

# Quad Temperature Controller Board

Model No. ICE-QT1

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Please read [Limited Warranty](#) and [General Warnings and Cautions](#) prior to operating the ICE-QT1.

## Description

The Quad Temperature Controller Board (ICE-QT1) provides 4 independent PID temperature servo loops capable of sub-mK stability<sup>1)</sup>. Each channel can drive either a single TEC (bipolar current output) or resistive heater (unipolar current output) and read a single 10k thermistor.

## Absolute Maximum Ratings

Note: All modules designed to be operated in laboratory environment

Parameter	Rating
Environmental Temperature	>15°C and <30°C
Environmental Humidity	<60%
Environmental Dew Points	<15°C

## Specifications

	Min	Typical	Max	Units
<b>Temperature Overview</b>				
Number of channels of Temperature Control	-	4	-	
Loop Transfer Function <sup>2)</sup>	-	PID	-	
Thermistor Resistance	-	10	-	kΩ
<b>Temperature Control</b>				
Temperature setpoint range	-10	-	60	°C
Temperature setpoint resolution		0.1		°C
Temperature error resolution			0.5	mK
Max TEC current			1	A
Max TEC voltage			1	V
<b>Electrical Specifications</b>				
	Min	Typical	Max	Units
5V_A Current Draw <sup>3)</sup>		0.5	4	A
5V_D Current Draw		60		mA
+15V Current Draw		80		mA

Electrical Specifications				
	Min	Typical	Max	Units
-15V Current Draw		60		mA

## I/O (ICE-BOX)



Applies only when purchased with the [ICE Platform](#).

### Laser Temp Output

The Front Panel for the ICE-QT1 has two 8-pin Hirose connector (HR25-7TR-8SA) that each carry the signals for two channels of temperature control. The pin diagram below is for the top Hirose connector; the bottom connect has the same wiring but for channels 3 & 4 instead of 1 & 2. Rth and Rth\_Rtn are the two ends of a 10k thermistor.

Pin	Signal
1	TEC1+
2	TEC1-
3	Rth1
4	Rth1-RTN
5	TEC2+
6	TEC2-
7	Rth2
8	Rth2-RTN

Tab. 1: Hirose connector pin definitions.

## I/O (OEM Only)



Only for OEM versions of the ICE-QT1 purchased without the [ICE Platform](#).

### Laser Temp Output

The ICE-QT1 has two 12-pin 1.00mm pitch flat flex connectors (FCI SFW12R-1STE1LF) that each carry the signals for two channels of temperature control. The left-most connector carries signals for channels 1 & 2 while the right-most connector carries signals for channels 3 & 4. The pin diagram for the left-most flat flex connector is shown below and the right-most connector has the same pin definition for channels 3 & 4. Rth and Rth\_Rtn are the two ends of a 10k thermistor.

Pin	Signal
1	TEC1+
2	TEC1+
3	TEC1-

Pin	Signal
4	TEC1-
5	Rth1
6	Rth1-RTN
7	TEC2+
8	TEC2+
9	TEC2-
10	TEC2-
11	Rth2
12	Rth2-RTN

Tab. 2: Flat flex connector pin definitions

## Quick Start Commands Guide

Please see [Overview of Commands and Basic Usage](#), [Common Commands to all Slave Boards](#) and [Quad Temperature Controller Commands](#) for a complete command list. Set the ICE-MC1 to communicate with the slot that this ICE-QT1 is in (see [Master and Control Board Overview](#) for details).

The ICE-QT1 has 4 channels of temperature control. Also all commands take the channel number (1-4) as the first argument. To read the temperature setpoint for channel 2, send the command

```
TempSet? 2
25.0
```

To change the temperature setpoint, the first agrument is the channel number (1-4) and the second is the desired temperature setpoint. The command will return the actual setpoint, which maybe be different than input setpoint because of the quantization of the available temperature setpoints. For example:

```
TempSet 2 23.77
23.8
```

When driving a TEC, the ICE-TM1 should be configured to be in bipolar mode. When driving a resistive heater, turn off bipolar mode. This can be done with the **BiPolar** command

```
BiPolar 3 On
On

BiPolar 4 Off
Off
```

The temperature min and max values can be set with the **TempMin** and **TempMax** commands. When the temperature is outside of this range, current to the TEC or resistive heater is turned off. Units are °C

```
TempMin 3 16
16
```

```
TempMax 3 40
40
```

The temperature servo loop can be turned on or off the the **Servo** command:

```
Servo 2 0n
0n

Servo 2 0ff
0ff
```

The temperature can be read with the **Temp?** command:

```
Temp? 3
24.56
```

When the temperature is near the temperature setpoint (within 300mK) the **TError?** command can read the temperature error ( $T_{\text{setpoint}} - T_{\text{actual}}$ ), in units of °C.

```
TError? 4
0.021
```

The gain of the temperature loop is set with the **Gain** command and has a range of 1-255.

```
Gain 1 56
56
```

Once the right values are set on the ICE-QT1, use the **Save** command to save the current settings so that the settings will be remembered when the device is power cycled. Please note that the temperature loop always starts off and must be turned on the the **Servo** command

```
Save
Success
```

1)

Sub-mK stability requires a proper thermal design and proper tuning of the temperature controller to the thermal plant. If you did not purchase the Laser Controller with a Laser Diode, please read the section on tuning the temperature controller.

2)

Not adjustable, fixed at factory

3)

Maximum based on all four channels having TEC current limit set to maximum of 1 A. Typical represents normal stabilized current draw for two DBR lasers.

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