Install Guide

SPECTRUM CONTROLS

Micro800™
4 Ch Universal Thermistor Input Module

(Catalog Number 2080sc-NTC)

Table of Contents

For More Information

PLC sample projects and documentation are available on our website at http://www.spectrumcontrols.com

Environment and Enclosure

ATTENTION

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters (6562 feet) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5 VA, V2, V1, V0 (or equivalent) if non-metallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1, for additional installation requirements.
- NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

Prevent Electrostatic Discharge

WARNING

Electrostatic discharge can damage integrated circuits or semiconductors if you touch bus connector pins. Follow these guidelines when you handle the module:

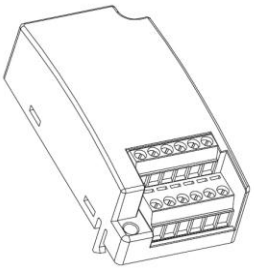
- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.
- When not in use, keep the module in its static-shield box.

WARNING

To comply with the CE Low Voltage Directive (LVD), all connected I/O must be powered from a source compliant with the following: Safety Extra Low Voltage (SELV) or Protected Extra Low Voltage (PELV).

Parts List

Your package contains one Micro800 Universal Thermistor Input Plug-in Module and one Quick Start guide.



You can choose to wire the plug-in before inserting it onto the controller, or wire it once the module is secured in place.

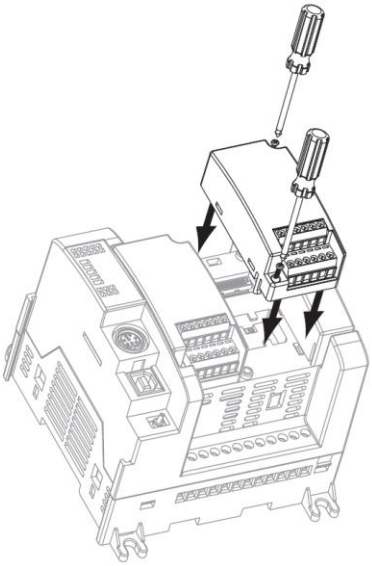
WARNING

- This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbance.
- Be careful when stripping wires. Wire fragments that fall into the controller could cause damage. Once wiring is complete, make sure the controller is free of all metal fragments before removing the protective debris strip.
- Do not wire more than 2 conductors on any single terminal.
- If you insert or remove the plug-in module while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.
- Cable length should be less than 10 meters (30 feet).
- Do not insert or remove the plug-in module while power is applied; otherwise, permanent damage to equipment may occur.

Insert Module into Controller

Follow the instructions to insert and secure the plug-in module to the controller.

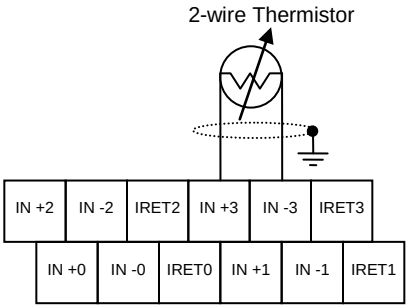
1. Position the plug-in module with the terminal block facing the front of the controller as shown.



2. Snap the module into the module bay.
3. Using a screwdriver, tighten the 10…12 mm (0.39…0.47 in.) M3 self-tapping screw to torque specifications.

Wire the Module

Use the wiring diagram below to wire the module.



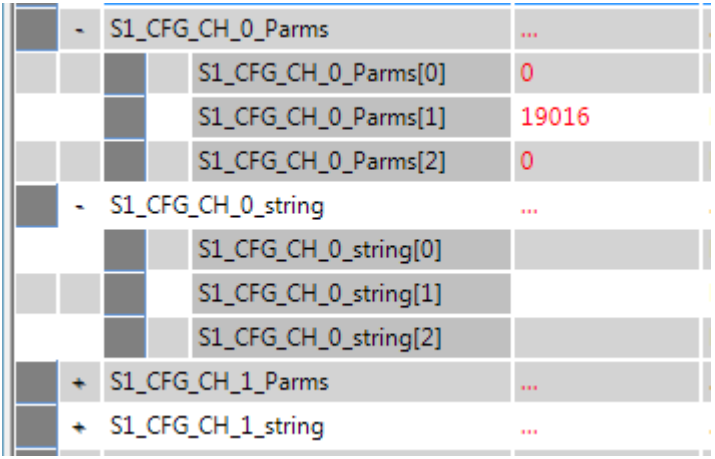
ATTENTION IRET0 to IRET3 are reserved for a later date.

Configuration Tags

This table shows the tags in the sample ladder program for configuration.

Details are described in the sub-sections that follow.

Register	Data Type	Comments
S1_CFG_Trigger	INT	Transition from 0 to non-zero to trigger new config.
S1_CFG_CH_n_Params[0]	INT	**Configuration Bits**
S1_CFG_CH_n_Params[1]	INT	**Maximum Range (default 19016)** Degrees C x100 or ohms div 10 Default: 19016
S1_CFG_CH_n_Params[2]	INT	**Minimum Range** Degrees C x100 or ohms div 10 Default: 0
S1_CFG_CH_n_String[0]	STRING	-**COEFF-A** for Steinhart-Hart Equation -BETA for BETA Equation
S1_CFG_CH_n_String[1]	STRING	-**COEFF-B** for Steinhart-Hart Equation -Resistance @25C for BETA Equation
S1_CFG_CH_n_String[2]	STRING	**-COEFF-C** for Steinhart-Hart Equation Ignored for BETA Equation



New Config Trigger (S1_CFG_Trigger)

This register is used as a trigger to the module that the configuration needs to be applied. You first modify all of the configuration parameters, and then trigger the new configuration.

To trigger, the register must first be set to zero for a minimum of 300 ms. A non-zero value is then placed into the register to initiate the trigger. The non-zero value should remain for a minimum of 300 ms before setting the register back to zero. Only a transition from 0 to non-zero will cause a new configuration event.

These time delays are used to ensure the module has enough time to detect the transition. It is not a hard requirement. It may be possible to trigger a new configuration below these minimum values but this is not guaranteed.

Configuration Bits (S1_CFG_CH_n_Params[0])

The table below describes this register. The default value of the configuration data is represented by zeros.

A configuration error will be set if any of the values marked **<unused>** are passed.

Configuring the Module

The 2080sc-NTC is configured using 8 SINT configuration registers. The following table describes the module configuration registers. The default value of the configuration is represented by zeroes (0).

A configuration error will be set if any of the values marked <unused> are passed.

(Configuration Assembly)

		Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
			MSB								LSB							
			7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Ch0 Config. 2x Bytes	Channel Enable	Enable Disable																0 1
	Filter Frequency	17 Hz (default) 4 Hz 60 Hz 240 Hz 470 Hz <unused>													0 0 0 0 1 1	0 0 1 1 0 0	0 1 0 1 0 x	
	Data Format[1]	EU X1 EU X10 Raw/Proportional <unused>											0 0 1 1	0 1 0 1				
	Linearization Equation	Resistance									0	0						
		Steinhart-Hart									0	1						
		BETA									1	0						
		<unused>									1	1						
	Unused		x	x	x	x	x	x	x	x								
Ch1 Config. 2x Bytes	Data structure the same as channel 0 above																	
Ch2 Config. 2x Bytes	Data structure the same as channel 0 above																	
Ch3 Config. 2x Bytes	Data structure the same as channel 0 above																	

[1] See Data Format

Data Format

EU x1

This displays the measured readings in their natural integer form. Due to the measurement range and 16-bit data size, the highest resolution that can be displayed for resistance is 10 ohms. Temperatures will have two decimal places of resolution.

For resistance, it will be in the range from 0 to 32767 which represents resistance in ohms divided by ten (0 to 327.67 k ohms).

For temperature, it will display in the range from +32767 to -32768 (+327.67 degrees C to -327.68 degrees C). The displayed values are clipped at the user-defined Maximum and Minimum parameters (defined below).

EU x10

This display format is the same as EU x1 but divided by 10.

Raw Proportional

The Raw Proportional Data Format uses the Maximum and Minimum user-defined values as its end points and scale relative to them. The Maximum Range is represented by +32767 while the Minimum Range is -32768 to give a full 16-bit span.

The output shall be scaled relative to those two user-defined values. When Equation is set to Resistance, you enter appropriate resistance values for the Maximum and Minimum parameters. For the other Equation settings, you enter appropriate temperature values for the Maximum and Minimum parameters.

Equation

BETA

If the Equation is set to BETA, the COEFF-A/BETA string contains the BETA parameter. The COEFF-B/R@25C string contains the resistance at 25˚ C.

COEFF-C string will be ignored.

Temperature in Kelvin is determined by the following formula:

$$\frac{1}{T} = \frac{1}{T_0} + \frac{1}{B}\ln\left(\frac{R}{R_0}\right)$$

B = User-supplied BETA parameter

R_0 = User-supplied resistance at room temperature (T_0).

T_0 = (constant) Room temperature (25˚ C) in Kelvin (298.15).

R = Measured resistance.

After solving for T, it is then converted to Celsius: T - 273.15

Steinhart-Hart

If the Equation is set to Steinhart-Hart, all three COEFF strings are used.

The module uses the following formula to determine temperature:

$$\frac{1}{T} = A + B\ln(R) + C(\ln(R))^3$$

A, B, C = Coefficients from thermistor specification.

R = Measured resistance

T = Temperature in Kelvin.

The final result is then converted to degrees Celsius: T - 273.15

The above formula images were copied from Wikipedia: http://en.wikipedia.org/wiki/Thermistor

Resistance

If the Equation is set to Resistance, all COEFF strings are ignored and only the actual measured resistance is displayed.

Maximum Range (S1_CFG_CH_n_Params[1])

Minimum Range (S1_CFG_CH_n_Params[2])

Since this module provides general purpose measurements, it is necessary to know the maximum and minimum displayed values to allow for status processing of over and under range as well as Raw Proportional. The thermistor type will determine what the optimal displayed values are. The displayed reading shall be clipped to these values. By default, Maximum Range is set to 19016, Minimum Range is set to 0.

The value is a signed, 16-bit integer. It represents temperature in degrees Celsius multiplied by 100 when the Equation is not set to Resistance.

If the Equation is set to Resistance, the values represent ohms divided by 10.

The Maximum cannot be not be equal to, or less than, the Minimum. An invalid configuration is set in that case.

This format allows for temperature spans from +327.67C to -327.68C. Setting extreme values does not guarantee measurement within that range.

Negative Resistance values are not valid.

Temperature example:

Enter 8000 for 80.00C as the Maximum.

Enter -2000 for -20.00C as the Minimum.

Resistance example:

Enter 10000 for 100 K ohms as the Maximum.

Enter 1 for 10 ohms as the Minimum.

Resistance spans are from 0 to 327,670 ohms.

String Parameters (COEFF-A/BETA, COEFF-B/R@25C, C)

These string parameters are ignored when the Equation is set to Resistance.

COEFF-A serves as the parameter for BETA when Equation is set to BETA.

COEFF-B serves as the parameter for R@25C when Equation is set to BETA.

Due to the limitation of CCW, it is not possible to use a raw floating point data type in the configuration. Instead, strings are used. The strings are in standard IEEE 754 floating point format.

The Steinhart-Hart coefficients presented in the thermistor datasheet are entered here. In the case of a BETA configured thermistor, only COEFF-A/BETA and COEFF-B/R at 25C are used.

The size of the string may be up to 16 characters. It is not necessary to terminate with NULL.

A valid floating point number string is formed by a succession of:

- An optional plus or minus sign.
- A sequence of numeric digits, optionally containing a single decimal-point character.
- An optional exponent part, which itself consists on an 'e' or 'E' character followed by an optional sign and a sequence of digits.

There shall be no characters following the floating point string (including white space). All characters in the string must be valid.

The following are examples of acceptable entries:

1234

-1234

1234.456

-123.45

0.1234E-03

-23.062E+12 (**E** or **e** may be used)

Invalid strings are rejected and an invalid configuration bit is set in MOD_STATUS register.

The following are invalid examples:

a1234 ← Alpha character.

1234 ← Space after digit.

0 . 2 ← Space between characters.

0.123-E03 ← invalid expression. Correct entry is **0.123E-03**

Adding the NTC to CCW

The 2080sc-NTC is configured for CCW (Connected Components Workbench) using the PLUGIN_READ and PLUGIN_WRITE instructions for generic plug-in modules.

The configuration, input data, and status structures discussed in the sections above, are stored at different memory locations in the module.

The following table lists the memory location offset for each parameter which is used when configuring the PLUGIN_READ, WRITE, and INFO instructions.

Parameter Offset for Module Block (0x00 [0] to 0x1F [31])

Parameter	Offset (Dec)	Comments	Default
MOD_ID_LO	0	Module ID	195
MOD_ID_HI	1		0
VENDOR_ID_LO	2	Vendor ID	58
VENDOR_ID_HI	3		0
PRODUCT_TYPE_LO	4		10
PRODUCT_TYPE_HI	5		0
PRODUCT_CODE_LO	6		80
PRODUCT_CODE_HI	7		0
MOD_REV_LO	8	Minor revision, 1-255	1
MOD_REV_HI	9	Major revision, 1-127	1
MOD_IRQ_STATUS	10	0: parity, 1: RA only, 2: user-defined, 3-7: reserved	0
CONTROLLER_STATUS	11	Read-only, written by controller	0
MOD_NUM_INPUT	12	Number of Input channels	4
MOD_NUM_OUTPUT	13	Number of Output channels	0
MOD_CONF_DATA_OFFSET	14	Starting address of configuration data	80
MOD_FEATURE	15	Module feature register	32
MOD_STATUS	16	Module status register	0
MODE_MODE_CONTROL	17	Module mode control register	
RESERVED	18 to 23	Returns value of zero when read	
MOD_INPUT_OFFSET	24	Starting address offset of Input Registers	32

Parameter	Offset (Dec)	Comments	Default
MOD_OUTPUT_OFFSET	25	Starting address offset of Output Registers	48
MOD_INPUT_LATCH	26	Writing with 0xA5 to this register will trigger input latch	
MOD_OUTPUT_APPLY	27	Writing with 0xA5 to this register will trigger output latch	0
MOD_INTERRUPT_CONF	28	Writing to this register will enable/disable module interrupt to controller	0
MOD_GC_DATA_LENGTH_LB	29	Low byte of the generic configuration data length	218
MOD_GC_DATA_LENGTH_HB	30	High byte of the generic configuration data length	0
RESERVED	31	Reserved	

Module ID

The Micro800™ 4 Ch Universal Thermistor Input Module is available in only one configuration: 2080-sc-NTC. The module uses the following parameters:

Parameter	Value
Vendor ID	58
Module ID	195
Product Type	10
Product Code	80
Module Rev.	1.1
Input Size (words)	4
Output Size	0
Configuration Registers (words)	109

Module Error Register (MOD_STATUS)

The Micro800™ 4 Ch Universal Thermistor Input Module is available in only one configuration: 2080-sc-NTC. The module uses the following parameters:

Bit Number	Description	Notes
0 to 1	These 2 bits define module operation mode: • 0: Idle: Module is ready to RUN, and I/O is off. • 2: Error: Error happens and I/O is off. • 3: Busy: Module is busy, cannot go to RUN, and I/O is off. See **Notes**.	3 is not supported
2	This bit defines module user interrupt mode: 0: User Interrupt is disabled. 1: User Interrupt is enabled. See Notes.	Always 0. 1 is not supported.
3	Reserved	
4	SW Error	Trigger condition. The Watchdog timer is triggered.
5	ADC Error	Trigger condition. The ADC communication has stopped, or the ADC has not sampled data for a long period of time.
7	Configuration Error	Wrong bits set in channel configuration.

Input Block (0x20 [32] to 0x2F [47])

Register	Address	Comments
Input Data Ch 0	32	Channel 0 through Channel 3 (Signed 16-bit INT)
Input Data Ch 1	34	
Input Data Ch 2	36	
Input Data Ch 3	38	
RESERVED	40	
RESERVED	41 to 47	

Output Block (0x30 [48] to 0x3F [63])

Register	Address	Comments
RESERVED	0x30 [48] to 0x3F [63]	Output words are not used on this module but the block space is reserved

Status Block (0x40 [64] to 0x4F [79])

Register	Address	Comments
OC_STATUS	49	Open circuit status. See Open Circuit Status Register (OC_STATUS) information below.
UO_STATUS	50	Under/Over Range Status. See information below.
SW_BUILD	51	Enumeration of build based on major/minor version. (0 to 255). This value is written by the module CPU.
FPGA_VER_MAJOR	52	Major revision of FPGA code. This value is hard-coded by the FPGA and not written by module CPU.
FPGA_VER_MINOR	53	Minor revision of FPGA code. This value is hard-coded by the FPGA and not written by module CPU.
LED_CODE	54	Internal register for module use only.
RESERVED	55	
RESERVED	71 to 79	

Open Circuit Status Register (S1_STS_CHAN_OC)

When an open circuit is detected, the open circuit bit is set for the channel and the input data is set to user Maximum.

Word/Bit	7	6	5	4	3	2	1	0
	N/A	N/A	N/A	N/A	OC3	OC2	OC1	OC0

Bit 0 for channel 0 open wire.

Bit 1 for channel 1 open wire.

Bit 2 for channel 2 open wire.

Bit 3 for channel 3 open wire.

Bit 4-7 are not used.

Under/Over Range Status Register (S1_STS_CHAN_OU)

These status bits are dependent on the setting of the Maximum and Minimum user values.

If the displayed value is greater than Maximum, the ‘O’ bit shall be set for the channel.

If the displayed value is less than Minimum, the ‘U’ bit shall be set for the channel.

Word/Bit	7	6	5	4	3	2	1	0
	O3	O2	O1	O0	U3	U2	U1	U0

Bit 0 is for channel 0 under range indication.

Bit 1 is for channel 1 under range indication.

Bit 2 is for channel 2 under range indication.

Bit 3 is for channel 3 under range indication.

Bit 4 is for channel 0 over range indication.

Bit 5 is for channel 1 over range indication.

Bit 6 is for channel 2 over range indication.

Bit 7 is for channel 3 over range indication.

Configuration Block (0x50 [80] to 0x129 [297])

Register	Byte Address	Size (Bytes)	Data Type	Comments
S1_CFG_Trigger (new Config Trigger)	80-81	2	INT	Transition from 0 to non-zero to trigger new configuration
S1_CFG_CH_n_Params[0] (CH 0 Configuration Bits)	82-83	2	INT	Configuration Bits
S1_CFG_CH_n_Params[1] (Ch 0 Maximum Range)	84-85	2	INT	Maximum Range (default 19016) Degrees C x 100 or ohms div 10 Default: 19016
S1_CFG_CH_n_Params[2] (CH 0 Minimum Range)	86-87	2	INT	**Minimum Range** Degrees C x 100 or ohms div 10 Default: 0

Register	Byte Address	Size (Bytes)	Data Type	Comments
S1_CFG_CH_n_String[0] (CH0 COEFF-A/BETA)	88-103	16	STRING	-**COEFF-A** for Steinhart-Hart Equation -BETA for BETA Equation
S1_CFG_CH_n_String[1] (CH0 COEFF-B/R@25C)	104-119	16	STRING	-**COEFF-B** for Steinhart-Hart Equation -Resistance @25C for BETA Equation
S1_CFG_CH_n_String[2] (CH0 COEFF-C)	120-135	16	STRING	**-COEFF-C** for Steinhart-Hart Equation Ignored for BETA Equation
See above	136-189	54	-	**Channel 1 Config Block**
See above	190-243	54	-	**Channel 1 Config Block**
See above	244-297	54	-	**Channel 1 Config Block**

Analog Data (S1_Input_CH_n)

These registers display the current analog reading.

The following sample program, written in structured text, demonstrates how to configure the module in CCW.

Controller.Micro830.Micro830.Main

```
(*******************************************)
(* FIRST TIME                              *)
(*******************************************)
FirstScanTimer(true, T#1ms);
IF (FirstScanTimer.Q = FALSE) THEN
        FirstScan := FALSE;
        CfgTimerEnable   := FALSE;
        CfgEnableWrite   := FALSE;
    S1_CFG_Trigger   := 1;
        previous_trigger := 0;

        ReadModInfo(true, Slot_ID);
        tmp_result := ANY_TO_DINT( ReadModInfo.ModRevision );
        S1_STS_REV_MOD_0_MAJOR := ANY_TO_USINT( SHR( tmp_result, 8) );
        S1_STS_REV_MOD_1_MINOR := ANY_TO_USINT( tmp_result );

        (* Make sure it's cleared on the module *)
        raw_config_array[0]       := 0;    (* Low byte *)
        raw_config_array[1]       := 0;    (* High byte *)
END_IF;

DelayTimer(CfgTimerEnable, CFG_DELAY_TIME);

IF CfgTimerEnable = FALSE THEN
        CfgTimerEnable := TRUE;
END_IF;


(*******************************************)
(* CONFIGURATION                           *)
(*******************************************)
IF (S1_CFG_Trigger    = 0 AND
        previous_trigger <> 0 AND
        DelayTimer.Q      = TRUE AND
        WriteConfig.Sts   = 1) THEN

        CfgEnableWrite   := TRUE;
        previous_trigger := 0;
        CfgTimerEnable   := FALSE;        (* Reset timer *)
        (* Make sure it's cleared on the module *)
        raw_config_array[0]       := 0;    (* Low byte *)
        raw_config_array[1]       := 0;    (* High byte *)

ELSIF (S1_CFG_Trigger   <> 0   AND
           previous_trigger =  0) THEN

        CfgEnableWrite   := TRUE;
        previous_trigger := 1;
        S1_CFG_Trigger   := 0;
        CfgTimerEnable   := FALSE;        (* Reset timer *)

        raw_config_array[0]       := 255;  (* Low byte *)
        raw_config_array[1]       := 255;  (* High byte *)

        idx := 2;
```

```
        (* Translate channel configurations. *)
        FOR chan_idx := 0 TO 3 BY 1 DO
                (* Copy the 3 word parameters. *)
                FOR i := 0 TO 2 BY 1 DO
                        CASE chan_idx OF
                                0: tmp_result :=
ANY_TO_DINT(S1_CFG_CH_0_Parms[i]);
                                1: tmp_result :=
ANY_TO_DINT(S1_CFG_CH_1_Parms[i]);
                                2: tmp_result :=
ANY_TO_DINT(S1_CFG_CH_2_Parms[i]);
                                3: tmp_result :=
ANY_TO_DINT(S1_CFG_CH_3_Parms[i]);
                        END_CASE;
                        raw_config_array[idx]     :=
ANY_TO_USINT(tmp_result); (* Low byte *)
                        tmp_result := SHR(tmp_result, 8);
                        raw_config_array[idx+1]   :=
ANY_TO_USINT(tmp_result); (* High byte *)
                        idx := idx + 2;
                                                (* Skip to next word
offset *)
                END_FOR;

                (* Copy the 3 string parameters. *)
                FOR i := 0 TO 2 BY 1 DO
                        CASE chan_idx OF
                                0: tmp_string := S1_CFG_CH_0_string[i];
                                1: tmp_string := S1_CFG_CH_1_string[i];
                                2: tmp_string := S1_CFG_CH_2_string[i];
                                3: tmp_string := S1_CFG_CH_3_string[i];
                        END_CASE;

                        (* Transfer the string into the config array *)
                        (* Only 16 chars will fit into chan config.  *)
                        FOR str_idx := 1 TO 16 BY 1 DO
                                raw_config_array[idx] :=
ANY_TO_USINT(ASCII(tmp_string, str_idx));
                                idx := idx + 1;
                        END_FOR;
                END_FOR;
        END_FOR;
ELSIF (S1_CFG_Trigger     = 0 AND
        previous_trigger   = 0 AND
        DelayTimer.Q       = TRUE AND
        WriteConfig.Sts    = 1) THEN

        CfgEnableWrite := FALSE;
        CfgTimerEnable := FALSE;  (* Reset timer *)
END_IF;

(* Override the config write for an amount of time defined by STARTUP_TIME *)
(* This is a one-time startup event *)


WriteConfig(CfgEnableWrite, Slot_ID, OFFSET_CFG, CFG_N_BYTES,
raw_config_array);

(*****************************************)
(* INPUTS                                *)
(*****************************************)
WriteInputLatch(true, Slot_ID, OFFSET_INP_LATCH, 1, InputLatch_val);
ReadInputs(true, Slot_ID, OFFSET_INPUT, INPUT_N_BYTES, raw_input_array);
idx := 0;

FOR i := 0 TO 3 BY 1 DO
```

```
        tmp_result := ANY_TO_DINT(raw_input_array[idx+1]);
        tmp_result := SHL(tmp_result, 8);
        tmp_result := tmp_result + ANY_TO_DINT(raw_input_array[idx]);
        CASE i OF
                0: S1_Input_CH_0 := ANY_TO_INT(tmp_result);
                1: S1_Input_CH_1 := ANY_TO_INT(tmp_result);
                2: S1_Input_CH_2 := ANY_TO_INT(tmp_result);
                3: S1_Input_CH_3 := ANY_TO_INT(tmp_result);
        END_CASE;
        idx := idx +2;
END_FOR;

(*****************************************)
(* STATUS                                *)
(*****************************************)
ReadStatus(true, Slot_ID, OFFSET_STATUS, STATUS_N_BYTES, raw_status_array);
S1_STS_CHAN_OC                  := raw_status_array[0];
S1_STS_CHAN_OU                  := raw_status_array[1];
S1_STS_REV_MOD_2_BUILD    := raw_status_array[2];
S1_STS_REV_FPGA_0_MAJOR := raw_status_array[3];
S1_STS_REV_FPGA_1_MINOR := raw_status_array[4];
S1_STS_LED                              := raw_status_array[5];
```

The sample project above can be downloaded from our website at http://www.spectrumcontrols.com/downloads.htm

Electrical Specifications

Input Specifications	Values		
Inputs per module	4 NTC thermistor input channels, 2-wire only		
Input ranges	Resistance (250 Ω-250 kΩ) Thermistor (derived from resistance measurement)		
Accuracy	Resistance: 1% Temperature: ± 0.5°C		
Temperature Repeatability (at 25ºC) Note: Resistance Repeatability may be added at a later date.	4 Hz filter	17 Hz filter	60, 240 and 470 Hz filters[1]
	± 0.25° C	± 0.5° C	± 1° C

[1] These filters do not reject 50/60 Hz. Repeatability for these filters is strongly dependent on how much 50/60Hz noise is in the system.

Input Specifications	Values
CMRR	< 1% reading error with 10 Vp-p input; 50 Hz and 60 Hz for 4 Hz and 16 Hz filters
NMRR	No NMRR requirement for this module
Crosstalk	-70 dB maximum
Output Source Voltage	2.5 V @ 25°C, ±3% from -20°C to 65°C
Input protection	Voltage Mode 24 VDC continuous.
Power source	3.3 VDC, 26 mA from backplane, and 24 VDC, 10 mA from backplane.
Channel to Channel Isolation	None
Inrush current	<500 mA at 3.3V, <500 mA at 24V
Fusing	2.7 Ω 1/10W resistor on 24 VDC input, 0.47 Ω 1/10W resistor on 3.3 VDC input
Fault detection	Over/under range for all types, open circuit in voltage, resistance ranges shown as over-range
Input filters	4 Hz, 17 Hz, 60 Hz, 470 Hz
Wire size	#16 to #30 AWG
Operating temperature	-20º C to 65º C (-4º F to 149º F)
Storage temperature	-45º C to 85º C (-49º F to 185º F)
Operating humidity	5% to 95% (non-condensing)
Agency approvals / evaluations	UL/cUL 508 & Hazloc (Class I, Div 2, Groups ABCD) and CE, RohS/WEEE
Manufacturing	RoHS and REACH compliant
Dimensions	58.4 mm x 29.3 mm x 25.0 mm

Environmental Specifications

Environmental Tests	Industry Standards	Test Level Limits
Temperature (Operating) (Performance Criteria A)	IEC60068-2-1: (Test Ad, Operating Cold), IEC60068-2-2: (Test Bd, Operating Dry Heat), IEC60068-2-14: (Test Nb, Operating Thermal Shock)	-20° C to 65° C (-4° F to 149° F)
Temperature (Non-operating) (Performance Criteria B)	IEC60068-2-1: (Test Ab, Unpackaged Non-operating Cold), IEC60068-2-2: (Test Bb, Unpackaged Non-operating Dry Heat), IEC60068-2-14: (Test Na, Unpackaged Non-operating Thermal Shock)	-40° C to 85°C (-40° F to 185° F)
Operating Altitude	2000 meters (6561 feet)	Not tested
Humidity (Operating) (Performance Criteria A)	IEC60068-2-30: (Test Db, Unpackaged Damp Heat):	5 to 95% non-condensing
Vibration (Operating) (Performance Criteria A)	IEC60068-2-6: (Test Fc, Operating)	5 g @ 10 to 500 Hz, 0.030 in. max. peak-to-peak
Shock (Operating) (Performance Criteria A)	IEC60068-2-27: (Test Ea, Unpackaged Shock)	30 g,11 ms half-sine (3 mutually perpendicular axes)
Shock (Non-operating) (Performance Criteria B)	IEC60068-2-27: (Test Ea, Unpackaged Shock)	50 g, 11 ms half-sine (3 mutually perpendicular axes)
Radiated Emissions	CSIPR 11; Group 1, Class A FCC 47 CFR part 15 Class A	(Enclosure) Class A, 30 MHz – 1 GHz

Environmental Tests	Industry Standards	Test Level Limits
Conducted Emissions	IEC 61000-6-4:2007 FCC 47 CFR part 15 Class A	Group 1, Class A (AC Mains), 150 kHz – 30 MHz
ESD immunity (Performance Criteria B)	IEC 61000-4-2	6 kV Indirect (Coupling Plate) 6 kV Contact Discharge (to points of initial contact) 8 kV Air Discharge (to points of initial contact)
Radiated RF immunity (Performance Criteria A)	IEC 61000-4-3: Level 3	10 V/M with 1 kHz sine-wave 80% AM from 80…2000 MHz 10 V/M with 200 Hz sine-wave 50% Pulse 100% AM @900 MHz 10 V/M with 200 Hz sine-wave 50% Pulse 100% AM @1890 MHz 1 V/M with 1 kHz sine-wave 80% AM from 2000…2700 MHz (3 V/M goal)

Environmental Tests	Industry Standards	Test Level Limits
EFT/B immunity (Performance Criteria B)	IEC 61000-4-4	Signal Ports: ± 3 kV @ 5 kHz for 5 minutes, Criteria B (Marine?) ± 2 kV @ 5 kHz for 5 minutes, Criteria A (Marine?) ± 2 kV @ 5 kHz for 5 minutes, Criteria B (standard) Power Ports: ± 2 kV @ 5 kHz for 5 minutes, Criteria A (Marine?) ± 2 kV @ 5 kHz for 5 minutes, Criteria B (standard)
Surge transient immunity (Performance Criteria B)	IEC 61000-4-5	Signal Ports: ± 2 kV line-earth {CM}@ 2Ω on shielded ports Power Ports ± 2 kV CM @ 12 Ω ± 1 kV DM @ 2 Ω
Conducted RF immunity (Performance Criteria A)	IEC 61000-4-6	10 V rms with 1 kHz sine wave 80% AM from 150 kHz…80 MHz on signal and power ports
Magnetic Field (Performance Criteria A)	IEC 61000-4-8	30 A rms/m
AC Mains Voltage Dips, Interruptions and Variations	IEC 61000-4-11	Follow the 61000-4-11.
Environmental Tests	Industry Standards	Test Level Limits

Safety Tests	Industry Standards	Test Level Limits
UL Safety	UL 508 Industrial Control Equipment Seventeenth Edition Dated January 28 1999, with revisions through July 11, 2005 (ANSI/UL 508-2005) (NRAQ, NRAQ7) cUL CSA C22.2 No. 142 -M1987 Process Control Equipment May 1987	UL Safety
UL Hazardous Locations	ULH ANSI/ISA–12.12.01–2007 Nonincendive Electrical Equipment for Use in Class I, Division 2 Hazardous (Classified) Locations T4 or better cULH CSA C22.2 No. 213-M1987 - Non-incendive Electrical Equipment for use in Class I Division 2 Hazardous Locations - March 1987	UL Hazardous Locations
CE Low Voltage Directive	IEC 61131-2 Programmable Controllers Part 2: Equipment Requirements and Tests; Second Edition 2003-02, Section 11-14	CE Low Voltage Directive

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Do not disconnect equipment while the circuit is live or unless the area is known to be free of ignitable concentrations.
- This product must be installed in an enclosure which can only be opened with the use of a tool.
- All wiring must comply with N.E.C. article 501-4(b).

Environnements dangereux

Cet équipement est conçu pour être utilisé dans des environnements de Classe I, Division 2, Groupes A, B, C, D ou non dangereux. La mise en garde suivante s'applique à une utilisation dans des environnements dangereux.

MISE EN GARDE

DANGER D'EXPLOSION

- La substitution de composants peut rendre cet équipement impropre à une utilisation en environnement de Classe 1, Division 2.
- Ne pas remplacer de composants ou déconnecter l'équipement sans s'être assuré que l'alimentation est coupée ou que il n'y ait pas de danger d'explosion.
- Ne pas déconnecter l'équipement tandis que le circuit est sous tension ou si la zone est connue pour ne pas avoir de produits inflammables.
- Ce produit doit être installé dans une armoire Ce produit doit être installe dans une armoire qui ne peut être ouverte qu'avec l'utilisation d'un outil
- Tout le cablage doit agreer la norme N.E.C. article 501-4(b).

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