LP0543
Rev 05 3/06

CRIMSON

USER MANUAL

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Running Crimson™

System Requirements

386DX or higher processor (486 recommended)

4 megabytes (MB) of RAM (8 MB recommended)

An additional 4 MB of hard drive space over what the OS requires

800 x 600 VGA or higher resolution (256-color SVGA recommended)

Windows® 9x/2000/NT/XP

RS-232 serial port for downloading the database to the Modular Controller

Installation

Insert the Crimson CD into your computer's CD ROM drive. Select Run from the Windows Start menu, and type x:\setup. Where x is the drive letter assigned to your PC's CD drive.

Introduction

System Overview

The Modular Controller Series is a flexible, modular system, which provides easy integration of I/O, as well as dedicated PID control into virtually any application. Each module provides stand-alone reliability, while the Master oversees the communications and storage of each module's parameters. By storing the parameters, the Master automatically upgrades and programs modules if they are replaced.

Crimson allows the user to quickly program each of the modules, as well as to map module data to a PC, HMI, or PLC. The first step in configuration of the system is to insert and program each of the modules before editing the Master's properties. By inserting the modules first, their data will be available when accessing the Master's communications blocks.

Crimson Overview

Crimson allows configuration and calibration of the Modular Controller Series. As a Windows-based program, Crimson offers standard drop-down menu commands, coupled with a graphical representation of the system hardware.

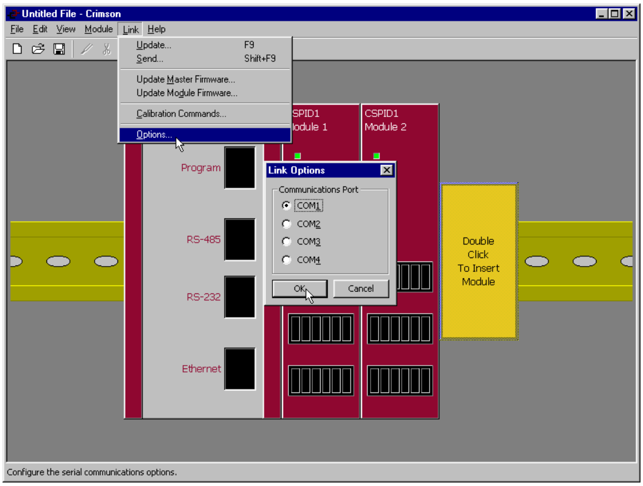
DOWNLOADING

Crimson database files are transferred to the system hardware by downloading. In most cases, the download process will only take a few seconds, but can take as long as a minute. That is because a Crimson database not only contains the configuration information for the Master and modules, it also contains the firmware. This allows previously installed hardware to be upgraded simply by obtaining the latest version of Crimson.

If you have older software, do realize that it is possible to downgrade the firmware in a new module. This is actually preferable, as it ensures that all software and system revisions are completely compatible.

LINK OPTIONS

To configure Crimson to download through the proper PC port, use the Options selection under the Link pull-down menu. Once the proper PC port is selected, you may download the Crimson database via several means.



UPDATE

For the quickest download, you can choose Update to send only the database items that have been changed. To update the database, select Update under the Link menu. Alternatively, you can use the F9 key, or click the lightning bolt on the toolbar.

SEND

The Send command forces Crimson to download the entire database, as well as the firmware, from the beginning. Select Send under the Link menu or you can use Shift+F9.

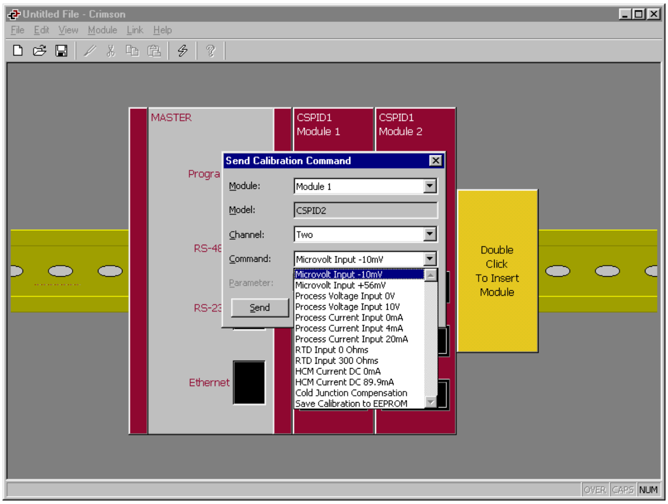
UPDATE MASTER FIRMWARE/UPDATE MODULE FIRMWARE

These menu items allow you to download the system firmware to the hardware without changing the configuration files.

MODULE CALIBRATION

Crimson contains a utility to perform module calibration. As with any calibration, highly accurate measurement and signal generation equipment used by authorized personnel is required. Calibration is recommended every 2 years. **New modules do not need to be calibrated before installation.**

To perform calibration, select Calibration Commands under the Link menu item. You will be prompted to select the module to calibrate. Depending on the type of module that Crimson detects, you may also be prompted to select a specific channel.



INPUT CALIBRATION

To calibrate an input, select the appropriate input point from the Command list. It is not necessary to calibrate all of the points, only those required for the signal being measured in the application. For example, if the application involves a CSPID module measuring a thermocouple, it is only necessary to calibrate the two uV input points and the Cold Junction point. It wouldn't be necessary to calibrate the Process Voltage or Process Current input points.

After selecting the calibration point, apply the exact signal level asked for in the utility, and click the Send button. This causes the module to read and store the signal level. Continue with as many points as necessary. When finished, select and send "Save Calibration to EEPROM" to save the values and end the utility.

OUTPUT CALIBRATION

To calibrate the output(s) of modules that have analog outputs, make sure any necessary output jumpers are properly positioned. Connect an accurate meter to the output terminals.

In the calibration utility, select the high or low linear output level, and click the Read button. The utility will read the calibration number stored within the module, and insert it into the Parameter field. Next, click the Send button. This will send the number back to the module, and it will force the module to generate that output level. Check the output's accuracy on the external meter. If the output is not accurate enough you may make changes to the number and Send it to the module.

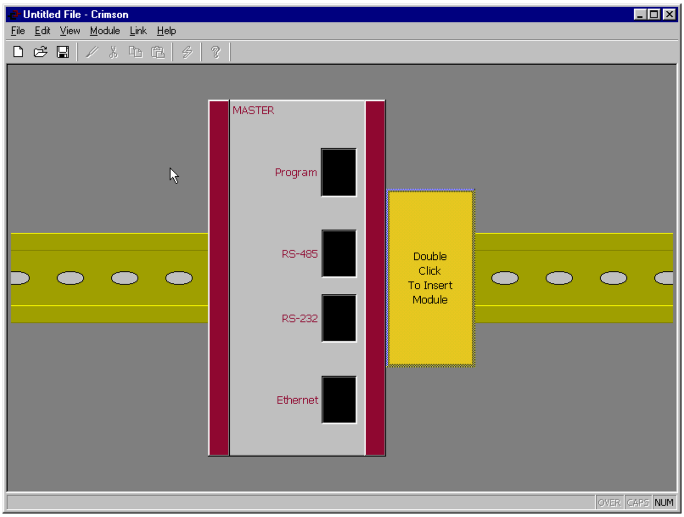
Once the high and low points have been checked and/or adjusted, you must select and Send "Save Calibration to EEPROM" and then send a "Linear Output Done" command.

Cold Junction Calibration

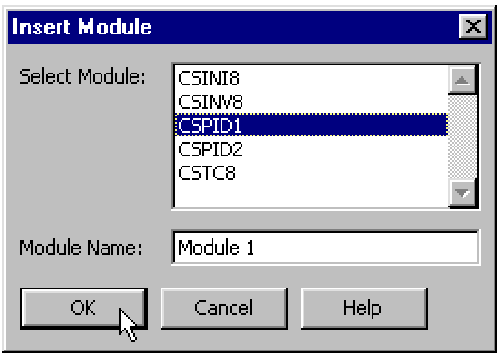
When calibrating an input for thermocouple signals, the Cold Junction Calibration value should also be verified. To determine the proper CJC value, an accurate thermometer or other temperature measurement device must be placed in contact with the thermocouple terminals. Use the Read button to check the value stored in EEPROM, and the Send button to make changes. The CJC value can be entered in degrees Celsius, to the hundredth of a degree. Enter the decimal point when entering the value. When finished, select and send "Save Calibration to EEPROM" to store the new value.

Inserting Modules

To insert a module into the system, double click on the blank base. You will be prompted to choose the type of module to insert. You may also provide a descriptive name for the module.



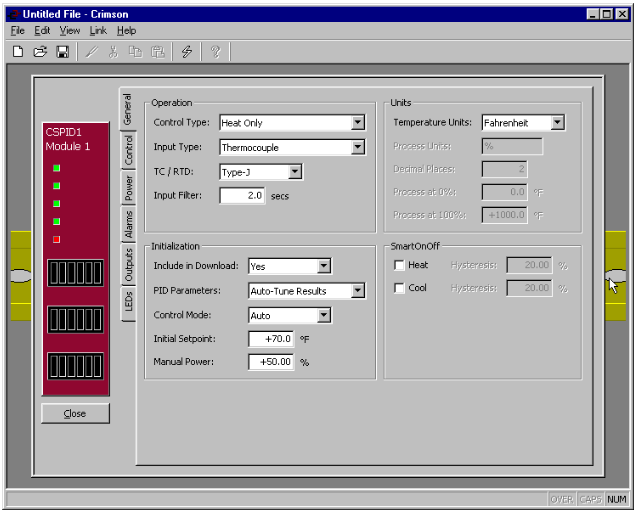
If you are going to program multiple modules the same, program just one, and then use the Copy and Paste functions to create duplicates. This can be done by right-clicking a module or the base.



CSPID - PID Module Programming

To access a module's configuration, double-click it. The module's parameters are broken into groups, each with their own page. The CSPID2 - Dual PID Module, has several extra tabs for configuration of the second loop. Use the tabs on the left hand side of the window to view the various pages.

GENERAL



Operation

Control Type

Select Heat, Cool, or Heat and Cool from the pull-down list. For processes other than thermal applications, select Heat for reverse applications, and Cool for direct acting.

Input Type

Select the RTD, Thermocouple, or the proper Process Input type from the pull down menu.

TC/RTD

If RTD or Thermocouple is selected for Input Type, specify the standard being used.

Input Filter

The Input Filter is a time constant used to stabilize fluctuating input signals.

UNITS

Temperature Units

If Thermocouple or RTD is selected for Input Type, select the Kelvin, Fahrenheit, or Celsius temperature scale.

Process Units

If a Process signal is selected for Input Type, you may enter a suitable name for the engineering units. This is used to label the appropriate fields throughout the software. This parameter is saved as part of the Crimson file, but is not saved within the module.

Decimal Places

If a temperature sensor is selected for Input Type, the input is measured to tenths of a degree resolution. If a Process signal is selected for Input Type, you may enter up to 4 decimal places. This is only used to display the appropriate resolution throughout the software. This parameter is saved as part of the Crimson file, but is not saved within the system.

Process at 0%
Process at 100%

If a Process signal is selected for Input Type, enter the desired PV reading for the minimum and maximum input signal levels. i.e. If the application involves a flow sensor with a 4 to 20 mA output proportional to 5 to 105 GPM, select Process 4-20mA for the Input Type, enter 5 for the Process at 0% setting, and enter 105 for the Process at 100% setting.

INITIALIZATION

The initialization parameters provide initial values for settings usually controlled by a PC or PLC. In typical applications, these settings will only be used until communications is established for the first time.

Include in Download

Select whether or not you want the initialization values downloaded to the module. Selecting “no” allows you to modify and download databases at will, without accidentally overwriting established process parameters such as the setpoint, PID values, etc.

PID Parameters

Select which PID parameters you want the module to load, and subsequently use, to control the process. The module controls the process using the Active PID values and Active Power Filter. (See ActConstP, ActConstI, ActConstD, and ActFilter variables in the **Available Data** chart at the end of this section.) The Active set is loaded with either the User PID Settings, or the Auto-Tune Results values, depending on the state of the ReqUserPID bit. If the bit is true, the Active set is loaded with the user's variables. If the bit is false, the values that were established by Auto-Tune are loaded. Adjusting the PID Parameters setting writes the ReqUserPID bit appropriately upon initialization.

Control Mode

Enter the desired Control Mode for the module to assume when initialized. In Auto mode, the controller calculates the required output to reach and maintain setpoint, and acts accordingly. In Manual mode, the output can be controlled directly by writing to the Power value.

Initial Setpoint

Enter the desired Setpoint value, in engineering units.

Manual Power

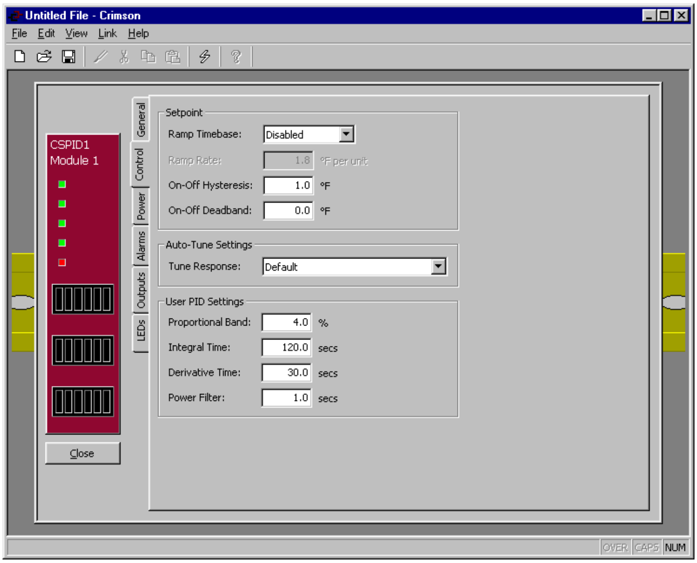
Enter the desired output power level that the PID module should assume in manual mode. You may enter values in excess of 100% and –100% to overcome the limitations caused by Power Transfer values, such as Gains and Offsets, that would otherwise limit the outputs to less than their maximums.

SMART ONOFF

SmartOnOff is designed for situations where on-off control would normally be used, but where the advantages of PID are also desired. When heat or cool is placed into this mode, the control output will either be driven on or off, with no intermediate values or time proportioning. However, rather than use the process value to decide when to turn the output on, SmartOnOff looks at the output of the PID calculation and activates the output when it exceeds half the defined gain for that channel. For example, with default settings, SmartOnOff for heating would turn the heat output on once the PID algorithm called for 50% power or more, with the hysteresis value being used to ensure that small changes in the PID calculation do not produce relay chatter.

Heat - Hysteresis
Cool - Hysteresis

CONTROL



SETPOINT

Ramp Timebase

Select from seconds, minutes, or hours for the ramp timebase.

Ramp Rate

To reduce sudden shock to a process during setpoint changes and system startup, a setpoint ramp rate can be used to increase or decrease the Actual Setpoint at a controlled rate. The value is entered in units/time. A value of 0 disables setpoint ramping.

If the Setpoint Ramp Rate is a non-zero value, and the Requested Setpoint is changed or the module is powered up, the controller sets the Actual Setpoint to the current process measurement, and uses that value as its setpoint. It then adjusts the Actual Setpoint according to the setpoint Ramp Rate. When the Actual Setpoint reaches the Requested Setpoint, the controller resumes use of the Requested Setpoint value. (In a properly designed and functioning system, the process will have followed the Actual Setpoint value to the Requested Setpoint value.)

On-Off Hysteresis

The module performs On/Off control when the Proportional Band is set to 0.0%. The On/Off Hysteresis value is used to eliminate output chatter by separating the on and off points of the output(s). The hysteresis value is centered around the setpoint, that is, the transition points of the output will be offset above and below the setpoint by half of the On/Off Hysteresis value. This value effects any output programmed for Heat or Cool.

During Auto-Tune, the controller cycles the process through 4 on/off cycles, so it is important to set the On-Off Hysteresis to an appropriate value before initializing Auto-Tune.

On-Off Deadband

This value provides a means of offsetting the on points of heat and cool outputs programmed for on/off operation. This results in a deadband if the value is positive, and overlap if the value is negative. When determining the actual transition points of the outputs, the On/Off Hysteresis value must also be taken into consideration.

AUTO-TUNE SETTINGS

Tune Response

The Tune Response setting is used to ensure that an Auto Tune yields the optimal P, I, and D values for varying applications. A setting of Very Aggressive results in a PID set that will reach setpoint as fast as possible, with no concern for overshoot, while a setting of Very Conservative sacrifices speed in order to prevent overshoot. **If the Tune Response setting is changed, Auto-Tune needs to be reinitiated for the changes to affect the PID settings. See the Auto-Tuning Section for more information.**

USER PID SETTINGS

Proportional Band

Entered as a percentage of the full input range, this is the amount of input change required to vary the output full scale. For temperature inputs, the input range is fixed per the entered thermocouple or RTD type. For process inputs, the input range is the difference between the Process at 0%, and Process at 100% values. The proportional value is adjustable from 0.0% to 1000.0%, and should be set to a value that provides the best response to a process disturbance while minimizing overshoot. A proportional band of 0.0% forces the controller into On/Off Control with its characteristic cycling at setpoint. The optimal Proportional Band may be established by invoking Auto-Tune.

Integral Time

The time, in seconds, that it takes the Integral action to equal the Proportional action, during a constant process error. As long as the error exists, integral action is repeated each Integral Time. The higher the integral time, the slower the response. The optimal Integral Time may be established by invoking Auto-Tune. The Integral Time is adjustable from 0 to 6000.0 seconds.

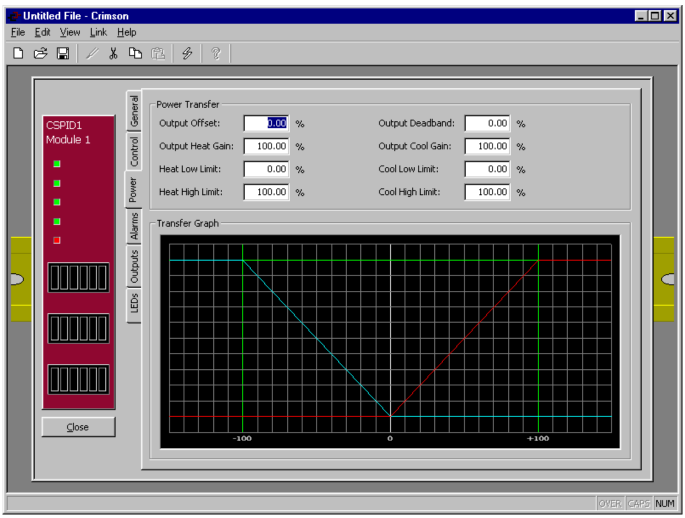
Derivative Time

The time, entered as seconds per repeat, that the controller looks ahead at the ramping error to see what the proportional contribution will be and it matches that value every Derivative Time. As long as the ramping error exists, the Derivative contribution is repeated every derivative time. Increasing the Derivative Time helps to stabilize the response, but too high of a Derivative Time, coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. Setting the time to zero disables derivative action. The optimal Derivative Time may be established by invoking Auto-Tune. The Time is adjustable from 0 to 600.0 seconds.

Power Filter

The Power Filter is a time constant, entered in seconds, that dampens the calculated output power. Increasing the value increases the dampening effect. Generally, a Power Filter in the range of one-twentieth to one-fiftieth of the controller's integral time (or process time constant) is effective. Values longer than these may cause controller instability due to the added lag effect.

POWER



Power Transfer

Output Offset

This value effectively shifts the zero output point of the module's output power calculation. This feature is most commonly used in proportional-only applications, to remove steady-state error.

Output Deadband

This setting defines the area in which both the heating and cooling outputs are inactive, known as deadband, or the area in which they will both be active, known as overlap. A positive value results in a deadband, while a negative value results in an overlap.

Output Heat Gain

This defines the gain of the heating output relative to the gain established by the Proportional Band. A value of 100% causes the heat gain to mimic the gain determined by the proportional band. A value less than 100% can be used in applications in which the heater is oversized, while a value greater than 100% can be used when the heater is undersized. For the majority of applications the default value of 100% is adequate, and adjustments should only be made if the process requires it.

Output Cool Gain

This defines the gain of the cooling output relative to the gain established by the Proportional Band. A value of 100% causes the cool gain to mimic the gain determined by the proportional band. A value less than 100% can be used in applications in which the cooling device is oversized, while a value greater than 100% can be used when the cooling device is undersized. For the majority of applications the default value of 100% is adequate, and adjustments should only be made if the process requires it.

Heat Low Limit

Heat High Limit

These parameters may be used to limit controller power due to process disturbances or setpoint changes. Enter the safe output power limits for the process. You may enter values in excess of 100% and –100% to overcome limitations caused by Power Transfer values, such as Gains and Offsets, that would otherwise limit the output to less than their maximums.

Cool Low Limit

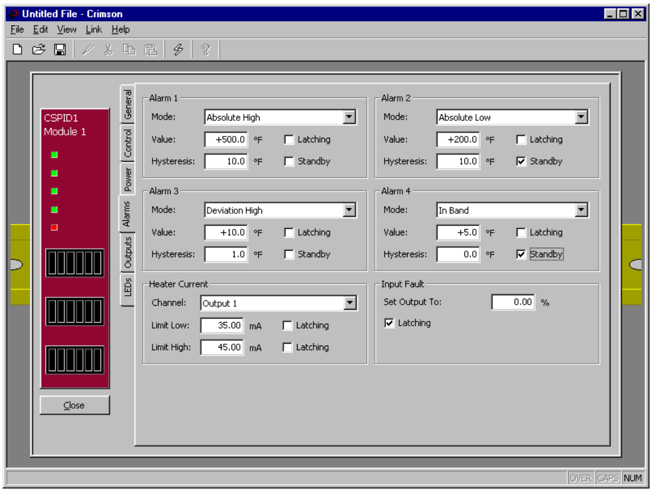
Cool High Limit

These parameters may be used to limit controller power due to process disturbances or setpoint changes. Enter the safe output power limits for the process. You may enter values in excess of 100% and –100% to overcome limitations caused by Power Transfer values, such as Gains and Offsets, that would otherwise limit the output to less than their maximums.

Transfer Graph

The power transfer graph illustrates the results of changes made to the power settings. The blue line represents the cooling, while the red line represents the heating.

ALARMS



Alarm 1 – 4

The four "soft" process alarms may be used to monitor process status.

Mode

Absolute Low – The alarm activates when the Process Value falls below the Alarm Value. The alarm deactivates when the Process Value goes above the Alarm Value + Hysteresis.

Absolute High – The alarm activates when the Process Value exceeds the Alarm Value. The alarm deactivates when the Process Value falls below the Alarm Value – Hysteresis.

Deviation Low – If the Process Value falls below the Setpoint Value by the amount of the Alarm Value, the alarm activates. In this mode, the alarm point tracks the Setpoint Value.

Deviation High – If the Process Value exceeds the Setpoint Value by the amount of the Alarm Value, the alarm activates. In this mode, the alarm point tracks the Setpoint Value.

In Band – If the difference between the Setpoint Value and the Process Value is not greater than the Alarm Value, the alarm activates.

Out of Band – If the Process Value exceeds, or falls below, the Setpoint Value by an amount equal to the Alarm Value, the alarm activates. In this mode, the alarm point tracks the Setpoint Value.

Value

Enter the turn-on point of the alarm. The alarm values are entered as process units or degrees.

Hysteresis

The hysteresis value separates the on and off points of the alarm. i.e. A high acting alarm programmed to turn on at 500 with a hysteresis of 10, will turn off when the PV falls below 490.

Latching

See Alarm Behavior Chart

Standby

See Alarm Behavior Chart

Alarm Behavior Chart

LATCHING	STANDBY	ALARM BEHAVIOR	EFFECT OF SETTING ALARM ACCEPT BIT TO "1"
		Alarm automatically turns on and off as the Process Value crosses in and out of the alarm region.	Disables alarm, regardless of state. If the alarm condition exists, and the bit is written to a "0", the alarm activates.
☑		Once activated, the alarm stays active until accepted.	If the alarm condition no longer exists, writing the Alarm Accept bit to "1" resets the alarm condition. As long as the Alarm Accept bit is "1", the alarm automatically turns on and off as the Process Value crosses in and out of the alarm region.
	☑	Alarm automatically turns on and off as the Process Value crosses in and out of the alarm region. The alarm is automatically disabled when a setpoint change occurs, or when the module is first powered up. This prevents nuisance alarms from occurring. The alarm remains disabled until the process enters a non-alarm state. The next time the Process Value enters an alarm condition, the alarm will activate accordingly.	Disables alarm, regardless of state. If the alarm condition exists, and the bit is written to a "0", the alarm activates.
☑	☑	Once activated, the alarm stays active until accepted. The alarm is automatically disabled when a setpoint change occurs, or when the module is first powered up. This prevents nuisance alarms from occurring. The alarm remains disabled until the process enters a non-alarm state. The next time the Process Value enters an alarm condition, the alarm will activate accordingly.	Momentarily writing the Alarm Accept bit to "1" turns off an active alarm. If the alarm condition still exists, the alarm remains off and is placed into standby mode. That is, the alarm will remain off until the alarm condition goes away, and is then reentered. If the Alarm Accept bit remains a "1", the alarm is disabled, and will not function.

Heater Current

The Heater Current alarm is useful for monitoring the condition of external AC control circuitry via the Heater Current Monitor input.

Channel

Select which one of the three discrete outputs that you want the heater current input to monitor.

Limit Low

Enter the desired low limit mA value, from 0-100.00 mA. This value is the allowable circuit-off current value. If the Heater Current Monitor input measures a current value greater than the Limit Low value during the off state of the output, the alarm becomes active.

Limit High

Enter the desired high limit mA value, from 0-100.00 mA. This value is the required circuit-on current value. If the Heater Current Monitor input measures a current value less than the Limit High value during the on state of the output, the alarm becomes active.

Latching

If Latching is selected, an activated alarm will stay active until accepted. To accept an alarm, the Alarm Accept bit must be written to a 1. If Latching is not selected, the alarm will deactivate when the alarm condition no longer exists.

If Latching is not selected, the alarm will automatically deactivate when the alarm condition no longer exists, and the Alarm Accept bit may be used as a means of disabling the alarm.

Input Fault

The Input Fault alarm is used to define the response of the CSPID module's control outputs in the event of an input failure. The Input Fault alarm is considered a process alarm for items that may be mapped to "any process alarm".

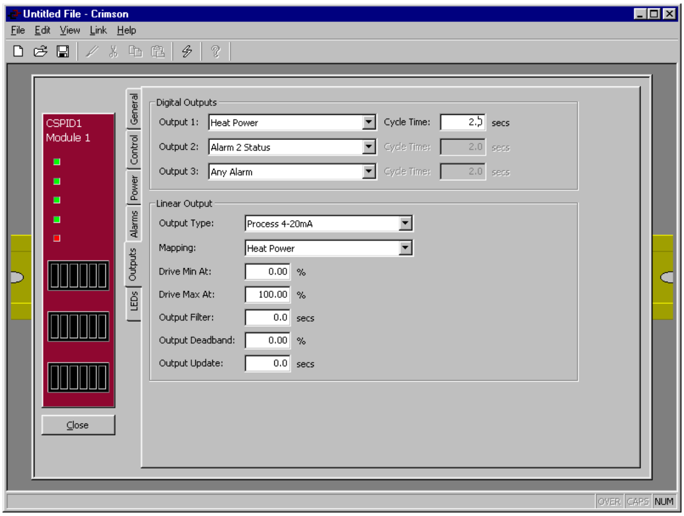
Set Output To

Enter the desired control output value for the controller to assume in the event that the input sensor fails. You may enter values in excess of 100% and –100% to overcome limitations caused by Power Transfer values, such as Gains and Offsets, that would otherwise limit the output to less than their maximums.

Latching

If Latching is selected, the alarm will stay active until accepted. To accept an alarm, the Alarm Accept bit must be written to a 1. If Latching is not selected, the alarm will deactivate when the input failure is corrected.

OUTPUTS



Digital Outputs

Output 1
Output 2
Output 3

You may assign each of the module's discrete outputs to one of the selections below. The CSPID2's list is expanded to include the channel number. e.g. Channel 1 Heat Power, or Channel 2 Heat Power.

Unassigned
Heat Power
Cool Power
Any Alarm
Any Process Alarm
Any HCM Alarm
Alarm 1 Status
Alarm 2 Status
Alarm 3 Status
Alarm 4 Status
HCM Alarm Low
HCM Alarm High
Input Fault
Manual Mode
Output Pegged Low
Output Pegged High
Auto-Tune Busy
Auto-Tune Done
Auto-Tune Fail
Remote Digital 1
Remote Digital 2
Remote Digital 3
Remote Digital 4
Remote Analog 1
Remote Analog 2
Remote Analog 3
Remote Analog 4

Cycle Time

When one of the discrete outputs is assigned to Heat, Cool, or Remote Analog, you may enter a Cycle Time from 0.1 to 60.0 seconds. The Cycle Time is the combined time of an on and off cycle, which provides time proportional control. With time proportional outputs, the percentage of control power is converted into output on-time of the cycle time value. (If the controller calculates that 65% power is required, and has a cycle time of 10 seconds, the output will be on for 6.5 seconds and off for 3.5 seconds.) For best control, a cycle time equal to one-tenth of the process time constant, or less, is recommended.

LINEAR OUTPUT - (CSPID1 ONLY)

Output Type

Select 0-10 V, 0-20 mA, or 4-20 mA, depending on the desired output type. Make sure that the output jumpers, located on the side of the CSPID1 module, are set for the same output type.

Mapping

Unassigned
Heat Power
Cool Power
Requested SP
Actual SP
Process Value
Process Error
Remote Analog 1
Remote Analog 2
Remote Analog 3
Remote Analog 4

You may assign the analog output to transmit one of the following values.

Drive Min At

Enter the value at which the analog output transmits its minimum signal. The units expressed are the same as the those of the Mapping value, so the numerical limits vary.

Drive Max At

Enter the value at which the analog output transmits its maximum signal. The units expressed are the same as the those of the Mapping value, so the numerical limits vary.

Output Filter

The Output Filter is a time constant entered in seconds that dampens the response of the analog output. Increasing the value increases the dampening.

Output Deadband

The Output Deadband value can be used to prevent the analog output from changing when only small adjustments are called for. This is useful in preventing mechanical wear when driving a linear input valve.

The analog output will not adjust unless the change called for exceeds half of the deadband value. i.e. With a deadband of 10 %, and an output value of 50 %, the output will not change until 45 % or 55 % is called for. The units expressed are the same as the those of the Mapping value.

Output Update

The Output Update time can be used to decrease the update frequency of the analog output. The time is entered in seconds.

When the Output Update timer expires, the analog output checks to see if the required change is greater than the Output Deadband value. If the required change is greater, the output will reflect the new value. If not, the output does not change, and the timer starts again.

AUTO-TUNING

OVERVIEW

Auto-Tune may be used to establish the optimal P, I, D, and Power Filter values. By cycling the process through four on/off cycles, the module learns information about the process, and determines the best values.

The setpoint used during Auto-Tune is the value 75 % above the difference between the current PV and the setpoint. This allows the oscillations to occur close to setpoint, while avoiding excessive overshoot. Since the module performs on/off control during Auto-Tune, it is important to set a suitable On/Off Hysteresis value prior to invoking Auto-Tune.

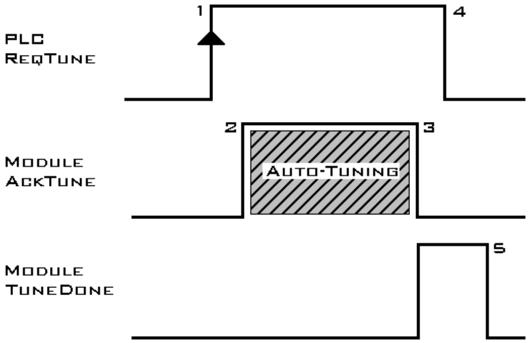
Customization of the PID set that Auto-Tune yields is possible by adjusting the Tune Response setting. Within Crimson, the Tune Response setting can be set to Very Aggressive, Aggressive, Default, Conservative, or Very Conservative. Further, the Tune Response setting can be adjusted by writing 0-4 respectively to the Tune Response word.

INVOKING AUTO-TUNE

The Auto-Tune sequence uses a Request/Acknowledgement structure. To invoke Auto-Tune, write the ReqTune bit to a 1. The module signifies that Auto-Tune is running by setting the AckTune bit high. When Auto-Tune is complete, the TuneDone bit goes high. The external logic should be written to turn off the Auto-Tune Request bit when the Done bit goes high. At this point, the module sets the AckTune bit back to 0.

If for some reason Auto-Tune fails to complete, the TuneDone and TuneFail bits both go high. This situation may occur if, for example, an input fault occurs, and will require that Auto-Tune be reinitialized.

An Auto-Tune request cycle looks like the following.



1. PLC sets ReqTune high.
2. Module starts Auto-Tuning, sets AckTune high.
3. Auto-Tune is complete. AckTune goes low, TuneDone goes high.
4. PLC sees TuneDone high, sets ReqTune low.
5. Module sees ReqTune go low, and resets the TuneDone bit.

AVAILABLE DATA

The following are the data values available to the Master, and therefore, may be mapped to PLC registers. Decimal places are used to denote resolution only, and are not read or written. i.e. An output power of 10000 is 100.00%.

Note: The following table shows available data for the CSPID1 module. In most cases, the CSPID2 module contains the same data for both Loop 1 and Loop 2. e.g. Instead of listing only Module1.PV, the CSPID2 will list Module1.Loop1.PV and Module1.Loop2.PV.

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
Loop	Control	ReqSP	Requested Setpoint – The setpoint value written to the controller. This value may be different than the Actual Setpoint in applications utilizing Setpoint Ramping.	❋	R/W
		Power	Manual output power setting	-200.00% to +200.00%	R/W
		SetHyst	Setpoint Hysteresis for On/Off Control	❋	R/W
		SetDead	Setpoint Deadband for On/Off Control	❋	R/W
		SetRamp	Setpoint Ramp Rate	❋	R/W
		InputFilter	Input Filter	0 – 60.0 Seconds	R/W
		ReqManual	Request Manual – Write this bit to a 1 to invoke manual mode. In manual mode, the output power is controlled by writing to the Power register.	0 or 1 (bit)	R/W
		ReqTune	Request Auto-Tune – Write this bit to a 1 to invoke Auto-Tune.	0 or 1 (bit)	R/W
		ReqUserPID	Request User PID Set – High loads User values into Active set, Low loads Auto-Tuned set into Active set.	0 or 1 (bit)	R/W

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
	Status	PV	Process Value – The input value	*	R
		Output	Output Power – Calculated output power of the PID loop prior to Gain, Offsets, and Limits	-200 to +200%	R
		HeatPower	Output applied to channels assigned for Heat	0 to 100.00%	R
		CoolPower	Output applied to channels assigned for Cooling	0 to 100.00%	R
		ActSP	Actual Setpoint		R
		Error	The difference between the Process Value and the Requested Setpoint	*	R
		ColdJunc	Cold Junction Calibration Value	Tenths of a degree	R
		HCMValue	Heater Current mA Input Value	0.00-100.00 mA	R
		AckManual	Acknowledge Manual mode	0 or 1 (bit)	R
		AckTune	Acknowledge Auto-Tune request	0 or 1 (bit)	R
		TuneDone	Tune Done – Auto-Tune completed	0 or 1 (bit)	R
		TuneFail	Tune Failed – Auto-Tune did not successfully finish	0 or 1 (bit)	R
		Alarm1	Alarm 1 status (on or off)	0 or 1 (bit)	R
		Alarm2	Alarm 2 status (on or off)	0 or 1 (bit)	R
		Alarm3	Alarm 3 status (on or off)	0 or 1 (bit)	R
		Alarm4	Alarm 4 status (on or off)	0 or 1 (bit)	R
		HCM AlarmLo	Heater Current Monitor low limit alarm (on or off)	0 or 1 (bit)	R
		HCM AlarmHi	Heater Current Monitor high limit alarm (on or off)	0 or 1 (bit)	R
		Input Alarm	Input out of range (Input fault, on or off)	0 or 1 (bit)	R
	Alarms	AlarmData1	Alarm 1 Value	*	R/W
		AlarmData2	Alarm 2 Value	*	R/W
		AlarmData3	Alarm 3 Value	*	R/W
		AlarmData4	Alarm 4 Value	*	R/W
		AlarmHyst1	Alarm 1 Hysteresis value	*	R/W
		AlarmHyst2	Alarm 2 Hysteresis value	*	R/W
		AlarmHyst3	Alarm 3 Hysteresis value	*	R/W
		AlarmHyst4	Alarm 4 Hysteresis value	*	R/W

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
	Alarms	(Continued)			
		Alarm Accept1	Alarm 1 Accept bit	0 or 1 (bit)	R/W
		Alarm Accept2	Alarm 2 Accept bit	0 or 1 (bit)	R/W
		Alarm Accept3	Alarm 3 Accept bit	0 or 1 (bit)	R/W
		Alarm Accept4	Alarm 4 Accept bit	0 or 1 (bit)	R/W
		HCM LimitLo	Heater Current Low Limit Alarm value	0 – 100.00 mA	R/W
		HCM LimitHi	Heater Current Low Limit Alarm value	0 – 100.00 mA	R/W
		HCM AcceptLo	Heater Current Low Limit Alarm Accept	0 or 1 (bit)	R/W
		HCM AcceptHi	Heater Current High Limit Alarm Accept	0 or 1 (bit)	R/W
		Input Accept	Input out of range alarm accept	0 or 1 (bit)	R/W
	PID	TuneCode	Tune Response Code	0-4	R/W
		UserConstP	User Proportional Value	0-1000.0%	R/W
		UserConstI	User Integral Value	0-6000.0 Seconds	R/W
		UserConstD	User Derivative Value	0-600.0 Seconds	R/W
		UserFilter	User Power Filter Value	0-60.0 Seconds	R/W
		AutoConstP	Auto-Tuned Proportional Value	0-1000.0%	R
		AutoConstI	Auto-Tuned Integral Value	0-6000.0 Seconds	R
		AutoConstD	Auto-Tuned Derivative Value	0-600.0 Seconds	R
		AutoFilter	Auto-Tuned Power Filter Value	0-60.0 Seconds	R
		ActConstP	Active Proportional Value	0-1000.0%	R
		ActConstI	Active Integral Value	0-6000.0 Seconds	R
		ActConstD	Active Derivative Value	0-600.0 Seconds	R
		ActFilter	Active Power Filter Value	0-60.0 Seconds	R

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
	Power	PowerFault	Power Output value for input fault	-200.00 to +200.00%	R/W
		PowerOffset	Power Output Offset value	-100.00 to +100.00%	R/W
		PowerDead	Power Output Deadband value	-100.00 to +100.00%	R/W
		PowerHeat Gain	Power Output Heat Gain value	0 to 500.00%	R/W
		PowerCool Gain	Power Output Cool Gain value	0 to 500.00%	R/W
		PowerHeat Hyst	Power Output SmartOnOff Heat Hysteresis	0 – 50.00%	R/W
		PowerCool Hyst	Power Output SmartOnOff Cool Hysteresis	0 – 50.00%	R/W
		HeatLimitLo	Heat Low Limit	0 – 200.00%	R/W
		HeatLimitHi	Heat High Limit	0 – 200.00%	R/W
		CoolLimitLo	Cool Low Limit	0 – 200.00%	R/W
		CoolLimitHi	Cool High Limit	0 – 200.00%	R/W
Outputs	Cycle Times	CycleTime1	Cycle Time for Output 1	0.1 to 60.0 Seconds	R/W
		CycleTime2	Cycle Time for Output 2	0.1 to 60.0 Seconds	R/W
		CycleTime3	Cycle Time for Output 3	0.1 to 60.0 Seconds	R/W
		CycleTime4	Cycle Time for Output 4 (CSPID2 only)	0.1 to 60.0 Seconds	R/W
	Remote Data	DigRemote1	Digital Remote 1 – Outputs assigned to Digital Remote can be controlled by writing the DigRemote bit to a 1 or 0.	0 or 1 (bit)	R/W
		DigRemote2	Digital Remote 2 – See DigRemote1	0 or 1 (bit)	R/W
		DigRemote3	Digital Remote 3 – See DigRemote1	0 or 1 (bit)	R/W
		DigRemote4	Digital Remote 4 – See DigRemote1	0 or 1 (bit)	R/W
		AnlRemote1	Analog Remote Value 1 – Outputs assigned to Analog Remote can be controlled by writing a number to this word.	✻	R/W
		AnlRemote2	Analog Remote Value 2 – See AnlRemote1	✻	R/W
		AnlRemote3	Analog Remote Value 3 – See AnlRemote1	✻	R/W
		AnlRemote4	Analog Remote Value 4 – See AnlRemote1	✻	R/W
	Information	OP1State	State of Output 1	0 or 1 (bit)	R
		OP2State	State of Output 2	0 or 1 (bit)	R
		OP3State	State of Output 3	0 or 1 (bit)	R

✻ Dependent on input configuration. Except for the application detailed below, these numbers may be treated as signed integers. All temperature inputs are measured to a tenth of a degree resolution. For process input, the resolution is dependent upon the user scaling values.

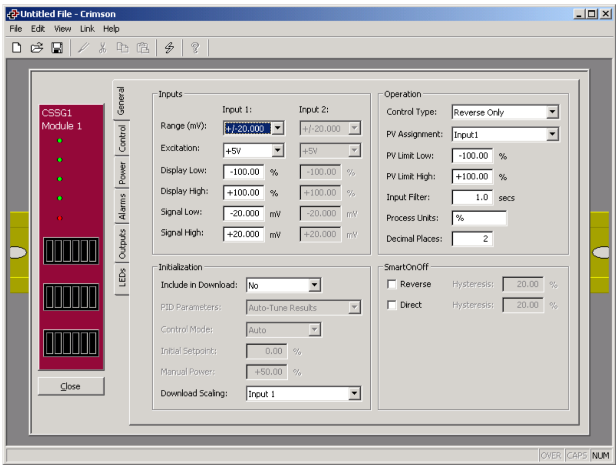
Application exception: If the application involves Fahrenheit measurement over 3000 degrees, with a C type thermocouple, the following values should be treated as unsigned.

PV
ReqSP
ActSP
AlarmData 1-4 (when configured for absolute operation)

CSSG – Strain Gage Input PID Module Programming

The CSSG module's parameters are broken into groups, each with their own page. Use the tabs on the left hand side of the window to view the various pages.

GENERAL



Inputs

The input parameters section contains settings for both inputs. If the module does not have the optional secondary input fitted, the secondary input parameters are ignored.

Range

Configure the input for various signal levels to allow for optimal resolution.

Excitation

Configure the output excitation voltage for either 5 or 10 volts.

Display Low
Display High

Enter the desired PV readings that correspond to the Signal Low and Signal High values, respectively. ie. If the application involves a strain gage that produces a 0 to 21.00 mV output proportional to 0 to 1000 lbs, enter 0 for the *Display Low* property, and 1000 for the *Display High* property.

Signal Low
Signal High

Enter the signal levels that correspond to the *Display Low* and *Display High* properties, respectively. ie. If the application involves a strain gage that produces a 0 to 21.00 mV output proportional to 0 to 1000 lbs, enter 0 for the *Signal Low* property, and +21.00 mV for the *Signal High* property.

OPERATION

The input parameters section contains settings for both inputs. If the module does not have the optional secondary input fitted, the secondary input parameters are ignored.

Control Type

Select from Reverse only, Direct only or Reverse and Direct, depending on the type of process to be controlled.

PV Assignment

Select how the module determines its measured process value. The PV value is the value that the module's PID algorithm will attempt to control. This can simply be the Input 1 value, or one of several mathematical results of Input 1 and Input 2.

PV Limit Low
PV Limit High

These properties are used to establish the working range of the PV value, and subsequently, the range over which the module can control. The reported PV value remains frozen at either limit as the process continues to move outside these boundaries. Exceeding either limit by more than 5% of the full range results in the module assuming a process fault, at which time the PV value reported becomes equal to the PV Limit High value (upscale drive response).

Input Filter

The Input Filter is a time constant used to stabilize fluctuating input signals.

Process Units

Enter the engineering units for the process. This is only used to identify the appropriate fields throughout the software. This parameter is saved as part of the Crimson file, but is not used within the module.

Decimal Places

The Decimal Places property is used to allow Crimson to display the engineering units in the proper resolution. This is only used to display the appropriate resolution throughout the software, and is not used within the module.

INITIALIZATION

The initialization parameters provide initial values for settings usually controlled by a PC or PLC. In typical applications, these settings will only be used until communications is established for the first time.

Include in Download

Select whether or not the initialization values will be downloaded to the module. Selecting "no" allows the modification and download of databases at will, without accidental overwriting of the established process parameters such as the setpoint, PID values, input scaling, etc.

PID Parameters

Select which PID parameters the module will load, and subsequently use, to control the process. The module controls the process using the Active PID values and Active Power Filter. (See ActConstP, ActConstI, ActConstD, and ActFilter variables in the Available Data chart at the end of this section.) The active set is loaded with either the User PID Settings, or the Auto-Tune Results values, depending on the state of the ReqUserPID bit. If the bit is true, the Active set is loaded with the user's variables. If the bit is false, the values that were established by auto-tune are loaded. Adjusting the *PID Parameters* property writes the ReqUserPID bit appropriately upon initialization.

Control Mode

Select whether the module will be in auto or manual mode upon initialization. In auto mode, the controller calculates the required output to reach and maintain setpoint, and acts accordingly. In manual mode, the output can be controlled directly by writing to the power variable.

Initial Setpoint

The *Initial Setpoint* property is used as the setpoint value upon initialization.

Manual Power

Enter the desired output power level the PID module will assume in manual mode. Values in excess of 100% and –100% can be entered to overcome the limitations caused by Power Transfer values, such as gains and offsets that would otherwise limit the outputs to less than their maximums.

Download Scaling

Select which scaling values, if any, will be downloaded to the module. To avoid overwriting the scaling values of a calibrated process, set this value to No.

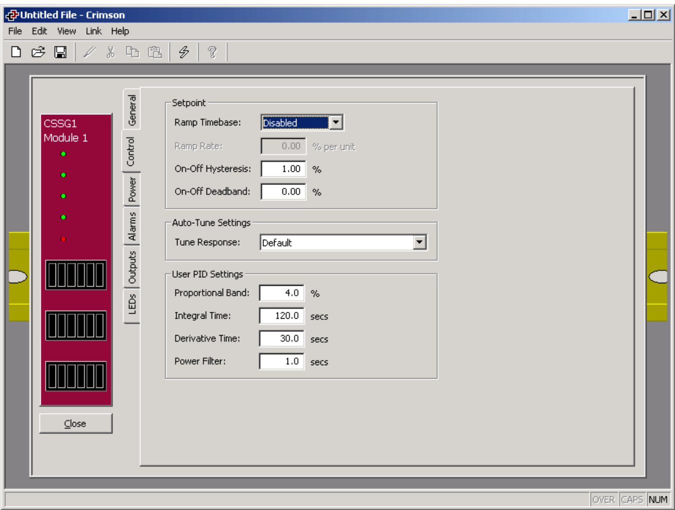
SmartOnOff

SmartOnOff is designed for situations where on-off control would normally be used, but where the advantages of PID are also desired. When the reverse or direct output is placed into this mode, the control output will either be driven on or off, with no intermediate values or time proportioning. However, rather than use the process value to decide when to turn the output on, SmartOnOff looks at the output of the PID calculation and activates the output when it exceeds half the defined gain for that channel. For example, with default settings, SmartOnOff for the reverse output would turn the output on once the PID algorithm called for 50% power or more, with the hysteresis value being used to ensure that small changes in the PID calculation do not produce relay chatter.

Hysteresis

Set to eliminate output chatter by separating the on and off points of the output(s) when performing SmartOnOff control. The *Hysteresis* value is centered around the setpoint, that is, the transition points of the output will be offset above and below the setpoint by half of the *Hysteresis* value.

CONTROL



Setpoint

Ramp Timebase

Select from seconds, minutes, or hours as the unit of time for ramping of the process.

Ramp Rate

To reduce sudden shock to a process during setpoint changes and system startup, a setpoint ramp rate can be used to increase or decrease the Actual Setpoint at a controlled rate. The value is entered in units/time. A value of 0 disables setpoint ramping.

If the Setpoint Ramp Rate is a non-zero value, and the Requested Setpoint is changed or the module is powered up, the controller sets the Actual Setpoint to the current process measurement, and uses that value as its setpoint. It then adjusts the Actual Setpoint according to the setpoint Ramp Rate. When the Actual Setpoint reaches the Requested Setpoint, the controller resumes use of the Requested Setpoint value. (In a properly designed and functioning system, the process will have followed the Actual Setpoint value to the Requested Setpoint value.)

On-Off Hysteresis

Eliminate output chatter by separating the on and off points of the output(s) when performing on/off control. The hysteresis value is centered around the setpoint, that is, the transition points of the output will be offset above and below the setpoint by half of the *On/Off Hysteresis* value. This value effects outputs programmed for Reverse or Direct. During auto-tune, the controller cycles the process through 4 on/off cycles, so it is important to set the *On-Off Hysteresis* to an appropriate value before initializing auto-tune.

On-Off Deadband

This value provides a means of offsetting the on-points of reverse and direct outputs programmed for on/off operation. This results in a deadband if the value is positive, and overlap if the value is negative. When determining the actual transition points of the outputs, the *On/Off Hysteresis* value must also be taken into consideration.

AUTO-TUNE SETTINGS

Tune Response

The Tune Response property is used to ensure that an auto-tune yields the optimal P, I, and D values for varying applications. A setting of Very Aggressive results in a PID set that will reach setpoint as fast as possible, with no concern for overshoot, while a setting of Very Conservative sacrifices speed in order to prevent overshoot.

Note: **If the *Tune Response* property is changed, auto-tune needs to be reinitiated for the changes to affect the PID settings. See the Auto-Tuning Section for more information.**

User PID Settings

Proportional Band

Entered as a percentage of the full input range, this is the amount of input change required to vary the output full scale. The input range is the difference between the PV Limit Lo and PV Limit Hi values. The Proportional Band is adjustable from 0.0% to 1000.0%, and should be set to a value that provides the best response to a process disturbance while minimizing overshoot. A Proportional Band of 0.0% forces the controller into On/Off Control with its characteristic cycling at setpoint. The optimal value may be established by invoking Auto-tune.

Integral Time

The time in seconds that it takes the integral action to equal the proportional action, during a constant process error. As long as the error exists, integral action is repeated each Integral Time. The higher the value, the slower the response. The optimal value may be established by invoking auto-tune. The Integral Time is adjustable from 0 to 6000.0 seconds.

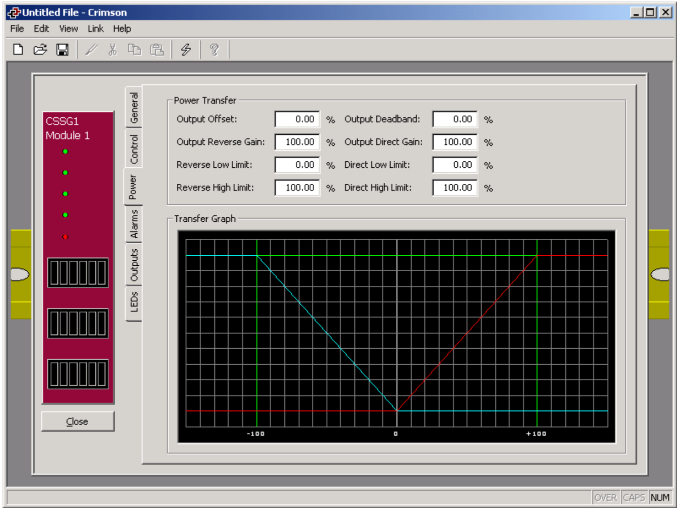
Derivative Time

The time, entered as seconds per repeat, that the controller looks ahead at the ramping error to see what the proportional contribution will be and it matches that value every Derivative Time. As long as the ramping error exists, the derivative contribution is repeated every derivative time. Increasing the value helps to stabilize the response, but too high of a value, coupled with noisy signal processes, may cause the output to fluctuate too greatly, yielding poor control. Setting the time to zero disables derivative action. The optimal Derivative Time may be established by invoking auto-tune. The value is adjustable from 0 to 600.0 seconds.

Power Filter

The Power Filter is a time constant, entered in seconds, that dampens the calculated output power. Increasing the value increases the dampening effect. Generally, a Power Filter in the range of one-twentieth to one-fiftieth of the controller's integral time (or process time constant) is effective. Values longer than these may cause controller instability due to the added lag effect.

POWER



Power Transfer

Output Offset

This value effectively shifts the zero output point of the module's output power calculation. This feature is most commonly used in proportional-only applications, to remove steady-state error.

Output Deadband

This property defines the area in which both the reverse and direct outputs are inactive, known as deadband, or the area in which they will both be active, known as overlap. A positive value results in a deadband, while a negative value results in an overlap.

Output Reverse Gain

This defines the gain of the reverse output relative to the gain established by the Proportional Band. A value of 100% causes the reverse gain to mimic the gain determined by the proportional band. A value less than 100% can be used in applications in which the output device is oversized, while a value greater than 100% can be used when the device is undersized. For the majority of applications the default value of 100% is adequate, and adjustments should only be made if the process requires it.

Output Direct Gain

This defines the gain of the direct output relative to the gain established by the Proportional Band. A value of 100% causes the direct gain to mimic the gain determined by the proportional band. A value less than 100% can be used in applications in which the output device is oversized, while a value greater than 100% can be used when the output device is undersized. For the majority of applications the default value of 100% is adequate, and adjustments should only be made if the process requires it.

Reverse Low Limit
Reverse High Limit

These properties may be used to limit controller power due to process disturbances or setpoint changes. Enter the safe output power limits for the process. You may enter values in excess of 100% and –100% to overcome limitations caused by power transfer values, such as gains and offsets, which would otherwise limit the output to less than their maximums.

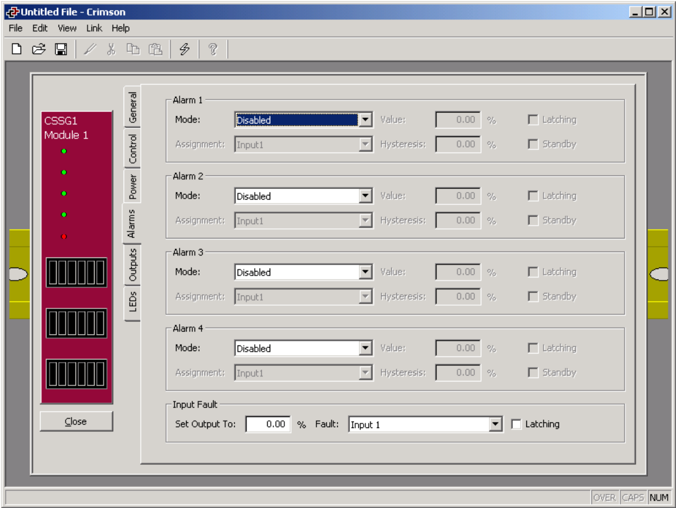
Direct Low Limit
Direct High Limit

These properties may be used to limit controller power due to process disturbances or setpoint changes. Enter the safe output power limits for the process. You may enter values in excess of 100% and –100% to overcome limitations caused by power transfer values, such as gains and offsets, which would otherwise limit the output to less than their maximums.

TRANSFER GRAPH

The power transfer graph illustrates the results of changes made to the power settings. The blue line represents the direct output, while the red line represents the reverse output.

ALARMS



The four "soft" process alarms may be used to monitor process status, and may be used to actuate the module's physical outputs. Otherwise, the bit alone may be monitored via the system itself, or via external devices.

Mode

This property determines what behavior the alarm will assume. The table below describes the various selections.

Absolute Low – The alarm activates when the measured value falls below the Alarm Value. The alarm deactivates when the measured value goes above the Alarm Value + Hysteresis.

Absolute High – The alarm activates when the measured value exceeds the Alarm Value. The alarm deactivates when the measured value falls below the Alarm Value – Hysteresis.

Deviation Low – If the measured value falls below the Setpoint Value by the amount of the Alarm Value, the alarm activates. In this mode, the alarm point tracks the Setpoint Value.

Deviation High – If the measured value exceeds the Setpoint Value by the amount of the Alarm Value, the alarm activates. In this mode, the alarm point tracks the Setpoint Value.

In Band – If the difference between the Setpoint Value and the measured value is not greater than the Alarm Value, the alarm activates.

Out of Band – If the measured value exceeds, or falls below, the Setpoint Value by an amount equal to the Alarm Value, the alarm activates. In this mode, the alarm point tracks the Setpoint Value.

Assignment Change the value that the alarms will monitor, and therefore react to.

Value Enter the point at which the alarm will turn on. The alarm values are entered in the same units of measure as those used to scale the variable chosen in the Assignment property.

Hysteresis The Hysteresis value separates the on and off points of the alarm ie. a high acting alarm programmed to turn on at 500 with a Hysteresis of 10, will turn off when the PV falls below 490.

Latching The Latching property dictates how the alarm behaves once activated. See the Alarm Behavior Chart for more information.

Standby The Standby property provides a means of preventing so called nuisance alarms during power up. See the Alarm Behavior Chart for more information.

Alarm Behavior Chart

LATCHING	STANDBY	ALARM BEHAVIOR	EFFECT OF SETTING ALARM ACCEPT BIT TO "1"
		Alarm automatically turns on and off as the measured value crosses in and out of the alarm region.	Disables alarm, regardless of state. If the alarm condition exists, and the bit is written to a "0", the alarm activates.
☑		Once activated, the alarm stays active until accepted.	If the alarm condition no longer exists, writing the Alarm Accept bit to "1" resets the alarm condition. As long as the Alarm Accept bit is "1", the alarm automatically turns on and off as the measured value crosses in and out of the alarm region.
	☑	Alarm automatically turns on and off as the measured value crosses in and out of the alarm region. The alarm is automatically disabled when a setpoint change occurs, or when the module is first powered up. This prevents nuisance alarms from occurring. The alarm remains disabled until the process enters a non-alarm state. The next time the measured value enters an alarm condition, the alarm will activate accordingly.	Disables alarm, regardless of state. If the alarm condition exists, and the bit is written to a "0", the alarm activates.
☑	☑	Once activated, the alarm stays active until accepted. The alarm is automatically disabled when a setpoint change occurs, or when the module is first powered up. This prevents nuisance alarms from occurring. The alarm remains disabled until the process enters a non-alarm state. The next time the measured value enters an alarm condition, the alarm will activate accordingly.	Momentarily writing the Alarm Accept bit to "1" turns off an active alarm. If the alarm condition still exists, the alarm remains off and is placed into standby mode. That is, the alarm will remain off until the alarm condition goes away, and is then reentered. If the Alarm Accept bit remains a "1", the alarm is disabled, and will not function.

Input Fault

The Input Fault section is used to define the response of the CSSG module's control outputs in the event of an input failure and/or the process value exceeds the PV Limit Low or PV Limit High values. The Input Fault alarm is considered a process alarm for items that may be mapped to "any process alarm".

Set Output To

Enter the output value that the controller will assume in the event of an input sensor failure. Values in excess of 100% and –100% may be entered to overcome limitations caused by power transfer values, such as gains and offsets, which would otherwise limit the output to less than their maximums.

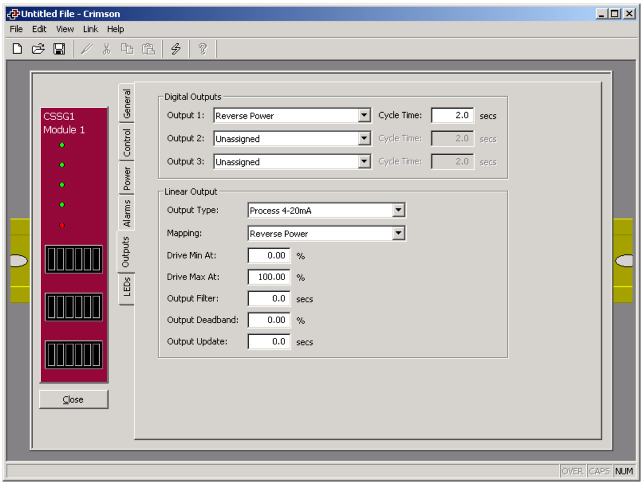
Fault

Select if a sensor failure on Input 1 alone, or either input, is required to drive the output to the Set Output To value.

Latching

If enabled, will cause the input fault bits to stay active until accepted, regardless of the state of the input(s). To accept the fault, the respective Accept bit must be written to a 1. If latching is not selected, the fault(s) will automatically deactivate when the input failure(s) is corrected.

OUTPUTS



Digital Outputs

Output n

Assign the module's physical outputs to various internal properties or values.

Cycle Time

The sum of a time-proportioned output's on and off cycles. With time proportional outputs, the percentage of output power is converted into output on time of the cycle time value eg. if the controller's algorithm calls for 65% power, and has a Cycle Time of 10 seconds, the output will be on for 6.5 seconds and off for 3.5 seconds. A Cycle Time equal to, or less than, one-tenth of the process time constant is recommended.

LINEAR OUTPUT

Output Type

Select between 0-10 V, 0-20 mA, or 4-20 mA outputs. Make sure that the output jumpers, located on the side of the module, are set for the same output type.

Mapping

Assign the module's analog output to one of various internal properties or values.

Drive Min At
Drive Max At

Enter the values used to scale the analog output. The units expressed are the same as those of the Mapping value, so the numerical limits vary eg. values of 0% and 100% are typically used to control a process.

Output Filter

The Output Filter is a time constant entered in seconds that dampens the response of the analog output. Increasing the value increases the dampening.

Output Deadband

The Output Deadband value can be used to prevent the analog output from changing when only small adjustments are called for. This is useful in preventing mechanical wear when driving a linear input valve. The analog output will not adjust unless the change called for exceeds half of the deadband value. i.e. With a deadband of 10 %, and an output value of 50 %, the output will not change until 45 % or 55 % is called for. The units expressed are the same as those of the Mapping value.

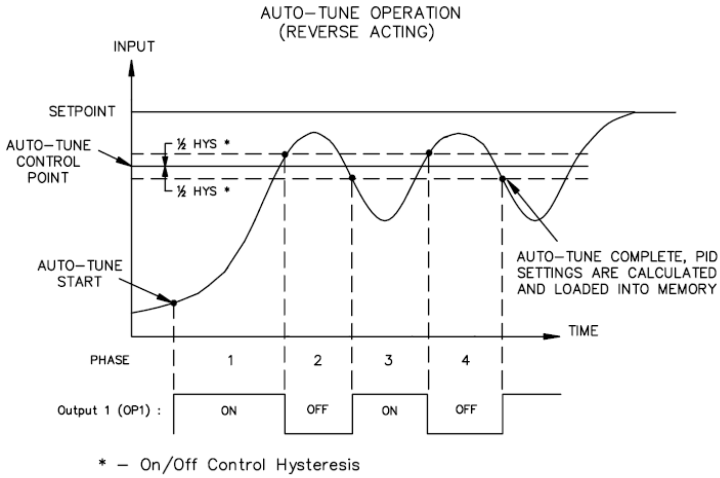
Output Update

The Output Update time can be used to decrease the update frequency of the analog output. When the Output Update timer expires, the analog output checks to see if the required change is greater than the Output Deadband value. If the required change is greater, the output will reflect the new value. If not, the output does not change, and the timer starts again.

AUTO-TUNING

OVERVIEW

Auto-Tune may be used to establish the optimal P, I, D, and Power Filter values. By cycling the process through four on/off cycles, the module learns information about the process, and determines the best values.



As shown above, the setpoint used during Auto-Tune is the value 75 % above the difference between the current PV and the setpoint. This allows the oscillations to occur close to setpoint, while avoiding excessive overshoot. Since the module performs on/off control during Auto-Tune, it is important to set a suitable On/Off Hysteresis value prior to invoking Auto-Tune.

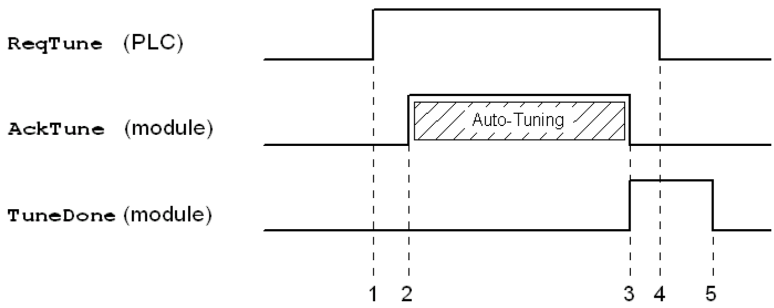
Customization of the PID set that Auto-Tune yields is possible by adjusting the Tune Response setting. Within Crimson, the Tune Response setting can be set to Very Aggressive, Aggressive, Default, Conservative, or Very Conservative. Further, the Tune Response setting can be adjusted by writing 0-4 respectively to the Tune Response register.

INVOKING AUTO-TUNE

The Auto-Tune sequence uses a Request/Acknowledgement handshaking. To invoke Auto-Tune, write the ReqTune bit to a 1. The module signifies that Auto-Tune is running by setting the AckTune bit high. When Auto-Tune is complete, the TuneDone bit goes high. The external logic should be written to turn off the Auto-Tune Request bit when the TuneDone bit goes high. At this point, the module sets the AckTune bit back to 0.

If for some reason Auto-Tune fails to complete, the TuneDone and TuneFail bits both go high. This situation may occur if, for example, an input fault occurs, and will require that Auto-Tune be reinitialized.

An Auto-Tune request cycle looks like the following.



1. PLC sets ReqTune high.
2. Module starts Auto-Tuning, sets AckTune high.
3. Auto-Tune is complete. AckTune goes low, TuneDone goes high.
4. PLC sees TuneDone high, sets ReqTune low.
5. Module sees ReqTune go low, and resets the TuneDone bit.

AVAILABLE DATA

The following are the data values available to the Master, and therefore, may be mapped to PLC registers. Decimal places are used to denote resolution only, and are not read or written ie. a Power value of 10000 is interpreted as 100.00%.

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
Loop	Status	PV	Process Value – The value being controlled by the PID loop.	✻	R
		Input1	Input 1 scaled value	✻	R
		Input2	Input 2 scaled value	✻	R
		Output	Output Power – Calculated output power of the PID loop prior to Gain, Offsets, and Limits	-200 to +200%	R
		RevPower	Output applied to channels assigned for Reverse	0 to 100.00%	R
		DirPower	Output applied to channels assigned for Direct	0 to 100.00%	R
		ActSP	Actual Setpoint	✻	R
		Error	The difference between the Process Value and the Requested Setpoint	✻	R
		AckManual	Acknowledge Manual mode	0 or 1 (bit)	R
		AckTune	Acknowledge Auto-Tune request	0 or 1 (bit)	R
		TuneDone	Auto-Tune completed	0 or 1 (bit)	R
		TuneFail	Auto-Tune did not successfully finish	0 or 1 (bit)	R

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
	Status	(Continued)			
		Alarm1	Alarm 1 status (on or off)	0 or 1 (bit)	R
		Alarm2	Alarm 2 status (on or off)	0 or 1 (bit)	R
		Alarm3	Alarm 3 status (on or off)	0 or 1 (bit)	R
		Alarm4	Alarm 4 status (on or off)	0 or 1 (bit)	R
		PV Alarm	PV out of range (Input fault, on or off)	0 or 1 (bit)	R
		Inp1 Alarm	Input 1 out of range (Input fault, on or off)	0 or 1 (bit)	R
		Inp2 Alarm	Input 2 out of range (Input fault, on or off)	0 or 1 (bit)	R
	Control	ReqSP	Requested Setpoint – The setpoint value written to the controller. This value may be different than the Actual Setpoint in applications utilizing Setpoint Ramping.	*	R/W
		Power	Manual output power setting	-200.00% to +200.00%	R/W
		SetHyst	Setpoint Hysteresis for On/Off Control	*	R/W
		SetDead	Setpoint Deadband for On/Off Control	*	R/W
		SetRamp	Setpoint Ramp Rate	*	R/W
		InputFilter	Input Filter	0 – 60.0 Seconds	R/W
		ReqManual	Request Manual – Write this bit to a 1 to invoke manual mode. In manual mode, writing to the Power register controls the output power.	0 or 1 (bit)	R/W
		ReqTune	Request Auto-Tune – Write this bit to a 1 to invoke Auto-Tune.	0 or 1 (bit)	R/W
		ReqUserPID	Request User PID Set – High loads User values into Active set, Low loads Auto-Tuned set into Active set.	0 or 1 (bit)	R/W
	Alarms	AlarmData1	Alarm 1 Value	*	R/W
		AlarmData2	Alarm 2 Value	*	R/W
		AlarmData3	Alarm 3 Value	*	R/W
		AlarmData4	Alarm 4 Value	*	R/W
		AlarmHyst1	Alarm 1 Hysteresis value	*	R/W
		AlarmHyst2	Alarm 2 Hysteresis value	*	R/W
		AlarmHyst3	Alarm 3 Hysteresis value	*	R/W
		AlarmHyst4	Alarm 4 Hysteresis value	*	R/W

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
	Alarms	(Continued)			
		Alarm Accept1	Alarm 1 Accept bit	0 or 1 (bit)	R/W
		Alarm Accept2	Alarm 2 Accept bit	0 or 1 (bit)	R/W
		Alarm Accept3	Alarm 3 Accept bit	0 or 1 (bit)	R/W
		Alarm Accept4	Alarm 4 Accept bit	0 or 1 (bit)	R/W
		Input Accept	Input out of range alarm accept	0 or 1 (bit)	R/W
	PID	TuneCode	Tune Response Code	0-4	R/W
		UserConstP	User Proportional Value	0-1000.0%	R/W
		UserConstI	User Integral Value	0-6000.0 Seconds	R/W
		UserConstD	User Derivative Value	0-600.0 Seconds	R/W
		UserFilter	User Power Filter Value	0-60.0 Seconds	R/W
		AutoConstP	Auto-Tuned Proportional Value	0-1000.0%	R
		AutoConstI	Auto-Tuned Integral Value	0-6000.0 Seconds	R
		AutoConstD	Auto-Tuned Derivative Value	0-600.0 Seconds	R
		AutoFilter	Auto-Tuned Power Filter Value	0-60.0 Seconds	R
		ActConstP	Active Proportional Value	0-1000.0%	R
		ActConstI	Active Integral Value	0-6000.0 Seconds	R
		ActConstD	Active Derivative Value	0-600.0 Seconds	R
		ActFilter	Active Power Filter Value	0-60.0 Seconds	R
	Power	PowerFault	Power Output value for input fault	-200.00 to +200.00%	R/W
		PowerOffset	Power Output Offset value	-100.00 to +100.00%	R/W
		PowerDead	Power Output Deadband value	-100.00 to +100.00%	R/W
		PowerRev Gain	Power Output Reverse Gain value	0 to 500.00%	R/W
		PowerDir Gain	Power Output Direct Gain value	0 to 500.00%	R/W
		PowerRev Hyst	Power Output SmartOnOff Reverse Hysteresis	0 – 50.00%	R/W
		PowerDir Hyst	Power Output SmartOnOff Direct Hysteresis	0 – 50.00%	R/W

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
	Power	(Continued)			
		RevLimitLo	Reverse Low Limit	0 – 200.00%	R/W
		RevLimitHi	Reverse High Limit	0 – 200.00%	R/W
		DirLimitLo	Direct Low Limit	0 – 200.00%	R/W
		DirLimitHi	Direct High Limit	0 – 200.00%	R/W
	Scale Input1	DispLo1	Input 1 display low value	-30,000 to +30,000	R/W
		DispHi1	Input 1 display high value	-30,000 to +30,000	R/W
		SiglLoKey1	Input 1 signal low – keyed-in (entered) value	-30,000 to +30,000	R/W
		SigHiKey1	Input 1 signal high – keyed-in (entered) value	-30,000 to +30,000	R/W
		SigLoApp1	Input 1 signal low – applied value	-30,000 to +30,000	R
		SigHiApp1	Input 1 signal high – applied value	-30,000 to +30,000	R
		StoreSigLo1	Store input 1 signal low (edge triggered) – on the positive going edge, the millivolt signal applied to input 1 is saved as SigLoApp1	0 or 1 (bit)	R/W
		StoreSigHi1	Store input 1 signal high (edge triggered) – on the positive going edge, the millivolt signal applied to input 1 is saved as SigHiApp1	0 or 1 (bit)	R/W
		Select Scaling1	Select input 1 applied signals (level sensitive) – when high, the applied signal values are active; when low, the keyed-in signal values are active	0 or 1 (bit)	R/W
	Scale Input2	Same as Scale Input 1 above			
	Peak Valley	PVPeak	The maximum PV value measured since the last peak reset	-30,000 to +30,000	R
		PVVall	The minimum PV value measured since the last valley reset	-30,000 to +30,000	R
		ResetPkVall	Reset Peak and Valley – Write this bit to 1 (level sensitive) to reset the peak and valley registers to the existing PV value.	0 or 1 (bit)	R/W
		ResetPeak	Reset Peak – Write this bit to 1 (level sensitive) to reset the peak register to the existing PV value.	0 or 1 (bit)	R/W
		ResetVall	Reset Valley – Write this bit to 1 (level sensitive) to reset the valley register to the existing PV value.	0 or 1 (bit)	R/W
	Tare	PVGross	Gross PV value; direct result of PV assignment math, before tare	-30,000 to +30,000	R
		Inp1Gross	Gross input 1 value; direct result of input scaling, before tare	-30,000 to +30,000	R
		Inp2Gross	Gross input 2 value; direct result of input scaling, before tare	-30,000 to +30,000	R
		PVTareTot	PV Tare Total – The sum of the tared PV values since the last reset of the PV tare total	-30,000 to +30,000	R

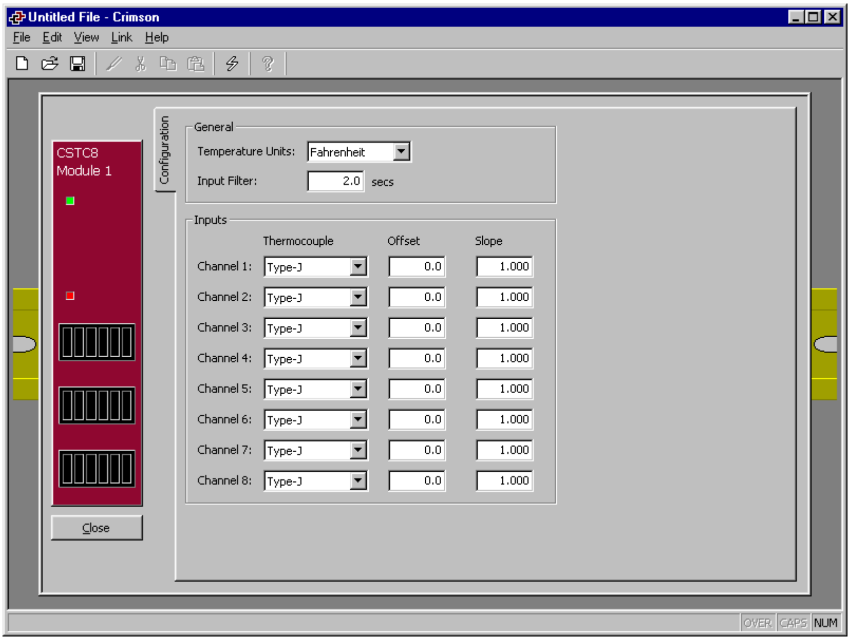
LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
	Tare	(Continued)			
		Inp1TareTot	Input 1 Tare Total – The sum of the tared input 1 values since the last reset of the input 1 tare total	-30,000 to +30,000	R
		Inp2TareTot	Input 2 Tare Total – The sum of the tared input 2 values since the last reset of the input 2 tare total	-30,000 to +30,000	R
		TarePV	Tare Process Value – Write this bit to a 1 (edge triggered) to tare (reset) the PV value to 0. The tared value is added to the PV tare total	0 or 1 (bit)	R/W
		TareInp1	Write this bit to a 1 (edge triggered) to tare (reset) the input 1 value to 0. The tared input 1 value is added to the input 1 tare total.	0 or 1 (bit)	R/W
		TareInp2	Write this bit to a 1 (edge triggered) to tare (reset) the input 2 value to 0. The tared input 2 value is added to the input 2 tare total.	0 or 1 (bit)	R/W
		RstPVTareTot	Write this bit to a 1 (edge triggered) to reset the PV tare total to 0	0 or 1 (bit)	R/W
		RstIn1TareTot	Write this bit to a 1 (edge triggered) to reset the input 1 tare total to 0	0 or 1 (bit)	R/W
		RstIn2TareTot	Write this bit to a 1 (edge triggered) to reset the input 2 tare total to 0	0 or 1 (bit)	R/W
Outputs	Cycle Times	CycleTime1	Cycle Time for Output 1	0.1 to 60.0 Seconds	R/W
		CycleTime2	Cycle Time for Output 2	0.1 to 60.0 Seconds	R/W
		CycleTime3	Cycle Time for Output 3	0.1 to 60.0 Seconds	R/W
	Remote Data	DigRemote1	Digital Remote 1 – Outputs assigned to Digital Remote can be controlled by writing the DigRemote bit to a 1 or 0.	0 or 1 (bit)	R/W
		DigRemote2	Digital Remote 2 – See DigRemote1	0 or 1 (bit)	R/W
		DigRemote3	Digital Remote 3 – See DigRemote1	0 or 1 (bit)	R/W
		DigRemote4	Digital Remote 4 – See DigRemote1	0 or 1 (bit)	R/W
		AnlRemote1	Analog Remote Value 1 – Outputs assigned to Analog Remote can be controlled by writing a number to this word.	❋	R/W
		AnlRemote2	Analog Remote Value 2 – See AnlRemote1	❋	R/W
		AnlRemote3	Analog Remote Value 3 – See AnlRemote1	❋	R/W
		AnlRemote4	Analog Remote Value 4 – See AnlRemote1	❋	R/W
	Information	OP1State	State of Output 1	0 or 1 (bit)	R
		OP2State	State of Output 2	0 or 1 (bit)	R
		OP3State	State of Output 3	0 or 1 (bit)	R

❋ Dependent on input configuration. For process input, the resolution is dependent upon the user scaling values.

CSTC/CSRTD – Input Module Programming

To access a module's configuration, double-click it. All of the module parameters are visible on a single page.

CONFIGURATION



General

These settings apply to all of the input channels.

Temperature Units	Select from Kelvin, Fahrenheit, or Celsius.
Input Filter	The Input Filter is a time constant used to stabilize fluctuating input signals.

Inputs

These settings allow individual customization of each input's parameters.

Channel x:	CSTC8 - Specify the thermocouple standard being used for each input. CSRTD6 - Specify the RTD standard (or ohms) being used for each input.

Offset: Enter the amount of degrees to compensate, or shift, the PV by. This setting allows customization of each input based on a given sensor's error. It also allows correction of the PV value in applications in which the sensor isn't measuring the process directly, thereby inducing an error.

See application example below.

Slope: Enter the amount of slope correction required to improve the reading from a non-linear input signal.

See application example below.

Application Example

PV reading from a thermocouple is 3 degrees low at 200 degrees Fahrenheit, but only 1 degree low at 300 degrees Fahrenheit.

Desired PV = (Reported PV x Slope) + Offset

Desired PV	Reported PV
200	197
300	299

$$\text{Slope} = \frac{300-200}{299-197} = 0.980$$

Offset = 200 – (0.980 x 197) = 6.940

A Slope value of 0.980, and an Offset value of 6.940 corrects the sensor error.

AVAILABLE DATA

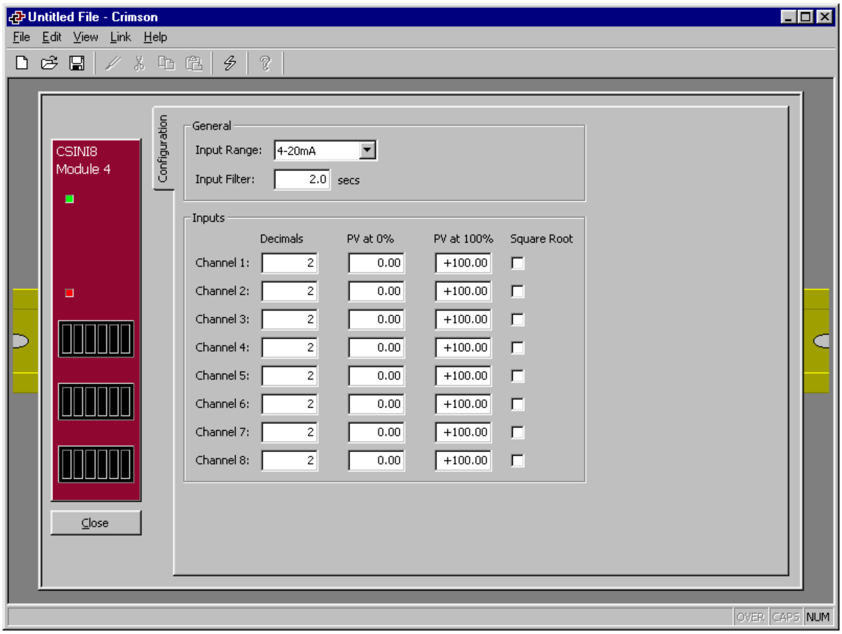
LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
Input	Status	PV1 – 8	Process Value – after Slope and Offset calculation	✻	R
	✻✻	ColdJunc	Cold Junction Calibration Value	Tenths of a degree	R
		InputAlarm 1 – 8	Input out of range	0 or 1 (bit)	R
	Control	InputFilter	Input Filter	0-60.0 seconds	R/W
		InputOffset 1 – 8	Offset value added to PV	-100.0 to +100.0	R/W
		InputSlope 1 – 8	Slope value applied to PV	.001 – 10.000	R/W

✻ Dependent on selected sensor type.
✻✻ CSTC Only

CSINI/CSINV - Analog Input Module Programming

To access a module's configuration, double-click it. All of the module parameters are visible on a single page.

CONFIGURATION



General

These settings apply to all of the input channels.

Input Range

CSINI8 – Select between 0-20 mA and 4-20 mA.

CSINV8 – Select between 0-10 V and +/-10V.

Input Filter

The Input Filter is a time constant used to stabilize fluctuating input signals.

INPUTS

These settings allow individual customization of each input's parameters.

Decimals

Enter up to 4 decimal places. This is only used to display the appropriate resolution in the *PV at 0%* and *PV at 100% fields*. This parameter is saved as part of the Crimson file, but is not saved within the system.

PV at 0%

Enter the PV reading that corresponds with the minimum input signal. The minimum input signal is dependent on the selected Input Range. e.g. If the application involves a flow sensor with a 4 to 20 mA output proportional to 5 to 105 GPM, enter 5 for the PV at 0% setting.

PV at 100%

Enter the PV reading that corresponds with the maximum input signal. The maximum input signal is dependent on the selected Input Range. e.g. If the application involves a flow sensor with a 4 to 20 mA output proportional to 5 to 105 GPM, enter 105 for the PV at 100% setting.

Square Root

Select the check box if the input signal is the square of the desired PV. This is common in flow measuring applications in which the sensor is a differential pressure cell or pitot tube sensor.

AVAILABLE DATA

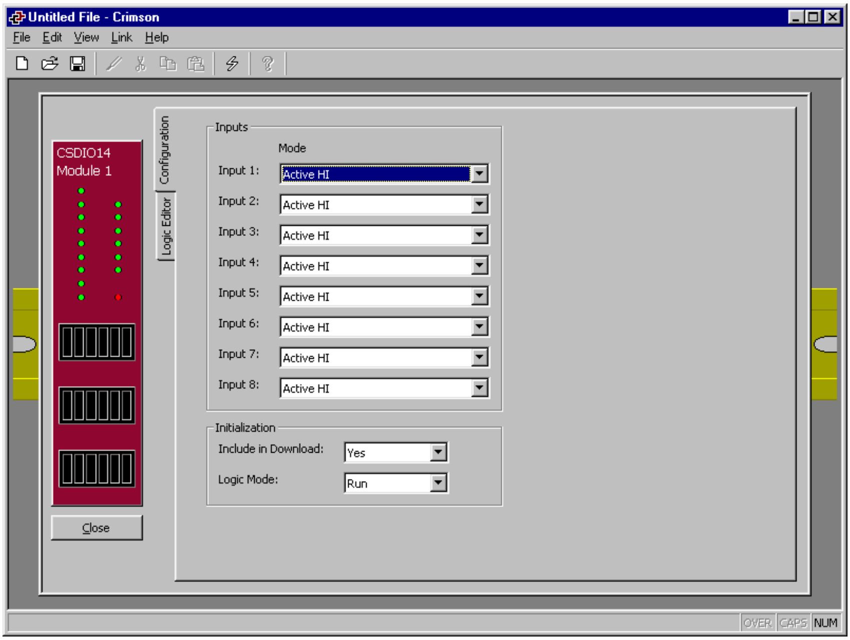
LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
Input	Status	PV1 – 8	Process Value – scaled according to PV at Minimum and PV at Maximum values	✻	R
		InputAlarm 1 – 8	Input out of range	0 or 1 (bit)	R
	Control	InputFilter	Input Filter	0-60.0 seconds	R/W
		ProcessMin 1 – 8	Desired PV at minimum input signal level	+/-30,000	R/W
		ProcessMax 1 – 8	Desired PV at maximum input signal level	+/-30,000	R/W

✻ Dependent on scaling.

CSDIO - Digital Module Programming

To access a module's configuration, double-click it. The module's parameters are accessed via multiple pages, which can be viewed by selecting the appropriate tab on the left-hand side of the pages.

CONFIGURATION



Inputs

These settings allow individual customization of each input's parameters.

Input x Specify for each input whether it should be considered active when high or when low.

Initialization

The initialization parameters provide initial values for settings usually controlled by a PC or PLC. In typical applications, these settings will only be used until communications is established for the first time.

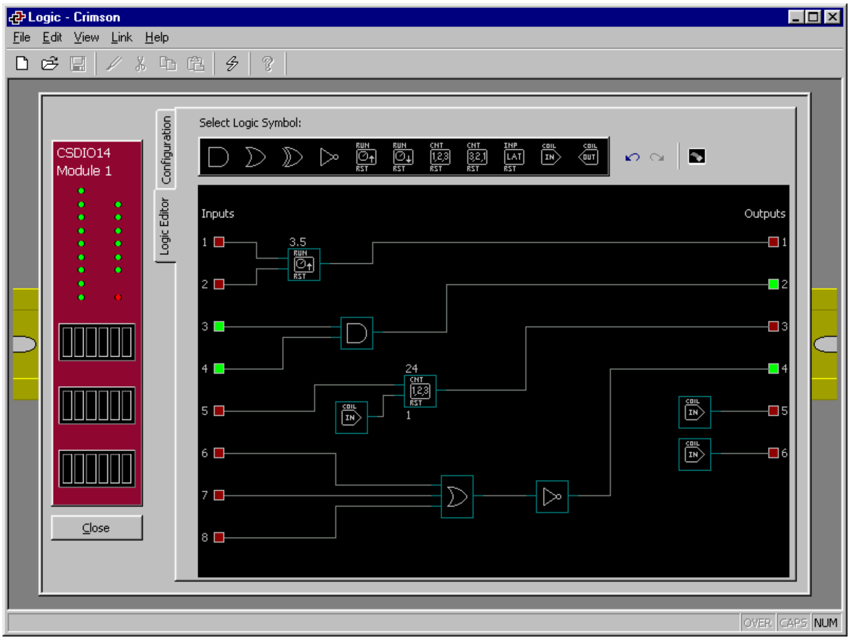
Include in Download Select whether or not you want the initialization settings downloaded to the module. Selecting "no" allows you to modify and download databases at will, without accidentally overwriting the Logic Mode.

Logic Mode

Select whether you want the logic engine of the module to Run or Stop when a download is performed. This can also be controlled via the LogicHalt bit. (See the Available Data chart at the end of this section.)

LOGIC EDITOR

The CSDIO module can perform logic, as well as provide timers and counters for processes requiring limited I/O. The logic UI is graphical, using standard gate symbols, as well as unique icons for added functionality. The UI also provides a means of logic simulation.



Symbols

Placing Symbols

You can select any symbol from the top of the page by left-clicking on it. To place the symbol(s) on the screen, simply left-click anywhere on the workspace. When you have finished placing a particular symbol, right-click again to deselect placement mode.

Moving Symbols

Symbols can be moved first by selecting them with a left-click, and then by dragging them to the new position. A subsequent left-click places the symbol in the new position.

Configuring Symbols

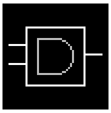
Most symbols have one or more parameters that can be adjusted. Double-click the symbol in question to access its parameters.

Deleting Symbols

Symbols are deleted by right-clicking on them.

Symbol Descriptions

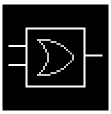
AND



The logical AND requires that all inputs be active for an output of 1. To add more inputs to the symbol, double-click it, and enter a new number.

INPUT 1	INPUT 2	OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

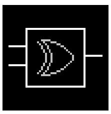
OR



The logical OR requires that one or more inputs be active for an output of 1. To add more inputs to the symbol, double-click it, and enter a new number.

INPUT 1	INPUT 2	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	1

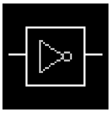
XOR



The logical XOR (exclusive OR) requires that one, but not all inputs, be active for an output of 1. To add more inputs to the symbol, double-click it, and enter a new number.

INPUT 1	INPUT 2	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	0

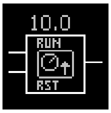
INVERTER

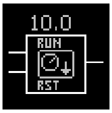


The inverter simply reverses the state of the input.

INPUT 1	OUTPUT
0	1
1	0

TIMERS





The timer symbol provides a run input, as well as a reset input. When the run input is true, the timer increases towards setpoint for up timers, and towards zero for down timers. When the run input is false, the timer stops incrementing. Once the setpoint or zero is reached, the output becomes true. An active reset input causes the timer to reset to zero, or preset, depending on the type of timer. To access the timer's preset value, double-click the timer symbol.

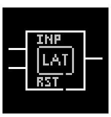
When using timers, you must assign each timer a unique Map ID number (1-8). When mapping both the actual timer value and the timer preset value via communications, the Map ID number will correspond to the variable numbers. (See Available Data table at the end of this section for more information.)

INPUT 1	INPUT 2	OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

COUNTERS

The counter symbol provides a count input, as well as a reset input. The counter increments towards preset (up counter), or decrements towards zero (down counter), every time the count input becomes active. Once the setpoint or zero is reached, the output becomes true. An active reset input causes the counter to reset to zero, or preset, depending on the type of counter. To access the counter's preset value, double-click the counter symbol.

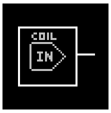
When using counters, you must assign each counter a unique Map ID number (1-8). When mapping both the actual count value and the counter preset value via communications, the Map ID number will correspond to the variable numbers. (See Available Data table at the end of this section for more information.)

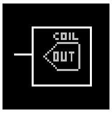


LATCH

The latch symbol allows a pulsed input to be converted to a maintained output. The output

COILS





The input and output coils act as "soft" inputs and outputs. These are used to provide signals that are mapped to external devices via communications, without actually requiring a physical input or output be consumed.

You must assign each coil a unique Map ID number (1-8). When mapping the coils via communications, the Map ID number will correspond to the variable number. (See Available Data table at the end of this section for more information.)

Wires

Placing Wires

Wires are drawn by left-clicking the mouse pointer on one connection point, and then left-clicking on another point. While hovering the mouse over a valid connection point, a small box appears to indicate proper positioning.

If you want to connect the output lead of a symbol to the input lead of more than one symbol, you must first click the input of the other symbol. You may then draw and connect the other end to any vertical wire segment of the output lead connection.

Moving Wires

Vertical wire segments and multi-wire junctions can be moved to change or improve the appearance of the diagram. This is done by first left-clicking the appropriate segment or junction, and then by dragging them to the new position. A subsequent left-click places the wire or segment in the new position.

To indicate proper positioning while hovering over wires, entire segments change to green, while vertical segments change to blue.

Deleting Wires

Wires are deleted by right-clicking on them.

LOGIC SIMULATION

To simulate the logic file, simply click on the inputs shown on the left of the Logic Editor diagram. Input coils can not be simulated (forced).

AVAILABLE DATA

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
Variables	Inputs	Input1...8	Input State	0 or 1 (bit)	R
		InputCoil1...8	Input Coil State	0 or 1 (bit)	R/W
	Outputs	Output1...6	Output State	0 or 1 (bit)	R/W
		OutputCoil1...8	Output Coil State	0 or 1 (bit)	R/W
	Counter/Timer Presets	CounterPreset1...8	Counter Preset Value	0-65535	R/W
		TimerPreset1...8	Timer Preset Value	0-6553.5 Seconds	R/W
	Counter/Timer Values	CounterValue1...8	Current Counter Value	0-65535	R
		TimerValue1...8	Current Timer Value	0-6553.5 Seconds	R
	Control	LogicHalt	Starts/stops Logic Engine	0 or 1 (bit)	R/W

CSMSTR – Master Programming

The primary function of the Master is to exchange data between the modules and external devices, such as PCs, PLCs, or HMIs. With this in mind, you'll want to insert and configure the modules that will be installed in the system before editing the Master's properties. By inserting the modules first, their data will be available when accessing the Master's communications blocks.

Ethernet Port Configuration

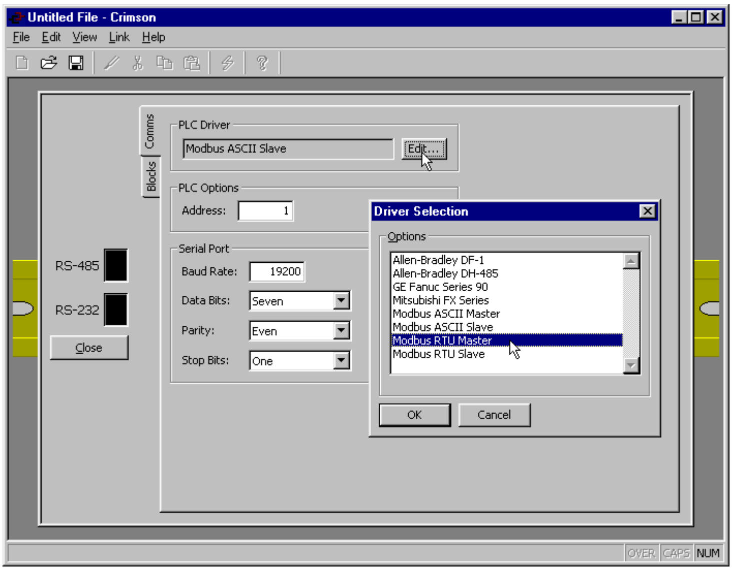
The 10-base-T Ethernet port supports up to two simultaneous connections using Modbus TCP/IP via port 502. Mapping of data between Modbus registers and the various modules is performed using the same techniques as for Port 2. The Ethernet port also supports ICMP echo requests ("pings") and a simple web server on port 80 for connectivity testing.

The port's IP configuration can be supplied manually, or automatically via DHCP. Automatic configuration is of little use unless the DHCP server is instructed to always allocate a particular IP to the unit's MAC address. If this is not done, the unit's IP address can change, making it very hard to tell clients which address they need to connect to! The Master's MAC address can be found on the barcode label located on the side of the unit.

Port 2 Configuration

After the appropriate modules have been added to the system, double-click the RS232/RS485 port of the Master to edit its properties.

COMMS



PLC DRIVER

Use the Edit button to choose the proper communications driver from the pop-up list.

PLC OPTIONS

Enter the relevant PLC information, such as the address of the PLC you are connecting to. Different options will appear depending on the PLC Driver chosen.

SERIAL PORT

Enter the settings of the serial port, such as Baud rate, Parity, and Stop bits, that you will be connecting the CS Master to.

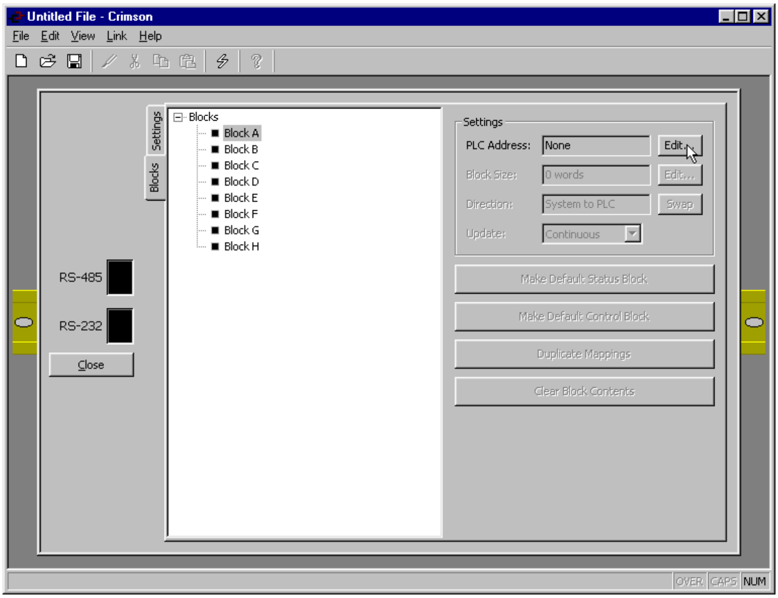
Baud Rate Enter a baud rate between 300 and 115200.

Data Bits Select seven or eight data bits.

Parity Select none, even, or odd parity.

Stop Bits Select one or two stop bits.

Mapping Data



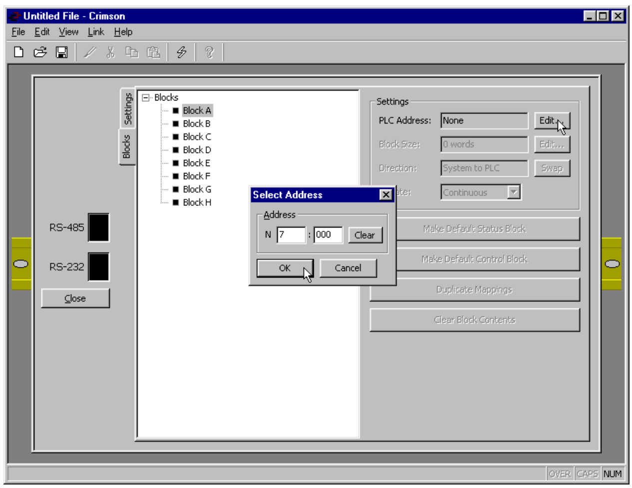
COMMUNICATIONS BLOCKS

The Communications Blocks are used to map data between the Modular Controller and the outside world. Initially, the left-hand pane shows the available blocks as empty. You can either map the data yourself, or…

Use Default Blocks To Build Your Application FAST!

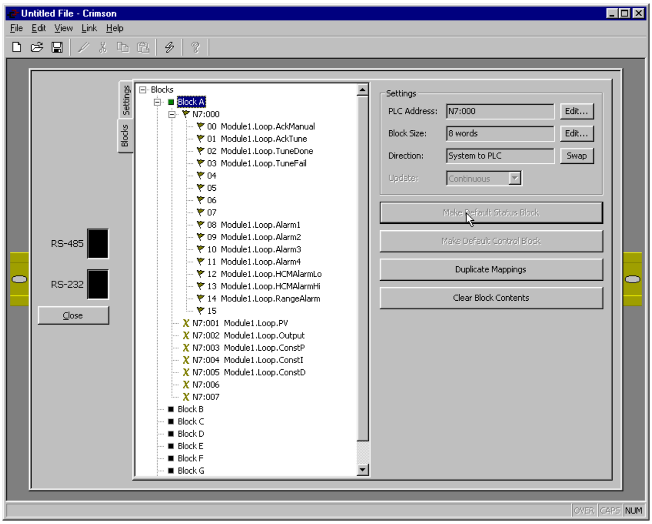
First, decide what PLC memory addresses you're going to map data to and from. You'll need two blocks; one that s**ends status data to the PLC**, and one that **gets control data from the PLC**.

To set up a status block, select Block A, then use the Edit button to enter the starting PLC address that you want to write data to.



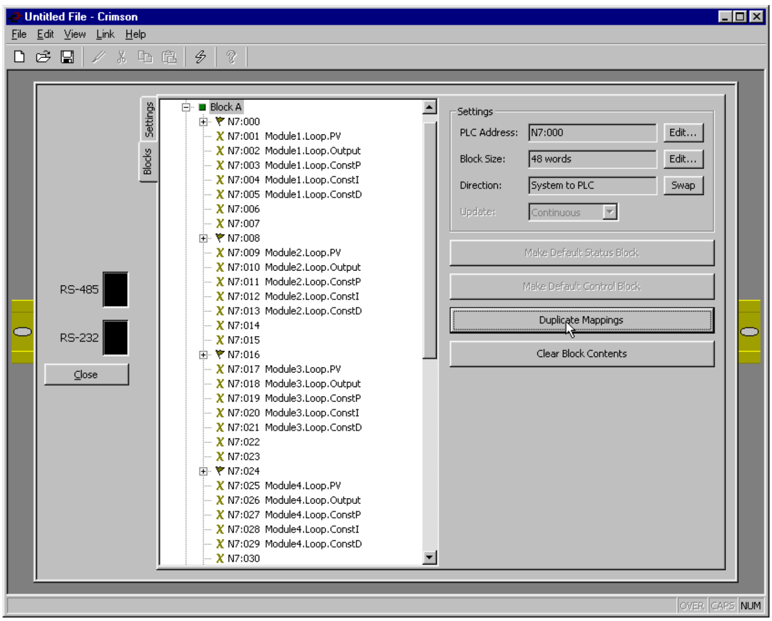
Once that is done, click the Make Default Status Block button.

Crimson will automatically map the most important status data to your PLC registers. You may wish to make changes or additions to the mapped data. If so, see the **Manually Mapping Data** section.

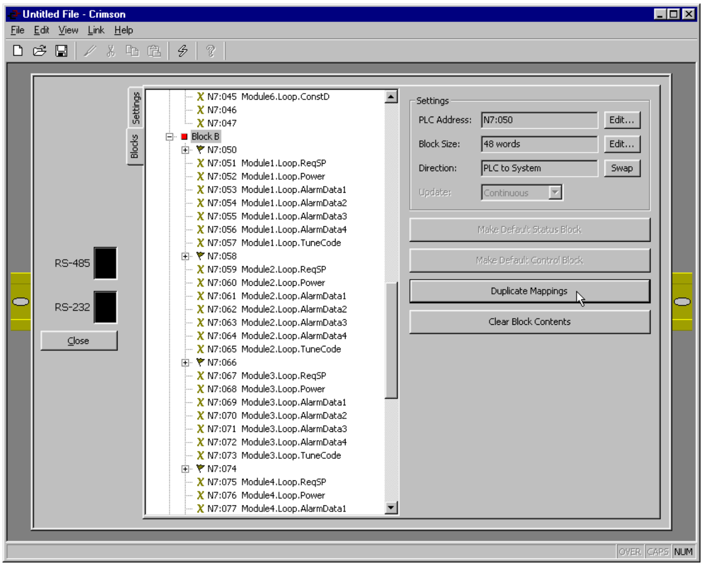


After making your changes, click the Duplicate Mappings button to map any like modules in the same fashion. The Duplicate Mappings button only duplicates Module 1 information, and provides an error message when data from any other module is mapped. If the configuration also contains other module types, those will have to be mapped manually.

If you want to remove mapped data, simply select the data, and press the delete key. Alternatively, you can use the Clear Block Contents button to start over.



To set up Block B with Control information that the PLC can write to, select Block B, enter a valid starting PLC address, and click the Make Default Control Block button. Again, make any necessary changes to the data mapping, then click the Duplicate Mappings button to map the rest of the modules.



MANUALLY MAPPING DATA

SETTINGS

By clicking on the Block, you can then access its Settings. Each of the block's settings are independent of the other's.

PLC Address

Use the Edit button to select the starting PLC address that you want to map data to or from.

Block Size

Enter the amount of registers from 1 to 255 that you want mapped by this Block. The Block tree will expand to display the registers in numerical order, starting with the number chosen in PLC Address.

Direction

Choose between System to PLC or PLC to System. By altering this setting, you can dictate whether the Master writes system data to the external device, or requests its data from the external device.

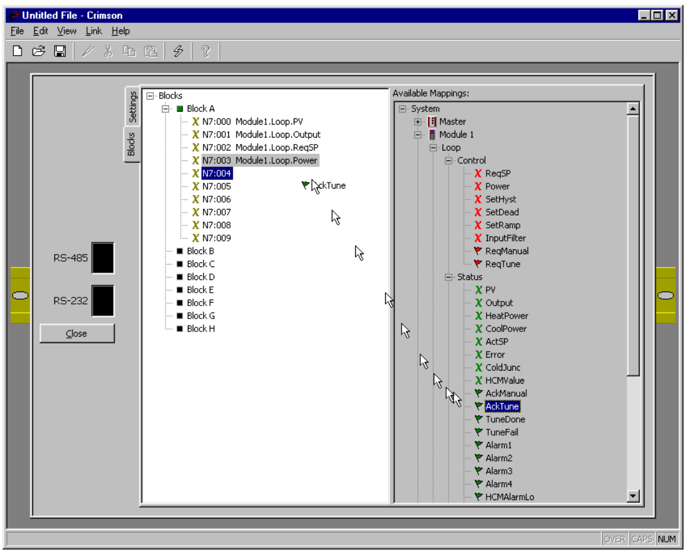
Update

Select how this block's data is updated. It may be updated continuously, or by a Strobe request. In most applications, an Update setting of Continuous is adequate, as Crimson will automatically optimize the request and receipt of data. For those applications which require manual control, the Update parameter can be set to Strobed. See **Strobed Data Requests** at the end of this section for an explanation of this feature.

Blocks A and B can only be set for Continuous, since the Strobed mode requires at least two Blocks be updated continuously.

EDITING BLOCKS

To map data between the system and the external device, click a register name in the left hand pane. The available system data will appear on the right. By double-clicking any data item on the right, it will appear next to the PLC register that it is mapped to on the left. You may also drag and drop the data from the right to the PLC register on the left.



If the data mapped to a register is a bit, you will be prompted to convert the entire register into bits. The tree structure will expand to show all of the available bits in the register. If a word is then assigned to the same register, you will be prompted to covert the register back into a word, and the mapped bits will be deleted.

The data in Available Mappings is presented in one of four ways. Data represented by an "X" is a 16-bit value, or word, while data represented with a flag is a single bit. Those items in green are read-only, and cannot be written to. The items in red are read/write variables.

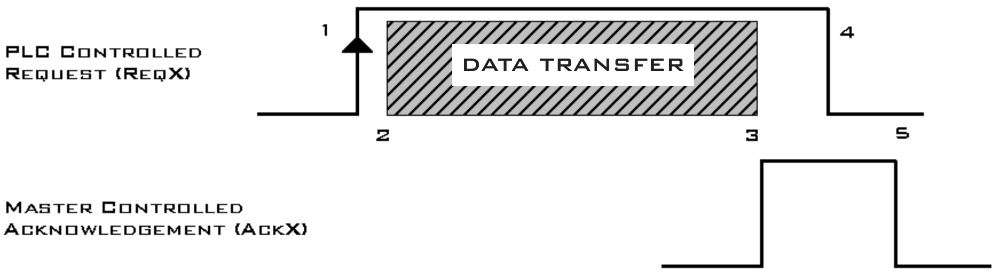
After manually mapping the first module, you may use the Duplicate Mappings button to automatically configure the rest of the modules for you.

Strobed Data Requests

Overview

For applications requiring large amounts of data transfer, especially in systems with multiple Modular Controller Masters, the communications blocks can be manually controlled. This method utilizes a Request/Acknowledgement structure. In other words, the Master will not read or write data in Blocks set for Strobed until requested to do so by the PLC. Once the update has occurred, the Master will provide an acknowledgement, so that the PLC knows it has occurred.

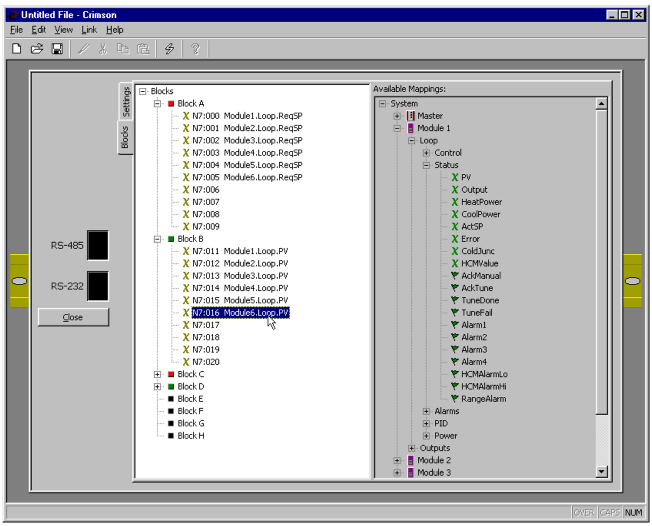
A full request/acknowledgement cycle looks like the following.



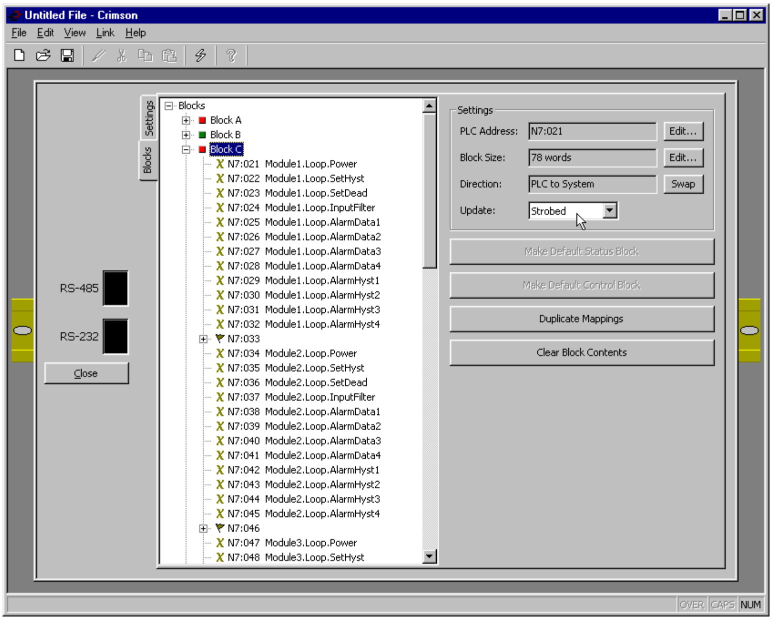
1. PLC requests data by setting appropriate bit high
2. Master “sees” bit go high, reads or writes appropriate data block.
3. When finished, Master acknowledges by setting Ack bit high.
4. PLC sees Ack go high, and resets the Req bit.
5. Master sees Req go low, and resets the Ack bit.

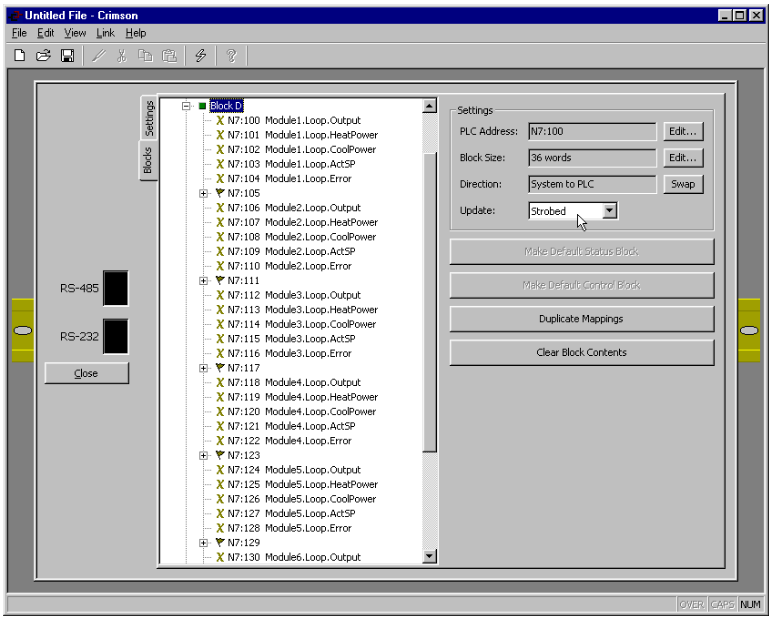
Using Strobed Data Requests

First, map any data that should be updated continuously, such as setpoint and process values, in Blocks A and B. Remember, one block will be status information, and should be set for System to PLC, the other will be control data, and should be set for PLC to System. Control Blocks A and B can only be programmed for Continuous Update, since a minimum of two blocks are required to control the Request and Acknowledgment of data.

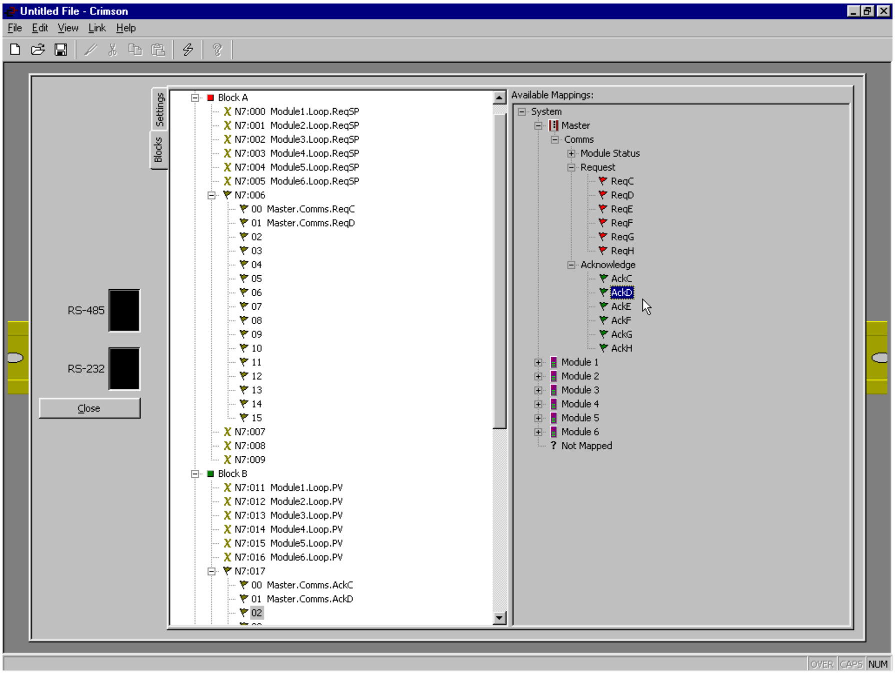


Second, map the data that should be updated based on a request in Blocks C through H. Set each of the Block's Updates for Strobed.





Map the appropriate Request bits into the control block, and the appropriate Acknowledge bits into the status block.



When the PLC needs the data refreshed for a particular Block, it can transition the appropriate Request bit to a 1. The Master will update the Block data, and signify its completion by setting the Acknowledge to a 1. The PLC logic should be written so that when the Acknowledge goes high, the Request is set back to 0. Upon seeing the Request go to 0, the Master resets its Acknowledge to 0, and is ready for another cycle.

AVAILABLE DATA

CSMSTR

The following are the data values available to the Master, and therefore, may be mapped to PLC registers.

LOCATION	GROUP	DATA	DESCRIPTION	RANGE	ACCESS R – READ W – WRITE
Comms	Module Status	Error01 – Error16	A 1 denotes a loss of communications to that module.	0 or 1 (bit)	R
	Request	ReqC – ReqH	Used to control Blocks set for Strobe.	0 or 1 (bit)	R/W
	Acknowledge	AckC – AckH	Used to signify Block transfer is complete. Automatically resets to 0 when associated Req bit goes low.	0 or 1 (bit)	R