INTRODUCTION

This application provides a test interface for communicating with heated regulators from a PC running Microsoft® Windows. Please follow all safety instructions as provided with the heated regulator. The heated regulator will be referred to as DUT (Device Under Test) in this document. The period of time when the application is communicating with the DUT will be referred to as an active session

HARDWARE

Two communication bus connections are possible with the DUT (see Table 2). Only one bus can be monitored at a time with this application. See picture 1 for temperature controller PCB layout.

Note: device address default is 10 and doesn't normally need to be changed. If multiple DUT's are connected on the same network, each must have a different address set by using the "device address" switch.

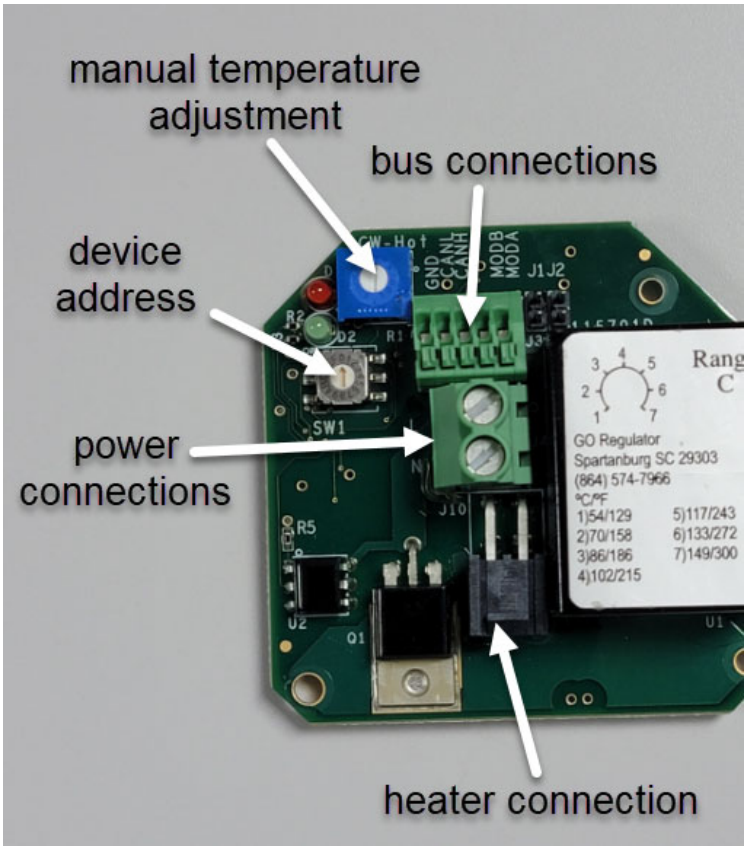
All hardware drivers must be installed prior to using this application.

Table 1 - Required Hardware

Hardware	*Details*
Cabling	Connection of power and datalines to DUT
Terminating Resistor	Prevents reflections on databus (only needed for CANbus)
T connectors	Connects cables together
PC connection	See table 2

Table 2 - Comm Variations

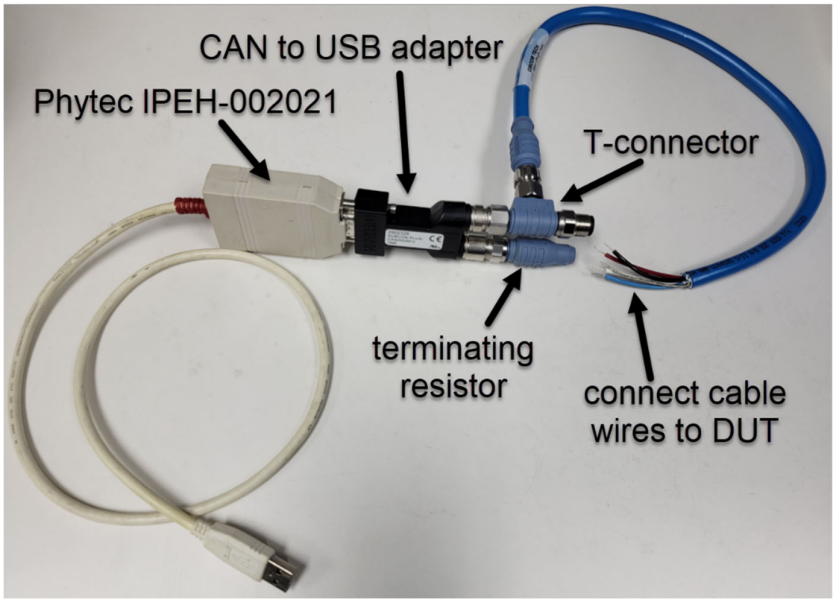
Hardware type	*Hardware Recommended*
MODBUS	RS485 COM port
CANbus	Phytec IPEH-002021



Picture 1 - Controller PCB Layout

WIRE CONNECTIONS

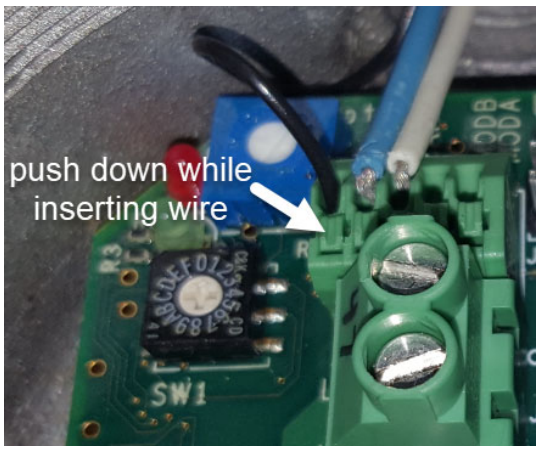
GO Regulator offers hardware kit G116771 for CANbus communication. Picture 2 shows a typical CANbus kit. Kits may vary slightly from the picture.



Picture 2 - CANbus communications kit G116771

When using this kit, connect the white wire to CANH port, blue wire to CANL port and black wire to GND port. The other wires and connections are not used. The port connections are spring loaded. A small screwdriver or similar tool can be used to push down on the top lever while inserting the wires. See picture 3 for reference.

MODBUS wire connections are white wire to MOD A port, blue wire to MOD B port and black wire to GND port.

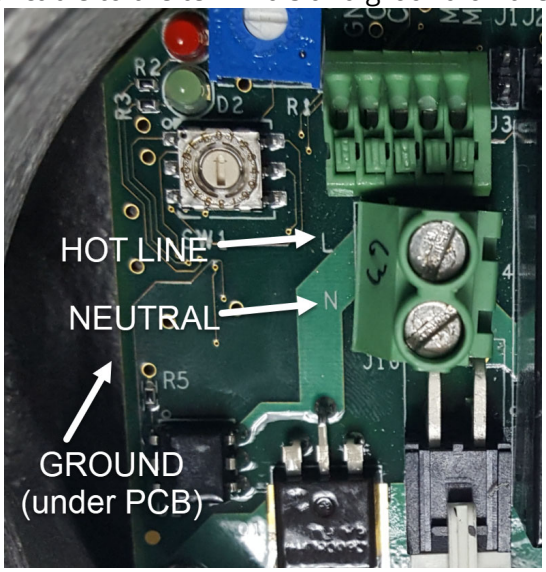


Picture 3 - CANbus wires connected

Connect the USB cable to the computer and install any drivers needed. Software driver for Phytec IPEH-002021 can be found here: https://www.peak-system.com/PCAN-USB.199.0.html?&L=1

Install the GO Regulator provided software.

Connect a suitable power cable to the terminals and ground on the DUT. See picture 4.



Picture 4 – Power Connections do DUT

Note: The DUT will accept either 230V or 110V but do not apply 230V if the heater is 110V, the heater will be damaged. 110V can be applied with 230V heaters. In this case the heater will act as if it's wattage is half the rated value.

OPERATION

Begin/End
After making all the applicable hardware connections mentioned above, select a communication bus (PCANUSB when using kit G116771) and DUT address (default is 10), and press 'Begin'. The app will continuously update several values until the user presses 'End'.

ReadOnce
Some values are only read at the user's request during an active session.

ReadEE
Several values are saved when the DUT is powered down. These values can be read with this function.

WriteEE
Values that are saved when the DUT is powered down can be overwritten. Be aware that incorrect values can damage the DUT.

WriteEESpecial
These values are saved when the DUT is powered down. Note that some changes, such as baud rate for MODBUS, will cause an active session to timeout.

Table 3 - Active Session Values

Value	*Details*	*Default*
ActualValue	Temperature of thermistor	ReadOnly
Setpoint	Setpoint of controller	ReadOnly
ManualSetting%	Manually adjusted value of Potentiometer	ReadOnly
DutyCycle	Current duty cycle of controller	ReadOnly
Status	Error state of controller*1	ReadOnly
FirmwareRev	Firmware Rev of controller	ReadOnly
FlashCS	Checksum of controller firmware	ReadOnly
SensorTemp	Temperature of thermistor	ReadOnly
SensorResistance	Resistance of thermistor	ReadOnly
SerialNr	Serial number of controller	ReadOnly
SensorVoltage	Voltage of thermistor	ReadOnly
uCTempVoltage	Temperature voltage of controller	ReadOnly
ucTempCalc	Temperature of controller	ReadOnly
RemSetpoint	Remote setpoint of controller	50
Pgain	Proportional gain	5
Igain	Integral gain	0.1
IerrorLim	Error above which Igain is not actively used	100

PositiveOvershoot	Allowed overshoot of setpoint before duty cycle is set to zero	15
UCtrlTempLo	Used in Range E as the low temperature*2	54
UCtrlTempHi	Used in Range E as the high temperature*2	193
TempLimitGood	Defines band around setpoint where a DUT is considered within range	2
TempRange	Defines four preset ranges (A, B, C, D) or a user defined range (E). See table 4.	C
Option	Gives option to set dutyCycle to zero if sensor resistance is not detected. Should not be enabled if process or ambient temperature (at startup) is below 0°C	Not enabled
Temperature Unit	Celsius or Fahrenheit	Celsius
Mode	Mode of controller. See table 5.	ManCtrl
BaudRate	Baudrate of Modbus comm	19200

Table 4 - Temperature Range

Flashes	*Value*	*Range*
1	A	55-85 °F (13-29 °C)
2	B	75-175 °F (24-80 °C)
3	C	130-300 °F (54-149 °C)
4	D	260-380 °F (126-194 °C)
5	E	Defined by UCtrlTempLo and UCtrlTempHi

Table 5 - Mode

Value	*Range*
Normal	Setpoint defined by RemSetpoint
Off	Duty cycle of controller is 0. Regulator will not heat.
ManualOn	Duty cycle of controller is 100%. No temperature controls are active. Use this option with caution. Heater TCO may be tripped if overheated.
PgainDutyCycle	Duty cycle of controller is the value of Pgain. No temperature controls are active. Use this option with caution.
ManCtrl	Setpoint is defined by TempRange setting (see table 4) and blue dial on board.

During powerup, the count of the green LED corresponds to the temperature range (see Table 4). After a few seconds, the DUT will flash a status message based on Table 6.

Table 6 - Status codes

Green LED Flash	Red LED Flash	Status Byte	Status
X	0	50	DUT is at setpoint
X	1	1	Thermistor voltage is low
X	2	2	Actual temperature is higher than HiHi Limit
X	3	3	Actual temperature is higher than Hi Limit
X	4	4	Actual temperature is lower than Lo Limit
X	5	5	Actual temperature is lower than LoLo Limit
X	6	6	Setup parameters are incorrect
X	7	7	Temperature is not valid
1	X		Controller mode is Normal
2	X		Controller mode is Off
3	X		Controller mode is ManualOn
4	X		Controller mode is Pgain DutyCycle
5	X		Controller mode is ManCtrl

Green LED operating flash details:

1 – Remote Setpoint: Temperature controlled by CANbus or MODbus.

2 – Heat OFF: Power is not applied to heater. Unit will not heat in this mode.

3 – Heat ON: Power is being applied to the heater at 100% regardless of what the setpoint is. NOTE: This setting must be used cautiously as the heater will be powered at 100%. Heater damage may result if allowed to overheat.

4 – P Gain Duty Cycle: CANbus or MODbus is set to % of heating.

5 – Manual Mode: Temperature setpoint is controlled by potentiometer on PCB. This is the normal operating mode unless controlled by CANbus or MODbus.

Red LED flash details:

1 – Temp Volt Low: This can be an indication that there is an open circuit on thermistor (circuit between heater wires 2 and 3). This can be caused by process media that is below around -20°C which will increase the thermistor resistance to a point where it can't be measured by the controller.

2 – Temp HH: The actual temperature of the heater is at least 300°C above the setpoint. The controller will not send power to the heater until the heater has cooled below the setpoint. This code would practically never be seen in normal operation so it may be an indication of an error

in the board or thermistor. Consult factory if this code is present after regulator has cooled down and will not heat for an extended length of time.

3 – Temp H: The actual temperature of the heater is more than 2 degrees above its setpoint. The controller will not send power to the heater until the heater has cooled below the setpoint.

4 – Temp L: The actual temperature of the heater is more than 2 degrees below its setpoint. The controller will send power proportional to the amount the heater temperature is below the setpoint. (If this occurs for an extended length of time it can be an indication of an open circuit between heater wires 1 and 4, or the media flowrate is too high, or the heater wattage is not sufficient to heat the media to the setpoint.)

5 – Temp LL: The actual temperature of the heater is at least 60°C below the setpoint. The controller will send power proportional to the amount the heater temperature is below the setpoint. (If this occurs for an extended length of time it can be an indication of an open circuit between heater wires 1 and 4, or the media flowrate is very high, or the heater wattage is not sufficient to heat the media within 60°C of the setpoint.)

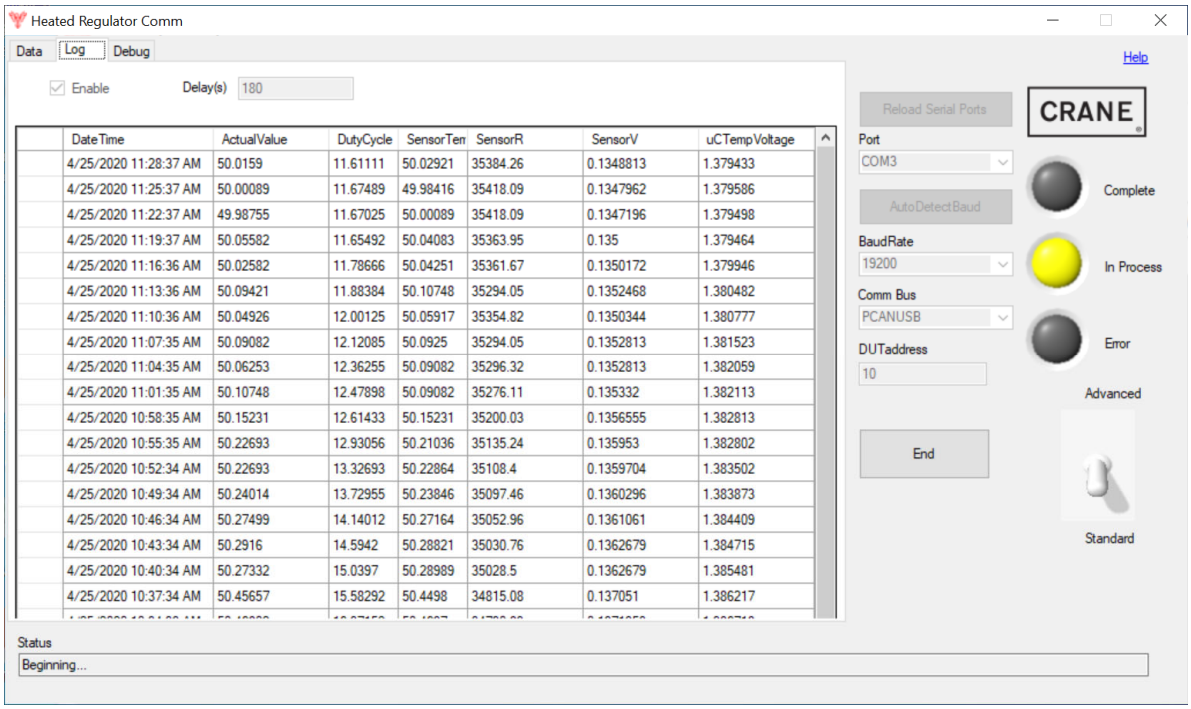
6 – Temp Limit Nan: This indicates that the setpoint has not been properly set. Consult factory if this code is present while in Manual Mode.

7 – Temp Limit Invalid: The setpoint set by bus software is not valid. Consult factory if this code is present while in Manual Mode.

0 – Okay: The heater temperature is within 2 degrees of its setpoint. The controller will send power as needed to maintain the setpoint.

LOG

If desired, a log can be collected. Before beginning an active session, set the delay between measurements and enable the log. Please note that the log will be cleared when a new session is started.



DateTime	ActualValue	DutyCycle	SensorTem	SensorR	SensorV	uCTempVoltage
4/25/2020 11:28:37 AM	50.0159	11.61111	50.02921	35384.26	0.1348813	1.379433
4/25/2020 11:25:37 AM	50.00089	11.67489	49.98416	35418.09	0.1347962	1.379586
4/25/2020 11:22:37 AM	49.98755	11.67025	50.00089	35418.09	0.1347196	1.379498
4/25/2020 11:19:37 AM	50.05582	11.65492	50.04083	35363.95	0.135	1.379464
4/25/2020 11:16:36 AM	50.02582	11.78666	50.04251	35361.67	0.1350172	1.379946
4/25/2020 11:13:36 AM	50.09421	11.88384	50.10748	35294.05	0.1352468	1.380482
4/25/2020 11:10:36 AM	50.04926	12.00125	50.05917	35354.82	0.1350344	1.380777
4/25/2020 11:07:35 AM	50.09082	12.12085	50.0925	35294.05	0.1352813	1.381523
4/25/2020 11:04:35 AM	50.06253	12.36255	50.09082	35296.32	0.1352813	1.382059
4/25/2020 11:01:35 AM	50.10748	12.47898	50.09082	35276.11	0.135332	1.382113
4/25/2020 10:58:35 AM	50.15231	12.61433	50.15231	35200.03	0.1356555	1.382813
4/25/2020 10:55:35 AM	50.22693	12.93056	50.21036	35135.24	0.135953	1.382802
4/25/2020 10:52:34 AM	50.22693	13.32693	50.22864	35108.4	0.1359704	1.383502
4/25/2020 10:49:34 AM	50.24014	13.72955	50.23846	35097.46	0.1360296	1.383873
4/25/2020 10:46:34 AM	50.27499	14.14012	50.27164	35052.96	0.1361061	1.384409
4/25/2020 10:43:34 AM	50.2916	14.5942	50.28821	35030.76	0.1362679	1.384715
4/25/2020 10:40:34 AM	50.27332	15.0397	50.28989	35028.5	0.1362679	1.385481
4/25/2020 10:37:34 AM	50.45657	15.58292	50.4498	34815.08	0.137051	1.386217

Picture 4 – Log Screen

CHANGING TEMPERATURE RANGE

To change the temperature range for manual operation, connect DUT as described above. Once in an active session, select the drop-down box for TempRange to the desired range and click on WriteEE. Click on ReadEE to verify that the temperature range is correct. The PCB will remain at the new temperature range when next powered up.

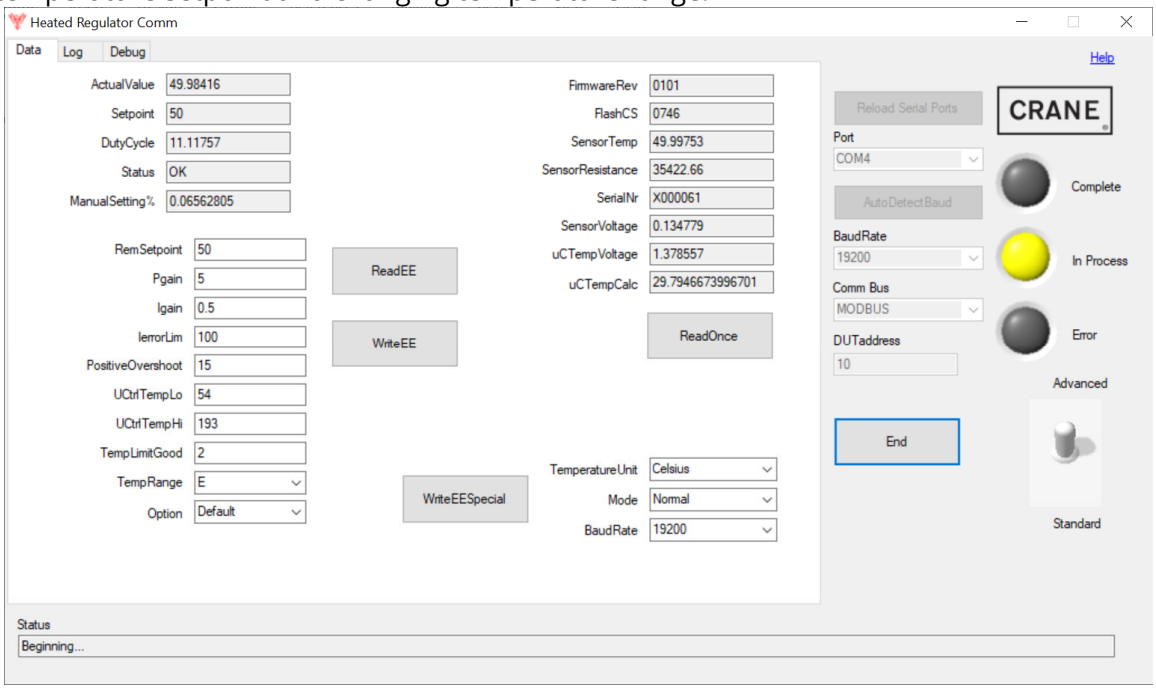
MONITORING/CHANGING SET TEMPERATURE REMOTELY

To monitor and/or change the DUT set temperature remotely, connect DUT as described above. Once in an active session, DUT actual temperature and status can be monitored with this software while in either Advanced or Standard mode.

To change temperature setpoint remotely, display must be in Advanced mode. See below to change mode. While in Advanced mode, change Mode to Normal and click WriteEESpecial. The temperature setpoint can now be controlled by changing RemSetpoint. Enter the desired temperature in RemSetpoint and click on WriteEE. The new setpoint will be displayed in Setpoint and the PCB will adjust DutyCycle as needed to reach and maintain the new value.

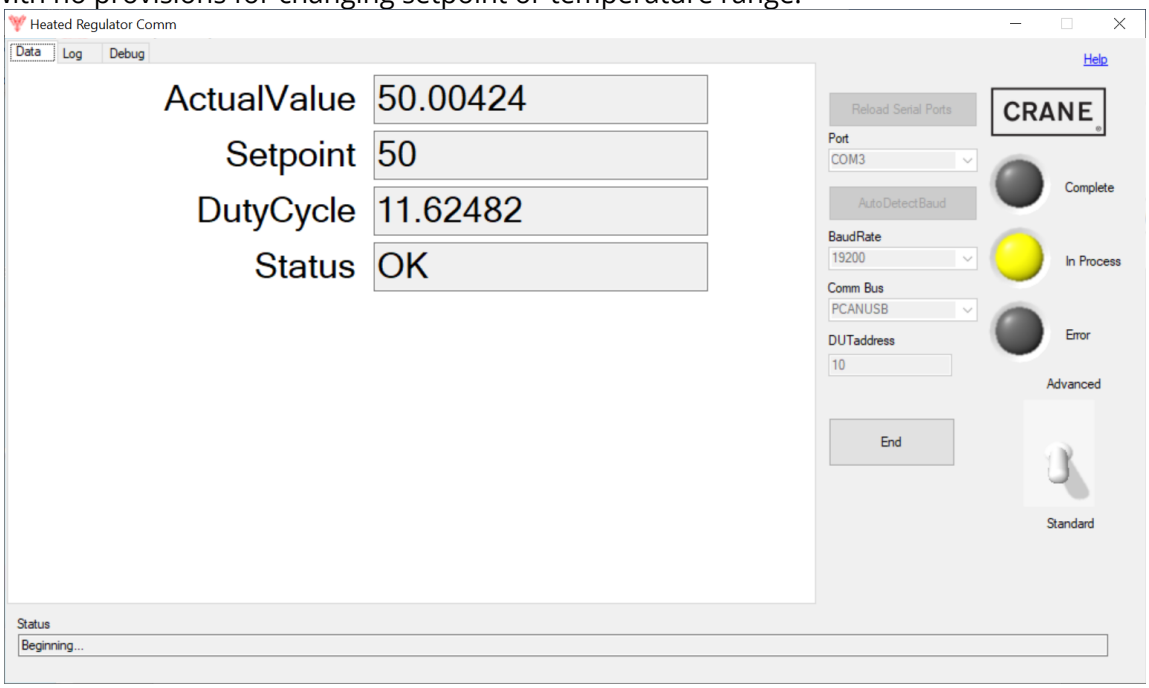
ADVANCED AND STANDARD MODE

Advanced mode shows all values associated with the DUT and allows modification of temperature setpoint and changing temperature range.



Picture 5 – MODBUS Advanced Mode Screen

Standard mode only displays actual DUT temperature, setpoint, duty cycle and PCB status with no provisions for changing setpoint or temperature range.



Picture 6 – CANbus Standard Mode Screen

To switch between these two modes, click on End if in active session, click on the toggle switch to change mode and click on Begin to enter an active session.

PORT

Port setting is used for MODBUS communication. After connecting wires to the DUT and plugging the USB connector into the computer, the appropriate COM port will need to be selected when using the MODBUS. It may be necessary to verify the COM port assigned to the RS485 MODBUS device in the computer's device manager. The BaudRate will also be in effect. Standard BaudRate is 19200. If the software errors out when trying to connect to the DUT through MODBUS, it may be necessary to click on AutoDetectBaud to determine the correct value.

Port and BaudRate are not used for CANbus communication.

Notes:

1. Status setting: This is controlled by TempLimitGood value shown in Table 3. For example, if the setpoint is set to 50 and the TempLimitGood value is set to 2, the controller will have no error (status byte 50) when operating from 48 to 52. If the actualValue drops below 48, a TempL error will be given. The HH and LL limits are set at Crane and aren't user adjustable at this time.

2. UCtrlTempLo and UCtrlTempHi shown in Table 3 are only used with an E range controller. It allows the user to customize the range of the controller. For example, if the customer sets the Lo value to 25 and the Hi value to 175, they will have a custom controller where the setpoint can be adjusted manually from 25 - 175 degrees.

TROUBLESHOOTING

This section details how to check the heater and controller for proper functioning.

If the heater does not heat after an extended period of time, disconnect power from the controller and unplug the heater from the PCB. Using a multimeter set to ohms mode, measure the ohms resistance between pins 1 and 4 on the heater connector.

If you have any questions regarding this information, please contact your local Crane representative for clarification.

DISCLAIMER