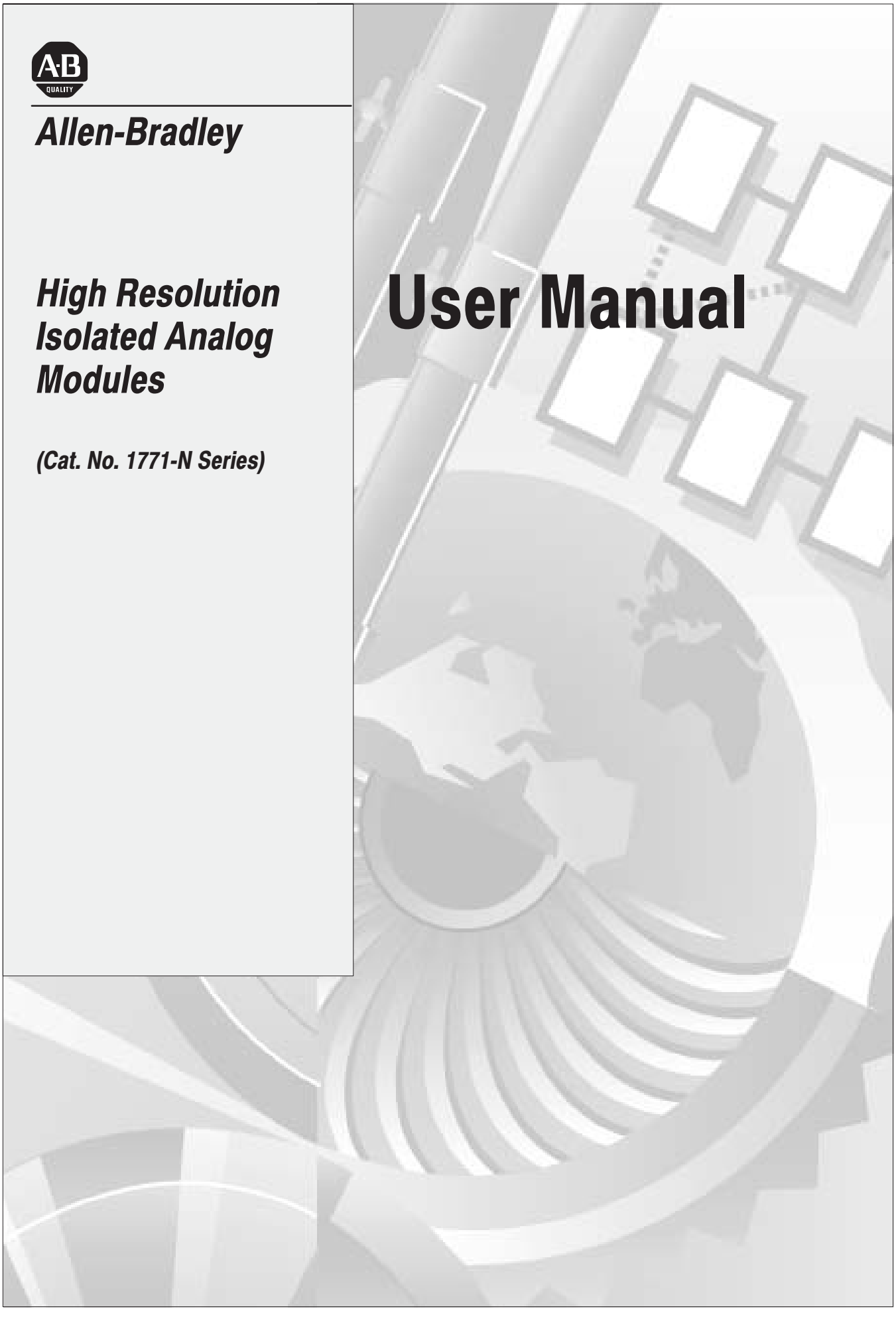


Allen-Bradley

User Manual

High Resolution Isolated Analog Modules

(Cat. No. 1771-N Series)

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of these products must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards. In no event will Rockwell Automation be responsible or liable for indirect or consequential damage resulting from the use or application of these products.

Any illustrations, charts, sample programs, and layout examples shown in this publication are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen–Bradley publication SGI–1.1, Safety Guidelines for Application, Installation, and Maintenance of Solid–State Control (available from your local Rockwell Automation office), describes some important differences between solid–state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.
Reproduction of the contents of this copyrighted publication, in whole or part, without written permission of Rockwell Automation, is prohibited.

Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard. avoid a potential hazard, and recognize the consequences of a potential hazard.

WARNING



Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION



Identifies information about practices or circumstances that may lead to personal injury or death, property damage, or economic loss.

IMPORTANT

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

ATTENTION



Environment and Enclosure

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 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 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.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosures. Also, see the appropriate sections in this publication, as well as the Allen–Bradley publication 1770–4.1, ("Industrial Automation Wiring and Grounding Guidelines"), for additional installation requirements pertaining to this equipment.

ATTENTION



Preventing Electrostatic Discharge

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- **Touch a grounded object to discharge potential static.**
- **Wear an approved grounding wriststrap.**
- **Do not touch connectors or pins on component boards.**
- **Do not touch circuit components inside the equipment.**
- **If available, use a static–safe workstation.**
- **When not in use, keep modules in appropriate static–safe packaging.**

Using this Manual

Purpose of Manual

This manual shows you how to use your high resolution isolated analog series input/output modules with an Allen-Bradley programmable controller. It helps you install, program, calibrate, and troubleshoot your modules.

Audience

You must be able to program and operate an Allen-Bradley programmable controller (PLC) to make efficient use of your analog module. In particular, you must know how to program block transfer instructions.

We assume that you know how to do this in this manual. If you do not, refer to the appropriate PLC programming and operations manual before you attempt to program this module.

Vocabulary

In this manual, we refer to:

- **the individual module as the "module."**
- **the programmable controller, as the "controller" or the "processor."**

Manual Organization

This manual is divided into seven chapters. The following chart shows each chapter with its corresponding title and a brief overview of the topics covered in that chapter.

Chapter	Title	Topics Covered
1	Overview of the High Resolution Isolated Analog Series Modules	Descriptions of the modules, including general and hardware features
2	Installing the Module	Module power requirements, keying, chassis location Wiring of module and remote termination panel
3	Communicating with your Analog Module	How to program your programmable controller for this module Sample programs
4	Configuring the Module	Hardware and software configuration Module write block format
5	Module Status and Input Data	Reading data from your module Module read block format
6	Module Calibration	How to calibrate your modules
7	Troubleshooting	Diagnostics reported by the module
Appendix A	Specifications	Your module's specifications
Appendix B	Block Transfer Read and Write Configurations for 0 out/8 in	Description of BTR/BTW words.
Appendix C	Block Transfer Read and Write Configurations for 8 out/0 in	Description of BTR/BTW words.

Chapter	Title	Topics Covered
Appendix D	Block Transfer Read and Write Configurations for 2 out/2 in	Description of BTR/BTW words.
Appendix E	Block Transfer Read and Write Configurations for 2 out/6 in	Description of BTR/BTW words.
Appendix F	Block Transfer Read and Write Configurations for 1 out/7 in	Description of BTR/BTW words.
Appendix G	Block Transfer Read and Write Configurations for 3 out/5 in	Description of BTR/BTW words.
Appendix H	Block Transfer Read and Write Configurations for 4 out/4 in	Description of BTR/BTW words.
Appendix I	Block Transfer Read and Write Configurations for 6 out/2 in	Description of BTR/BTW words.
Appendix J	Block Transfer Read and Write Configurations for 5 out/3 in	Description of BTR/BTW words.
Appendix K	Block Transfer Read and Write Configurations for 7 out/1 in	Description of BTR/BTW words.
Appendix L	UL/CSA Hazardous Location	

Related Products

You can install your module in any system that uses Allen-Bradley processors that support block transfer and the 1771 I/O structure.

Contact your nearest Allen-Bradley office for more information about your programmable controllers.

Product Compatibility

These modules can only be used with 1771-A1B, A2B, A3B, A3B1, A4B or later 1771 I/O chassis and 1771-AM1, -AM2 chassis. Communication between the analog module and the processor is bidirectional. The processor block-transfers output data through the output image table to the module and block-transfers input data from the module through the input image table. The module also requires an area in the data table to store the read block and write block data. I/O image table use is an important factor in module placement and addressing selection. Refer to the table below.

Compatibility and Use of Data Table

Catalog Number	Use of Data Table				Compatibility			
	Input Image Bits	Output Image Bits	Read Block Words	Write Block Words	Addressing			Chassis
					1/2-slot	1-slot	2-slot	
1771-N Series	8	8	28	59	Yes	Yes	Yes	B

A = Compatible with 1771-A1, A2, A4 chassis.
B = Compatible with 1771-A1B, A2B, A3B, A3B1, A4B, 1771-AM1, -AM2 chassis.
Yes = Compatible without restriction
No = Restricted to complementary module placement

You can place your analog module in any I/O module slot of the I/O chassis.

Do not put the analog module in the same module group as a digital high density module unless you are using 1 or 1/2-slot addressing. Avoid placing the analog module close to ac modules or high voltage dc modules.

Related Publications

For a list of publications with information on Allen-Bradley programmable controller products, consult our publication index SD499.

Table of Contents

Overview of the High Resolution Isolated Analog Modules — **Chapter 1**

Chapter Objectives 1–1
Module Description 1–1
Features of the High Resolution Isolated Analog Series Modules . . . 1–2
Catalog/Channel Numbers 1–3
How the High Resolution Isolated Analog Modules Communicate with Processors 1–4
Accuracy 1–4
Chapter Summary 1–4

Installing the Module — **Chapter 2**

Chapter Objectives 2–1
Before You Install Your Analog Module 2–1
Electrostatic Damage 2–1
Calculate Power Requirements for the I/O Chassis 2–1
. 2–1
Determine Module Location in the I/O Chassis 2–2
Install the Analog Module 2–2
Install the Module in the Chassis and Connect the Cable 2–3
Connecting Wiring 2–5
Connecting 4-Wire Sensors 2–9
Sourcing Input Analog Modules 2–10
Making Your Own Cables 2–11
Grounding the Field Devices 2–12
Interpreting the Indicator Lights 2–13
Chapter Summary 2–13

Communicating With Your Analog Module — **Chapter 3**

Chapter Objectives 3–1
Block Transfer Programming 3–1
PLC-2 Programming 3–2
PLC-3 Program Example 3–2
PLC-5 and PLC-5/250 Program Example 3–3
Module Scan Time 3–4
Programming Samples 3–4
Sample Ladder Diagram - PLC-3 Family Processors 3–5
Sample Ladder Diagram - PLC-5 Family Processors 3–6
Setting Up the Data Table File 3–7
Chapter Summary 3–8

Configuring the Module

Chapter 4

Chapter Objectives 4–1
Configuring the High Resolution Isolated Analog Modules 4–1
Default Configurations 4–2
Module Level Programming Features 4–3
Module “Configuration” Verification 4–3
Temperature Scale 4–3
Data Format 4–3
    Two’s Complement Binary 4–5
Real Time Sampling 4–5
Output Channel Programming Features 4–6
Scaling 4–6
Clamping 4–9
Ramping 4–10
Alarm Enable 4–10
Reset State 4–10
Reset Value 4–11
Input Channel Programming Features 4–11
Scaling 4–11
Alarms 4–11
Alarm Deadband 4–12
Rate Alarm 4–13
Digital Filtering 4–13
Thermocouple Type 4–14
RTD Type 4–15
10 Ohm Offset 4–15
Configuration Block for a Block Transfer Write 4–15
Block Transfer Write Configuration Data Header 4–15
    Module Configuration Data Header 4–15
    Bit/Word Description of Word 0 4–16
    Output Configuration Words 1 and 2 4–16
    Bit/Word Description of Output Configuration Words 1 and 2 . . 4–16
    Output Configuration Words 3 and 4 4–16
    Bit/Word Description of Output Configuration Words 3 and 4 . . 4–17
    Output Programming 4–17
    Output Configuration Words 5 through 10 4–17
    Bit/Word Description of Output Configuration Words 5 through 10 4–18
    Input Programming 4–19
    Bit/Word Description of Input Configuration Words 17 through 23 4–19
Chapter Summary 4–20

Module Status and Input Data — **Chapter 5**

Chapter Objectives 5–1
Reading Data from the Module 5–1
Block Transfer Read Data Format 5–2
"Outputs Only" Block Transfer Read Data Header 5–2
"Inputs Only" and "Output/Input" Block Transfer Read Data Header . 5–3
Input Status Data 5–4
Bit/Word Description for Input Status Data Words 5–5
Output Status Data 5–6
Bit/Word Description for Output Status Data Words 5–7
Chapter Summary 5–7

Module Calibration — **Chapter 6**

Chapter Objective 6–1
Tools and Equipment 6–1
Calibrating Your Module 6–2
Indicator Operation During Calibration 6–3
Manual Calibration 6–3
Input Channel Calibration 6–3
Output Channel Calibration 6–7
Chapter Summary 6–8

Troubleshooting — **Chapter 7**

Chapter Objective 7–1
Diagnostics Reported by the Module 7–1
Troubleshooting with the Indicators 7–2
Status Reported by the Module 7–2
Chapter Summary 7–4

Specifications — **Appendix A**

Specifications A–1
General Specifications A–1

Block Transfer Write and Block Transfer Read Configurations for 0 Output/8 Input 1771-N Series Modules — **Appendix B**

What This Appendix Contains B–1
Block Transfer Write Configuration Block for 8 Input Modules B–1
Block Transfer Write Bit/Word Descriptions for 8 Input Modules B–3
Block Transfer Read Word Assignments for 8 Input Modules B–5
Block Transfer Read Bit/Word Descriptions for 8 Input Modules B–7

Block Transfer Write and Block Transfer Read Configurations for 8 Output/0 Input 1771-N Series Modules

Appendix C

What This Appendix Contains C–1
Block Transfer Write Configuration Block for 8 Output Modules C–1
Block Transfer Write Bit/Word Descriptions for 8 Output Modules . . . C–3
Block Transfer Read Word Assignments for 8 Output Modules C–5
Block Transfer Read Bit/Word Description for 8 Output Module C–6

Block Transfer Write and Block Transfer Read Configurations for 2 Output/2 Input 1771-N Series Modules

Appendix D

What This Appendix Contains D–1
Block Transfer Write Configuration Block for the 2 Output/2 Input Modules D–1
Block Transfer Write Bit/Word Descriptions for 2 Output/2 Input Modules D–2
Block Transfer Read Word Assignments for 2 Output/2 Input Module D–5
Block Transfer Read Bit/Word Description for 2 Output/2 Input Module D–6

Block Transfer Write and Block Transfer Read Configurations for 2 Output/6 Input 1771-N Series Modules

Appendix E

What This Appendix Contains E–1
Block Transfer Write Configuration Block for 2 Output/6 Input Modules E–1
Block Transfer Write Bit/Word Descriptions for 2 Output/6 Input Modules E–3
Block Transfer Read Word Assignments for 2 Output/6 Input Modules E–6
Block Transfer Read Bit/Word Description for 2 Output/6 Input Modules E–7

Block Transfer Write and Block Transfer Read Configurations for 1 Output/7 Input 1771-N Series Modules

Appendix F

What This Appendix Contains F–1
Block Transfer Write Configuration Block for 1 Output/7 Input Modules F–1
Block Transfer Write Bit/Word Descriptions for 1 Output/7 Input Modules F–3
Block Transfer Read Word Assignments for 1 Output/7 Input Module F–6
Block Transfer Read Bit/Word Description for 1 Output/7 Input Module F–7

Block Transfer Write and Block Transfer Read Configurations for 3 Output/5 Input 1771-N Series Modules

Appendix G

What This Appendix Contains G–1
Block Transfer Write Configuration Block for 3 Output/5 Input Modules G–1
Block Transfer Write Bit/Word Descriptions for 3 Output/5 Input Modules G–3
Block Transfer Read Word Assignments for 3 Output/5 Input Modules G–6
Block Transfer Read Bit/Word Descriptions for 3 Output/5 Input Modules G–7

Block Transfer Write and Block Transfer Read Configurations for 4 Output/4 Input 1771-N Series Modules

Appendix H

What This Appendix Contains H–1
Block Transfer Write Configuration Block for 4 Output/4 Input Modules H–1
Block Transfer Write Bit/Word Descriptions for 4 Output/4 Input Modules H–3
Block Transfer Read Word Assignments for 4 Output/4 Input Modules H–6
Block Transfer Read Bit/Word Descriptions for 4 Output/4 Input Modules H–7

Block Transfer Write and Block Transfer Read Configurations for 6 Output/2 Input 1771-N Series Modules

Appendix I

What This Appendix Contains I–1
Block Transfer Write Configuration Block for 6 Output/2 Input Modules I–1
Block Transfer Write Bit/Word Descriptions for 6 Output/2 Input Modules I–3
Block Transfer Read Word Assignments for 6 Output/2 Input Modules I–6
Block Transfer Read Bit/Word Descriptions for 6 Output/2 Input Modules I–8

Block Transfer Write and Block Transfer Read Configurations for 5 Output/3 Input 1771-N Series Modules

Appendix J

What This Appendix Contains J–1
Block Transfer Write Configuration Block for 5 Output/3 Input Modules J–1
Block Transfer Write Bit/Word Descriptions for 5 Output/3 Input Modules J–3
Block Transfer Read Word Assignments for the 5 Output/3 Input Modules J–6
Block Transfer Read Bit/Word Descriptions for 5 Output/3 Input Modules J–7

Block Transfer Write and Block Transfer Read Configurations for 7 Output/1 Input 1771-N Series Modules

Appendix K

What This Appendix Contains K–1
Block Transfer Write Configuration Block for 7 Output/1 Input Modules K–1
Block Transfer Write Bit/Word Descriptions for 7 Output/1 Input Modules K–3
Block Transfer Read Word Assignments for 7 Output/1 Input Modules K–6
Block Transfer Read Bit/Word Descriptions for 7 Output/1 Input Modules K–7

CSA Hazardous Location

Appendix L

CSA Hazardous Location L–1

Overview of the High Resolution Isolated Analog Modules

Chapter Objectives

This chapter gives you information on:

- features of the input/output modules
- how the modules communicate with programmable controllers

Module Description

The high resolution isolated analog modules are intelligent block transfer modules that interface analog signals with Allen-Bradley PLC-3 and PLC-5 family programmable controllers that have block transfer capability. Block transfer programming moves input data words from the module's memory to a designated area in the processor data table in a single scan. It also moves configuration words and output data from the processor data table to module memory.

The N-series family includes modules with both analog inputs and outputs on the same module. The modules use 16-bit analog-to-digital converters and 14-bit digital-to-analog converters for high resolution and accuracy. All of these modules require only a single slot in the I/O chassis, and do not require an external power supply.

Since the N-series modules are combination modules, with input and output capabilities on the same module, block transfer reads from the module are structured differently from dedicated input or output modules. Normally, block transfer read information is contiguous, and is stored in contiguous locations in the data block. N-series modules transmit channel data on an individual basis with status information in between. This results in non-contiguous blocks of data in non-contiguous data locations. Care must be taken when transferring this information. Additional programming may be required.

IMPORTANT Use with PLC-2 family programmable controllers isnot recommended. Refer to chapter 3, page 3-2.

Input data is converted to a specified data type in a digital format to be transferred to the processor's data table on request. Output data is converted to analog signals and sent to the appropriate output channels. If real time sampling is selected, block transfer reads will only occur at the time selected. Consequently, the minimum interval between block transfer reads is the same as the total input update time for each analog input module (25ms).

The modules have either four or eight channels, each electrically isolated from each other and from the backplane. Input and output terminations are made through prefabricated cables which connect to remote termination panels (RTP). The modules are compatible with all 1771-A1B, A2B, A3B, A3B1, A4B, and later 1771 universal I/O chassis. In addition, they can be used in 1771-AM1, and -AM2 chassis.

Features of the High Resolution Isolated Analog Series Modules

The analog modules are comprised of modular analog signal conditioning blocks that are plugged into a common circuit board.

These signal conditioning blocks provide the following:

- **4–20mA output range**
- **0–50mA output range**
- **±10V output (scalable -5V, 0-5V, 0-10V, etc.)**
- **thermocouple input (±100mV)**
- **±5V input (±20mA with resistor RTP)**
- **±10V input (±20mA with resistor RTP)**
- **4–20mA input with sourcing/sinking input**
- **1–650 ohm RTD input**

Your particular module may have a combination of the above conditioning blocks.

The N-Series analog modules feature:

- **scaling of data to engineering units**
- **self-calibration (external reference required)**
- **software configuration**
- **user-selectable high and low alarms with deadband (hysteresis)**
- **self diagnostics**
- **input open circuit detection**
- **programmable ramped outputs**

Specific analog modules have these additional features:

- **Thermocouple input channels**
  - **input channels configurable for thermocouple input ranges — Types B, E, J, K, R, S and T thermocouples (1771-NT2 also includes types C and N)**
  - **cold junction compensation**
  - **scaling to selected temperature range in °C or °F**
  - **temperature resolution — up to 0.03°C/0.06°F (E, J, K, T, N) up to 0.1°C/0.2°F (B, R, S) up to 0.07°C/0.1°F (C)**
  - **millivolt resolution up to 1 microvolt**

- **RTD input channels**
  - **reports ºC, ºF, or ohms for 100Ω platinum, 120Ω nickel, or 10Ω copper sensors**
  - **reports ohms for other types of sensors**
  - **0.1ºC/0.1ºF resolution on 100Ω platinum sensor**
  - **resistance resolution to 10mΩ**
- **±5V and ±10V input channels — can be used with remote termination panel resistor to achieve a nonsourcing current input**
- **4-20mA input with internal loop power supply**
- **±10V output channels**
- **0-25mA output channels**
- **0-50mA output channels**

Catalog/Channel Numbers

The following are standard catalog numbers and their respective channel configurations:

Module	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8	Refer to Appendix
1771-NIS	4–20mA	4–20mA	4–20mA	4–20mA	4–20mA	4–20mA	4–20mA	4–20mA	B
1771-NIV	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	B
1771-NIV1	±10V	±10V	±10V	±10V	±10V	±10V	±10V	±10V	B
1771-NIVR	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	RTD	RTD	RTD	RTD	B
1771-NIVT	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	B
1771-NR	RTD	RTD	RTD	RTD	RTD	RTD	RTD	RTD	B
1771-NT1	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	B
1771-NT2	–5/+55mV/TC	–5/+55mV/TC	–5/+55mV/TC	–5/+55mV/TC	–5/+55mV/TC	–5/+55mV/TC	–5/+55mV/TC	–5/+55mV/TC	B
1771-NOC	0–25mA out	0–25mA out	0–25mA out	0–25mA out	0–25mA out	0–25mA out	0–25mA out	0–25mA out	C
1771-NOV	±10V out	±10V out	±10V out	±10V out	±10V out	±10V out	±10V out	±10V out	C
1771-NB4T	0–25mA out	0–25mA out	±100mV/TC	±100mV/TC					D
1771-NB4S	0–25mA out	0–25mA out	4–20mA	4–20mA					D
1771-NBSC	0–25mA out	0–25mA out	4–20mA	4–20mA	4–20mA	4–20mA	4–20mA	4–20mA	E
1771-NBRC	0–25mA out	0–25mA out	RTD	RTD	RTD	RTD	RTD	RTD	E
1771-NBTC	0–25mA out	0–25mA out	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	±100mV/TC	E
1771-NBV1	±10V out	±10V out	±10V in	±10V in	±10V in	±10V in	±10V in	±10V in	E
1771-NBVC	0–25mA out	0–25mA out	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	±5V (±20mA)	E
1771-NX1	0–50mA out	0–25mA out	0–50mA out	0–25mA out	0–25mA out	RTD	RTD	100mV/TC	F
1771-NX2	0–50mA out	0–25mA out	0–50mA out	0–25mA out	RTD	RTD	100mV/TC	100mV/TC	G
1771-NX3	0–50mA out	0–25mA out	0–50mA out	0–25mA out	RTD	RTD	RTD	100mV/TC	G
1771-NX4	0–50mA out	0–25mA out	0–25mA out	0–25mA out	0–25mA out	0–25mA out	RTD	100mV/TC	H

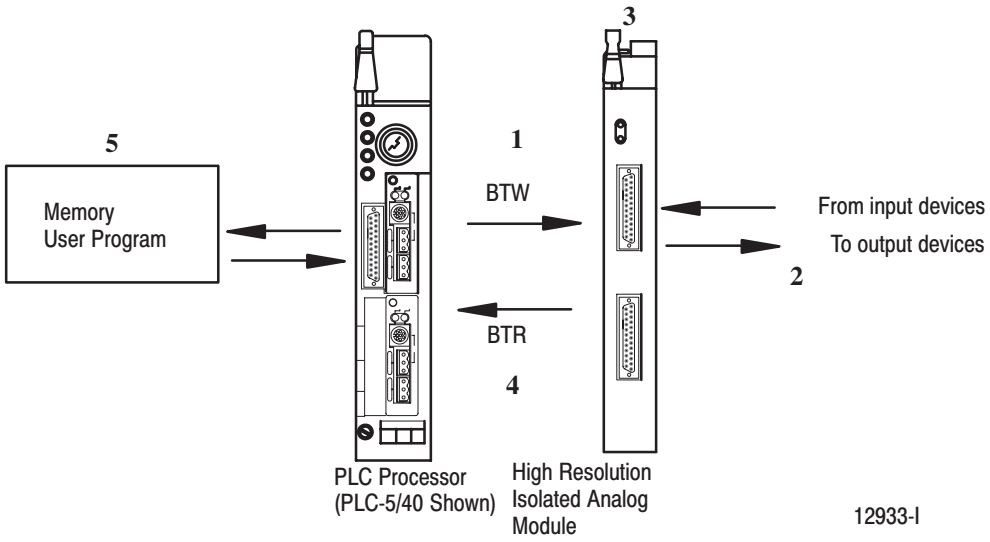
Note: Appendices I thru L cover other variations of the 1771-N series module.

How the High Resolution Isolated Analog Modules Communicate with Processors

The processor transfers data to and from the module using BTW (block transfer write) and BTR (block transfer read) instructions in your ladder diagram program. These instructions let the processor obtain input values and status from the module, and let you establish the module's mode of operation (Figure NO TAG).

1. **The processor transfers your configuration data, output data and calibration values to the module using a block transfer write instruction.**
2. **External input devices generate analog signals that are transmitted to the module. Internal output circuitry generates analog signals that drive field devices.**
3. **The module converts the analog signals into binary or BCD format and stores theses values until the processor requests their transfer.**

Table 1.A
Communication Between the Processor and the Module



4. **When instructed by your ladder program, the processor performs a read block transfer of the values and stores them in a data table.**
5. **The processor and module determine that the transfer was made without error, and that input values are within specified range.**
6. **Your ladder program can use and/or move the data (if valid) before it is written over by the transfer of new data in a subsequent transfer.**

See chapter 4, "Configuring the Module," for more information.

Accuracy

The accuracy of each of the high resolution isolated analog modules is described in Appendix A.

Chapter Summary

In this chapter you read about the functional aspects of the analog modules and how they communicate with programmable controllers.

Installing the Module

Chapter Objectives

This chapter gives you information on:

For information on	See page
Before You Install Your Module	2–1
Determining Power Requirements	2–1
Determining Module Location in the Chassis	2–2
Installing the Module	2–2
Connecting Wiring	2–5
Connecting 4–wire sensors	2–9
Sourcing input Analog Modules	2–10
Making Your Own Cables	2–11
Grounding Field Devices	2–12
Module Indicators	2–13

Before You Install Your Analog Module

Before installing your module in the I/O chassis you must:

Action required:	Refer to:
Calculate power requirements for the I/O chassis.	page 2–1
Determine module location in the I/O Chassis	page 2–2
Connect the cable and make wiring connections to the remote termination panel	page 2–3

Electrostatic Damage

ATTENTION



Preventing Electrostatic Discharge

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- **Touch a grounded object to discharge potential static.**
- **Wear an approved grounding wriststrap.**
- **Do not touch connectors or pins on component boards.**
- **Do not touch circuit components inside the equipment.**
- **If available, use a static–safe workstation.**
- **When not in use, keep modules in appropriate static–safe packaging.**

Calculate Power Requirements for the I/O Chassis

Your module receives its power through the 1771 I/O chassis backplane from the chassis power supply. The maximum current drawn by the module from this supply ranges from 1.5 to 3.3A, dependent upon the particular type of module. Refer to the specifications in appendix A for standard modules.

Add this value to the requirements of all other modules in the I/O chassis to prevent overloading the chassis backplane and/or backplane power supply.

Determine Module Location in the I/O Chassis

Place your module in any slot of the I/O chassis except for the extreme left slot. This slot is reserved for processors or adapter modules.

Group your modules to minimize adverse affects from radiated electrical noise and heat. We recommend the following.

- **Group analog and low voltage dc modules away from ac modules or high voltage dc modules to minimize electrical noise interference.**
- **Do not place this module in the same I/O group with a discrete high-density I/O module when using 2-slot addressing. This module uses a byte in both the input and output image tables for block transfer.**

Install the Analog Module

To install your module in an I/O chassis:

1. First, turn off power to the I/O chassis:

ATTENTION



Remove power from the 1771 I/O chassis backplane and disconnect the cable from the module before removing or installing an I/O module.

- **Failure to remove power from the backplane could cause injury or equipment damage due to possible unexpected operation.**
- **Failure to remove power from the backplane could cause module damage, degradation of performance, or injury.**

ATTENTION



Observe the following precautions when inserting or removing keys:

- **insert or remove keys with your fingers**
- **make sure that key placement is correct**

Incorrect keying or the use of a tool can result in damage to the backplane connector and possible system faults.

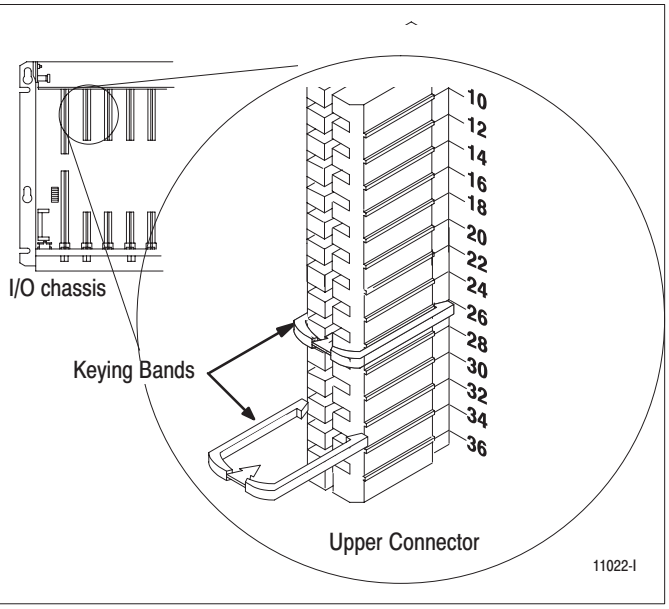
Key the Backplane Connector

Place your module in any slot in the chassis except the leftmost slot which is reserved for processors or adapters.

Position the keying bands in the backplane connectors to correspond to the key slots on the module.

Place the keying bands:
between **26** and **28**
between **32** and **34**

You can change the position of these bands if subsequent system design and rewiring makes insertion of a different type of module necessary.



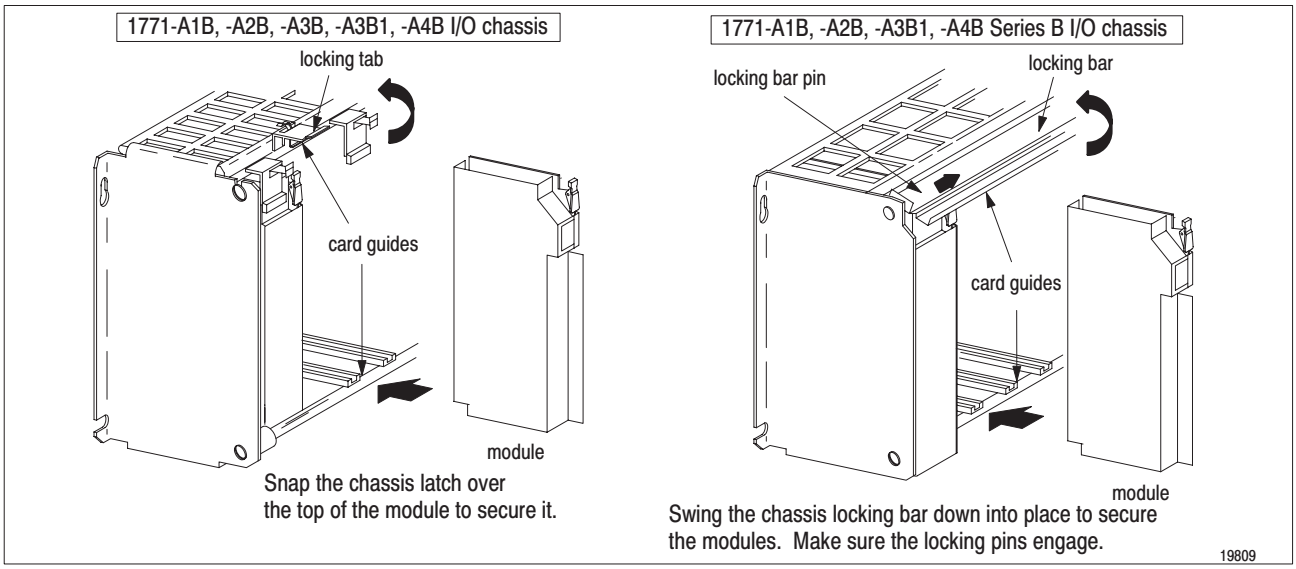
Install the Module in the Chassis and Connect the Cable

ATTENTION

Remove power from the 1771 I/O chassis backplane and field wiring arm before removing or installing an I/O module.

- **Failure to remove power from the backplane or wiring arm could cause module damage, degradation of performance, or injury.**
- **Failure to remove power from the backplane could cause injury or equipment damage due to possible unexpected operation.**

1. **Place the module in the plastic tracks on the top and bottom of the slot that guides the module into position.**
2. **Do not force the module into its backplane connector. Apply firm even pressure on the module until it is firmly seated in the chassis. Note: The chassis locking bar will not close if all modules are not seated properly.**



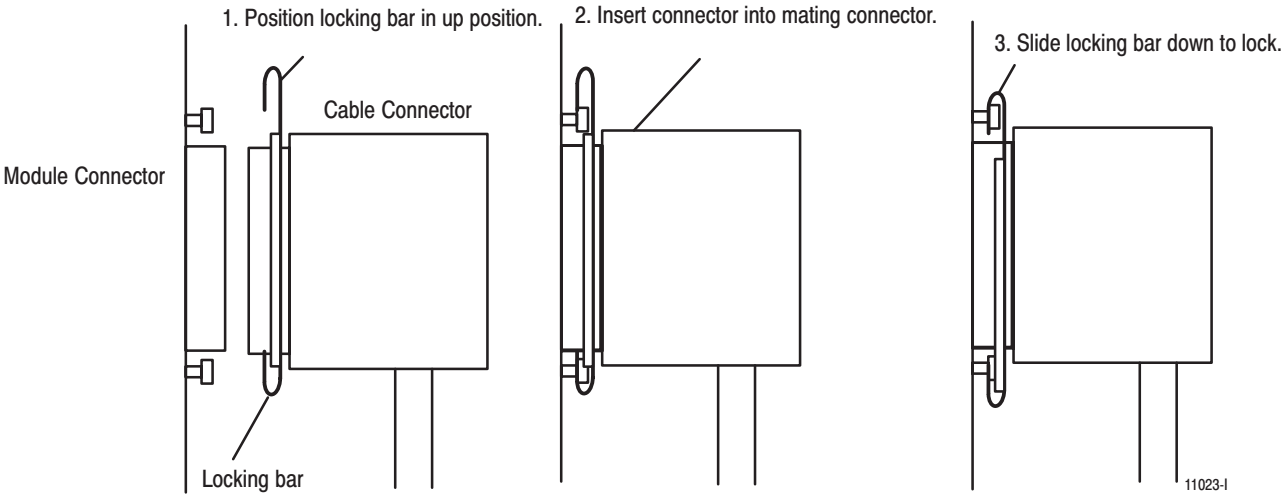
3. Connect the 1771-NC cable to the module as shown in Figure 2.1.

A. Slide the locking bar up.

B. Insert the cable connector into the mating connector on the front of the module.

C. Slide the locking bar down over the mating pins on the module to lock the connector onto the module.

Figure 2.1
Connecting the Cable to the Front of the Module



Connecting Wiring

The N-series modules are cable-connected to a remote termination panel using cat. no. 1771-NC6 (6 ft) or -NC15 (15 ft) cables.

Variations of remote termination panels are used, depending on the type of module used. These are:

Catalog Number	Description
1771-RTP1	has cold junction compensation for thermocouples
1771-RTP3	incorporates resistors and fuses; used primarily for 4-20mA inputs when using ±5V inputs (Uses 5mm x 20mm fast acting 1/4A fuses such as Bussmann GMA–1/4, 250V/250mA.)
1771-RTP4	a general-use block with straight-thru wiring that can be used for all applications except thermocouples[1]
1771-RT41	a 4-channel block with cold junction compensation for thermocouples
1771-RT44	a general-use 4-channel block with straight-thru wiring that can be used for all applications except thermocouples[1]

[1] RTP4 and RT44 can be used with thermocouples if a method of cold junction compensation is provided at the interface of thermocouple and copper wires within the system.

The remote termination panels are designed for mounting on standard DIN 1 or DIN 3 mounting rails.

Figure 2.2
Mounting Dimensions for the Remote Termination Panels

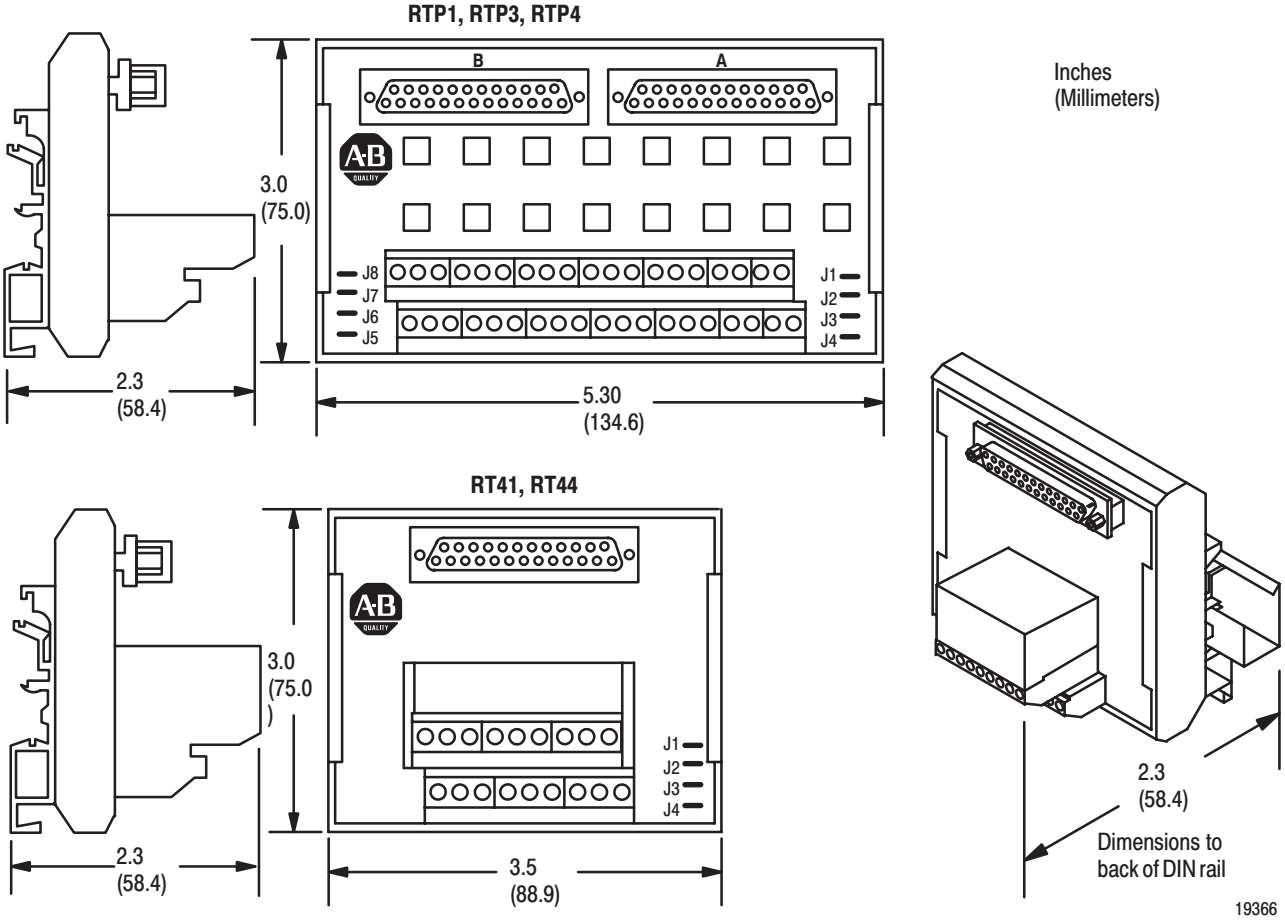
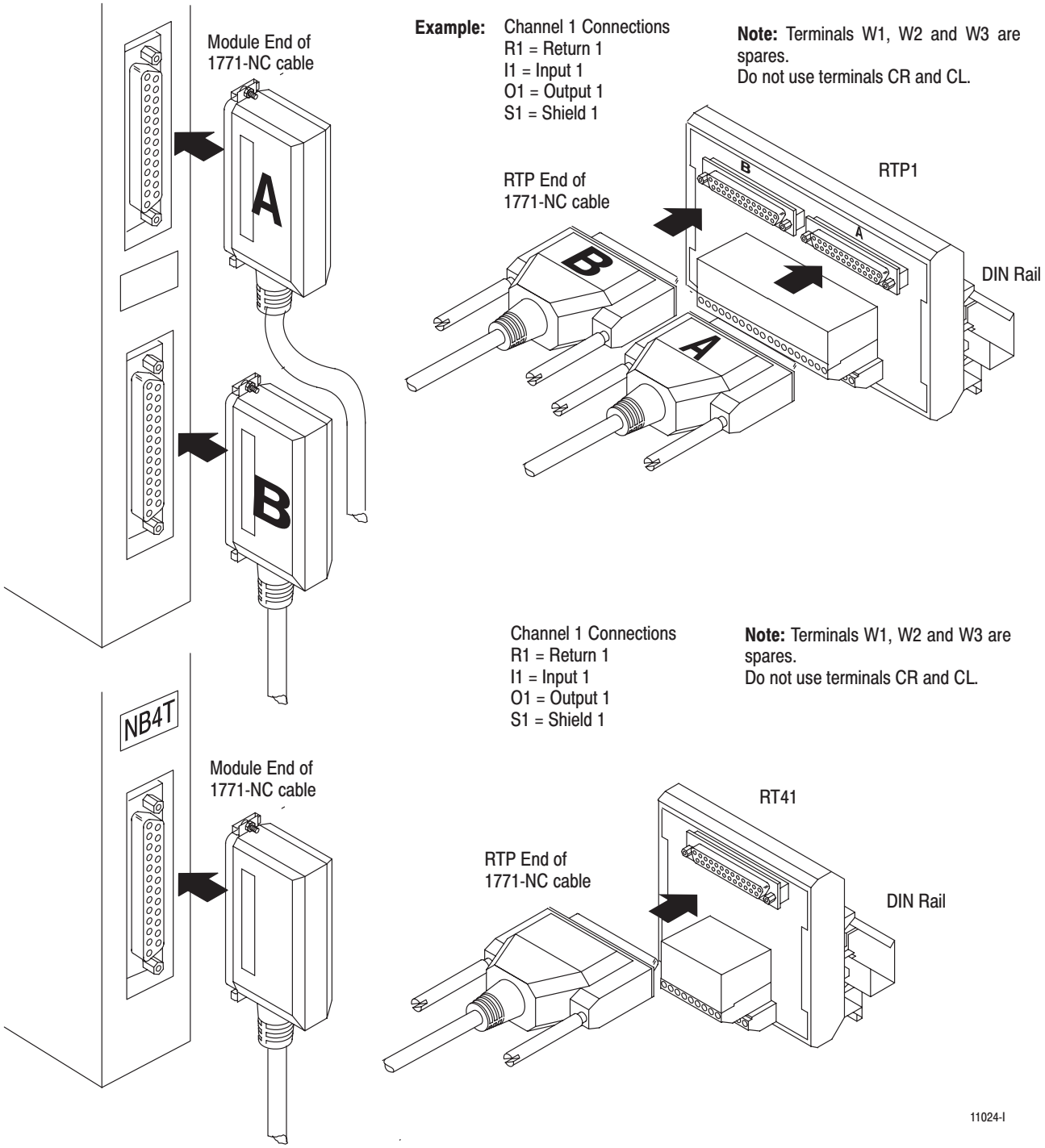


Table 2.A
Remote Termination Panel Connection Points for Field Devices (Channel 1 shown)

Input Type	Connect	To	Input Type	Connect	To	Input Type	Connect	To	Input Type	Connect	To
Voltage	+	I1	Current (with external resistor)	+	I1	Thermocouple	+	I1	Current (Source/ Sink)	+	I1
	-	R1		-	R1		-	R1		- [2]	R1
	Shield	S1		Shield	S1		Shield	S1		Shield	S1
Output Type	**Connect**	**To**	**Output Type**	**Connect**	**To**	**Input Type**	**Connect**	**To**		Loop Power	O1
Voltage	+	O1	Current	+	O1	RTD[1]	Excitation (A)	O1			
	-	R1		-	R1		Lead Compensation (B)	I1			
	Shield	S1		Shield	S1		Common (C)	R1			

[1] When using 4-wire RTD, leave the 4th wire open.
[2] Not used when N-Series module is supplying loop power. Refer to Figure 2.6 in this document.

Figure 2.3
Remote Termination Panel Wiring



Field wiring to the remote termination panel is the same for all remote termination panel variations. Refer to Figure 2.4.

Each channel has 4 connections: R, I, O, and S.

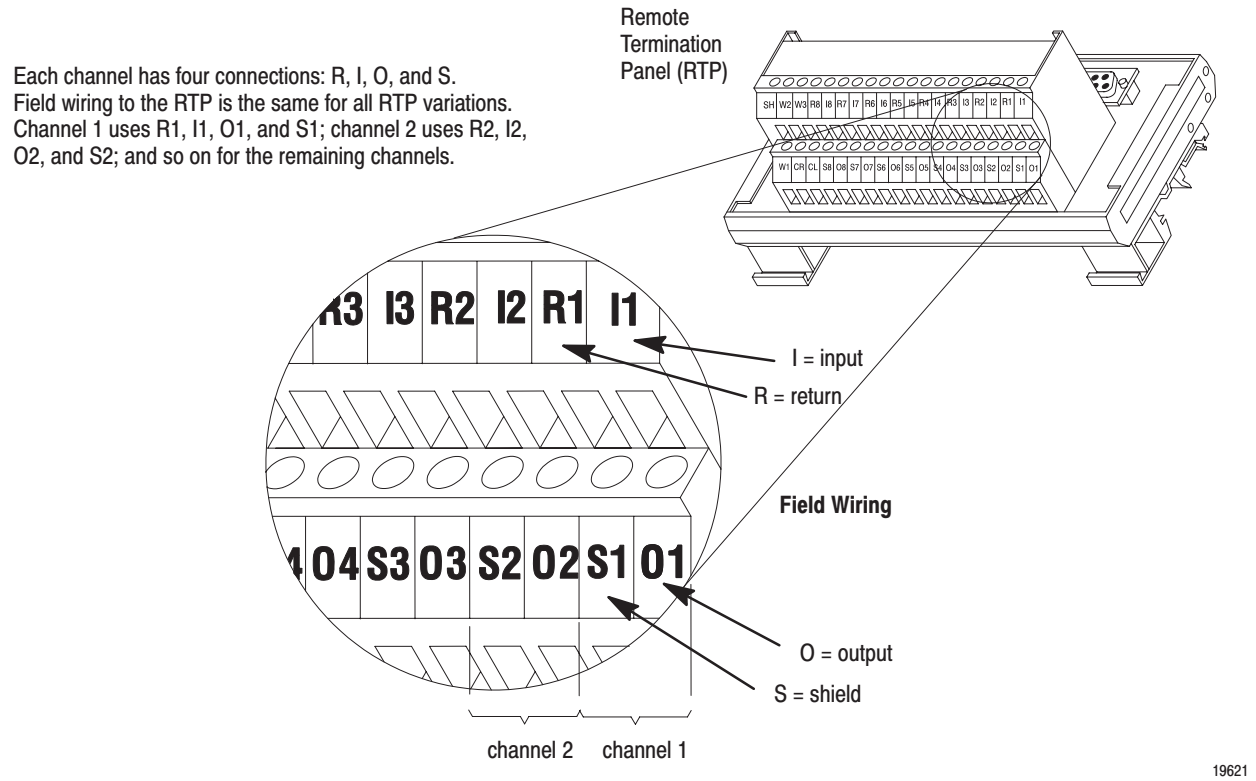
- **R = return**
- **I = input**
- **O = output**
- **S = shield**

Channel 1 would use R1, I1, O1, and S1; channel 2 would use R2, I2, O2, and S2; and so on for the remaining channels.

To connect field wiring to the remote termination panel:

1. **Strip 3/8 inch (9.25 mm) of insulation from the 22-12 AWG wire.**
2. **Insert the wire into the open connector slot.**
3. **Tighten the screw to 4.4–5.2 lb–in. (0.5–0.6Nm) to clamp the wire.**

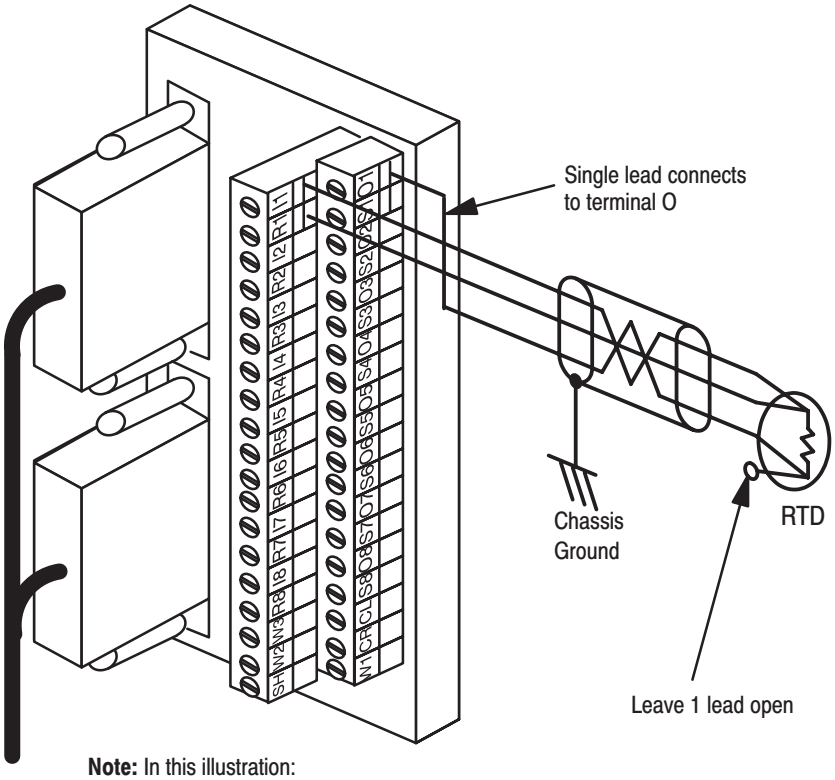
Figure 2.4
Connecting Wire to the Remote Termination Panel



Connecting 4-Wire Sensors

Figure 2.5 shows how to connect 4-wire sensors to the remote termination panel. A 4-wire sensor has two pairs of leads; one pair for each resistor junction. One wire of the four is not used (it does not matter which one). This leaves three wires – one pair and one single wire. You must connect the single wire to the terminal marked "O_". You connect the remaining pair of wires to terminals "I_" and "R_". It doesn't matter which wire of the pair connects to terminal "I_" and which wire connects to terminal "R_" so long as all three wires are the same AWG gauge.

Figure 2.5
Connecting a 4-Wire Sensor to the Remote Termination Panel



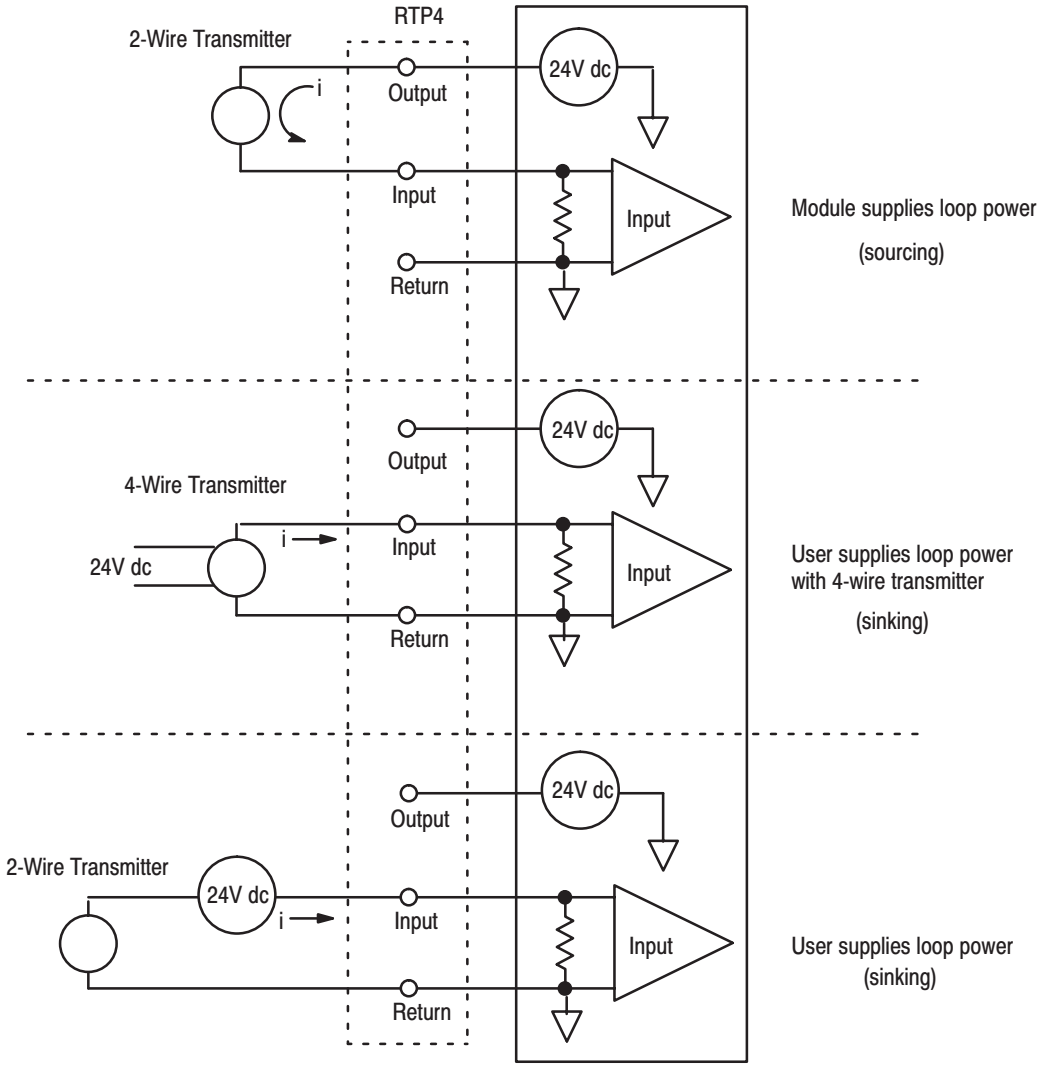
Note: In this illustration:
Terminal O is the 1mA excitation (A) sourcing current
Terminal I is the lead compensation (B) sense input
Terminal R is common (C)

12935–I

Sourcing Input Analog Modules

The 1771-NIS, 1771-NBSC and 1771-NB4S modules are sourcing/sinking input modules. These modules can supply the necessary loop power for 2-wire transmitters connected to the input. All loop power functionality is contained within the analog module. Examples of typical configurations are shown in Figure 2.6. No external resistors are required.

Figure 2.6
Examples of Sourcing/Sinking Input Modules



Inputs can be configured as sourcing or sinking inputs. For sourcing inputs, the N-series module supplies the loop power. For sinking inputs, you supply the loop power.

When the loop power is supplied externally, the 16-bit resolution provides 65535 counts over the 0–20mA current range. This provides about twice the resolution of voltage inputs with external resistors.

Making Your Own Cables

If you are not using thermocouples, you can terminate the analog module to a terminal block by cutting the 25-pin RTP end connector off the standard cable and wiring to your terminal block. Refer to Table 2.B for wire termination designations.

Table 2.B
Wire Termination Designations

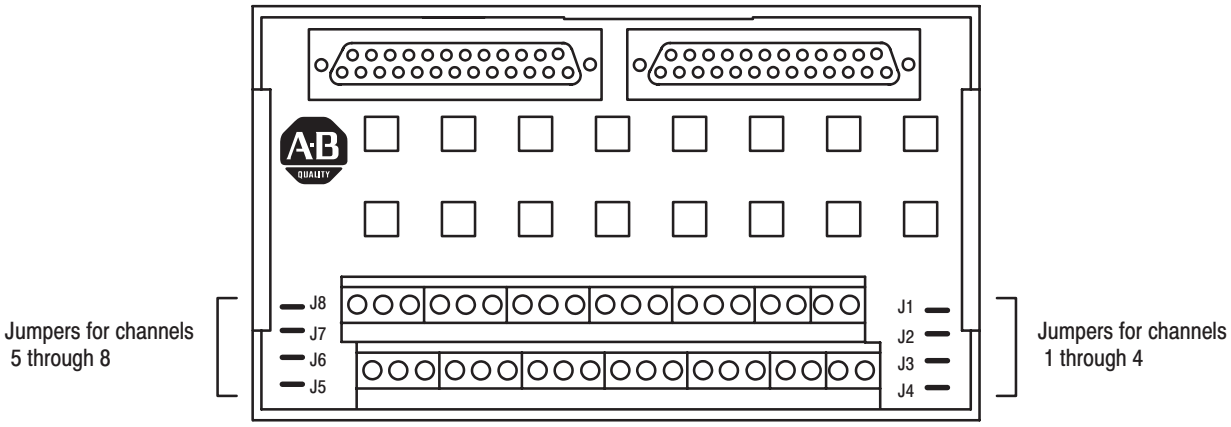
Module Top Connector				Module Bottom Connector			
Channel Number	**Signal**	**37-Pin Connector**	**Wire Color**	**Channel Number**	**Signal**	**37-Pin Connector**	**Wire Color**
1	I1	20	Blk	5	I5	20	Blk
	O1	22	Blk/Wht		O5	22	Blk/Wht
	R1	21	Wht/Blk		R5	21	Wht/Blk
2	I2	24	Orn	6	I6	24	Orn
	O2	26	Orn/Blk		O6	26	Orn/Blk
	R2	25	Wht		R6	25	Wht
3	I3	29	Grn	7	I7	29	Grn
	O3	31	Grn/Blk		O7	31	Grn/Blk
	R3	30	Grn/Wht		R7	30	Grn/Wht
4	I4	33	Blu	8	I8	33	Blu
	O4	35	Blu/Blk		O8	35	Blu/Blk
	R4	34	Blu/Wht		R8	34	Blu/Wht
				Cold Junction Thermistor		36	Red
						37	Red/Wht

Grounding the Field Devices

When using shielded cable or shielded thermocouple extension wire, ground the foil shield and drain wire only at one end of the cable. We recommend that you wrap the foil shield and drain wire together and connect them to the "S" connection on the RTP for the particular channel. All shield connections are internally connected together in the RTP so that only one wire is required to ground the entire remote termination panel. Connect a wire from the "SH" connection on the RTP to a ground stud on the metal cabinet in which the remote termination panel is mounted.

If you do not want to ground a particular shield at the RTP, you can remove the jumper for that particular channel. This will allow the shield to float at the RTP end. To remove a jumper, you must cut it out. Once the jumper is removed it cannot be replaced. Clip as close to the circuit board as possible at both ends to completely remove it. The jumpers (Figure 2.7) are labeled J1 through J8, corresponding to channels 1 through 8 respectively.

Figure 2.7
Jumper Positions

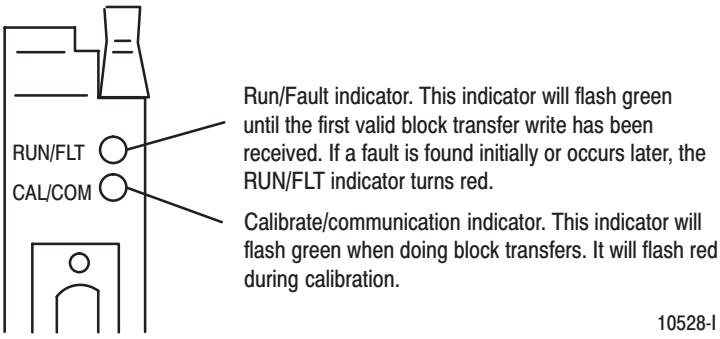


Refer to publication 1770-4.1, Programmable Controller Wiring and Grounding Guidelines, for additional information.

Interpreting the Indicator Lights

The front panel of the analog module contains two bi-color indicators: a red/green RUN/FLT (fault) indicator and a red/green CAL/COM indicator (Figure 2.8).

Figure 2.8
Diagnostic Indicators



At power-up, an initial module self-check occurs. The RUN/FLT indicator will be green when the check is completed satisfactorily. It will flash green until the first valid block transfer write has been received. If a fault is found initially or occurs later, the RUN/FLT indicator turns red.

The bottom indicator is the calibrate/communication indicator. This indicator will flash green when doing block transfers. It will flash red during calibration.

Possible module fault causes and corrective action are discussed in Chapter 7, "Troubleshooting."

Chapter Summary

In this chapter you learned how to install your module in an existing programmable controller system and how to wire to the remote termination panel.

Communicating With Your Analog Module

Chapter Objectives

In this chapter, we describe

- **block transfer programming**
- **quick-startup sample programs for the PLC-3 and PLC-5 processors**
- **module scan time issues**

Block Transfer Programming

Your module communicates with the processor through bidirectional block transfers. This is the sequential operation of both read and write block transfer instructions.

For the 1771-N series modules, block transfer writes (BTWs) can perform two different functions.

If you want to:	Description	This type of BTW is called:
configure the module	This involves setting the bits which enable the programmable features of the module, such as scaling, alarming, real time sampling, etc.	the **"configuration BTW"**
send data to the output channels of those modules having outputs	This type of BTW is generally shorter in length than the configuring BTW because it does not configure the module each time it is initiated.	the **"output update BTW"**

A configuration BTW is initiated when the analog module is first powered up, and subsequently only when the programmer wants to enable or disable features of the module.

An output update BTW is initiated when the programmer wants the output channels on the module to change value. This shortened version of the BTW allows faster response time from the output channels.

The following example programs are minimum programs; all rungs and conditioning must be included in your application program. You can disable BTRs, or add interlocks to prevent writes if desired. Do not eliminate any storage bits or interlocks included in the sample programs. If interlocks are removed, the program may not work properly.

Your analog module works with a default configuration upon powerup as long as a block transfer write (BTW) has not been initiated. See the configuration default section in chapter 4 to understand what this configuration looks like. Refer to the sample programs in this chapter to get started.

Your program should monitor status bits (such as overrange, underrange, alarms, etc.) and block transfer read activity.

The following example programs illustrate the minimum programming required for the 1771-N series module to powerup and operate.

PLC-2 Programming

Due to the number of digits required for high resolution readings, the 1771-N series modules normally read input values in 2's complement binary. Binary coded decimal (BCD) can be used, but with lower resolution. As a result, the 1771-N series modules are not recommended for use with PLC-2 family programmable controllers.

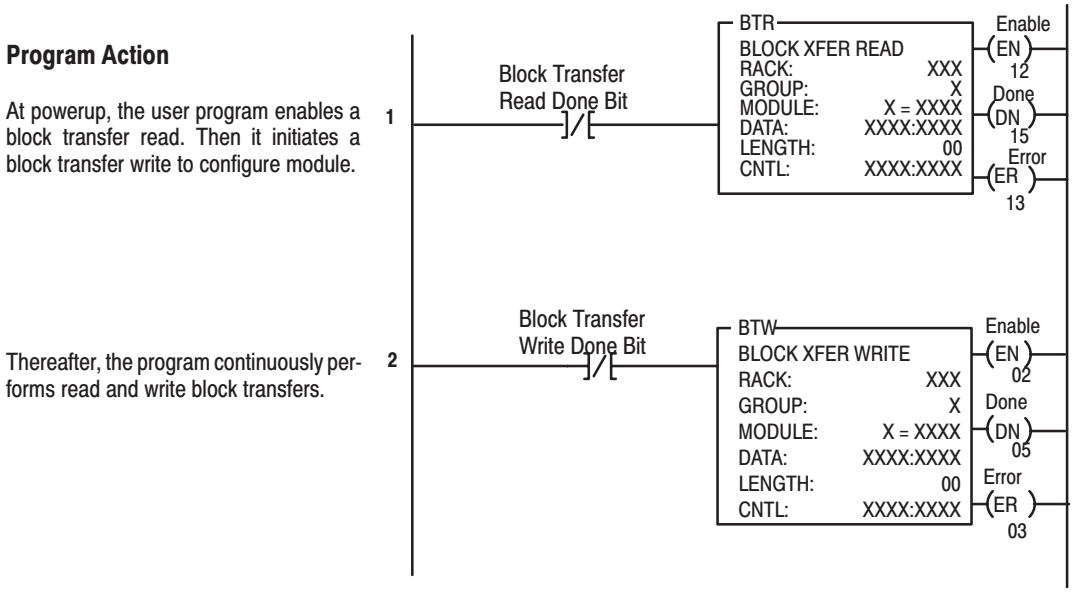
PLC-3 Program Example

Block transfer instructions with the PLC-3 processor use three data table files. A binary file is used for module location and other related data. This is the block transfer control file. Two separate block transfer data files store data that you want transferred to the module (when programming a block transfer write) or from the module (when programming a block transfer read). The address of the block transfer data files are stored in the block transfer control file.

The industrial terminal prompts you to create a control file when a block transfer instruction is being programmed. The same block transfer control file is used for both the read and write instructions for your module. A different block transfer control file is required for every module.

An example program segment with block transfer instructions is shown in Figure 3.1, and described below.

Figure 3.1
PLC-3 Family Sample Program Structure

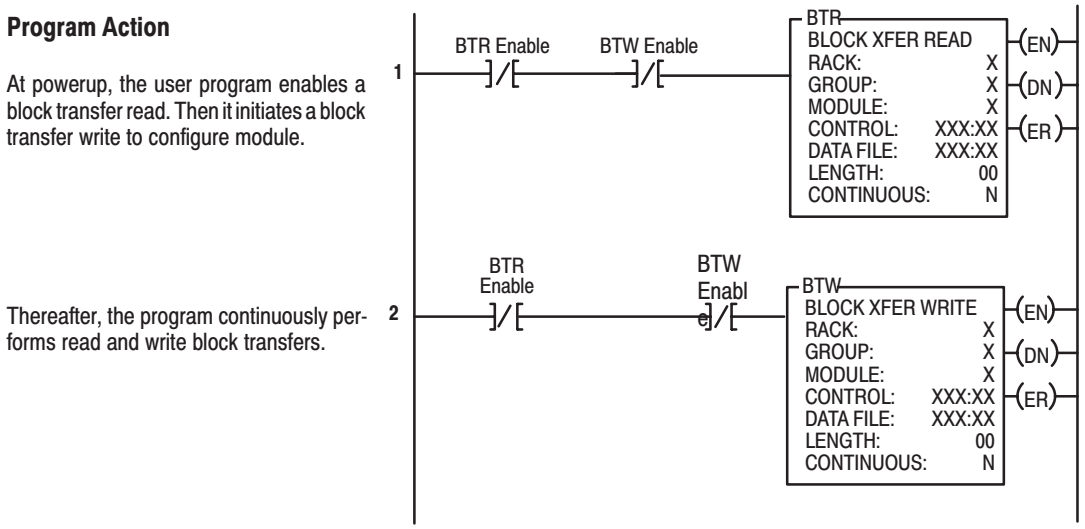


PLC-5 and PLC-5/250 Program Example

This program is very similar to the PLC-3 program with the following exceptions:

- **Block transfer enable bits are used instead of done bits as the conditions on each rung.**
- **Separate block transfer control files are used for the block transfer instructions.**

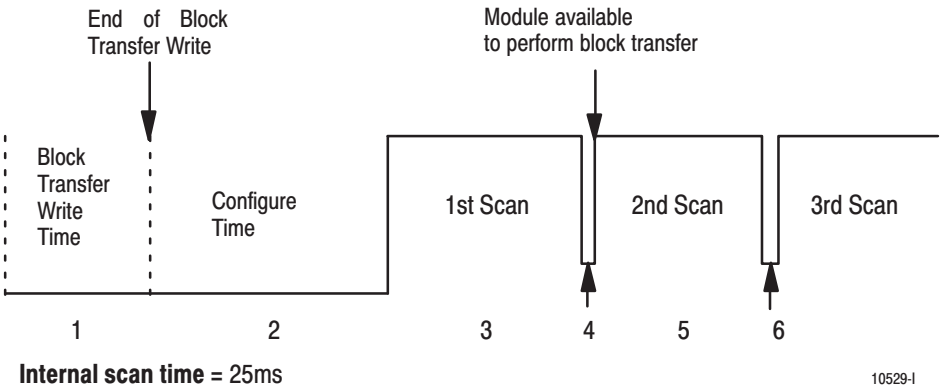
Figure 3.2
PLC-5 Family Sample Program Structure



Module Scan Time

Scan time is defined as the amount of time it takes for the module to read the input channels and place new data into the data buffer and/or read the data buffer and write new data to the output channels. Scan time for your module is shown in Figure 3.3.

Figure 3.3
Block Transfer Time



The following description references the sequence numbers in Figure 3.3.

Following a block transfer write (1) the module inhibits communication until after it has configured the data and loaded calibration constants (2), scanned the inputs and/or outputs (3), and filled the data buffer (4). Configuration block transfers, therefore, should only be performed when the module is being configured or calibrated.

Any time after the buffer is filled (4), a block transfer read (BTR) request can be acknowledged.

When operated in the default mode, new data will be available for a BTR every 25 milliseconds. When operated in real time sample mode
(RTS = T), BTRs will be ignored by the module for "T" milliseconds, at which time a single BTR will be allowed.

Programming Samples

The following are sample programs for using your modules more efficiently when operating with the PLC-3 or PLC-5 family processors.

These programs show you how to configure the module and read data from the module, and efficiently update the output channels on those modules with outputs.

Refer to the proper PLC-3 or PLC-5 documentation for additional information on processor programming and data entry.

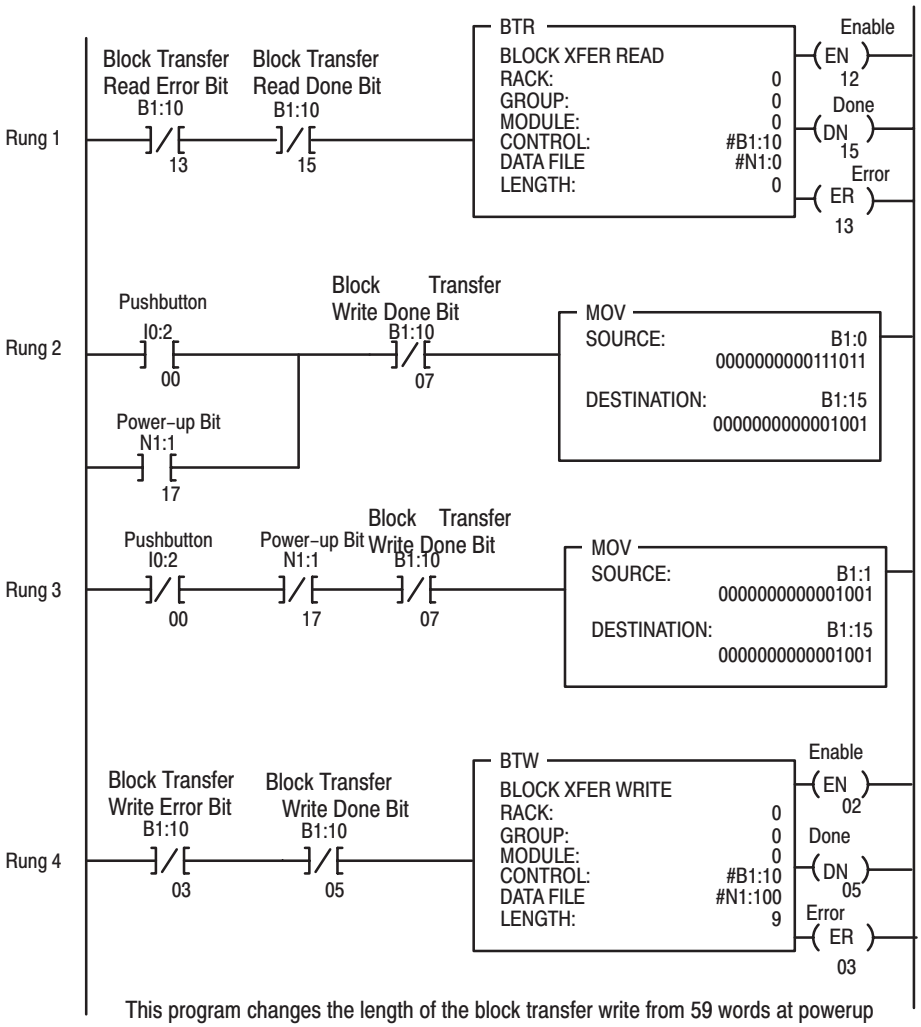
The differences between the types of 1771-N series modules is related to the number of output channels each module has. A module with only inputs (no outputs) requires one BTW after powerup. Thereafter, it sends back input data and module status by way of BTRs.

A module with outputs requires BTWs to configure it and update its output data. BTRs are required to send back input data and module status.

Sample Ladder Diagram - PLC-3 Family Processors

The following PLC-3 program can be used for all 1771-N series modules. The program can be altered to effectively address modules with or without output channels.

Figure 3.4
PLC-3 Family Example Program Structure



This program changes the length of the block transfer write from 59 words at powerup or when reconfigured, to 9 words at all other times.

Modules without output channels do not require rungs 2 and 3. Instead, move the input condition instructions from rung 2 to the front of rung 4, and specify the BTW length equal to 59.

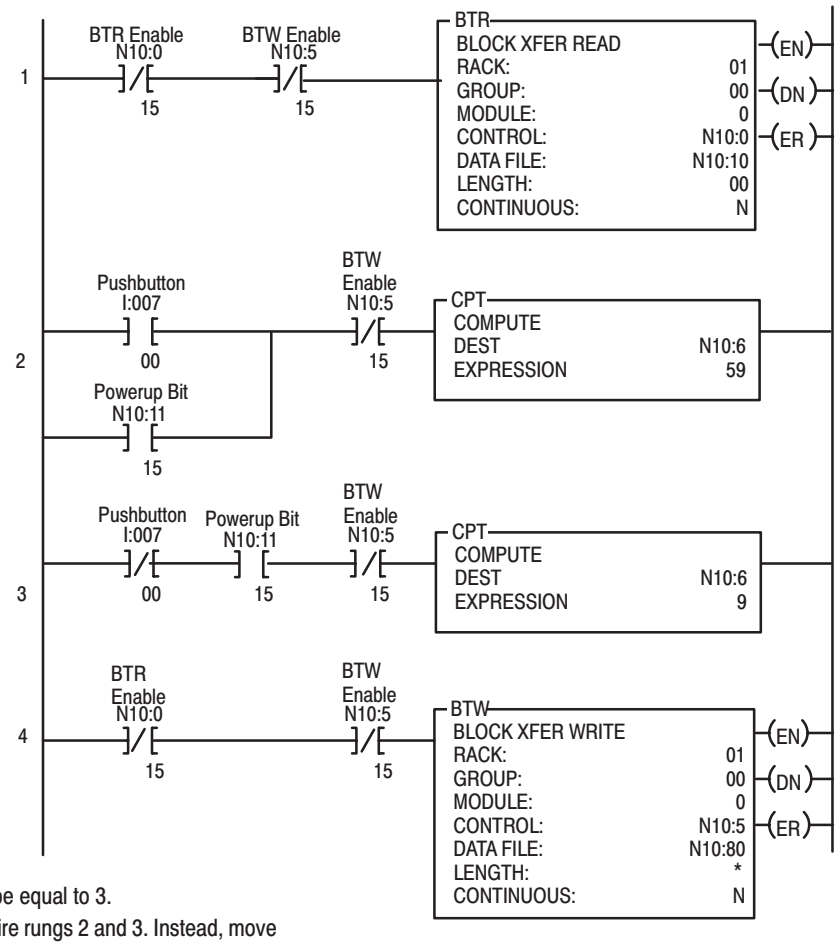
Sample Ladder Diagram - PLC-5 Family Processors

The following PLC-5 program is very similar to the preceding PLC-3 program with the following exceptions:

- **You use enable bits instead of done bits as the conditions on each rung.**
- **A separate control file must be selected for each of the block transfer instructions.**

Figure 3.5
PLC-5 Family Example Program Structure

For the following example, assume the analog module is physically located at rack address 01, module group 00, module slo and the input module connected to the pushbutton is located at rack address 00, module group 7, slot 6. The block transfer data files correspond to the example on the following pages.



* Length = (number of outputs + 1) words.
For 2 output/6 input modules, this would be equal to 3.

Modules without output channels do not require rungs 2 and 3. Instead, move the input
condition instructions (pushbutton and powerup) from rung 2 to the front of rung 4, and specify the BTW length equal to 59.

Setting Up the Data Table File

If you use a 1771-NBTC module with the parameters listed below, the PLC-5 data table file screen on an industrial terminal screen would look similar to Figure 3.6.

Overall Module Functions Chosen	
Number of outputs:	2
Verify mode:	Disabled
Temperature Scale:	Fahrenheit
BCD Select Bit:	2's complement binary data format
Cold Junction Temperature Alarm:	Enabled
Real Time Sampling Rate:	200 milliseconds

	Scale Value Low/High (counts)	Clamp Value Low/High (counts)	Max Output Ramp Rate (mA/sec)	Reset State	Alarm Enable	Reset Value (mA)			
Channel 1	400/2000	0/0	1.6	Minimum	Yes	N/A			
Channel 2	-1000/1000	-900/900	8.0	User	Yes	100			
	Scale Value Low/High (counts)	**Alarm Value Low/High (counts)**	**Input Rate Alarm (ºF/sec)**	**Alarm Enable**	**Alarm Deadband (ºF)**	**Filter Time (sec)**	**10 Ohm Offset**	**RTD Type**	**TC Type**
Channel 3	0/0	25000/26000	17	Yes	20.0	0.5	N/A	N/A	B
Channel 4	0/0	10000/10500	1.7	Yes	10.0	1.0	N/A	N/A	E
Channel 5	0/0	20000/20500	1.7	Yes	10.0	1.5	N/A	N/A	J
Channel 6	0/0	10000/10500	1.7	Yes	10.0	2.0	N/A	N/A	K
Channel 7	0/0	20000/21000	N/A	Yes	20.0	2.5	N/A	N/A	R
Channel 8	0/0	30000/31000	N/A	Yes	20.0	3.0	N/A	N/A	S

The above configuration for the 2 output/6 input module (cat. no. 1771-NBTC) would be set up using the following PLC-5 data table file (Figure 3.6).

Figure 3.6
Sample PLC-5 Data File (Hexadecimal Data) for a 2 Output/6 Input Module

Address	0	1	2	3	4	5	6	7	8	9
N10:0	C684	0000	001C	000A	000A	6404	0000	003B	000A	0050
N10:10	8800	2000	8000	02EC	0000	39A9	0000	39C1	8000	642C
N10:20	8010	0C71	8010	0EA4	8010	1288	8010	4045	8010	44E6
N10:30	0062	0062	0005	0005	0005	0005	0005	0005	0000	0000
N10:40	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
N10:50	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
N10:60	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
N10:70	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
N10:80	8820	04B0	0000	8002	00C8	0190	07D0	0000	0000	A00A
N10:90	0000	FC18	03E8	FC7C	0384	E032	0064	0000	0000	61A8
N10:100	6590	80AA	05C8	1000	0000	0000	2710	2904	8011	0A64
N10:110	2000	0000	0000	4E20	5014	8011	0E64	3000	0000	0000
N10:120	2710	2904	8011	1464	4000	0000	0000	4E20	5208	8000
N10:130	19C8	5000	0000	0000	7530	7918	8000	1DC8	6000	0000

Press a function key or enter a value.
N10:25 =

Rem Prog Forces: None Data: Hex/BCD Addr: Decimal 5/25 Addr 11 APL_NBTC

Change Radix F1 | Specify Address F5 | Next File F7 | Prev File F8

The block transfer read data file is located at N10:10 thru N10:37.
The block transfer write data file is located at N10:80 thru N10:138.

Chapter Summary

In this chapter, you learned how to program your programmable controller. You were given sample programs for your PLC-3 and PLC-5 family processors, and shown what the data file for a module looks like.

You also read about module scan time.

Configuring the Module

Chapter Objectives

In this chapter you will read how to:

- **configure your module's features**
- **condition your inputs and outputs and**
- **enter your data.**

Configuring the High Resolution Isolated Analog Modules

Because of the many analog devices available and the wide variety of possible configurations, you must configure your module to conform to the analog device and specific application that you have chosen. Data is conditioned through a group of data table words that are transferred to the module using a block transfer write instruction.

Configure your module for its intended operation by means of your programming terminal and write block transfers.

Note: Programmable controllers that use 6200 software (release 4.2 or higher) programming tools can take advantage of the IOCONFIG Addendum utility to configure this module. IOCONFIG Addendum uses menu-based screens for configuration without having to set individual bits in particular locations. You must have block transfer read and block transfer write rungs in your program before using IOCONFIG software. Refer to your 6200 software literature for details.

Important: **It is strongly recommended that you use IOCONFIG to configure this module. The IOCONFIG utility greatly simplifies configuration. If the IOCONFIG is not available, you must enter data directly into the data table. Use this chapter as a reference when performing this task.**

Note: Programmable controllers that use process configuration and operation software (cat. no. 6190-PCO) can take advantage of those development and runtime tools used for the application of programmable controllers in process control. The PCO worksheets and the menu-driven configuration screens and faceplates let you configure, test/debug and operate the I/O module. Refer to your 6190-PCO software literature for details.

During normal operation, the processor transfers from 1 to 59 words to the module when you program a BTW instruction to the module's address. The BTW file contains configuration words, high and low channel alarm settings, and calibration values that you enter for each channel.

When making entries in the configuration block, use binary or hexadecimal only.

Default Configurations

The modules can be operated in a default mode by using zeroes in all but the first word of the BTW data file. The first word must identify the number of outputs on the module. For example, the first word for the 8 output module (cat. no. 1771-NOC) would be 8880 hexadecimal; the first word for the 2 out/6 input module (cat. no. 1771-NBVC, -NBTC, -NBRC) would be 8820 hexadecimal; and the first word for the 8 input module (cat. no. 1771-NIV, -NT1, -NR) would be 8800 hexadecimal.

First Word in BTW file	Number of Outputs
8880 hexadecimal	8
8870 hexadecimal	7
8860 hexadecimal	6
8850 hexadecimal	5
8840 hexadecimal	4
8830 hexadecimal	3
8820 hexadecimal	2
8810 hexadecimal	1
8800 hexadecimal	0

The default scaling values that apply to the inputs and outputs are listed in the specifications in appendix A. In default mode, all programmable features (alarming, filtering, real time sampling, etc.) are disabled.

Module Level Programming Features

Module level programming features include:

- **module "configuration" verification**
- **temperature scale**
- **data format**
- **real time sample**

Module "Configuration" Verification

The verify bit 00 in the block transfer write word 3 allows you to compare the configuration information the module is using to the configuration information contained in a block transfer write (BTW). You set the verify bit in the BTW you wish to check, and download the BTW to the module. After the BTW is completed, request a BTR from the module. The program verify field in the BTR (bits 09-10 decimal, bits bits 11-12 octal, word 1) will contain either of two values: 10 (binary) indicates the verify failed; 11 (binary) indicates the verify succeeded.

If the verify bit is set, configuration information in the BTW data file will not be used by the module regardless of the success or failure of the verify.

Temperature Scale

You select the temperature scale that the module will use when returning temperature to the processor using bit 01, word 3 of the block transfer write data file. If the bit is set to 0, the temperature is in degrees C; if the bit is set to 1, the temperature is in degrees F.

Data Format

Use bit 02, word 3 of the block transfer write data file to select a data format. If this bit is 0, all data fields will be in two's complement binary format. If the bit is 1, all fields will be in BCD format. In BCD, the most significant bit is the sign bit for all signed fields. This sign bit applies to both BTW and BTR words.

NOTE: Available resolution is poor when using BCD format.

The 4-digit BCD format uses an arrangement of 16 binary digits to represent a 4-digit decimal number from 0000 to 9999 (Figure 4.1). The BCD format is used when the input values are to be displayed for operator viewing. Each group of four binary digits is used to represent a number from 0 to 9. The place values for each group of digits are 2^0, 2^1, 2^2 and 2^3 (Table 4.A). The decimal equivalent for a group of four binary digits is determined by multiplying the binary digit by its corresponding place value and adding these numbers.

The 1771-N series modules use 15-bit signed magnitude BCD. The maximum range value available then becomes 7999.

Figure 4.1
4-Digit Binary Coded Decimal

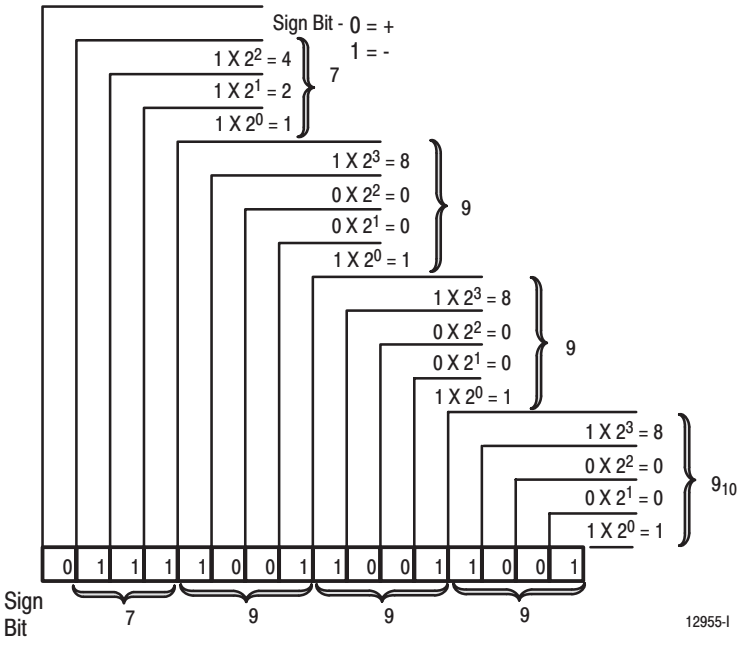


Table 4.A
BCD Representation

Place Value				Decimal Equivalent
2^3 (8)	2^2 (4)	2^1 (2)	2^0 (1)	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

Two's Complement Binary

Two's complement binary is used with PLC-3 processors when performing mathematical calculations internal to the processor. To complement a number means to change it to a negative number. For example, the following binary number is equal to decimal 22.

$$10110_2 = 22_{10}$$

First, the two's complement method places an extra bit (sign bit) in the left-most position, and lets this bit determine whether the number is positive or negative. The number is positive if the sign bit is 0 and negative if the sign bit is 1. Using the complement method:

0 10110 = 22

To get the negative using the two's complement method, you must invert each bit from right to left after the first "1" is detected.

In the above example:

0 10110 = +22

Its two's complement would be:

1 01010 = -22

Note that in the above representation for +22, starting from the right, the first digit is a 0 so it is not inverted; the second digit is a 1 so it is not inverted. All digits after this one are inverted.

If a negative number is given in two's complement, its complement (a positive number) is found in the same way:

1 10010 = -14
0 01110 = +14

All bits from right to left are inverted after the first "1" is detected.

The two's complement of 0 is not found, since no first "1" is ever encountered in the number. The two's complement of 0 then is still 0.

Real Time Sampling

Real time sampling is set using word 4 of the block transfer write data file. The real time sampling (RTS) mode of operation provides data from the module at a fixed time period for use by the processor. RTS is invaluable for time based functions (such as PID and totalization) in the processor. It allows accurate time based calculations in local or remote I/O racks.

In the RTS mode, the module scans and updates its inputs at a user defined time interval (ΔT) instead of the default interval. The module ignores block transfer read (BTR) requests for data until the sample time period elapses. The BTR of particular data set occurs only once at the end of the sample period and subsequent requests for transferred data are ignored by the module until a new data set is available. If a BTR does not occur before the end of the next RTS period, a time-out bit is set in the BTR status area (word 1). When set, this bit indicates that at least one data set was not transferred to the processor. (The actual number of data sets missed is unknown.) The time-out bit is reset at the completion of the BTR.

Legal RTS values are in intervals of 1ms from 0.100 to 10.000 seconds in binary format, or 0.100 to 9.999 seconds in BCD format. An RTS value of 0 disables the real time sampling feature.

Output Channel Programming Features

Output channel programming features include:

- **low and high scaling**
- **low and high clamping**
- **ramping**
- **alarm enable**
- **reset state**
- **reset value**

Scaling

Scaling is the conversion of unscaled data to engineering units. You use scaling so that the data for each channel is represented in actual engineering units.

Each channel has two scaling points, low and high. The signal value at these points is fixed. For example, the high scaling point of a ±10V output channel always corresponds to an output signal equal to +10.000V.

Channel Type	Sensor	Low Scaling Point	High Scaling Point
10V Output		-10.0V	+10.0V
25mA Output		4mA	20mA
50mA Output		1mA	50mA
5V Input		1.0V	5.0V
10V Input		-10.0V	+10.0V
4-20mA Input		4mA	20mA
-5/+55mV Input	Millivolt	-5mV	+55mV
	Temperature	-300C/-508F	1800C/3272F
100mV Input	Millivolt	-100mV	+100mV
	Temperature	-300C/-508F	1800C/3272F
650 Ohm Input	Resistance	1.0 Ohm	650 Ohm
	Temperature	-200C/-328F	900C/1652F

To implement the scaling feature, you insert the minimum and maximum scaled values in the appropriate configuration words.

Scaling values can be entered in either BCD or binary format. The range of binary format scaling values is ±32767; BCD format is ±7999. Remember to check the data format bit for proper control.

For example, assume that at 0mA, the device connected to this input channel is producing 0 psi, and at 20mA it produces 150 psi. Extrapolation indicates that at 4mA, the device is producing 30 psi. By setting the low scale value of the input to 30 and the high scale value to 150, this input channel will report data in psi.

For better resolution, you can multiply both of the scaling values by the same multipler as long as both scale values are in the range of ±32767 binary or ±7999 BCD. By setting the low scale to 3000 and the high scale value to 15000, you would report data in units of 0.01 psi per count.

Maximum resolution can be obtained by setting the low scale value to -32767 (-7999 in BCD) and the high scale value to +32767 (+7999 in BCD).

If both the low scale and high scale values are set to 0, the module reports data in the default resolution as shown below.

Channel Type	Data Format	Temperature Scale	Resolution
10V Output	Binary	N/A	0.1mV/count
	BCD	N/A	1mV/count
25mA Output	Binary	N/A	0.1mA
	BCD	N/A	1mA
50mA Output	Binary	N/A	0.1mA
	BCD	N/A	1mA
5V Input	Binary	N/A	0.1mV
	BCD	N/A	1mV
10V Input	Binary	N/A	0.1mV
	BCD	N/A	1mV
4-20mA Input	Binary	N/A	0.1mA
	BCD	N/A	1mA
-5/+55mV Input	Binary	Voltage Mode	0.01mV/count
	BCD	Voltage Mode	1mV/count
	Binary	Celsius Mode	0.1°C/count
	BCD	Celsius Mode	10°C/count
	Binary	Fahrenheit Mode	0.1°F/count
	BCD	Fahrenheit Mode	10°F/count
100mV Input	Binary	Voltage Mode	0.01mV/count
	BCD	Voltage Mode	1mV/count
	Binary	Celsius Mode	0.1°C/count
	BCD	Celsius Mode	10°C/count
	Binary	Fahrenheit Mode	0.1°F/count
	BCD	Fahrenheit Mode	10°F/count
650 Ohm Input	Binary	Resistance Mode	0.1 Ohm/count
	BCD	Resistance Mode	1 Ohm/count
	Binary	Celsius Mode	0.1°C/count
	BCD	Celsius Mode	10°C/count
	Binary	Fahrenheit Mode	0.1°F/count
	BCD	Fahrenheit Mode	10°F/count

Clamping

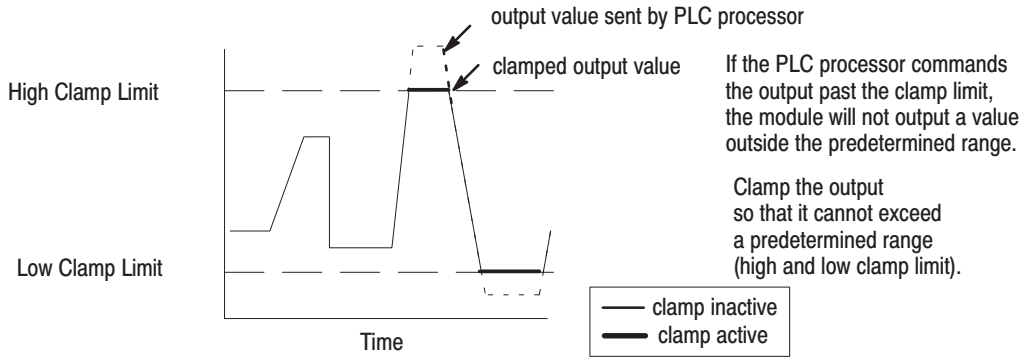
Output channels can be configured to limit or clamp the output signal at a specified value regardless of the output data value written to the module. Low and high clamping values are written to the module in scaled units, and must be within the absolute signal limits shown below.

Output Type	Low Absolute Limit	High Absolute Limit
± 10V	-10.4V	10.4V
25mA	0mA	26mA
50mA	0mA	50mA

If either value is outside of these limits, or if the low clamp is higher than the high clamp, the bad programming status bit (bit 07 in BTR word 1) will be set.

When the clamp feature is activated (output from the programmable controller is greater than the high clamp or lower than the low clamp) a corresponding high or low clamp status bit is set in the channel status word returned in the BTR.

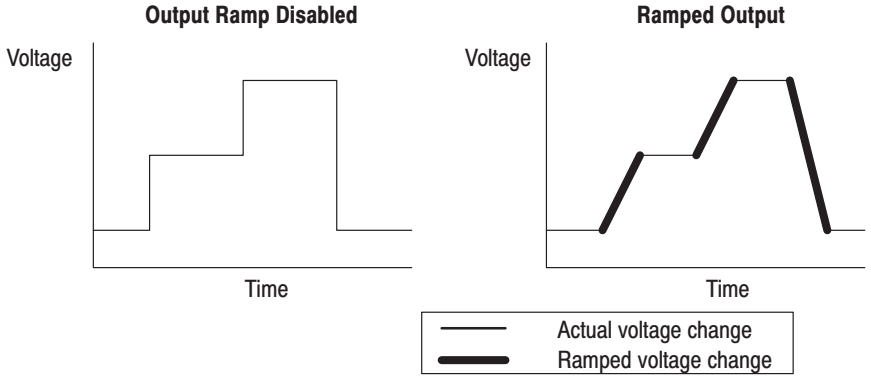
Figure 4.2Clamped Outputs



Ramping

Output ramping is used to limit the rate of change of an output channel. You enter the rate as a percentage (between 0 and 200%) of full scale per second, where 0 disables the ramping feature, and full scale is the difference between the low and high scaling points. 4.3 shows the effect of ramping on the output signal.

Figure 4.3Ramping on the Output Signal



Alarm Enable

Clamping and ramping are only active when the alarm enable bit (decimal bit 17, octal bit 15) has been set to 1.

Reset State

This field determines the action taken by the channel if the I/O reset backplane pin is asserted.

I/O Reset State	Binary Value	
Decimal Octal	Bit 14 (Bit 16)	Bit 13 (Bit 15)
Last State	0	0
Minimum	0	1
Maximum	1	0
User Selectable	1	1

The minimum and maximum values are defined as the low and high absolute limits respectively.

Reset Value

If the channel is programmed to go to a user-selectable reset value upon I/O reset, the value is entered (in scaled units) into that channel's proper configuration word. The value entered must be between the high and low absolute limits. If user-selectable resetting is not chosen, this field should be set to 0.

Input Channel Programming Features

Input channel programming includes:

- **low and high scaling**
- **low and high alarming**
- **alarm deadband**
- **rate alarming**
- **alarm enable**
- **digital filtering**
- **thermocouple type**
- **RTD type**
- **10 Ohm offset**

Scaling

Scaling input channels is identical to scaling output channels. Refer to "Output Channel Programming Features" on page 4–6.

Alarms

Each input channel has five alarm functions that provide status indication through five associated status bits in the block transfer read data returned by the module.

Input alarms let the user specify a range of "good" input values. If the input value goes outside of this range, and the alarm enable bit is set, the module will set the low or high alarm bit for that channel. The alarm values are written to the module in the same units as the scaling values, and must be within the absolute signal limits specified in appendix A.

- **Underrange - This bit is set if the input falls below the minimum range for that specific input type. This alarm is predefined and cannot be changed by the user. In current loop inputs, this bit also indicates an open loop.**

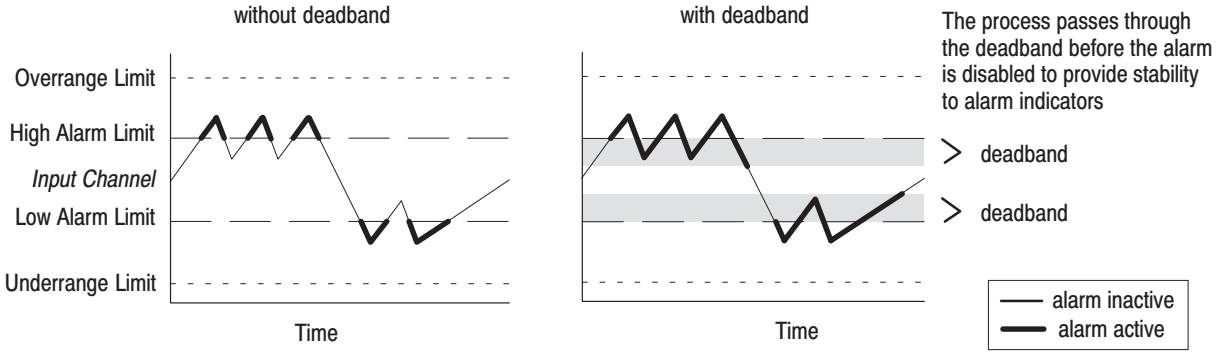
- **Overrange - This bit is set if the input rises above the maximum range for that specific input type. This alarm is predefined and cannot be changed by the user. For all voltage, RTD and thermocouple inputs, this bit indicates an open channel.**

Alarm Deadband

Alarm deadband allows the user to program a hysteresis effect on the alarming for a given channel. The deadband cannot be larger than 255 binary or 99 BCD, or 1/2 of the difference between the low alarm and high alarm values.

- **Low Alarm With Deadband - The low alarm bit is set when the input falls below the user-defined low alarm value. If a deadband is programmed, the low alarm bit will reset when the input rises above the level equal to the low alarm value plus the deadband.**
- **High Alarm With Deadband - The high alarm bit is set when the input rises above the user-defined high alarm value. If a deadband is programmed, the high alarm bit will reset when the input falls below the level equal to the high alarm value and deadband.**

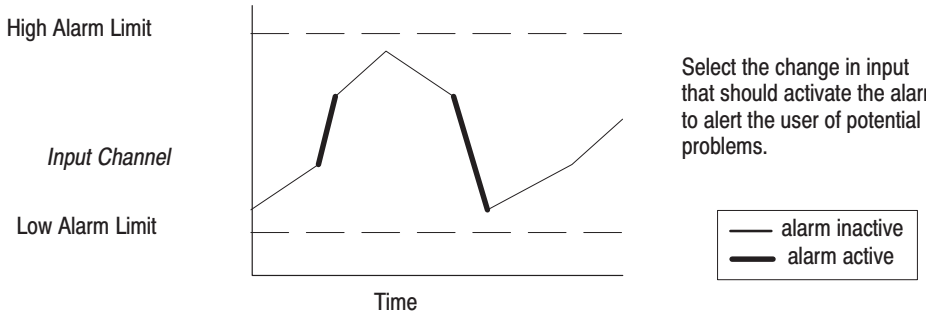
Figure 4.4
Deadband Example



Rate Alarm

This bit is set when the input changes at a rate faster than the user-defined value. Rate of change values can range from 0.05% to 50% of the input's full scale range per second. Full scale range is defined as the difference between the high scale value and the low scale value. The rate is specified in scaled units per second.

Figure 4.5
Rate of Change Alarm



Digital Filtering

This value specifies the time constant for a digital first order lag filter on the input. It is specified in units of 0.1 seconds. Values range from 0.1-9.9 seconds in BCD and 0.1-10.0 seconds in binary. A value of 0 disables the filter.

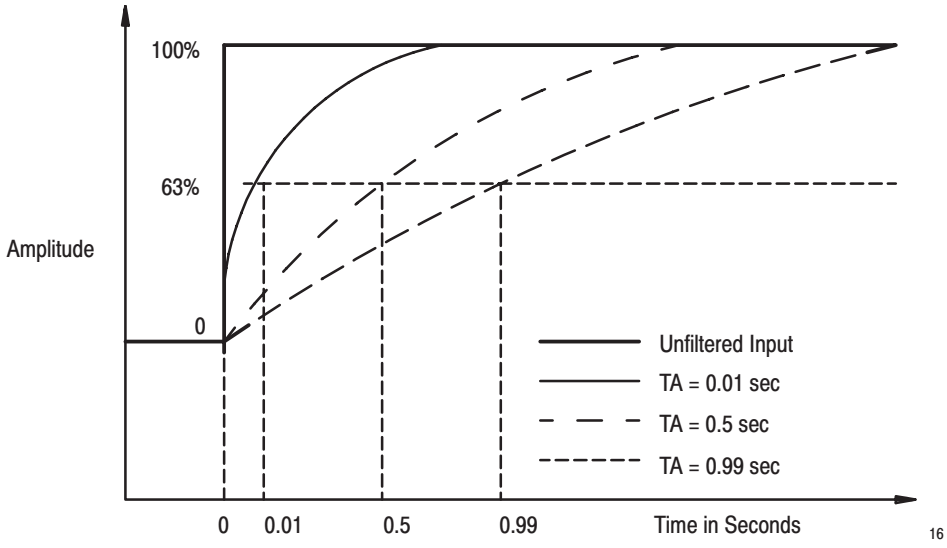
The digital filter equation is a classic first order lag equation (Figure 4.6). Using a step input change to illustrate the filter response (Figure 4.7), you can see that when the digital filter constant time elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response.

Figure 4.6
Digital Filter Equation

$$Y_n = Y_{n-1} + \left[\frac{\triangle t}{\triangle t + TA} \right] (X_n - Y_{n-1})$$

Where:
Y_n = present output, filtered peak voltage (PV)
Y_{n-1} = previous output, filtered PV
$\triangle t$ = module channel update time (seconds)
TA = digital filter time constant (seconds)
X_n = present input, unfiltered PV

Figure 4.7
Digital Filter Lag Equation Illustration



Thermocouple Type

This field lets you select the type of sensor connected to a thermocouple input channel. This field must be 0 for all other channel types.

Sensor Type	Binary Value			
Decimal	15	14	13	12
Octal	17	16	15	14
Millivolt	0	0	0	0
B	0	0	0	1
E	0	0	1	0
J	0	0	1	1
K	0	1	0	0
R	0	1	0	1
S	0	1	1	0
T	0	1	1	1
C[1]	1	0	0	0
N[1]	1	0	0	1

[1] For 1771-NT2 only.

RTD Type

This field lets you select the type of sensor connected to a 650 ohm input channel. This field must be 0 for all other channel types.

Sensor Type	Binary Value		
Decimal	10	09	08
Octal	12	11	10
Resistance	0	0	0
100 Ohm Pt. European Std.	0	0	1
100 Ohm Pt. U.S. Std.	0	1	0
10 Ohm Copper	0	1	1
120 Ohm Nickel	1	0	0

10 Ohm Offset

This field lets you compensate for a small offset error in a 10 ohm copper RTD. Values can range from -0.99 to +0.99 ohms in units of 0.01 ohms.

For example, if the resistance of a copper RTD used with this channel was 9.74 ohms at 25C, you would enter -0.26 in this field.

Configuration Block for a Block Transfer Write

The configuration block for a block transfer write consists of:

- **module configuration header**
- **output channel data (if applicable)**
- **output channel programming (if applicable)**
- **input channel programming (if applicable)**

Block Transfer Write Configuration Data Header

The configuration data header consists of information required for the processor to properly identify the type of information it will be receiving.

Module Configuration Data Header

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
0	BTW word type		Constant						Number of outputs				Constant			
	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0

Bit/Word Description of Word 0

Word	Bit	Definition
Word 0	00-03	Constant = 0
	Bits 04-07	Number of outputs = 0010
	Bits 10-15	Constant = 00 1000
	Bits 16-17	Block transfer write type = 10

The next group of words sets the outputs of the module, if the module has outputs. For example, if this is a 2 output/6 input module, words 1 and 2 would contain the data for the two output channels. If the module has four outputs, words 1 thru 4 would contain output channel data.

Output Configuration Words 1 and 2

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
1	Channel 1 Output Data															
2	Channel 2 Output Data															

Bit/Word Description of Output Configuration Words 1 and 2

Word	Decimal Bit (Octal Bit)	Definition
Word 1	Bits 00-15 (00-17)	First Output channel data
Word 2	Bits 00-15 (00-17)	Second Output channel data

Additional module configuration data is contained in the next two words. This includes verify, temperature scale, BCD select, cold junction alarm enable and real time sample time. These are explained in the bit/word description.

Output Configuration Words 3 and 4

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
3	CJ alarm enable	Unused = 0												BCD select	Temp scale	Verify
4	RTS Sample Time: 1 millisecond units															

Bit/Word Description of Output Configuration Words 3 and 4

Word	Decimal Bit (Octal Bit)	Definition
Word 3	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary
	Bits 03-14 (03-16)	Not used. Always 0
	Bit 15 (17)	CJ alarm enable. A value of 1 enables over and underrange indication for the cold junction channel. If the module does not have a cold junction channel, this bit is 0.
Word 4	Bits 00-15 (00-17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD.

Output Programming

The next group of six words contain channel-specific parameters. This includes low and high scale values, low and high clamp values, ramp rate, reset state, alarm enable and reset value.

Output Configuration Words 5 through 10

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	Channel 1 Programming															
5	Low Scale Value															
6	High Scale Value															
7	Low Clamp Value															
8	High Clamp Value															
9	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
10	Reset Value															

Bit/Word Description of Output Configuration Words 5 through 10

Word	Decimal Bit (Octal Bit)	Definition
Word 5	Bits 00-15 (00-17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 6	Bits 00-15 (00-17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 7	Bits 00-15 (00-17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 8	Bits 00-15 (00-17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 9	Bits 00-11 (00-13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the full scale range of the module. Legal values are from 1 to 200%.
Word 9 continued	Bit 12 (14)	Constant = 0
	Bits 13-14 (15-16)	Reset state. This field controls what an output channel will go to if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < -10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 10	Bits 00-15 (00-17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.

The above six words of output channel-specific information would be repeated for the next output channel (2), as shown below. The bit/word descriptions would be the same as above.

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	Channel 2 Programming															
11	Low Scale Value															
12	High Scale Value															
13	Low Clamp Value															
14	High Clamp Value															
15	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
16	Reset Value															

The following six words configure the first input channel of the module. These words are repeated as necessary for each input in the module. For example, if this is a 2 output/6 input module, words 1 through 4 would configure the module, words 5 through 16 would configure the 2 output channels (six words each). Then six groups of seven words each (one group for each input channel) would configure the module's six input channels.

Input Programming

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	Channel 3 Programming															
17	Low Scale Value															
18	High Scale Value															
19	Low Alarm Value															
20	High Alarm Value															
21	Alarm enable	Rate Alarm: Scaled Units per second														
22	Filter Time Constant: 0.1 second units								Alarm Deadband							
23	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							

Bit/Word Description of Input Configuration Words 17 through 23

Word	Decimal Bit (Octal Bit)	Definition
Word 17	Bits 00-15 (00-17)	Low scale value for channel 3.
Word 18	Bits 00-15 (00-17)	High scale value for channel 3.
Word 19	Bits 00-15 (00-17)	Low alarm value for channel 3.
Word 20	Bits 00-15 (00-17)	High alarm value for channel 3.
Word 21	Bits 00-14 (00-16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 22	Bits 00-07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.

Word	Decimal Bit (Octal Bit)	Definition
	Bits 8-15 (10-17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 10.0 seconds (binary) or 0.1 to 9.9 (BCD). A value of 0 disables the filter.
Word 23	Bits 00-07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of ±0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08-10 (10-12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non-RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12-15 (14-17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T; 1000= C (1771-NT2 only), 1001= N (1771-NT2 only). This field must be 0 for non-thermocouple channels.

The above group of words would be repeated for each of the remaining five input channels. The bit/word descriptions would be identical for each of those channels.

Refer to the Appendix specific to your module for block transfer write configurations to be used with your module.

Chapter Summary

In this chapter you learned how to configure your module's hardware, condition your inputs and enter your data.

Module Status and Input Data

Chapter Objectives

In this chapter you will read about:

- **reading data from your module**
- **block transfer read data format**

Reading Data from the Module

Block transfer read (BTR) programming moves status and data from the module to the processor's data table in one I/O scan. The processor user program initiates the request to transfer data from the module to the processor.

The transferred words contain module status, channel status and input data from the module. The maximum BTR data file length required is 28 words.

Block transfer reads are defined for each type of module platform, rather than type of outputs/inputs. The types of modules are:

Possible Combinations	Appendix
8 out/0 in	C
7 out/1 in	K
6 out/ 2 in	I
5 out/ 3 in	J
4 out/4 in	H
3 out/5 in	G
2 out/6 in	E
1 out/ 7 in	F
0 out/8 in	B
2 out/2 in	D

For example, the BTR from the 1771-NB4T (two 0-25mA out/two thermocouple in) is identical to the BTR for the 1771-NB4S (two 0-25mA out/two 4-20mA in), since both are 2 input/2 output modules.

When you perform a BTR for a specific module, the bits for fields that do not pertain to your specific module are set to zero.

Complete block transfer read data formats and bit/word descriptions for your particular module are shown in the Appendices.

Block Transfer Read Data Format

The block transfer read data format consists of an initial block header which identifies the type of module (input, output, or output/input), and groups of words that contain information on either an input channel or an output channel.

Output channel words are configured immediately after the block header. If the module contains both output and input channels, the output channel words come first in the block transfer read data format.

"Outputs Only" Block Transfer Read Data Header

This header is used for modules with outputs only (such as cat. no. 1771-NOC and 1771-NOV).

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	Constant = 8000 Hexadecimal															
3	Unused = 0															

The bit/word descriptions for the "outputs only" header block are shown below.

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00-15 (00-17)	Always 8800 Hexadecimal
Word 1	Bit 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09-10 (11-12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.

Word	Decimal Bit (Octal Bit)	Definition
Word 1 continued	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not legal BCD values.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2		Always 8000 hexadecimal.
Word 3		Not used. Always 0

"Inputs Only" and "Output/Input" Block Transfer Read Data Header

This following three-word header is used if the module only has input channels, or if it contains both input and output channels.

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															

The bit/word descriptions for the "inputs only" and "output/input" header block are shown below.

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00-15 (00-17)	Always = 8800 hexadecimal
Word 1	Bits 00-05	Not used
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.

Word	Decimal Bit (Octal Bit)	Definition
Word 1 continued	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09-10 (11-12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02-14 (02-16)	Not used. Always 0
	Bit 15 (17)	Always = 1
Word 3	Bits 00-15 (00-17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)

Input Status Data

Each input channel has two words associated with it. One word provides underrange, overrange, low and high alarms, rate alarm, bad program and bad calibration information to the processor. The second word contains channel input data. These words would immediately follow the header on modules containing only inputs, or after the output channel words on modules containing both outputs and inputs.

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Channel 1 Status																
4	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
5	Channel 1 Input Data															

The above two words would be repeated for each input channel. For example, if this module had two input channels, the following words would be used.

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Channel 1 Status																
4	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
5	Channel 1 Input Data															
Channel 2 Status																
6	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
7	Channel 2 Input Data															

Bit/word descriptions for the input status data words are shown below.

Bit/Word Description for Input Status Data Words

Word	Decimal Bit (Octal Bit)	Definition
Word 4	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used. Always 0
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input data is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input data is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Not used. Always 0
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10-14 (12-16)	Not used. Always 0
	Bit 15 (17)	Not used. Always = 1
Word 5	Bits 00-15 (00-17)	Channel 1 input data.

Output Status Data

Each output channel also has two words associated with it. The first word contains low and high clamp, rate alarm, bad data, bad program and bad calibration information for the processor. This is followed by raw count data for that channel. If the module contains both input and output channels, the output channel words would immediately follow the header words.

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Channel 1 Status																
4	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															

The above two words would be repeated for each output channel. For example, if this module had two output channels, the following words would be used.

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Channel 1 Status																
4	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
Channel 2 Status																
6	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															

Bit/Word Description for Output Status Data Words

Word	Decimal Bit (Octal Bit)	Definition
Word 4	Bit 00–03	Not used. Always 0
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD format was chosen and the output data is not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10-15 (12-17)	Not used. Always = 0
Word 5	Bits 00-15 (00-17)	Channel 1 Raw data sent to DAC.

Refer to the Appendix specific to your module for block transfer read configurations.

Chapter Summary

In this chapter you learned the meaning of the status information that the modules send to the processor.

Module Calibration

Chapter Objective

In this chapter we tell you how to calibrate your module. Your module is shipped from the factory already calibrated. This chapter tells you how to recalibrate or change calibration.

Tools and Equipment

In order to calibrate your analog module you will need the following tools and equipment:

Tool or Equipment	Description		
Precision Voltage Source	0–10V, 1μV resolution		
Precision Resistors **OR** Precision Decade Resistor Box	High Precision Resistors: 649 ohm, 0.01%, 5ppm/ºC 1 ohm, 0.1%, 5ppm/ºC	Lower Precision Resistors: If calibration to rated accuracy is not required, lower precision resistors can be used. Add percentage of tolerance and temperature coefficient error for expected accuracy. Refer to 6.A and 6.B below.	
	Accuracy: Minimum three decades; Decade one – 10 ohm decade, 1 ohm per step, better than 0.005 ohms (0.5% accuracy) Decade two – 100 ohm decade, 10 ohm per step, better than 0.005 ohms (0.05% accuracy) Decade three – 1000 ohm decade, 100 ohm per step, better than 0.01% accuracy		
	Any vendor's model that meets or exceeds the above specifications can be used. The user is responsible for assuring that the decade box maintains accuracy by periodic calibration as specified by the vendor. As a service to its customers, Allen-Bradley offers this partial list of vendors who can supply decade resistor boxes that meet or exceed the specifications.		
	Electro Scientific Industries Portland, OR Series DB 42	IET Labs Westbury, NY HARS–X Series	Julie Research Labs New York, NY DR 100 Series
Precision Multimeter	50mA, 1μA resolution 10V, 1μV resolution		
Industrial Terminal and Interconnect Cable	Programming terminal for A–B family processors		

If calibration to rated accuracy is not required, lower precision resistors can be used. Add the percentage of tolerance and the temperature coefficient error for expected accuracy.

Resistor Accuracy

Resistors change value over time. Both load life and temperature reduce the accuracy. The best way to determine the resistance of a resistor is to measure its value to the accuracy needed under the conditions in which it is used.

Table 6.A
Resistor Tolerance vs. Expected Error

Resistor Tolerance	Expected Error
0.1%	0.1%
0.5%	0.5%
1.0%	1.0%

Note: If the tolerance error of the 649 ohm resistor is > than ±18 ohms (2.8%), calibration will fail.

Table 6.B
Temperature Coefficient Error

Temperature Coefficient of Resistor	△T (Calibration temperature deviation from 25°C)	Expected Error
25ppm/°C	5°C	0.081 ohms (0.012%)
	10°C	0.162 ohms (0.025%)
	20°C	0.325 ohms (0.05%)
50ppm/°C	5°C	0.162 ohms (0.025%)
	10°C	0.325 ohms (0.05%)
	20°C	0.649 ohms (0.1%)
200ppm/°C	5°C	0.649 ohms (0.1%)
	10°C	1.298 ohms (0.2%)
	20°C	2.596 ohms (0.4%)

Example: Using a 649 ohm resistor, rated for 1% accuracy, with a temperature coefficient of 50ppm/°C, provides an expected accuracy of 1.05% (1.0% plus 0.05%) when calibration is done at 35°C (△T of 10°C).

Calibrating Your Module

The analog module is shipped already calibrated. If it becomes necessary to recalibrate the module, you must calibrate the module in an I/O chassis. The module must communicate with the processor and an industrial terminal.

Calibration service is available from Allen–Bradley. Contact your local sales office or field support center for information on how to send your module in for calibration. Modules under warranty will be calibrated at no charge. Modules out of warranty, sent in for calibration only, will be calibrated for less than the standard repair charge.

Before calibrating the module, you must enter ladder logic into the processor memory, so that you can send block transfer data to the module, and the processor can read block transfer data from the module.

Calibration can be accomplished using any of three methods:

- **manual calibration – refer to the procedure below.**
- **6200 I/O CONFIG software – refer to your 6200 software publications (release 4.2 or later) for procedures for calibrating.**
- **PCO operator interface software – refer to your 6190-PCO software publications for procedures for calibrating.**

Indicator Operation During Calibration

During calibration, the RUN/FLT indicator will turn to green. The CAL/COM indicator will turn to flashing red. The indicators will remain with these indications throughout the calibration procedure.

Manual Calibration

You can calibrate any number of channels, in any order. The following procedures define how to calibrate input and output channels.

IMPORTANT **In order to allow the module to stabilize, energize the module for at least 30 minutes before calibrating.**

Set up a block transfer write data file as shown in table 6.C.

Input Channel Calibration

1. **Set the appropriate bit in the BTW input calibration mask (word 2); channel 1 is bit 00, channel 2 is bit 01, etc. If calibrating only one channel, set the appropriate bit. If calibrating all channels (all inputs), set bits (00 through 07). Refer to Table 6.C.**

Table 6.C
Calibration Block Transfer Write

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
0	Calibration BTW Header = CC00 Hexadecimal															
1	Unused = 0														Cal Clk	High/ Low
2	Unused = 0								Input Cal Mask							
3	Unused = 0								Output Cal Mask							
4	1st Low Output Cal Value															
5	1st High Output Cal Value															
6	2nd Low Output Cal Value															
7	2nd High Output Cal Value															
8	3rd Low Output Cal Value															

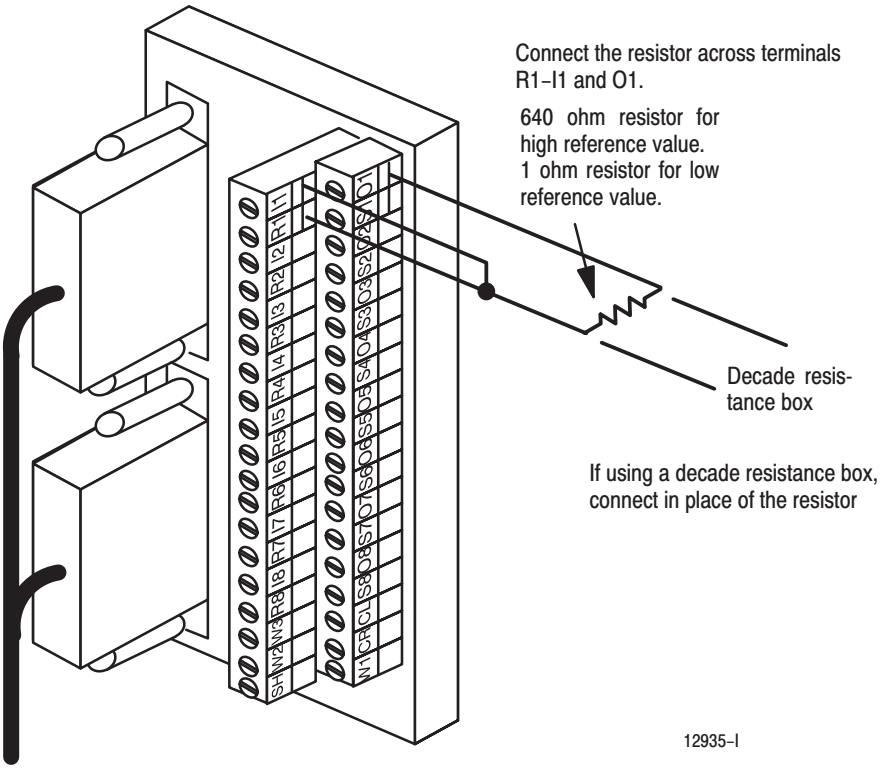
Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
9	3rd High Output Cal Value															
10	4th Low Output Cal Value															
11	4th High Output Cal Value															
12	5th Low Output Cal Value															
13	5th High Output Cal Value															
14	6th Low Output Cal Value															
15	6th High Output Cal Value															
16	7th Low Output Cal Value															
17	7th High Output Cal Value															
18	8th Low Output Cal Value															
19	8th High Output Cal Value															

2. Apply the appropriate low reference signal (Table 6.D) to all input channels being calibrated (for channel 1, I1 on RTP).

Table 6.D
Calibration Reference Signal Values

Type	Low Reference Value	High Reference Value
5 Volt input	0.0000V	5.0000V
10V input	0.0000V	10.0000V
4–20mA sourcing input	1.000mA	21.000mA
–5 to 55mV/TC input	0.000mV	55.000mV
100mV/TC input	0.000mV	100.000mV
650 Ohm RTD input	1.000 Ohms	649.0 Ohms
10V output	0.000V	10.000V
25mA output	0.500mA	22.000mA
50mA output	1.000mA	50.000mA

Figure 6.1
Connecting a Resistor or Decade Resistance Box to the Remote Termination Panel



3. **Send a block transfer write to the module with word 1 containing CAL CLK bit (01) = 1, and HI/LO bit (00) = 0.**
4. **Send a block transfer write to the module with word 1 containing CAL CLK bit (01) = 0, and HI/LO bit (00) = 0.**

Table 6.E
Calibration Block Transfer Read

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Calibration BTR Header = C000H															
1	Unused = 0													Range	EEPROM	Bad BTW
2	Input Cal Done bits															
3	Output Cal Done bits															
4	Input Bad Cal bits															
5	Output Bad Cal bits															
6	Corrected Channel 1 Data															
7	Corrected Channel 2 Data															
8	Corrected Channel 3 Data															
9	Corrected Channel 4 Data															
10	Corrected Channel 5 Data															
11	Corrected Channel 6 Data															
12	Corrected Channel 7 Data															
13	Corrected Channel 8 Data															

5. **Apply the appropriate high reference signal (Table 6.D) to all input channels being calibrated (for channel 1, I1 on RTP).**
6. **Send a block transfer write to the module with word 1 containing CAL CLK bit (01) = 1, and HI/LO bit (00) = 1.**
7. **Send a block transfer write to the module with word 1 containing CAL CLK bit (01) = 0, and HI/LO bit (00) = 1.**
8. **Request a block transfer read (BTR) from the module. If the INPUT BAD CAL bit (block transfer read word 4, bit 00, for channel 1 for example) is reset, and the INPUT CAL DONE bit (BTR word 2, bit 00 for channel 1 for example) is set, the procedure is complete.**

   If the bad BTW bit (word 1, bit 00) is set any time during the calibration procedure, an error occurred during the calibration procedure. Repeat the calibration.

   If the EEPROM bit (word 1, bit 01) is set, the module has a hardware fault. The module cannot be calibrated.

   If the RANGE bit (word 1, bit 02) is set, the channel(s) did not calibrate because one of the reference signals was out of range. Repeat the procedure. If the RANGE bit is set a second time, either the channel is bad, or there is a problem with the calibration equipment.

Output Channel Calibration

1. **Set the appropriate bit in the BTW output calibration mask (word 3); channel 1 is bit 0, channel 2 is bit 01, etc. If calibrating only one channel, set the appropriate bit. If calibrating the entire module (all outputs), set all bits (00 through 07).**
2. **Send a block transfer write to the module with word 1 containing CAL CLK bit (01) = 1, and HI/LO bit (00) = 0 and all output cal values = 0.**
3. **Send a block transfer write to the module with CAL CLK bit (01) = 0, and HI/LO bit (00) = 0 and all output cal values = 0.**
4. **Measure the signal on the channel you are calibrating. Use the appropriate equation below to calculate the output cal low value for this channel. Record this value for later use. Do not enter it into the BTW file at this time.**

10V Output

$$Y = (X \times 6000) - 30000$$

Where: X = meter reading in volts
Y = output cal low/high value

25mA Output

$$Y = \left[\frac{(X - 0.500)}{21.500} \times 60000 \right] - 30000$$

Where: X = meter reading in mA
Y = output cal low/high value

50mA Output

$$Y = \left[\frac{(X - 1.000)}{49.000} \times 60000 \right] - 30000$$

Where: X = meter reading in mA
Y = output cal low/high value

5. **Send a block transfer write to the module with word 1 containing CAL CLK bit (01) = 1, and HI/LO bit (00) = 1 and all output cal values = 0.**
6. **Send a block transfer write to the module with CAL CLK bit (01) = 0, and HI/LO bit (00) = 0 and all output cal values = 0.**
7. **Measure the signal on the channel you are calibrating. Use the appropriate equation above (step 4) to convert the value to the output cal high value for this channel. Record this value for later use. Do not enter it into the BTW file at this time.**

8. **Enter the first set of calculated low and high values into the first channel output cal values of the block transfer write calibration data file. If you are calibrating more than one output channel simultaneously, enter the output cal values from the lowest numbered output channel in the first output cal value slots. The next lowest channel in the output mask goes in the second slot of output cal values, and so on.**
9. **Send a block transfer write to the module with word 1 containing CAL CLK bit (01) = 1, and HI/LO bit (00) = 1.**
10. **Send a block transfer write to the module with word 1 containing CAL CLK bit (01) = 0, and HI/LO bit (00) = 1.**
11. **Request a block transfer read (BTR) from the module.**

    If the OUTPUT BAD CAL bit (word 5, bit 00, for channel 1 for example) is reset, and the OUTPUT CAL DONE bit (word 3, bit 00 for channel 1 for example) is set, the procedure is complete.

    If the bad BTW bit is set any time during the calibration procedure, an error in the calibration procedure. Repeat the calibration.

    If the EEPROM bit is set, the module has a hardware fault. The module cannot be calibrated.

    If the RANGE bit (word 1, bit 02) is set, the channel(s) did not calibrate because one of the reference signals was out of range. Repeat the procedure. If the RANGE bit is set a second time, either the channel is bad, or there is a problem with the calibration equipment.

Chapter Summary

In this chapter, you learned how to calibrate your module's channels.

Troubleshooting

Chapter Objective

We describe how to troubleshoot your module by observing indicators and by monitoring status bits reported to the processor.

Diagnostics Reported by the Module

At power-up, the module turns the RUN/FLT indicator to red, then checks for:

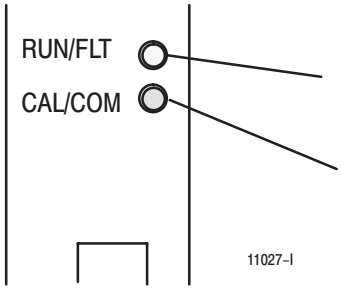
- **correct RAM operation**
- **EPROM operation**
- **EEPROM operation**

After passing initial diagnostics, the module turns the RUN/FLT indicator to flashing green. The indicator will continue to flash green until it receives a valid BTW. After the BTW, it will stay solid green during operation. It will turn red if it detects a fault condition. If the RUN/FLT indicator is red, block transfers will be inhibited.

The lower CAL/COM indicator flashes green when the module is communicating with the processor. The speed of the flashing is dependent upon system speed. If the module is accessed in less than 100ms intervals, the CAL/COM indicator will be solid red.

The module also reports status and specific faults (if they occur) in every transfer of data to the processor. Monitor the green/red indicators and status bits in the appropriate word of the BTR file when troubleshooting your module.

Figure 7.1
Indicators



Indicator	When Green	When Red
RUN/FAULT	flashes – during initial power-up solid – first valid block transfer write successfully completed	solid – a fault is found
CAL/COM	flashes – when communication is taking place between the PLC processor and the N-series module.	flashes – during calibration

Troubleshooting with the Indicators

Table 7.A shows indications, probable causes and recommended actions to correct common faults which may occur.

Table 7.A
Troubleshooting Chart

Indication	Probable Cause	Recommended Action
Both indicators are OFF	No power to module	Check power to I/O chassis. Recycle as necessary.
	Possible short on the module LED driver failure	Replace module.
RUN/FLT indicator ON red	Microprocessor, oscillator or EPROM failure	
	If immediately after power–up, indicates RAM or EPROM failure.	
	If during operation, indicates possible microprocessor or backplane interface failure.	
	Internal fuse bad	
RUN/FLT indicator is flashing green	Power–up diagnostics successfully completed.	Normal operation.
RUN/FLT indicator is solid green	Initial block transfer write successfully completed	
CAL/COM indicator is green (solid or flashing)	Normal operation	None required
CAL/COM indicator is green and RUN/FLT indicator is green but module data is wrong (for example, with cable off, input channel data values are at minimum scale values)	Internal module problem	Replace module

Status Reported by the Module

Design your program to monitor module and channel status bits, and to take appropriate action depending on your application requirements. You may also want to monitor these bits while troubleshooting with your industrial terminal. The module sets a bit (1) to indicate it has detected one or more of the following module conditions as shown in Table 7.B.

The module sets a bit (1) to indicate it has detected one or more of the following input channel conditions (Table 7.D), or output channel conditions (Table 7.C).

Table 7.B
Module Status Reported in BTR Word 1

	Decimal Bit (Octal Bit)	Explanation
Word 1	Bit 00-05	Not used
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09-10 (11-12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if no BTR was requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	CJC Underrange bit. This bit is set if the CJC temperature is below the input channel minimum range.
	Bit 01	CJC Overrange bit. This bit is set if the CJC temperature is above the input channel maximum range.

Table 7.C
Output Channel Status Word (1 per output channel)

	Decimal Bit (Octal Bit)	Definition
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD data format was chosen and the output data was not a legal BCD value.
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.

Table 7.D
Input Channel Status Word (1 per input channel)

	Decimal Bit (Octal Bit)	Definition
	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input signal is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input signal is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 08 (10)	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.

Chapter Summary

In this chapter, you learned how to interpret the status indicators, status words and troubleshoot your analog module.

Specifications

General Specifications

	Number of Channels (depends on specific module)	8 individually isolated, or 4 individually isolated
	I/O Chassis Location	any single I/O module slot
	A/D Resolution	16 bits or 15 bits plus sign bit
	D/A Resolution	14 bits or 13 bits plus sign bit
	Input Filtering	6 pole, low pass hardware filter
	Calibration Interval	1 year
	Isolation Voltage	Designed to withstand 1000V dc continuous between input and output channels and between input and backplane connections. Modules are 100% tested at 1200V dc for 1 second between input channels and backplane connections.
	Maximum Backplane Current and Power Dissipation @ 5V	<u>Current</u> <u>Power</u> 1771-NBRC 1.8A 8.5W 1771-NB4S 1.6A 7.0W 1771-NB4T 1.5A 5.0W 1771-NBSC 3.0A 13.0W 1771-NBTC 1.6A 7.5W 1771-NBV1 1.8A 8.0W 1771-NBVC 1.8A 8.5W 1771-NIS 2.9A 12.0W 1771-NIV 1.5A 6.0W 1771-NIV1 1.5A 6.0W 1771-NIVR 1.5A 6.0W 1771-NIVT 1.5A 5.5W 1771-NOC 2.9A 14.0W (20mA) 3.3A 16.0W (25mA) 1771-NOV 2.1A 10.0W 1771-NR 1.5A 6.0W 1771-NT1 1.5A 5.0W 1771-NT2 1.5A 5.0W
Environmental Conditions		
	Operational Temperature	IEC 60068–2–1 (Test Ad, Operating Cold) IEC 60068–2–2 (Test Bd, Operating Dry Heat) IEC 60068–2–14 (Test Nb, Operating Thermal Shock) 32 to 140°F (0 to 60°C) Ambient changes > 0.5ºC per minute may temporarily degrade performance during periods of change.
	Storage Temperature	IEC 60068–2–1 (Test Ab, Unpackaged, Nonoperating Cold) IEC 60068–2–2 (Test Bb, Unpackaged, Nonoperating Dry Heat) IEC 60068–2–14 (Test Na, Unpackaged, Nonoperating Thermal Shock) –40 to 185°F (–40 to 85°C)
	Relative Humidity	IEC 60068–2–30 (Test Db, Unpackaged, Nonoperating Damp Heat) 5 to 95% noncondensing
	Shock Operating Nonoperating	IEC 60068–2–27 (Test Ea, Unpackaged Shock) 30g 50g

Vibration	IEC 60068–2–6 (Test Fc, Operating) 2g @ 10–500Hz
ESD Immunity	IEC 61000–4–2 4kV contact discharges
Radiated RF Immunity	IEC 61000–4–3 10V/m with 1kHz sine–wave 80% AM from 30MHz to 1000MHz 10V/m with 200Hz 50% Pulse 100% AM at 900MHz
EFT/B Immunity	IEC 61000–4–4 ±1kV @ 5kHz on signal ports
Surge Transient Immunity	IEC 61000–4–5 ±2kV line–earth (CM) on shielded ports
Conducted RF Immunity	IEC 61000–4–6 10V rms with 1kHz sine wave 80% AM from 150kHz to 30MHz
Emissions	CISPR 11 Group 1, Class A (with appropriate enclosure)
Enclosure Type	None (open style
Connecting Cable(s)	1771-NC6 = 1.8m (6ft) 1771-NC15 = 4.6m (15ft)
Field Wiring Arm Wiring Size Insulation Category	 14–22AWG (2.5–0.25mm^2) solid or stranded copper wire rated at 60ºC or greater 3/64 inch (1.2mm) maximum 2[1]
Keying	Between 26 and 28 Between 32 and 34
Certifications (when product is marked)	UL UL Listed Industrial Control Equipment CSA CSA Certified Process Control Equipment CE[2] European Union 89/336/EEC EMC Directive, compliant with: EN 61000–6–4, Industrial Emissions EN 50082–2, Industrial Immunity EN 61000–6–2, Industrial Immunity EN 61326, Meas./Control/Lab., Industrial Requirements C–Tick[2] Australian Radiocommunications Act,compliant with AS/NZS 2064, Industrial Emissions

1 Use this conductor category information for planning conductor routing . Refer to publication 1770-4.1, "Industrial Automation Wiring and Grounding Guidelines."
2 See the Product Certification link at `www.ab.com` for Declarations of Conformity, Certificates, and other certification details.

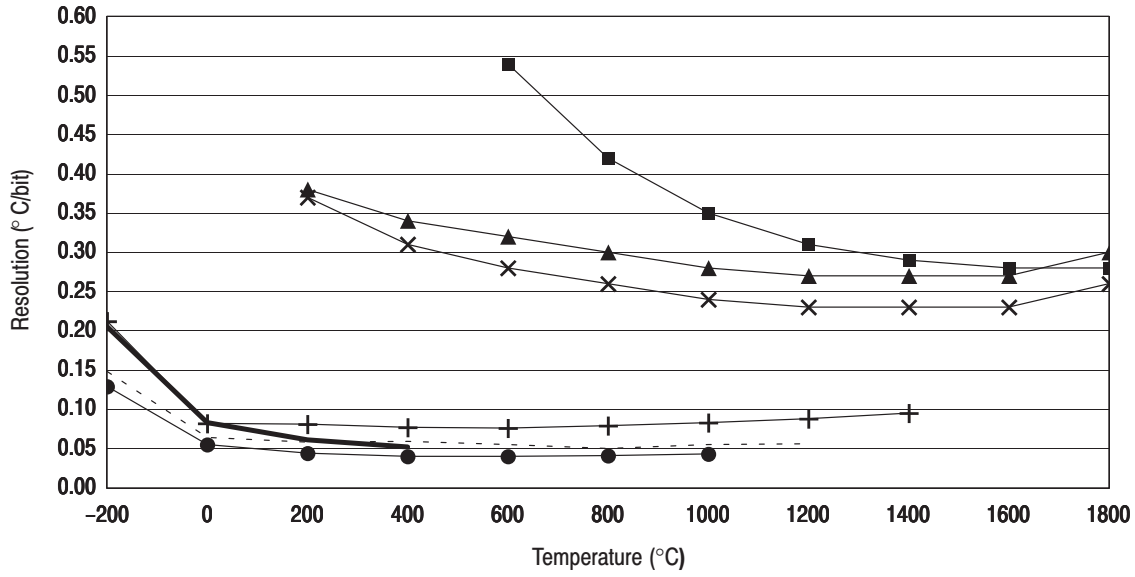
Temperature Specifications

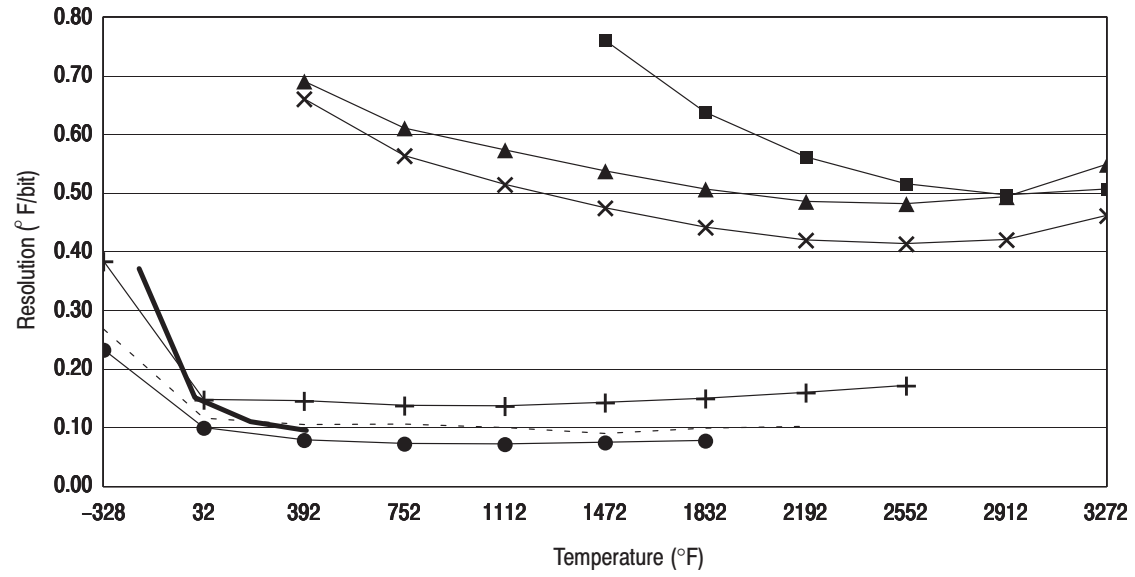
	±100mV Thermocouple Input	–5 to +55mV Thermocouple Input	1-650Ω RTD Input
Input Range (selectable)	±105mV	–5.5 to 56.0mv	4 to 650Ω
	Type B: 300 to 1800°C (572 to 3272°F) Type E: –270 to 1000°C (–454 to 1832°F) Type J: –210 to 1200°C (–346 to 2192°F) Type K: –270 to 1372°C (–454 to 2502°F) Type R: –50 to 1768°C (–58 to 3214°F) Type S: –50 to 1768°C (–58 to 3214°F) Type T: –270 to 400°C (–454 to 752°F)	Type B: 300 to 1800°C (572 to 3272°F) Type C: 0 to 2315°C (32 to 4199°F) Type E: –20 to 735°C (–4 to 1355°F) Type J: –37 to 966°C (–34 to 1770°F) Type K: –71 to 1372°C (–95 to 2502°F) Type N: –270 to 1300°C (–450 to 2372°F) Type R: –50 to 1768°C (–58 to 3214°F) Type S: –50 to 1768°C (–58 to 3214°F) Type T: –73 to 400°C (–99 to 752°F)	100Ω Pt a=0.00385 European standard: –200 to +870°C (–328 to +1598°F) 100Ω Pt a=0.003916 U.S. standard: –200 to +630°C (–328 to +1166°F) 10Ω copper: –200 to +260°C (–328 to +500°F) 120Ω nickel: –80 to +320°C (–112.1 to +608°F)
Maximum Input Resolution[1]	3.3µV/bit @ 15 bits with sign bit Type E, J, K, T 0.1°C (0.2°F)[2] Type B, R, S: 0.3°C (0.6°F)[2]	0.95µV/bit @ 16 bits unipolar Type E, J, K, T, N: 0.03°C (0.06°F)[2] Type B, R, S: 0.1°C (0.2°F)[2] Type C: 0.07°C (0.1°F)[2]	10mΩ/bit @ 16 bits unipolar 100Ω Pt & 120Ω Ni 0.03 °C (0.06°F) 10Ω Cu 0.3°C (0.5°F)
Default Display Resolution	0.01mV / 0.1°C (0.1°F)	0.1mV / 1.0°C (0.1°F)	0.01 ohm / 0.1°C (0.1°F)
Temperature Scale (per module)	°C (°F)	°C (°F)	°C (°F)
Input Impedance	> 10 MΩ	> 10 MΩ	
Thermocouple Linearization	IPTS-68 standard, NBS MN-125	IPTS-68 standard, NBS MN-125	
Cold Junction Compensation	0 to 70°C ±0.25°C	0 to 70°C ±0.25°C	
Open Input Detection	upscale	upscale	upscale
Open TC Leakage Current	< 10 nA (maximum)	< 10 nA (maximum)	
Time to Detect Open Input	10s (maximum)	5s (maximum)	5s (maximum)
RTD Excitation Current			1mA (typical)
Input Overvoltage Protection	140V ac rms continuous	140V ac rms continuous	140V ac rms continuous
Normal Mode Rejection (50/60Hz)	50dB / 60dB (minimum)	50dB / 60dB (minimum)	50dB / 60dB (minimum)
Common Mode Rejection (60Hz)	150dB (typical)	150dB (typical)	150dB (typical)
Offset Drift (maximum)	±0.50µV/°C	±0.50µV/°C	±25 mΩ/°C
Gain Drift (maximum)	±35ppm/°C	±35ppm/°C	±50ppm/°C
Input Bandwidth	9Hz	9Hz	9Hz
Update Time (per module)	25ms (maximum)	25ms (maximum)	25ms (maximum)
Settling Time to within 0.1% of Full Scale	125ms (maximum)	125ms (maximum)	125ms (maximum)
Non-linearity	0.02% of full range (maximum)	0.02% of full range (maximum)	0.02% of full range (maximum)
Accuracy with Calibration (includes non-linearity, gain, offset)	0.01% of full range @ 25°C (typical) 0.05% of full range @ 25°C (maximum)	0.01% of full range @ 25°C (typical) 0.05% of full range @ 25°C (maximum)	0.025% of full range @ 25°C (typical) 0.05% of full range @ 25°C (max.)
Calibration Values	0.000 / 100.000mV	0.000 / 55.000mV	1.00 / 649.0Ω
Underrange Threshold	–103.0mV	–5.5mV	0.9Ω
Overrange Threshold	+103.0mV	+56.0mV	650Ω
Rate Alarm Value Minimum (0.04% FSR) Maximum (50% FSR)	 0.08mV / 0.9°C (1.6°F) per second 100mV / 1050°C (1890°F) per second	 24uV / 0.9°C (1.6°F) per second 30mV / 1050°C (1890°F) per second	 0.26Ω / 0.44°C (0.8°F) per second 325Ω / 550°C (990°F) per second
Scaling Points → Default Scaling Values[3]	–100/+100mV → –10000/+10000 –300/1800°C → –3000/18000 –508/3272°F → –5080/32720	–5/+55mV → –500/+5500 –300/1800°C → –3000/18000 –508/3272°F → –5080/32720 Type C only: –300/2500°C → –3000/25000 –508/4532°F →–508/4532	+1/650Ω → +10/6500 –200/900°C → –2000/9000 –328/1652°F → –3280/16520

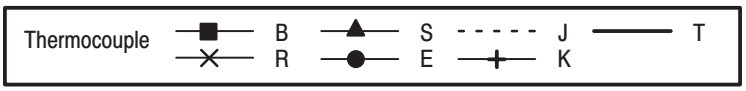
[1] Maximum resolution is obtained by rescaling input data to counts.
[2] These resolutions apply to the commonly used ranges for these thermocouples. See graphs.
[3] Values shown are applicable when using 2's complement data format.

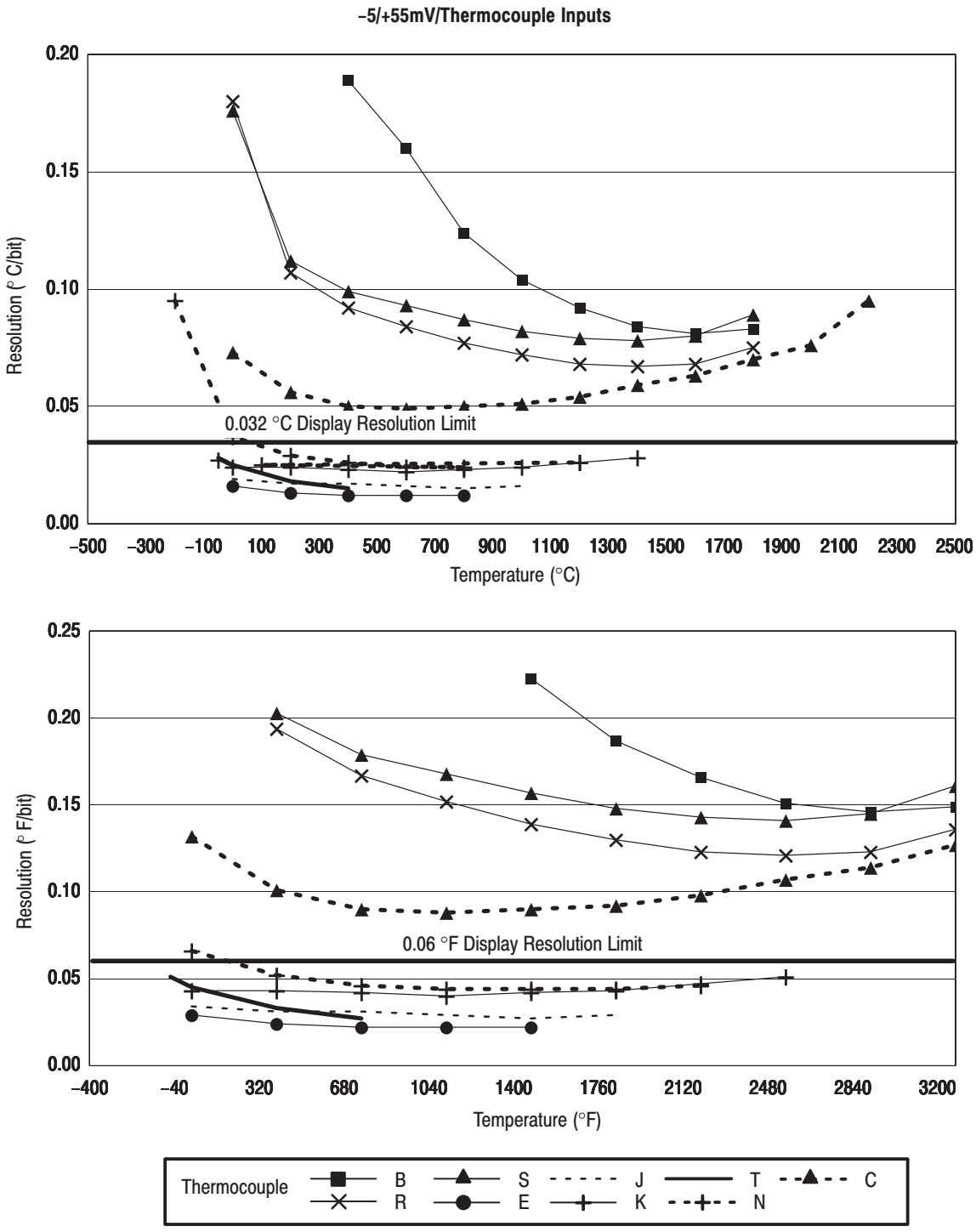
Temperature Resolution of Thermocouple Inputs

+100mV/Thermocouple Inputs







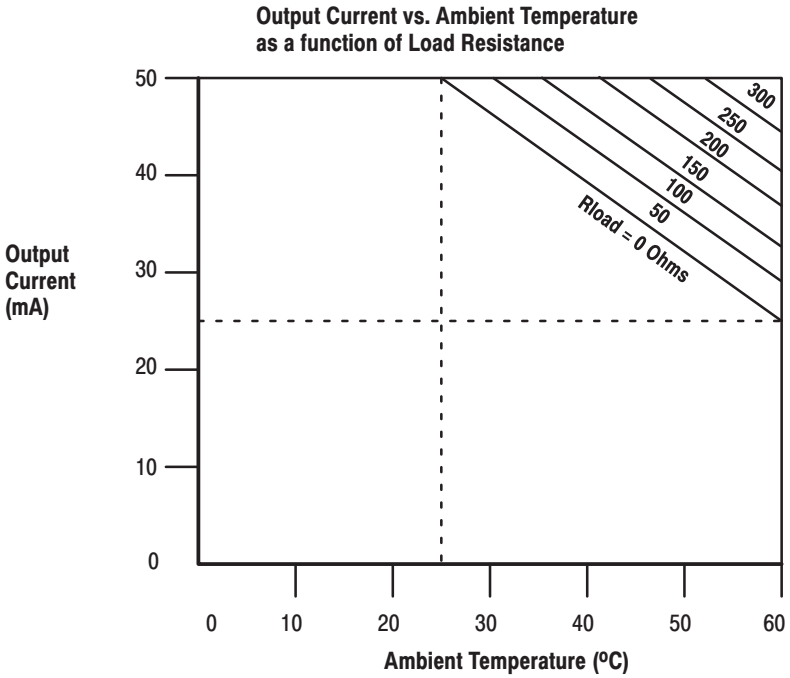

–5/+55mV/Thermocouple Inputs
Resolution (° C/bit)
0.20
0.15
0.10
0.05
0.00
0.032 °C Display Resolution Limit
–500 –300 –100 100 300 500 700 900 1100 1300 1500 1700 1900 2100 2300 2500
Temperature (°C)
Resolution (° F/bit)
0.25
0.20
0.15
0.10
0.05
0.00
0.06 °F Display Resolution Limit
–400 –40 320 680 1040 1400 1760 2120 2480 2840 3200
Temperature (°F)
Thermocouple
B
S
J
T
C
R
E
K
N

	±5V Inputs	±10V Inputs	4-20mA Sourcing Input
Input Range	±5.5V (±22mA with resistor)	±10.5V (±42mA with resistor)	0.1-21.0mA
Input Resolution	168µV/bit (0.7µA/bit) 15 bits with sign bit	330µV/bit 15 bits with sign bit	330nA/bit 16 bits unipolar
Input Impedance	> 10 MΩ	> 10 MΩ	300Ω (maximum)
Loop Power Voltage Source			20 to 30V dc (0 to 20mA range) current limited to < 29mA
Input Overvoltage Protection	140V ac rms continuous	140V ac rms continuous	24V dc continuous
Open Input Detection	upscale	upscale	downscale
Time to Detect Open Input	5s (maximum)	9s (maximum)	5s (maximum)
Open Input Detection Leakage Current	< 1.0µA (maximum)	< 1.0µA (maximum)	
Normal Mode Rejection 50/60Hz	50dB / 60dB (minimum)	50dB / 60dB (minimum)	50dB / 60dB (minimum)
Common Mode Rejection (60Hz)	150dB (typical)	150dB (typical)	150dB (typical)
Offset Drift	±20µV/ºC (±85nA/°C with resistor)	±30 µV/ºC	±200nA/°C
Gain Drift	±35 ppm/ºC (±55ppm/°C with resistor)	±35 ppm/ºC	±95 ppm/ºC
Input Bandwidth	9Hz	9Hz	9Hz
Update Time (per module)	25ms (maximum)	25ms (maximum)	25ms (maximum)
Settling Time to within 0.1% of Full Scale	125ms (maximum)	125ms (maximum)	125ms (maximum)
Non-linearity	0.02% of full range (maximum)	0.02% of full range (maximum)	0.02% of full range (maximum)
Accuracy with Calibration (including non-linearity, gain,and offset) typical worst case	0.01% of full range @ 25ºC 0.05% of full range @ 25ºC	0.01% of full range @ 25ºC 0.05% of full range @ 25ºC	0.025% of full range @ 25ºC 0.05% of full range @ 25ºC
Calibration Values	0.0000V / 5.0000V	0.0000V / 10.0000V	1.000mA / 21.000mA
Underrange Threshold	0.8V dc (3.2mA)	–10.4V dc	3.2mA
Overrange Threshold	5.2V dc (20.8mA)	+10.4V dc	21.0mA
Rate Alarm Value minimum (0.04% FSR) maximum (50% FSR)	1.6mV (6.4µA) per second 2.0V (8.0mA) per second	8mV per second 10V per second	6.4µA per second 8mA per second
Scaling Points → Default Scaling Values[1]	1.0/5.0V → 1000/5000	–10 / +10V → –10000/+10000	4.0/20.0mA → 4000/20000

	±10V Outputs	4–20mA (0–25mA) Outputs	0–50mA Outputs
Output Range	±10.4V into an open circuit	0-25.0mA	0-50.0mA
Output Resolution	1.32mV/bit 13 bits with sign bit	3.2µA/bit 13 bits unipolar	6.4µA/bit 13 bits unipolar
Output Impedance	1.0Ω maximum	> 1 MΩ	> 1 MΩ
Output Drive Capability	1KΩ or larger (10mA maximum)	20.0mA maximum into 0-1kΩ 25.0mA maximum into 0-700Ω	20.0mA maximum into 0-1kΩ 25.0mA maximum into 0-700Ω 50.0mA maximum into 0-300Ω[2]
Output Overvoltage Protection	140V ac rms continuous	140V ac rms continuous	140V ac rms continuous
Offset Drift	±400 µV/°C	±1.0µA/ºC	±1.0µA/ºC
Gain Drift	±50 ppm/ºC	±50 ppm/ºC	±50 ppm/ºC
Update Time (per module)	25ms maximum	25ms maximum	25ms maximum
D/A Converter — Settling Time to within 10% of Full Scale into a Resistive Load	5ms	500µs	500µs
Accuracy with Calibration (Including Non-linearity, Gain, and Offset) typical worst case	0.01% of full range @ 25ºC 0.08% of full range @ 25ºC	0.01% of full range @ 25ºC 0.08% of full range @ 25ºC	0.01% of full range @ 25ºC 0.08% of full range @ 25ºC
Calibration Values	0.0/10.0V dc	0.5mA / 22.0 mA	1.0mA / 50.0 mA
Ramping Value minimum (1% FSR) maximum (200% FSR)	0.2V per second 40.0V per second	0.16mA per second 32.0mA per second	0.40mA per second 80.0mA per second
Scaling Points → Default Scaling Values[1]	–10 / +10V → –10,000/+10,000	4.0 / 20.0mA → 4,000/20,000	10.0 / 50.0mA → 1,000/5,000

[1] Values shown are applicable when using two's complement data format.
[2] See derating curves for various temperature, current and load conditions.

Figure A.2
Derating Curves for 50mA Outputs on the 1771-N Series Modules



Important: If you require 60C operation with 50mA outputs, install a resistance in series with the load impedance so that the total load impedance is equal to 300 ohms.

Block Transfer Write and Block Transfer Read Configurations for 0 Output/8 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with no outputs and eight inputs.

Block Transfer Write Configuration Block for 8 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	BTW word type		Constant						Number of outputs				Constant			
	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1	CJ alarm enable	Unused = 0												BCD select	Temp scale	Verify
2	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
3	Low Scale Value															
4	High Scale Value															
5	Low Alarm Value															
6	High Alarm Value															
7	Alarm enable	Rate Alarm: Scaled Units per second														
8	Filter Time Constant: 0.1 second units								Alarm Deadband							
9	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							
	Channel 2 Programming															
10	Low Scale Value															
11	High Scale Value															
12	Low Alarm Value															
13	High Alarm Value															
14	Alarm enable	Rate Alarm: Scaled Units per second														
15	Filter Time Constant: 0.1 second units								Alarm Deadband							
16	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							
	Channel 3 Programming															
17	Low Scale Value															
18	High Scale Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
19	Low Alarm Value															
20	High Alarm Value															
21	Alarm enable	Rate Alarm: Scaled Units per second														
22	Filter Time Constant: 0.1 second units								Alarm Deadband							
23	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							
	Channel 4 Programming															
24	Low Scale Value															
25	High Scale Value															
26	Low Alarm Value															
27	High Alarm Value															
28	Alarm enable	Rate Alarm: Scaled Units per second														
29	Filter Time Constant: 0.1 second units								Alarm Deadband							
30	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							
	Channel 5 Programming															
31	Low Scale Value															
32	High Scale Value															
33	Low Alarm Value															
34	High Alarm Value															
35	Alarm enable	Rate Alarm: Scaled Units per second														
36	Filter Time Constant: 0.1 second units								Alarm Deadband							
37	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							
	Channel 6 Programming															
38	Low Scale Value															
39	High Scale Value															
40	Low Alarm Value															
41	High Alarm Value															
42	Alarm enable	Rate Alarm: Scaled Units per second														
43	Filter Time Constant: 0.1 second units								Alarm Deadband							
44	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	Channel 7 Programming															
45	Low Scale Value															
46	High Scale Value															
47	Low Alarm Value															
48	High Alarm Value															
49	Alarm enable	Rate Alarm: Scaled Units per second														
50	Filter Time Constant: 0.1 second units								Alarm Deadband							
51	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							
	Channel 8 Programming															
52	Low Scale Value															
53	High Scale Value															
54	Low Alarm Value															
55	High Alarm Value															
56	Alarm enable	Rate Alarm: Scaled Units per second														
57	Filter Time Constant: 0.1 second units								Alarm Deadband							
58	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							

Block Transfer Write Bit/Word Descriptions for 8 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	00–03	Constant = 0
	Bits 04–07	Number of outputs = 0000
	Bits 08–13 (10–15)	Constant = 00 1000 binary
	Bits 14–15 (16–17)	Block transfer write type = 10 binary
Word 1	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary

Word	Decimal Bit (Octal Bit)	Definition
Word 1 continued	Bits 03–14 (03–16)	Not used. Always 0
	Bit 15 (17)	CJ alarm enable. A value of 1 enables over and underrange indication for the cold junction channel. If the module does not have a cold junction channel, this bit is 0.
Word 2	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD.
Word 3	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 4	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 5	Bits 00–15 (00–17)	Low alarm value for channel 1. Alarm values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 6	Bits 00–15 (00–17)	High alarm value for channel 1. Alarm values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 7	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 8	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.
Word 9	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of ±0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0

Word	Decimal Bit (Octal Bit)	Definition
Word 9 continued	Bits 12–15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T; 1000 = C (1771-NT2 only); 1001 = N (1771-NT2 only). This field must be 0 for non–thermocouple channels.
Words 10 thru 16		Same as words 3 thru 9 but for channel 2.
Words 17 thru 23		Same as words 3 thru 9 but for channel 3.
Words 24 thru 30		Same as words 3 thru 9 but for channel 4.
Words 31 thru 37		Same as words 3 thru 9 but for channel 5.
Words 38 thru 44		Same as words 3 thru 9 but for channel 6.
Words 45 thru 51		Same as words 3 thru 9 but for channel 7.
Words 52 thru 58		Same as words 3 thru 9 but for channel 8.

Block Transfer Read Word Assignments for 8 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
Channel 1 Status																
4	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
5	Channel 1 Input Data															
Channel 2 Status																
6	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
7	Channel 2 Input Data															
Channel 3 Status																
8	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
9	Channel 3 Input Data															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Channel 4 Status																
10	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
11	Channel 4 Input Data															
Channel 5 Status																
12	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
13	Channel 5 Input Data															
Channel 6 Status																
14	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
15	Channel 6 Input Data															
Channel 7 Status																
16	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
17	Channel 7 Input Data															
Channel 8 Status																
18	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
19	Channel 8 Input Data															
20–27	For factory use only															

Block Transfer Read Bit/Word Descriptions for 8 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Always = 8800 hexadecimal
Word 1	Bits 00–05	Not used
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02–14 (02–16)	Not used. Always 0
	Bit 15 (17)	Always = 1
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)
Word 4	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used. Always 0

Word	Decimal Bit (Octal Bit)	Definition
Word 4 continued	Bit 04	Low alarm. This bit is set if alarms are enabled and the input data is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input data is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Not used. Always 0
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0
	Bit 15 (17)	Not used. Always = 1
Word 5	Bits 00–15 (00–17)	Channel 1 input data.
Words 6 and 7		Same as words 4 and 5 but for Channel 2
Words 8 and 9		Same as words 4 and 5 but for Channel 3
Words 10 and 11		Same as words 4 and 5 but for Channel 4
Words 12 and 13		Same as words 4 and 5 but for Channel 5
Words 14 and 15		Same as words 4 and 5 but for Channel 6
Words 16 and 17		Same as words 4 and 5 but for Channel 7
Words 18 and 19		Same as words 4 and 5 but for Channel 8
Words 20 thru 27		For factory use only

Block Transfer Write and Block Transfer Read Configurations for 8 Output/0 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with eight outputs and no inputs.

Block Transfer Write Configuration Block for 8 Output Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
1	Channel 1 Output Data															
2	Channel 2 Output Data															
3	Channel 3 Output Data															
4	Channel 4 Output Data															
5	Channel 5 Output Data															
6	Channel 6 Output Data															
7	Channel 7 Output Data															
8	Channel 8 Output Data															
9	Unused = 0													BCD select	Temp scale	Verify
10	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
11	Low Scale Value															
12	High Scale Value															
13	Low Clamp Value															
14	High Clamp Value															
15	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
16	Reset Value															
	Channel 2 Programming															
17	Low Scale Value															
18	High Scale Value															
19	Low Clamp Value															
20	High Clamp Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
21	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
22	Reset Value															
	Channel 3 Programming															
23	Low Scale Value															
23	High Scale Value															
25	Low Clamp Value															
26	High Clamp Value															
27	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
28	Reset Value															
	Channel 4 Programming															
29	Low Scale Value															
30	High Scale Value															
31	Low Clamp Value															
32	High Clamp Value															
33	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
34	Reset Value															
	Channel 5 Programming															
35	Low Scale Value															
36	High Scale Value															
37	Low Clamp Value															
38	High Clamp Value															
39	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
40	Reset Value															
	Channel 6 Programming															
41	Low Scale Value															
42	High Scale Value															
43	Low Clamp Value															
44	High Clamp Value															
45	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
46	Reset Value															
	Channel 7 Programming															
47	Low Scale Value															
48	High Scale Value															
49	Low Clamp Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
50	High Clamp Value															
51	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
52	Reset Value															
	Channel 8 Programming															
53	Low Scale Value															
54	High Scale Value															
55	Low Clamp Value															
56	High Clamp Value															
57	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
58	Reset Value															

Block Transfer Write Bit/Word Descriptions for 8 Output Modules

Word	Bit	Definition
Word 0	Bits 00–03	Constant = 0
	Bits 04–07	Number of outputs = 1000 binary
	Bits 08–13 (10–15)	Constant = 00 1000 binary
	Bits 14–15 (16–17)	Block transfer write type = 10 binary
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bits 00–15 (00–17)	Second Output channel data
Word 3	Bits 00–15 (00–17)	Third Output channel data
Word 4	Bits 00–15 (00–17)	Fourth Output channel data
Word 5	Bits 00–15 (00–17)	Fifth Output channel data
Word 6	Bits 00–15 (00–17)	Sixth Output channel data
Word 7	Bits 00–15 (00–17)	Seventh Output channel data
Word 8	Bits 00–15 (00–17)	Eighth Output channel data

Word	Bit	Definition
Word 9	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. All values are then entered in the selected format. If the field is a signed field, the most significant digit represents the sign.
	Bits 03–15 (03–17)	Not used. Always 0.
Word 10	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD
Word 11	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 12	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 13	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 14	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 15	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200% of full scale/second.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
Word 15 continued	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 16	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.
Words 17 thru 22		Same as words 11 thru 16 but for channel 2.
Words 23 thru 28		Same as words 11 thru 16 but for channel 3.
Words 29 thru 34		Same as words 11 thru 16 but for channel 4.
Words 35 thru 40		Same as words 11 thru 16 but for channel 5.

Word	Bit	Definition
Words 41 thru 46		Same as words 11 thru 16 but for channel 6.
Words 47 thru 52		Same as words 11 thru 16 but for channel 7.
Words 53 thru 58		Same as words 11 thru 16 but for channel 8.

Block Transfer Read Word Assignments for 8 Output Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	Constant = 8000 Hexadecimal															
3	Unused = 0															
	Channel 1 Status															
4	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
	Channel 2 Status															
6	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															
	Channel 3 Status															
8	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
9	Channel 3 Raw Count sent to DAC															
	Channel 4 Status															
10	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
11	Channel 4 Raw Count sent to DAC															
	Channel 5 Status															
12	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
13	Channel 5 Raw Count sent to DAC															
	Channel 6 Status															
14	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
15	Channel 6 Raw Count sent to DAC															
	Channel 7 Status															
16	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
17	Channel 7 Raw Count sent to DAC															
	Channel 8 Status															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
18	Unused = 0						Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
19	Channel 8 Raw Count sent to DAC															
20–27	For factory use only															

Block Transfer Read Bit/Word Description for 8 Output Module

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Always 8800 Hexadecimal
Word 1	Bit 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
Word 1 continued	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not legal BCD values.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2		Always 8000 hexadecimal.
Word 3		Not used. Always 0
Word 4	Bit 00–03	Not used. Always 0
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value.

Word	Decimal Bit (Octal Bit)	Definition
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD format was chosen and the output data is not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–15 (12–17)	Not used. Always = 0
Word 5	Bits 00–15 (00–17)	Channel 1 Raw data sent to DAC.
Words 6 and 7		Same as words 4 and 5 but for Channel 2.
Words 8 and 9		Same as words 4 and 5 but for Channel 3.
Words 10 and 11		Same as words 4 and 5 but for Channel 4.
Words 12 and 13		Same as words 4 and 5 but for Channel 5.
Words 14 and 15		Same as words 4 and 5 but for Channel 6.
Words 16 and 17		Same as words 4 and 5 but for Channel 7.
Words 18 and 19		Same as words 4 and 5 but for Channel 8.
Words 20 thru 27		For factory use only

Block Transfer Write and Block Transfer Read Configurations for 2 Output/2 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with two outputs and two inputs.

Block Transfer Write Configuration Block for the 2 Output/2 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
1	Channel 1 Output Data															
2	Channel 2 Output Data															
3	CJ alarm enable	Unused = 0												BCD select	Temp scale	Verify
4	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
5	Low Scale Value															
6	High Scale Value															
7	Low Clamp Value															
8	High Clamp Value															
9	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
10	Reset Value															
	Channel 2 Programming															
11	Low Scale Value															
12	High Scale Value															
13	Low Clamp Value															
14	High Clamp Value															
15	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
16	Reset Value															
	Channel 3 Programming															
17	Low Scale Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
18	High Scale Value															
19	Low Alarm Value															
20	High Alarm Value															
21	Alarm enable	Rate Alarm: Scaled Units per second														
22	Filter Time Constant: 0.1 second units								Alarm Deadband							
23	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 4 Programming															
24	Low Scale Value															
25	High Scale Value															
26	Low Alarm Value															
27	High Alarm Value															
28	Alarm enable	Rate Alarm: Scaled Units per second														
29	Filter Time Constant: 0.1 second units								Alarm Deadband							
30	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
31–58	Null															

Block Transfer Write Bit/Word Descriptions for 2 Output/2 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	00–03	Constant = 0
	Bits 04–07	Number of outputs = 0010
	Bits 08–13 (10–15)	Constant = 00 1000
	Bits 16–17	Block transfer write type = 10
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bits 00–15 (00–17)	Second Output channel data

Word	Decimal Bit (Octal Bit)	Definition
Word 3	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary
	Bits 03–14 (03–16)	Not used. Always 0
	Bit 15 (17)	CJ alarm enable. A value of 1 enables over and underrange indication for the cold junction channel. If the module does not have a cold junction channel, this bit is 0.
Word 4	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD.
Word 5	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 6	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 7	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 8	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 9	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200%.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 10	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.
Word 11 thru 16		Same as words 5 thru 10 but for channel 2.
Word 17	Bits 00–15 (00–17)	Low scale value for channel 3.

Word	Decimal Bit (Octal Bit)	Definition
Word 18	Bits 00–15 (00–17)	High scale value for channel 3.
Word 19	Bits 00–15 (00–17)	Low alarm value for channel 3.
Word 20	Bits 00–15 (00–17)	High alarm value for channel 3.
Word 21	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 22	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.
Word 23	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of $\pm$0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12–15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T. This field must be 0 for non–thermocouple channels.
Words 24 thru 30		Same as words 17 thru 23 but for channel 4.
Words 31 thru 58		Null

Block Transfer Read Word Assignments for 2 Output/2 Input Module

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
Channel 1 Status																
4	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
Channel 2 Status																
6	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															
Channel 3 Status																
8	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
9	Input Data															
Channel 4 Status																
10	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
11	Input Data															
12–19	For factory use only															
20–27	Null															

Block Transfer Read Bit/Word Description for 2 Output/2 Input Module

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Always = 8800 hexadecimal
Word 1	Bits 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0°C.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70°C.
	Bits 02–14 (02–16)	Not used. Always 0.
	Bit 15 (17)	Always 1.
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)
Word 4	Bit 00–03	Not used. Always 0.
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.

Word	Decimal Bit (Octal Bit)	Definition
Word 4 continued	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD data format was chosen and output value was not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 0.
Word 5	Bits 00–17	Channel 1 Raw data sent to DAC.
Words 6 and 7		Same as words 4 and 5, but for channel 2
Word 8	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used. Always 0.
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input signal is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input signal is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Not used. Always 0.
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12)–16	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 1.
Word 9	Bits 00–15 (00–17)	Channel 3 input data.

Word	Decimal Bit (Octal Bit)	Definition
Words 10 and 11		Same as words 8 and 9 but for channel 4.
Words 12 thru 19		For factory use only
Words 20 thru 27		Null

Block Transfer Write and Block Transfer Read Configurations for 2 Output/6 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with two outputs and six inputs.

Block Transfer Write Configuration Block for 2 Output/6 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
1	Channel 1 Output Data															
2	Channel 2 Output Data															
3	CJ alarm enable	Unused = 0												BCD select	Temp scale	Verify
4	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
5	Low Scale Value															
6	High Scale Value															
7	Low Clamp Value															
8	High Clamp Value															
9	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
10	Reset Value															
	Channel 2 Programming															
11	Low Scale Value															
12	High Scale Value															
13	Low Clamp Value															
14	High Clamp Value															
15	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
16	Reset Value															
	Channel 3 Programming															
17	Low Scale Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
18	High Scale Value															
19	Low Alarm Value															
20	High Alarm Value															
21	Alarm enable	Rate Alarm: Scaled Units per second														
22	Filter Time Constant: 0.1 second units								Alarm Deadband							
23	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 4 Programming															
24	Low Scale Value															
25	High Scale Value															
26	Low Alarm Value															
27	High Alarm Value															
28	Alarm enable	Rate Alarm: Scaled Units per second														
29	Filter Time Constant: 0.1 second units								Alarm Deadband							
30	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 5 Programming															
31	Low Scale Value															
32	High Scale Value															
33	Low Alarm Value															
34	High Alarm Value															
35	Alarm enable	Rate Alarm: Scaled Units per second														
36	Filter Time Constant: 0.1 second units								Alarm Deadband							
37	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 6 Programming															
38	Low Scale Value															
39	High Scale Value															
40	Low Alarm Value															
41	High Alarm Value															
42	Alarm enable	Rate Alarm: Scaled Units per second														
43	Filter Time Constant: 0.1 second units								Alarm Deadband							
44	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 7 Programming															
45	Low Scale Value															
46	High Scale Value															
47	Low Alarm Value															
48	High Alarm Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
49	Alarm enable	Rate Alarm: Scaled Units per second														
50	Filter Time Constant: 0.1 second units								Alarm Deadband							
51	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 8 Programming															
52	Low Scale Value															
53	High Scale Value															
54	Low Alarm Value															
55	High Alarm Value															
56	Alarm enable	Rate Alarm: Scaled Units per second														
57	Filter Time Constant: 0.1 second units								Alarm Deadband							
58	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							

Block Transfer Write Bit/Word Descriptions for 2 Output/6 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	00–03	Constant = 0
	Bits 04–07	Number of outputs = 0010
	Bits 08–13 (10–15)	Constant = 00 1000
	Bits 14–15 (16–17)	Block transfer write type = 10
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bits 00–15 (00–17)	Second Output channel data
Word 3	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary
Word 3 continued	Bits 03–14 (03–16)	Not used. Always 0

Word	Decimal Bit (Octal Bit)	Definition
	Bit 15 (17)	CJ alarm enable. A value of 1 enables over and underrange indication for the cold junction channel. If the module does not have a cold junction channel, this bit is 0.
Word 4	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD.
Word 5	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 6	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 7	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 8	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 9	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200%.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 10	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.
Word 11 thru 16		Same as words 5 thru 10 but for channel 2.
Word 17	Bits 00–15 (00–17)	Low scale value for channel 3.
Word 18	Bits 00–15 (00–17)	High scale value for channel 3.
Word 19	Bits 00–15 (00–17)	Low alarm value for channel 3.
Word 20	Bits 00–15 (00–17)	High alarm value for channel 3.
Word 21	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.

Word	Decimal Bit (Octal Bit)	Definition
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 22	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.
Word 23	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of ±0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12–15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T. This field must be 0 for non–thermocouple channels.
Words 24 thru 30		Same as words 17 thru 23 but for channel 4.
Words 31 thru 37		Same as words 17 thru 23 but for channel 5.
Words 38 thru 44		Same as words 17 thru 23 but for channel 6.
Words 45 thru 51		Same as words 17 thru 23 but for channel 7.
Words 52 thru 58		Same as words 17 thru 23 but for channel 8.

Block Transfer Read Word Assignments for 2 Output/6 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
	Channel 1 Status															
4	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
	Channel 2 Status															
6	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															
	Channel 3 Status															
8	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
9	Input Data															
	Channel 4 Status															
10	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
11	Input Data															
	Channel 5 Status															
12	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
13	Input Data															
	Channel 6 Status															
14	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
15	Input Data															
	Channel 7 Status															
16	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
17	Input Data															
	Channel 8 Status															
18	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
19	Input Data															
20–27	For factory use only															

Block Transfer Read Bit/Word Description for 2 Output/6 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Always = 8800 hexadecimal
Word 1	Bits 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02–14 (02–16)	Not used. Always 0.
	Bit 15 (17)	Always 1.
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)
Word 4	Bit 00–03	Not used. Always 0.
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value

Word	Decimal Bit (Octal Bit)	Definition
Word 4 continued	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD data format was chosen and output value was not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 0.
Word 5	Bits 00–15 (00–17)	Channel 1 Raw data sent to DAC.
Words 6 and 7		Same as words 4 and 5, but for channel 2
Word 8	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input signal is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input signal is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Unused = 0
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 1.
Word 9	Bits 00–15 (00–17)	Channel 3 input data.
Words 10 and 11		Same as words 8 and 9 but for channel 4.
Words 12 and 13		Same as words 8 and 9 but for channel 5.
Words 14 and 15		Same as words 8 and 9 but for channel 6.

Word	Decimal Bit (Octal Bit)	Definition
Words 16 and 17		Same as words 8 and 9 but for channel 7.
Words 18 and 19		Same as words 8 and 9 but for channel 8.
Words 20 thru 27		For factory use only

Block Transfer Write and Block Transfer Read Configurations for 1 Output/7 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with one output and seven inputs.

Block Transfer Write Configuration Block for 1 Output/7 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
1	Channel 1 Output Data															
2	CJ alarm enable	Unused = 0												BCD select	Temp scale	Verify
3	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
4	Low Scale Value															
5	High Scale Value															
6	Low Clamp Value															
7	High Clamp Value															
8	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
9	Reset Value															
	Channel 2 Programming															
10	Low Scale Value															
11	High Scale Value															
12	Low Alarm Value															
13	High Alarm Value															
14	Alarm enable	Rate Alarm: Scaled Units per second														
15	Filter Time Constant: 0.1 second units								Alarm Deadband							
16	Thermocouple Type			0	RTD Type				10 Ohm Offset: 0.01 Ohm units							
	Channel 3 Programming															
17	Low Scale Value															
18	High Scale Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
19	Low Alarm Value															
20	High Alarm Value															
21	Alarm enable	Rate Alarm: Scaled Units per second														
22	Filter Time Constant: 0.1 second units								Alarm Deadband							
23	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 4 Programming															
24	Low Scale Value															
25	High Scale Value															
26	Low Alarm Value															
27	High Alarm Value															
28	Alarm enable	Rate Alarm: Scaled Units per second														
29	Filter Time Constant: 0.1 second units								Alarm Deadband							
30	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 5 Programming															
31	Low Scale Value															
32	High Scale Value															
33	Low Alarm Value															
34	High Alarm Value															
35	Alarm enable	Rate Alarm: Scaled Units per second														
36	Filter Time Constant: 0.1 second units								Alarm Deadband							
37	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 6 Programming															
38	Low Scale Value															
39	High Scale Value															
40	Low Alarm Value															
41	High Alarm Value															
42	Alarm enable	Rate Alarm: Scaled Units per second														
43	Filter Time Constant: 0.1 second units								Alarm Deadband							
44	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 7 Programming															
45	Low Scale Value															
46	High Scale Value															
47	Low Alarm Value															
48	High Alarm Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
49	Alarm enable	Rate Alarm: Scaled Units per second														
50	Filter Time Constant: 0.1 second units								Alarm Deadband							
51	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 8 Programming															
52	Low Scale Value															
53	High Scale Value															
54	Low Alarm Value															
55	High Alarm Value															
56	Alarm enable	Rate Alarm: Scaled Units per second														
57	Filter Time Constant: 0.1 second units								Alarm Deadband							
58	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							

Block Transfer Write Bit/Word Descriptions for 1 Output/7 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	00–03	Constant = 0
	Bits 04–07	Number of outputs = 0001
	Bits 09–13 (10–15)	Constant = 00 1000
	Bits 14–15 (16–17)	Block transfer write type = 10
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary
	Bits 03–14 (03–16)	Not used. Always 0
Word 2 continued	Bit 15 (17)	CJ alarm enable. A value of 1 enables over and underrange indication for the cold junction channel. If the module does not have a cold junction channel, this bit is 0.

Word	Decimal Bit (Octal Bit)	Definition
Word 3	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD.
Word 4	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 5	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 6	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 7	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 8	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200%.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 9	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.
Word 10	Bits 00–15 (00–17)	Low scale value for channel 2.
Word 11	Bits 00–15 (00–17)	High scale value for channel 2.
Word 12	Bits 00–15 (00–17)	Low alarm value for channel 2.
Word 13	Bits 00–15 (00–17)	High alarm value for channel 2.
Word 14	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.

Word	Decimal Bit (Octal Bit)	Definition
Word 15	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.
Word 16	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of ±0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12–15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T. This field must be 0 for non–thermocouple channels.
Words 17 thru 23		Same as words 10 thru 16 but for channel 3.
Words 24 thru 30		Same as words 10 thru 16 but for channel 4.
Words 31 thru 37		Same as words 10 thru 16 but for channel 5.
Words 38 thru 44		Same as words 10 thru 16 but for channel 6.
Words 45 thru 51		Same as words 10 thru 16 but for channel 7.
Words 52 thru 58		Same as words 10 thru 16 but for channel 8.

Block Transfer Read Word Assignments for 1 Output/7 Input Module

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
	Channel 1 Status															
4	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
	Channel 2 Status															
6	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
7	Input Data															
	Channel 3 Status															
8	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
9	Input Data															
	Channel 4 Status															
10	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
11	Input Data															
	Channel 5 Status															
12	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
13	Input Data															
	Channel 6 Status															
14	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
15	Input Data															
	Channel 7 Status															
16	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
17	Input Data															
	Channel 8 Status															
18	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
19	Input Data															
20–27	For factory use only															

Block Transfer Read Bit/Word Description for 1 Output/7 Input Module

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Always = 8800 hexadecimal
Word 1	Bits 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02–14 (02–16)	Not used. Always 0.
	Bit 15 (17)	Always 1.
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)

Word	Decimal Bit (Octal Bit)	Definition
Word 4	Bit 00–03	Not used. Always 0.
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD data format was chosen and output value was not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 0.
Word 5	Bits 00–15 (00–17)	Channel 1 Raw data sent to DAC.
Word 6	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input signal is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input signal is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Unused = 0
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 1.

Word	Decimal Bit (Octal Bit)	Definition
Word 7	Bits 00–15 (00–17	Channel 2 input data.
Words 8 and 9		Same as words 6 and 7 but for channel 3.
Words 10 and 11		Same as words 6 and 7 but for channel 4.
Words 12 and 13		Same as words 6 and 7 but for channel 5.
Words 14 and 15		Same as words 6 and 7 but for channel 6.
Words 16 and 17		Same as words 6 and 7 but for channel 7.
Words 18 and 19		Same as words 6 and 7 but for channel 8.
Words 20 thru 27		For factory use only

Block Transfer Write and Block Transfer Read Configurations for 3 Output/5 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with three outputs and five inputs.

Block Transfer Write Configuration Block for 3 Output/5 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0
1	Channel 1 Output Data															
2	Channel 2 Output Data															
3	Channel 3 Output Data															
4	CJ alarm enable	Unused = 0												BCD select	Temp scale	Verify
5	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
6	Low Scale Value															
7	High Scale Value															
8	Low Clamp Value															
9	High Clamp Value															
10	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
11	Reset Value															
	Channel 2 Programming															
12	Low Scale Value															
13	High Scale Value															
14	Low Clamp Value															
15	High Clamp Value															
16	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
17	Reset Value															
	Channel 3 Programming															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
18	Low Scale Value															
19	High Scale Value															
20	Low Clamp Value															
21	High Clamp Value															
22	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
23	Reset Value															
	Channel 4 Programming															
24	Low Scale Value															
25	High Scale Value															
26	Low Alarm Value															
27	High Alarm Value															
28	Alarm enable	Rate Alarm: Scaled Units per second														
29	Filter Time Constant: 0.1 second units								Alarm Deadband							
30	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 5 Programming															
31	Low Scale Value															
32	High Scale Value															
33	Low Alarm Value															
34	High Alarm Value															
35	Alarm enable	Rate Alarm: Scaled Units per second														
36	Filter Time Constant: 0.1 second units								Alarm Deadband							
37	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 6 Programming															
38	Low Scale Value															
39	High Scale Value															
40	Low Alarm Value															
41	High Alarm Value															
42	Alarm enable	Rate Alarm: Scaled Units per second														
43	Filter Time Constant: 0.1 second units								Alarm Deadband							
44	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 7 Programming															
45	Low Scale Value															
46	High Scale Value															
47	Low Alarm Value															
48	High Alarm Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
49	Alarm enable	Rate Alarm: Scaled Units per second														
50	Filter Time Constant: 0.1 second units								Alarm Deadband							
51	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 8 Programming															
52	Low Scale Value															
53	High Scale Value															
54	Low Alarm Value															
55	High Alarm Value															
56	Alarm enable	Rate Alarm: Scaled Units per second														
57	Filter Time Constant: 0.1 second units								Alarm Deadband							
58	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							

Block Transfer Write Bit/Word Descriptions for 3 Output/5 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	00–03	Constant = 0
	Bits 04–07	Number of outputs = 0011 binary
	Bits 08–13 (10–15)	Constant = 00 1000 binary
	Bits 14–15 (16–17)	Block transfer write type = 10 binary
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bits 00–15 (00–17)	Second Output channel data
Word 3	Bits 00–15 (00–17)	Third Output channel data
Word 4	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary
	Bits 03–14 (03–16)	Not used. Always 0
	Bit 15 (17)	CJ alarm enable. A value of 1 enables over and underrange indication for the cold junction channel. If the module does not have a cold junction channel, this bit is 0.

Word	Decimal Bit (Octal Bit)	Definition
Word 5	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD.
Word 6	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 7	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 8	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 9	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 10	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200% of full scale/second.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 11	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.
Word 12 thru 17		Same as words 6 thru 11 but for channel 2.
Word 18 thru 23		Same as words 6 thru 11 but for channel 3.
Word 24	Bits 00–15 (00–17)	Low scale value for channel 4.
Word 25	Bits 00–15 (00–17)	High scale value for channel 4.
Word 26	Bits 00–15 (00–17)	Low alarm value for channel 4.
Word 27	Bits 00–15 (00–17)	High alarm value for channel 4.
Word 28	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 29	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.

Word	Decimal Bit (Octal Bit)	Definition
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.
Word 30	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of ±0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12–15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T. This field must be 0 for non–thermocouple channels.
Words 31 thru 37		Same as words 24 thru 30 but for channel 5.
Words 38 thru 44		Same as words 24 thru 30 but for channel 6.
Words 45 thru 51		Same as words 24 thru 30 but for channel 7.
Words 52 thru 58		Same as words 24 thru 30 but for channel 8.

Block Transfer Read Word Assignments for 3 Output/5 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
Channel 1 Status																
4	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
Channel 2 Status																
6	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															
Channel 3 Status																
8	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
9	Channel 3 Raw Count sent to DAC															
Channel 4 Status																
10	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
11	Channel 4 Input Data															
Channel 5 Status																
12	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
13	Channel 5 Input Data															
Channel 6 Status																
14	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
15	Channel 6 Input Data															
Channel 7 Status																
16	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
17	Channel 7 Input Data															
Channel 8 Status																
18	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
19	Channel 8 Input Data															
20–27	For factory use only.															

Block Transfer Read Bit/Word Descriptions for 3 Output/5 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Constant = 8800 hexadecimal
Word 1	Bits 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02–14 (02–16)	Not used. Always 0.
	Bit 15 (17)	Always 1.
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)
Word 4	Bit 00–03	Not used. Always 0.
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value

Word	Decimal Bit (Octal Bit)	Definition
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD data format was chosen and output value was not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 0.
Word 5	Bits 00–15 (00–17)	Channel 1 Raw data sent to DAC.
Words 6 and 7		Same as words 4 and 5, but for channel 2
Words 8 and 9		Same as words 4 and 5, but for channel 3
Word 10	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used. Always 0.
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input signal is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input signal is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Not used. Always 0.
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 1.
Word 11	Bits 00–15 (00–17)	Channel 4 input data.
Words 12 and 13		Same as words 10 and 11 but for channel 5.

Word	Decimal Bit (Octal Bit)	Definition
Words 14 and 15		Same as words 10 and 11 but for channel 6.
Words 16 and 17		Same as words 10 and 11 but for channel 7.
Words 18 thru 19		Same as words 10 and 11 but for channel 8.
Words 20 thru 27		For factory use only.

Block Transfer Write and Block Transfer Read Configurations for 4 Output/4 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with four outputs and four inputs.

Block Transfer Write Configuration Block for 4 Output/4 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
1	Channel 1 Output Data															
2	Channel 2 Output Data															
3	Channel 3 Output Data															
4	Channel 4 Output Data															
5	CJ alarm enable	Unused = 0												BCD select	Temp scale	Verify
6	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
7	Low Scale Value															
8	High Scale Value															
9	Low Clamp Value															
10	High Clamp Value															
11	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
12	Reset Value															
	Channel 2 Programming															
13	Low Scale Value															
14	High Scale Value															
15	Low Clamp Value															
16	High Clamp Value															
17	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
18	Reset Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	Channel 3 Programming															
19	Low Scale Value															
20	High Scale Value															
21	Low Clamp Value															
22	High Clamp Value															
23	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
24	Reset Value															
	Channel 4 Programming															
25	Low Scale Value															
26	High Scale Value															
27	Low Clamp Value															
28	High Clamp Value															
29	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
30	Reset Value															
	Channel 5 Programming															
31	Low Scale Value															
32	High Scale Value															
33	Low Alarm Value															
34	High Alarm Value															
35	Alarm enable	Rate Alarm: Scaled Units per second														
36	Filter Time Constant: 0.1 second units								Alarm Deadband							
37	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 6 Programming															
38	Low Scale Value															
39	High Scale Value															
40	Low Alarm Value															
41	High Alarm Value															
42	Alarm enable	Rate Alarm: Scaled Units per second														
43	Filter Time Constant: 0.1 second units								Alarm Deadband							
44	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 7 Programming															
45	Low Scale Value															
46	High Scale Value															
47	Low Alarm Value															
48	High Alarm Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
49	Alarm enable	Rate Alarm: Scaled Units per second														
50	Filter Time Constant: 0.1 second units								Alarm Deadband							
51	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 8 Programming															
52	Low Scale Value															
53	High Scale Value															
54	Low Alarm Value															
55	High Alarm Value															
56	Alarm enable	Rate Alarm: Scaled Units per second														
57	Filter Time Constant: 0.1 second units								Alarm Deadband							
58	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							

Block Transfer Write Bit/Word Descriptions for 4 Output/4 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–03	Constant = 0
	Bits 04–07	Number of outputs = 0100 binary
	Bits 08–13 (10–15)	Constant = 00 1000 binary
	Bits 14–15 (16–17)	Block transfer write type = 10 binary
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bits 00–15 (00–17)	Second Output channel data
Word 3	Bits 00–15 (00–17)	Third Output channel data
Word 4	Bits 00–15 (00–17)	Fourth Output channel data

Word	Decimal Bit (Octal Bit)	Definition
Word 5	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary
	Bits 03–14 (03–16)	Not used. Always 0
	Bit 15 (17)	CJ alarm enable. A value of 1 enables over and underrange indication for the cold junction channel. If the module does not have a cold junction channel, this bit is 0.
Word 6	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD.
Word 7	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 8	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 9	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 10	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 11	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200% of full scale/second.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 12	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.
Word 13 thru 18		Same as words 7 thru 12 but for channel 2.
Word 19 thru 24		Same as words 7 thru 12 but for channel 3.
Word 25 thru 30		Same as words 7 thru 12 but for channel 4.
Word 31	Bits 00–15 (00–17)	Low scale value for channel 5.
Word 32	Bits 00–15 (00–17)	High scale value for channel 5.
Word 33	Bits 00–15 (00–17)	Low alarm value for channel 5.
Word 34	Bits 00–15 (00–17)	High alarm value for channel 5.

Word	Decimal Bit (Octal Bit)	Definition
Word 35	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 36	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.
Word 37	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of $\pm$0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12–15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T. This field must be 0 for non–thermocouple channels.
Words 38 thru 44		Same as words 31 thru 37 but for channel 6.
Words 45 thru 51		Same as words 31 thru 37 but for channel 7.
Words 52 thru 58		Same as words 31 thru 37 but for channel 8.

Block Transfer Read Word Assignments for 4 Output/4 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
Channel 1 Status																
4	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
Channel 2 Status																
6	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															
Channel 3 Status																
8	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
9	Channel 3 Raw Count sent to DAC															
Channel 4 Status																
10	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
11	Channel 4 Raw Count sent to DAC															
Channel 5 Status																
12	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
13	Channel 5 Input Data															
Channel 6 Status																
14	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
15	Channel 6 Input Data															
Channel 7 Status																
16	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
17	Channel 7 Input Data															
Channel 8 Status																
18	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
19	Channel 8 Input Data															
20–27	For factory use only.															

Block Transfer Read Bit/Word Descriptions for 4 Output/4 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Constant = 8800 hexadecimal
Word 1	Bits 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02–14 (02–16)	Not used. Always 0.
	Bit 15 (17)	Always 1.
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)
Word 4	Bit 00–03	Not used. Always 0.
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value

Word	Decimal Bit (Octal Bit)	Definition
Word 4 continued	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD data format was chosen and output value was not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 0.
Word 5	Bits 00–15 (00–17)	Channel 1 Raw data sent to DAC.
Words 6 and 7		Same as words 4 and 5, but for channel 2
Words 8 and 9		Same as words 4 and 5, but for channel 3
Words 10 and 11		Same as words 4 and 5, but for channel 4
Word 12	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used. Always 0.
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input signal is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input signal is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Not used. Always 0.
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 1.
Word 13	Bits 00–15 (00–17)	Channel 5 input data.

Word	Decimal Bit (Octal Bit)	Definition
Words 14 and 15		Same as words 12 and 13 but for channel 6.
Words 16 and 17		Same as words 12 and 13 but for channel 7.
Words 18 thru 19		Same as words 12 and 13 but for channel 8.
Words 20 thru 27		For factory use only.

Block Transfer Write and Block Transfer Read Configurations for 6 Output/2 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with six outputs and two inputs.

Block Transfer Write Configuration Block for 6 Output/2 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
1	Channel 1 Output Data															
2	Channel 2 Output Data															
3	Channel 3 Output Data															
4	Channel 4 Output Data															
5	Channel 5 Output Data															
6	Channel 6 Output Data															
7	Unused = 0													BCD select	Temp scale	Verify
8	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
9	Low Scale Value															
10	High Scale Value															
11	Low Clamp Value															
12	High Clamp Value															
13	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
14	Reset Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	Channel 2 Programming															
15	Low Scale Value															
16	High Scale Value															
17	Low Clamp Value															
18	High Clamp Value															
19	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
20	Reset Value															
	Channel 3 Programming															
21	Low Scale Value															
22	High Scale Value															
23	Low Clamp Value															
24	High Clamp Value															
25	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
26	Reset Value															
	Channel 4 Programming															
27	Low Scale Value															
28	High Scale Value															
29	Low Clamp Value															
30	High Clamp Value															
31	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
32	Reset Value															
	Channel 5 Programming															
33	Low Scale Value															
34	High Scale Value															
35	Low Clamp Value															
36	High Clamp Value															
37	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
38	Reset Value															
	Channel 6 Programming															
39	Low Scale Value															
40	High Scale Value															
41	Low Clamp Value															
42	High Clamp Value															
43	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
44	Reset Value															
	Channel 7 Programming															
45	Low Scale Value															
46	High Scale Value															
47	Low Alarm Value															
48	High Alarm Value															
49	Alarm enable	Rate Alarm: Scaled Units per second														
50	Filter Time Constant: 0.1 second units								Alarm Deadband							
51	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							
	Channel 8 Programming															
52	Low Scale Value															
53	High Scale Value															
54	Low Alarm Value															
55	High Alarm Value															
56	Alarm enable	Rate Alarm: Scaled Units per second														
57	Filter Time Constant: 0.1 second units								Alarm Deadband							
58	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							

Block Transfer Write Bit/Word Descriptions for 6 Output/2 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	00–03	Constant = 0
	Bits 04–07	Number of outputs = 0110 binary
	Bits 08–13 (10–15)	Constant = 00 1000 binary
	Bits 14–15 (16–17)	Block transfer write type = 10 binary
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bits 00–15 (00–17)	Second Output channel data
Word 3	Bits 00–15 (00–17)	Third Output channel data
Word 4	Bits 00–15 (00–17)	Fourth Output channel data

Word	Decimal Bit (Octal Bit)	Definition
Word 5	Bits 00–15 (00–17)	Fifth Output channel data
Word 6	Bits 00–15 (00–17)	Sixth Output channel data
Word 7	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary All values are then entered in the selected format. If the field is a signed field, the most significant digit represents the sign.
	Bits 03–15 (03–17)	Not used. Always 0.
Word 8	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD
Word 9	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 10	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 11	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 12	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 13	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200% of full scale/second.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 14	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.

Word	Decimal Bit (Octal Bit)	Definition
Words 15 thru 20		Same as words 9 thru 14 but for channel 2.
Words 21 thru 26		Same as words 9 thru 14 but for channel 3.
Words 27 thru 32		Same as words 9 thru 14 but for channel 4.
Words 33 thru 38		Same as words 9 thru 14 but for channel 5.
Words 39 thru 44		Same as words 9 thru 14 but for channel 6.
Word 45	Bits 00–15 (00–17)	Low scale value for channel 7.
Word 46	Bits 00–15 (00–17)	High scale value for channel 7.
Word 47	Bits 00–15 (00–17)	Low alarm value for channel 7.
Word 48	Bits 00–15 (00–17)	High alarm value for channel 7.
Word 49	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 50	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.

Word	Decimal Bit (Octal Bit)	Definition
Word 51	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of ±0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12–15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T. This field must be 0 for non–thermocouple channels.
Words 52 thru 58		Same as words 45 thru 51 but for channel 8.

Block Transfer Read Word Assignments for 6 Output/2 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
Channel 1 Status																
4	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
Channel 2 Status																
6	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Channel 3 Status																
8	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
9	Channel 3 Raw Count sent to DAC															
Channel 4 Status																
10	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
11	Channel 4 Raw Count sent to DAC															
Channel 5 Status																
12	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
13	Channel 5 Raw Count sent to DAC															
Channel 6 Status																
14	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
15	Channel 6 Raw Count sent to DAC															
Channel 7 Status																
16	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
17	Channel 7 Input Data															
Channel 8 Status																
18	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
19	Channel 8 Input Data															
20–27	For factory use only.															

Block Transfer Read Bit/Word Descriptions for 6 Output/2 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Constant = 8800 hexadecimal
Word 1	Bits 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02–14 (02–16)	Not used. Always 0.
	Bit 15 (17)	Always 1.
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)

Word	Decimal Bit (Octal Bit)	Definition
Word 4	Bit 00–03	Not used. Always 0.
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD data format was chosen and output value was not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 0.
Word 5	Bits 00–15 (00–17)	Channel 1 Raw data sent to DAC.
Words 6 and 7		Same as words 4 and 5, but for channel 2
Words 8 and 9		Same as words 4 and 5, but for channel 3
Words 10 and 11		Same as words 4 and 5, but for channel 4
Words 12 and 13		Same as words 4 and 5, but for channel 5
Words 14 and 15		Same as words 4 and 5, but for channel 6
Word 16	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used. Always 0.
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input signal is lower than the low alarm setpoint.

Word	Decimal Bit (Octal Bit)	Definition
Word 16 continued	Bit 05	High alarm. This bit is set if alarms are enabled and the input signal is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Not used. Always 0.
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 1.
Word 17	Bits 00–15 (00–17)	Channel 7 input data.
Words 18 and 19		Same as words 16 and 17 but for channel 8.
Words 20 thru 27		For factory use only.

Block Transfer Write and Block Transfer Read Configurations for 5 Output/3 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with five outputs and three inputs.

Block Transfer Write Configuration Block for 5 Output/3 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0
1	Channel 1 Output Data															
2	Channel 2 Output Data															
3	Channel 3 Output Data															
4	Channel 4 Output Data															
5	Channel 5 Output Data															
6	CJ alarm enable	Unused = 0												BCD select	Temp scale	Verify
7	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
8	Low Scale Value															
9	High Scale Value															
10	Low Clamp Value															
11	High Clamp Value															
12	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
13	Reset Value															
	Channel 2 Programming															
14	Low Scale Value															
15	High Scale Value															
16	Low Clamp Value															
17	High Clamp Value															
18	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
19	Reset Value															
	Channel 3 Programming															
20	Low Scale Value															
21	High Scale Value															
22	Low Clamp Value															
23	High Clamp Value															
24	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
25	Reset Value															
	Channel 4 Programming															
26	Low Scale Value															
27	High Scale Value															
28	Low Clamp Value															
29	High Clamp Value															
30	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
31	Reset Value															
	Channel 5 Programming															
32	Low Scale Value															
33	High Scale Value															
34	Low Clamp Value															
35	High Clamp Value															
36	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
37	Reset Value															
	Channel 6 Programming															
38	Low Scale Value															
39	High Scale Value															
40	Low Alarm Value															
41	High Alarm Value															
42	Alarm enable	Rate Alarm: Scaled Units per second														
43	Filter Time Constant: 0.1 second units								Alarm Deadband							
44	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							
	Channel 7 Programming															
45	Low Scale Value															
46	High Scale Value															
47	Low Alarm Value															
48	High Alarm Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
49	Alarm enable	Rate Alarm: Scaled Units per second														
50	Filter Time Constant: 0.1 second units								Alarm Deadband							
51	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							
	Channel 8 Programming															
52	Low Scale Value															
53	High Scale Value															
54	Low Alarm Value															
55	High Alarm Value															
56	Alarm enable	Rate Alarm: Scaled Units per second														
57	Filter Time Constant: 0.1 second units								Alarm Deadband							
58	Thermocouple Type				0	RTD Type			10 Ohm Offset; 0.01 Ohm units							

Block Transfer Write Bit/Word Descriptions for 5 Output/3 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	00–03	Constant = 0
	Bits 04–07	Number of outputs = 0101 binary
	Bits 08–13 (10–15)	Constant = 00 1000 binary
	Bits 14–15 (16–17)	Block transfer write type = 10 binary
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bits 00–15 (00–17)	Second Output channel data
Word 3	Bits 00–15 (00–17)	Third Output channel data
Word 4	Bits 00–15 (00–17)	Fourth Output channel data
Word 5	Bits 00–15 (00–17)	Fifth Output channel data

Word	Decimal Bit (Octal Bit)	Definition
Word 6	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary
	Bits 03–14 (03–16)	Not used. Always 0
	Bit 15 (17)	CJ alarm enable. A value of 1 enables over and underrange indication for the cold junction channel. If the module does not have a cold junction channel, this bit is 0.
Word 7	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD.
Word 8	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 9	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 10	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 11	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 12	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200% of full scale/second.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 13	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.
Word 14 thru 19		Same as words 8 thru 13 but for channel 2.
Word 20 thru 25		Same as words 8 thru 13 but for channel 3.
Word 26 thru 31		Same as words 8 thru 13 but for channel 4.
Word 32 thru 37		Same as words 8 thru 13 but for channel 5.
Word 38	Bits 00–15 (00–17)	Low scale value for channel 6.
Word 39	Bits 00–15 (00–17)	High scale value for channel 6.

Word	Decimal Bit (Octal Bit)	Definition
Word 40	Bits 00–15 (00–17)	Low alarm value for channel 6.
Word 41	Bits 00–15 (00–17)	High alarm value for channel 6.
Word 42	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 43	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.
Word 44	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of $\pm$0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12 15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T. This field must be 0 for non–thermocouple channels.
Words 45 thru 51		Same as words 38 thru 44 but for channel 7.
Words 52 thru 58		Same as words 38 thru 44 but for channel 8.

Block Transfer Read Word Assignments for the 5 Output/3 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
	Channel 1 Status															
4	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
	Channel 2 Status															
6	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															
	Channel 3 Status															
8	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
9	Channel 3 Raw Count sent to DAC															
	Channel 4 Status															
10	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
11	Channel 4 Raw Count sent to DAC															
	Channel 5 Status															
12	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
13	Channel 5 Raw Count sent to DAC															
	Channel 6 Status															
14	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
15	Channel 6 Input Data															
	Channel 7 Status															
16	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
17	Channel 7 Input Data															
	Channel 8 Status															
18	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
19	Channel 8 Input Data															
20–27	For factory use only															

Block Transfer Read Bit/Word Descriptions for 5 Output/3 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Constant = 8800 hexadecimal
Word 1	Bits 00–05	Not used
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
Word 1	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02–14 (02–16)	Not used. Always 0
	Bit 15 (17)	Always = 1
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)

Word	Decimal Bit (Octal Bit)	Definition
Word 4	Bit 00–03	Not used. Always 0
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD format was chosen and the output data is not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–15 (12–17)	Not used. Always = 0
Word 5	Bits 00–15 (00–17)	Channel 1 Raw data sent to DAC.
Word 6 and 7		Same as words 4 and 5 but for channel 2.
Word 8 and 9		Same as words 4 and 5 but for channel 3.
Word 10 and 11		Same as words 4 and 5 but for channel 4.
Word 12 and 13		Same as words 4 and 5 but for channel 5.
Word 14	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used. Always 0
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input data is lower than the low alarm setpoint.
	Bit 05	High alarm. This bit is set if alarms are enabled and the input data is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Not used. Always 0
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0
	Bit 15 (17)	Not used. Always = 1

Word	Decimal Bit (Octal Bit)	Definition
Word 15	Bits 00–15 (00–17)	Channel 6 input data.
Words 16 and 17		Same as words 14 and 15 but for Channel 7
Words 18 and 19		Same as words 14 and 15 but for Channel 8
Words 20 thru 27		For factory use only

Block Transfer Write and Block Transfer Read Configurations for 7 Output/1 Input 1771-N Series Modules

What This Appendix Contains

This appendix contains block transfer write and block transfer read configurations and bit/word descriptions for 1771-N series modules with seven outputs and one input.

Block Transfer Write Configuration Block for 7 Output/1 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
	BTW word type		Constant						Number of outputs				Constant			
0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0
1	Channel 1 Output Data															
2	Channel 2 Output Data															
3	Channel 3 Output Data															
4	Channel 4 Output Data															
5	Channel 5 Output Data															
6	Channel 6 Output Data															
7	Channel 7 Output Data															
8	Unused = 0													BCD select	Temp scale	Verify
9	RTS Sample Time: 1 millisecond units															
	Channel 1 Programming															
10	Low Scale Value															
11	High Scale Value															
12	Low Clamp Value															
13	High Clamp Value															
14	Alarm enable	Reset State	0	Maximum Ramp Rate, % of Full Scale per second												
15	Reset Value															
	Channel 2 Programming															
16	Low Scale Value															
17	High Scale Value															
18	Low Clamp Value															
19	High Clamp Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
20	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
21	Reset Value															
	Channel 3 Programming															
22	Low Scale Value															
23	High Scale Value															
24	Low Clamp Value															
25	High Clamp Value															
26	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
27	Reset Value															
	Channel 4 Programming															
28	Low Scale Value															
29	High Scale Value															
30	Low Clamp Value															
31	High Clamp Value															
32	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
33	Reset Value															
	Channel 5 Programming															
34	Low Scale Value															
35	High Scale Value															
36	Low Clamp Value															
37	High Clamp Value															
38	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
39	Reset Value															
	Channel 6 Programming															
40	Low Scale Value															
41	High Scale Value															
42	Low Clamp Value															
43	High Clamp Value															
44	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
45	Reset Value															
	Channel 7 Programming															
46	Low Scale Value															
47	High Scale Value															
48	Low Clamp Value															

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
49	High Clamp Value															
50	Alarm enable	Reset State		0	Maximum Ramp Rate, % of Full Scale per second											
51	Reset Value															
	Channel 8 Programming															
52	Low Scale Value															
53	High Scale Value															
54	Low Alarm Value															
55	High Alarm Value															
56	Alarm enable	Rate Alarm: Scaled Units per second														
57	Filter Time Constant: 0.1 second units								Alarm Deadband							
58	Thermocouple Type				0	RTD Type			10 Ohm Offset: 0.01 Ohm units							

Block Transfer Write Bit/Word Descriptions for 7 Output/1 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	00–03	Constant = 0
	Bits 04–07	Number of outputs = 0111 binary
	Bits 08–13 (10–15)	Constant = 00 1000 binary
	Bits 14–15 (16–17)	Block transfer write type = 10 binary
Word 1	Bits 00–15 (00–17)	First Output channel data
Word 2	Bits 00–15 (00–17)	Second Output channel data
Word 3	Bits 00–15 (00–17)	Third Output channel data
Word 4	Bits 00–15 (00–17)	Fourth Output channel data
Word 5	Bits 00–15 (00–17)	Fifth Output channel data
Word 6	Bits 00–15 (00–17)	Sixth Output channel data
Word 7	Bits 00–15 (00–17)	Seventh Output channel data

Word	Decimal Bit (Octal Bit)	Definition
Word 8	Bit 00	Verify. If this bit is set to 1, the module will compare its current programming with the programming downloaded in the BTW. If they are the same, it will verify good; if they are different, the module will verify bad. In no case will any programming data in the BTW be applied to the module.
	Bit 01	Temperature scale. 0 = Celsius, 1 = Fahrenheit
	Bit 02	BCD select. 1 = all values in BCD format. 0 = all values in 2's complement binary All values are then entered in the selected format. If the field is a signed field, the most significant digit represents the sign.
	Bits 03–15 (03–17)	Not used. Always 0.
Word 9	Bits 00–15 (00–17)	Real time sample. Sample time in milliseconds. 0 = off. RTS minimum is 100msec (counts = 100). Maximum 10 seconds in binary; 9.999 seconds in BCD
Word 10	Bits 00–15 (00–17)	Low scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 11	Bits 00–15 (00–17)	High scale value for channel 1. Scale values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 12	Bits 00–15 (00–17)	Low clamp value for channel 1. The channel output will not be allowed to go below this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 13	Bits 00–15 (00–17)	High clamp value for channel 1. The channel output will not be allowed to go above this value (in scaled units) regardless of the data sent to the module. Clamp values are limited to ±32767 in binary format; ±7999 in BCD format.
Word 14	Bits 00–11 (00–13)	Maximum ramp rate. If this field is not 0, the module will limit the maximum rate of change for this channel to be a percentage of the scaled range of the module. Legal values are from 1 to 200% of full scale/second.
	Bit 12 (14)	Constant = 0
	Bits 13–14 (15–16)	Reset state. This field controls what the channel will output if the I/O reset line is asserted: 00 binary = last state; 01 binary = minimum output; (example: < –10V, < 4mA) 10 binary = maximum output; (example: > 10V, > 22mA) 11 binary = user reset value.
	Bit 15 (17)	Alarm enable. If set to 1, the module reports high clamp, low clamp and rate limit. If 0, these warnings are suppressed.
Word 15	Bits 00–15 (00–17)	Reset value. If the user selects the channel to go to a user reset value upon I/O reset, the value in scaled units is entered here. Otherwise, set to 0.
Words 16 thru 21		Same as words 10 thru 15 but for channel 2.
Words 22 thru 27		Same as words 10 thru 15 but for channel 3.
Words 28 thru 33		Same as words 10 thru 15 but for channel 4.

Word	Decimal Bit (Octal Bit)	Definition
Words 34 thru 39		Same as words 10 thru 15 but for channel 5.
Words 40 thru 45		Same as words 10 thru 15 but for channel 6.
Words 46 thru 51		Same as words 10 thru 15 but for channel 7.
Word 52	Bits 00–15 (00–17)	Low scale value for channel 8.
Word 53	Bits 00–15 (00–17)	High scale value for channel 8.
Word 54	Bits 00–15 (00–17)	Low alarm value for channel 8.
Word 55	Bits 00–15 (00–17)	High alarm value for channel 8.
Word 56	Bits 00–14 (00–16)	Rate alarm. If the channel's input changes at a rate faster than this value and the alarm enable bit is set, the channel will indicate a rate alarm condition. Legal values are from 0.05 to 50% of full scale per second.
	Bit 15 (17)	Alarm enable bit. If set to 1, the module will report high alarm, low alarm, underrange, overrange, and rate alarm conditions. If 0, these warnings are suppressed.
Word 57	Bits 00–07	Alarm deadband. This field creates a hysteresis effect on the low and high alarms. For an alarm condition to be removed, the input signal must go above the low alarm limit or below the high alarm limit by an amount equal to the specified deadband. Alarm deadband values must be less than or equal to one half the difference of the high and low alarm values.
	Bits 08–15 (10–17)	Filter time constant. Specifies the time constant of a digital, first order lag filter on the input in 0.1 second units. Legal values are 0.1 to 9.9 seconds. A value of 0 disables the filter.
Word 58	Bits 00–07	10 ohm offset. Compensates for a resistance offset on a 10 ohm copper RTD. Range of $\pm$0.99 ohms, in units of 0.01 ohms. This field must be 0 for all other RTDs.
	Bits 08–10 (10–12)	RTD type. Specifies type of RTD linearization on RTD channels: 001 = 100 ohm Pt, European standard; 010 = 100 ohm Pt. US standard; 011 = 10 ohm copper; 100 = 120 ohm nickel. This field is 0 for non–RTD channels.
	Bit 11 (13)	Constant = 0
	Bits 12–15 (14–17)	Thermocouple type. Specifies type of TC linearization on TC channels. 0000 = millivolts; 0001 = B; 0010 = E; 0011 = J; 0100 = K; 0101 = R; 0110 = S; 0111 = T. This field must be 0 for non–thermocouple channels.

Block Transfer Read Word Assignments for 7 Output/1 Input Modules

Word/Dec. Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word/Octal Bit	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
0	Constant = 8800 Hexadecimal															
1	Power up	Bad Chan. Data	Mod Alarm	RTS Time out	I/O Reset	Program Verify		Mod Fault	Bad Prog	Bad Struct	Unused = 0					
2	1	Unused = 0													CJC Over Range	CJC Under Range
3	Cold Junction Temperature; Units of 0.01 degrees C or 0.1 degrees F															
Channel 1 Status																
4	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
5	Channel 1 Raw Count sent to DAC															
Channel 2 Status																
6	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
7	Channel 2 Raw Count sent to DAC															
Channel 3 Status																
8	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
9	Channel 3 Raw Count sent to DAC															
Channel 4 Status																
10	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
11	Channel 4 Raw Count sent to DAC															
Channel 5 Status																
12	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
13	Channel 5 Raw Count sent to DAC															
Channel 6 Status																
14	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
15	Channel 6 Raw Count sent to DAC															
Channel 7 Status																
14	0	Unused = 0					Bad Calib	Bad Prog	Bad Data	Rate Alarm	High Clamp	Low Clamp	Unused = 0			
15	Channel 6 Raw Count sent to DAC															
Channel 8 Status																
18	1	Unused = 0					Bad Calib	Bad Prog	0	Rate Alarm	High Alarm	Low Alarm	Unused = 0		Over Range	Under Range
19	Channel 8 Input Data															
20–27	For factory use only.															

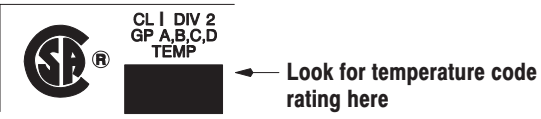
Block Transfer Read Bit/Word Descriptions for 7 Output/1 Input Modules

Word	Decimal Bit (Octal Bit)	Definition
Word 0	Bits 00–15 (00–17)	Constant = 8800 hexadecimal
Word 1	Bits 00–05	Not used. Always 0
	Bit 06	Bad structure. This bit is set if there is an error in the BTW header.
	Bit 07	Bad program. This bit is set if any of the module level programming data is illegal.
	Bit 08 (10)	Module fault. This bit is set if any of the programming data sent to the module in the most recent BTW was illegal, or if one or more channels has the bad calibration bit set.
	Bits 09–10 (11–12)	Program verify. Indicates the result of verify request. 00 = verify not requested; 10 = verify failed; 11 = verify succeeded
	Bit 11 (13)	I/O reset. This bit is set whenever the I/O reset line on the backplane is asserted.
	Bit 12 (14)	RTS timeout. This bit is set if a BTR was not requested of the module within the RTS sample time.
Word 1 continued	Bit 13 (15)	Module alarm. This bit is set if there is an alarm bit set for one or more channels. The input alarm bits are low, high alarm and rate alarm. The output channel alarm bits are low and high clamp, and the rate limit alarm.
	Bit 14 (16)	Bad channel data. This bit is set if the module is in BCD mode and one or more of the input data values sent in the last BTW are not a legal BCD value.
	Bit 15 (17)	Powerup bit. This bit is set until a BTW with programming data is received by the module.
Word 2	Bit 00	Cold junction compensation (CJC) underrange bit. This bit is set if the CJC temperature is below 0ºC.
	Bit 01	Cold junction compensation (CJC) overrange bit. This bit is set if the CJC temperature is above 70ºC.
	Bits 02–14 (02–16)	Not used. Always 0.
	Bit 15 (17)	Always 1.
Word 3	Bits 00–15 (00–17)	Cold junction temperature. Units of 0.01 degrees C or 0.1 degrees F. (0.1 degrees C or 1.0 degrees F in BCD.)

Word	Decimal Bit (Octal Bit)	Definition
Word 4	Bit 00–03	Not used. Always 0.
	Bit 04	Low clamp. This bit is set if alarms are enabled and the output data is lower than the low clamp value.
	Bit 05	High clamp. This bit is set if alarms are enabled and the output data is higher than the high clamp value
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the output data changed faster than the programmed ramp rate.
	Bit 07	Bad data. This bit is set if BCD data format was chosen and output value was not a legal BCD value.
	Bits 08 (10)	Bad programming. This bit is set if the most recent BTW contained improper programming data for this channel
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 0.
Word 5	Bits 00–15 (00–17)	Channel 1 Raw data sent to DAC.
Words 6 and 7		Same as words 4 and 5, but for channel 2
Words 8 and 9		Same as words 4 and 5, but for channel 3
Words 10 and 11		Same as words 4 and 5, but for channel 4
Words 12 and 13		Same as words 4 and 5, but for channel 5
Words 14 and 15		Same as words 4 and 5, but for channel 6
Words 16 and 17		Same as words 4 and 5, but for channel 7
Word 18	Bit 00	Underrange bit. This bit is set if the input signal is below the input channels minimum range.
	Bit 01	Overrange bit. This bit is set if the input signal is above the input channels maximum range.
	Bits 02–03	Not used. Always 0.
	Bit 04	Low alarm. This bit is set if alarms are enabled and the input signal is lower than the low alarm setpoint.

Word	Decimal Bit (Octal Bit)	Definition
Word 18 continued	Bit 05	High alarm. This bit is set if alarms are enabled and the input signal is higher than the high alarm setpoint.
	Bit 06	Rate alarm. This bit is set if alarms are enabled and the input signal changed at a rate faster than the input rate alarm setpoint.
	Bit 07	Not used. Always 0.
	Bit 08 (10)	Bad program. This bit is set if any of the channel level programming data is illegal.
	Bit 09 (11)	Bad calibration. This bit is set if the channel has not had a valid calibration.
	Bits 10–14 (12–16)	Not used. Always 0.
	Bit 15 (17)	I/O select bit. 0 = output, 1 = input. This bit is set to 1.
Word 19	Bits 00–15 (00–17)	Channel 7 input data.
Words 20 thru 27		For factory use only.

CSA Hazardous Location

CSA Hazardous Location Approval	Approbation d'utilisation dans des emplacements dangereux par la CSA
CSA® certifies products for general use as well as for use in hazardous locations. **Actual CSA certification is indicated by the product label** as shown below, and not by statements in any user documentation.	La CSA® certifie les produits d'utilisation générale aussi bien que ceux qui s'utilisent dans des emplacements dangereux. **La certification CSA en vigueur est indiquée par l'étiquette du produit** et non par des affirmations dans la documentation à l'usage des utilisateurs.
Example of the CSA certification product label 	Exemple d'étiquette de certification d'un produit par la CSA 
To comply with CSA certification for use in hazardous locations, the following information becomes a part of the product literature for CSA-certified Allen-Bradley industrial control products. • This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D, or non-hazardous locations only. • The products having the appropriate CSA markings (that is, Class I Division 2, Groups A, B, C, D), are certified for use in other equipment where the suitability of combination (that is, application or use) is determined by the CSA or the local inspection office having jurisdiction.	Pour satisfaire à la certification de la CSA dans des endroits dangereux, les informations suivantes font partie intégrante de la documentation des produits industriels de contrôle Allen-Bradley certifiés par la CSA. • Cet équipement convient à l'utilisation dans des emplacements de Classe 1, Division 2, Groupes A, B, C, D, ou ne convient qu'à l'utilisation dans des endroits non dangereux. • Les produits portant le marquage approprié de la CSA (c'est à dire, Classe 1, Division 2, Groupes A, B, C, D) sont certifiés à l'utilisation pour d'autres équipements où la convenance de combinaison (application ou utilisation) est déterminée par la CSA ou le bureau local d'inspection qualifié.
Important: Due to the modular nature of a PLC® control system, the product with the highest temperature rating determines the overall temperature code rating of a PLC control system in a Class I, Division 2 location. The temperature code rating is marked on the product label as shown.	**Important:** Par suite de la nature modulaire du système de contrôle PLC®, le produit ayant le taux le plus élevé de température détermine le taux d'ensemble du code de température du système de contrôle d'un PLC dans un emplacement de Classe 1, Division 2. Le taux du code de température est indiqué sur l'étiquette du produit.
Temperature code rating 	Taux du code de température 
The following warnings apply to products having CSA certification for use in hazardous locations.	Les avertissements suivants s'appliquent aux produits ayant la certification CSA pour leur utilisation dans des emplacements dangereux.
ATTENTION: Explosion hazard — • Substitution of components may impair suitability for Class I, Division 2. • Do not replace components unless power has been switched off or the area is known to be non-hazardous. • Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous. • Do not disconnect connectors unless power has been switched off or the area is known to be non-hazardous. Secure any user-supplied connectors that mate to external circuits on an Allen-Bradley product using screws, sliding latches, threaded connectors, or other means such that any connection can withstand a 15 Newton (3.4 lb.) separating force applied for a minimum of one minute.	**AVERTISSEMENT:** Risque d'explosion — • La substitution de composants peut rendre ce matériel inacceptable pour lesemplacements de Classe I, Division 2. • Couper le courant ou s'assurer quel'emplacement est désigné non dangereux avant de remplacer lescomposants. • Avant de débrancher l'équipement, couper le courant ou s'assurer que l'emplacement est désigné non dangereux. • Avant de débrancher les connecteurs, couper le courant ou s'assurer que l'emplacement est reconnu non dangereux. Attacher tous connecteurs fournis par l'utilisateur et reliés aux circuits externes d'un appareil Allen-Bradley à l 'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens permettant aux connexions de résister à une force de séparation de 15 newtons (3,4 lb. - 1,5 kg) appliquée pendant au moins une minute.

Le sigle CSA est la marque déposée de l'Association des Standards pour le Canada.

PLC est une marque déposée de Allen-Bradley Company, Inc.

CSA logo is a registered trademark of the Canadian Standards Association

PLC is a registered trademark of Allen-Bradley Company, Inc.

A

accuracy, 1–5

alarms, 4–11
- deadband, 4–12
- overrange, 4–12
- underrange, 4–11

B

bit/word description
- 2 output/2 input module, D–2
- 2 output/6 input module, E–3, F–3
- 4 output/4 input module, G–3, H–3
- 5 output/3 input module, J–3
- 8 output module, C–3

block transfer configuration block, 8 output module, C–1

block transfer configurations
- 0 out/8 in, B–1
- 1 out/7 in, F–1
- 2 out/2 in, D–1
- 2 out/6 in, E–1
- 3 out/5 in, G–1
- 4 out/4 in, H–1
- 5 out/3 in, J–1
- 6 out/2 in, I–1
- 7 out/1 in, K–1
- 8 out/0 in, C–1

block transfer programming, 3–1

block transfer read, 5–1
- bit/word descriptions, 2 output/2 input modules, D–6
- bit/word descriptions, 2 output/6 input modules, E–7, F–7
- bit/word descriptions, 4 output/4 input modules, G–6, G–7, H–6, H–7
- bit/word descriptions, 5 output/3 input modules, J–6, J–7
- bit/word descriptions, 6 output/2 input modules, I–6, I–8, K–6, K–7
- bit/word descriptions, 8 input modules, B–7
- bit/word descriptions, 8 output modules, C–6
- BTR word assignments, 2 output/2 input modules, D–5
- BTR word assignments, 2 output/6 input modules, E–6, F–6
- BTR word assignments, 8 input module, B–5
- BTR word assignments, 8 output modules, C–5

block transfer write, 3–1

BTR header
- “inputs only” and “inputs/outputs”, 5–3
- “outputs only”, 5–2
- bit/word descriptions, “outputs only”, 5–2

BTR header bit word descriptions, “inputs only” and “inputs/outputs”, 5–3

C

cables, 2–6

calibration
- block transfer read, 6–6
- block transfer write, 6–3
- input channel, 6–3
- methods, 6–2
- output channel, 6–7
- tools, 6–1

catalog numbers, standard, 1–3

catalog numbers of modules, 1–3

channel configurations, 1–3

channel descriptions, module, 1–3

clamping, output channels, 4–9

communication, how data is transferred, 1–4

configuration, output, 4–16

configuration BTW, 3–1
- 2 output, 6 input module, E–1, F–1
- 2 output/2 input module, D–1
- 4 output, 4 input module, G–1, H–1
- 5 output/3 input module, J–1
- 6 output, 2 input module, I–1, I–3, K–1, K–3
- 8 input module, B–1
- bit/word description for 8 input module, B–3

configuration data header, block transfer write, 4–15

configuration verification, 4–3

configurations, channel, 1–3

connecting wiring, 2–6

D

data format, 4–3

data table formats
- 2’s complement binary, 4–5
- 4–digit BCD, 4–3

default configuration, 3–2, 4–2
diagnostic indicators, 2–14
diagnostics, indicators, 7–1
digital filtering, 4–13

E

electrostatic damage, 2–2
European Union Directive compliance, 2–1

F

features, 1–2
  5V input, 1–3
  general, 1–2
  RTD input, 1–3
  thermocouple inputs, 1–2
filtering, input, 4–13

G

grounding, 2–13

I

indicators
  CAL/COM, 7–1
  operation during calibration, 6–3
  RUN/FLT, 7–1
installation, of module, 2–3

M

module configuration, 4–1
module description, 1–1
module installation, 2–3
module location, 2–3

O

output update BTW, 3–1

P

power requirements, 2–2
pre–installation considerations, 2–1
programming
  input, 4–19
  output, 4–17
programming example
  PLC–3, 3–2
  PLC–5, 3–3

R

ramping, outputs, 4–10
rate alarm, 4–13
real time sampling, 4–5
reference values, calibration, 6–4
remote termination panel, connections, 2–8
remote termination panels, 2–6
reset state, 4–10
reset value, 4–11
RTD, types, 4–15

S

sample programs, 3–4
  data table file, 3–7
  PLC–3, 3–5
  PLC–5, 3–6
scaling, 4–6
scan time, 3–4
sensors, connecting 4–wire, 2–10

T

temperature scale, 4–3
thermocouple, types, 4–14
troubleshooting
  input channel status word, 7–4
  output channel status word, 7–4
  status reported by the module, 7–2
  with indicators, 7–2

W

wiring connections, channel, 2–9

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products.
At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1771-UM127B-EN-P - December 2002 PN-955132-05B
Supersedes Publication 1771-6.5.127 - June 1999
Copyright © 2002 Rockwell Automation, Inc. All rights reserved. Printed in the U.S.A.