



# Tracer™ TD7 with UC 800



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# Table of Contents

General Recommendations .....	3
Installer-Supplied Components / Interconnecting Wiring .....	5
Installer-Supplied Components .....	5
Interconnecting Wiring .....	5
Pump relay Operation for multi-pipe unit .....	5
Programmable Relays .....	7
Relay Assignments Using .....	8
Tracer™ TU .....	8
Low Voltage Wiring / Ice Making (Optional) .....	9
Low Voltage Wiring .....	9
Ice Making (Optional) .....	9
External setpoints & capacity outputs (Optional) .....	11
External Chilled Water Setpoint (ECWS) .....	11
External Current Limit Setpoint (ECLS) .....	12
ECWS and ECLS Analog Input Signal Wiring Details .....	13
Chilled Water Reset (CWR) .....	14
Functional Description .....	14
Diagnostic .....	17
Smart Communication Protocol .....	18
LonTalk™ Interface (LCI-C) .....	18
BACnet Interface (BCNT) .....	18
BACnet Testing Laboratory (BTL) Certification .....	18
ModBus RTU Interface .....	18
Wiring and Port Descriptions for MODBUS, BACnet and LonTalk .....	19
Smart Com protocol .....	19
Rotary Switches .....	19
LED Description and Operation .....	20
Tracer TD7 Operator Interface .....	21
Tracer™ TU .....	22

# General Recommendations

As you review this manual, keep in mind that:

- All field-installed wiring must conform to European guidelines and any applicable local codes. Be sure to satisfy proper equipment grounding requirements per European guidelines.
- Compressor motor and unit electrical data (including motor kW, voltage utilization range, rated load amps) is listed on the chiller nameplate.
- All field-installed wiring must be checked for proper terminations, and for possible shorts or grounds.

**Note:**

*Always refer to wiring diagrams shipped with unit submittal for specific electrical schematic and connection information.*

**WARNING:**

Proper field wiring and grounding required!

All field wiring **MUST** be performed by qualified personnel.

Improperly installed or improperly grounded machines can cause FIRE and ELECTROCUTION hazards.

To avoid these hazards, you **MUST** follow requirements in local electrical codes.

Failure to follow code could result in death or serious injury.

**WARNING:**

Hazardous voltage w/capacitors!

Disconnect all electric power, including remote disconnects and discharge all motor start/run and AFD (Adaptive Frequency™ Drive) capacitors before servicing.

Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized.

- For variable frequency drives or others energy storing component provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged.
- DC bus capacitors retain hazardous voltages after input power has been disconnected. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. After disconnecting input power, wait five (5) minutes for units which are equipped with EC fans and wait twenty (20) minutes for units which are equipped with variable frequency drive (0V DC) before touching any internal components.

Failure to follow these instructions could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see "[Adaptive Frequency™ Drive \(AFD<sub>3</sub>\) Capacitor Discharge](#)," and BAS-SVX19\*.

**WARNING!**

**Hazardous Voltage - Pressurized Burning Fluid:**

Before removing compressor terminal box cover for servicing, or servicing power side of control panel, CLOSE COMPRESSOR DISCHARGE SERVICE VALVE and disconnect all electric power including remote disconnects. Discharge all motor start/run capacitors. Follow lockout/tagout procedures to ensure the power cannot be inadvertently energized. Verify with an appropriate voltmeter that all capacitors have discharged.

The compressor contains hot, pressurized refrigerant. Motor terminals act as a seal against this refrigerant. Care should be taken when servicing NOT to damage or loosen motor terminals.

Do not operate compressor without terminal box cover in place. Failure to follow all electrical safety precautions could result in death or serious injury.

For additional information regarding the safe discharge of capacitors, see "[Adaptive Frequency™ Drive \(AFD<sub>3</sub>\) Capacitor Discharge](#)," and BAS-SVX19\*.

**NOTICE:**

Use Copper Conductors Only!

Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors could result in equipment damage.

**Important:**

To prevent control malfunctions, do not run low voltage wiring (<30 V) in conduit with conductors carrying more than 30 volts.

## General Recommendations

### WARNING!

#### Discharge Time:

Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect AC mains, any permanent magnet type motors, and any remote DC link power supplies, including battery backups, UPS and DC-link connections to other frequency converters. Wait for the capacitors to fully discharge before performing any service or repair work. The amount of wait time is listed in the Discharge Time table. Failure to wait the specified time after power has been removed before doing service or repair could result in death or serious injury.

**Table 1 – Capacitor Discharge Times**

Voltage	Power	Minimum waiting time [min]
380 – 500 V	90 – 250 kW	20
	315 – 800 kW	40

# Installer-Supplied Components / Interconnecting Wiring

## Installer-Supplied Components

Customer wiring interface connections are shown in the electrical schematics and connection diagrams that are shipped with the unit. The installer must provide the following components if not ordered with the unit:

- Power supply wiring (in conduit) for all field-wired connections.
- All control (interconnecting) wiring (in conduit) for field supplied devices.
- Fused-disconnect switches or circuit breakers.

## Interconnecting Wiring

### Chilled Water Pump Control

#### NOTICE:

Equipment Damage!

If the microprocessor calls for a pump to start and water does not flow, the evaporator may be damaged catastrophically. It is the responsibility of the installing contractor and/or the customer to ensure that a pump will always be running when called upon by the chiller controls.

An evaporator water pump output relay closes when the chiller is given a signal to go into the Auto mode of operation from any source. The contact is opened to turn off the pump in the event of most machine level diagnostics to prevent pump overheat.

The relay output is required to operate the Evaporator

Water Pump (EWP) contactor. and Heat recovery Water Pump (HRWP) (multipipe unit) Contacts should be compatible with 115/240 VAC control circuit. Normally, the EWP/HRWP relay follows the AUTO mode of the chiller. Whenever the unit has no diagnostics and is in the AUTO mode, regardless of where the auto command is coming from, the normally open relay is energized. When the unit exits the AUTO mode, the relay is timed to open in an adjustable (using TU or TD7) 0 to 30 minutes.

The non-AUTO modes, in which the pumps are stopped, includes Reset, Stop, External Stop, Remote Display Stop, Stopped by Tracer, Start Inhibited by Low Ambient Temp, and Ice Making complete (if applicable).

**Table 2 – Pump relay operation**

Chiller Mode	Relay Operation
Auto	Instant Close
Ice Making	Instant Close
Tracer Override	Close
Stop	Timed Open
Ice Complete	Instant Open
Diagnostics	Instant Open

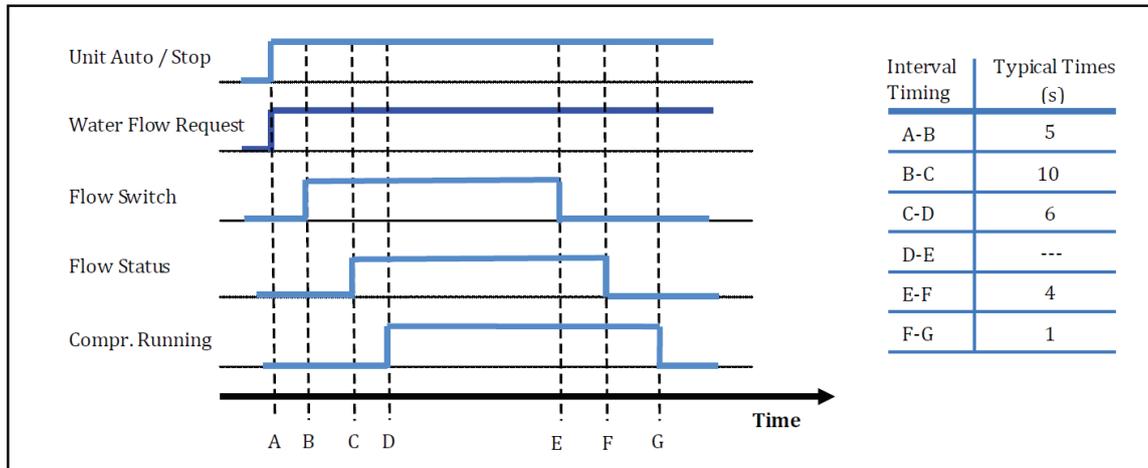
When going from Stop to Auto, the Evaporator Water Pump relay is energized. Water flow switch is activating, and flow status information back after 15 seconds.

## Pump relay Operation for multi-pipe unit

Priority mode	Evaporator Pump command	Heat Recovery Pump command
Cooling Only	Active	OFF
Heating Only	OFF	Active
Cooling Priority	Active	Active
Heating Priority	Active	Active
Heat Recovery Priority	Active	Active
Max Capacity Priority	Active	Active

Unit mode	Evaporator or Heat recovery Pump Relay
Auto	Active
Tracer Override	OFF
Stop	Active
Diagnostic	Active

## Installer-Supplied Components / Interconnecting Wiring



If water flow is not established in 20 minutes (for normal transition), the UC800 de-energizes the Pump relay and generates a non-latching diagnostic. If flow returns (e.g. someone else is controlling the pump), the diagnostic is cleared, the Pump is re-energized, and normal control resumed.

If evaporator water flow is lost once it had been established, the EWP relay remains energized and a non-latching diagnostic is generated. If flow returns, the diagnostic is cleared and the unit returns to normal operation. In general, when there is either a non-latching or latching diagnostic, the Pump relay is turned off as though there was a zero time delay. Exceptions whereby the relay continues to be energized occur with:

- Low Water Temp. diagnostic (non-latching) (Unless also accompanied by a Leaving Water Temperature Sensor Diagnostic)  
OR
- Loss of Water Flow diagnostic (non-latching) and the unit is in the AUTO mode, after initially having proven water flow.

### Lead Lag Dual Pump

The running pump is changed each time the unit is switched on.

# Programmable Relays

A programmable relay concept provides for enunciation of certain events or states of the chiller, selected from a list of likely needs, while only using four physical output relays, as shown in the field wiring diagram.

The four relays are provided (generally with a Quad Relay Output LLID) as part of the Programmable Relay Option. The relays contacts are isolated Form C (SPDT), suitable for use with 120 VAC circuits drawing up to 2.8 amps inductive, 7.2 amps resistive, or 1/3 HP and for 240 VAC circuits drawing up to 0.5 amp resistive.

The list of events/states that can be assigned to the programmable relays can be found in Table (...) Chiller events/ Status description. The relay will be energized when the event/state occurs.

**Table 3 – Chiller event/status descriptions**

<b>Alarm - Latching</b>	This output is true whenever there is any active latching shutdown diagnostic that targets the Unit, Circuit, or any of the Compressors on a circuit.
<b>Alarm - NonLatching</b>	This output is true whenever there is any active non-latching shutdown diagnostic that targets the Unit, Circuit, or any of the Compressors on a circuit.
<b>Alarm</b>	This output is true whenever there is any active latching or non-latching shutdown diagnostic that targets the Unit, Circuit, or any of the Compressors on a circuit.
<b>Alarm Ckt x</b>	This output is true whenever there is any active latching or non-latching shutdown diagnostic that targets Circuit x, or any of the Compressors on Circuit x.
<b>Unit Limit Mode</b>	This output is true whenever a circuit on the unit has been running in one of the limit modes continuously for the Limit Relay debounce time. A given limit or overlapping of different limits must be in effect continuously for the debounce time prior to the output becoming true. It will become false if no limits are present for the debounce time.
<b>Compressor Running</b>	The output is true whenever any compressor is running.
<b>Circuit x Running</b>	The output is true whenever any compressor of Circuit x is running.
<b>Ice Building</b>	This output is true when Ice Building status is active.
<b>Maximum Capacity</b>	The output is true whenever the unit has reached maximum capacity continuously for the Max Capacity Relay s time. The output is false when the unit is not at maximum capacity continuously for the filter time.
<b>Evaporator Water Freeze Avoidance Request</b>	This relay output is energized any time either the Low Evaporator Water Temperature – Unit Off or the Low Evaporator Temperature Ckt x – Unit Off diagnostics are active. This relay is intended for use as an external interlock for a field engineered and provided solution to mitigate the freeze danger implied by these diagnostics. Generally, this would be used in cases where operation of the evaporator water pump is unacceptable due to the system constraints, (i.e. such as mixing unconditioned warm water with controlled supply water as provided by other parallel chillers. The relay's output can provide the method to close bypass valves so the circulation becomes local to the evap and excludes the load, or can be used to defeat the evap pump override entirely while initiating an independent source of heat / flow to the evap.
<b>None:</b>	On Multi-pipe units, it mandatory to connect Evaporator Freeze avoidance relay output to pump or valve that rapidly establish evaporator water flow even if unit is in AUTO mode.  This selection is desirable to provide an easy way for a customer to defeat the effect of the relay, if it has already been wired. For instance, if the relay was normally programmed as an "alarm" relay, and was wired to a claxon, it may be desirable to temporarily defeat the feature without changing wiring.
<b>Service request (for Unit, Compressor(s) or water pump):</b>	This relay will be energized when at least one Maintenance alert condition (refer to Service required message specification) occurs, as long as at least one of associated informational diagnostic(s) will be active.

## Warning

The output is true whenever there is any active warning diagnostic that is associated with the Unit, Circuit, or any of the compressors on a circuit.



# Relay Assignments Using

## Tracer™ TU

Tracer™ TU ServiceTool is used to install the Programmable Relay Option package and assign any of the above lists of events or status to each of the four relays provided with the option. (See “Tracer™ TU;” for more information on the TracerTU service tool) The relays to be programmed are referred to by the relay’s terminal numbers on the LLID board 1A10.

The eight available relays in the Alarm Package Option are assigned with the following defaults as follows:

**Table 4 – Alarm Package Relay option Default assignments**

LLID Name	LLD Software Relay Designation	Output Name	Default
Operating Status Programmable Relays Module 1	Relay 0	Status Relay 1, J2-1,2,3	Evaporator Water Freeze Avoidance Request
	Relay 1	Status Relay 2, J2-4,5,6	Maximum Capacity
	Relay 2	Status Relay 3, J2-7,8,9	Compressor Running
	Relay 3	Status Relay 4, J2-10,11,12	Latching Alarm
Operating Status Programmable Relays Module 2	Relay 4	Status Relay 5, J2-1,2,3	Alarm Ckt 2
	Relay 5	Status Relay 6, J2-4,5,6	Alarm Ckt 1
	Relay 6	Status Relay 7, J2-7,8,9	Alarm (Latching or Non latching)
	Relay 7	Status Relay 8, J2-10,11,12	Non Latching Alarm

If any of the Alarm/Status relays are used, provide electrical power, 115 VAC with fused-disconnect to the panel and wire through the appropriate relays (terminals on 1A10). Provide wiring (switched hot, neutral, and ground connections) to the remote annunciation devices. Do not use power from the chiller’s control panel transformer to power these remote devices. Refer to the field diagrams which are shipped with the unit.

# Low Voltage Wiring / Ice Making (Optional)

## Low Voltage Wiring

The remote devices described below require low voltage wiring. All wiring to and from these remote input devices to the Control Panel must be made with shielded, twisted pair conductors. Be sure to ground the shielding only at the panel.

### Important:

To prevent control malfunctions, do not run low voltage wiring (<30 V) in conduit with conductors carrying more than 30 volts.

### Emergency Stop

UC800 provides auxiliary control for a customer specified/installed latching trip out. When customer furnished remote contact 6S2, the chiller will run normally when the contact is closed. When the contact opens, the unit will stop and a manually resettable diagnostic is generated. This condition requires manual reset at the chiller switch on the front of the control panel.

This customer-furnished contact must be compatible with 24 VDC, 12 mA resistive load.

### External Auto/Stop

If the unit requires external Auto/Stop function, the installer must provide remote contact 6S1.

The chiller will run normally when the contact is closed. When contact opens, the compressor(s), if operating, will go to the RUN: UNLOAD operating mode and cycle off. Unit operation will be inhibited. Closure of the contact will permit the unit to return to normal operation.

Field-supplied contacts for all low voltage connections must be compatible with dry circuit 24 VDC for a 12mA resistive load. Refer to the field diagrams that are shipped with the unit.

## Ice Making (Optional)

When the Ice Making Command is removed (i.e. all the installed Ice Making inputs are set to "auto"), the compressors shall be stopped after the run unload period (if not already stopped due to Ice Making Complete). The chiller shall return to normal Auto mode of operation, and allowed to restart only after enforcing a 2 minute delay called the "Ice to Normal Transition time". During this inhibit, the Evaporator water flow request shall be commanded on. After the delay, the chiller can restart again per the differential to start and the normal Chilled Water Setpoint (or Hot Water Setpoint – if in Heating Mode). The Ice To Normal Transition inhibit shall be annunciated as a Chiller Submode and a countdown timer showing the remaining time left shall be displayed.

### Ice Making Configuration:

Ice Making is configured through TU, and there shall be two installation options:

1. Not Installed
2. Installed with Hardware

### Ice Making: Not Installed

If the Ice Building Configuration item is set to 'Not Installed', the application will not build the Ice Making objects, and will require none of the Ice Making specific LLIDS.

### Ice Making: Installed with Hardware

If the Ice Making Configuration item is set to 'Installed', the application will require the following LLIDs:

- External Ice Making Input (Dual Low Voltage Binary Input)

### Ice Making Setpoints:

After Ice Making is configured, there shall be three Ice Making Settings or Setpoints:

1. Ice Making Command
2. Ice Making Enable/Disable
3. Ice Making Termination Setpoint

The ice making setpoints can all be manipulated through TU. Some of the Setpoints can be manipulated with User Interface on the Display, the External Hardware Interface BAS (if a BAS is installed).

The setpoints associated with ice making are explained in more detail below.



## Ice Making (Optional)

### Ice Making Command

This is the command to enter ice making. This setting is defined as an Auto/On settings. Setting this to On will command the application into ice building if ice building is enabled and the Chiller is in the "Auto" command mode. Setting the Ice Making command to Auto will command the application to follow the next priority functional mode.

Regardless of the setting of the Setpoint Source (see setpoint arbitration.doc) any of the following 4 signals can combine to comprise the Ice Building Command (assuming they are each installed).

Contact closure input for External Ice Making Command Front Panel Ice Making Command (also writable from TU Lontalk Communicated Ice Making Command (LCI-C, BACnet, Modbus)

### Time of Day scheduler

All ice making signals have to be turned to "auto" to be able to turn back Ice Making Command to "Auto" mode.

The overall Ice Making Command, must be toggled from "Ice Making"; to "Auto" to "Ice Making" again, before Ice Making can be entered a second time.

### Ice Making Enable/Disable setting

This setting does not start or stop ice building. This is the command to enable or disable the entire ice building feature. It can only be set through the Display or TU. The Ice Making Command starts and stops ice building.

### Ice Making Termination setpoint

This setpoint controls when Ice Making is complete. If the Entering Water Temperature decreases below this setpoint with no deadband Ice Making will be deemed complete. This setpoint has a range of -6.7°C (20°F) to 0°C (32°F) with a default of -2.8°C (27°F).

Evaporator Application defines controls settings: if ICE is selected, Ice making is enabled. Specific hardware is required for ice making command input and ice making status relay output.

UC800 provides auxiliary control thanks to Ice Making Status Relay. The normally open contact will be closed when ice making is in progress and open when ice making has been normally terminated either through Ice Termination setpoint being reached or removal of the Ice Making command. This relay inform customer equipment with chiller mode changes from "ice making" to "ice complete".

When contact is provided, the chiller will run normally when the contact is open.

UC800 will accept either an isolated contact closure (External Ice Making command) or a Remote Communicated input (Tracer) to initiate and command the Ice Making mode.

UC800 also provides a "Front Panel Ice Termination Setpoint", settable through Tracer™ TU, and adjustable from 20 to 31°F (-6.7 to -0.5°C) in at least 1°F (1°C) increments.

### Note:

*When the unit runs in Ice Making mode, and the evaporator entering water temperature drops below the ice termination setpoint, the chiller terminates the Ice Making mode and changes to the Ice Making Complete Mode.*

### NOTICE:

Equipment Damage!

Freeze inhibitor must be adequate for leaving water temperature unless system components can be damaged.

Tracer™ TU must also be used to enable or disable Ice Machine Control. This setting does not prevent the Tracer from commanding Ice Making mode. Upon contact closure, the UC800 will initiate an ice making mode, in which the unit runs fully loaded at all times. Ice making shall be terminated either by opening the contact or based on the entering evaporator water temperature. UC800 will not permit the ice making mode to be entered again until the unit has been switched out of ice making mode.

If, while in ice making mode, the unit gets down to the freeze stat setting (water or refrigerant), the unit will shut down on a manually resettable diagnostic, just as in normal operation.

Connect leads to the proper terminals. Refer to the field diagrams which are shipped with the unit. This customer supplied contacts must be compatible with 24 VDC, 12 mA resistive load.

# External setpoints & capacity outputs (Optional)

## External Chilled Water Setpoint (ECWS)

The UC800 provides inputs that accept either 4-20 mA or 2-10 VDC signals to set the external chilled water setpoint (ECWS). This is not a reset function. The input defines the setpoint. This input is primarily used with generic BAS (building automation systems).

### Functional Description

When the unit is in cooling mode, the external water setpoint (EWS) will correspond to the chilled water setpoint. The external chilled water setpoint shall have a configurable minimum and maximum.

2-10 VDC and 4-20 mA shall each correspond to an EWS range with a configurable minimum and maximum EWS. The following relationships exist:

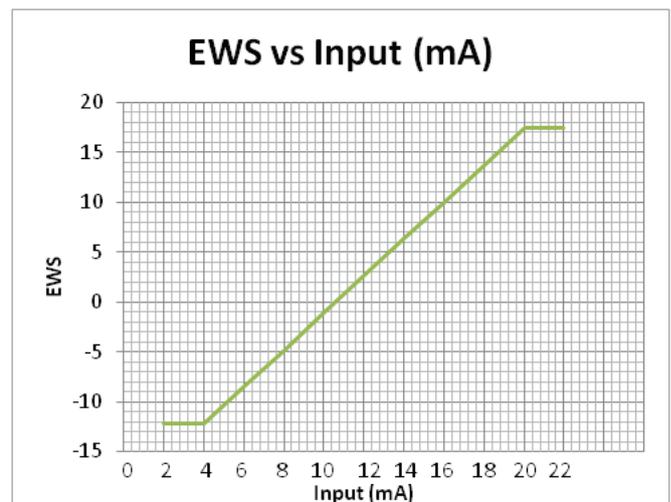
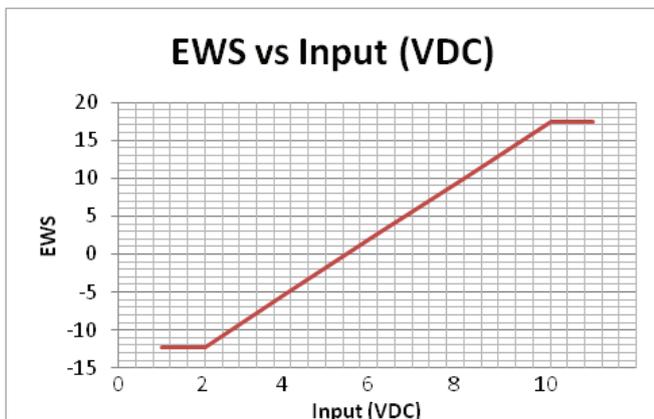
Input Signal	External Water Setpoint
< 1 VDC	Invalid
1 VDC to 2 VDC	min
2 VDC to 10 VDC	$\text{min} + (\text{max} - \text{min}) * \frac{(\text{Signal} - 2)}{8}$
10 VDC to 11 VDC	max
> 11 VDC	Invalid
< 2 mA	Invalid
2 mA to 4 mA	min
4 mA to 20 mA	$\text{min} + (\text{max} - \text{min}) * \frac{(\text{Signal} - 4)}{16}$
20 mA to 22 mA	max
> 22 mA	Invalid

If the ECWS input develops an open or short, the LLID will report either a very high or very low value back to the main processor. This will generate an informational diagnostic and the unit will default to using the Front Panel (TD7) Chilled Water Setpoint.

TracerTU ServiceTool is used to set the input signal type from the factory default of 2-10 VDC to that of 4-20 mA. TracerTU is also used to install or remove, enable or disable the External Chilled Water Setpoint.

### Examples

The following graphs are examples for min = -12.2°C and max = 18.3°C:



## External setpoints & capacity outputs (Optional)

### External Current Limit Setpoint (ECLS)

Like previously, either 2-10 VDC (default) or 4-20 mA inputs are available as option to set External Current Limit Setpoint. The Demand Limit Setting can also be set via the Tracer TD7 or through digital communication with Tracer (Comm4). The arbitration of the various sources of demand limit is described in the flow charts at the end of this section. The External Current Limit Setpoint may be changed from a remote location by hooking up the analog input signal to the 1A19 LLID terminals 5 and 6. Refer to the following paragraph on Analog Input Signal Wiring Details.

#### Functional Description

The UCM shall accept either a 2-10 VDC or 4-20 mA analog input suitable for customer connection to set the unit external current limit set point (ECLS).

2-10 VDC and 4-20 mA shall each correspond to a 60 to 120% RLA range for units using GP2 compressors and 50% to 100% for units using CHHC compressors. The following equations exist.

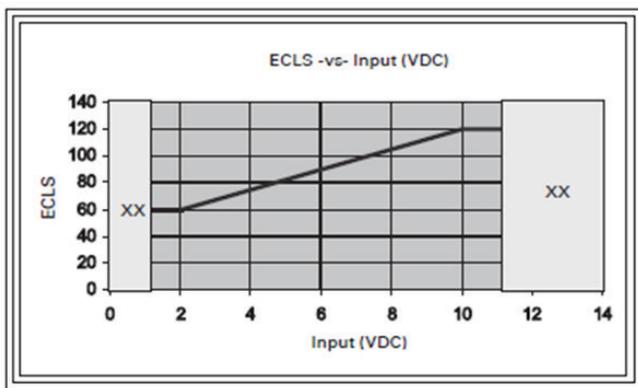
	Voltage Signal
As generated from external source	$V_{dc} = 0.133 * (\%) - 0.6$
As processed by UCM	$\% = 7.5 * (VDC) + 45.0$

	Current Signal
As generated from external source	$mA = 0.266 * (\%) - 12.0$
As processed by UCM	$\% = 3.75 * (mA) + 45.0$

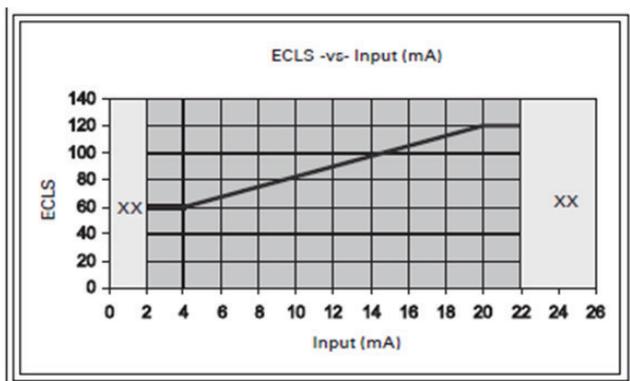
If the EDLS input develops an open or short, the LLID will report either a very high or very low value back to the main processor. This will generate an informational diagnostic and the unit will default to using the Front Panel (Tracer TD7) Demand Limit Setpoint.

The Tracer™ TU Service Tool must be used to set the input signal type from the factory default of 2-10 VDC to that of 4-20 mA current. Tracer TU must be also be used to install or remove the External Current Limit Setpoint Option for field installation, or can be used to enable or disable the feature (if installed).

#### Current limit Setpoint via 2-10 VDC signal



#### Current limit Setpoint via 4-20 mA signal



## External setpoints & capacity outputs (Optional)

### ECWS and ECLS Analog Input Signal Wiring Details

Both the ECWS and ECLS can be connected and setup as either a 2-10 VDC (factory default), 4-20 mA, or resistance input (also a form of 4-20mA) as indicated below. TracerTU must be used to set Analog Input Signal LLID type.

This is done by a setting change on the Custom Tab of the Configuration View within TracerTU.

#### Priority

When Not Installed, external chilled water setpoint analog input, external demand limit setpoint analog input and auxiliary binary input setpoint enable will not be used (Front panel or BAS sources used, depending which one is valid).

Setpoint Source selections are: BAS/Ext/FP, Ext/FP, or Front Panel.

When Installed, both analog I/O and binary will be used, with respect of following status:

- External chilled water setpoint: IF it is the highest priority and it is a valid source THEN use this external setpoint for active chilled water setpoint.
- External demand limit setpoint: IF it is the highest priority and it is a valid source THEN use this external setpoint for active demand limit setpoint.
- External auxiliary chilled water setpoint enable input: IF setpoint source is set to external/Front Panel or Front Panel THEN:
  - IF input open, use the next highest priority setpoint source (see priority list below)
  - IF input closed, use the auxiliary chilled water setpoint

Note on auxiliary chilled water setpoint source:

- Not Installed: auxiliary chilled water setpoint not used
- Front Panel: front panel auxiliary chilled water setpoint used instead of front panel chilled water setpoint
- External: the setpoint used will depend on binary input state.

Priority (from highest to lowest):

- BAS communication (Bacnet, Lonworks or Modbus)
- Ice Making
- External setpoints
- Front Panel setpoints

#### Important:

For proper unit operation, BOTH the ECLS and ECWS settings MUST be the same (2-10 VDC or 4-20mA), even if only one input is to be used.



# Chilled Water Reset (CWR)

## Functional Description

The UC800 shall reset the chilled water temperature setpoint based on return water temperature or outdoor air temperature. The Return Reset and Outdoor Reset functions are standard.

The chilled water reset settings are as follows:

1. Reset Type – The following options are selectable: No Chilled Water Reset, Outdoor Air Temperature Reset, Return Water Temperature Reset, or Constant Return Water Temperature Reset.
2. Reset Ratio – For Outdoor Air Temperature Reset, both positive and negative reset ratios will be allowed.
3. Start Reset
4. Maximum Reset – The maximum resets shall be with respect to the chilled water setpoint.

All parameters shall be factory set to a pre determined set of values. Field adjustment of two, three and four above is expected to be very infrequent. Pre determined factory settings shall be set for all Reset Types.

Variable definitions:

CWS – Arbitrated chilled water setpoint, before any reset has occurred

CWS' – Active chilled water setpoint, includes the effect of chilled water reset

CWR – Amount of chilled water reset (also called Degrees of Reset).

The above quantities are related by the equation:

$$CWS' = CWS + CWR$$

or

$$CWR = CWS' - CWS$$

With the chiller running and any type of chilled water reset enabled, CWR is allowed to change at a maximum rate of -17.2°C every 5 minutes until the actual CWR equals the desired CWR. When the chiller is not running, actual CWR shall be set equal to the desired CWR within one minute (no maximum rate is in effect).

If Chilled Water Reset is disabled, desired CWR is 0.

Additional variable definitions:

RESET RATIO – User adjustable gain

START RESET – User adjustable reference

TOD – Outdoor air temperature

TWE – Evaporator entering water temperature

TWL – Evaporator leaving water temperature

MAXIMUM RESET – User adjustable limit providing the maximum amount of reset.

The equations for each type of reset:

### **Outdoor Air Temperature Reset**

$$CWR = \text{RESET RATIO} * (\text{START RESET} - \text{TOD})$$

With limits:

$$CWR \geq 0$$

$$CWR \leq \text{Maximum Reset}$$

### **Return Water Temperature Reset**

$$CWR = \text{RESET RATIO} * (\text{START RESET} - (\text{TWE} - \text{TWL}))$$

With limits:

$$CWR \geq 0$$

$$CWR \leq \text{Maximum Reset}$$

### **Constant Return Water Temperature Reset**

$$CWR = 100\% * (\text{Design Delta Temperature} - (\text{TWE} - \text{TWL}))$$

With limits:

$$CWR \geq 0$$

$$CWR \leq \text{Design Delta Temperature}$$

## Chilled Water Reset (CWR)

### Using the Equations for calculating CWR

Notes for doing calculations:

Equation used to get Degrees of Reset:

Outdoor Air:

$$\text{Degrees of Reset} = \text{Reset Ratio} * (\text{Start Reset} - \text{TOD})$$

Return Reset:

$$\text{Degrees of Reset} = \text{Reset Ratio} * (\text{Start Reset} - (\text{TWE} - \text{TWL}))$$

Const Return:

$$\text{Degrees of Reset} = 100\% * (\text{Design Delta Temp} - (\text{TWE} - \text{TWL}))$$

To obtain Active CWS from Degrees of Reset:

$$\text{Active CWS} = \text{Degrees of Reset} + \text{Arbitrated CWS}$$

Note: Arbitrated CWS can either be Front Panel, BAS, or External

Reset Ratio calculation:

The Reset Ratio on the User Interface is displayed as a percentage. To use it in the above equation it must be converted to its decimal form.

$$\text{Reset Ratio percent} / 100 = \text{Reset Ratio decimal}$$

Example of converting Reset Ratio:

If the Reset Ratio displayed on the User Interface is 50% then use  $(50/100) = .5$  in the equation

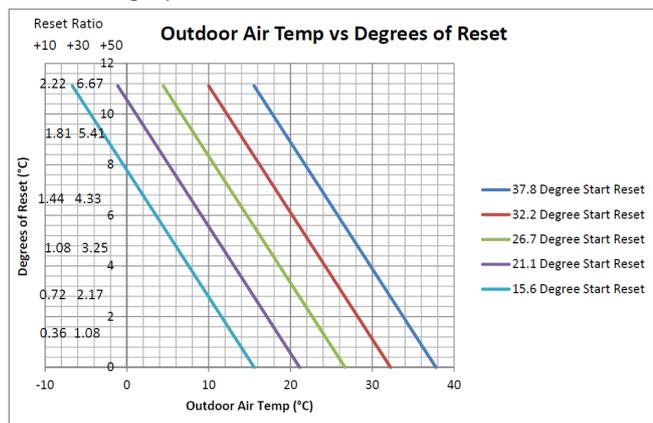
TOD = Outdoor Air Temp

TWE = Evap Entering Water Temp

TWL = Evap Leaving Water Temp

The following graph shows the reset function for Outdoor Air Temp:

Note: This graph assumes that Maximum Reset is set to 11.11 °C



Example of Calculating Reset for Outdoor Air Temp:

If:

Reset Ratio = 35%

Start Reset = 26.67 °C

TOD = 18.33 °C

Maximum Reset = 5.83 °C

How many Degrees of Reset will there be?

$$\text{Degrees of Reset} = \text{Reset Ratio} * (\text{Start Reset} - \text{TOD})$$

$$\text{Degrees of Reset} = .35 * (26.67 - 18.33)$$

$$\text{Degrees of Reset} = 2.92$$



## Chilled Water Reset (CWR)

If:

Reset Ratio = -70%  
 Start Reset = 32.22 °C  
 TOD = 37.77°C  
 Maximum Reset = 9.44 °C

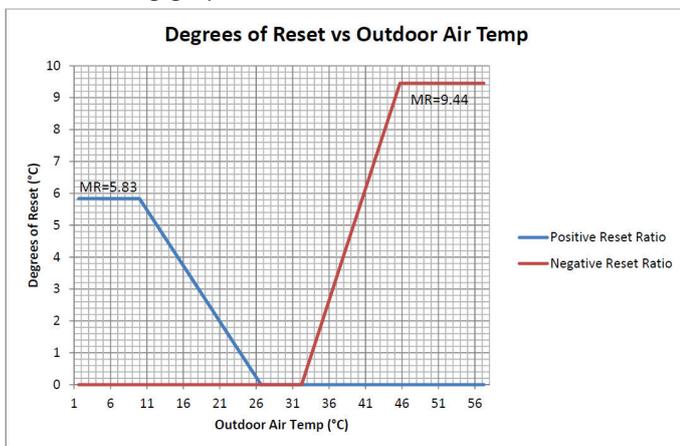
How many Degrees of Reset will there be?

Degrees of Reset = Reset Ratio\*(Start Reset - TOD)

Degrees of Reset =  $-0.7 * (32.22 - 37.77)$

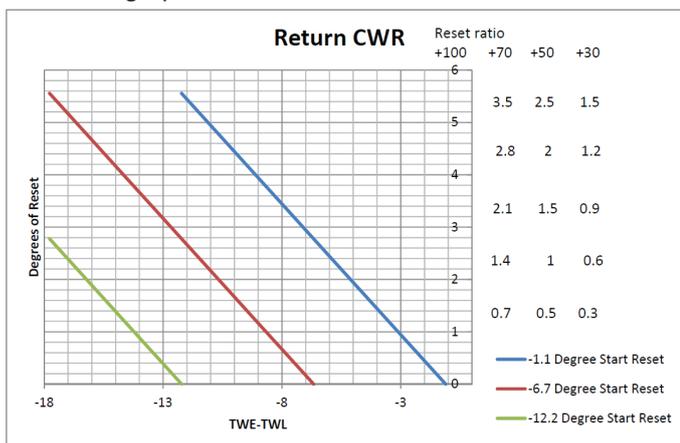
Degrees of Reset = 3.89

The following graph illustrates the reset functions of the above examples:



The following graph shows the reset function for Return Chilled Water Reset:

Note: This graph assumes Maximum Reset is set to -6.7°C.



TWE-TWL is the difference between the evaporator entering water temp and the evaporator leaving water temperature.

### Using the Equation for calculating CWR for Return Water Temp

Example of Calculating Reset for Return Water Temp:

If:

Reset Ratio = 50%  
 Start Reset = -6.67°C  
 TWE = 18.3°C  
 TWL = 7.22°C  
 Maximum Reset = 4.44°C

## Chilled Water Reset (CWR)

How many Degrees of Reset will there be?

$$\text{Degrees of Reset} = \text{Reset Ratio} * (\text{Start Reset} - (\text{TWE} - \text{TWL}))$$

$$\text{Degrees of Reset} = .5 * (-6.67 - (18.3 - 7.22))$$

$$\text{Degrees of Reset} = -8.875$$

If:

$$\text{Reset Ratio} = 70\%$$

$$\text{Start Reset} = -6.67^{\circ}\text{C}$$

$$\text{TWE} = 15.55^{\circ}\text{C}$$

$$\text{TWL} = 11.67^{\circ}\text{C}$$

$$\text{Maximum Reset} = -10^{\circ}\text{C}$$

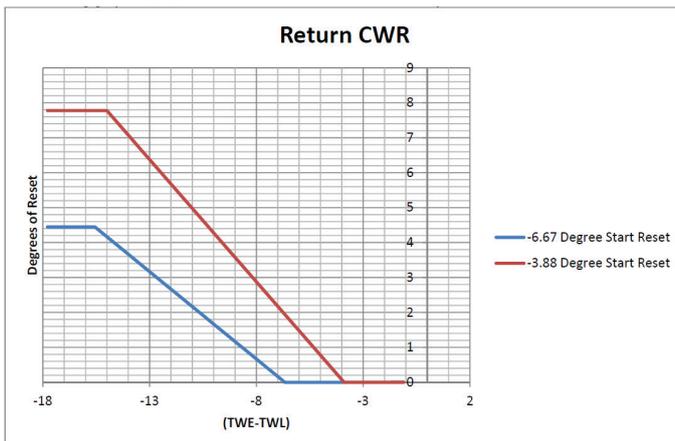
How many Degrees of Reset will there be?

$$\text{Degrees of Reset} = \text{Reset Ratio} * (\text{Start Reset} - (\text{TWE} - \text{TWL}))$$

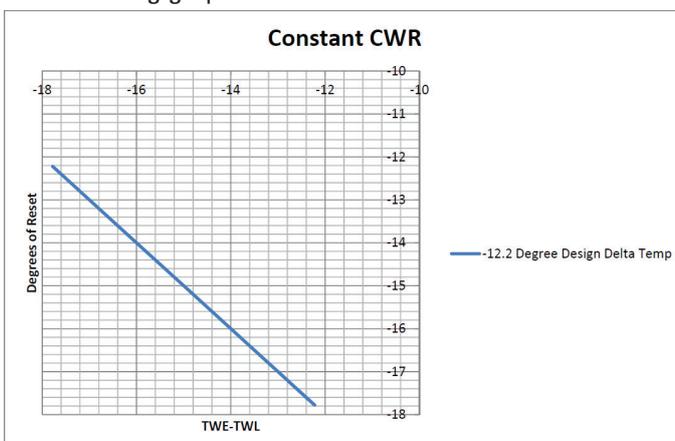
$$\text{Degrees of Reset} = .7 * (-6.67 - (15.55 - 11.67))$$

$$\text{Degrees of Reset} = -18.12$$

The following graph illustrates the Reset Actions of the above examples:



The following graph illustrates the Reset Action of Constant Return temperature:



Note: This graph assumes a Design Delta Temp of  $-12.2^{\circ}\text{C}$ .

### Diagnostic

If any sensor measurement needed to perform the currently selected chilled water reset type is invalid due to loss of communication or sensor failure, the desired CWR will be set to 0. The actual CWR is subject to maximum rate limits described earlier.



# Smart Communication Protocol

## LonTalk™ Interface (LCI-C)

UC800 provides an optional LonTalk™ Smart Com Protocol (LCI-C) between the chiller and a Building Automation System (BAS). An LCI-C LLID shall be used to provide “gateway” functionality between a LonTalk compatible device and the Chiller. The inputs/outputs include both mandatory and optional network variables as established by the LonMark Functional Chiller Profile 8040. See integration guide for detailed information.

## BACnet Interface (BCNT)

The Building Automation and Control Network (BACnet and ANSI/ASHRAE Standard 135-2004) protocol is a standard that allows building automation systems or components from different manufacturers to share information and control functions. BACnet provides building owners the capability to connect various types of building control systems or subsystems together for a variety of reasons. In addition, multiple vendors can use this protocol to share information for monitoring and supervisory control between systems and devices in a multi-vendor interconnected system. The BACnet interface identifies standard objects (data points) called BACnet objects. Each object has a defined list of properties that provide information about that object. BACnet also defines a number of standard application services that are used to access data and manipulate these objects and provides a client/server communication between devices. See integration guide for detailed information.

## BACnet Testing Laboratory (BTL) Certification

AllTracer™ UC800 controllers are designed to support BACnet Smart Com Protocol. In addition, some particular revisions of the UC800 firmware have been tested and have achieved BTL certification by an official BACnet testing laboratory.

For more details, refer to the BTL website at [www.bacnetassociation.org](http://www.bacnetassociation.org).

## ModBus RTU Interface

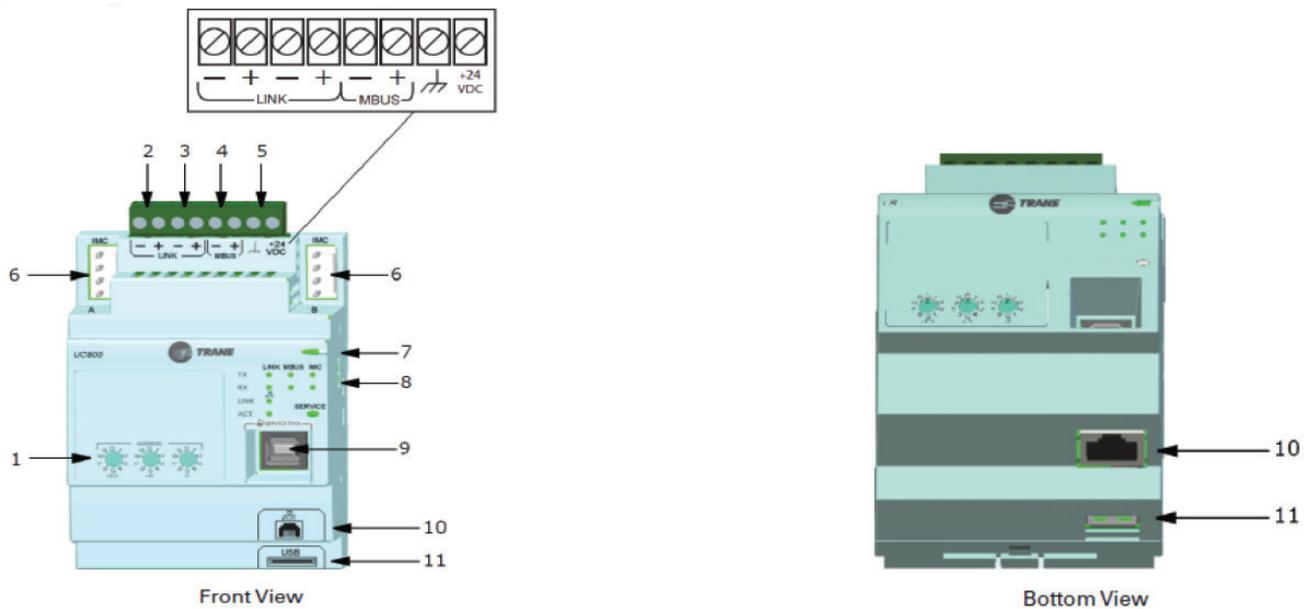
Modicon Communication Bus (Modbus) is an application layer-messaging protocol that, like BACnet, provides client/server communication between devices over a variety of networks. During communications on a Modbus RTU network, the protocol determines how each controller will know its device address, recognize a message addressed to its device, determine what action to take, and extract any data or other information contained in the message. Controllers communicate using a master/slave technique, whereby, only one device (master) can initiate transactions (queries). Other devices (slaves) respond by supplying the requested data to the master or by taking the action requested in the query.

The master can address individual slaves or it can initiate a broadcast message to all slaves. In turn, the slaves respond to queries that are addressed to them individually or broadcasted. The Modbus RTU Interface establishes the format for the master’s query by placing into it the device address, a function code defining the requested action, any data to be sent, and an error-checking field. See integration guide for detailed information.

# Wiring and Port Descriptions for MODBUS, BACnet and LonTalk

Figure 1 illustrates the UC800 controller ports, LEDs, rotary switches, and wiring terminals. The numbered list following Figure 1 Wiring locations and connection ports corresponds to the numbered callouts in the illustration.

**Figure 1 – Wiring locations and connection ports of UC800 controller**



1. Rotary Switches for setting BACnet<sup>®</sup> MAC address or MODBUS ID.
2. LINK for BACnet MS/TP, or MODBUS Slave (two terminals, ±). Field wired if used.
3. LINK for BACnet MS/TP, or MODBUS Slave (two terminals, ±). Field wired if used.
4. Machine bus for existing machine LLIDs (IPC3 Tracer bus 19.200 baud). IPC3 Bus: used for Comm4 using TCI or LonTalk<sup>®</sup> using LCI-C.
5. Power (210 mA at 24 Vdc) and ground terminations (same bus as item 4). Factory wired.
6. Not used.
7. Marquee LED power and UC800 Status indicator.
8. Status LEDs for the BAS link, MBus link, and IMC link.
9. USB device type B connection for the service tool (Tracer TU).
10. The Ethernet connection can only be used with the Tracer AdaptiView display.
11. USB Host (not used).

## Smart Com protocol

There are four connections on the UC800 that support the communication interfaces listed. Refer to Figure 2 for the locations of each of these ports.

- BACnet MS/TP
- MODBUS Slave
- LonTalk using LCI-C (from the IPC3 bus)

## Rotary Switches

There are three rotary switches on the front of the UC800 controller. Use these switches to define a three-digit address when the UC800 is installed in a BACnet or MODBUS system (e.g., 107, 127, etc.).

### Note:

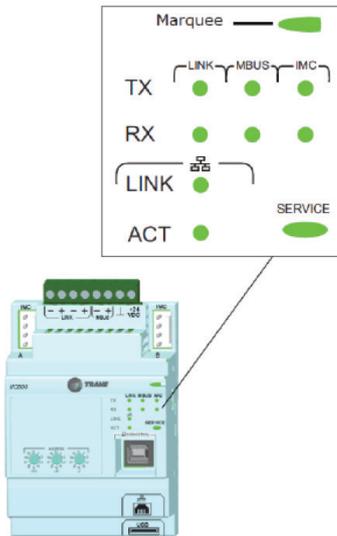
Valid addresses are 001 to 127 for BACnet and 001 to 247 for MODBUS.

## Wiring and Port Descriptions for MODBUS, BACnet and LonTalk

### LED Description and Operation

There are 10 LEDs on the front of the UC800. Figure 2 shows the locations of each LED and Table 5 describes their behavior in specific instances.

**Figure 2 – LED locations**



**Table 5 – LED behavior**

LED	UC800 Status
<b>Marquee LED</b>	<b>Powered.</b> If the Marquee LED is green solid, the UC 800 is powered and no problem exist <b>Low power or malfunction.</b> If the Marquee LED is red solid, the UC800 is powered, but there are problems present <b>Alarm.</b> The Marquee LED blinks Red when an alarm exists
<b>LINK, MBUS, IMC</b>	The <b>TX</b> LED blinks green at the data transfer rate when the UC800 transfers data to other devices on the link The <b>Rx</b> LED blinks yellow at the data transfer rate when UC800 receives data from other devices on the link
<b>Ethernet Link</b>	The <b>LINK</b> LED is solid green if the Ethernet links is connected and connecting The <b>ACT</b> LED blinks yellow at the data transfer rate when data flow is active on the link
<b>Service</b>	The Service LED is solid green when pressed. For qualified service technicians only.

#### NOTICE:

Electrical Noise!

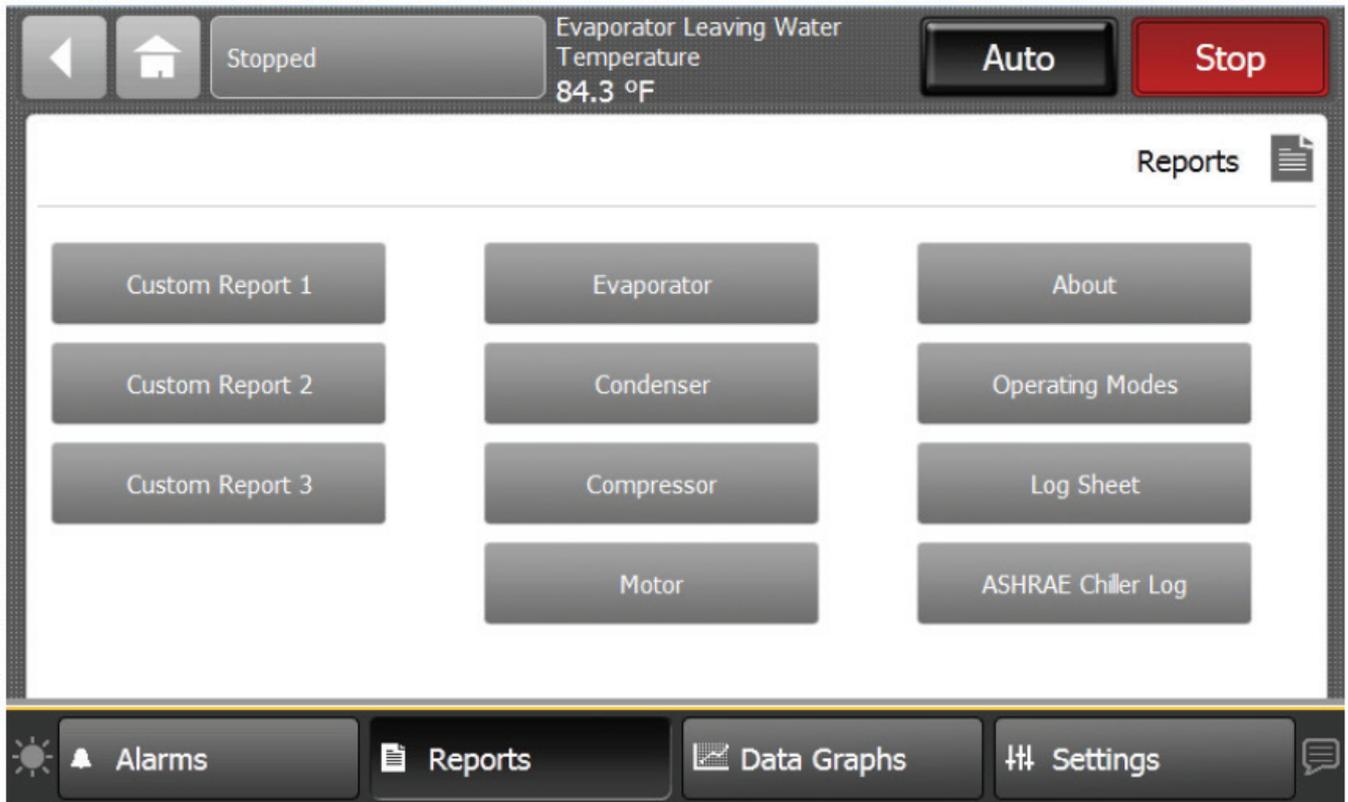
Maintain at least 6 inches between low-voltage (<30V) and high voltage circuits. Failure to do so could result in electrical noise that could distort the signals carried by the low-voltage wiring, including IPC.

# Tracer TD7 Operator Interface

Information is tailored to operators, service technicians, and owners.

When operating a chiller, there is specific information you need on a day-to-day basis—setpoints, limits, diagnostic information, and reports.

**Figure 3 – TD7 operator interface report**



Day-to-day operational information is presented at the display. Logically organized groups of information— chiller modes of operation, active diagnostics, settings and reports put information conveniently at your fingertips.



# Tracer™ TU

The operator interface allows for daily operational tasks and setpoint changes. However, to adequately service chillers Tracer™ TU service tool is required. (Non-Trane personnel, contact your local Trane office for software purchase information.) Tracer TU adds a level of sophistication that improves service technician effectiveness and minimizes chiller downtime. This portable PC-based service-tool software supports service and maintenance tasks, and is required for software upgrades, configuration changes and major service tasks.

Tracer TU serves as a common interface to all Trane® chillers, and will customize itself based on the properties of the chiller with which it is communicating. Thus, the service technician learns only one service interface.

The panel bus is easy to troubleshoot using LED sensor verification. Only the defective device is replaced. Tracer TU can communicate with individual devices or groups of devices.

All chiller status, machine configuration settings, customizable limits, and up to 100 active or historic diagnostics are displayed through the service-tool software interface.

LEDs and their respective Tracer TU indicators visually confirm the availability of each connected sensor, relay, and actuator.

Tracer TU is designed to run on a customer's laptop, connected to the Tracer control panel with a USB cable.

Your laptop must meet the following hardware and software requirements:

- 1 GB RAM (minimum)
- 1024 x 768 screen resolution
- CD-ROM drive
- Ethernet 10/100 LAN card
- An available USB 2.0 port
- Microsoft® Windows 7
- Enterprise or Professional operating system (32-bit or 64-bit)
- Microsoft .NET Framework 4.0 or later

**Note:**

Tracer TU is designed and validated for this minimum laptop configuration. Any variation from this configuration may have different results. Therefore, support for Tracer TU is limited to only those laptops with the configuration previously specified.

For more information, see TTU-SVN01A-EN Tracer TU Getting Started Guide

**Diagnostic Name and Source:** Name of Diagnostic and its source. Note that this is the exact text used in the User Interface and/or Service Tool displays.

**Affects Target:** Defines the "target" or what is affected by the diagnostic.

Usually either the entire Chiller, or a particular Circuit or Compressor is affected by the diagnostic (the same one as the source), but in special cases functions are modified or disabled by the diagnostic. None implies that there is no direct affect to the chiller, sub components or functional operation.

**Design Note:** Tracer™ TU does not support the display of certain targets on its Diagnostics pages although the functionality implied by this table is supported. Targets such as Evap Pump, Ice Mode, Chilled Water Reset, External Setpoints etc. – are displayed as simply "Chiller" even though they do not imply a chiller shutdown – only a compromise of the specific feature.

**Severity:** Defines the severity of the above effect. Immediate means immediate shutdown of the affected portion, Normal means normal or friendly shutdown of the affected portion, Special Action means a special action or mode of operation (limp along) is invoked, but without shutdown, and Info means an Informational Note or Warning is generated. Design Note: Tracer TU does not support display of "Special Action"; on its Diagnostics pages, so that if a diagnostic has a special action defined in the table below, it will be displayed only as "Informational Warning" as long as no circuit or chiller shutdown results. If there is a shutdown and special action defined in the table, then the Tracer TU Diagnostics Page display will indicate the shutdown type only.

**Persistence:** Defines whether or not the diagnostic and its effects are to be manually reset (Latched), or can be either manually or automatically reset when and if the condition returns to normal (Nonlatched).

**Active Modes [Inactive Modes]:** States the modes or periods of operation that the diagnostic is active in and, as necessary, those modes or periods that it is specifically "not active" in as an exception to the active modes. The inactive modes are enclosed in brackets, [ ]. Note that the modes used in this column are internal and not generally announced to any of the formal mode displays.

**Criteria:** Quantitatively defines the criteria used in generating the diagnostic and, if nonlatching, the criteria for auto reset. If more explanation is necessary a hot link to the Functional Specification is used.

**Reset Level:** Defines the lowest level of manual diagnostic reset command which can clear the diagnostic. The manual diagnostic reset levels in order of priority are: Local or Remote. For example, a diagnostic that has a reset level of Remote, can be reset by either a remote diagnostic reset command or by a local diagnostic reset command.

**Help Text:** Provides for a brief description of what kind of problems might cause this diagnostic to occur. Both control system component related problems as well as chiller application related problems are addressed (as can possibly be anticipated). These help messages will be updated with accumulated field experience with the chillers.

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