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1746 nt8 user manual

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SLC 500 Thermocouple/mV Analog Input Module User Manual... Module Setup Modules are equipped with green LEDs for status indication. Thermocouple/mV input signals can be received from either a thermocouple or an analog device. Each channel is configurable to accept one type of input, converting thermocouple inputs into digital temperature readings. Module Functionality The module features eight differential analog inputs that are multiplexed and converted into a digital value using an A/D converter. It also continuously samples CJC sensors and compensates for temperature changes at the terminal block. Terminal Block Details The terminal block contains input circuitry, including thermocouple and millivolt device compatibility. A resistive voltage divider is recommended for strain gage bridge applications. Installation Instructions To install and wire the module, refer to the installation chapter in the publication. This includes avoiding electrostatic damage, determining power requirements, installing the module, and wiring signal cables to the terminal block. Power Requirements The module receives power from the SLC 500 chassis backplane through a fixed or modular +5 V dc/+24 V dc supply. The maximum current drawn by the module is shown in a provided table. Before installing or removing your module, ensure that you've disconnected power from the SLC 500 system and any other source connected to it. Additionally, disconnect any devices linked to the module. Installing The Module 4. Cover unused slots with a filler (1746-N2) Terminal Block Removal To remove the terminal block: Loosen the release screws, alternating between them to avoid cracking the block. Terminal Block Diagram CJC Sensors Recommended Torque: wiring screws and release screws (0.25 Nm or 2.2 in-lb) Possible Equipment Operation ATTENTION Before wiring your module, ensure that you've disconnected power from the SLC 500 system and any other source connected to it. Wiring Your Module Follow these guidelines for input signal cables: * Power, input, and output (I/O) wiring must comply with Class 1, Division 2 wiring methods [Article 501-4(B) of the National Electrical Code, NFPA 70] and local authority regulations. Preparing And Wiring Cables To prepare and connect cable leads and drain wires, follow these steps: * Remove foil shield and drain wire from sensor end of the cable * Connect signal wires of each channel to the terminal block. Verify connections are correct for each channel before trimming lengths. Terminal Block Diagram with Input Cable CJC + CJC A- Channel 0+ Thermocouple or mV Cable Channel 1+ Channel 1- Shield for CH 0 and CH 1. Publication 1746-UM022B-EN-P January 2005... The ID code defines the type of I/O module and number of words used in the processor's I/O image table. The module ID code for the 1746-NT8 module is 3533. Considerations Before Using Your Module Module Addressing The following memory map shows how the SLC processor's output and input tables are defined for the module. Image Table Bit 15 Bit 0 Address Word 0 Channel 0 Configuration Word 0.e.0 Word 1 0.e.1 Channel 1 Configuration Word... Chapter 4 provides detailed bit information about the data content of the configuration word. Input Image - Data Words and Status Words Eight SLC processor input image table reserved space for module. Input image words multiplexed due to one data word and one status word per channel. Before using module, consider following: Available filter frequencies, cut-off frequency, step response, and DC effective resolution. Cut-off frequency, step response time, and effective resolution depend on filter frequency. Signal attenuation tables provided for 10 Hz, 50 Hz, and 60 Hz input filters. Update time defined as time required to sample and convert input signals, making data available to SLC processor. Example: calculate module update time with channels configured at different frequencies. CJC sensors acquired at 60 Hz to balance resolution and update rate. Configure each input channel and check configuration and status in Chapter Channel Configuration, Data, and Status. Default channel configuration settings are all zero. Set configuration bits to determine data format, thermocouple inputs, and other parameters. Configuring the channel settings involves selecting either Fahrenheit or Celsius units and entering a value of one or zero in bit 9 of the configuration word. According to Page 44, "Channel Configuration, Data, and Status," this process is detailed in the following table: | Channel | Bit Definitions | |---| |---| | To Select Make these bit settings | Channel Disable Enable Channel Enable Thermocouple | Thermocouple K Thermocouple T Thermocouple E Thermocouple R Thermocouple S... | The channel enable bit (Bit 0) is used to enable a channel. The thermocouple module only scans enabled channels, so it's recommended to disable unused channels by setting the channel enable bit to zero. When set to one, this bit allows the module to read configuration word information selected from options such as 0.1°F, 0.1°C, 1°F, 1°C, 0.01 mV, 0.1 mV. Scaled-for-PID, and Proportional Counts. Scaling examples are provided on Page 48, including the equation for converting Scaled-for-PID to Engineering Units: Equivalent = S + [(S) x (Scaled-for-PID value displayed/16384)]. For instance, assuming a type J input with scaled-for-PID display type, channel data of 3421 wants to be calculated in °C equivalent. In other cases, like when millivolts are selected, the temperature setting is ignored, and analog input data remains the same for either °C or °F selection. Additionally, type B thermocouple cannot be represented in engineering units above 3276.7°F due to its limited range of 0 to 1820°C, which translates to a very small input voltage range of 0 to 13.82mV. Checking the status word can help determine if input channel configurations are valid per your settings in 0.e.0 through 0.e.7. Each bit in the channel status provides information on an enabled or disabled channel and how input data is translated from thermocouple or millivolt sensors. **Channel Configuration, Data, and Status** - **4-13 Channel 0 to 7 Status Word (I.e.0 through I.e.7)** - Bit Definitions: - **10 Hz input filter** - **10 Hz input filter** - **50 Hz input filter** - **60 Hz input filter** - **250 Hz input filter** - Channel filter frequencies. - **Open-circuit No error error** - Bit settings indicating the presence or absence of an error. - **4-14 Channel Configuration, Data, and Status** - **Data Format Type Status (Bits 5 and 6)** - The data format reflects what has been defined for the channel. - It indicates the selected data type in bits 5 and 6 of the channel configuration word. - **4-15 Over-Range Error (Bit 14)** - This bit is set when a configured channel detects an over-range condition, which occurs when the input value exceeds the specified upper limit of its sensor. - **Programming Examples** - Earlier chapters explain how configuration words operate channels. - Programming examples are provided for specific situations to help meet programming requirements. - **Length 0001** - On power-up, bit 5:1/15 is set during the first program scan. During this scan, configuration data in N10:0 through N10:7 will be sent to the 1746-NT8 channel configuration words. - The ladder program should use thermocouple temperature data location N10:20 and CJC temperature readings data location N10:12. - **Checking CJC** - During the first pass, send channel configuration data to the thermocouple module. - If not checking CJC, copy Channel 0 temperature data into a different data location for use. Temperature control logic should use N10:20 instead of the TC image (I.1.0) to prevent problems during CJC checking. - Wait 7 seconds for Channel 0 to accept CJC configuration and provide a data value (time depends on module configuration). Copy file from CJC register N10:12 into memory and load program data into CJC temp register T11. Configure data table for configuration changes in address 0x0000, 0x0010, 0x0011, 0x0012, 0x0028, 0x0038, 0x0048, 0x0058, 0x0068, 0x0078, 0x0088. Use PID instruction with scaled-for-PID data type in channel configuration word. Monitor open-circuit error bits of each channel and set alarm if thermocouple opens. NT8 CH CNF copy file source from CJC register N10:12. NT8 program data update at I/O image. Check status error flags by masking off appropriate bits, then check if these bits are set (non-zero). If an error is detected, set channel status error flags. Use remote rack communication protocol for 1746-NT8 module in remote rack. PLC/5 processor uses same configuration words as SLC 500 processors. First, perform an SFC scan and check NT8_CONFIGURED B3:0 to initiate the NT8 configuration process if a rack fault occurs. If the NT8 is configured, clearing the NT8 Configured bit (B3/4) will restart the process. The 1746-NT8 module requires block transfer reads and writes for communication with its remote rack network. Ensure SLC processors use these instructions for optimal performance. For troubleshooting purposes, refer to Chapter Troubleshooting Your Module on page 72. The chapter addresses issues with channel-status and module-status LEDs, including what corrective actions can be taken when a fault is detected. Channel fault bits are self-clearing when fault conditions are corrected. However, if the condition persists after resetting the module's power cycle or consulting your local distributor for assistance, you may need to address a jumper issue. When interpreting I/O error codes in word 5:6 of the SLC processor status file, check CJC set (1) connections and correct any issues. Contact your local distributor for guidance if an open-circuit condition is present. To maintain your module's performance, follow preventive maintenance procedures and adhere to safety considerations as outlined by the National Fire Protection Association (NFPA). When troubleshooting issues with SLC 500 systems, it's crucial to maintain a safe distance from machinery and ensure all personnel are clear of the area. This is because problems may be intermittent, and equipment could move unexpectedly. Have someone ready to activate an emergency stop switch in case of any unexpected movements. The 1746-NT8 Thermocouple/Millivolt Input Module has specific electrical specifications, including a maximum backplane current consumption of 120 mA at 5V DC or 70 mA at 24VDC, and a maximum backplane power consumption of 2.28W (0.6W at 5V DC, 1.68W at 24V DC). The module also has physical specifications, including nine green status indicators, one for each of the eight channels and one for the module's overall status. The recommended cable for thermocouple inputs is a shielded twisted pair extension wire from Belden. In terms of input specifications, the 1746-NT8 supports thermocouples of types J, K, T, E, and R. These thermocouples can measure temperatures ranging from -210°C to +760°C (-346°F to +1400°F) for type J, and -270°C to +1370°C (-454°F to +2498°F) for type K. The module's accuracy is influenced by errors due to cold junction compensation for thermocouples and hardware/software errors associated with the system. The specified accuracies include errors caused by these factors. For thermocouple inputs, the module has an error range of ±100mV spanning 60 Hz, 0°C, 25°C, and 60°C. For millivolt inputs, the error range is also ±100mV spanning 60 Hz, 0°C, 25°C, and 60°C. The following table provides the total error expected for thermocouple measurements based on thermocouple type and reference point at 25°C. Additionally, diagrams are provided for each thermocouple type, showing data for a sample module over its input range of temperature. The document provides specifications for thermocouples used with the 1746-NT8 module, including deviations over temperature ranges. Page 89 and 90 detail thermocouple J, K, T, E, and B type specifications, while Page 91 and 92 discuss thermocouple N and junction/exposed junction types. Thermocouple Types: The document explains the three main thermocouple junction types: Grounded Junction, Exposed Junction, and Ungrounded Junction. Each type has unique characteristics and considerations when connecting them to the 1746-NT8 module. Grounded Junction: * The measuring junction is physically connected to the protective sheath. * Completely sealed integral junction. * Metal sheath with electrical continuity to thermocouple signal wires. Exposed Junction: * Measures process temperature directly without any insulation or protection. * Multiple exposed thermocouples should not have direct contact with electrically conductive process material. * Use ungrounded junction thermocouples instead of exposed junction type. * The measuring junction is not connected to the protective sheath. * Nonconductive protective sheath. * Metal sheath with electrical continuity to thermocouple signal wires. Page 97 and 98 explain how to configure the 1746-NT8 module with RSLogix 500, including accessing the I/O Configuration menu, determining the chassis number and slot location, and configuring the module. Configure options for each channel in the RSLogix 500 software. This publication provides instructions on how to configure the 1746-NT8 module. The dialog box allows access to parameters for all channels, with identical menus on each tab displaying parameters. The following summarizes available options for each parameter: Channel controls enable or disable channel use. Each tab edits configuration data for a total of eight words. Press OK to set parameters and proceed. Added Rung Parameters appear next. Glossary Analog-to-digital conversion (ADC) converts analog signals to digital values proportional to their magnitude. Attenuation reduces signal magnitude as it passes through the system, opposite to gain. Configuration word contains channel configuration information for module operation. Cut-off frequency is the frequency at which the input signal is attenuated 3 dB by the digital filter. Input data scaling depends on selected data format for channel data words. Choose from scaled-for-PID or Engineering Units for millivolt, thermocouple, or CJC inputs. Local system refers to a control system with I/O chassis within feet of the processor using 1746-C7 or 1746-C9 ribbon cables. Status word contains status information about the channel's current configuration and operational state. Step response time is the time required for the AD signal to reach 93% of its expected value after a full-scale step change in the input signal. Index Diagnostics at powerup: auto calibration, automatic monitoring, thermocouples, and CJC sensors; electrical specifications; electrostatic damage; environmental specifications. Channel Configuration Procedure: A Comprehensive Guide ----- As you navigate the world of thermocouple/mV analog input modules, it's essential to understand the channel configuration procedure. This process involves selecting general considerations, effective resolutions, and modular system physical parameters. **Module Addressing** ----- The module addressing system is crucial for efficient communication between devices. Understanding how to address individual modules is vital for proper operation. In this manual, we will explore the ins and outs of module addressing, including module ID codes and their significance. **System Overview** ----- Before diving into the intricacies of channel configuration, it's essential to understand the overall system overview. This includes familiarizing yourself with the input image data words and status words, as well as the output config words. A block diagram provides a visual representation of the module's operation. **Diagnostics and Maintenance** ----- To ensure optimal performance and safety, regular maintenance is crucial. Chapter 7 delves into preventive maintenance techniques, emphasizing the importance of scheduled checks and adjustments to prevent potential issues. **Summary of Changes** ** This update summarizes the changes made to this user manual since the last printing. Notably, the software used in the manual has been updated from APS to RSLogix 500. To help you quickly find new and updated information, change bars have been added throughout the text. The table below outlines the sections that cover new features and updates to existing information. **Preface** This preface provides an overview of this user manual, covering who should use it, what it covers, related documents, and common techniques used in the manual. This manual is intended for those who design, install, program, or maintain control systems using SLC 500 controllers. It assumes a basic understanding of SLC 500 products. **Related Documentation** The following table lists various Rockwell Automation documents that may be helpful as you use these products: * Publication Number: 1746-SG001 * Title: SLC 500 Systems Selection Guide * Publication Number: SGI-1.1 * Title: Safety Guidelines for the Application, Installation and Maintenance of Solid State Controllers * Publication Number: 1770-4.1 * Title: Industrial Automation Wiring and Grounding Guidelines * Publication Number: 1747-UM011 * Title: SLC 500 Modular Hardware Style User Manual **Module Overview** This chapter introduces the thermocouple/mV input module, explaining how the SLC 500 processor reads thermocouple or millivolt analog input data from the module. It covers the temperature range and input ranges for each channel. Each input channel can be individually configured for a specific input device and provides open-circuit, over-range, and under-range detection and indication. The module also features status LEDs and cable tie slots. The module's input part has eight analog inputs that are mixed together and sent to an A/D converter. This converter takes the analog signals and turns them into digital values. It also keeps track of and adjusts for temperature changes in the CJC sensors, which are connected to the terminal block. For addressing, the module needs eight words each in the SLC processor's input and output image tables. The module has a circuit that includes CJC A sensor connections and can work with many millivolt devices, including strain gage bridges and resistive voltage dividers using fixed resistors. When installing and wiring the module, it's essential to avoid electrostatic damage by not touching backplane connector pins. The module gets its power from the SLC 500 chassis through the +5 V dc/+24 V dc power supply, and its maximum current draw is shown in a table. The compatibility of fixed I/O chassis with modules can be checked using a chart that depicts current combinations supported by the chassis. If the point of intersection falls within the operating region, it's valid. Additionally, when using the BAS or KE module to supply power to an AIC Link Coupler, use the higher current drawn values for the AIC at 24 V dc. Before installing or removing the module, always disconnect power from the SLC 500 system and any other source. **Important Precautions Before Installing Your Module** 1. Never "hot swap" your module, and disconnect any devices connected to it. Failure to do so can lead to unintended equipment operation and damage. 2. **Disconnect Power** - Before wiring your module, ensure you have disconnected power from the SLC 500 system and all other sources connected to it. **Terminal Block Removal** 1. Loosen the two terminal block release screws in an alternating pattern to avoid cracking the terminal block. 2. Use a screwdriver or needle-nose pliers to carefully pry the terminal block loose, taking care not to damage the CJC sensors. **Wiring Your Module** 1. **Class 1, Division 2 Wiring** - Ensure your power, input, and output (I/O) wiring complies with Class 1, Division 2 wiring methods (NFPA 70 Article 501-4(b)) and local authority regulations. 2. **Route Signal Wires** - Keep thermocouple and millivolt signal wires away from sources of electrical noise, such as motors, transformers, contactors, and AC devices. **Preparing and Wiring Cables** 1. Remove foil shield and drain wire from sensor end of the cable. 2. Strip casing at each end to expose individual wires. 3. Trim signal wires to 5-inch lengths beyond the cable casing. 4. Connect signal wires to terminal block after verifying correct connections for each channel. **Additional Tips** 1. Only trim signal wires short after verifying connections are correct. 2. Connect TBI chassis ground connector to nearest chassis mounting bolt using 14-gauge wire. 3. Refer to the terminal block diagram for proper wiring and connection of input cables. Setting Up Your I/O Module: Key Considerations This chapter explains how the module and the SLC processor communicate through the processor's I/O image tables, describing the module's input filter characteristics. Topics discussed include: * Unique module ID code * Module addressing * Channel filter frequency selection * Channel turn-on, turn-off, and reconfiguration times * Response to slot disabling The module ID code is a unique number assigned to each 1746 I/O module. Module Addressing The SLC processor's output and input tables are defined for the module as shown in the memory map. The image table has 15 bits, with thermocouple modules having their own image table. Input Image - Data Words and Status Words Eight words of the SLC processor's input image table are reserved for the module. Input image words are multiplexed since each channel has one data word and one status word. Filter Frequencies and Characteristics The following table shows available filter frequencies, cut-off frequency, step response time, and DC effective resolution for each filter frequency: | Filter Frequency | Cut-Off Frequency | Step Response Time | Effective Resolution | |---| |---| |---| |---| | 10 Hz | 15.72 Hz | 66.7 ms | 19.0 | 15 | 250 Hz | 65.5 Hz | 16 ms | 15 | Signal attenuation with different input filter frequencies is also discussed, including signal frequency and amplitude in dB. Channel Step Response The channel filter frequency selection affects the step response of the channel. The module update time is calculated as follows: - sum of all enabled input sample times - plus one CJC update time Enabled channels include those with a filter frequency of 250 Hz and 50 Hz, but exclude disabled channels. The auto-calibration time for each channel is: - 250 Hz: 325 ms - 60 Hz: 525 ms - 50 Hz: 585 ms - total: 1.435 s During auto-calibration, input values are not updated. The channel enable bit serves as a control for accessing configuration word information corresponding to the chosen channel. The thermocouple module offers proportional counts that are adjusted according to the defined temperature or voltage range. The input signal range corresponds to the user's selected input, and is scaled into a -32,768 to 32,767 range. Thermocouple data displays can be configured in eight different modes including Scaled-for-PID and Proportional Counts. Scaling equations are provided for converting data from Scaled-for-PID values to engineering units. Channel configurations for temperature ranges are listed in the table below: | Channel | Temperature Range | |---| |---| | 1 | -210°C to +760°C | | 2 | -346°F to +1400°F | Data resolutions and input accuracies are explained, with note that data resolution does not equate to data accuracy. Open-circuit detection enables the channel update time by approximately 45 ms. Resolution Trade-off The thermocouple module samples inputs at a frequency of 60 Hz. Channel Configuration and Data Format You can analyze the channel status by checking each bit in the status word. For channels configured as 0.e.0 through 0.e.7, the channel configuration data is compared to your setup in 0.e.0 through 0.e.7, 4-13 Channel Status Word (I.e.0 through I.e.7) The data format field indicates the selected data type for the channel, based on bits 5 and 6 of the channel configuration word. The open-circuit bit field shows how you have defined the response to an open-circuit condition in the thermocouple module. 4-14 Channel Configuration, Data, and Status Over-range Error (Bit 14) and Channel Error (Bit 15) are set when a configured channel detects an over-range or error condition. In Publication 1746-UM022B-EN-P - January 2005, Chapter 5 provides programming examples for thermocouple modules. 5-2 Programming Examples To configure the module, create integer file N10 with eight elements (N10:0 through N10:7). Enter configuration parameters into data file locations N10:0 through N10:7 using the programming software. Automatic Monitoring Thermocouples and CJC Sensors An example shows how to change channel configuration data when a channel is enabled. Every 60 seconds, change from monitoring an external type K thermocouple to the CJC sensors on the terminal block. 5-4 Programming Examples During the first pass, send the channel configuration data to the thermocouple module in slot 1 of a 1746 chassis. If not checking CJC, copy Channel 0 temperature data into a data location for use. To avoid issues during CJC checking, use logic with N10:20 instead of the TC image (I.1.0). For Channel 0 configuration, wait 7 seconds for acceptance and a data value (time depends on module settings). To set CJC temperature into the register (N10:12), copy it from I:1.0 to N10:20. The configuration timer T11:1 is used with DN as B3:0 and OSR as 4. The programming examples provide a data table for configuration changes at address N10:0-N10:7, showing the preset value of 7 and an accumulation value of 0