position the unit so it is not difficult to operate the disconnecting device.

CAUTION

If the unit's power cord is used as the disconnecting device, it must be easily accessible at all times. ▲

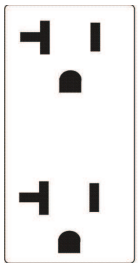
Refer to the bath nameplate on the rear, upper-left-hand corner of the bath for specific electrical requirements. Voltage deviations of ± 10% are permissible. The outlet must be rated as suitable for the total power consumption of the unit, see next page.

NOTE If a bath and immersion circulator were purchased separately, follow the electrical requirements listed on the bath nameplate. ▲

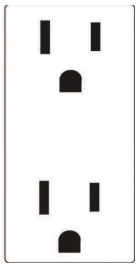
The following power options are available:

Unit	Volts[1]/Hertz/Phase	Amps[2]	Total Wattage	Plug Type
A28/A25	115/60/1	11.7	1185	N5-15
	100/50-60/1	11.5	1135	N5-15
	230/50/1	10.4	2395	Country Specific
A28F	115/60/1	11.5	1165	N5-15
	100/50-60/1	11.4	1120	N5-15
	230/50/1	10.3	2370	Country Specific
A40/A24B	115/60/1	14.4	1660	N5-20
	100/50-60/1	15.3	1525	N5-20
	230/50/1	11.3	2600	Country Specific
G50	200-230/60/1 or 200/50/1	12.9	2980	N6-20
	230/50/1	12.9	2980	Country Specific
PC 200 All Heated Baths/Circulators	115/60/1	11.3	1300	N5-20
	100/50-60/1	10.0	1300	N5-20
	230/50/1	9.3	2135	Country Specific
PC 201/300 All Heated Baths/Circulators	230/50/1	13.6	3140	Country Specific

1. Volts ± 10%
2. Maximum amp draw



20 Amp Outlet
(16 Amp)

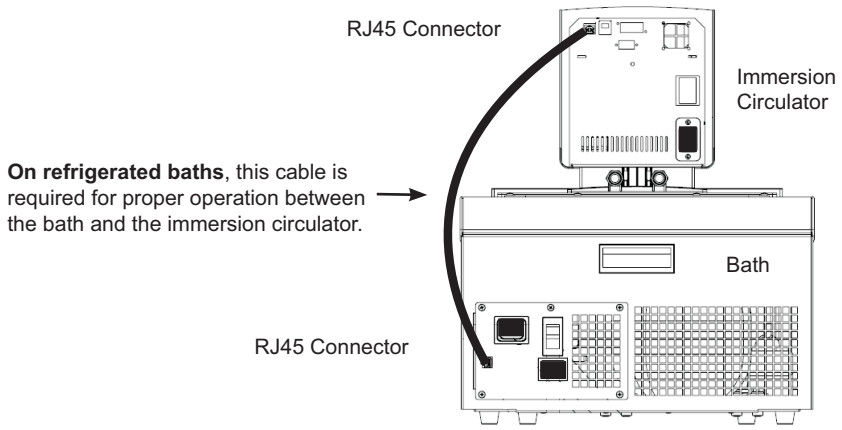


15 Amp Outlet
(12 Amp)

⚠ CAUTION

For refrigerated baths:
Ensure all communication and electrical connections are made prior to starting the unit.

- Install the supplied RJ45 shielded cable between the immersion circulator and the bath RJ45 connectors (similar to Ethernet). **This is required for proper operation.**



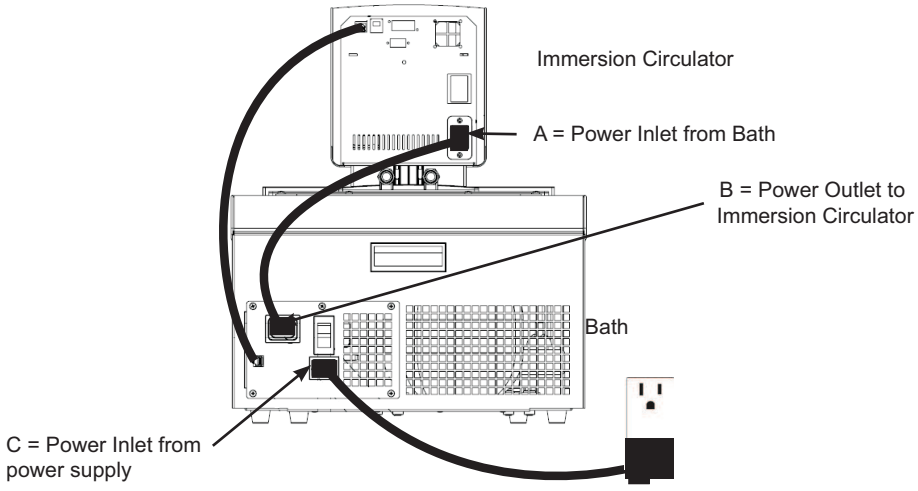
- Install the power cord from the connector on the rear of the controller, A, to the connector on the rear of the refrigerated bath, B.
- Connect the bath's power cord, C, to a grounded power outlet.

⚠ CAUTION

For refrigerated baths, never connect controller power inlet, A, to a power outlet. Never connect power outlet, B, to anything but an immersion circulator.

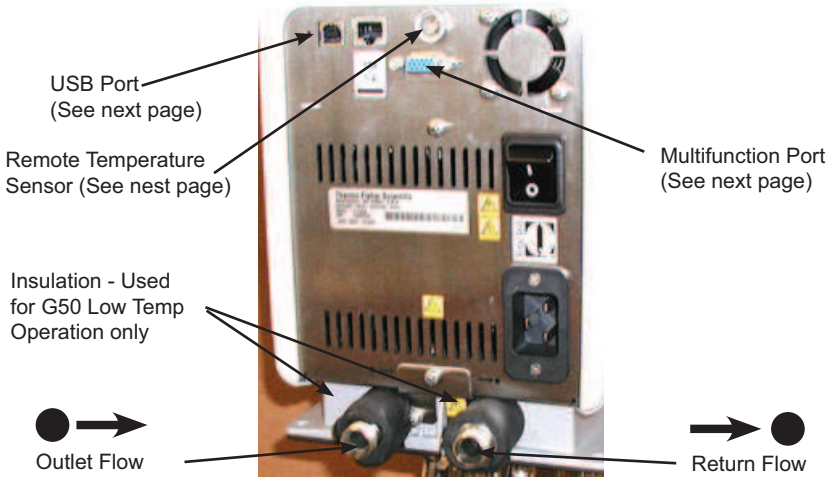
⚠ CAUTION

Ensure the electrical cords do not come in contact with any of the plumbing connections or tubing.



External Circulation

The plumbing connections for external circulation are located on the rear of the immersion circulator. → ● is the return flow from the external application. ● → is the outlet flow to the external application (supply side). The connections are 16 mm O.D. Remove the union nuts and plates to install the 8 mm or 12 mm hose barbs and clamps supplied with the unit.



Connections (Typical)

NOTE G50 units are supplied with 2" pieces of insulation (4 total). For low-temperature operation, install a single piece of insulation on each of the pump lines. ▲

CAUTION

To prevent damage to the unit's plumbing, use a 19 mm backing wrench when removing/installing the external connections. ▲

Remote Temperature Sensor

The remote temperature sensor on the rear of the immersion circulator requires a 4-pin connector that must mate to a LEMO # ECP.1S.304.CLL. The immersion circulator uses a 3 wire sensor, but a 4 wire sensor can be used (pins 3 and 4 are interconnected in the control head). The pin-out is:

Pin 1 and 2 = Pt100 + Pin 3 and 4 = Pt100 -

See Section 4 for instructions to enable the remote sensor.

Multifunction Port

The Multifunction port on the rear of the immersion circulator is used in conjunction with an *optional* accessory box to select and activate additional features. See Section 4 for additional information.

USB Port

If your computer does not automatically recognize the USB driver, installation instructions are provided in the Appendix.

Tubing Requirements

CAUTION

Ensure none of the tubing comes in contact with the power cord. ▲

Tubing is normally used to connect the pump to an external application. **NOTE** For maximum pressure to the external application cap the pump nozzle with the supplied fitting, it may be necessary to remove the immersion circulator from the bath to access the nozzle. ▲

NOTE The maximum allowable length of tube depends largely on the size, form and material of the external vessel. The length of tube and its diameter, combined with the circulating capacity, have a large effect on the temperature stability. Whenever possible, use a wider tube diameter and place the application as close as possible to the circulator. ▲

Extreme operating temperatures will lead to extreme temperatures on the tube surface, this is even more critical with metal nozzles. ▲

- the required tube material depends on the heat transfer liquid used
- tubes must not be folded or bent
- after prolonged use, tubes may become brittle or they may get very soft, check them on a regular basis and replace if necessary
- secure all tube connections using clamps

When using the internal bath only, the plumbing connections can be closed with the supplied plate and union nuts.

Tubing

Tubing for Thermo Scientific temperature control systems is optional. Please select the proper tubing from the table shown in Section 5.

⚠ CAUTION

Ensure the tubing you select will meet your maximum temperature and pressure requirements. ▲

Plastic and rubber tubing

If other plastic and rubber tubes are used, ensure that the tubes selected are fully suitable for the particular application, i.e., that they will not split, crack or become disengaged from their connections.

Connect the tubing using the supplied tube fittings for 8 or 12 mm i.d. They are attached to the plumbing connections with a supplied coupling nut.

We highly recommend using foam rubber insulation on the tubing and the fittings.

Metal tubing

Thermo Scientific metal tubing (stainless steel insulated) offers a particularly high degree of safety and is suitable for both low and high temperatures/ liquids.

The metal tubing is attached directly to the plumbing connections, gaskets are not required.

⚠ CAUTION

Do not subject tubing to mechanical strain and ensure any specified bend radius is not exceeded. ▲

Tubing is available in lengths of 0.5, 1.0 and 1.5 meters. Couplings for connecting tubes are also available.

The smallest opening inside the metal tubes is 10 mm. The metal tubing is provided with coupling nuts (M16 x 1, DIN 12 879, part 2) at either end.

Fluids

The user is always responsible for the fluid used. Never use corrosive fluids with this unit. ▲

Never use 100% glycol. ▲

Handling and disposal of liquids other than water should be done in accordance with the fluid manufacturers specification and/or the MSDS for the fluid used. ▲

Always adjust the unit's software to the fluid used, see Section 4. ▲

When using water above 80°C closely monitor the fluid level, frequent top-offs will be required. It will also create steam. ▲

Water/glycol mixtures require top-offs with pure water, otherwise the percentage of glycol will increase resulting in high viscosity and poor performance. ▲

The fluid information is only a guide since specifications may change.

Thermo Fisher Scientific takes no responsibility for damages caused by the selection of an unsuitable bath fluid.

Unsuitable bath fluids are fluids which:

- are very highly viscous (much higher than 30 mPas at the respective working temperature)
- have corrosive characteristics or
- tend to break down at high temperatures

For fluid selection consider application requirements, operating temperature range, material compatibility, safety concerns, and environmental issues.

5°C to 95°C — Distilled Water or Deionized Water (up to 3 MΩ-cm)
Normal tap water leads to calcareous deposits necessitating frequent unit decalcification, see table on next page.

Calcium tends to deposit itself on the heating element. The heating capacity is reduced and service life shortened.

-30°C to 80°C — Water with Glycol
Below 5°C water has to be mixed with a glycol. The amount of glycol added should cover a temperature range 5°C lower than the operating temperature of the particular application. This will prevent the water/glycol from gelling (freezing) near the evaporating coil.

Excess glycol deteriorates the temperature accuracy due to its high viscosity.

-40°C to 200°C — SIL180:
SIL180 is suitable for covering nearly the entire range with just one liquid, especially when used with the cooling units. See next page for additional information.

Unfortunately SIL180 has a wetting tendency necessitating the occasional cleaning of the bath cover.

other temperatures:
Thermo Fisher Scientific offers a range of heat transfer fluids for these temperature control applications.

SYNTH 60, SYNTH 200, SYNTH 260:
Synthetic thermal liquid with a medium life span (several months) and little smell annoyance. See next page for additional information.

SIL 100, SIL 180, SIL 300:
Silicone oil with a very long life span (over 1 year) and negligible smell. See next page for additional information.

Thermo Fisher heat transfer fluids are supplied with an EC Safety Data Sheet.

Ensure, when selecting the heat transfer fluid, that no toxic gases can be generated. Flammable gases can build up over the fluid during usage. ▲

Ensure the over temperature cut-off point is set lower than the fire point for the heat transfer fluid selected. ▲

The highest working temperature as defined by the EN 61010 (IEC 1010) must be limited to 25°C below the fire point of the bath fluid. ▲

Additional Fluid Precautions

When working with fluids other than water:

- Do not use any fluid until you have read and understood the label and the Material Safety Data Sheet (MSDS).
- Do not blend any fluids.
- Ensure any fluid residue or any other material is thoroughly removed before filling the unit with a different fluid.
- Always wear protective clothing, especially a face shield and gloves.
- Avoid spattering on any of the unit's components, always *slowly* add fluid. When adding, point the opening of a container away from yourself.
- Use fume hoods.
- Do not allow any ignition sources in the vicinity.

Fire point
Flammable thermal liquids can ignite when a specified temperature is surpassed. The bath liquid is limited to a temperature level 25°C below the fire point as defined by the EN 61010.

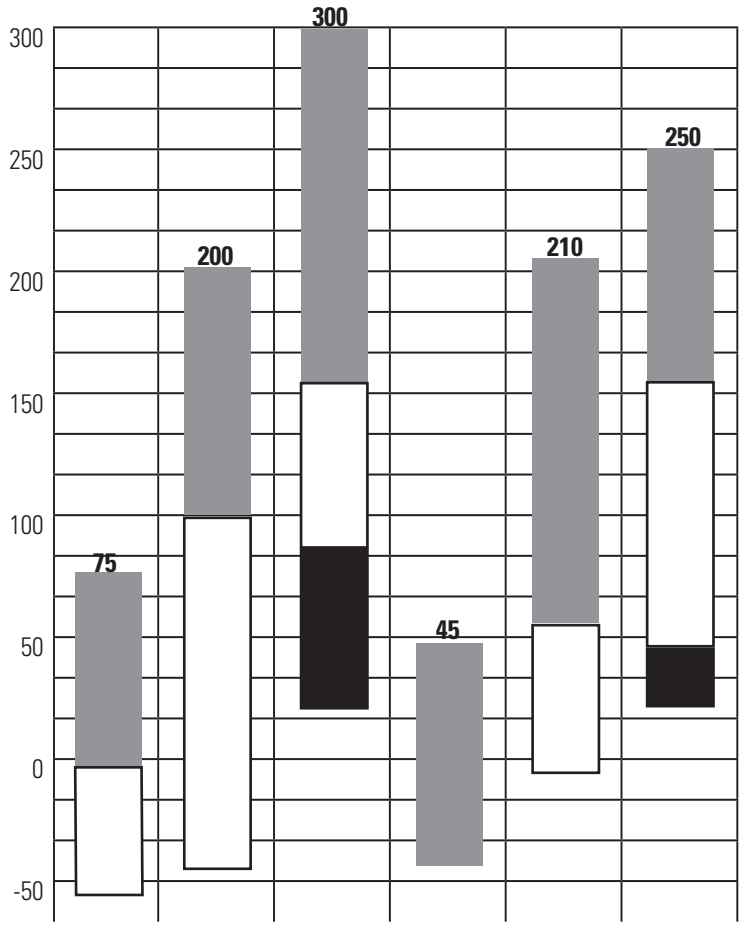
Viscosity
For optimum temperature accuracy, it is important that heat transfer liquids have a low viscosity.

Working temperature range
This is the recommended long-term operating range. The maximum viscosity is approximately 5 mPas.

Operating temperature range
Long-term operation is recommended only under certain conditions. The viscosity may rise to a maximum of 30 mPas. The pump capacity will not match specifications.

Heating-up range
Long-term operation is not recommended, the pump motor's excess temperature protection may switch off the pump.

Range of Application	Sil 100	Sil 180	Sil 300	Synth 60	Synth 200	Synth 260
Fire Point °C	>100	>225	>325	70	>235	275
Flash Point °C	57	170	300	59	227	260
Viscosity at 20°C (mPas)	3	11	200	2	100	140
Density at 20°C (kg/dm³)	0.89	0.93	1.08	0.76	0.86	1.03
Specific heat capacity (kJ/Kg*K)	1.67	1.51	1.56	2.10	1.96	2.00



Order Number 10 liter container	999-0202	999-0204	999-0206	999-0210	999-0226	999-0214
Order Number 5 liter container	999-0201	999-0203	999-0205	999-0209	999-0225	999-0213
Color	trans-parent, colorless	trans-parent, colorless	trans-parent, colorless	trans-parent, colorless	transpar-ent, light-brown	trans-parent, yellow
Reacts with	Silicone	Silicone	Silicone	Rubber Silicone	Copper Light metals Bronze	Copper Light metals Bronze

EC-Safety Data Sheets will be delivered together with each container of liquid.

Water Quality and Standards

Process Fluid	Permissible (PPM)	Desirable (PPM)
Microbiologicals		
(algae, bacteria, fungi)	0	0
Inorganic Chemicals		
Calcium	<25	<0.6
Chloride	<25	<10
Copper	<1.3	<1.0
0.020 ppm if fluid in contact with aluminum		
Iron	<0.3	<0.1
Lead	<0.015	0
Magnesium	<12	<0.1
Manganese	<0.05	<0.03
Nitrates\Nitrites	<10 as N	0
Potassium	<20	<0.3
Silicate	<25	<1.0
Sodium	<20	<0.3
Sulfate	<25	<1
Hardness	<17	<0.05
Total Dissolved Solids	<50	<10
Other Parameters		
pH	6.5-8.5	7-8
Resistivity	0.01*	0.05-0.1*

* MΩ-cm (compensated to 25°C)

Unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting. Eventually, the pitting will become so extensive that refrigerant will leak into the water reservoir.

As an example, raw water in the United States averages 171 ppm (of NaCl). The recommended level for use in a water system is between 0.5 to 5.0 ppm (of NaCl).

Recommendation: Initially fill the tank with distilled or deionized water. Do not use untreated tap water as the total ionized solids level may be too high. This will reduce the electrolytic potential of the water and prevent or reduce the galvanic corrosion observed.

Filling Requirements

Ensure the reservoir drain port on the front of the unit is *closed* and that all plumbing connections are secure. Also ensure any residue is thoroughly removed before filling the unit.

⚠ CAUTION

Before using any fluid refer to the manufacturer's MSDS and EC safety data sheets for handling precautions. ▲

To avoid spilling, place your containers into the bath before filling.

With a low level WARNING the unit continues to run, with a FAULT the unit will shut the refrigeration, pump and heater will shut down, see Section 7. The low level warning is at approximately 47 mm (1 7/8") below the top, the low level fault is at approximately 63 mm (2 1/2").

Avoid overfilling, oil-based fluids expand when heated. ▲

When pumping to an external system, keep extra fluid on hand to maintain the proper level in the circulating lines and the external system.

NOTE Monitor the fluid level whenever heating the fluid. ▲

Draining

⚠ CAUTION

Before draining any fluid refer to the manufacturer's MSDS and EC safety data sheets for handling precautions. ▲

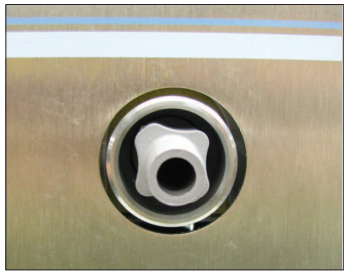
Ensure the fluid is at a safe handling temperature, ~55°C. Wear protective clothing and gloves. ▲

- place a suitable vessel underneath the drain. If desired, attach an 8 mm id tube on the drain.
- *slowly* turn the drain plug until flow is observed.

⚠ CAUTION

Turning the drain cap more than 1 1/2 turns will result in the drain cap and fitting coming off the bath.

In this case, the drain fitting can be screwed back into the unit. Attaching the cap onto the fitting will aid in installation. If required, contact us for additional information.

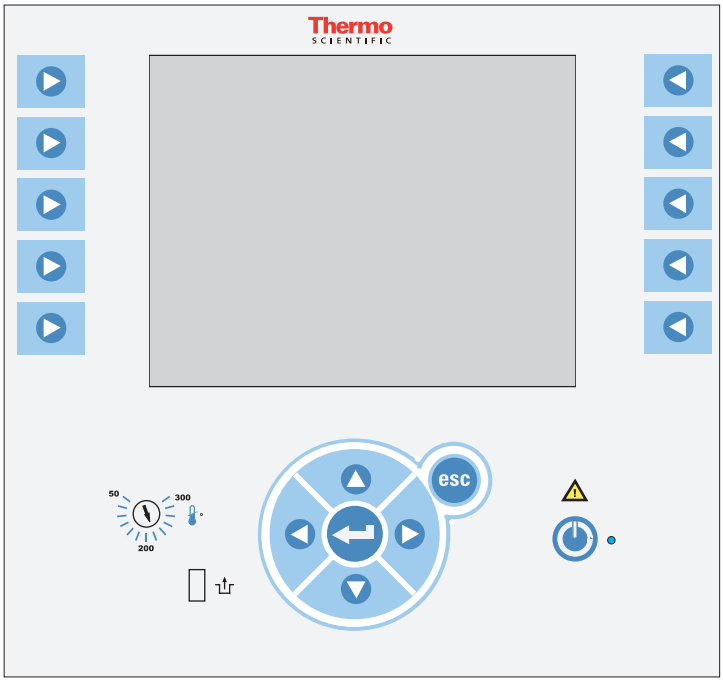


Installed Drain Fitting with Cap Removed

Section 4 Operation

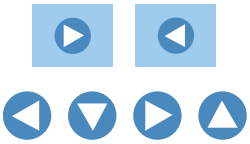
PREMIUM Heated Immersion Circulator

The Thermo Scientific PREMIUM Heated Immersion Circulators have a digital display and easy-to-use touch pad, five programmable setpoint temperatures, acoustic and optical alarms and adjustable high temperature protection.



This label indicates read the instruction manual before starting the unit.

Use this button to place the unit in and out of standby mode, see page 4-3 for more details. The blue LED illuminates when standby mode is enabled.



Use these arrows to move through the controller displays and adjust values.

Use these arrows to adjust values.

Pressing this button to save changes made on the controller's displays.

Use this button to cancel any changes and to return the controller to its previous display. Canceling a change can only be made before the change is saved. In some cases, it is also used to save changes.

NOTE Holding this button depressed for five seconds brings up the language selection display. ▲

Use the adjacent dial for adjusting the High Temperature Cutout. Details are explained in Sections 5 and 6.

High Temperature Cutout reset, also explained in Section 6.

Setup

⚠ CAUTION

Refrigerated units should be left in an upright position for 24 hours at room temperature before starting. This will ensure the lubrication oil has drained back into the compressor. ▲

⚠ CAUTION

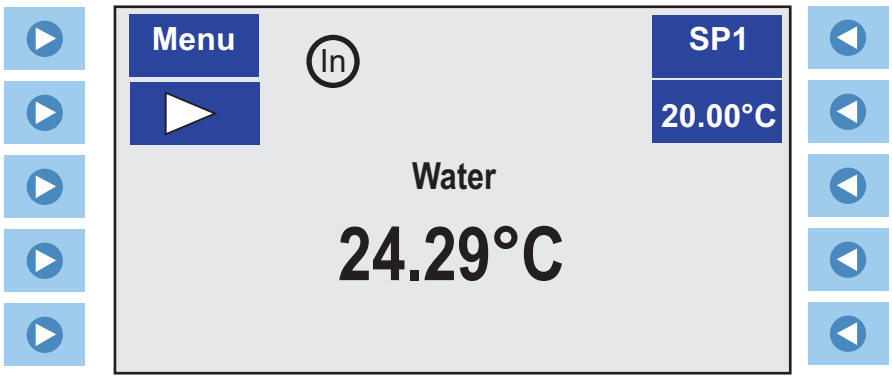
Before starting the unit, double check all communication, electrical and plumbing connections. ▲

Initial Start Up

Do not run the unit until fluid is added to the bath. Have extra fluid on hand. If the unit will not start refer to Section 6 Troubleshooting.

- For refrigerated units, place the circuit protector located on the rear of the bath to the **I** position.

- For all units, place the circuit protector located on the rear of the immersion circulator to the **I** position.
- Press  . The controller will momentarily display Thermo Scientific.
- And then the Start Display will appear.



Start Display

- Press  to the left of the start symbol,  . The unit will start and the start symbol will turn into a stop symbol,  .

NOTE After start up, check all the plumbing connections for leaks. ▲

The **Menu** and **SP1** portions on the top of the display are used to view and/or change the circulator's settings. The reservoir fluid is also displayed. These features are explained in detail later in this Section.

In indicates the controller is using its internal sensor for temperature control. Ex is displayed when the external sensor is selected for temperature control.

Daily Start Up

CAUTION

Before starting the unit, double check all communication, electrical and plumbing connections. ▲

The blue LED on the immersion circulator illuminates to indicate it is in standby.

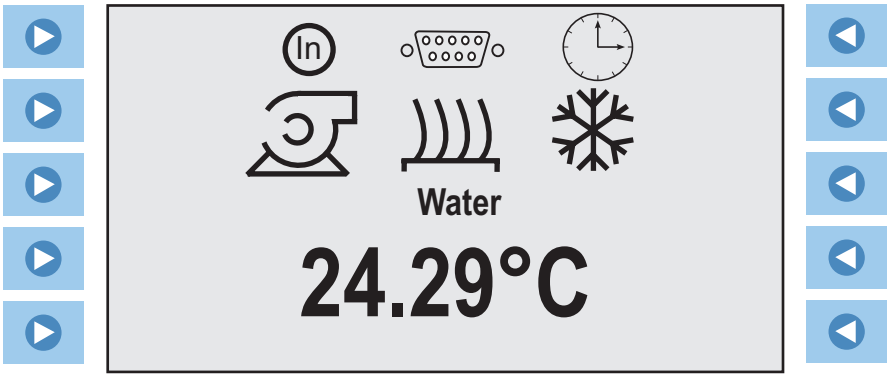
If so, press  . If Auto Restart is enabled the unit will start. If Auto Restart is not enabled, or if the blue LED is not illuminated, use the **Initial Start Up** procedure described on the previous page.

The Auto Restart feature is described later in this Section.

NOTE When using oil as a reservoir fluid, we recommend running the unit at 95°C for 15 minutes to remove any moisture in the fluid. ▲

Status Display

If desired, press esc to toggle between the Start and Status Displays.



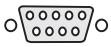
Status Display

This icon is illuminated when the pump is running.

This icon is illuminated when the heater is on. The icon flashes when the reservoir fluid temperature is close to the desired setpoint.

This icon is illuminated when the refrigeration is on. The icon flashes when the unit is in the energy saving mode, the mode is explained later in this section.

One of these icons is on to indicate which sensor is selected for temperature control, internal or external.



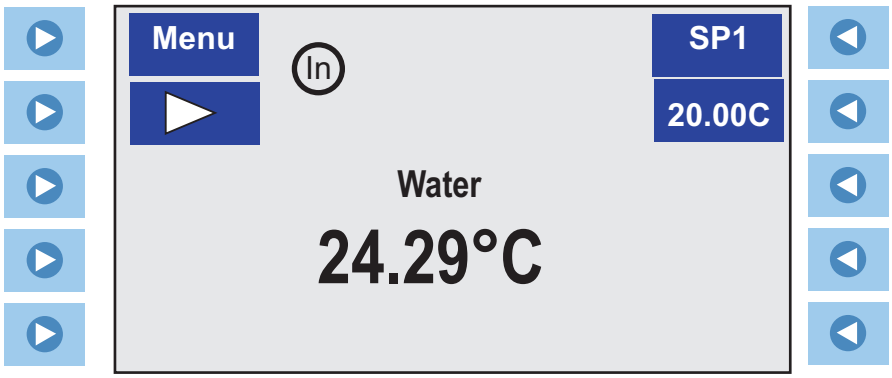
This icon is illuminated when the serial communications or analog option is enabled.

The icon is illuminated when both the circulator and timer are running. The icon flashes when the timer is enabled but not running.

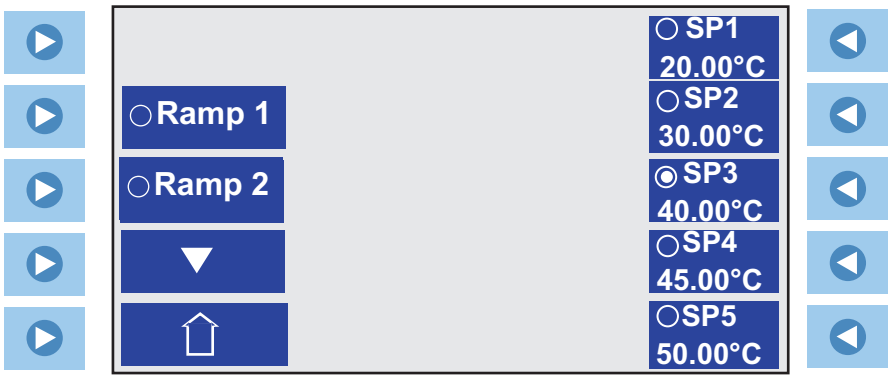
Changing the Setpoint

The Setpoint is the desired fluid temperature. The controller can store up to five setpoints, **SP1** through **SP5**. The procedure for changing the stored setpoint values is discussed later in this Section.

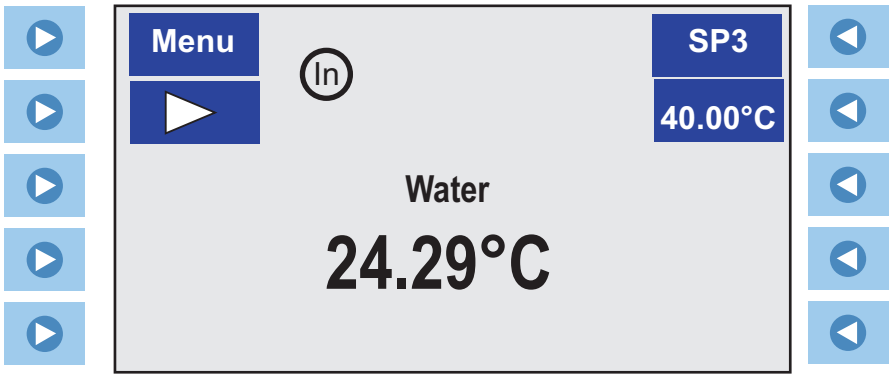
• On the Start Display press ◀ to the right of **SP1**.



The following display will appear:



• Press ◀ to the right of the desired setpoint (in this example **SP3**) and then press esc, or ▶ to the left of the home symbol ⌂, to return to the Start Display.



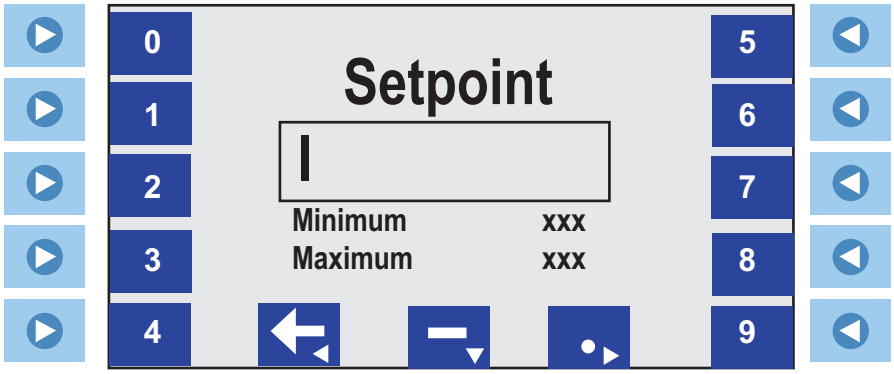
Change a Value Display

This display automatically appears when you request a change in value.

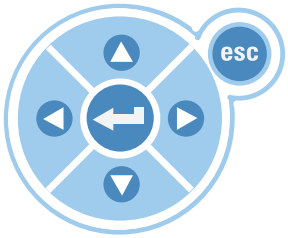
NOTE The unit does not need to be running to change a value. ▲

• A cursor will appear on the left side of the entry window as shown below.

• Press  or  to enter the corresponding digit. Use the arrow keys on the circular keypad to move the cursor back to the left  , enter a negative value  of insert a decimal point  .



Change a Value Display



• Press  when the desired value is displayed.

NOTE The unit will beep if you try to enter a value outside the minimum or maximum value or by trying to enter more than one negative dash or decimal point.. ▲

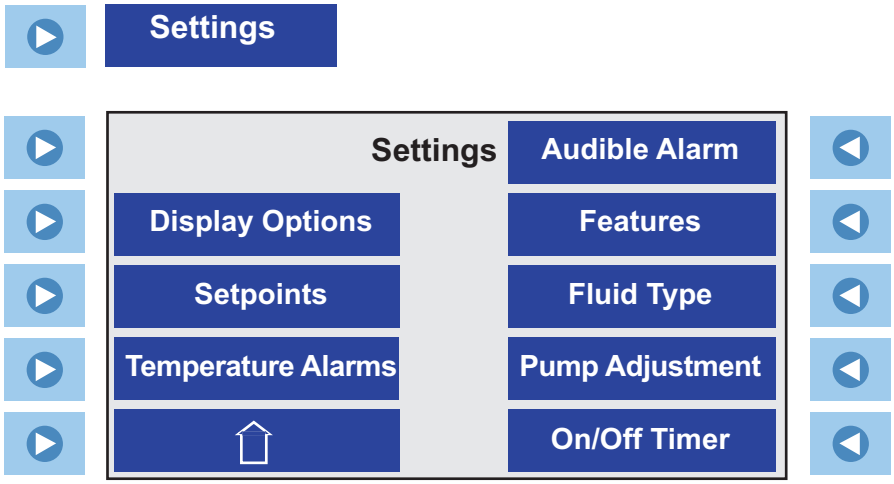
Menu Displays

The controller uses menus to view/change the unit's settings.

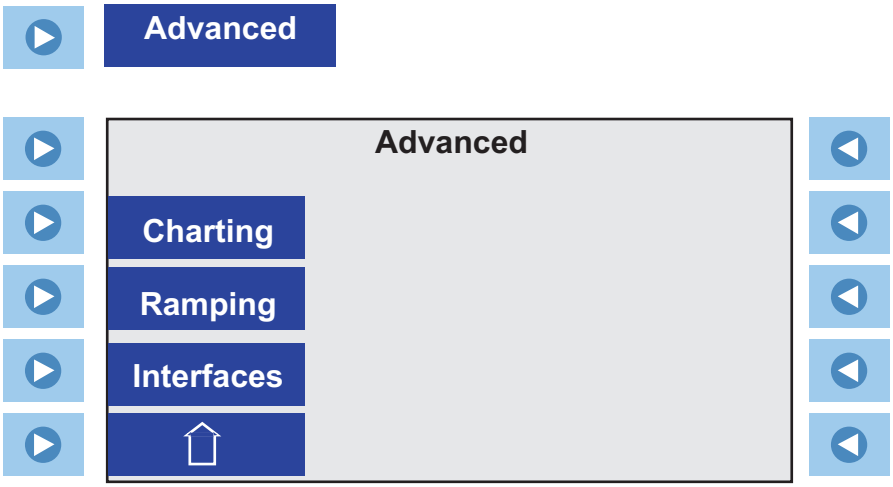
NOTE Unless noted, the unit does not need to be running to view/change settings. ▲

• Press ▶ to the left of **Menu** to bring up the Main Menu Display.

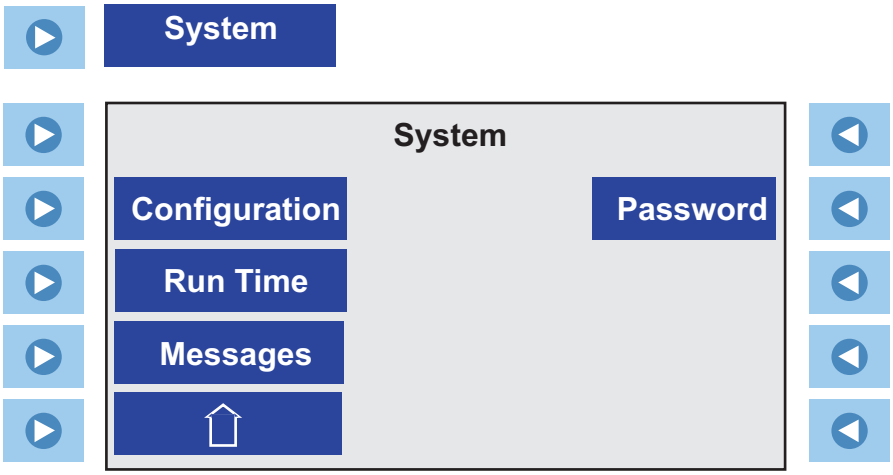
• Press ▶ to the left of the desired line to bring up submenus.



See page 4-10.

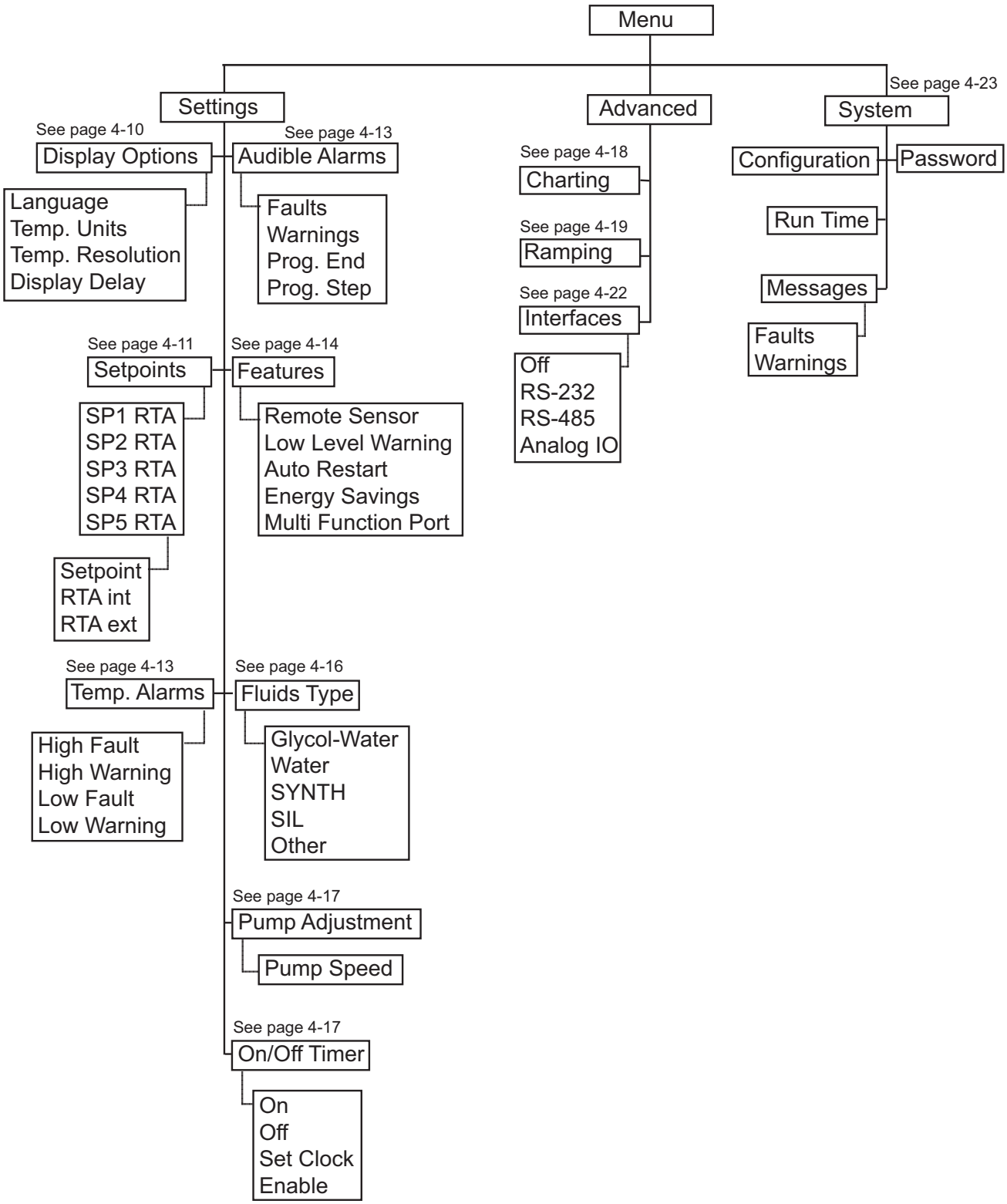


See page 4-18.



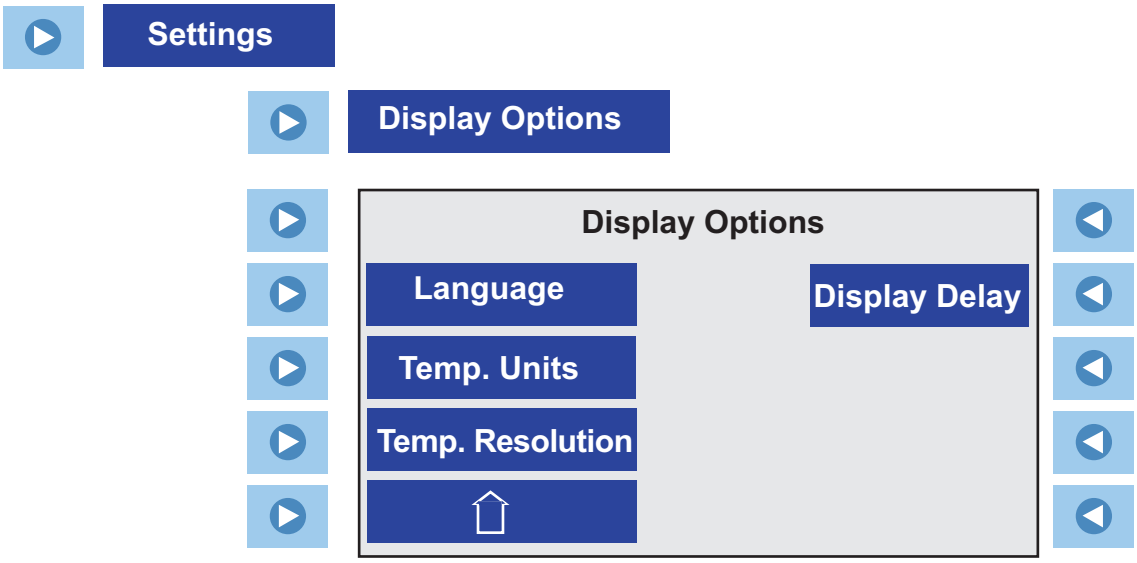
See page 4-23.

Menu Tree


Menu
Settings
Advanced
System
See page 4-23
See page 4-10
Display Options
Language
Temp. Units
Temp. Resolution
Display Delay
See page 4-13
Audible Alarms
Faults
Warnings
Prog. End
Prog. Step
See page 4-18
Charting
See page 4-19
Ramping
See page 4-22
Interfaces
Off
RS-232
RS-485
Analog IO
Configuration
Password
Run Time
Messages
Faults
Warnings
See page 4-11
Setpoints
SP1 RTA
SP2 RTA
SP3 RTA
SP4 RTA
SP5 RTA
Setpoint
RTA int
RTA ext
See page 4-14
Features
Remote Sensor
Low Level Warning
Auto Restart
Energy Savings
Multi Function Port
See page 4-13
Temp. Alarms
High Fault
High Warning
Low Fault
Low Warning
See page 4-16
Fluids Type
Glycol-Water
Water
SYNTH
SIL
Other
See page 4-17
Pump Adjustment
Pump Speed
See page 4-17
On/Off Timer
On
Off
Set Clock
Enable

Settings - Display Options

Display Options is used to view/adjust the circulator's temperature scale, select the temperature resolution and set the display delay.

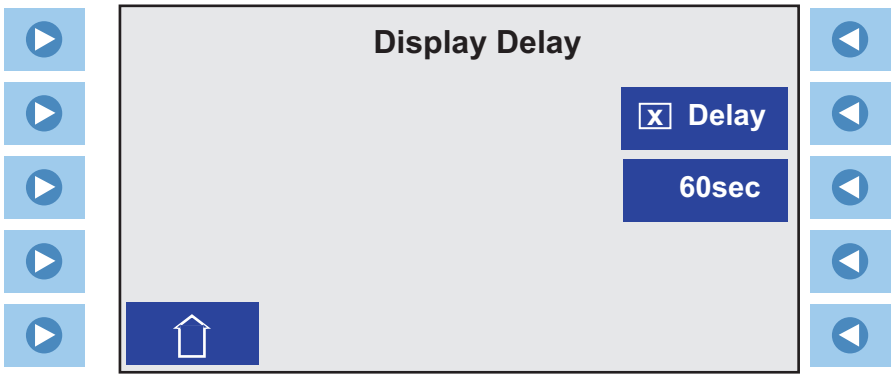


Language is used to select which language is displayed, English, German, French, Spanish or Italian.

Temp. Units is used to select the displayed temperature scale, **°C** , **°F** or **°K**.

Temp. Resolution is used to select the displayed temperature resolution, **0.01** or **0.1** degree.

Display Delay is used to enable/disable and to select the Start Display display delay. The delay range is **5** to **900** seconds. If no arrows are pressed, the Start Display will change to the Status Display after the delay expires.



Press  next to the **Delay** to bring up the Change a Value Display.

Settings - Setpoints

Setpoints is used to view/adjust the circulator's five Setpoints (**SP**) and Real Temperature Adjustments (**RTA**). The display shows the temperature measured by the internal or external sensor, if this temperature does not accurately reflect the actual temperature in the reservoir an RTA is required. The RTA can be set ±10°C (±18°F).

As an example, if the temperature is stabilized and displaying 20°C but a calibrated reference thermometer reads 20.5°C, the RTA should be set to -0.5°C. After you enter a RTA value allow unit to stabilize before verifying the temperature in the bath. **NOTE** If display accuracy is required, we recommend repeating this procedure at various setpoint temperatures and on a regular basis. ▲

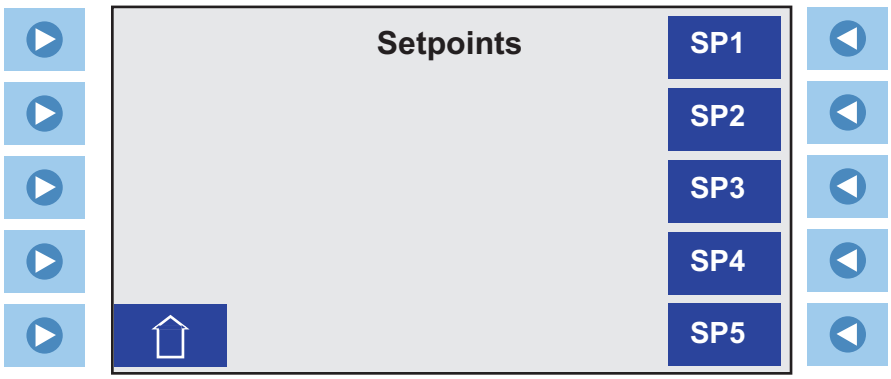
NOTE For refrigerated units, the setpoint limits are determined by the combination of the head, bath and fluid. The highest setpoint is the lesser of the highest limit of the three while the lowest setpoint is the greater of the lowest limit of the three. For heated units, only the head and fluid are used. ▲

Circulator Limits °C:	Min	Max
PC 200	-90	200
PC 201	-90	200
PC 300	-50	300

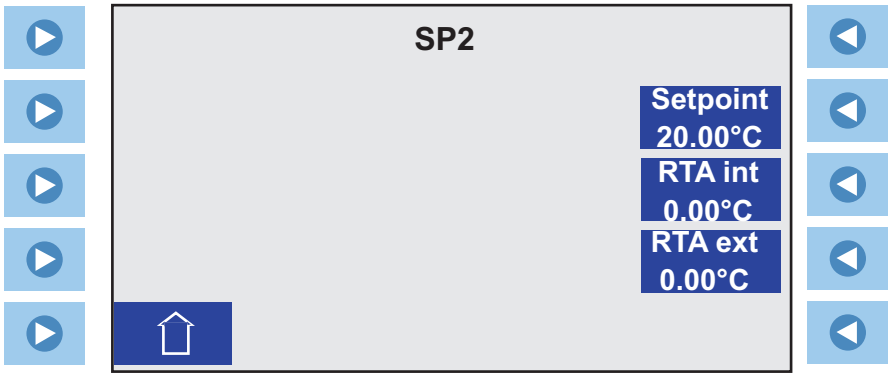
Fluid Limits °C:	Min,	Max
SYNTH 60	-50	45
SYNTH 200	30	210
SYNTH 260	45	250
SIL 100	-75	75
SIL 180	-40	200
SIL 200	20	200
SIL 300	80	300
Water	5	95
EG/Water	-30	100
Other	-90	300

Bath Limits °C:	Min	Max
A28	-28	200
A25	-25	200
A40	-40	200
A28F	-28	200
A24B	-24	200
G50	-50	200

When selecting a different fluid, the limits shrink if they are outside of the new system limits. However, they do not expand if they are well within the system limits.



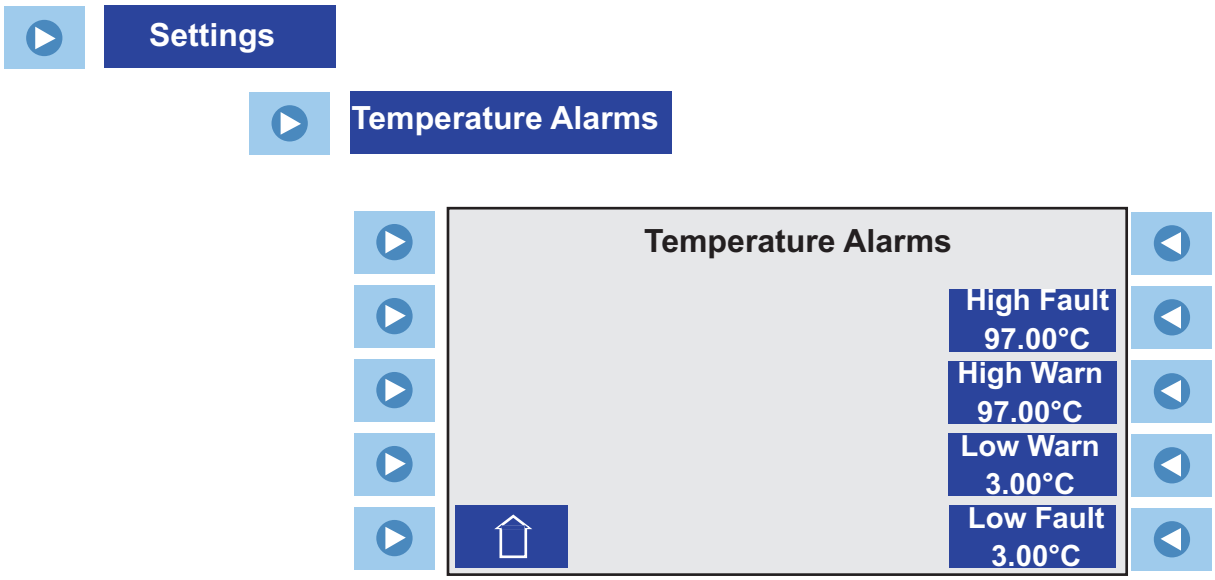
Press  next to the desired setpoint to bring up:



Press  next to the desired setting to bring up the Change a Value Display to make changes.

Settings - Temperature Alarms

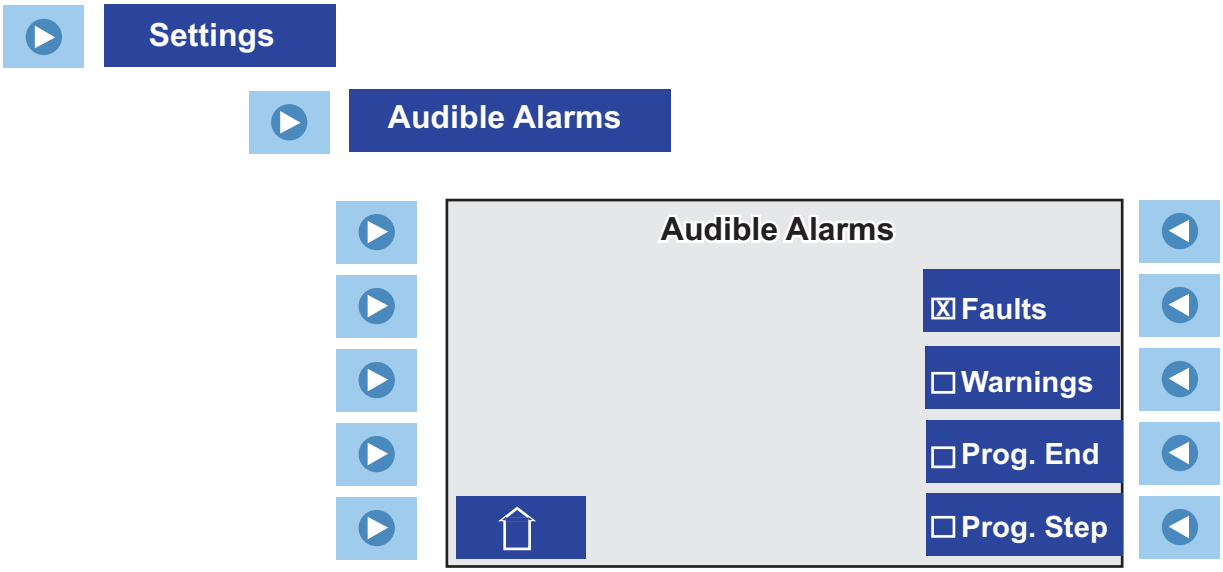
Temperature Alarms is used to view/adjust the temperature warning and fault limits. If a limit is exceeded the alarm will sound, if enabled. In the case of a fault the unit will also shut down.



Press ◀ next to the desired fault/warning to make changes .

Settings - Audible Alarms

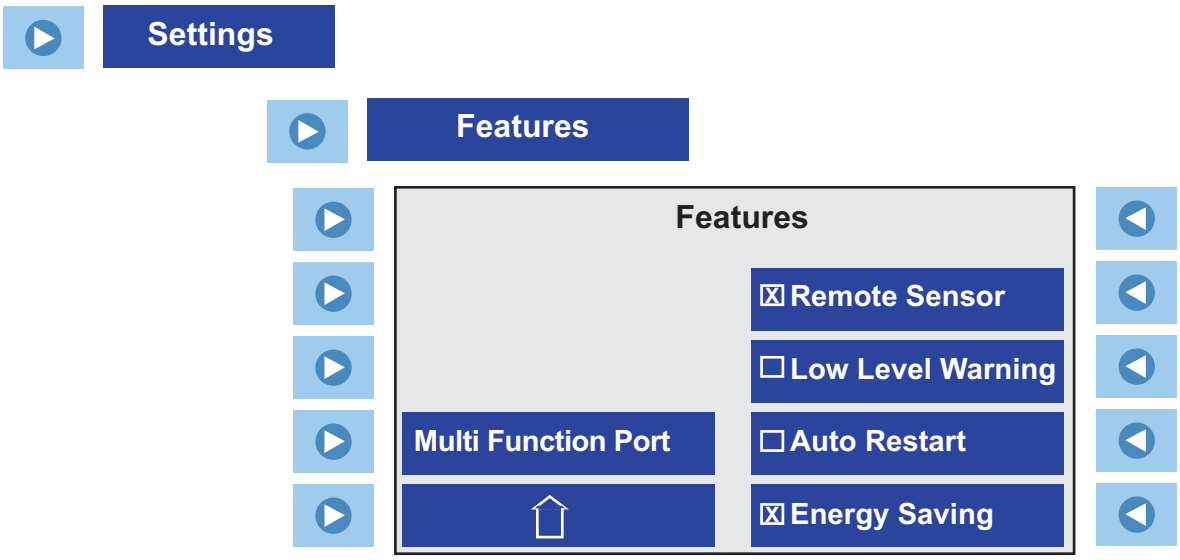
Audible Alarms is used to enable/disable the audible alarms.



Press ◀ to enable/disable the desired alarm(s).

Settings - Features

Features is used to enable/disable immersion circulator features.



Press ◀ next to the desired feature to enable/disable.

The **Remote Sensor** connector on the rear of the immersion circulator requires a 4-pin connector that must mate to a LEMO # ECP.1S.304. CLL. The immersion circulator uses a 3 wire sensor, but a 4 wire sensor can be used (pins 3 and 4 are interconnected in the control head). The pin-out is:

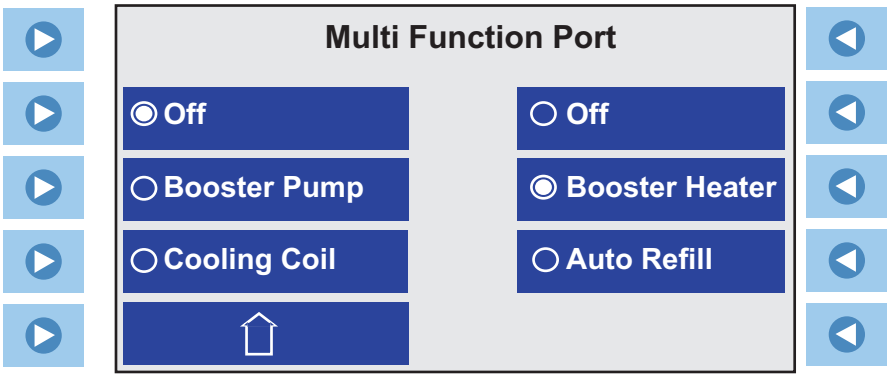
Pin 1 and 2 = Pt100 + Pin 3 and 4 = Pt100 -

When **Low Level Warning** is enabled, the unit will sound an alarm if a low level condition occurs.

When **Auto Restart** is enabled, the unit will automatically restart, if it was running, after a power interruption condition.

The **Energy Saving** mode is primarily designed for applications running under a stable load. Enabling the mode saves energy by reducing the unit's heater power and cooling requirements. This can result in substantial energy savings over the life of the unit. The default setting is on.

The refrigeration icon ❄ blinks when the **Energy Saving** mode is enabled.

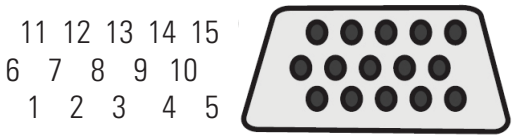


Booster Pump (pins 4 and 14) is on whenever the option is enabled.

Boost Heater (pins 5 and 10) is on when enabled and the setpoint is >2°C above the bath temperature. The boost heater is normally off when the bath temperature is within 2°C of setpoint.

Cooling Coil (pins 4 and 14) is on when the bath temperature is >2°C above setpoint or when the heater power drops to 0%, it's off when the heater power exceeds 80%. This feature is used in conjunction with an *optional* accessory box to select and activate additional features. The accessory box connects to the multifunction port.

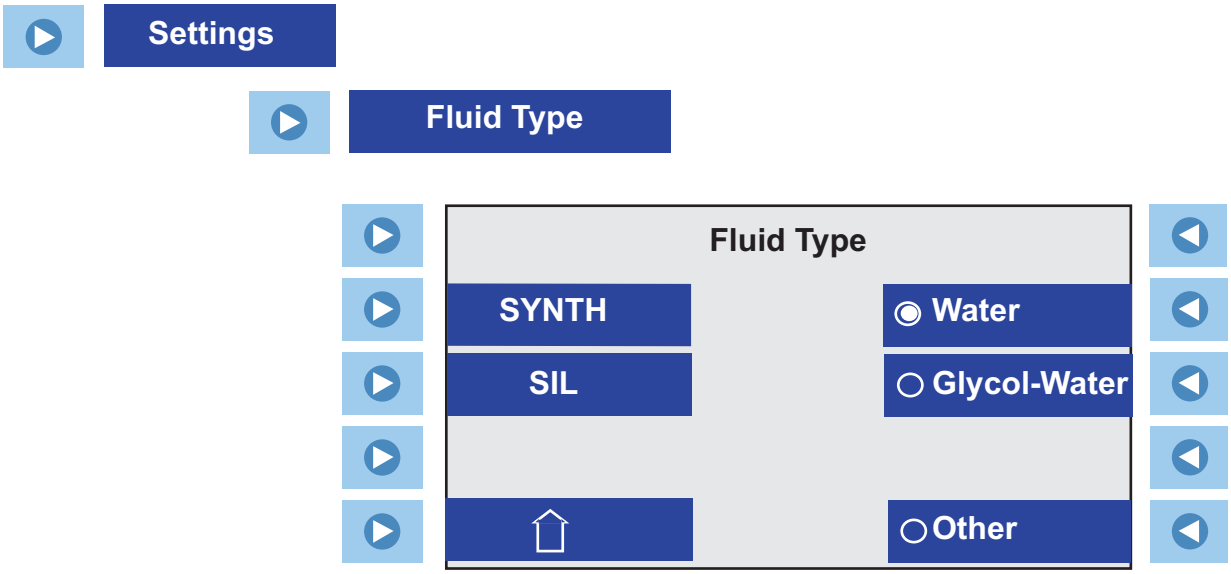
Auto Refill (pins 5 and 10) is on when the fluid level drops below 47 mm (~1 7/8") from the top and is off when the fluid level is at 27 mm (~1") from the top. This feature is used in conjunction with an *optional* accessory box to select and activate additional features. The accessory box connects to the multifunction port.



Multifunction Port Pin Out

Settings - Fluid Type

Fluids Type is used to identify the type of fluid used. The controller uses the fluid type to automatically set certain operating parameters.



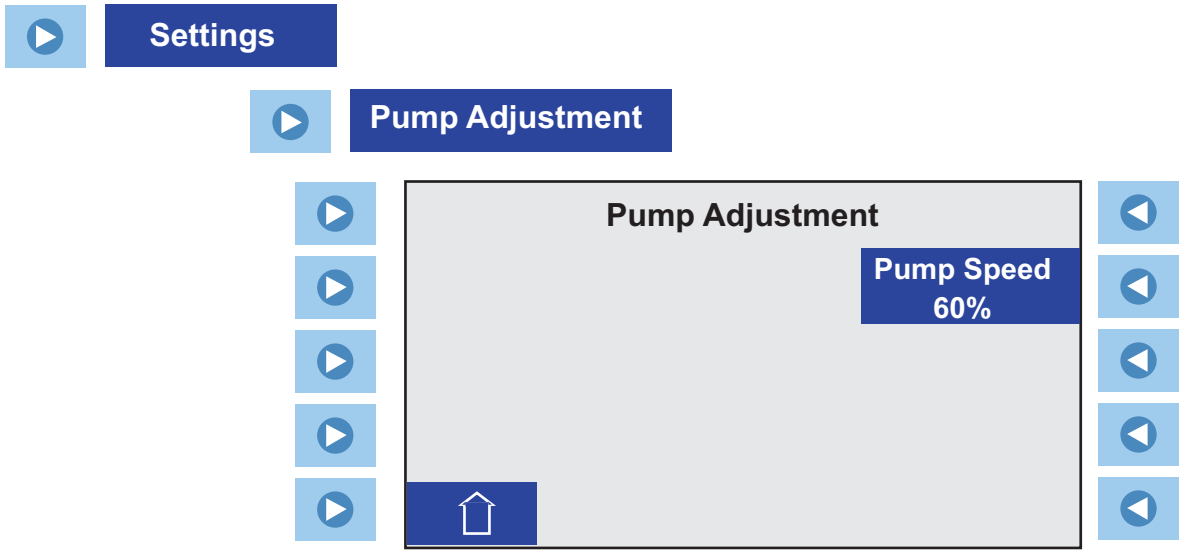
Press ▶ or ◀ next to the desired fluid or fluid type.

NOTE For high viscosity fluids with a wide "Heating-up range" (e.g., SIL300 - see Section 3), the controller automatically slows the heating from ambient to the "Operating temperature range" to help prevent fluid degradation that is caused by rapid heating while still at high viscosities. ▲

Fluid Limits °C:	Min,	Max
SYNTH 60	-50	45
SYNTH 200	30	210
SYNTH 260	45	250
SIL 100	-75	75
SIL 180	-40	200
SIL 200	20	200
SIL 300	80	300
Water	5	95
EG/Water	-30	100
Other	-90	300

Settings - Pump Adjustment

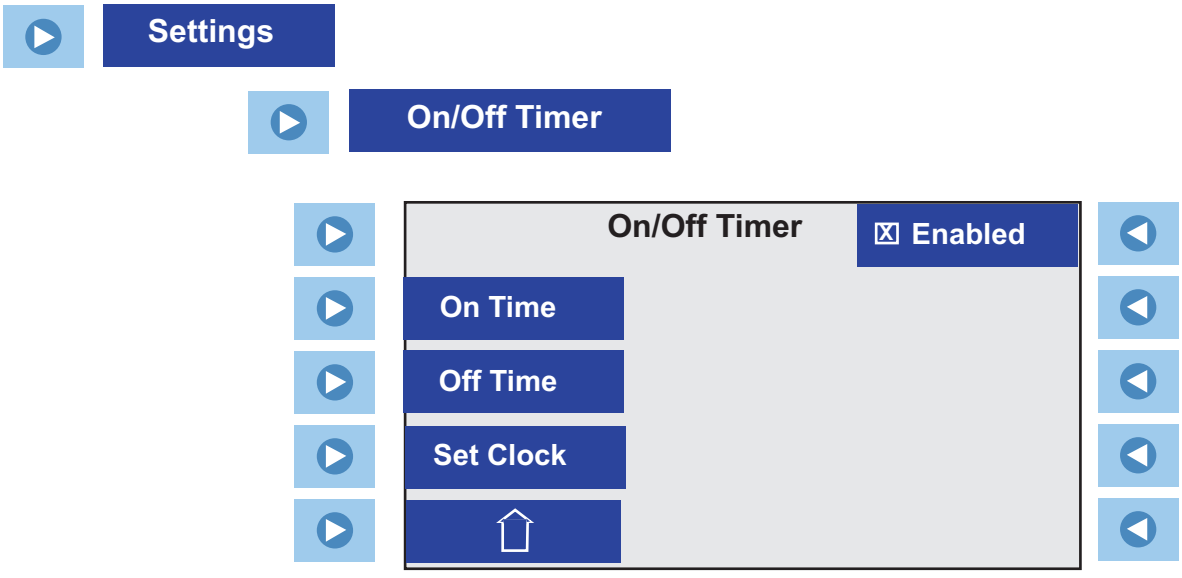
Pump Adjustment is used to set the pump speed.



Press  next to **Pump Speed** to bring up the Change a Value Display to make changes. **NOTE** The minimum pump speed is 40%. ▲

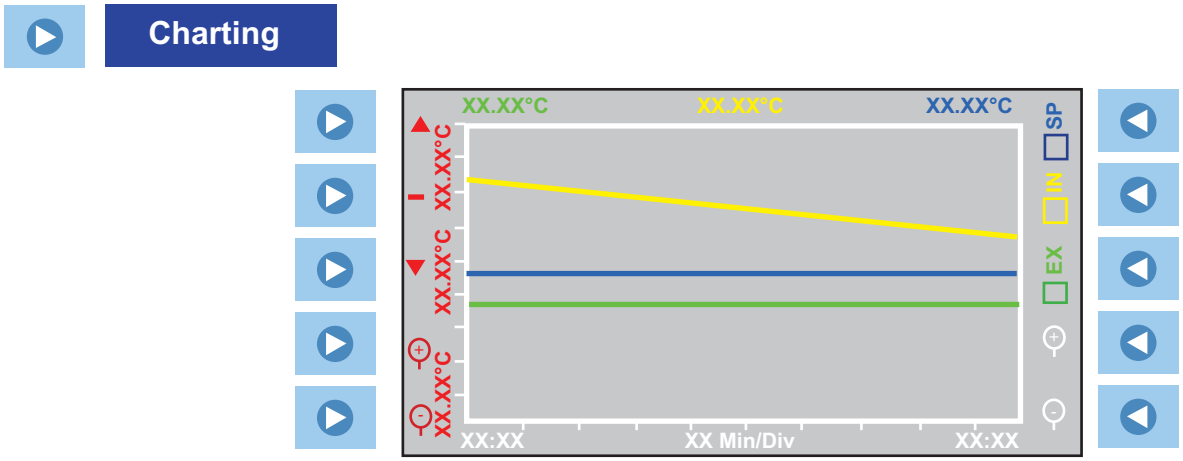
Settings - On/Off Timer

On/Off Timer is used to set/verify the timer date and time as well as its on/off settings. It is also used to enable/disable the timer.



Advanced - Charting

Charting is used to view a graphical display of your program.



Enable the green box to display the external temperature sensor chart. The current external temperature sensor will also be displayed in the upper left hand corner of the display.

Enable the yellow box to display the internal temperature sensor chart. The current internal temperature sensor will also be displayed in the upper middle of the display.

Enable the blue box to display the setpoint chart. The current setpoint will also be displayed in the upper right hand corner of the display.

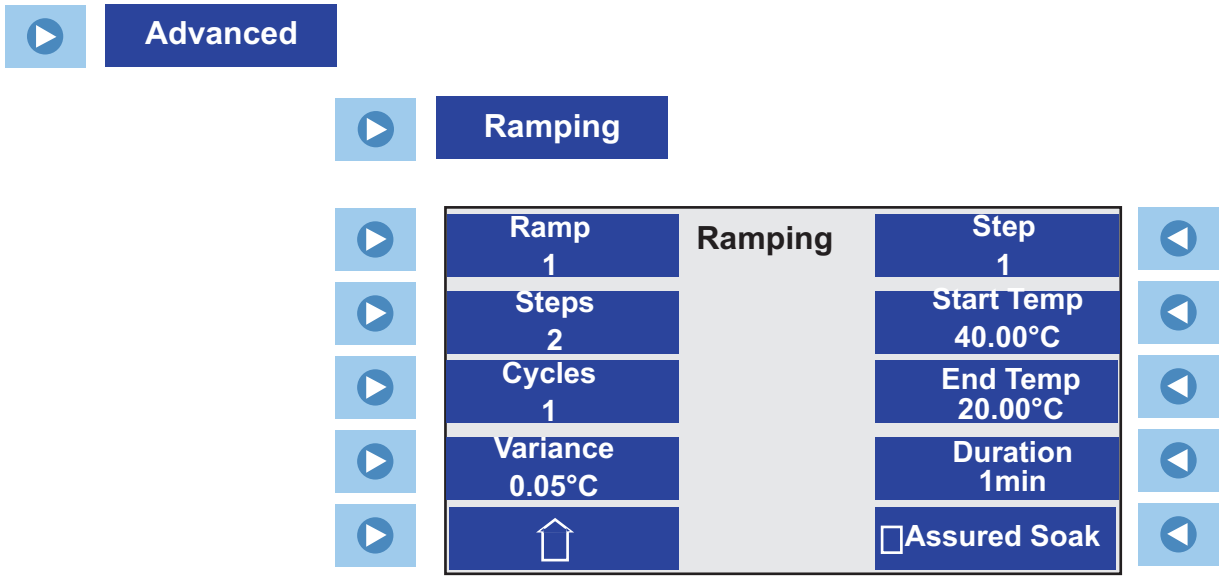
The white horizontal axis on the bottom of the display represents time. The right end of the display always shows the current time. Use the white zoom tools to change the displayed time increments. There are eight incremental ranges available, from one minute to two hours. Units are minutes/division or hours/division.

The red vertical axis on the left hand side of the display represents temperature. The temperature scale depends on the units selected in **Menu - Display Options - Temp. Units**. Use the red zoom tools to change the displayed temperature increments. There are 12 incremental ranges available, from 0.1 of a degree to 500 degrees.

The red dash is used to horizontally center the setpoint chart on the display. If desired, use the triangles to move the desired setpoint chart up or down the display. Use the red dash again to center it.

Advanced - Ramping

Ramping is used to build/edit a ramp program.



There can be 10 **Ramps**, each with 30 **Steps**. Each **Ramp** can be **Cycled** up to 100 times.

Cycles sets the number of times the entire ramp program will be repeated after the last step is completed. For example, selecting 3 **Cycles** runs the entire ramp program a total of 3 times.

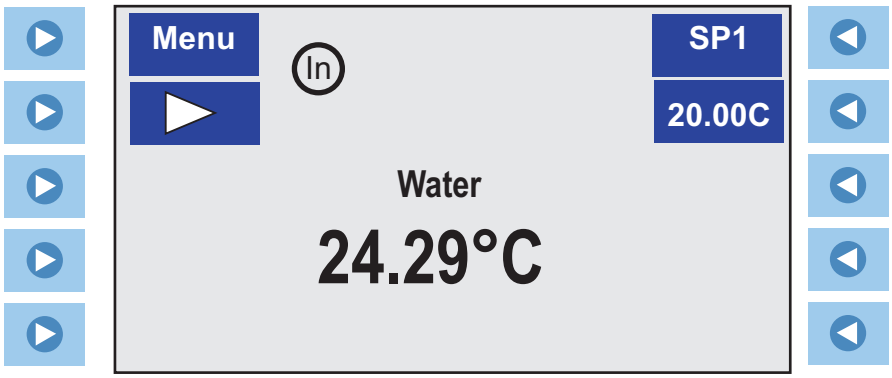
The **Variance** is used to set a temperature range, the program will start when the fluid temperature is within this range. For example, if the desired **Start Temp** is 25°C and the **Variance** is set to +5°C, the program will automatically start when the bath temperature is between 20°C to 30°C.

NOTE The **Start Temp** for a step 2 will be the **End Temp** from step 1, and so on.

The ramp program has an optional **Assured Soak** feature that can be enabled for each step independently. When enabled this feature pauses the ramp timer while the temperature reaches setpoint, ± variance. This assures the temperature reaches setpoint before the ramp program continues to the next step.

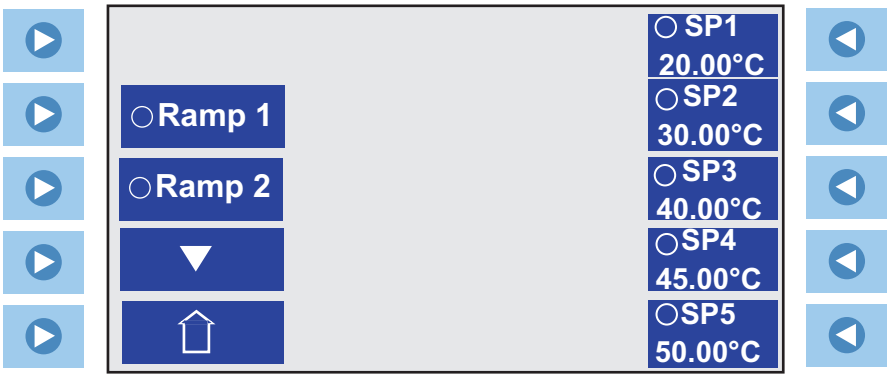
Running a Ramp Program

You can enable an alarm to sound when each step and/or the program is complete, see **Settings - Audible Alarms** in this section.

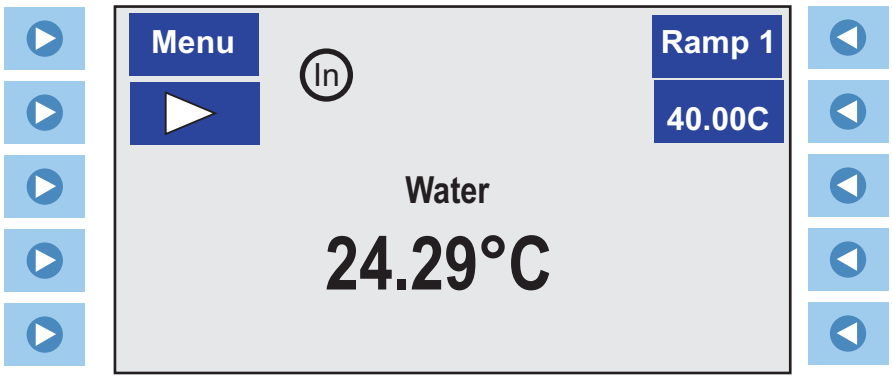


• Press  to the right of  .

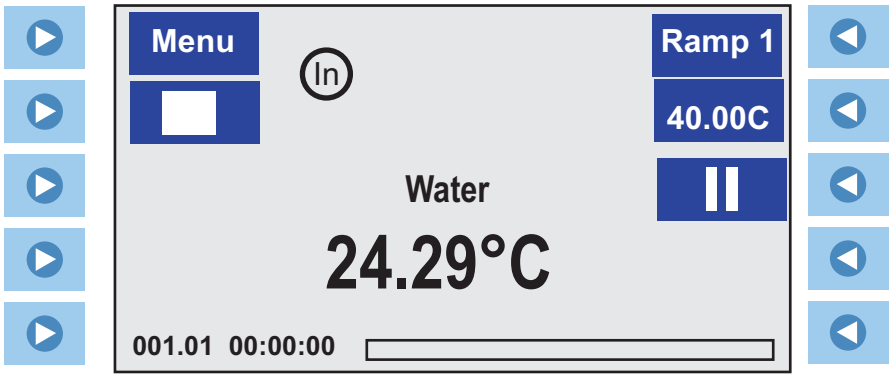
The following display will appear:



• Select the desired ramp and then press  , or  to the left of the home symbol  , to return to the Start Display.



• Press  to the left of  to start the program. The display will change to the Program Display



The program does not start until the process fluid temperature is at the **Start Temp** ± the **Variance**.

• Press  to the left of  to stop the program or  to the right of  to pause the program at the current temperature.

When the program is complete the controller will maintain the last set-point.

When  is pressed after the ramp program is complete the refrigeration, pump and controller shut off.

NOTE Other than the current ramp step, you can edit any other step of the ramp during the run or in the pause mode. ▲

The numbers at the bottom indicates the cycle number, step number and total time remaining for the program (hours, minutes and seconds).
NOTE If assured soak is enabled the time will stop counting down at the end of the step until the desired temperature ± variance is reached. ▲

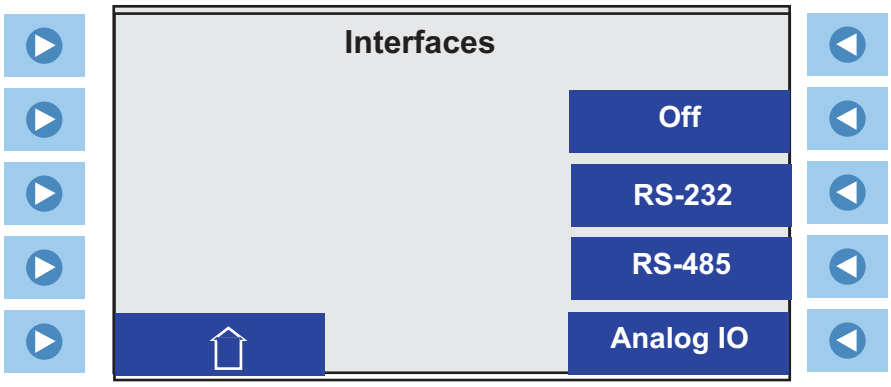
When the program is complete the alarm, if enabled, will sound.

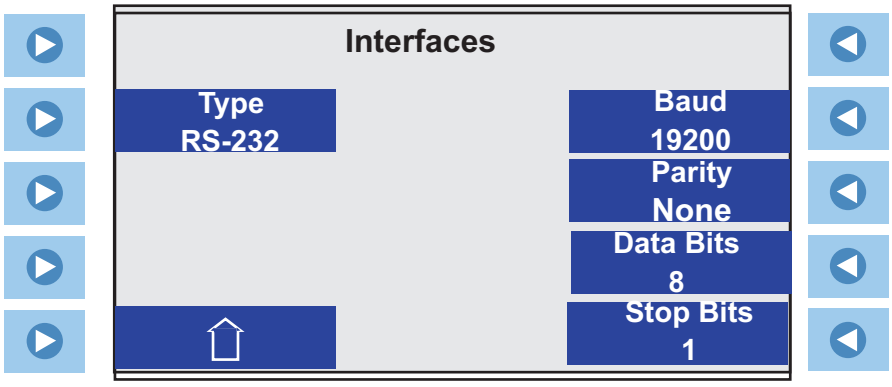
NOTE If you do not stop/end the ramp program before going back to the setpoint (**SP**) mode, changing the setpoint has no effect. For example on a program which ends with the bath at 25°C the bath will continue to hold this setpoint. Changing from ramp mode to setpoint mode and then changing the setpoint to 20°C has no effect, the bath will continue to hold 25°C. ▲

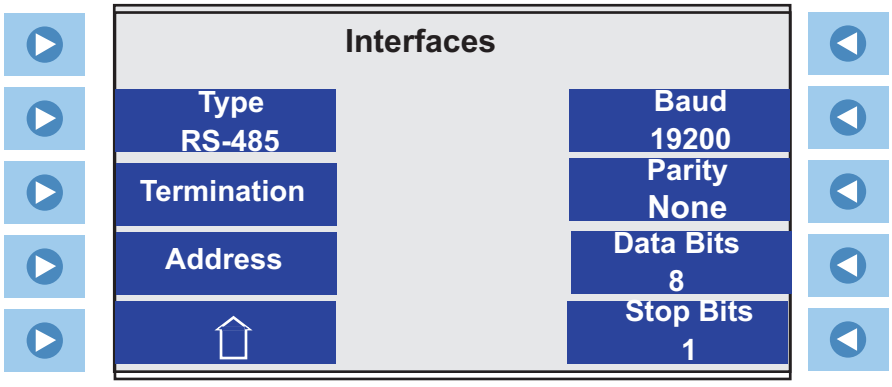
Advanced - Interfaces

Interfaces is used to view/change communication and communication settings.

• Press  on the right to select Off, RS 232 or RS 485, or Analog IO. See Appendix for additional information.

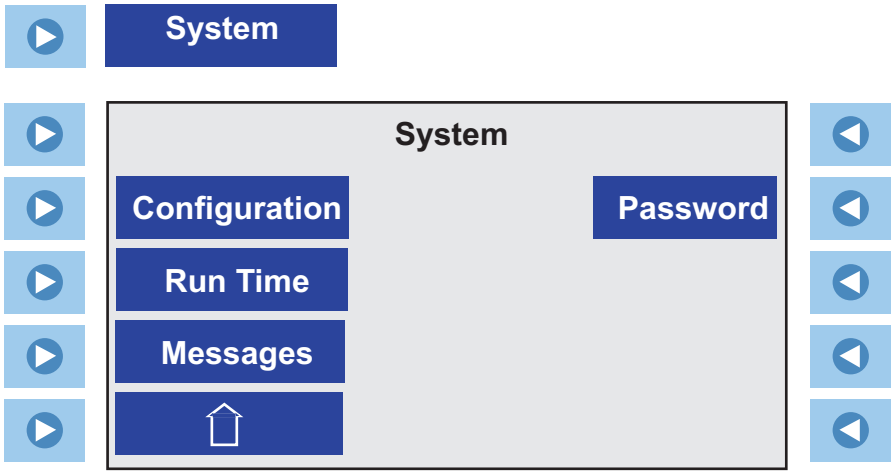






System - Configuration

Configuration is used to view the unit's firmware version(s).



System - Run Time

Run Time is used to view the operating hours for the unit and its components.

System - Messages

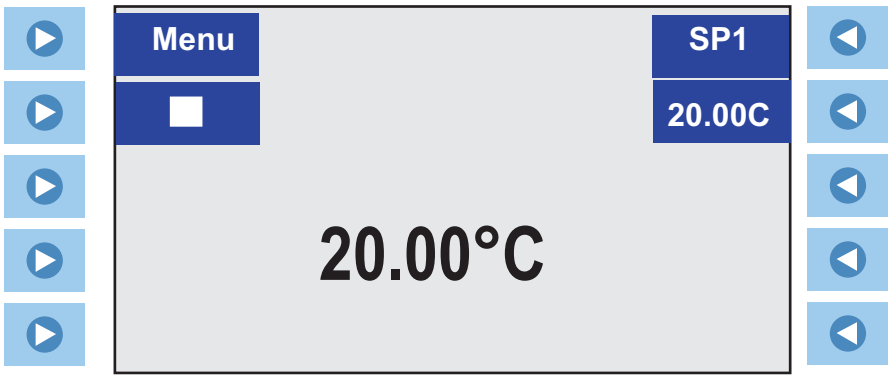
Messages is used to view and, if desired, delete any stored messages. The controller can store and display up to the last 10 Warning and last 10 Fault messages. Messages can be then deleted individually or as a group.

System - Password

Password is used if the unit needs a calibration or if the controller PID values require changing. Changing the Password also allows you to restore the controller to factory preset values. See Section 7.

Stopping the Unit

• Press  to the left of the stop symbol,  . The unit will stop and the stop symbol will turn into a start symbol,  .



Power Down

• Press  . The circulator's display will go blank and the blue LED will illuminate indicating the unit is in the standby mode.

Shut Down

• Place the circuit protector on the rear of the immersion circulator to the **O** position. The blue LED will extinguish.

• On refrigerated units, place the circuit protector on the rear of the bath to the **O** position.

⚠ CAUTION **Using any other means to shut the unit down can reduce the life of the compressor. ▲**

⚠ CAUTION **Always turn the unit off and disconnect it from its supply voltage before moving the unit. ▲**

⚠ CAUTION **The circuit protector(s) located on the rear of the component(s) is not intended to act as a disconnecting means. ▲**

Restarting

NOTE When quickly restarting refrigerated units, the compressor may take up to 10 minutes before it starts to operate. ▲

Section 5 Preventive Maintenance

Disconnect the power cord prior to performing any maintenance. ▲

CAUTION

Handle the unit with care. Sudden jolts or drops can damage the unit's components. ▲

Cleaning

After time, the unit's stainless steel surfaces may show spots and become tarnished. Normal stainless steel cleaners can be used.

Clean the bath vessel and built-in components at least every time the bath liquid is changed. Use water and a soft cloth.

CAUTION

Do not use scouring powder. ▲

The inside of the bath must be kept clean in order to ensure a long service life. Substances containing acidic or alkaline substances and metal shavings should be removed quickly as they could harm the surfaces causing corrosion. If corrosion (e.g., small rust marks) should occur in spite of this, cleaning with stainless steel caustic agents has proved to be suitable. These substances should be applied according to the manufacturer's recommendations.

CAUTION

For cleaning the baths do not use any substances which contain solvents. ▲

Condenser Fins

In order to maintain the cooling capacity of the unit, clean the fins two to four times per year, depending on the operating environment.

Switch off the unit and unplug the power cord.

For ARCTIC A40
1 Remove the condenser panel.

2 Clean fins with brush or similar tool.

3 Replace the panel.

For all other refrigerated baths:
Clean the fins with compressed air.

For extreme soiling a qualified technician will need to remove the cooling compressor casing.

Testing the Safety Features

The safety features for high temperature protection and low liquid level protection must be checked at regular intervals. The frequency depends on the unit's designated application and the heat transfer fluid used.

High temperature protection
Use a flat head screwdriver to turn the arrow to the desired temperature.

Set a cut-off temperature that is lower than the desired setpoint temperature.

Switch on the circulator and ensure the unit shuts down at the set cut-off temperature.

If the unit does not shut down have the unit checked by a qualified technician.

Low liquid level protection
With the unit on, slowly drain the bath fluid (use a drainage tap if necessary) and ensure the unit shuts down.

If not, have the unit checked by a qualified technician.

Section 6 Troubleshooting

Error Displays

Error messages are cleared by pressing the enter key ( ). Once the cause of the error message is identified and corrected, to restart the unit - on units with an HTC error press the reset key full down - and then for all units press the enter key again. If the message does not clear contact our Sales, Service and Customer Support.

FAULT:
HTC
HIGH TEMP. CUTOUT-
PRESS ENTER

Error Message (Typical)

Fault Displays

The heating element, pump and, if applicable, refrigeration shut down with a fault. A fault also sounds the alarm, if enabled.

Message	Action
High Fixed Temp.	• unit's nonadjustable high temperature protection limit exceeded • check fluid selection • check environmental conditions
High Temperature	• adjustable high temperature protection limit exceeded • check limit setting • check fluid selection • ensure unit has adequate ventilation
High Temperature Refrigeration	• check voltage supply • the refrigeration may need servicing
HPC High Press. Cutout	• check for obstructions to air flow • the refrigeration may need servicing
HTC High Temp. Cutout	• high temperature protection limit exceeded • check limit setting • allow unit to cool down • Reset HTC • when operating at high temperatures ensure pump is in high-speed mode
LLC Low Level Cutout	• reservoir fluid level too low for safe operation • check fluid level • check for leaks

Low Fixed Temp.	• unit's nonadjustable low temperature protection limit exceeded • check fluid selection
Low Temperature	• adjustable high temperature protection limit exceeded • check limit setting • check fluid selection
Motor Fault	• it can take over 10 minutes for the motor temperature to get low enough before the unit can be restarted
MOL Motor Overload	• allow unit to cool down
Open RTD1 Internal	• open internal temperature sensor
Open RTD2 External	• open external temperature sensor
Shorted RTD1 Internal	• shorted internal temperature sensor
Shorted RTD2 External	• shorted external temperature sensor

Warning Displays

The unit will continue to run with a warning. A warning also sounds the alarm, if enabled.

High Temperature	• adjustable high temperature protection limit exceeded • check limit setting • check fluid selection
Low Level	• reservoir fluid level too low for safe operation • check fluid level
Low Temperature	• adjustable low temperature protection limit exceeded • check limit setting • check fluid selection

Messages

Bad Calibration	• redo calibration
Bath not found **Non-refrigerated?** **No** **Yes**	• for refrigerated baths, check all communication connections • **NOTE** before connecting ensure the power is off. ▲ • for non-refrigerated baths, select Yes
Calibration Saved	• press enter
Calibration Restored	• press enter
RS232 Enabled	• press enter
RS485 Enabled	• press enter
Remote Start Enabled	• press enter

Checklist

Unit will not start

Check the controller for error displays, see Error Displays in this section.

Ensure the circuit protector is in the on (**I**) position.

Make sure supply voltage is connected and matches the unit's nameplate rating ±10%.

No display on controller

Cycle the circuit protector on the front of the unit.

Unit will not circulate process fluid

Check the reservoir level. Fill, if necessary.

Check the application for restrictions in the cooling lines.

The pump motor overloaded. The pump's internal overtemperature overcurrent device will shut off the pump causing the flow to stop. This can be caused by low fluid, debris in system, operating unit in a high ambient temperature condition or excessively confined space. Allow time for the motor to cool down.

Make sure supply voltage matches the unit's nameplate rating ±10%.

Inadequate temperature control

Verify the setpoint.

Make sure the condenser is free of dust and debris.

Check the fluid concentration.

Ensure unit installation complies with the site requirements in Section 3.

Make sure supply voltage matches unit nameplate rating ±10%.

If the temperature continues to rise, make sure your application's heat load does not exceed the rated specifications.

Check for high thermal gradients (e.g., the application load is being turned on and off or rapidly changing).

Unit shuts down

Ensure  button wasn't accidently pressed.

Ensure the circuit protector is in the on (I) position.

Check the controller for error codes.

Make sure supply voltage is connected and matches the unit's nameplate rating ±10%.

Restart the unit.

Erratic RS485 communications

Cable may be too long. Turn on the Termination feature using the RS485 Menu Screen.

USB driver not recognized

If your operating system does not automatically recognize the driver log on to:

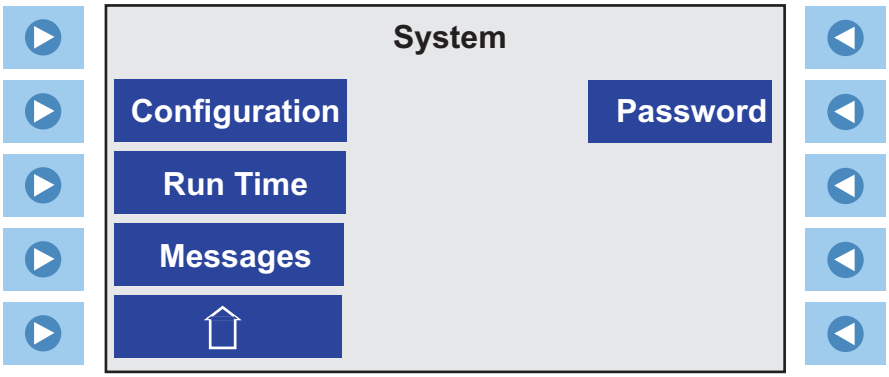
http://www.ftdichip.com/FTDrivers.htm

for instructions.

Please contact Thermo Fisher Scientific Sales Service and Customer Support if you need any additional information, see inside cover for contact instructions.

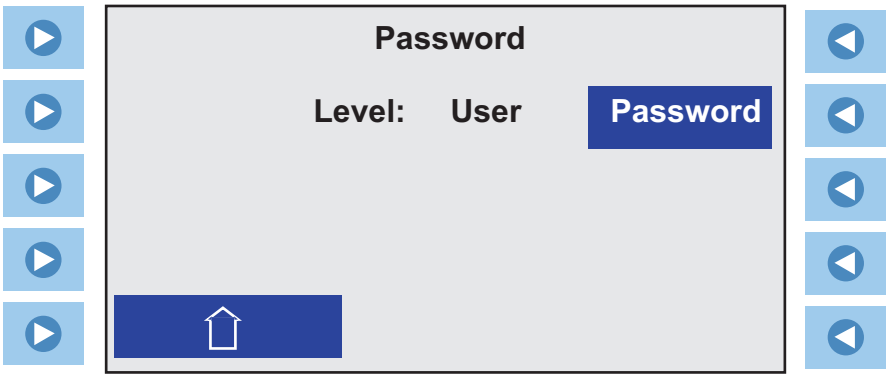
Section 7 Password

Password is used to perform a calibration or to change the controller's PID values. It is also used to reset the controller to factory preset values. To do this the controller has to placed in the Operator Mode.

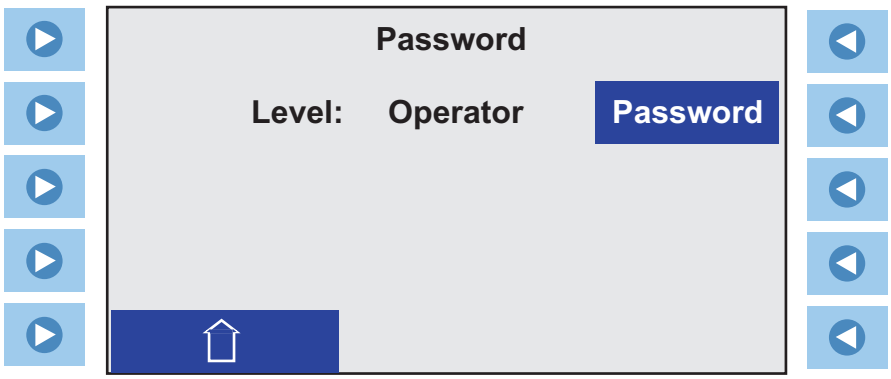


Operator Mode

• Press next to **Password** to display:

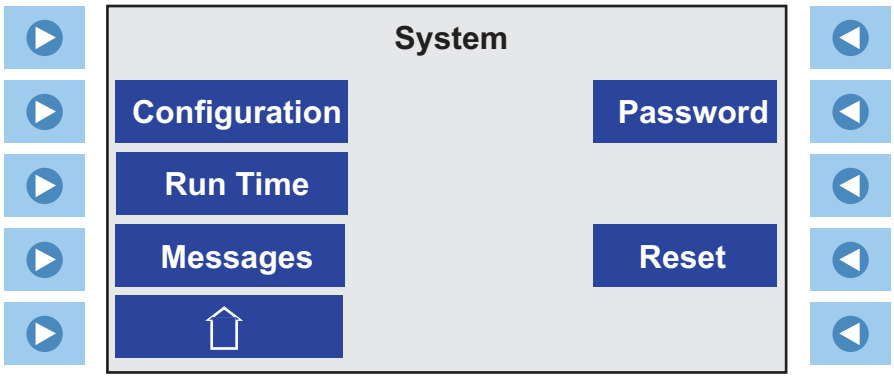


• Press next to **Password** to display the Change a Value Display. Change the **Password** to **1** and press to display:



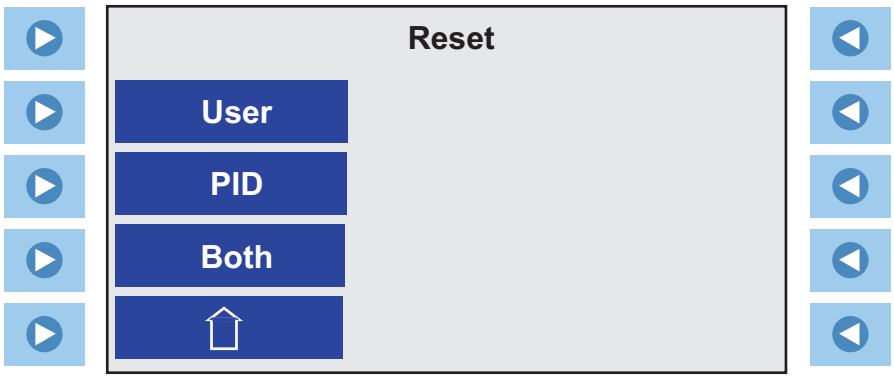
• The controller is now in the Operator Mode.

• Press esc to display:



Reset

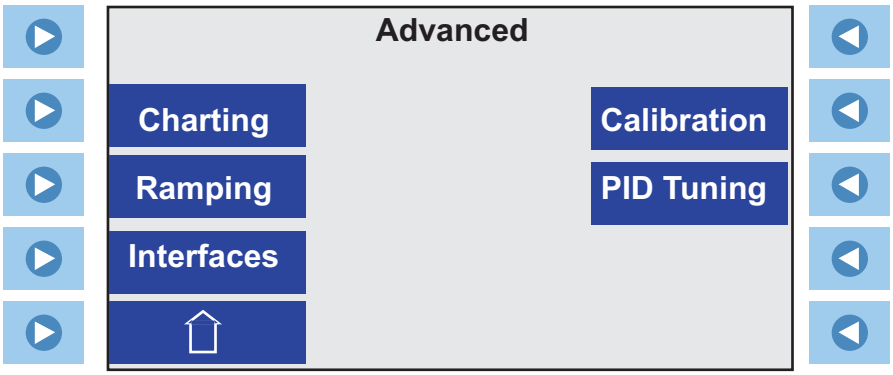
• If desired, press next to **Reset** to display:



• Press on the left of **User** adjustable settings, **PID** values or **Both** to reset factory values. **NOTE** The reset takes several seconds.▲

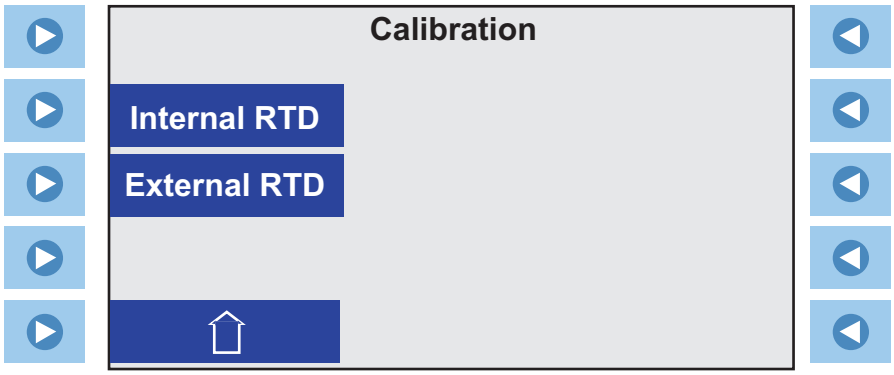
Calibration

• Return to the Advanced menu screen to now display:



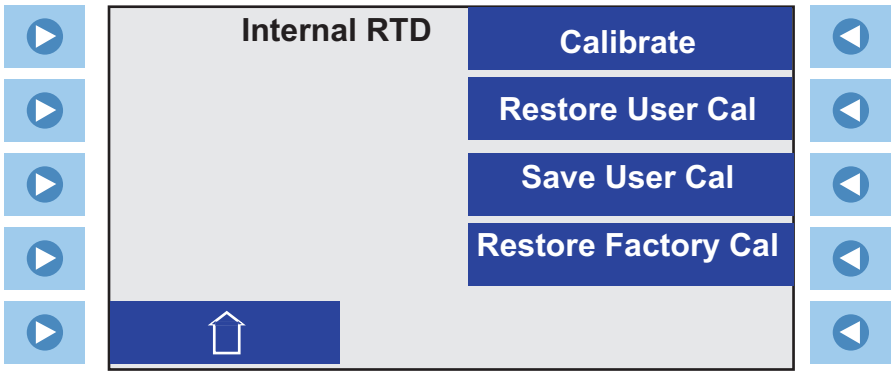
NOTE Ensure RTAs are set to zero before performing a calibration. ▲

• To perform a calibration, press on the right of **Calibration** to display:

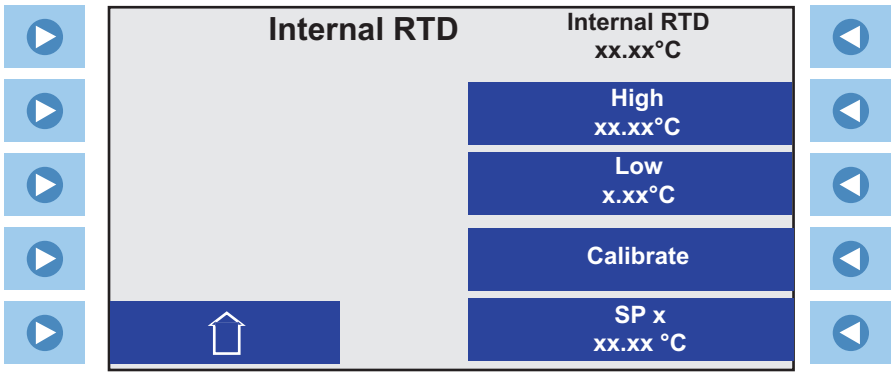


• Press on the left of the desired temperature sensor to display:

NOTE For ease of calibration, ensure the sensor selected is the sensor controlling the temperature. Do not calibrate the internal probe if the external probe is controlling temperature. ▲



• Press on the right of **Calibrate** to display:



• Press on the right of **SPx** to display the Change of Value Display. Enter the desired high of low calibration temperature. Press .

• Using the temperature display at the top right of the display, allow the temperature to stabilize near the calibration temperature. **Internal RTD xx.xx°C**

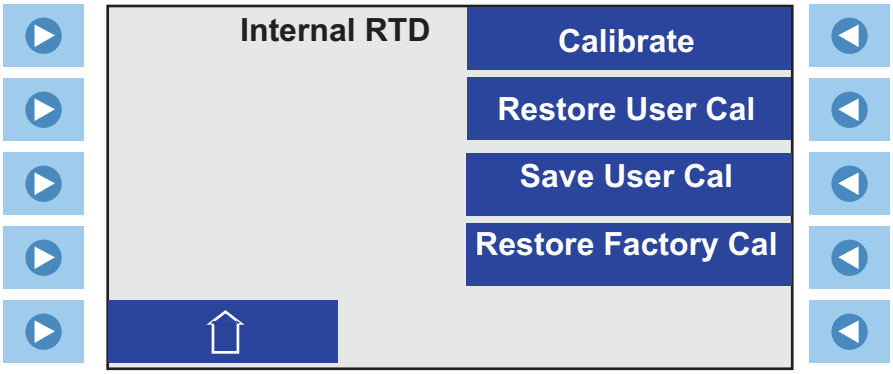
• Once stabilized, press  on the right of either the **High** or **Low**.

• Press  on the right of **SPx** to again display the Change of Value Display. Enter the other calibration temperature and repeat the procedure.

• Once both points are entered, press  on the right of **Calibrate** to complete the procedure. The calibration is strored in the controller's non-volatile memory.

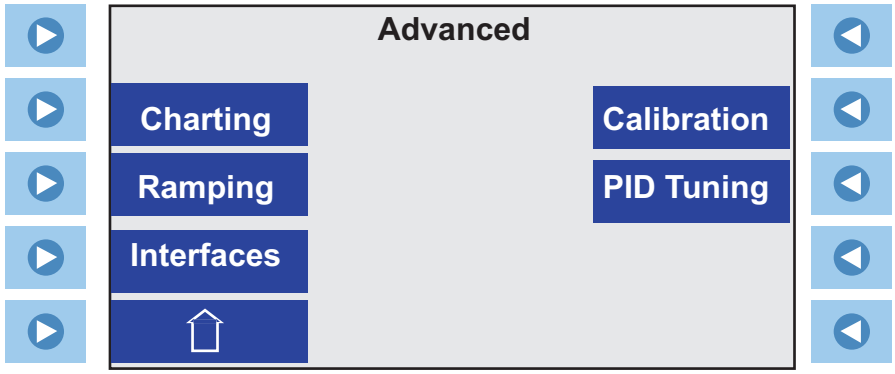
As a backup, once the calibration is complete you can store it into the controller's memory by selecting **Save User Cal**. You can later restore that calibration by pressing **Restore User Cal**.

Another option is to restore the factory calibration values by pressing **Restore Factory Cal**.

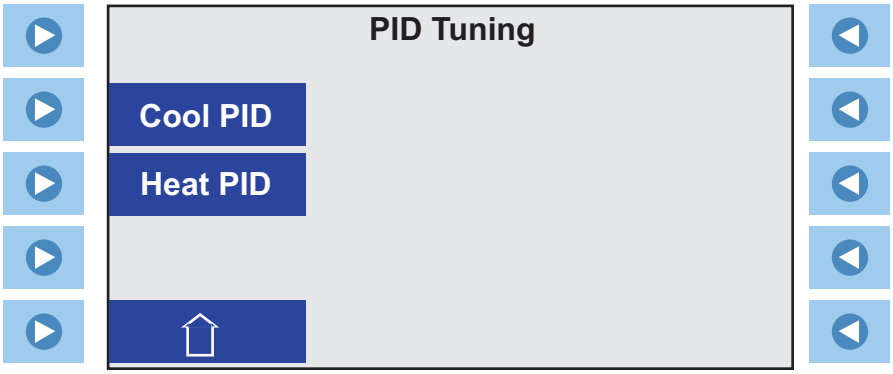


PID Tuning

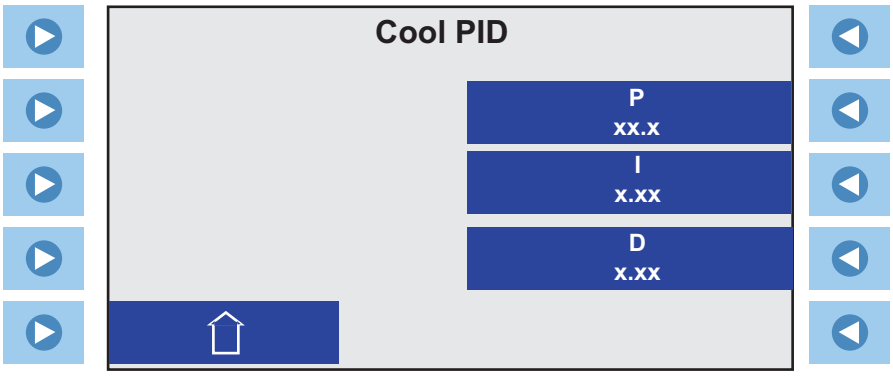
• To change the controller's PID values press ◀ to the right of **PID Tuning**.



• The controller will display:



• Press ▶ to the left of either **Cool** or **Heat** to display:



• Press ◀ on the right of the desired value to display the Change of Value Display.

User Mode

NOTE The controller resets to the **User** mode by changing the **Password** back to **0**. It also resets whenever the unit is turned off. The controller also resets to the **User** mode whenever either the Start or Status Display is displayed continuously for 10 minutes. ▲

Appendix NC Serial Communications Protocol

NOTE This appendix assumes you have a basic understanding of communications protocols. ▲

Serial communication is accomplished either through the optional 9-pin Serial Communications Box or through the USB port on the immersion circulator.

If your operating system does not automatically recognize the optional driver log on to: http://www.ftdichip.com/FTDrivers.htm for instructions.

A long cable may cause erratic RS485 communications. Turn on the Termination feature using the RS485 Menu Screen.

All data is sent and received in binary form, do not use ASCII. In the following pages the binary data is represented in hexadecimal (hex) format.

The NC Serial Communications Protocol is based on a master-slave model. The master is a host computer, while the slave is the chiller's controller. Only the master can initiate a communications transaction (half-duplex). The slave ends the transaction by responding to the master's query. The protocol uses an RS-232/RS-485 serial interface with the default parameters: 9600 baud, 8 data bits, 1 stop bit, no parity and no RS-232 handshaking. RS-485 offers a a slave address selection from 1 to 100, default parameter: 1.

All commands must be entered in the exact format shown in the tables on the following pages. The tables show all commands available, their format and responses. Controller responses are either the requested data or an error message. The controller response *must* be received before the host sends the next command.

The host sends a command embedded in a single communications packet, then waits for the controller's response. If the command is not understood or the checksums do not agree, the controller responds with an error command. Otherwise, the controller responds with the requested data. If the controller fails to respond within 1 second, the host should resend the command.

NOTE All byte values are shown in hex, hex represents the binary values that must be sent to the chiller. **Do not use ASCII.** ▲

The framing of the communications packet in both directions is:

	Checksum region						
Lead char CA or CC	**Addr-MSB 0**	**Addr-LSB 1**	**Command**	**n d-bytes**	**d-byte 1 ...**	**d-byte n**	**Checksum**

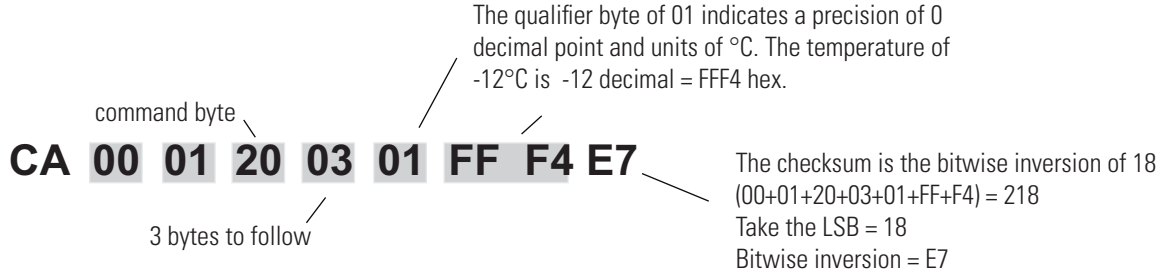
Lead char	0xCA (RS-232) 0xCC (RS-485)
	Device address is 1 (RS-232)
Addr-msb	Most significant byte of device address (RS-232: 0).
Addr-lsb	Least significant byte of device address is 1 (RS-232).
Command	Command byte (see Table 1).
n d-bytes	Number of data bytes to follow (00 to 03 hex).
d-byte 1	1st data byte (the qualifier byte is considered a data byte).
...	...
d-byte n	nth data byte.
Checksum	Bitwise inversion of the 1 byte sum of bytes beginning with the most significant address byte and ending with the byte preceding the checksum. (To perform a bitwise inversion, "exclusive OR" the one byte sum with FF hex.)

The master requests information by sending one of the Read Functions as shown in Table 1. Since no data is sent to the chiller during a read request, the master uses 00 for the number of data bytes following the command byte.

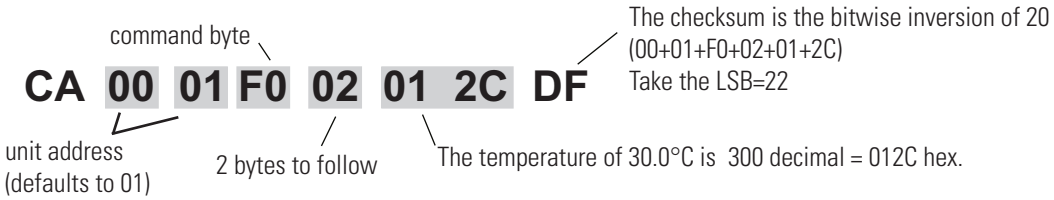
The chiller will respond to a Read Function by echoing the lead character, address, and command byte, followed by the requested data and checksum. When the chiller sends data, a qualifier byte is sent first, followed by a two byte signed integer (16 bit, MSB sent first). The qualifier byte indicates the precision and units of measure for the requested data as detailed in Table 2.

As an RS-232 example, the master requests to read internal temperature unit address 01 by sending:

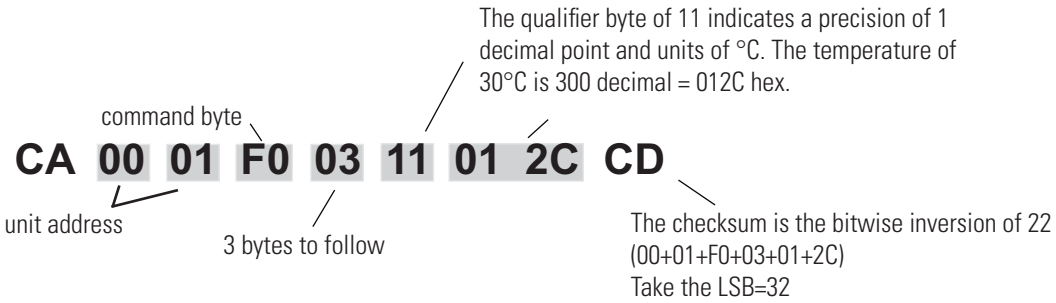
If the temperature is -12°C, the unit would reply:



The master sets parameters in the chiller by sending one of the Set Functions as shown in Table 1. The master does not send a qualifier byte in the data field. The master should be pre-programmed to send the correct precision and units (it could also read the parameter of interest first to decode the correct precision and units needed).



Unit responds:



NOTE When °F or °K units and 0.01 precision are selected use the 4 byte integer option for temperatures, temperature settings and setpoints.

Example: Set setpoint to 573.15K

Master sends: **CA 00 01 F0 04 00 00 DF E3 48**

Unit responds: **CA 00 01 F0 05 2D 00 00 DF E3 1A 48**

Table 1 Commands (All bytes are in hex)

NOTE 16 bit used with °C, 32 bit with °F and °K

FUNCTION	MASTER SENDS	UNIT RESPONDS
Read Acknowledge	CA 00 01 **00** 00 FE	CA 00 01 **00** 02(v1)(v2)(cs)
Read Status (see Table 3)	CA 00 01 **09** 00 F5	CA 00 01 **09** 05(d1)(d2)(d3)(d4)(d5)(cs)
Error		CA 00 01 **0F** 02(en)(ed)(cs)
Read Internal Temperature (RTD1)	CA 00 01 **20** 00 DE	CA 00 01 **20** 03(qb)(d1)(d2)(cs) or CA 00 01 **20** 05(qb)(d1)(d2)(d3)(d4)(cs)
Read External Temperature(RTD2)	CA 00 01 **21** 00 DD	CA 00 01 **21** 03(qb)(d1)(d2)(cs) or CA 00 01 **21** 05(qb)(d1)(d2)(d3)(d4)(cs)
Read Currently Selected Setpoint	CA 00 01 **70** 00 8E	CA 00 01 **70** 03(qb)(d1)(d2)(cs) or CA 00 01 **70** 05(qb)(d1)(d2)(d3)(d4)(cs)
Read Low Temperature Warning	CA 00 01 **40** 00 BE	CA 00 01 **40** 03(qb)(d1)(d2)(cs) or CA 00 01 **40** 05(qb)(d1)(d2)(d3)(d4)(cs)
Read Low Temperature Fault	CA 00 01 **41** 00 BD	CA 00 01 **41** 03(qb)(d1)(d2)(cs) or CA 00 01 **41** 05(qb)(d1)(d2)(d3)(d4)(cs)
Read High Temperature Warning	CA 00 01 **60** 00 9E	CA 00 01 **60** 03(qb)(d1)(d2)(cs) or CA 00 01 **60** 05(qb)(d1)(d2)(d3)(d4)(cs)
Read High Temperature Fault	CA 00 01 **61** 00 9D	CA 00 01 **61** 03(qb)(d1)(d2)(cs) or CA 00 01 **61** 05(qb)(d1)(d2)(d3)(d4)(cs)
Read Cool Proportional Band (P)	CA 00 01 **74** 00 8A	CA 00 01 **74** 03(qb)(d1)(d2)(cs)
Read Cool Integral (I)	CA 00 01 **75** 00 89	CA 00 01 **75** 03(qb)(d1)(d2)(cs)
Read Cool Derivative (D)	CA 00 01 **76** 00 88	CA 00 01 **76** 03(qb)(d1)(d2)(cs)
Read Heat Proportional Band (P)	CA 00 01 **71** 00 8D	CA 00 01 **71** 03(qb)(d1)(d2)(cs)
Read Heat Integral (I)	CA 00 01 **72** 00 8C	CA 00 01 **72** 03(qb)(d1)(d2)(cs)
Read Heat Derivative (D)	CA 00 01 **73** 00 8B	CA 00 01 **73** 03(qb)(d1)(d2)(cs)

command bytes shown in **bold**
qb = qualifier byte, see Table 2
d1,d2 = 16 bit signed integer of the value being sent or received
cs = the checksum of the string (see text)
d1,d2,d3,d4 = 32 bit signal integer of the value being sent or received

v1, v2 = protocol version
ed Bad command byte gets echoed)
en (error number) 01 = Bad command,
02 = Bad checksum
xx = no valid data, include in checksum

Table 1 Commands (continued) (All bytes are in hex)

NOTE 16 bit used with °C, 32 bit with °F and °K

FUNCTION	MASTER SENDS	UNIT RESPONDS
Set Currently Selected Setpoint*	CA 00 01 **F0** 02(d1)(d2)(cs)	CA 00 01 **F0** 03(qb)(d1)(d2)(cs) or
	CA 00 01 **F0** 04(d1)(d2)(d3)(d4)(cs)	CA 00 01 **F0** 05(qb)(d1)(d2)(d3)(d4)(cs)
Set Low Temp Warning	CA 00 01 **C0** 02(d1)(d2)(cs)	CA 00 01 **C0** 03(qb)(d1)(d2)(cs) or
	CA 00 01 **C0** 04(d1)(d2)(d3)(d4)(cs)	CA 00 01 **C0** 05(qb)(d1)(d2)(d3)(d4)(cs)
Set Low Temp Fault	CA 00 01 **C1** 02(d1)(d2)(cs)	CA 00 01 **C1** 03(qb)(d1)(d2)(cs) or
	CA 00 01 **C1** 04(d1)(d2)(d3)(d4)(cs)	CA 00 01 **C1** 05(qb)(d1)(d2)(d3)(d4)(cs)
Set High Temp Warning	CA 00 01 **E0** 02(d1)(d2)(cs)	CA 00 01 **E0** 03(qb)(d1)(d2)(cs) or
	CA 00 01 **E0** 04(d1)(d2)(d3)(d4)(cs)	CA 00 01 **E0** 05(qb)(d1)(d2)(d3)(d4)(cs)
Set High Temp Fault	CA 00 01 **E1** 02(d1)(d2)(cs)	CA 00 01 **E1** 03(qb)(d1)(d2)(cs) or
	CA 00 01 **E1** 04(d1)(d2)(d3)(d4)(cs)	CA 00 01 **E1** 05(qb)(d1)(d2)(d3)(d4)(cs)
Set Cool Proportional Band (P = 0.1 - 99.9)	CA 00 01 **F4** 02(d1)(d2)(cs)	CA 00 01 **F4** 03(qb)(d1)(d2)(cs)
Set Cool Integral (I = 0 - 9.99)	CA 00 01 **F5** 02(d1)(d2)(cs)	CA 00 01 **F5** 03(qb)(d1)(d2)(cs)
Set Cool Derivative (D = 0 - 5.0)	CA 00 01 **F6** 02(d1)(d2)(cs)	CA 00 01 **F6** 03(qb)(d1)(d2)(cs)
Set Heat Proportional Band (P = 0.1 - 99.9)	CA 00 01 **F1** 02(d1)(d2)(cs)	CA 00 01 **F1** 03(qb)(d1)(d2)(cs)
Set Heat Integral (I = 0 - 9.99)	CA 00 01 **F2** 02(d1)(d2)(cs)	CA 00 01 **F2** 03(qb)(d1)(d2)(cs)
Set Heat Derivative (D = 0 - 5.0)	CA 00 01 **F3** 02(d1)(d2)(cs)	CA 00 01 **F3** 03(qb)(d1)(d2)(cs)

Set On/Off Array
The Set On/Off Array command is used to set and/or request unit settings. The master can send the array with a value of 0 (turn off/disable), 1 (turn on/enable), or 2 (do not change). 0 or 1 causes the unit to change the setting, 2 only requests the state of a setting. The slave returns values of 0 (off/disabled) or 1 (on/enabled).

SW Version	CA 00 01 **81** 01(d1)(cs)	CA 00 01 **81** 01(d1)(cs)
Sample - turn unit on	CA 00 01 **81** 08 01 02 02 02 02 02 02 02 66	
Sample - turn unit off	CA 00 01 **81** 08 00 02 02 02 02 02 02 02 67	

* = limited to the range of the head, bath and fluid combination **d1 - unit off = 0, on =1
command bytes shown in **bold**
qb = qualifier byte, see Table 2

The eight items in the set on off array: CA 00 01 **81** 08 02 02 02 02 02 02 02 02 (cs)

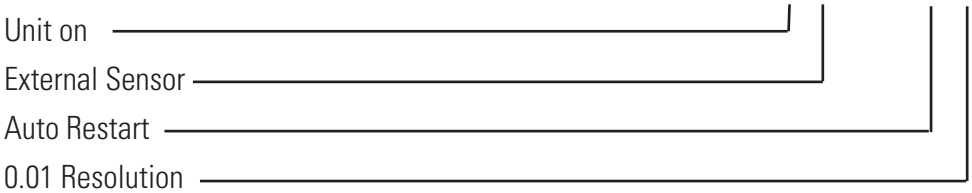


Table 2

QUALIFIER BYTE	
00	0 precision (1), no units of measure
10	1 precision (0.1), no units of measure
20	2 precision (0.01), no units of measure
11	1 precision (0.1), °C
21	2 precision (0.01), °C
12	1 precision (0.1), °F
22	2 precision (0.01), °F
1D	1 precision (0.1), °K
2D	2 precision (0.01), °K

Example: The temperature of 45.6°C would be represented by the qualifier 11 hex, followed by the 2 bytes 01 C8 hex (456 decimal).

Table 3 REQUEST STATUS (5 bytes)

BIT	d1	d2	d3	d4	d5
b.7	RTD1 Open Error	RTD2 Open Error	High temp fixed fault	Beeper on	External Sensor controlling
b.6	RTD1 Short Error	RTD2 Short Error	Low temp fixed fault	0	Heat icon flashing
b.5	RTD1 Open Fault	RTD2 Open Warn	High temp fault	Fault	Heat icon on
b.4	RTD1 Short Fault	0	Low temp fault	Unit stopping	Cool icon flashing
b.3	0	RTD2 Open*	Low level fault	Unit on	Cool icon on
b.2	0	RDT2 Short*	High temp warn	Pump on	HPC fault
b.1	0	High RA temp fault	Low temp warn	Compressor on	MOL fault
b.0	0	HTC fault	Low level warn	Heat output > 0	Pump speed fault

*Ignore this display

	Unit of Measure (not all used)
Index	Unit
0	NONE
1	Temperature in °C
2	Temperature in °F
3	Flow liters per minute
4	Flow in gallons per minute
5	Time in seconds
6	Pressure in PSI
7	Pressure in bars

	Unit of Measure (not all used)
Index	Unit
8	Resistivity in MΩ-cm
9	%
10	Volts
11	Pressure in kPa
12	Conductivity in µS/cm
13	Temperature in °K

Laboratory Equipment Div.
25 Nimble Hill Road
Newington, NH 03801

DECLARATION OF CONFORMITY

Manufacturer: Thermo Fisher Scientific

Address: 25 Nimble Hill Road
Newington, NH 03801 USA

CE

Date of inception 2009

We declare that the following products conform to the Directives and Standards listed below.

Products: ThermoTemp Refrigerated and non refrigerated heated liquid baths
All rated 100V-50 & 60Hz or 115V-60Hz or 230V-50Hz.

Refrigerated and non refrigerated heated liquid baths:

Models: SC100, SC150, SC150L, AC150 or AC200 control head assembled with an A5B, A10B, A25B, A10, A25, A28, A28F, A40, G50, S3, S7, S13, S15, S21, S30, S45, S49, S5P, S14P S21P, S6T, S12T or S19T.

Control heads, intended as a component for use only in the ThermoTemp product line of refrigerated and non refrigerated liquid baths.

Models: SC100, SC150, SC150L, AC150, AC200, PC200 & PC300.

Bath assemblies intended as a component for use only with ThermoTemp control heads.

Models: A5B, A25, A10B, A24B, A25, A25B, A28 & A40.

Immersion circulators:

Models: SC100, SC150, SC150L, AC150, AC200, PC200, PC201 & PC300.

ThermoTemp bath accessories, not mains connected:

BOM #s: 1600027, 1600075 & 1600076.

Equipment Class: Measurement, control and laboratory

Directives and Standards:

2004/108/EC – Electromagnetic Compatibility (EMC Directive):

EN 61326-1: 2006 – Electrical equipment for measurement, control, and laboratory use – EMC Requirements - EMC Class A.

2006/95/EC – Low Voltage Directive (LVD):

EN 61010-1: 2001 – Safety requirements for electrical equipment for measurement, control, and laboratory use – General Requirements.

EN 61010-2-010: 2003 – Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-010: Particular requirements for laboratory equipment for the heating of materials.

Manufacturer's Authorized Representative: Date: 29 June 2011

Reid Poole
Product Line Manager Laboratory Equipment

Laboratory Equipment Div.
25 Nimble Hill Road
Newington, NH 03801

RoHS DECLARATION OF CONFORMITY

Manufacturer: Thermo Fisher Scientific

Address: 25 Nimble Hill Road
Newington, NH 03801 USA

Products: Standard ThermoTemp refrigerated and non refrigerated heated liquid baths and their associated standard accessories .

Thermo Fisher Scientific certifies that the above ThermoTemp models meet the requirements of DIRECTIVE 2002/95/EC, Restriction of Hazardous Substances Directive (RoHS). Thermo Fisher Scientific certifies that these ThermoTemp models contains less than the following amounts of the six RoHS banned substances with the exemption stated in Note 2 below:

Substance		Threshold Level
Lead…	Pb	Less than 0.1% 1 & 2
Mercury…	Hg	Less than 0.1% 1
Hexavalent Chromium …	Cr (VI)	Less than 0.1% 1
Polybrominated Biphenyls …	PBB	Less than 0.1% 1
Polybrominated Diphenyl Ethers …	PBDE	Less than 0.1% 1
Cadmium …	Cd	Less than 0.01% 1

Notes:

1. Tolerated maximum concentration value by weight in homogeneous materials.
2. Exemptions - Lead as an alloying element in steel containing up to 0.35% lead by weight, aluminum containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight.

Manufacturer's Authorized Representative: Date: 29 June 2011

Reid Poole
Product Line Manager Laboratory Equipment

Warranty

Thermo Fisher Scientific warrants for 36 months from date of shipment the Thermo Scientific PREMIUM series of Immersion Circulators, ARCTIC and GLACIER refrigerated bath circulators, and SAHARA heated bath circulators according to the following terms.

Any part of the unit manufactured or supplied by Thermo Fisher Scientific and found in the reasonable judgment of Thermo Fisher to be defective in material or workmanship will be repaired at an authorized Thermo Fisher Repair Depot without charge for parts or labor. The unit, including any defective part must be returned to an authorized Thermo Fisher Repair Depot within the warranty period. The expense of returning the unit to the authorized Thermo Fisher Repair Depot for warranty service will be paid for by the buyer. Our responsibility in respect to warranty claims is limited to performing the required repairs or replacements, and no claim of breach of warranty shall be cause for cancellation or recision of the contract of sales of any unit. With respect to units that qualify for field service repairs, Thermo Fisher Scientific's responsibility is limited to the component parts necessary for the repair and the labor that is required on site to perform the repair. Any travel labor or mileage charges are the financial responsibility of the buyer.

The buyer shall be responsible for any evaluation or warranty service call (including labor charges) if no defects are found with the Thermo Scientific product.

This warranty does not cover any unit that has been subject to misuse, neglect, or accident. This warranty does not apply to any damage to the unit that is the result of improper installation or maintenance, or to any unit that has been operated or maintained in any way contrary to the operating or maintenance instructions specified in this Instruction and Operation Manual. This warranty does not cover any unit that has been altered or modified so as to change its intended use.

In addition, this warranty does not extend to repairs made by the use of parts, accessories, or fluids which are either incompatible with the unit or adversely affect its operation, performance, or durability.

Thermo Fisher Scientific reserves the right to change or improve the design of any unit without assuming any obligation to modify any unit previously manufactured.

THE FOREGOING EXPRESS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

OUR OBLIGATION UNDER THIS WARRANTY IS STRICTLY AND EXCLUSIVELY LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE COMPONENT PARTS AND Thermo Fisher Scientific DOES NOT ASSUME OR AUTHORIZE ANYONE TO ASSUME FOR IT ANY OTHER OBLIGATION.

Thermo Fisher Scientific ASSUMES NO RESPONSIBILITY FOR INCIDENTAL, CONSEQUENTIAL, OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO LOSS OR DAMAGE TO PROPERTY, LOSS OF PROFITS OR REVENUE, LOSS OF THE UNIT, LOSS OF TIME, OR INCONVENIENCE.

This warranty applies to units sold in the United States. Any units sold elsewhere are warranted by the affiliated marketing company of Thermo Fisher Scientific. This warranty and all matters arising pursuant to it shall be governed by the law of the State of New Hampshire, United States. All legal actions brought in relation hereto shall be filed in the appropriate state or federal courts in New Hampshire, unless waived by Thermo Fisher Scientific.

Future Technology Devices International Ltd

Application Note AN_104

FTDI Drivers Installation guide for Windows XP

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Future Technology Devices International Ltd (FTDI)

373 Scotland Street, Glasgow G5 8QB United Kingdom

Tel.: +44 (0) 141 429 2777 Fax: + 44 (0) 141 429 2758

E-Mail (Support): support1@ftdichip.com Web: http://www.ftdichip.com

Table of Contents

List of Figures

Acronyms and Abbreviations

Terms	Description
CDM	Combined Driver Model. FTDI's Windows driver that supports both D2XX and VCP interfaces.
VCP	Virtual COM Port. Emulation of a legacy RS232 COM port.

Table 1.1 Acronyms and Abbreviations

1 Introduction

This document is intended to guide the reader through the process of installing FTDI's combined driver model (CDM) driver for the Microsoft Windows XP operating system. The CDM driver provides access to both virtual COM port (VCP) and FTDI's proprietary "direct" (D2XX) interfaces.

2 Installing CDM Drivers

2.1 Installing Via The Found New Hardware Wizard

To install CDM drivers for an FTDI device under Windows XP, follow the instructions below:

- If a device of the same type has been installed on your machine before and the drivers that are about to be installed are different from those installed already, the original drivers need to be uninstalled. Please refer to the Uninstalling CDM Drivers section of this document for further details of this procedure.
- Download the latest available CDM drivers from the FTDI web site and unzip them to a location on your PC.
- If you are running Windows XP or Windows XP SP 1, temporarily disconnect your PC from the Internet. This can be done by either removing the network cable from your PC or by disabling your network card by going to the "Control Panel\Network and Dial-Up Connections", right-clicking on the appropriate connection and selecting "Disable" from the menu. The connection can be re-enabled after the installation is complete. This is not necessary under Windows XP SP 2 if configured to ask before connecting to Windows Update. Windows XP SP 2 can have the settings for Windows Update changed through "Control Panel\System" then select the "Hardware" tab and click "Windows Update".
- Connect the device to a spare USB port on your PC. If the device is based on the FT2232, the Microsoft composite device driver is automatically loaded in the background. Once the composite driver has been installed Windows Found New Hardware Wizard will launch. If there is no available Internet connection or Windows XP SP 2 is configured to ask before connecting to Windows Update, the screen shown in Figure 2.1 is displayed. Select "No, not this time" from the options available and then click "Next" to proceed with the installation. If there is an available Internet connection, Windows XP will silently connect to the Windows Update website and install any suitable driver it finds for the device in preference to the driver manually selected.

Figure 2.1

- Select "Install from a list or specific location (Advanced)" as shown in Figure 2.2 below and then click "Next".

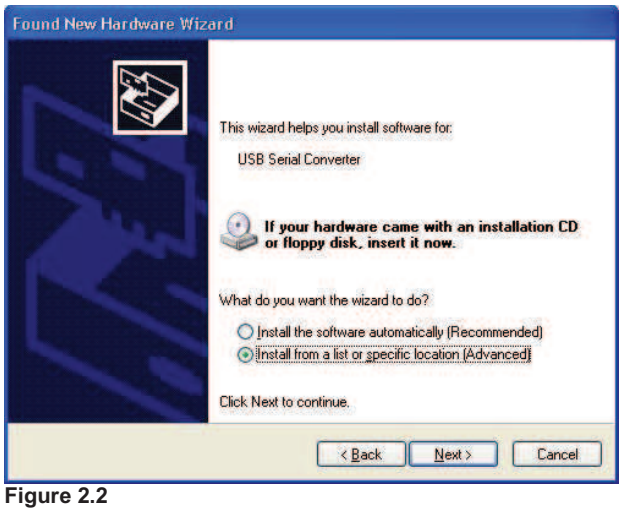


Figure 2.2

- Select "Search for the best driver in these locations" and enter the file path in the combo-box ("C:\CDM 2.02.04" in Figure 2.3 below) or browse to it by clicking the browse button. Once the file path has been entered in the box, click next to proceed.

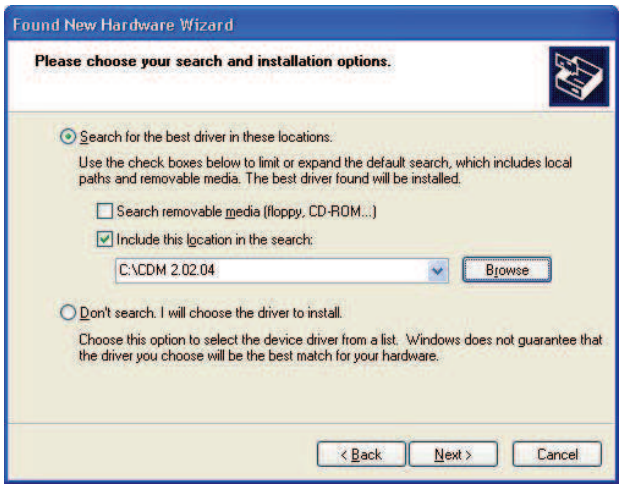


Figure 2.3

- If Windows XP is configured to warn when unsigned (non-WHQL certified) drivers are about to be installed, the message dialogue shown in Figure 2.4 will be displayed unless installing a Microsoft WHQL certified driver. Click on "Continue Anyway" to continue with the installation. If Windows XP is configured to ignore file signature warnings, no message will appear.

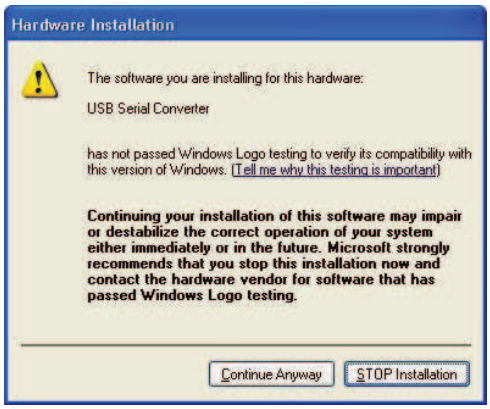


Figure 2.4

- The screen shown in Figure 2.5 will be displayed as Windows XP copies the required driver files.

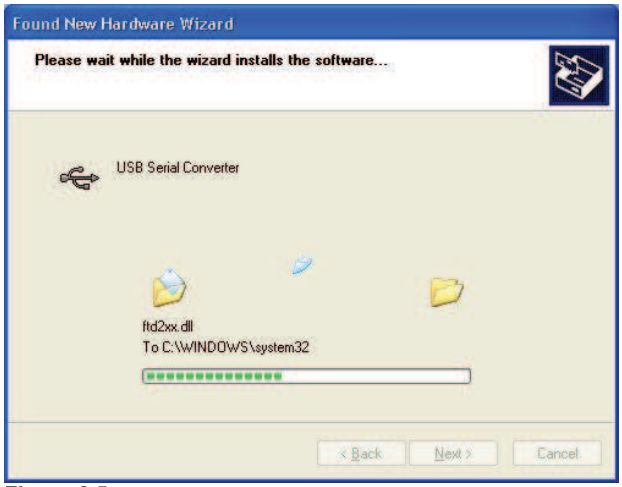


Figure 2.5

- Windows should then display a message indicating that the installation was successful (Figure 2.6). Click "Finish" to complete the installation for the first port of the device.

Figure 2.6

- If the device is based on the FT2232, the Found New Hardware Wizard will continue by installing the USB Serial Converter driver for the second port of the FT2232 device. The procedure for installing the second port is identical to that for installing the first port from the first screen of the Found New Hardware Wizard. This is done automatically if the driver is Microsoft WHQL certified. If the device is not based on the FT2232, the COM port emulation driver is loaded as indicated in the following steps.

- The Found New Hardware Wizard will launch automatically to install the COM port emulation drivers. As above, select "No, not this time" From the options and click "Next" to proceed with the installation (Figure 2.7).

Figure 2.7

- Select "Install from a list or specific location (Advanced)" as shown in Figure 2.8 below and then click "Next".

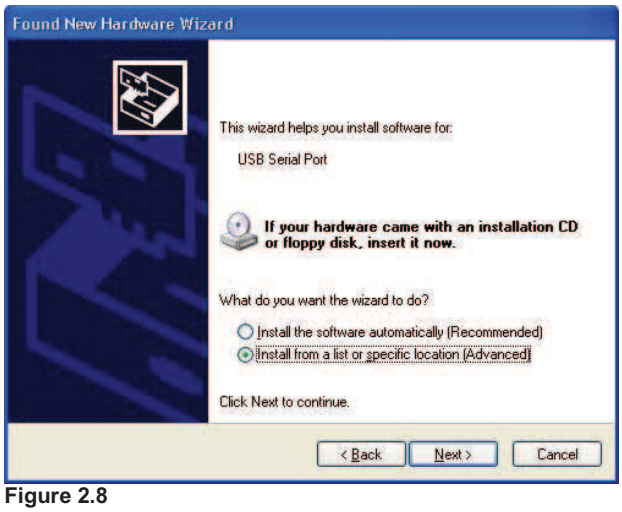


Figure 2.8

- Select "Search for the best driver in these locations" and enter the file path in the combo-box ("C:\CDM 2.02.04" in figure 2.9 below) or browse to it by clicking the browse button. Once the file path has been entered in the box, click next to proceed.

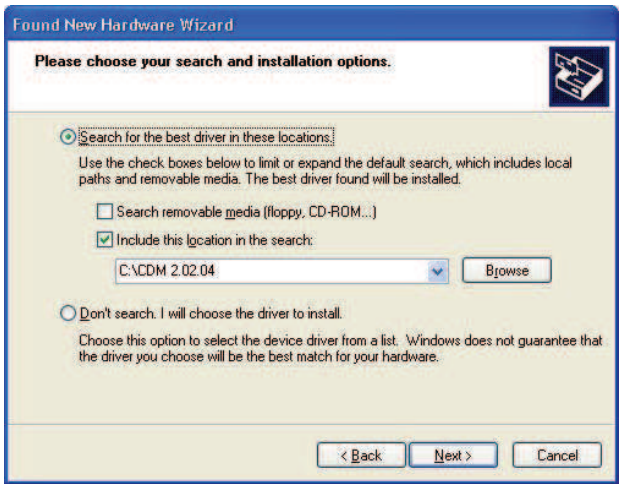


Figure 2.9

- If Windows XP is configured to warn when unsigned (non-WHQL certified) drivers are about to be installed, the message dialogue shown in Figure 2.10 will be displayed unless installing a Microsoft WHQL certified driver. Click on "Continue Anyway" to continue with the installation. If Windows XP is configured to ignore file signature warnings, no message will appear.

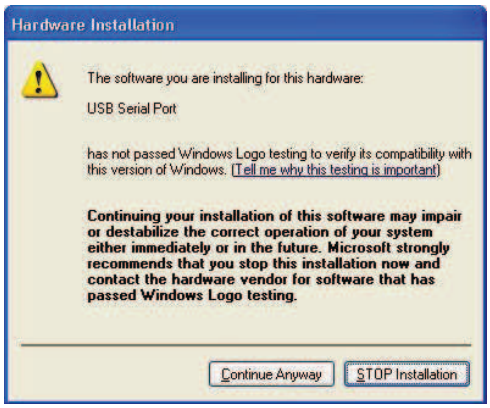


Figure 2.10

- The screen shown in Figure 2.11 will be displayed as Windows XP copies the required driver files.

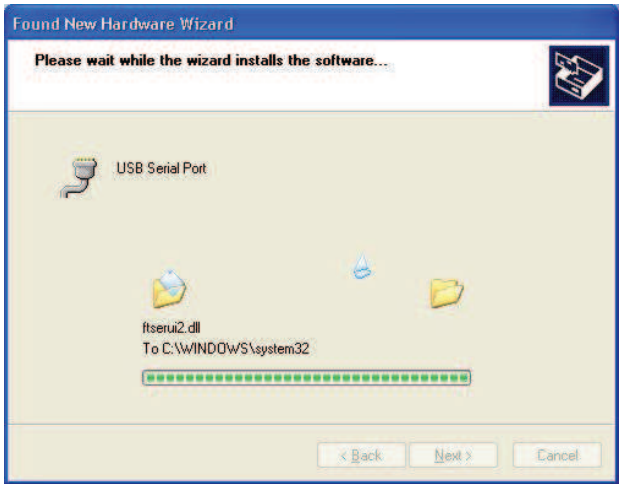


Figure 2.11

- Windows should then display a message indicating that the installation was successful (Figure 2.12). Click "Finish" to complete the installation for the first port of the device.

Figure 2.12

- If the device is based on the FT2232, the second port must also be installed. The procedure for installing the second port is identical to that for installing the first port from the first screen of the Found New Hardware Wizard for the USB Serial Port device. If the driver is Microsoft WHQL certified, this is done automatically.

- Open the Device Manager (located in "Control Panel\System" then select the "Hardware" tab and click "Device Manger") and select "View > Devices by Connection", the device appears as a "USB Serial Converter" with an additional COM port with the label "USB Serial Port" (Figure 2.13). If the device is based on the FT2232, two ports will be available from a composite USB device.

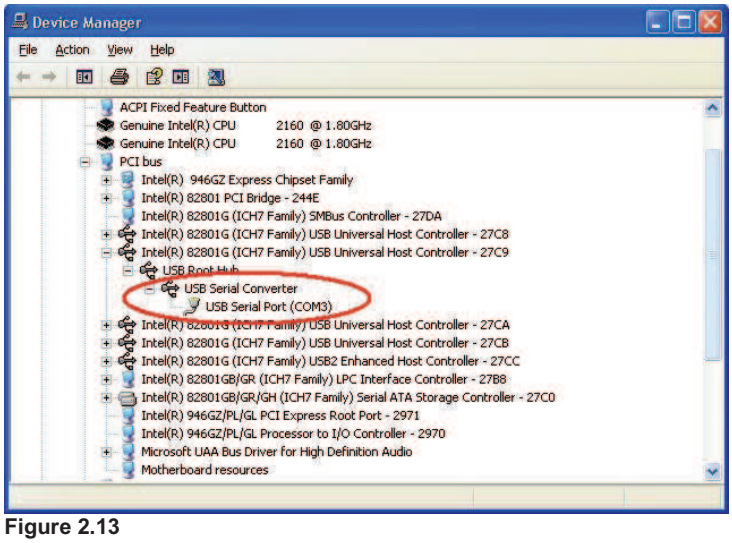


Figure 2.13

- In the case of the FT2232, port A of the FT2232 will be installed as COMX and port B will be installed as COMX+1 where COMX is the first available COM port number.

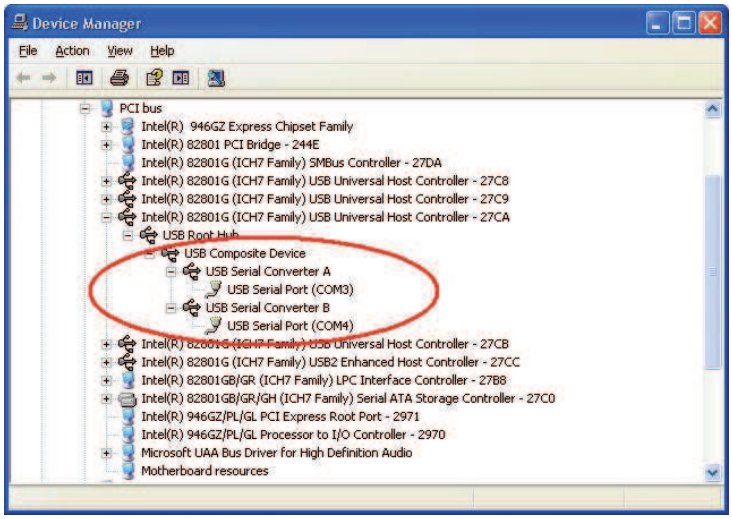


Figure 2.14

2.2 Installing Using DPInst

In the case of a Microsoft WHQL certified driver package, it is possible to pre-install the driver package using the Microsoft Driver Install Frameworks (DIFx) tools. The simplest tool provided is the Driver Package Installer (DPInst). When placed in the same directory as the INF files for the driver package, simply run DPInst.exe and the certified driver package will be installed on the machine.

The current FTDI CDM driver package supports 32-bit and 64-bit systems through common INF files. DPInst has separate executables for 32-bit and 64-bit installation. This means that if a single solution is desired for 32-bit and 64-bit systems, the developer must be able to detect which version of DPInst is required for the system the driver is being installed on.

For more information on DPInst, see the FTDI Windows Driver Pre-Installation application note.

2.3 Installing From Windows Update

If a certified driver is available for the target operating system, it is possible to install the driver from the Windows Update web site.

Directions to install the driver from Windows Update are very similar to those outlined in 2.1 Installing Via The New Hardware Wizard, except that the “Yes, this time only” or “Yes, now and every time I connect a device” option should be selected on the first screen of the wizard when asked if Windows Update should be checked for a driver. If the wizard finds a matching driver on Windows Update, the driver will be automatically downloaded and installed for the device.

3 Uninstalling CDM Drivers

FTDI no longer supply an uninstaller program as part of the driver package. Consequently, a new method for uninstalling has to be used. Devices can be removed using the Device Manager by simply right-clicking on the device and selecting "Uninstall". This will delete the associated registry entries for that device only.

Under Windows XP, driver files and OEM INF and PNF files must be removed manually or by using a custom application. OEM INF and PNF files are located in the Windows\Inf directory and can be identified by searching for a VID and PID string matching the device installed e.g. VID_0403&PID_6001. Once the matching OEM INF files are found (e.g. oem10.inf for FTDIBUS.INF and oem11.inf for FTDIPORT.INF), the corresponding PNF files must also be removed (e.g. oem10.pnf and oem11.pnf). Driver files are located in the Windows\System32 and Windows\System32\Drivers directories.

Some points to note about this un-installation method:

- In the case of FT2232 devices, a composite device is also installed. This can also be removed by right-clicking on the composite device in the Device Manager and selecting "Uninstall".
- If the VCP driver has been installed, the COM port driver should be removed before the bus driver. If the bus is removed first, the COM port will no longer appear in the Device Manager.
- If the driver files are deleted while other installed devices still require them those devices will not work correctly. This can be fixed by right clicking the device and selecting "Reinstall Driver" which will replace the missing files.
- If a device to be uninstalled is not connected to the PC, the device can still be removed by setting the device manager to show phantom devices. This can also allow a virtual COM port to be uninstalled if the bus layer has been removed first. Instructions on how to display phantom devices are given in the Advanced Driver Options application note.

4 Troubleshooting

4.1 Windows XP Cannot Find Drivers For My Device

This error can occur if the VID and PID programmed into the device EEPROM do not match those listed in the INF files for the driver. The VID and PID programmed into the device EEPROM may be found by using the USBView utility from the FTDI web site. These can then be checked against the VID and PID entries in the driver INF files. If they do not match, that driver cannot be installed for that device without either re-programming the device EEPROM or modifying the list of VID and PID numbers in the INF files.

Please note that only your own company VID and PID or FTDI's VID (0x0403) and FTDI PID issued for use by your company should be used in the EEPROM and INF/INI files.

End customers should obtain modified drivers from the OEM of the device, and not necessarily edit the files themselves.

4.2 Windows XP Forces A Reboot After Installing a Device

This problem can occur if an application is accessing a file while the New Hardware Wizard is trying to copy it. This usually occurs with the FTD2XX.DLL file. Selecting not to restart the computer then unplugging and re-plugging the device may allow the device to function properly without restarting. Restarting the machine will allow the device to work correctly.

4.3 Driver Installation Fails And Windows XP Gives Error Code 10

Windows error code 10 indicates a hardware error or failed driver installation. This error may appear if a device has insufficient power to operate correctly (e.g. plugged into a bus powered hub with other devices), or may indicate a more serious hardware problem. Also, it may be indicative of USB root hub drivers being incorrectly installed.

Please refer to the example schematics on the FTDI web site for standard device configurations. If the error persists, please contact the FTDI support department.

4.4 Windows XP Displays An Error And Then Terminates Installation

If the following screen is displayed with this message, Windows XP has been configured to block the installation of any drivers that are not WHQL certified.

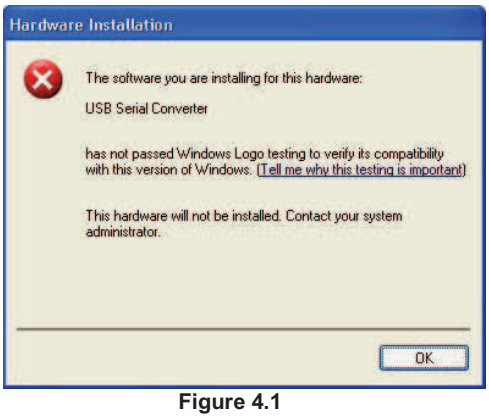


Figure 4.1

Two options are available to successfully install the device. Either a certified version of the driver can be installed (if available) or the driver signing options can be changed to either warn or ignore to allow the installation to complete.

To change the current driver signing setting, go to "Control Panel\System", click on the "Hardware" tab and then click "Driver Signing". The desired signing option may then be selected.

5 Contact Information

Head Office - Glasgow, UK

Future Technology Devices International Limited
373 Scotland Street
Glasgow G5 8QB
United Kingdom
Tel: +44 (0) 141 429 2777
Fax: +44 (0) 141 429 2758
E-Mail (Sales): sales1@ftdichip.com
E-Mail (Support): support1@ftdichip.com
E-Mail (General Enquiries): admin1@ftdichip.com
Web Site URL: http://www.ftdichip.com
Web Shop URL: http://apple.clickandbuild.com/cnb/shop/ftdichip

Branch Office - Taiwan

Future Technology Devices International Limited (Taiwan)
4F, No 16-1, Sec. 6 Mincyuan East Road
Neihu District
Taipei 114
Taiwan, R.O.C.
Tel: +886 2 8791 3570
Fax: +886 2 8791 3576
E-Mail (Sales): tw.sales1@ftdichip.com
E-Mail (Support): tw.support1@ftdichip.com
E-Mail (General Enquiries): tw.admin1@ftdichip.com
Web Site URL: http://www.ftdichip.com

Branch Office - Hillsboro, Oregon, USA

Future Technology Devices International Limited (USA)
7235 NW Evergreen Parkway, Suite 600
Hillsboro, OR 97124-5803
USA
Tel: +1 (503) 547-0988
Fax: +1 (503) 547-0987
E-Mail (Sales): us.sales@ftdichip.com
E-Mail (Support): us.support@ftdichip.com
E-Mail (General Enquiries): us.admin@ftdichip.com
Web Site URL: http://www.ftdichip.com

Distributors and Sales Representatives
Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) in your country.

Appendix A – Revision History

Version 0.1	First Draft	08/09/2008
Version 1.0	First Release	23/09/2008

Future Technology Devices International Ltd.

Application Note AN_119

FTDI Drivers Installation guide for Windows 7

Document Reference No.: FT_000160

Version 1.0

Issue Date: 2009-10-29

The purpose of this application note is to provide users of FTDI chips with a simple procedure for installing FTDI drivers for FTDI devices used under Windows 7.

Future Technology Devices International Limited (FTDI)

Unit 1, 2 Seaward Place, Centurion Business Park, Glasgow G41 1HH, United Kingdom
Tel.: +44 (0) 141 429 2777 Fax: + 44 (0) 141 429 2758
E-Mail (Support): Support1.support@ftdichip.com Web: http://www.ftdichip.com

Table of Contents

1 Introduction

The purpose of this application note is to provide users of FTDI chips with a simple procedure for installing FTDI drivers for their devices under Windows 7.

2 Installing FTDI Device Drivers

FTDI have previously provided two types of driver for Windows OS: a D2XX direct driver and a virtual COM port (VCP) driver. Previously, these drivers were mutually exclusive and could not be installed at the same time. The new Windows combined driver model (CDM) which may be installed on Windows 2000, XP, VISTA or Windows 7 allows applications to access FTDI devices through either the D2XX DLL or a COM port without having to change driver type. However, it should be noted that an application can only communicate through one of these interfaces at a time and cannot send commands to the D2XX DLL and the associated COM port at the same time.

The CDM driver comes in two parts. The first part is the bus layer that provides D2XX style functionality and is always installed. The second part is the serial COM port layer and the CDM driver will determine whether a COM port should be exposed by reading the EEPROM of FT232R, FT245R, FT2232D, FT2232H and FT4232H devices. In the case of FT232BM, FT245BM, devices, the CDM driver will default to always installing a COM port.

This behavior can be changed and EEPROM settings ignored by changing the driver INF files as detailed in FTDI Application Note AN-107, Advanced Driver Options. Please note that modifying the INF files of a Microsoft WHQL certified driver will invalidate the Windows certification.

The driver is downloadable from the FTDI website by clicking the word download: download.

3 Installing CDM Drivers

To install CDM drivers for an FTDI device under Windows 7, follow the instructions below:

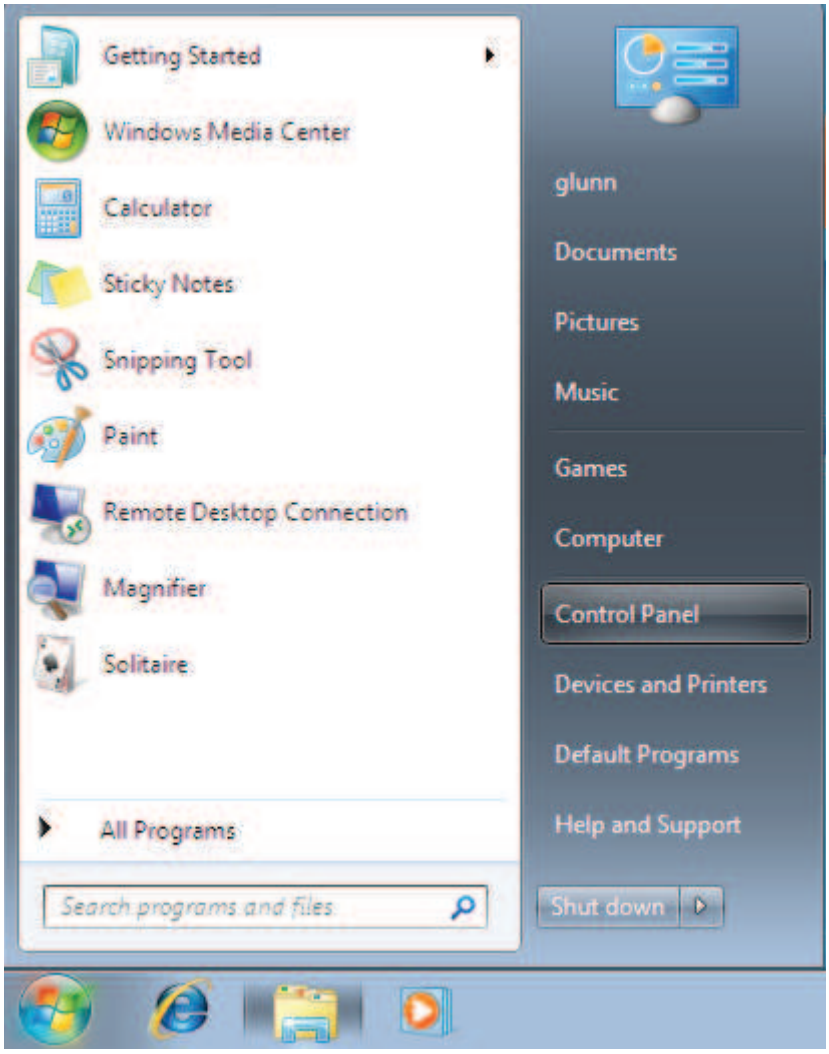
Connect the device to a spare USB port on your PC.

If there is an available Internet connection, Windows 7 will silently connect to the Windows Update website and install any suitable driver it finds for the device.

If the automatic installation takes place there is no need to continue with the procedure outlined below.

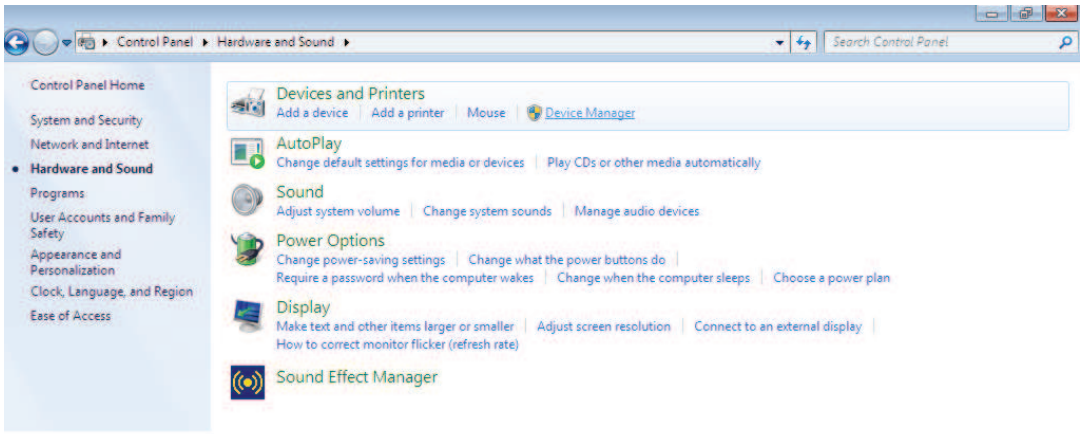
If no suitable driver is automatically found then the following procedure should be followed.

Press the Windows start button to bring up the start menu and select "Control Panel".

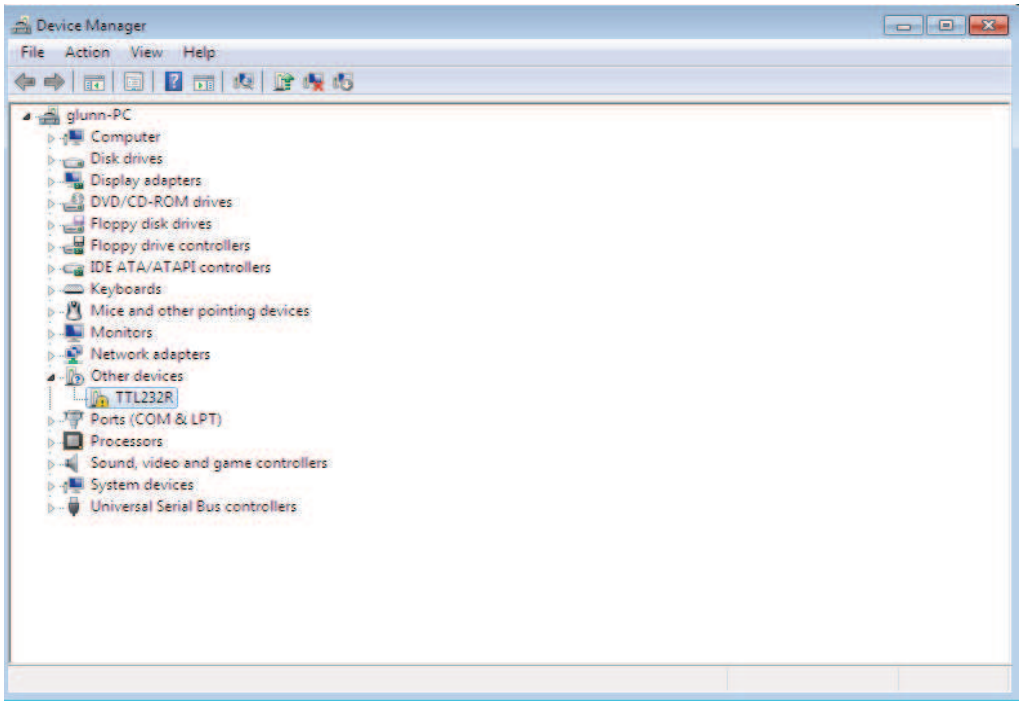


From the Control Panel window select Hardware and Sound

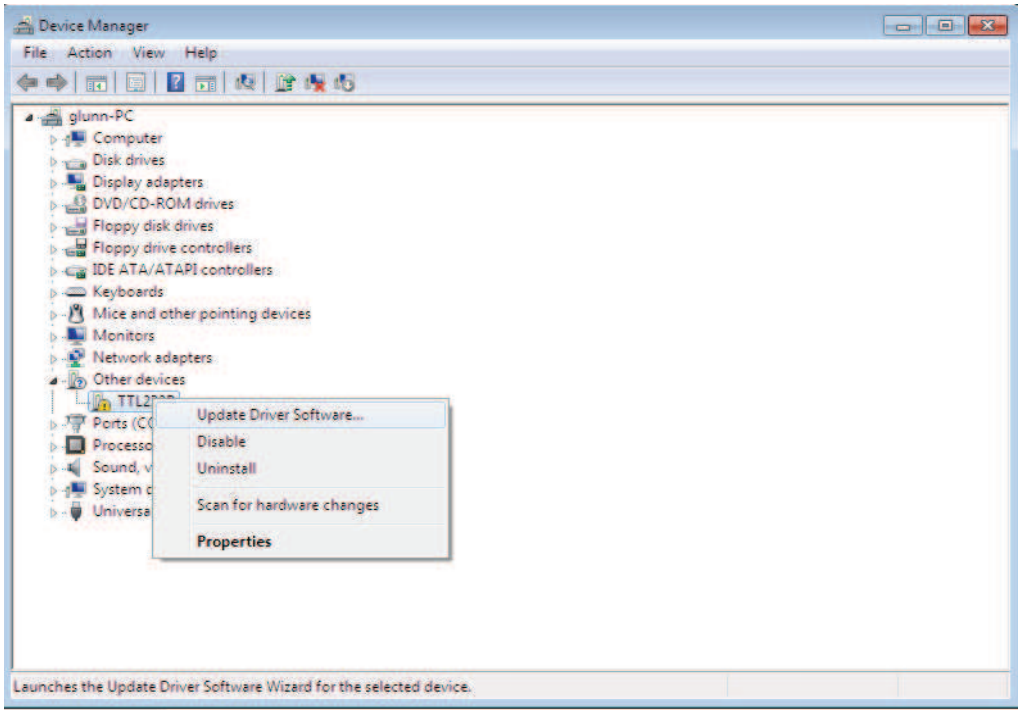
At the next screen select Device Manager:



In the Device Manager window there will be a device under Other Devices with a yellow warning symbol to indicate a problem ie no driver installed. The text next to this device will depend on the device attached. In this example the device was a TTL232R device.

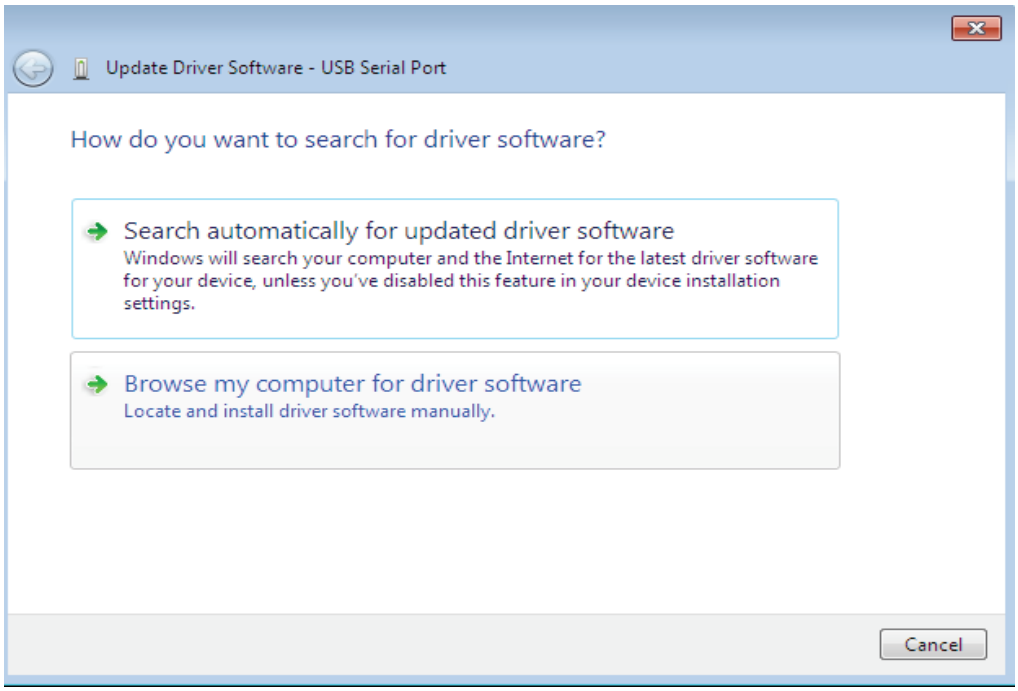


Right click on the other device (TTL232R in this example) to bring up a menu as shown below.

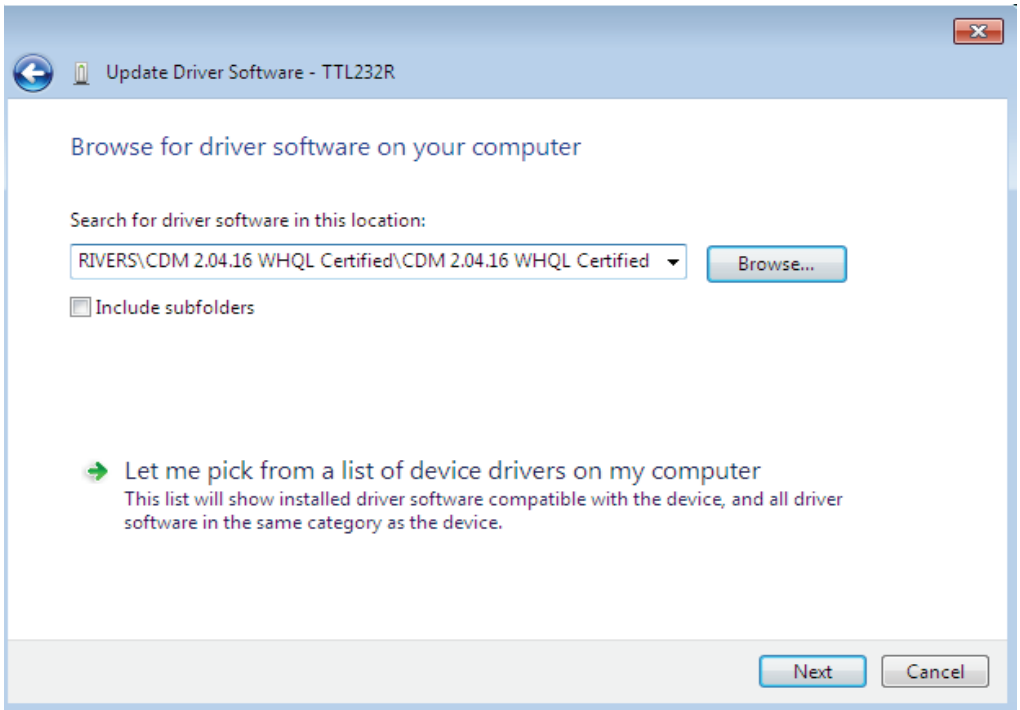


From the displayed menu select "Update Driver Software…"

This then displays the option for an automatic search or a manual search.

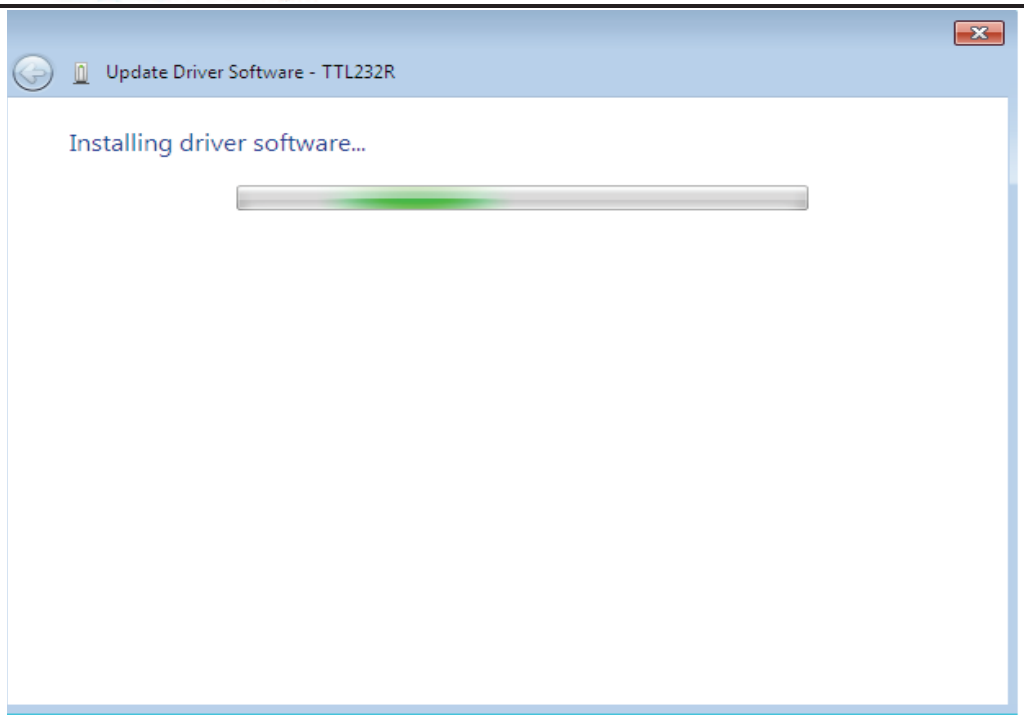


Select the second option to browse manually.

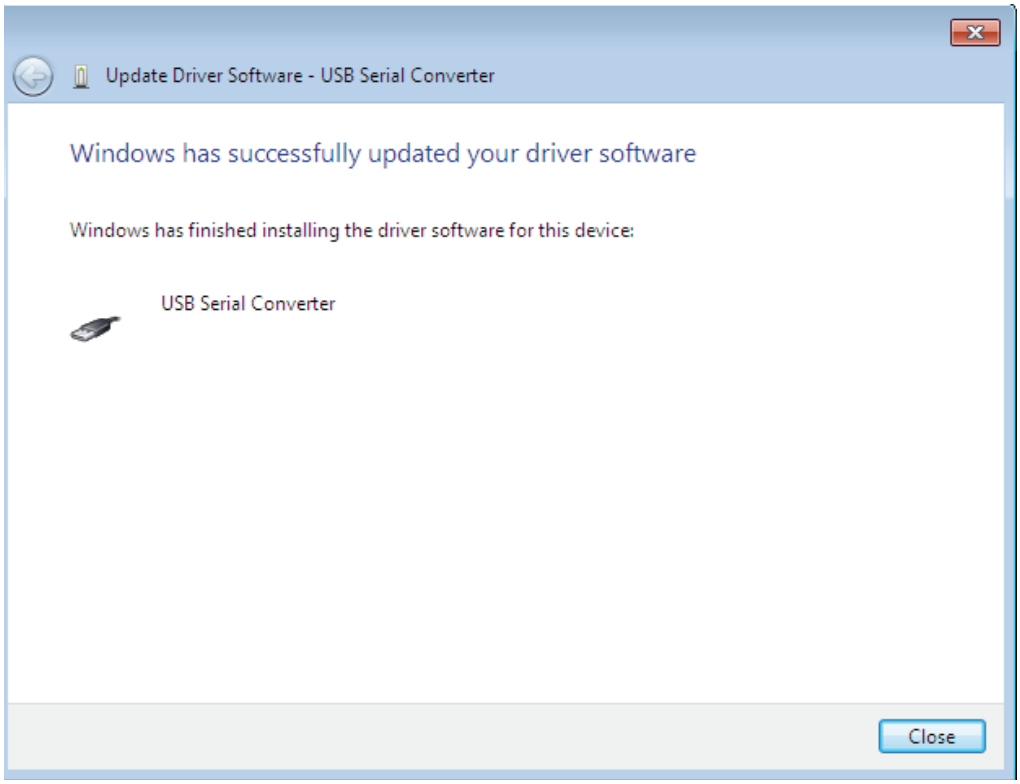


In the address box put the exact location where the drivers have been saved to. This may be on a CD or in a folder on the PC. It is not necessarily the exact same location as shown in the screenshot. The drivers could have been saved anywhere of the users choosing.

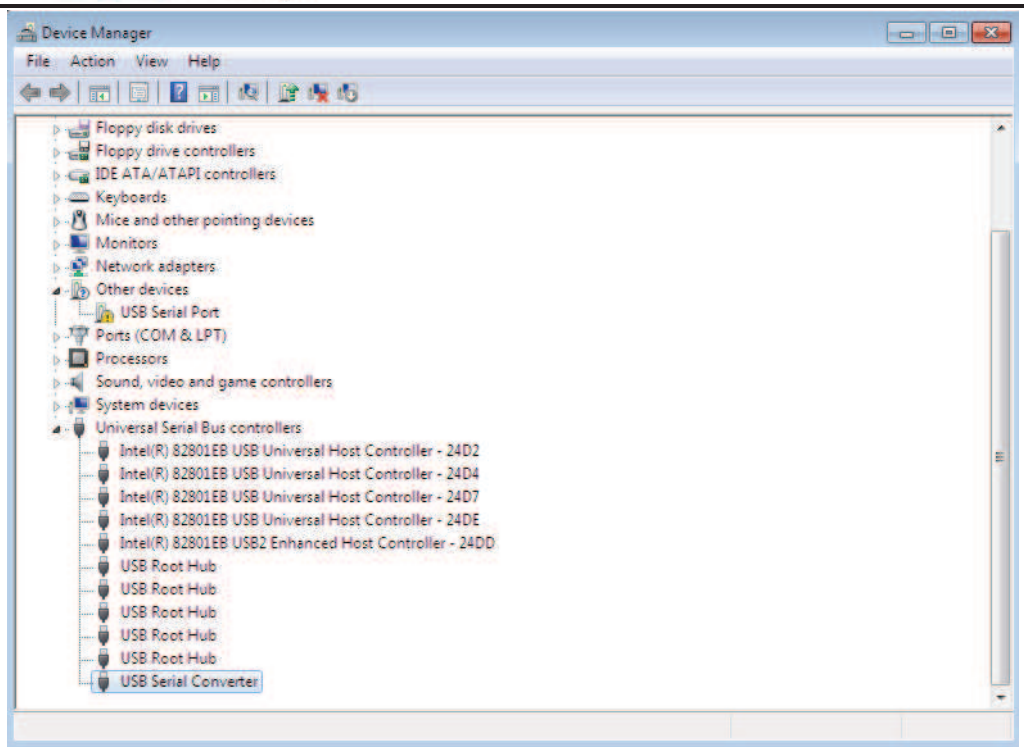
After entering the address select "NEXT" to start the installation.



When the installation has finished a completion screen is displayed.

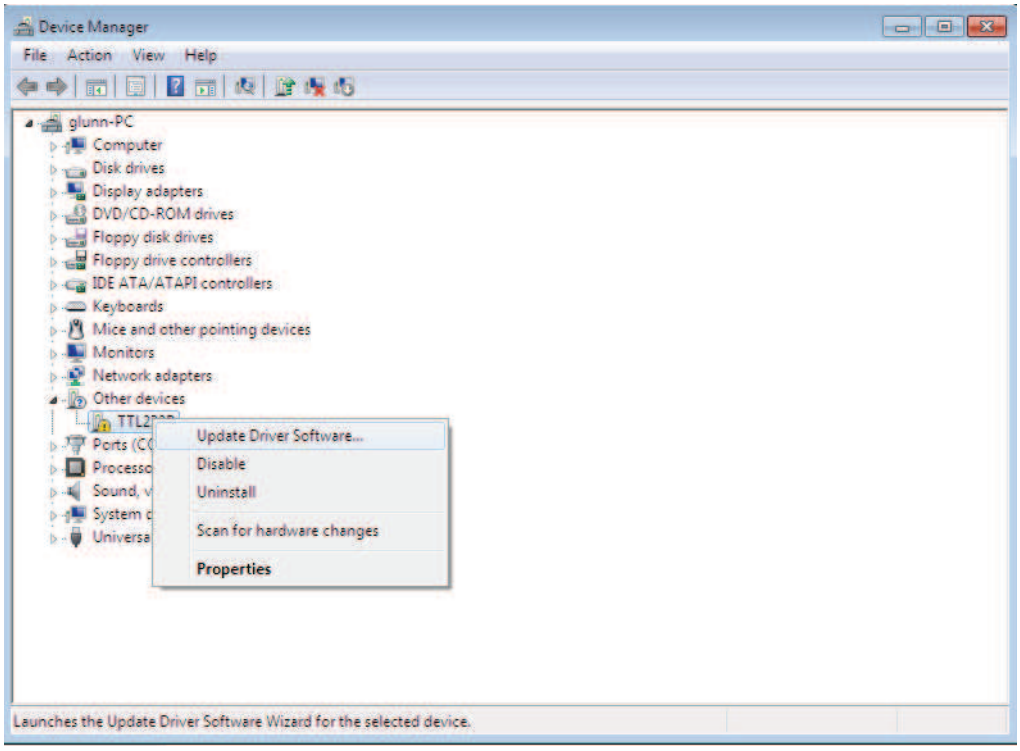


Press Close to close this window and go back to the Device Manager Window.



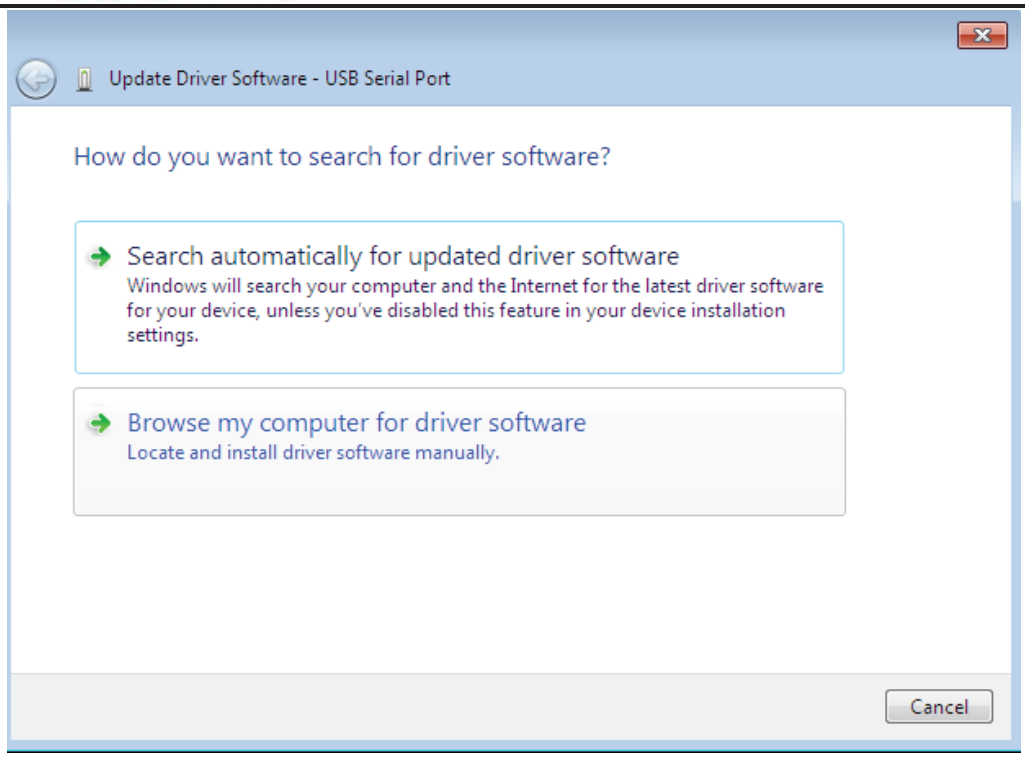
The Device Manager will still show a device under Other Devices but in addition to this there is a new entry under Universal Serial Bus Controllers indicated in the screenshot above as the USB Serial Converter. This indicates the bus layer of the driver is installed. Installing the Virtual Com Port layer of the driver is almost a repeat of the last few steps.

Right click on the other device (TTL232R in this example) to bring up a menu as shown below.

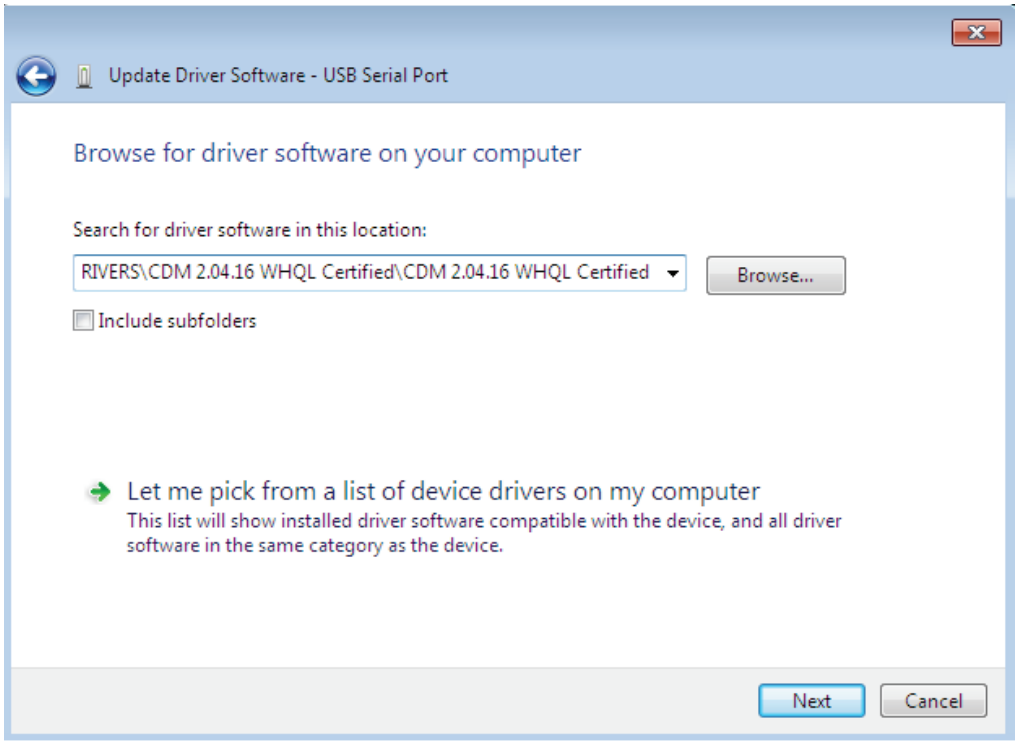


From the displayed menu select "Update Driver Software…"

This then displays the option for an automatic search or a manual search.

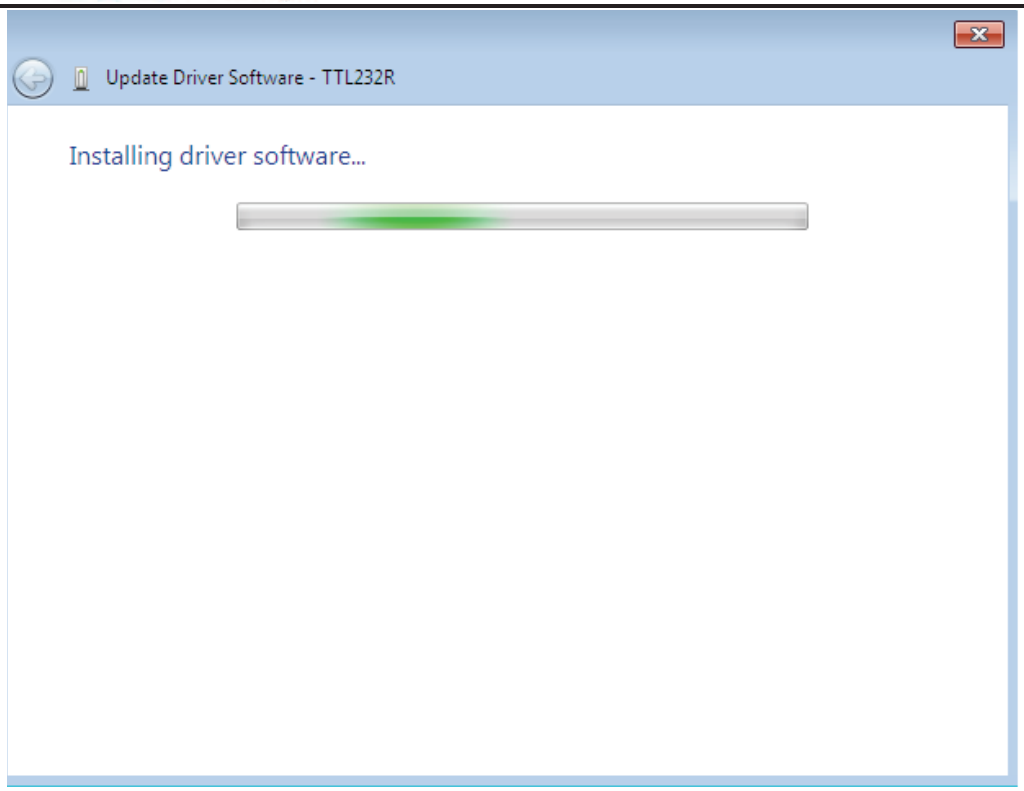


Select the second option to browse manually.

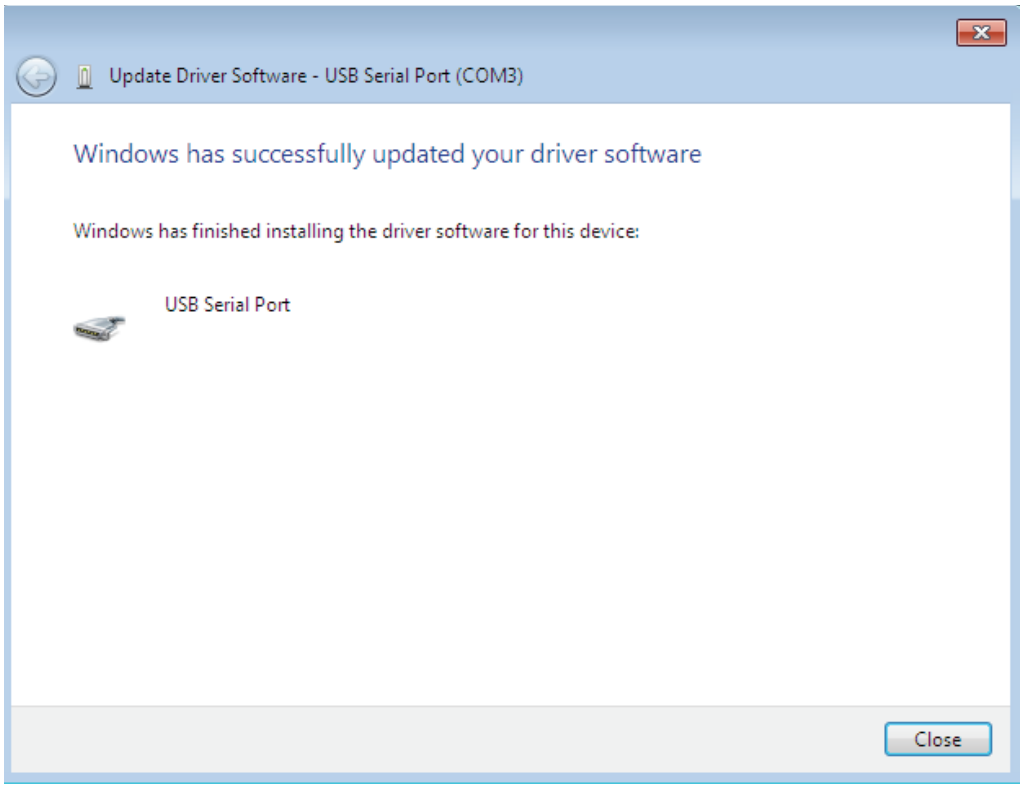


In the address box put the exact location where the drivers have been saved to. This may be on a CD or in a folder on the PC. It is not necessarily the exact same location as shown in the screenshot. The drivers could have been saved anywhere of the users choosing.

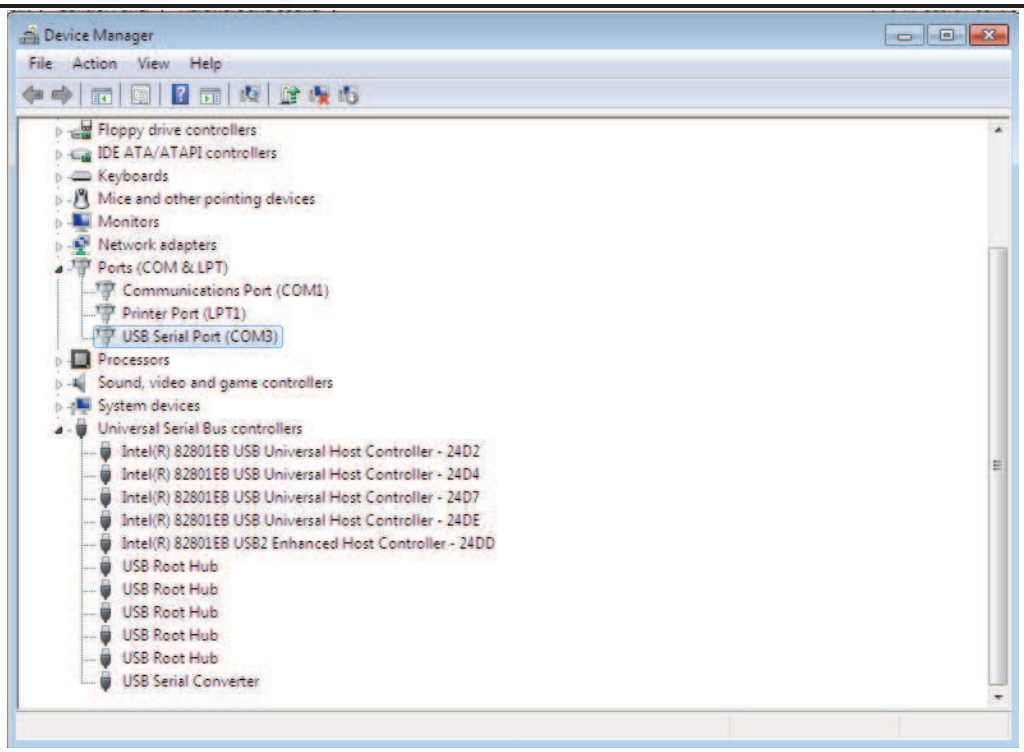
After entering the address select "NEXT" to start the installation.



When the installation is finished a completion screen is displayed.



Note this screen also displays the COM port assigned to the device.
Press Close to close this window and go back to the Device Manager Window.



This time the Device Manager does not have a TTL232R entry under Other Devices but does show entries under Universal Serial Bus Controllers and Ports (COM & LPT). The above screen shot displays a correct installation. The device is now ready to use on COM3.

NOTE: Not all devices will install to COM3. The COM port allocation is determined by the installation wizard on the basis of the next free com port as designated in the PC registry.

4 Uninstalling FTDI Devices

With the release of Microsoft Windows 7, the FTDI uninstaller has been rendered unusable due to Windows Resource Protection preventing the executable from deleting driver files and associated registry values. Windows 7 will only allow the system itself to modify files and registry values in these locations.

Devices can be removed using the Device Manager by simply right-clicking on the mouse and selecting "Uninstall".This will delete the associated registry entries for that device only. Windows 7 provides an automatic method to delete driver files via a check box to "Delete the driver software for this device" on the uninstall dialog box.

This stage is done twice. Once for the device under Ports(COM & LPT) and once for the device under Universal Serial Bus Controllers.

Windows 2000, XP and Server 2003 do not have this check box, so driver files and OEM INF and PNF files must be removed manually or by using a custom application.

Some points to note about the new un-installation method:

- In the case of FT2232 / FT4232 devices, a composite device is also installed. This can also be removed by right-clicking and selecting "Uninstall". There is no option to delete the driver files when doing this as the driver for the composite device is a native Windows driver.
- If the VCP driver has been installed, the COM port driver should be uninstalled before the bus driver. If the bus is removed first, the COM port will no longer appear in the Device Manager.
- If the files are deleted while other installed devices still require them those devices will not work correctly. This can be fixed by right clicking the device and selecting "Reinstall Driver" which will replace the missing files.
- If a device to be uninstalled is not connected to the PC, the device can still be removed by setting the device manager to show phantom devices . This also allows a virtual COM port to be uninstalled if the bus layer has been removed first.

5 Troubleshooting

5.1 Windows 7 cannot find drivers for my device

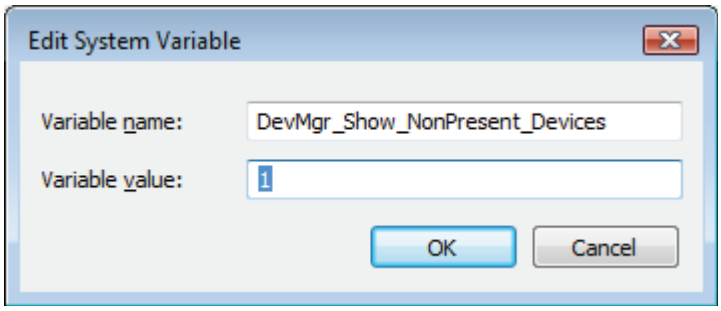
This error can occur if the VID and PID programmed into the device EEPROM do not match those listed in the INF files for the driver. The VID and PID programmed into the device EEPROM may be found by using the USBView utility from the FTDI web site. These can then be checked against the VID and PID entries in the driver INF files. If they do not match, that driver cannot be installed for that device without either re-programming the device EEPROM or modifying the list of VID and PID numbers in the INF files. Please note that only your own company VID and PID or FTDI's VID (0x0403) and FTDI PID issued for use by the customer should be used in the EEPROM and INF files.

End customers should obtain modified drivers from the OEM of the device, and not necessarily edit the files themselves.

5.2 Devices not shown in Device Manager for uninstalling

Devices that have been installed on a system but are not currently available are referred to as "phantom devices". These devices are not usually displayed in the device manager, but can be made to be displayed as though they are attached. This allows device properties to be changed or devices to be uninstalled via Device Manger even though the device is not physically connected to the PC.

To display phantom devices in Device Manager, a new system variable is required. Open "Control Panel > System" then select the "Advanced" tab and click "Environment Variables". In the System Variables section (**NOT THE USER VARIABLES SECTION**), click "New..." to display the following window:

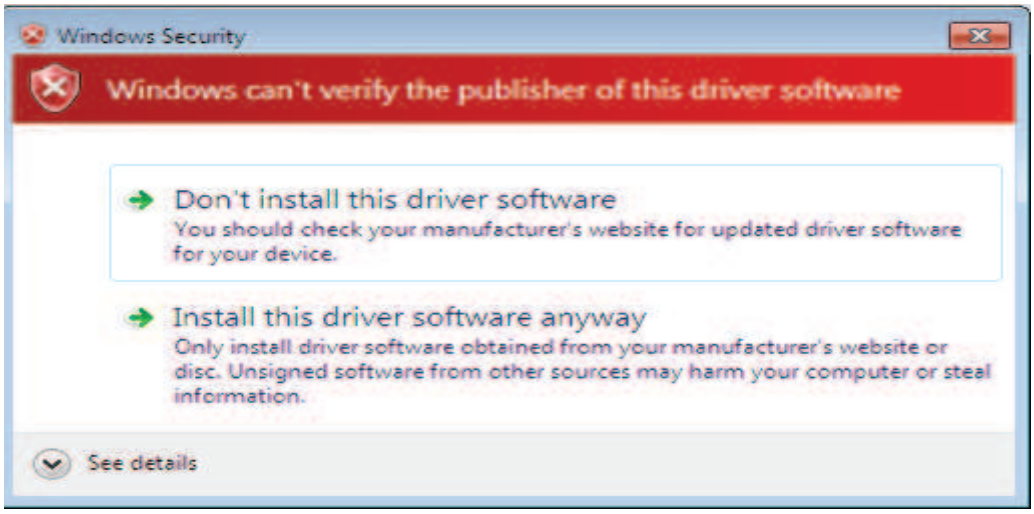


Create a new System Variable called "DevMgr_Show_NonPresent_Devices" and set the value to 1, then click OK.

Open the Device Manager ("Control Panel > System" then select the "Hardware" tab and click "Device Manager…", or "Control Panel > Device Manger" in Windows 7) and select "View > Show Hidden Devices". Device Manager will then show all hidden and phantom devices available on that PC as shaded.

5.3 Windows 7 shows a warning that the driver is not certified

If the driver is not certified then a pop up window such as shown below will be displayed.



If you are certain of the source of the driver the warning can be ignored and you can continue installation by selecting "Install this driver software anyway".

If you are unsure about the driver source contact your vendor.

5.4 Driver will not install on Windows 7 x64

Windows 7 x64 OS will only allow certified drivers to be installed. The certified driver supplied by FTDI will work with VID 0403 and PID 6001 for FT232 and FT245 devices. It will also work with VID 0403 and PID 6010 for FT2232 devices and VID 0403 and PID 6011 for FT4232.

If you have a product where the manufacture has customised the driver but has not re-certified it, then the driver will not load. You should contact your vendor to determine if they will support Windows 7 x64.

6 Contact Information

Head Office – Glasgow, UK

Future Technology Devices International Limited
Unit 1, 2 Seaward Place,
Centurion Business Park
Glasgow G41 1HH
United Kingdom

Tel: +44 (0) 141 429 2777
Fax: +44 (0) 141 429 2758

E-mail (Sales) sales1@ftdichip.com
E-mail (Support) support1@ftdichip.com
E-mail (General Enquiries) admin1@ftdichip.com
Web Site URL http://www.ftdichip.com
Web Shop URL http://www.ftdichip.com

Branch Office – Taipei, Taiwan

Future Technology Devices International Limited (Taiwan)
2F, No 516, Sec. 1 NeiHu Road
Taipei 114
Taiwan, R.O.C.
Tel: +886 (0) 2 8797 1330
Fax: +886 (0) 2 8751 9737

E-mail (Sales) tw.sales1@ftdichip.com
E-mail (Support) tw.support1@ftdichip.com
E-mail (General Enquiries) tw.admin1@ftdichip.com
Web Site URL http://www.ftdichip.com

Branch Office – Hillsboro, Oregon, USA

Future Technology Devices International Limited (USA)
7235 NW Evergreen Parkway, Suite 600
Hillsboro, OR 97123-5803
USA
Tel: +1 (503) 547 0988
Fax: +1 (503) 547 0987

E-Mail (Sales) us.sales@ftdichip.com
E-Mail (Support) us.support@ftdichip.com
Web Site URL http://www.ftdichip.com

Branch Office – Shanghai, China

Future Technology Devices International Limited (China)
Room 408, 317 Xianxia Road,
ChangNing District,
ShangHai, China

Tel: +86 (21) 62351596
Fax: +86(21) 62351595

E-Mail (Sales): cn.sales@ftdichip.com
E-Mail (Support): cn.support@ftdichip.com
E-Mail (General Enquiries): cn.admin1@ftdichip.com
Web Site URL: http://www.ftdichip.com

Distributor and Sales Representatives

Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) and sales representative(s) in your country.

Appendix A – Abbreviations

Terms	Description
PID	Product ID, a unique product identification issued by the holder of the
VID	Vendor ID, a unique vendor identification number issued by the USB
USB	USB Universal Serial Bus
WHQL	WHQL Microsoft Windows® Hardware Quality Labs
OS	Operating System

Appendix B – Revision History

Version 0.1	First Draft	21/08/2009
Version 1.0	First Release	29/10/2009

