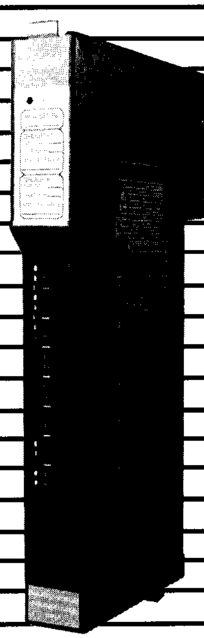
SQUARE D

Instruction Bulletin

SY/MAX®

Class 8030 Type RIM126
Eight Channel Isolated Analog-Thermocouple Input Module

Bulletin #30598-208-01D2
May, 1995



Replaces 30598-208-01D1
Dated February, 1995

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD

To avoid improper handling of equipment:

1. **Never remove this device while power is ON. Turn power supply switch to OFF and wait until all indicating lights are off before removing.**
2. ***Do not subject to static discharge.* This module contains electronic components that are very susceptible to damage from electrostatic discharge.**

Failure to observe this precaution can result in equipment damage.

⚠ WARNING

HAZARDOUS VOLTAGE

Do not touch the terminal block or the circuit board while power input wiring is connected.

Failure to observe this precaution can result in severe personal injury or death.

PLEASE NOTE

Electrical equipment should be serviced only by qualified electrical maintenance personnel, and this document should not be viewed as sufficient instruction for those who are not otherwise qualified to operate, service or maintain the equipment discussed. Although reasonable care has been taken to provide accurate and authoritative information in this document, no responsibility is assumed by Square D for any consequences arising out of the use of this material.

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1.0 DESCRIPTION OF THE TYPE RIM126 MODULE

1.1 Introduction

1.1.1 General Purpose

The Type RIM126 isolated analog/thermocouple input module can input up to eight channels of analog signals to any SY/MAX processor which possesses register I/O addressing capability.

Analog input signals are user-selectable for two types: *high level analog* and *low level/thermocouple*. High level analog signals include ranges of 0-20mA, 4-20mA, 0-5VDC, 1-5VDC, 0-10VDC, ±5VDC and ±10VDC. Low level/thermocouple analog signals include ±50mV, and thermocouple types J, K, T, E, B, N, R, S & C. See Section 2.1.

All of the input signals are isolated channel-to-channel and channel-to-ground. The user can define two unique input function groups on the module, with each input function group monitoring different types and/or ranges of signals simultaneously. See Section 3.3.

The RIM126 can be inserted into any slot of a register rack (except slot 1) or a register slot a digital rack.

Each RIM126 module utilizes twelve registers in the programmable controller system:

- The first eight registers correspond to the analog input data for input channels one through eight, one register per input channel. Each of these eight registers converts the high level analog current or voltage being measured into a value ranging from 0 to 9995 in increments of 5. This conversion provides a register value based on a percent of full scale, with 2 decimal place resolution for high level analog signals. Simple programming techniques allow these input readings to be scaled to engineering values, provided the processor being used has math capability. The low level/thermocouple values are converted directly to readings in degrees C or F.

- The ninth and tenth registers provide thermocouple status information such as open input detection and under/over range indication.

- The eleventh and twelfth registers provide software control of the module and allow the user to read the analog signal type and range for each of the two input function groups, as well as the group border definitions and software averaging routines, if desired.

Input update rate is selectable. In the FAST mode, input updates are performed rapidly, although accuracy is somewhat reduced. In the HIGH ACCURACY mode, better accuracy is achieved for the volt and millivolt ranges, but updates are not performed as often. See Section 3.3.7.

The RIM126 module requires no external power supply to operate since it draws power from the SY/MAX rack. No additional components, such as current loop resistors, are needed. No user adjustment of span and zero is required, since *automatic* calibration is performed by the onboard microprocessor. A removable terminal strip facilitates quick module replacement, and eliminates the need for extensive rewiring.

1.1.2 General Operation

The RIM126 module performs its tasks utilizing several subsystems. Channel-to-channel isolation is accomplished through the use of **isolation amplifiers**. An **analog-to-digital converter** (ADC) performs the actual conversion of the selected input channel, while the **multiplexer** (MUX), under the control of an on-board **microprocessor**, performs the channel selection. The **auto-calibration system** (ACS) provides zero and reference voltage. The module also contains a **DC-to-DC converter** to provide the ±15VDC required.

For complete operational details, as well as a block diagram of RIM126 operation, see Section 7.

1.2 Front Panel Features

Refer to Figure 1.1. The front of the RIM126 contains a terminal strip and a green RUN LED. The terminal strip contains eight groups of two terminals; each group corresponds to one input channel. One terminal in the group is for the positive wire of the signal source, the other is for both the negative and shield wire. The Square D replacement part number for the terminal strip is D30617-083-50. For field wiring considerations, see Section 3.4.

The RUN LED indicates the RIM126 microprocessor is functioning properly, however it does not guarantee proper RIM126 operation. See Section 6.1 for a complete description of this LED.

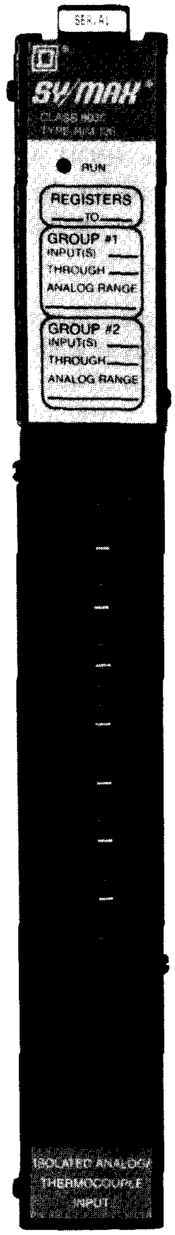

Figure 1.1 - RIM126 Front Panel

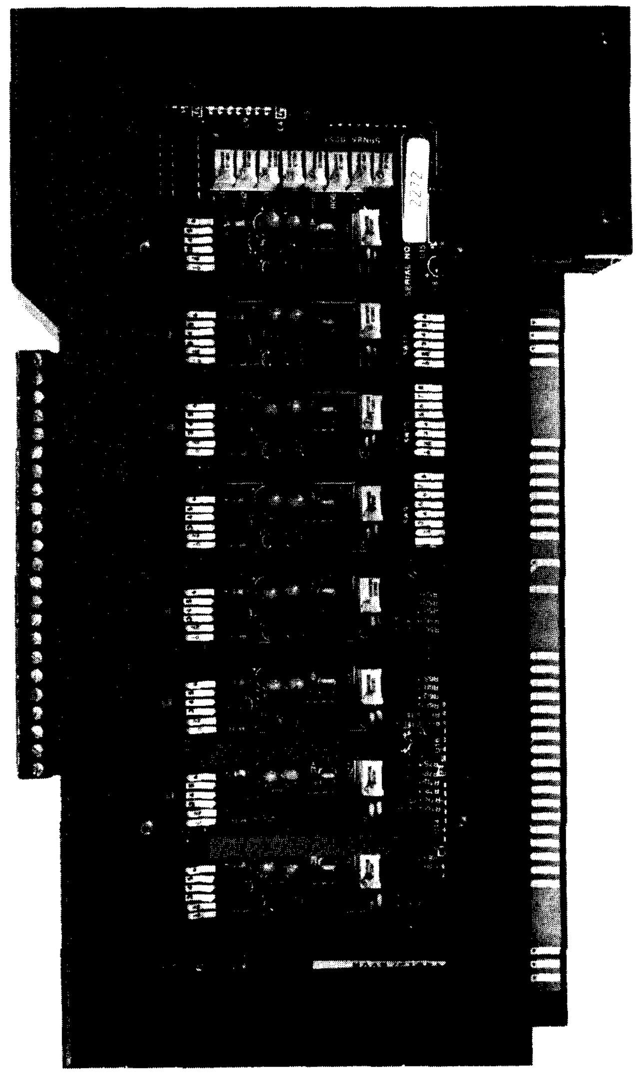

Figure 1.2 - DIP Switch Access

1.3 Side Panel Features

Removing the side cover plate provides access to eight sets of six-position DIP switches and three sets of eight-position DIP switches. These switches are used to set input ranges, and to define the two input function groups. *See Section 3.3 for instructions on how to set these switches.*

2.0 SPECIFICATIONS

2.1 Electrical

Inputs per module . . . . . . .Eight (two user-defined groups)

Registers required for rack addressing 12

User-definable function groups. . . . . . .Two independent input function groups, each with its own range and number of inputs, can be created per module.

High-level ranges . . . . . . .Seven: 0-5VDC, 1-5VDC, 0-10VDC, ±1-5VDC, ±10VDC, 0-20mA, 4-20mA

Low-level ranges. . . . . . . .Nine: ±50mVDC, and thermocouple types J, K, T, E, B, N, R, S & C

Thermocouple operation ranges (full-scale):

Type	Temp. Range, °F	Temp. Range, °C
J	-50 to +1400	-40 to +760
K	-100 to +2250	-80 to +1240
T	-200 to +660	-130 to +350
E	-400 to +1250	-240 to +680
N	-325 to +2010	-200 to +1100
R	0 to +3200	-20 to +1760
S	0 to +3200	-20 to +1760
B	+500 to +3200	+260 to +1760
C	0 to +4200	-20 to +2320

Resolution:
(VDC, mA, mV DC). . .Five parts in 10,000 (full scale range)

Resolution:

Thermocouple
Types J, K, E, T . . . . . .0.5° (°C and °F)

Thermocouple
Types R, S, B, C . . . . . .4°F, 2°C

Thermocouple
Type N . . . . .4°F, 2°C

Thermocouple accuracy and repeatability:

Type/ Range	Accuracy (% of full-scale)				Repeat ability (% of full-scale)
	Fast Update		High Accuracy Update*		
	@20°C	Overall 0-60°C	@20°C	Overall 0-60°C	
J	0.3%	0.4%	0.3%	0.4%	0.1%
K	0.25%	0.3%	0.25%	0.3%	0.1%
T	0.5%	0.6%	0.5%	0.6%	0.2%
E	0.5%	0.5%	0.5%	0.5%	0.15%
R	0.5%	0.75%	0.5%	0.75%	0.15%
S	0.4%	0.5%	0.4%	0.5%	0.15%
N	0.5%	0.5%	0.5%	0.5%	0.15%
B**	0.5%	0.5%	0.5%	0.5%	0.15%
C	0.4%	0.5%	0.4%	0.5%	0.15%
mV	0.2%	0.2%	0.1%	0.15%	0.05%
V	0.4%	0.5%	0.1%	0.15%	0.05%

* The *"HIGH ACCURACY"* mode affects only the mV, current and V ranges (Series B1 or later)

** Type B thermocouple accuracy is ±2.0% below 1500°F (815°C). Above this temperature the figures in the table above apply.

NOTE: The accuracies in the above table relate strictly to the RIM126. The accuracy of thermocouples varies greatly and should be taken into account when used with this module.

Calibration. . . . . Automatic

Under-range indication (VDC, mA, mV DC). . Converted to -1 for the 1-5VDC and 4-20mA inputs at signals less than 0.9VDC and 3.6mA respectively. All other unipolar voltage ranges are converted to 0.

Under-range indication (Thermocouple). . . . . . Provided in RIM126 register number 10; bits 1 through 8 turn ON for channels 1 through 8 respectively.

Over-range indication
(VDC, mA, mV DC) . . Converted to 9999. Use ≥ in programming comparison rungs. (Converted to 9995 for Series B1, Rev. 2.01 only.)

Over-range indication
(Thermocouple). . . . . . Provided in RIM126 register number 10; bits 9 through 16 turn ON for channels 1 through 8 respectively

Open input detection
(Thermocouple). . . . . . Provided in RIM126 register number 9; bits 1 through 8 turn ON for channels 1 *through 8 respectively*

Update time:

NOTE: "Update time" is defined as the time required for a change in input to be available to the SY/MAX processor/bus master. See Section 5.4 on page 5-2.

FAST Mode. . . . . 12 milliseconds for all eight high-level input channels, *260 milliseconds for all eight* thermocouple input channels

HIGH ACCURACY
Mode . . . . 24 milliseconds for all eight high-level input channels, 285 milliseconds for all eight thermocouple input channels.

Input isolation . . . . 750V channel-to-channel and channel-to-ground (or analog circuit to digital logic circuit) continuously applied. 1500V transient isolation.

Maximum input
overload. . . . . CURRENT RANGE: 30mA (continuous)
VOLTAGE AND THERMOCOUPLE RANGE: 50VDC (continuous)

Overvoltage protection . . Clamping diode

Current loop resistors . . . 250 ohm ±0.05%, 25 PPM/deg. C (resident in the module)

Power requirements
from SY/MAX supply . . . 1250 mA

Input impedances
Hi-level voltage. . . . . . 1 Megohm
Hi-level current . . . . . . 250 ohms
LO level/
thermocouple. . . . . 100 Megohms

Common mode
rejection ratio . . . . 110 dB

A/D conversion . . . . 14-bit high speed

Multiplexer type . . . . AD7508, 16-channel, single-ended CMOS

Microprocessor type and
clock speed . . . . *70116C-8 (8086 equiv.),* 8MHz clock

Indicator light . . . . Green RUN LED indicates that microprocessor is operating correctly

Product certification . . . . UL, CSA, FM

2.2 Physical

Weight . . . . 3.5 lbs (1.6 kg) approx.

Dimensions (WxHxD). . . 1.5 x 12.8 x 6.6 inches
3.8 x 32.5 x 16.8 cm

2.3 Environmental

Ambient temperature ratings:
Operational . . . . 0 to 60°C
Storage . . . . -40 to +85°C

Humidity rating . . . . 5-95% RH, non-condensing

2.4 Compatibility with Racks

The following SY/MAX Class 8030 racks are compatible with the Type RIM126 module:

- RRK100, RRK200, RRK300 (except the first slot of all RRK racks and slots 17 & 18 of RRK300)
- HRK100, HRK150, HRK200 (register slots only)
- CRK210, CRK300 (register slot only)
- DRK210, DRK300 (register slot only)
- GRK110, GRK210 (register slot only)

2.5 Compatibility with Processors

The following SY/MAX Class 8030 and 8055 Type SCP programmable controllers can be used with the Type RIM126 module:

- SCP311 and 332 (Series E and later)
- SCP323 and 344 (Series C and later)
- SCP313, 321, 322, 323, 333 (Series D and later)
- All Model 400, 450, 500, 600, 650 and 700 programmable controllers

3.0 INSTALLATION

3.1 Physical Inspection

3.1.1 New Module

The Type RIM126 module requires no additonal components to function, and requires no manual adjustments for zero and span since these adjustments are performed by the Automatic Calibration System.

The following compatibility checks must be made before plugging the RIM126 into a rack assembly. Refer to the section shown in parentheses for more information on each check.

- The desired range for the application is available (2.1).
- The proper range is selected (3.3).
- The system processor is compatible (2.6).
- The rack and necessary slot is available (2.4).
- The SY/MAX power supply is adequately sized (Section 2.1 and Instruction Bulletins 30598-159 and 30598-802).
- The rack is not keyed to prevent module insertion (3.2).
- Field wiring terminations are understood (3.4 and 5.2).
- The required programming, especially Rack Addressing, is understood (see appropriate programmer Instruction Bulletin).

⚠ CAUTION

EQUIPMENT DAMAGE

Do not insert or remove the RIM126 while **the rack is powered up, or while wires carrying input signals are connected to the module. See Section 3.5 for general start-up procedures and Section 5.1 for application considerations regarding module insertion.**

Failure to observe this precaution can result in equipment damage.

3.1.2 Replacing A Module

The RIM126 is installed by aligning the module edge connector with the desired slot in the rack and inserting the module so that it snaps into place. Secure to the rack using the module's captive screw.

The RIM126 can be quickly and easily replaced with another module. There is no need to rewire the analog input points since the terminal strip can be removed by simply pulling it straight off the face of the module (Figure 3.1). The DIP switches in the replacement module must be properly coded for the desired range. No software reprogramming is necessary. See Section 5.1 for application considerations regarding module insertion and removal.

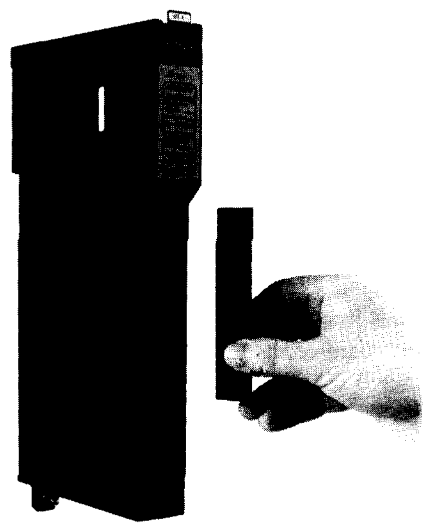

Figure 3.1 - Terminal Block Removal

3.2 Keying

It is possible to key a particular slot on the rack assembly so that only the Type RIM126 module can be inserted there. A keying pin kit, Class 8030 Type CBP104, may be used to insert a keying pin between pins 67-68 and 69-70 of the appropriate slot, as described in the register rack Instruction Bulletin, 30598-265. The same procedure also applies to the register slot(s) of any digital rack.

The factory installed keying pin should not be removed from the register slots, as it ensures proper alignment between the slot pins and edge connector pads when the module is inserted or removed.

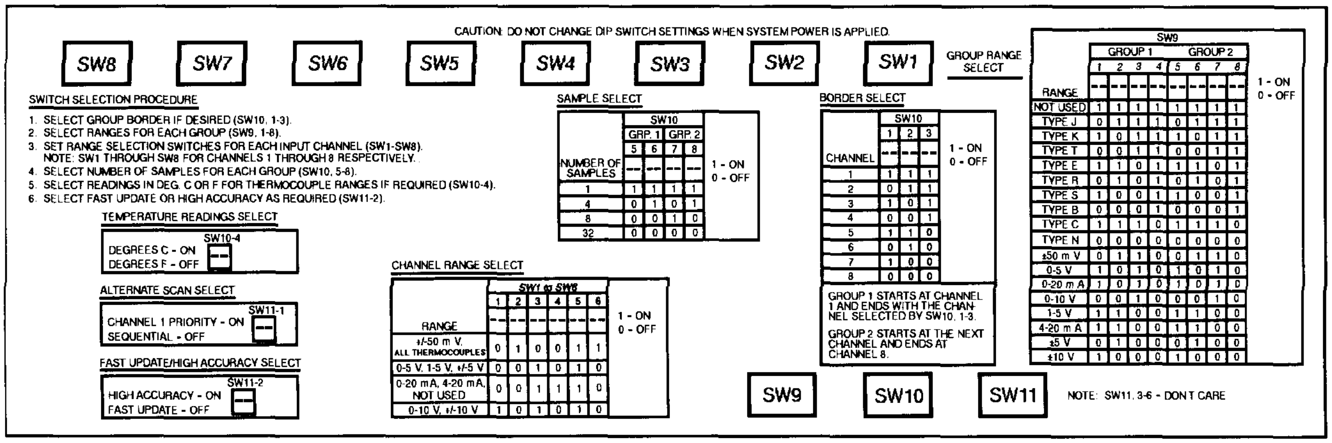

Figure 3.2 - DIP Switch Summary

3.3 DIP Switch Settings

Removing the large cover plate on the side of the module provides access to eleven DIP switches. Eight of these switches (SW1 through SW8) are six-position (that is, there are six actuators per switch), and are located on the RIM126 module's lower (larger) circuit board. The upper (smaller) circuit board contains three additional switches: two of the switches (SW9 and SW10) are eight-position, while the third (SW11) is a six-position type. See Figure 3.2. See Sections 3.3.1 through 3.3.6 on the following pages for appropriate switch settings.

⚠ CAUTION

EQUIPMENT DAMAGE

DIP switch settings should never be changed while power is applied to the module!

Failure to observe this precaution can result in equipment damage.

3.3.1 *Channel Range Selection*

DIP switches **SW1** through **SW8** are used to select the gain, current, and voltage ranges for input Channels 1 through 8 respectively. See Figure 3.3.

⚠ CAUTION

EQUIPMENT DAMAGE

Switches should not be set in any combination other than described in Figure 3.3.

Failure to observe this precaution can result in equipment damage.

Range Desired	Positions on SW1 Through SW8 (1 = ON, 0 = OFF)					
	1	2	3	4	5	6
±50 mV DC	0	1	0	0	1	1
All Thermo-couples	0	1	0	0	1	1
Not Used	0	0	1	1	1	0
0-5 VDC	0	0	1	0	1	0
0-20 mA	0	0	1	1	1	0
1-5 VDC	0	0	1	0	1	0
4-20 mA	0	0	1	1	1	0
±5 VDC	0	0	1	0	1	0
0-10 VDC	1	0	1	0	1	0
±10 VDC	1	0	1	0	1	0

Figure 3.3 - Channel Range Selection (SW1-SW8)

3.3.2 Function Group Range Selection

The eight channels of the RIM126 can be divided into two distinct analog function groups. Each function group assumes the analog range (0-5VDC, 4-20mA, Type T, etc.) assigned it by **SW9**, assuming that the Channel Range Selection DIP switches are correctly set per Figure 3.3. Refer to Figure 3.5. If settings for DIP switches **SW1** through **SW8** do not match **SW9** the scaled value will be incorrectly reported by module.

3.3.3 Border Selection

Positions 1 - 3 of DIP switch **SW10** are used to separate Function Group 1 inputs from Function Group 2 inputs. Group 1 begins with Channel 1, and ends with the channel that is selected by SW10. *The ending channel is included in group 1.* Group 2 begins with the channel following the one selected by SW10. See Figure 3.4.

EXAMPLE: If SW10 is set to Channel 5, then Group 1 will consist of Channels 1 through 5 and Group 2 will consist of Channels 6 through 8.

Range Desired	Positions on SW10 (1 = ON, 0= OFF)		
	1	2	3
1	1	1	1
2	0	1	1
3	1	0	1
4	0	0	1
5	1	1	0
6	0	1	0
7	1	0	0
8 (No Group 2)	0	0	0

Figure 3.4 - Border Selection (SW10)

Range Desired	Positions on SW1 Through SW8 (1 = ON, 0 = OFF) ----- Group 1 -----				-----Group 2 -----			
	1	2	3	4	5	6	7	8
NOT USED	1	1	1	1	1	1	1	1
Type J	0	1	1	1	0	1	1	1
Type K	1	0	1	1	1	0	1	1
Type T	0	0	1	1	0	0	1	1
Type E	1	1	0	1	1	1	0	1
Type N	0	0	0	0	0	0	0	0
Type R	0	1	0	1	0	1	0	1
Type S	1	0	0	1	1	0	0	1
Type B	0	0	0	1	0	0	0	1
Type C	1	1	1	0	1	1	1	0
±50VDC	0	1	1	0	0	1	1	0
0-5VDC	1	0	1	0	1	0	1	0
0-20mA	1	0	1	0	1	0	1	0
0-10VDC	0	0	1	0	0	0	1	0
1-5VDC	1	1	0	0	1	1	0	0
4-20mA	1	1	0	0	1	1	0	0
±5VDC	0	1	0	0	0	1	0	0
±10VDC	1	0	0	0	1	0	0	0

NOTE: 4-20mA and 1-5VDC ranges can be mixed within a single function group since their function group switch positions are identical.

Figure 3.5 - Function Group Range Selection (SW9)

3.3.4 Temperature Readings Selection

Position 4 of DIP switch **SW10** selects either °C or °F for the thermocouple temperature ranges (i.e., the value stored in the SY/MAX processor's register):

- For °C, SW10 position 4 is **ON**
- For °F, SW10 position 4 is **OFF**

3.3.5 Sample Selection

Positions 5-8 of DIP switch **SW10** are used to select software averaging of the input signals on Function Groups 1 and 2. Positions 5 and 6 are used for Group 1, while positions 7 and 8 are used for Group 2. Each sample is placed in a stack, the stack's contents are averaged, and the average for the number of samples selected is given to the processor. See Figure 3.6.

Numer of Samples	Positions on SW10 to Depress (1 = ON, 0= OFF)			
	5	6	7	8
1	1	1	1	1
4	0	1	0	1
8	1	0	1	0
32	0	0	0	0

Figure 3.6 - Sample Selection

3.3.6 Alternate Scan Selections

The "NOT USED" setting shown in Figure 3.5 allows the user to turn OFF the scanning of either groups of inputs. For example, setting switches SW5, SW6, SW7, SW8 to the ON position will allow the RIM126 to scan only Channels 1, 2, 3, 4 and improve the overall update time for these four channels.

The RIM126 normally scans Channels 1-8 sequentially, starting with Channel 1. To accommodate high speed requirements, Channel 1 can be updated by the module after every other channel update:

- In a normal (*sequential*) scan, the RIM126 scans the channels like this:

  1, 2, 3, 4, 5, 6, 7, 8, 1, . . .

  But in a *Channel 1 priority* scan, the RIM126 scans like this:

  1, 2, 1, 3, 1, 4, 1, 5, 6, 1, 7, 1, 8, 1, . . .

Position 1 of DIP switch **SW11** activates the Channel 1 priority feature.

NOTE: This feature does not apply to the thermocouple ranges.

- For Channel 1 priority, position 1 of SW11 is **ON**.
- For normal scan, position 1 of SW11 is **OFF**.

The Alternate Scan Selection changes the channel update time as follows:

- Channel 1 will be updated every 7 ms
- Channels 2 - 8 will be updated every 16 ms

3.3.7 Update Rate Selection (Series "B1" or Later)

On RIM126 Series B1 Revision 2.0 or later, two update rates are available – FAST mode and HIGH ACCURACY mode. The FAST mode updates eight high level inputs once every 12 milliseconds and eight thermocouple inputs every 260 milliseconds. The HIGH ACCURACY mode updates eight high level inputs every 24 milliseconds and eight thermocouple inputs every 285 milliseconds.

Position 2 of DIP switch **SW11** selects the update rate:

- For the **FAST** mode, position 2 of SW11 is **OFF**.
- For the **HIGH ACCURACY** mode, position 2 of SW11 is **ON**.

NOTE: *The Update Rate selection affects both function groups.*

The remainder of SW11 is unused.

3.4 Field Wiring Terminations

Each analog input signal, either high or low level, is wired to one pair of RIM126 front panel input terminals. The numbered terminal (1-8) accepts the positive input from the analog source. The "C" terminal (1C-8C) is the common analog ground and accepts the negative input from the analog source along with the shield wire.

For connection to high level signals (4-20mA, 0-5VDC, etc.), it is recommended the wiring used be a shielded twisted pair (Belden 8760 or equivalent), and that the shield be connected to the RIM126 module **only**. Each of the eight "C" terminals is internally isolated from each other.

For connection to thermocouples, shielded thermocouple extension wire must be used. Thermocouple extension wire has the same temperature-EMF characteristics (made of the same material) as the thermocouple itself. This ensures the accuracy of the thermocouple is maintained. The extension wire shield must be connected to the RIM126 module only.

The typical wiring for both high level analog and low level thermocouple connections is shown in Figures 3.7, 3.8 and 3.9. See Section 5.2 for additional wiring considerations.

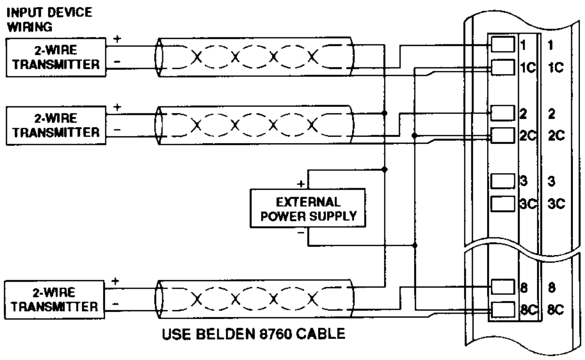

Figure 3.7 - Typical 2-Wire Analog Input Wiring

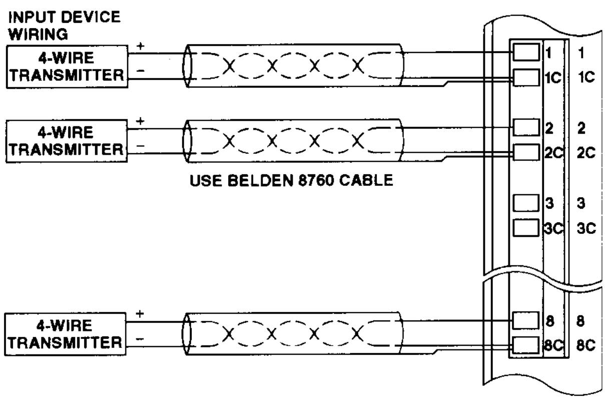

Figure 3.8 - Typical 4-Wire Analog Input Wiring

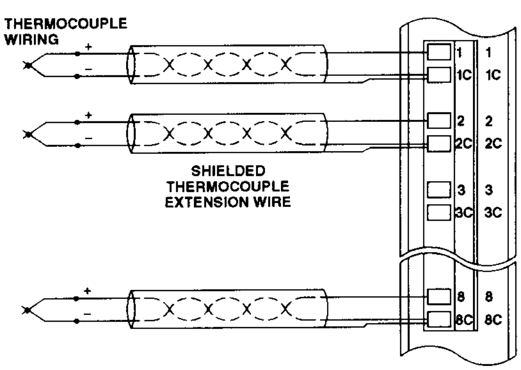

Figure 3.9 - Typical Thermocouple Input Wiring

3.5 RIM126 Start-Up

3.5.1 Processor Requirements

Before inserting the RIM126 into the rack, confirm that all DIP switches are correctly set (Section 3.1.1).

With the rack assembly's power OFF, and with no input signals applied to any terminals of the RIM126, the module can now be inserted into the appropriate slot in the rack.

If system Rack Addressing has been correctly assigned to recognize the RIM126, and the module's microprocessor is functioning properly, bits 25 through 32 of the status field for the RIM126 - assigned registers will show the following code at system power-up:

	1 = ON, 0 = OFF							
STATUS	1	1	0	0	0	1	1	1
BIT #	32	31	30	29	28	27	26	25

NOTE: *The hex value of the above code (C7) is shown in the slot that is rack addressed to the RIM126.*

If the above bit pattern is not found in the registers assigned to the RIM126, then either the system has been misaddressed or the RIM126 has failed its initialization sequence and is sending back an alternate bit pattern to describe the failure. See Section 4.1.1 for an explanation of the error codes. The module's RUN light may also remain OFF.

It is possible that non-zero values may appear in the data field of the processor registers which are monitoring the analog input channels, even when those channels have no input signal connected to them. This may occur when operating on any of the voltage range settings, due to the RIM126's high input impedances and CMOS multiplexing circuitry. To prevent this condition, select the current loop resistors for unused channels by turning position 4 of SW1 through SW8 ON for Channels 1 through 8, as needed.

If a more systematic check of the interaction of the RIM126 module with a processor is needed, the following three sample configurations can be used.

NOTE: *The following examples are intended only as samples of possible configurations, to be used for familiarization purposes. Final actual system layout is dependent upon proper understanding of the system definition or rack addressing as outlined in the programmer instruction bulletin.*

EXAMPLE 1

HARDWARE CONFIGURATION
Rack Type . . . . CRK, DRK, GRK or HRK
In Register Slot (2) RIM126
In CPU Slot (1) . . . . Model 300 Processor

SYSTEM ADDRESSING
CPU Slot 0
Channel 0
Drop Number 0
Slot Number 1 100
Slot Number 2 112

Comments:
This configuration will assign RIM126 input Channels 1-8 to processor registers 101-112.

EXAMPLE 2

HARDWARE CONFIGURATION
Rack Type . . . . RRK100 or RRK200
In Slot 1 . . . . Model 300 Processor
In Slot 2 . . . . CRM210
In Slot 3 . . . . RIM126

SYSTEM ADDRESSING
CPU Slot 0
Channel 0
Drop Number 0
Slot Number 1 . . . . --
Slot Number 2 100
Slot Number 3 112

Comments:
This configuration will assign analog input Channels 1-8 to processor registers 101-112.

EXAMPLE 3

HARDWARE CONFIGURATION
Rack Type . . . . RRK100 or RRK200
In Slot 1 and Slot 2 . . . . Model 500 Processor
. . . . (Double-width module)
In Slot 3 . . . . RIM126

SYSTEM ADDRESSING
CPU Slot 0
Channel 0
Drop Number 0
Slot Number 1 460
Slot Number 2 . . . . --
Slot Number 3 472

Comments:
This configuration will assign analog input Channels 1-8 to processor registers 461-472.

3.5.2 Indicator Light

Illumination of the green RUN light indicates that the RIM126's microprocessor is functioning properly, but does NOT necessarily mean that incoming analog signals are being properly converted.

If the RUN light is ON, but the RIM126 is not functioning properly, one of the following conditions may exist:

1. The slot in which the module is inserted may be misaddressed.

2. The user-defined border settings may be invalid.

3. The RIM126 may be set for a range that is not compatible with the input device.

4. The user-defined range settings may be invalid.

5. The RIM126 may be experiencing one of several miscellaneous non-fatal errors.

See Section 4.1.1 for possible error code conditions, and Section 6 for troubleshooting procedures.

4.0 PROGRAMMING

4.1 Register Usage and Rack Addressing

The Type RIM126 can be assigned from 8 to 12 registers in rack addressing (refer to Section 4.3 below for details). These registers must be assigned to the slot in which the RIM126 is inserted, and will be reserved even if some of the eight input channels on the RIM126 remain unused. For more information on rack addressing, refer to the appropriate SY/MAX processor or programmer instruction bulletin.

4.1.1 Status and Error Register Table

Figure 4.1 is a table of bit patterns which may appear in positions 25 through 32 of the status field for the registers assigned to the RIM126. These patterns are generated by the RIM126's microprocessor.

BIT PATTERN * (32 31 30 29 28 27 26 25)	**CONDITION**
1 1 0 0 0 1 1 1 (C7 in hex)	Normal Operation (Registers 1-10)
1 0 0 0 0 0 0 1	Normal Operation (Registers 11 & 12)
0 1 1 0 0 0 1 0	EPROM or RAM Failure
0 1 1 0 0 0 0 0	DC--DC Failure
0 1 0 1 0 0 1 1	Watchdog Failure
0 0 0 1 0 1 0 0	No Card Acknowledged in Slot
0 1 1 0 1 0 0 1	Diagnostics in Progress
0 0 0 0 0 0 0 0	Slot not Addressed

* The hex values of these codes are displayed in the programmer's rack addressing mode.

Figure 4.1 - Status and Error Indictors

See Section 6.2 for a detailed explanation of these conditions.

4.2 Programming Equipment

Any series of the following types of Class 8010 programming devices can be used with the RIM126:

SY/MAX CRT Programmers	SPR250, SPR260, SPR300, SPR310
SY/MATE Personal Computer Software	SYM322/422 SYM323/423/533 SYM324/424/534 *SFW374, SFW472/473/474*

4.3 RIM126 Register Allocation

The RIM126 has twelve 16-bit registers to provide analog input, thermocouple status (open input detection, over/under range), and DIP switch control information. Figure 4.2 describes these 12 registers and their respective bits. Each of the 12 registers is explained in Sections 4.3.1 and 4.3.2.

REGISTER	BITS 16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1	--Decimal Value of Channel 1 Analog Input--															
2	--Decimal Value of Channel 2 Analog Input--															
3	--Decimal Value of Channel 3 Analog Input--															
4	--Decimal Value of Channel 4 Analog Input--															
5	--Decimal Value of Channel 5 Analog Input--															
6	--Decimal Value of Channel 6 Analog Input--															
7	--Deciaml Value of Channel 7 Analog Input--															
8	--Decimal Value of Channel 8 Analog Input--															
9	•	•	•	•	•	•	•	•	I	I	I	I	I	I	I	I
10	0	0	0	0	0	0	0	0	U	U	U	U	U	U	U	U
11	DIP Switches 9 (8 *least* significant bits) & 10 (8 *most* significant bits) status.															
12	DIP Switch 11 Status															

• = Not Used
I = Thermocouple Open Input Detection
U = Thermocouple Under-range Detection (Bit 10 = Channel 1)
0 = Thermocouple Over-range Detection (Bit 10 = Channel 1)
9 = DIP Switch SW9 Status
10 = DIP Switch SW10 Status
11 = DIP Switch SW11 Status

Figure 4.2 - RIM126 Data Registers

NOTE: *In addition to slot keying, DIP switch status can be used in the control program to sound an alarm or prevent the programmable control system from operating should an incorrectly configured RIM126 be inserted into a rack.*

4.3.1 Analog Input (Registers 1-8)

The information contained in the first eight registers assigned to the RIM126 represent the decimal values of the eight analog input channels, respectively.

The value stored in the analog input registers may be utilized as would any storage register value (that is, in IFs, LETs, COMM statements, and so on). Valid data in the storage registers can range from *1* to *9995* (in increments of 5), or in °C or °F for the thermocouple ranges. The values stored in each channel's register (for all input ranges except thermocouple) indicate to two decimal places (0.00) the percent of full-scale range that is selected for that channel.

EXAMPLE: A midrange (half of full-scale) input for all high level ranges will produce a value of 4995, 5000 or 5005 in that input register. These values relate to 49.95%, 50.00% and 50.05% of full-scale, respectively (depending upon the input source).

Thermocouple values represent temperature in degrees C or F, depending on the setting of DIP switch SW10's position four (see Section 3.3.4). If type J, K, T or E thermocouples are used, the actual temperature (to one decimal place) appears in the input register.

EXAMPLE: A Type K thermocouple sensing 700 degrees F will produce a value of 6995, 7000 or 7005 in that input register. These values relate to 699.5, 700.0 and 700.5 degrees F respectively (depending on the accuracy of the input source).

Type R, S, B and C thermocouples work similarly, but to zero decimal places.

EXAMPLE: A Type R thermocouple sensing 1600 degrees F will produce a register value of 1596, 1600 or 1604 (depending on the accuracy of the input source).

4.3.2 Thermocouple Status (Registers 9 & 10)

Registers 9 and 10 are used to monitor the status of any thermocouples connected to the RIM126. The bits in these registers can be monitored using the contact symbol to annunciate alarm conditions in a programmable controller system.

NOTE: *All thermocouple inputs are given to the SY/MAX processor in engineering units only (i.e., degrees C or F). If one or more of these inputs is intended as an input to a PID loop, the value should be scaled to 0-100% (0 to 9999).*

REGISTER 9

Bits 1 through 8 of register 9 turn ON for input channels 1 through 8 respectively when an OPEN thermocouple channel is detected. These bits are OFF during normal thermocouple operation.

Bits 9 through 16 of register 9 are not currently used by the RIM126.

REGISTER 10

Bits 1 through 8 of register 10 turn ON for input channels 1 through 8 respectively when an UNDER-RANGE thermocouple condition is detected. An under-range condition is created when the signal level from the thermocouple drops below the range specified for that input channel. The thermocouple reading is locked at the under-range value when this occurs. The under-range bit also turns ON when an open input is detected. When an in-range value is present the module responds normally, and the under-range bit is turned OFF.

Bits 9 through 16 of register 10 turn ON for input channels 1 through 8 respectively when an OVER-RANGE thermocouple condition is detected. An over-range condition is created when the signal level from the thermocouple rises above the range set for that channel. The thermocouple reading is locked at the over-range value when this occurs. When an in-range value is present the module responds normally, and the over-range bit is turned OFF.

4.3.3 DIP Switch Status (Registers 11 & 12)

Registers 11 and 12 are used within the RIM126 to monitor the status of DIP switches SW9, SW10 and SW11. These registers are READ ONLY: a "1" indicates that position is ON, a "0" indicates that position is OFF. This data can be used in the control program to sound an alarm or prevent the programmable controller system from operating should an incorrectly configured RIM126 be inserted into the rack.

REGISTER 11 monitors SW9 and SW10

Bits 1 through 8 of register 11 represent positions 1-8 on SW9. See Section 3.3.2 for a definition of SW9.

Bits 9 through 16 of register 11 represent positions 1-8 on SW10. See Section 3.3.3 for a definition of SW10.

REGISTER 12 monitors SW11.

Bit 1 of register 12 represents position 1 of SW11. See Section 3.3.6 for a description of this position.

Bit 2 of register 12 represents position 2 of SW11. See Section 3.3.7 for a description of this position. The remainder of register 12 is not used.

4.4 Sample Scaling Programs

Incoming analog signals can be scaled to reflect the actual voltage or current values being received. The following table (Figure 4.3) indicates the resolution of the various signal ranges, and demonstrates mathematically how the register values can be scaled or converted to their actual input values.

Input Range	Programming Rung Unused	Result (Read Register 100 in:)	Resolu-tion (per bit)
±50mVDC	LET S100 = S109-5000	x10μV	50μV
0-20mA	LET S100 = S109 X 2	μA	10μA
4-20mA	LET S100 = S109 / 5 X 8 + 4000	μA	8μA
0-5VDC	LET S100 = S109 / 2	mV	2.5mV
1-5VDC	LET S100 = S109 / 5 X 2 + 1000	mV	2mV
0-10VDC	LET S100 = S109	mV	5mV
±5VDC	LET S100 = S109-5000	mV	5mV
±10VDC	LET S100 = S109 X 2 -10,000	mV	10mV

Figure 4.3 - Input Scaling Rungs

The same technique is used to convert a register value to engineering units such as PSI or temperature.

The following conditions apply for the examples in Figure 4.3:

- Register S109 contains the signal being received by the analog input channel. Note that a value of 0 or 9999 in register S109 could be flagged as a limit or out-of-range condition.
- Register S100 contains a mathematical result which has been scaled to reflect the actual voltage or current being input. These registers are used strictly for this purpose.
- Register S101 is any unused storage register.

When converting data the user must be aware of the computational limits of the various SY/MAX processors. For example, the Models 300 and 500 processors are restricted to integer math, whereas the Models 400, 450, 600, 650 and 700 processors can do floating point calculations. Furthermore, the intermediate or final results of a Model 300 calculation cannot exceed ±32,767, while in the Model 500 the *intermediate* result may be ±2,147,483,647 but the *final* result must be within ±32,767.

When performing scaling on a register value, it is wise to observe the most stringent limitation of the processor: *No intermediate or final result should exceed ±32,767.* The following example demonstrates this guideline.

EXAMPLE: A 4 to 20 mA input is being monitored, and is producing a register value of 5000. All variables to solve the transfer equation are provided:

$$\textbf{INPUT SIGNAL} = \frac{5.000 \times 16}{10{,}000} + 4 = 12\text{mA}$$

Since the relatively large units (mA) being used will cost a great deal of precision, it is better to use microamps instead of milliamps. The equation now becomes:

$$\textbf{INPUT SIGNAL} = \frac{5.000 \times 16.000}{10{,}000} + 4 = 12{,}000\mu\text{A}$$

Assuming the value of 5,000 is in register 9 and that register 101 is an unused storage register, the proper ladder rung to solve the transfer equation is:

LET S0101 = S0009 / 0005 x 0008 + 4000

which would result in S101 = 12,000 in the example. Note how the wise placement of the mathematical operators prevents the generation of an incorrect result. If the operation was first multiplied by 8, followed by the division by 5, an intermediate result greater than 32,767 would be generated and the calculation would fail in a Model 300.

NOTE: *All SY/MAX processors execute math operations strictly left-to-right.*

4.5 Program Editing

Ladder rung statements containing analog input registers may be edited as would any other statement containing storage registers.

5.0 APPLICATION CONSIDERATIONS

5.1 Insertion and Removal Considerations

⚠ CAUTION

EQUIPMENT DAMAGE

Do not insert or remove the RIM126 while the rack is powered up, or while wires carrying input signals are connected to the module. See Section 3.5 for general start-up procedures.

Failure to observe this precaution can result *in equipment damage.*

- NEVER INSERT OR REMOVE THE RIM126 MODULE WHILE IT IS POWERED UP. Doing so can generate bus errors in the system, causing the processor that is connected to the RIM126 to go to HALT (due to an I/O ERROR condition).

  If this type of error is generated in the processor, and the processor keyswitch is in the RUN position, clear the error by toggling the processor keyswitch to HALT and then back to RUN.
- Prior to installing the RIM126, do not remove the factory installed keying pins from the slots in the rack assembly. These keying pins act as guides to ensure that the card edge connector on the module mates properly with the rack's slot connector.

5.2 Wiring Considerations

- Confirm that the RIM126 and all signal-generating devices are powered down before connecting any signal carrying wiring to the input channels. Differences in ground potentials between the analog and digital portions of the RIM126 may cause problems if this is not done.
- The cabling between high-level input devices and the RIM126 should consist only of shielded twisted-pair wire such as Belden 8760. The shield in this wire protects the center conductors from noise, while the twisting of the conductors helps to ensure that any noise that does penetrate the shield will influence both conductors equally. In this way, the differential signal level between the two conductors is maintained, and the signal is preserved due to the common-mode rejection that is designed into the RIM126. The cabling between thermocouples and the RIM126 must consist of shielded thermocouple extension wire.
- Make sure that the conventions and instructions supplied by the manufacturer of the input devices are followed carefully. Polarity and wiring may differ from manufacturer to manufacturer.
- The RIM126 should be treated as any load which is part of a signal loop. Note that 2-wire and 4-wire transmitter wiring polarities will typically differ. Refer to Figures 3.7 and 3.8.
- The shield portion of the input cable must be connected *only to the RIM126 module's "C" terminal.* At the transmitting device's end (near the thermocouple, for example), the shield should be peeled back and insulated to prevent contact with other signal carrying wires. *Do not attach the shield to the transmitting device.*

  This practice of singly grounding the shield is especially applicable when a cable has been spliced or nicked. The shield must be insulated along its entire length, and never be allowed to come in contact with any other surface.
- The unshielded portions of the wire run (such as at the transmitting device and at the RIM126) should be kept as short as possible.
- Wires carrying analog signals must be routed as far as possible from potential sources of noise such as motors, transformers, contactors, etc. Be especially suspicious of any AC devices. As a rule of thumb, *allow six inches (15.2 cm) minimum separation for* every 120 volts. Analog signal wires must never share the same conduit with AC wiring. On occasions where analog signal cabling must pass close to AC wiring, make sure it does so at right angles.
- Transmitting devices must never share the same signal return wire.
- The 0-20 and 4-20mA current range settings will have better noise immunity than the voltage range settings.
- When operating on a high level voltage range, the allowable length of wire between the transmitting device and the RIM126 is limited by capacitance build-up to approximately 50 feet.
- When operating on a *current* range, cable length is limited by the drive capability of the transmitter (typically 600-1000 ohms) and the total loop resistance.

Consult the bibliography at the end of this instruction bulletin for additional sources of information regarding wiring of analog signals.

5.3 Miscellaneous Considerations

- *REGISTER ASSIGNMENT.* When using the RIM126, eight to twelve registers can be assigned to the slot in *which it is installed.*

NOTE: *The RIM126 actually has 16 onboard registers. Registers 13 to 16 are used for manufacturer's testing and are NOT available to the user. If it is necessary to assign more than 12 registers to the RIM126's slot (to allow for future expansion, etc.) keep in mind that registers 13 through 16 CANNOT be used for data storage or other functions.*

- *PROCESSOR/REGISTER COMPATIBILITY.* When the RIM126 resides in the same rack assembly as a SY/MAX Model 500 or 700 processor, *either* 8 *or* 12 registers *must* be assigned to the module. Refer to the instruction bulletin for the Model 500 (30598-105) or Model 700 (30598-107) for details.
- *UNUSED INPUTS.* Due to the nature of CMOS multiplexing circuitry, non-zero values may appear across the positive and "C" terminals of the RIM126 when using its voltage, even with no wires connected to the terminals. This is caused by the RIM126's high input impedance, and is normal. This condition can be eliminated by selecting the current loop resistors for unused channels (position 4 of SW1 through SW8 = ON for 1 through 8, respectively).
- *DIP SWITCHES. NEVER ALTER THE DIP SWITCH SETTINGS FOR "RANGE" WHILE THE RIM126 IS POWERED UP.* These switches control the gain of various front-end stages, and improper settings made with power applied will cause permanent damage to the RIM126.
- *ISOLATION.* Since the RIM126 "C" (common) inputs are individually isolated, analog input signals with different ground references and grounded or ungrounded thermocouples can be attached to the same module without producing erroneous readings.
- *RESOLUTION.* Analog accuracy is inherently temperature sensitive; the specified *overall* accuracy of ±0.15% of full-scale will improve to ±0.1% at room temperature.

5.4 Update Times

- The UPDATE TIME is the time required for a change in the analog input signal to be made available to the SY/MAX bus master.
- If the RIM126 is used in the same rack assembly as the SY/MAX processor, the processor is the bus master. If the RIM126 is configured in the remote rack of a remote interface (RI) or remote transfer interface (RTI) system, then the RI module or RTI module is the master. Refer to instruction bulletin 30598-247 (remote interface system) or 30598-251 (remote transfer interface system) for more details on how these modules effect system response time.
- In Series B1 (or later) modules, the setting of DIP switch 11, position 2 (FAST or HIGH ACCURACY mode), has an effect on the update time.

The following is a summary of update time for the Series B1, Revision 2.00 RIM126 module. Update times when using (1) *All standard analog ranges,* (2) *All thermocouple ranges,* and (3) *A mixture of standard and thermocouple ranges* are examined.

1. ***ALL STANDARD ANALOG RANGES:*** With the *FAST* update mode selected, and only standard analog ranges in use, the average update time of the RIM126 is 12 milliseconds. This figure applies no matter how many channels are activated. If the *ALTERNATE SCAN* mode is used, Channel 1 is updated every 7 milliseconds while Channels 2 through 8 are updated every 16 milliseconds. If the *HIGH ACCURACY* (slower scan) mode is used, all the above times will aproximately double.

2. ***ALL THERMOCOUPLE RANGES:*** With the FAST update mode selected and a *single* thermocouple channel active (other channels set to "not used"), the average update time for that channel is 130 milliseconds. Each additional thermocouple channel that is activated will add five milliseconds to the update time. With all eight channels reading thermocouple signals, each channel is updated approximately every 165 milliseconds. If the *HIGH ACCURACY* mode is selected, the update time will increase by less than 10%.

If a *single* ±50 millivolt channel is selected with other channels unused, the update time for that single channel will be about 45 milliseconds. Add three milliseconds for each additional ±50 millivolt channel activated.

3. ***A MIXTURE OF STANDARD ANALOG AND THERMOCOUPLE RANGES:*** If two "function groups," one standard analog and one thermocouple, are defined, update times are as shown in the chart below. The times shown are with the FAST update mode selected.

Number of Channels Set to:		Update Time for:	
Analog	Thermo-couple	Analog Channels	Thermo-couple Channels
8	0	12 ms	---
7	1	24 ms	155 ms
6	2	26 ms	170 ms
5	3	28 ms	185 ms
4	4	30 ms	200 ms
3	5	32 ms	215 ms
2	6	34 ms	230 ms
1	7	36 ms	245 ms
0	8	---	260 ms

6.0 TROUBLESHOOTING

6.1 Diagnostic Light

Although the green RUN LED indicates that the RIM126 microprocessor is functioning properly, other problems not directly related to the microprocessor may be occurring. Section 3.5.2 lists some of the situations in which the RUN LED may be ON, but the analog signals are not being properly converted. In other words, an illuminated RUN light does not always indicate proper RIM126 operation; a RUN LED that is OFF, however (with power applied to the rack), indicates a definite problem.

Failures experienced by the RIM126 module are classified as *fatal* or *non-fatal*.

Fatal errors are indicated by the RUN LED remaining OFF. Recovery (when possible) can only be accomplished by cycling power to the rack in which the module is inserted.

During a *non-fatal* error, the RIM126 RUN LED is illuminated but the processor (or drop) may refuse to go into RUN. Simple toggling of the processor keyswitch to HALT and back to RUN may be sufficient to clear the error.

Distinctions between fatal and non-fatal errors are handled in this fashion because under certain "cold start" conditions, the RIM126 circuitry may require a brief warm-up period. Such a condition is not a true module error, but rather a normal physical limitation which clears itself after a brief period of time. In these cases, toggling the processor keyswitch is sufficient to allow the system to recover.

If the RUN LED fails to come on at all, the module is not receiving DC power; check to see that the rack is connected to a properly sized SY/MAX power supply which itself is producing power.

If the RUN LED flashes briefly upon the application of power and then remains OFF, the RIM126 module has failed to complete its power-up sequence and is experiencing a fatal error. Once again, *this does not necessarily indicate a defective RIM126 module.* The DC power from the rack may be inadequate to sustain operation. This brief flash will also occur if there is no processor or remote interface module located in the same rack, since the RIM126's microprocessor can sense that there is no device present with which to communicate.

If the RUN LED refuses to illuminate, try installing the module in a configuration in which these possibilities can be ruled out. See Section 3.5.1 for three examples of simple system layouts.

If the module is proven to be defective, register status bits will identify the reason. See Section 6.2.

> ⚠ **CAUTION**
>
> **EQUIPMENT DAMAGE HAZARD**
>
> **The RIM126 module must never be inserted or removed from the rack while under power. This principle must be observed when performing any troubleshooting.**
>
> Failure to observe this precaution can result in equipment damage.

6.2 Using Programming Equipment

If the RUN LED is ON, the next step is to check the controlling processor to verify that communication has been established. This is best done by using a programming device's DATA mode to examine the registers that are assigned to the analog input channels.

Status bits 25 through 32 of the respective registers reveal a great deal of information. Section 4.1.1 contains a table that describes these status bits and their meaning.

If *none* of the bit patterns in Section 4.1.1 appear, suspect a rack addressing problem. See instruction bulletin 50598-165 or 30598-167.

The bit patterns in Section 4.1.1 may be interpreted as follows:

Normal Operation - All digital circuitry is functioning reliably. Applying an analog signal (within the intended operating range) should cause changes in the assigned storage register to reflect the changing input. If this does not occur, suspect either the signal generating device or the analog portion of the RIM126 module.

NOTE: If is possible for the multiplexer or the analog-to-digital converter chip to malfunction and still give the indication of normal operation via the RUN LED.

EPROM Failure - The RIM126 is defective and must be replaced.

DC-DC Failure - The DC power being supplied to the digital circuitry of the RIM126 is insufficient for reliable operation. If the SY/MAX power supply powering the rack is functioning properly, the fault lies with the DC-to-DC converter inside the RIM126 module. The module must be replaced if its DC-to-DC converter is defective.

Watchdog Failure - A failure of the RIM126's microprocessor to prevent the watchdog circuit from timing out. If this condition occurs, power down the rack in which the module resides and the reapply power. If the module comes up in the Normal Operation mode, the condition which caused the fault has been eliminated. If, however, the same error code is produced, the RIM126 is defective and must be replaced.

No Card Acknowledged In Slot - The processor is not aware of the RIM126's presence. Try reinserting the module to make sure that it is seated properly. If this doesn't work, check the rack slot addressing for proper allocation of registers and slots.

Slot Not Addressed - The overall programmable controller system is not properly configured.

6.3 Erratic Operation

One cause of erratic operation is improper grounding and routing of signal wires.

Ensure that the programmable controller system is grounded per the instructions in the "Planning and Installation Guide" instruction bulletin (30598-175).

Also, confirm that the shield of each analog signal wire is connected to the "C" terminal of the RIM126 and that the other end (transmitting device's end) is not grounded. See Section 5.2 for other wiring considerations.

If the defective element in the system can still not be tracked down, try one or more of the sample hardware configurations shown in Section 3.5.1. Because of their simplicity, these example layouts can help narrow down the source of the problem.

7.0 THEORY OF OPERATION

This section describes the various RIM126 subsystems. Refer to the block diagram on page 7-2 (Figure 7.1) while reading this section.

The operation of the module is governed by a Type uD70116C-8 (80C86) microprocessor running at 8MHz. It controls such tasks as power-up and diagnostic checks, monitoring of DIP switch selections, software signal averaging (when selected), and communications to the SY/MAX processor. Also controlled by the microprocessor are the multiplexer, gain/offset stage selections, the Automatic Calibration System (ACS) and the Analog-to-Digital Converter (ADC).

The RIM126 module has its own DC/DC power supply which converts the 5VDC from the SY/MAX power supply to the ±15VDC required by some of the RIM126's analog circuitry. A -5VDC output furnishes power required by the digital circuitry, and balance of the analog circuitry, of the RIM126.

The RIM126 employs a Type AD7506 sixteen channel, single-ended CMOS multiplexer (MUX) to switch, in turn, each of the eight input channels into the ADC. This MUX also switches the on-board precision voltage reference, ground, and two cold junction temperature sensors that provide reference signals to the ADC.

The analog MUX selects an input channel to feed to the ADC system. The ADC used in the RIM126 is a 14-bit high-speed A/D converter. The 14-bit resolution (1 part in 16,384) of this ADC is mathematically "compressed," for reasons of accuracy, to 5 parts in 10,000 for use in the RIM126.

The analog circuitry of the module is designed to float at the potential of the analog input common. Isolation of power and signal is achieved through the use of isolation amplifiers.

The ACS, under the control of the isolated microprocessor, eliminates the need for externally calibrated input signals. Adjustments to eliminate initial errors in system offset and gain are performed internally. The ACS uses protected CMOS switches to apply both a precision voltage (5.000V) and analog ground (0.0000V) signal to the ADC. These signals are fed through each gain and offset stage currently in use by the RIM126 to provide a base line. When subsequent conversions are performed on field-produced analog input signals, the conversion circuitry errors are eliminated using a Y=mX+b software algorithm, providing corrected digital information to the user. Accurate ACS operation is dependent on the following points:

1. The initial accuracy of the 5V reference must be high; the RIM126 accuracy is 5.0000V ±0.0002V (less than 1/4 of 1 bit worst case).

2. The temperature drift of the reference must be low; the RIM126 drift is 0.3 to 0.5ppm/deg. C typical.

A diagram depicting all these subsystems appears in Figure 7.1.

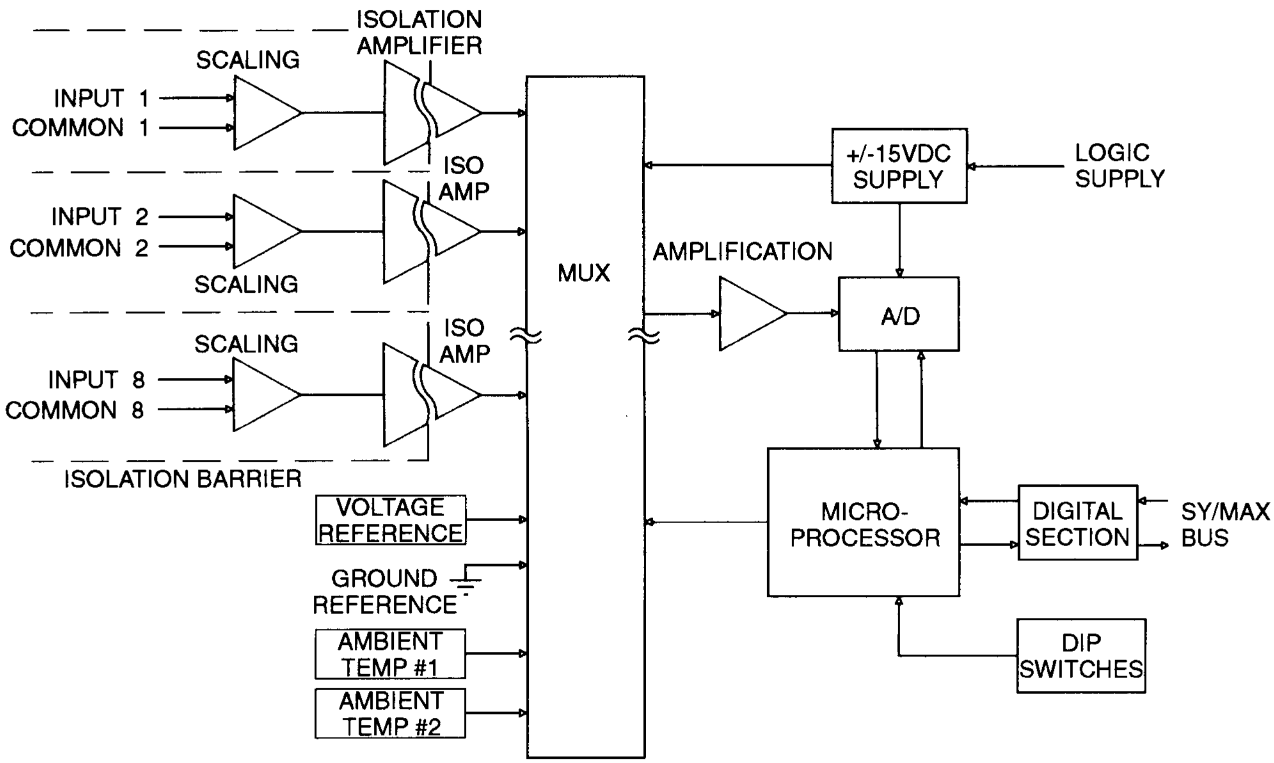

Figure 7.1 - Block Diagram

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