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Micro800™ 4-Channel Universal Thermistor Input Module

Catalog Number: 2080sc-NTC

Important Notes

1. Please read all the information in this owner's guide before installing the product.
2. The information in this owner's guide applies to hardware Series A and firmware version 1.1 or later.
3. This guide assumes that the reader has a full working knowledge of the relevant processor.

Notice

The products and services described in this owner's guide are useful in a wide variety of applications. Therefore, the user and others responsible for applying the products and services described herein are responsible for determining their acceptability for each application. While efforts have been made to provide accurate information within this owner's guide, Spectrum Controls, Inc. assumes no responsibility for the accuracy, completeness, or usefulness of the information herein.

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Table of Contents

Preface

Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- Who should use this manual
- How to use this manual
- Rockwell Automation technical support
- Documentation
- Conventions used in this manual

Who Should Use This Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use Allen-Bradley I/O and/or compatible controllers, such as CompactLogix and ControlLogix.

How to Use This Manual

As much as possible, we organized this manual to explain, in a task-by-task manner, how to install, configure, program, operate, and troubleshoot a control system using the Micro800™ 2080sc-NTC 4-Channel Universal Thermistor Input Module.

Rockwell Automation Technical Support

For technical support, please contact your local Rockwell Automation TechConnect Office for all Spectrum products. Contact numbers are as follows:

- USA   1-440-646-6900 (US/global, English only
- United Kingdom   +44 0 1908 635 230 (EU phone, UK local)
- Australia, China, India, 1-800-722-778 or +61 39757 1502
  and other East Asia
  locations:
- Mexico   001-888-365-8677
- Brazil   55-11-5189-9500 (general support)
- Europe   +49-211-41553-630 (Germany/general support)

or send an email to support@spectrumcontrols.com

Documentation

If you would like a .PDF version of a manual, you can download a free electronic version at www.spectrumcontrols.com.

Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists (like this one) provide information not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.
- **Bold** type identifies headings and sub-headings:

WARNING	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you to identify a hazard, avoid a hazard, and recognize the consequences.

ATTENTION	Actions ou situations risquant d'entraîner des blessures pouvant être mortelles, des dégâts matériels ou des pertes financières. Les messages « Attention » vous aident à identifier un danger, à éviter ce danger et en discerner les conséquences.

NOTE	Identifies information that is critical for successful application and understanding of the product.

Chapter 1
Module Overview

**Section 1.1
General
Description**

1.1.1 What is it?

The Micro800™ 2080sc-NTC 4-Channel Analog Input Module is a thermistor/resistance input module designed for use for use with Rockwell Automation Micro800™ systems. This module is optimized for Negative Temperature Coefficient (NTC) thermistors for temperature measurement. The module interfaces with the controller via an Asynchronous Parallel Interface (API) which it shares with other plug-in peripherals in the controller. Power is provided across the same connector used to implement the API.

1.1.2 How does it connect mechanically?

The module plugs into any spare plug-in slot on the PLC. A 40-pin connector provides the connection between the controller and the module.

Thermistor/Resistance input connections are connected to the module via a 12-pin terminal block on the module.

1.1.3 How does it connect via software?

The exchange of data between the module and controller is used to communicate module configuration, status and digitized samples from the four analog inputs.

Other types of exchanges also occur across the API. These exchanges include reset commands by the controller, interrupts from the module to the controller, module status queries by the controller, configuration changes and other associated communications.

The plug-in module contains memory with specific locations holding configuration, status, and channel values accessible to the controller as register locations.

1.1.4 How does it indicate normal function?

The module has a single green LED which is ON for normal operation and blinks in the case of a fault detected by the module.

The 2080sc-NTC module uses a 20-bit, Sigma-Delta, analog-to-digital converter to achieve 16-bit resolution. All inputs have fault tolerance and ESD protection to avoid damage to circuitry on the board.

The module operates in normal run mode when installed in a Micro800 controller chassis and is powered on and is designed to operate 24 hours a day, 7 days a week, for a period of years.

Section 1.2
Environment
and Enclosure

WARNING ⚠	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.

ATTENTION	Cet équipement est prévu pour fonctionner en environnement industriel avec une pollution de niveau 2, dans des applications de surtension de catégorie II (telles que définies dans la publication 60664-1 de la CEI) et à une altitude maximum de 2000 m sans déclassement.
	Cet équipement est considéré comme étant un équipement industriel du Groupe 1, classe A selon CEI/CISPR 11. En l'absence de précautions appropriées, des problèmes de compatibilité électromagnétique peuvent survenir dans des environnements résidentiels et dans d'autres environnement en raison de perturbations conduites et rayonnées.
	Cet équipement est fourni en tant qu'équipement de type « ouvert ». Il doit être installé à l'intérieur d'une armoire fournissant une protection adaptée aux conditions d'utilisation ambiantes et suffisante pour éviter toute blessure pouvant résulter d'un contact direct avec des composants sous tension.
	L'armoire doit posséder des propriétés ignifuges capables d'empêcher ou de limiter la propagation des flammes, correspondant à un indice de propagation de 5VA, V2, V1, V0 (ou équivalent) dans le cas d'une armoire non métallique.
	L'accès à l'intérieur de l'armoire ne doit être possible qu'à l'aide d'un outil. Cette armoire doit permettre des connexions d'alimentation par un système de câblage de Classe I, Division 2, conformément au code électrique national (NEC). Certaines sections de la présente publication peuvent comporter des recommandations supplémentaires portant sur les indices de protection spécifiques à respecter pour maintenir la conformité à certaines normes de sécurité.
	En plus de cette publication, consultez:
	• La publication Rockwell Automation 1770-4.1, « Industrial Automation Wiring and Grounding Guidelines », pour d'autres critères d'installation.
	• La publication 250 de la norme NEMA ou la publication 60529 de la CEI, selon le cas, pour obtenir une description des indices de protection que fournissent les différents types d'armoires.

Section 1.3
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 workstation.
	• When not in use, keep the module in its static-shield box.

ATTENTION	Cet équipement est sensible aux décharges électrostatiques, lesquelles peuvent entraîner des dommages internes et nuire à son bon onctionnement.
	Conformez-vous aux directives suivantes lorsque vous manipulez cet équipement :
	• Touchez un objet mis à la terre pour vous décharger de toute électricité statique éventuelle.
	• Portez au poignet un bracelet antistatique agréé.
	• Ne touchez pas les connecteurs ni les broches figurant sur les cartes des composants.
	• Ne touchez pas les circuits internes de l'équipement.
	• Utilisez si possible un poste de travail antistatique.
	• Lorsque vous n'utilisez pas l'équipement, stockez-le dans un emballage antistatique.

NOTE	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).

Section 1.4
Parts List

Your package contains one Micro800 Universal Thermistor Input Module, installation screws, and one Quick Start Guide.

You can choose to wire the plug-in before inserting it into 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.
	• Do not insert or remove the plug-in module while power is applied; otherwise, permanent damage to equipment may occur.

ATTENTION	• Cet équipement est considéré comme étant un équipement industriel du Groupe 1, classe A selon CEI/CISPR 11. En l'absence de precautions appropriées, des problèmes de compatibilité électromagnétique peuvent survenir dans des environnements résidentiels et dans d'autres environnements en raison de perturbations conduites et rayonnées.
	• Soyez vigilant en dénudant les fils. Tout fragment de fil tombé dans l'automate risquerait de le détériorer. Une fois le câblage terminé, veillez à ce que l'automate ne présente aucun copeau de métal avant de retirer la bande de protection.
	• Ne câblez pas plus de 2 conducteurs sur une même borne.
	• L'insertion ou le retrait du module enfichable sous tension peut provoquer un arc électrique, susceptible de provoquer une explosion dans un environnement dangereux. Assurez-vous que l'alimentation est coupée ou que l'environnement est classé non dangereux avant de poursuivre.
	• N'insérez pas et ne retirez pas le module enfichable quand l'équipement est sous tension, au risque de provoquer des dommages irrémédiables à l'équipement.

Section 1.5
Hardware Features

The module plugs into, and communicates with, a controller in the Micro800 family. The only exchange of data between the controller and the Plug-In Module is through the API. The Plug-In Module shares the parallel bus with other plug-in peripherals in the controller.

The block diagram for the plug-in module interface is shown below:
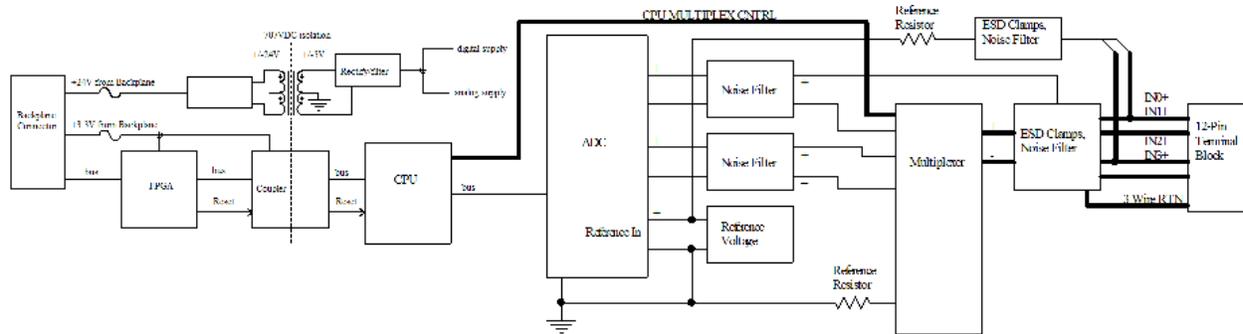
Section 1.6 Module Power Specifications

The controller provides two Power Supplies to the module:

- 3.3 Volts (3.0 V Min, 3.6 V Max), Current Rating: 30 mA
- 24 Volts (20.4 V Min, 26.4 V Max), Current Rating: 30 mA

You may not use an external power source to power the module. Refer to the specifications in the Appendix for further information.

Section 1.7 Module Chassis Earth Ground

The Micro800 controller does not have a chassis (earth) ground. If a chassis (earth) ground connection is needed for a plug-in module or devices connected to a plug-in module, it must be provided externally. A capacitive coupling between chassis (earth) ground and plug-in module signal ground is acceptable if required. The capacitor must be rated for least 500 VAC (707 VDC). The module does not use a chassis ground since it is not available on the backplane or the terminal block.

Chapter 2
Installation and Wiring

Section 2.1
Insert Module
into Controller

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

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 workstation.
	• When not in use, keep the module in its static-shield box.

ATTENTION	Cet équipement est sensible aux décharges électrostatiques, lesquelles peuvent entraîner des dommages internes et nuire à son bon onctionnement.
	Conformez-vous aux directives suivantes lorsque vous manipulez cet équipement:
	• Touchez un objet mis à la terre pour vous décharger de toute électricité statique éventuelle.
	• Portez au poignet un bracelet antistatique agréé.
	• Ne touchez pas les connecteurs ni les broches figurant sur les cartes des composants.
	• Ne touchez pas les circuits internes de l'équipement.
	• Utilisez si possible un poste de travail antistatique.
	• Lorsque vous n'utilisez pas l'équipement, stockez-le dans un emballage antistatique.

1. Position the plug-in module with the terminal block facing the front of the controller as shown:
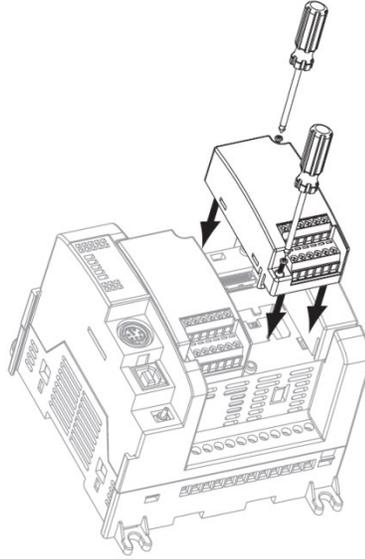
2. Snap the module into the module bay.
3. Using a screwdriver, tighten the 10…12 mm (0.39…0.47 in.) M3 self-tapping screw to torque specifications.
4. Follow the wiring diagrams below to wire the module:

2-wire Thermistor

IN +2	IN -2	IRET2	IN +3	IN -3	IRET3

	IN +0	IN -0	IRET0	IN +1	IN -1	IRET1
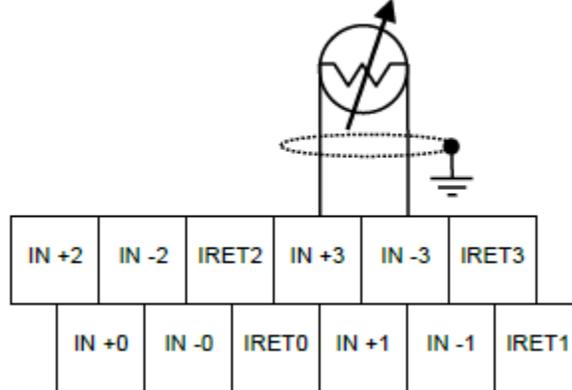
NOTE	IRET0 to IRET3 are reserved for a later date.

**Section 2.2
Configuration
Tags**

The following table describes the tags in the sample ladder program for module configuration:

Table 2-1. Module Register Tags

Register	Data Type	Comments
S1_CFG_Trigger	INT	Transition from 0 to non-zero to trigger new config.
S1_CFG_CH_*n*_Parms[0]	INT	Configuration Bits
S1_CFG_CH_*n*_Parms[1]	INT	Maximum Range (default 19016) Degrees C ×100 or ohms div 10 Default: 19016
S1_CFG_CH_*n*_Parms[2]	INT	Minimum Range Degrees C ×100 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 at 25 ºC for BETA Equation
S1_CFG_CH_n_String[2]	STRING	-COEFF-C for Steinhart-Hart Equation Ignored for BETA Equation

Name	Initial Value	Comment	Data Type
⌄ S1_CFG_CH_0_Parms	...		INT ⌄
› S1_CFG_CH_0_Parms[0]	130	130d=Enable, 4Hz, EUx1, BETA	INT
› S1_CFG_CH_0_Parms[1]	20000	Maximum 200.00C	INT
› S1_CFG_CH_0_Parms[2]	0	Minimum 0C	INT
⌄ S1_CFG_CH_0_string	...		STRING ⌄
S1_CFG_CH_0_string[0]	'3435'	BETA=3435	STRING
S1_CFG_CH_0_string[1]	'10000'	R@25C	STRING
S1_CFG_CH_0_string[2]			STRING
› S1_CFG_CH_1_Parms	...		INT ⌄
› S1_CFG_CH_1_string	...		STRING ⌄

Section 2.3
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 may be possible to trigger a new configuration below these minimum values but this is not recommended.

Section 2.4
Configuration Bits
(S1_CFG_CH_n_Parms[0])

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.

Table 2-2. 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. 2× Bytes	Channel Enable	Enable																0
		Disable																1
	Filter Frequency	17 Hz													0	0	0	
		4 Hz													0	0	1	
		60 Hz													0	1	0	
		240 Hz													0	1	1	
		470 Hz													1	0	0	
		<unused>													1	×	×	
	Data Format[1]	Engr. ×1											0	0				
		Engr. ×10											0	1				
		Raw/Proportional											1	0				
		<unused>											1	1				
	Linearization Equation	Resistance									0	0						
		Steinhart-Hart									0	1						
		Raw Proportional									1	0						
		<unused>									1	1						
	Unused		×	×	×	×	×	×	×	×								

---

[1] See Data Format.

	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
Ch1 Config. 2× Bytes		Data structure the same as channel 0 above															
Ch2 Config. 2× Bytes		Data structure the same as channel 0 above															
Ch3 Config. 2× Bytes		Data structure the same as channel 0 above															

Section 2.5
Data Format

2.5.1 EU×1

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 kohms).

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).

2.5.2 EU×10

This display format is the same as EU ×1 but divided by 10.

2.5.3 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 is 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.

2.5.4 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:

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

Where:

B = User-supplied BETA parameter

R0 = User-supplied resistance at room temperature (T0).

T0 = (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:

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

Where:

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_Parms[1])

Minimum Range (S1_CFG_CH_n_Parms[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 will 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 +327.67 C to -327.68 C. Setting extreme values does not guarantee measurement within that range.

Negative Resistance values are not valid.

Temperature example:

Enter 8000 for 80.00 C as the Maximum.

Enter -2000 for -20.00 C as the Minimum.

Resistance example:

Enter 10000 for 100 Kohms 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 25 C 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 of 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**

Section 2.6
Add 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 that is used for each parameter when configuring the PLUGIN_READ, WRITE, and INFO instructions.

Table 2-3. Parameter Offset for Module Block (0×00 [0] to 0×1F [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 0×A5 to this register will trigger input latch	
MOD_OUTPUT_APPLY	27	Writing with 0×A5 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	

Section 2.7 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

2.7.1 Module Error Register (MOD_STATUS)

The Micro800™ 4 Ch Universal Thermistor Input Module is available in only one configuration: 2080sc-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 (0×20 [32] to 0×2F [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 (0×30 [48] to 0×3F [63])

Register	Address	Comments
RESERVED	0×30 [48] to 0×3F [63]	Output words are not used on this module, but the block space is reserved

Status Block (0×40 [64] to 0×4F [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 will be set for the channel.
- If the displayed value is less than Minimum, the 'U' bit will 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 (0×50 [80] to 0×129 [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_Parms[0] (CH 0 Configuration Bits)	82-83	2	INT	Configuration Bits.
S1_CFG_CH_n_Parms[1] (Ch 0 Maximum Range)	84-85	2	INT	Maximum Range (default 19016) Degrees C × 100 or ohms div 10 Default: 19016
S1_CFG_CH_n_Parms[2] (CH 0 Minimum Range)	86-87	2	INT	Minimum Range Degrees C × 100 or ohms div 10 Default: 0
S1_CFG_CH_n_String[0] (CH0 COEFF-A/BETA)	88-103	16	STRING	-COEFF-A for Steinhart-Hart Equation. -BETA for BETA Equation.

Register	Byte Address	Size (Bytes)	Data Type	Comments
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.

Section 2.8 2080sc-NTC Example Structured Text

```
(***********************************************)
(* 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];
```

Example code for this module can be downloaded from our website at
http://www.spectrumcontrols.com

Section 2.9
Technical Assistance

Note that your module contains electrostatic components that are susceptible to damage from electrostatic discharge (ESD). An electrostatic charge can accumulate on the surface of ordinary wrapping or cushioning material. **In the unlikely event that the module should need to be returned to Spectrum Controls, Inc., please ensure that the unit is enclosed in approved ESD packaging (such as static-shielding/metallized bag or black conductive container).** Spectrum Controls, Inc. reserves the right to void the warranty on any unit that is improperly packaged for shipment.

For further information or assistance, please contact your local distributor, or call the technical support number provided under the Technical Support section in the Preface.

Appendix A Configuration Information

This appendix contains configuration information as follows:

Input 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 25 ºC) Note: Resistance Repeatability may be added at a later date.	4 Hz filter	17 Hz filter	60, 240, and 470 Hz filters[2]
	±0.25° C	±0.5° C	±1° C
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 at 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 3.3 V, <500 mA at 24 V		
Fusing	2.7 Ω 1/10 W resistor on 24 VDC input, 0.47 Ω 1/10 W 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	-20 ºC to 65 ºC (-4 ºF to 149 ºF)		

---

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

Input Specifications	Values
Storage temperature	-45 ºC to 85 ºC (-49 ºF to 185 ºF)
Operating humidity	5% to 95% (non-condensing)
Agency approvals / evaluations	UL/cUL 508 & Hazloc (Class I, Div 2, Groups A, B, C, D) and CE, RohS/WEEE
Manufacturing	RoHS and REACH compliant
Dimensions	58.4 mm × 29.3 mm × 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)
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 at 10 to 500 Hz, 0.030 in. maximum 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
Conducted Emissions	IEC 61000-6-4:2007 FCC 47 CFR part 15 Class A	Group 1, Class A (AC Mains), 150 kHz – 30 MHz

Environmental Tests	Industry Standards	Test Level Limits
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 at 900 MHz 10 V/M with 200 Hz sine-wave 50% Pulse 100% AM at 1890 MHz 1 V/M with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity (Performance Criteria B)	IEC 61000-4-4	Signal Ports: ±3 kV at 5 kHz for 5 minutes, Criteria B (Marine?) ±2 kV at 5 kHz for 5 minutes, Criteria A (Marine?) ±2 kV at 5 kHz for 5 minutes, Criteria B (standard) Power Ports: ±2 kV at 5 kHz for 5 minutes, Criteria A (Marine?) ±2 kV at 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}at 2 Ω on shielded ports Power Ports ±2 kV CM at 12 Ω ±1 kV DM at 2 Ω
Conducted RF immunity (Performance Criteria A)	IEC 61000-4-6	10 VRMS 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 Arms/m
AC Mains Voltage Dips, Interruptions and Variations	IEC 61000-4-11	Follow the 61000-4-11.

Regulatory Requirements

Safety Tests	Industry Standards
UL Safety	UL 508, 17th Edition Safety for Industrial Control Equipment (NRAQ, NRAQ7) CAN/CSA C22.2 No. 142-M1987 (Reaffirmed 2006), Industrial Products, Process Control Equipment
UL Hazardous Locations	ANSI/ISA–12.12.01 Nonincendive Electrical Equipment for Use in Class I, Division 2 Hazardous (Classified) Locations (NRAG) CSA C22.2 No. 213-M1987 - Non-incendive Electrical Equipment for use in Class I Division 2 Hazardous Locations - March 1987 (NRAG7) Temp code T4 or better, Pollution degree 2, gas groups A, B, C, & D
CE EMC Directive	EN 61131-2 Programmable Controllers: Third Edition 2007-02, Clause 8, Zones A&B EN 61000-6-2: Generic Industrial Immunity EN 61000-6-4: Generic Industrial Emissions
UKCA	Electromagnetic Compatibility Regulations 2016 BS EN 61131-2, BS EN 61000-6-4, BS EN 61000-6-2
FCC	27 CFR Part 15, Class A
CMIM	Arrêté ministériel n° 6404-15 du 29 ramadan 1436 (16 juillet 2015) NM EN 61131-2, NM EN 61000-6-4, NM EN 61000-6-2, NM EN 61010-2-201

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.

ATTENTION ⚠️	**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).

Index

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