Resolver Input Module

M/N 57C411

Instruction Manual J-3640-1

RELIANCE ELECTRIC

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WARNING

THIS UNIT AND ITS ASSOCIATED EQUIPMENT MUST BE INSTALLED, ADJUSTED, AND MAINTAINED BY QUALIFIED PERSONNEL WHO ARE FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF ALL EQUIPMENT IN THE SYSTEM AND THE POTENTIAL HAZARDS INVOLVED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY

WARNING

INSERTING OR REMOVING THIS MODULE OR ITS CONNECTING CABLES MAY RESULT IN UNEXPECTED MACHINE MOVEMENT. TURN OFF POWER TO THE MACHINE BEFORE INSERTING OR REMOVING THE MODULE OR ITS CONNECTING CABLES. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

CAUTION

THIS MODULE CONTAINS STATIC-SENSITIVE COMPONENTS. CARELESS HANDLING CAN CAUSE SEVERE DAMAGE.

DO NOT TOUCH THE CONNECTORS ON THE BACK OF THE MODULE. WHEN NOT IN USE, THE MODULE SHOULD BE STORED IN AN ANTI-STATIC BAG. THE PLASTIC COVER SHOULD NOT BE REMOVED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.

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1.0 INTRODUCTION

The Resolver Input Module is used to input the angular position of a resolver rotor to the DCS 5000 system. The module provides 12-bit resolution of one revolution and a 2-bit revolution counter. The resolver position may be sampled from 500 microseconds to 32.767 seconds. An external strobe input is provided to permit synchronization of the DCS 5000 system to an external event. The module can be programmed to interrupt on every sample.

Typically, this module is used to input rotary shaft position for the purpose of determining shaft position or velocity.

This manual describes the functions and specifications of the module. It also includes a detailed overview of installation and servicing procedures, as well as examples of programming methods.

Related publications that may be of interest:

- J-2611 DCS 5000 PRODUCT SUMMARY
- J-3600 DCS 5000 ENHANCED BASIC LANGUAGE INSTRUCTION MANUAL
- J-3601 DCS 5000 CONTROL BLOCK LANGUAGE INSTRUCTION MANUAL
- J-3602 DCS 5000 LADDER LOGIC LANGUAGE INSTRUCTION MANUAL
- J-3629 DCS 5000 REMOTE I/O INSTRUCTION MANUAL
- J-3630 DCS 5000 PROGRAMMING TERMINAL INSTRUCTION MANUAL
- J-3635 DCS 5000 PROCESSOR MODULE INSTRUCTION MANUAL
- IEEE 518 GUIDE FOR THE INSTALLATION OF ELECTRICAL EQUIPMENT TO MINIMIZE ELECTRICAL NOISE INPUTS TO CONTROLLERS FROM EXTERNAL SOURCES

2.0 Mechanical/Electrical Description

The following is a description of the faceplate LEDs, field termination connectors, and electrical characteristics of the field connections.

2.1 Mechanical Description

The input module is a printed circuit board assembly that plugs into the backplane of the DCS 5000 rack. It consists of the printed circuit board, a faceplate, and a protective enclosure. The faceplate contains tabs at the top and bottom to simplify removing the module from the rack. Module dimensions are listed in Appendix A.

The faceplate of the module contains a female connector socket and 5 LED indicators for module status, including one light that indicates when the board is operational (on) or malfunctioning (off).

Input signals are brought into the module via a multiconductor cable (M/N 57C373; see Appendix D). One end of this cable attaches to the faceplate connector, while the other end of the cable has stake-on connectors that attach to a terminal board for easy field wiring. The faceplate connector socket and cable plug are keyed to prevent the cable from being plugged into the wrong module.

On the back of the module are two edge connectors that attach to the system backplane.

2.2 Electrical Description

The input module contains a tracking resolver-to-digital converter that produces a 12-bit digital number proportional to one electrical revolution of a resolver. The digital position may be sampled in one of two ways. The most common method is to specify the sampling period. The period may range from a low of 500 microseconds to a high of 32.7675 seconds, in increments of 500 microseconds.

The second method is to sample the position when an external event occurs. This method is useful when it is necessary to synchronize the DCS 5000 with the occurrence of a particular event. Using an external strobe input is a simple method of synchronizing your application software to the exact position of an object when an external event occurs. See figure 2.1 for details about the electrical characteristics of the external strobe input circuit. Because of the high input impedance of the strobe input, the device driving the input must have low leakage. See figure 2.2.

The module can be programmed to generate an interrupt whenever it does a periodic sample. This mode allows you to synchronize task execution with the conversion of new data. The converted data will be latched when the interrupt is generated.

The module contains a 2-bit electronic counter that can count a total of 4 electrical resolver revolutions. This 2-bit counter is contained in the most significant two bits of resolver position, registers 0 and 1. This counter is reset whenever power is turned on to the system or a board reset command occurs.

The module produces a 26 volt rms 2381 Hertz sine wave reference output signal which is capable of driving a 400 ohm load. This reference signal is transformer-isolated and short-circuit protected through a current limiter. The module also receives 11.8 volt rms sine and cosine signals from the resolver, as well as the 26 volt rms reference.

There are 5 LEDs on the faceplate of the module. The top LED, labeled DIRECTION, indicates the direction of rotation of the resolver. When it is on, the resolver is rotating clockwise. The next LED, labeled FDBK OK, indicates that the resolver is connected to the module. The next LED, labeled CCLK OK, indicates that the common clock is on. The fourth LED, labeled IPS OK, indicates that the isolated power supply is working. Finally, the bottom LED, labeled OK, indicates whether the common clock is on and the isolated power supply is functional. See figure 2.3.

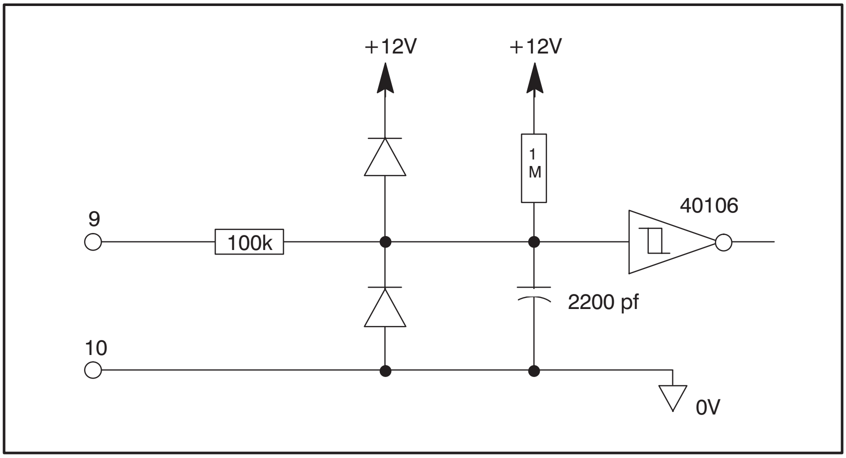

Figure 2.1 - External Strobe Input Circuit

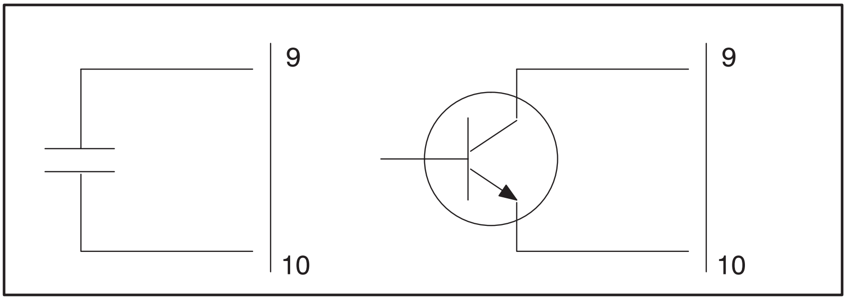

Figure 2.2 - Low Leakage Requirement for Devices Driving Strobe Input

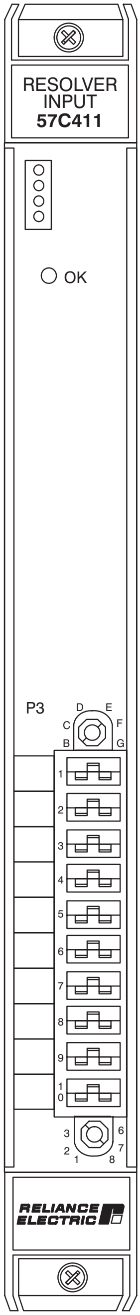

Figure 2.3 - Module Faceplate

3.0 INSTALLATION

3.1 Wiring

The installation of wiring should conform to all applicable codes.

To reduce the possibility of electrical noise interfering with the proper operation of the control system, exercise care when installing the wiring from the system to the external devices. For detailed recommendations, refer to IEEE 518.

You should use twisted pair (2 twists per inch) wiring to/from the resolver.

3.2 Initial Installation

Use the following procedure to install the module:

WARNING
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Step 1. Remove power from the system. Power to the rack as well as all power to the wiring leading to the module should be off.

Step 2. Take the module out of its shipping container. Take the module out of the anti-static bag. Be careful not to touch the connectors on the back of the module.

Step 3. Insert the module into the desired slot in the rack. Refer to figure 3.1. Use a screwdriver to secure the module into the slot.

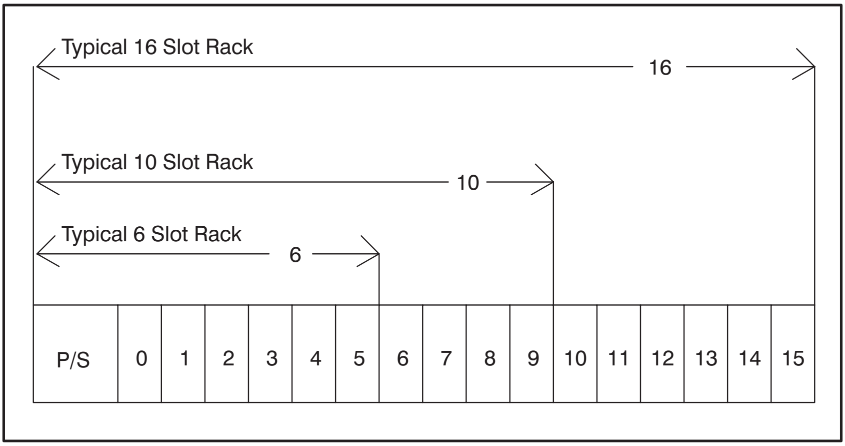


Figure 3.1 - Rack Slot Numbers

Step 4. Mount the terminal strip (from cable assembly M/N 57C373) on a panel. The terminal strip should be mounted to allow easy access to the screw terminals. Be sure that the terminal strip is close enough to the rack so that the cable will reach between the terminal strip and the module. The cable assembly is approximately 60 inches long.

Step 5. Attach the resolver but leave the mechanical coupling between the resolver and the motor unconnected.

Fasten the field wires from the resolver to the terminal strip. Typical field connections are shown in figures 3.2 and 3.3.

Use twisted-pair wire, connected as shown, for the cabling between the resolver and the terminal strip in the control enclosure. Recommended twisted-pair wire is Belden™ 9497 cable or equivalent. Maximum operating cable length is dependent upon the type of cable you use.

Make certain that all field wires are securely fastened.

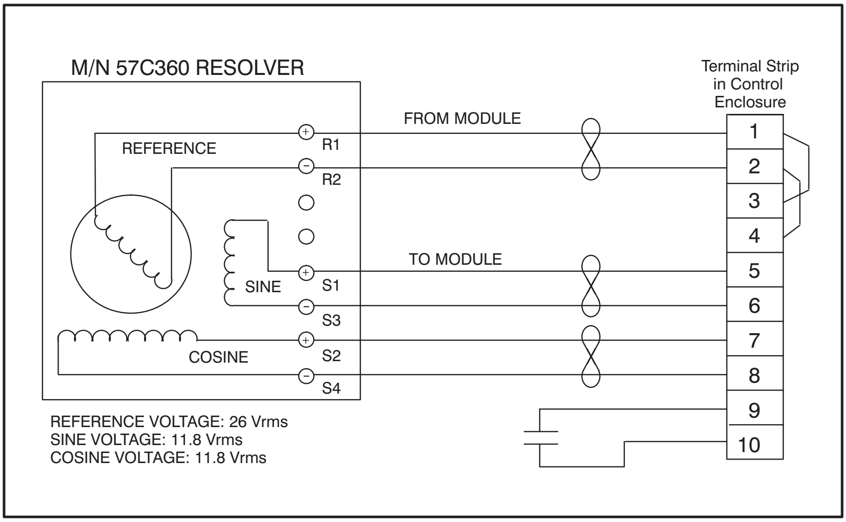


Figure 3.2 - Typical M/N 57C360 Resolver Field Connections

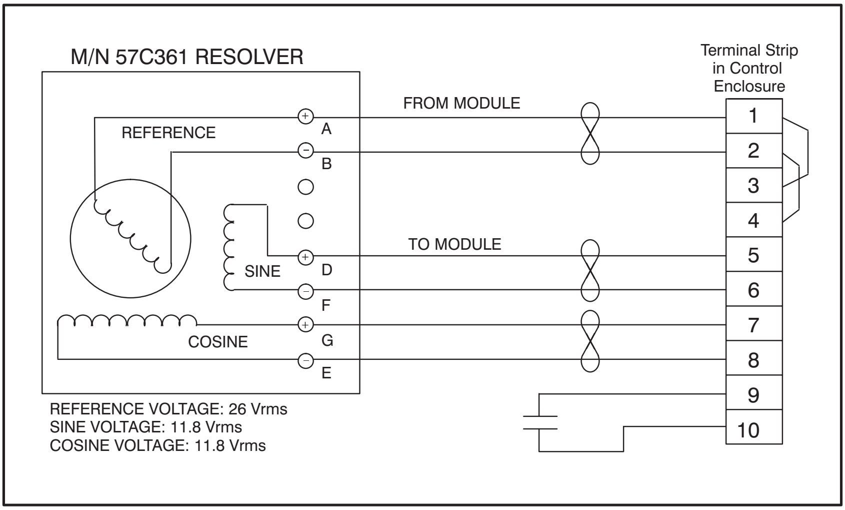


Figure 3.3 - Typical M/N 57C361 Resolver Field Connections

Step 6. Insert the cable assembly's (M/N 57C373) field terminal connector into the mating half on the module. Use a screwdriver to secure the connector to the module.

Note that both the module and the terminal strip connector are equipped with "keys". These keys should be used to prevent the wrong cable from being connected to the module in the event that the connector needs to be removed for any reason and then reattached later.

At the time of installation, rotate the keys on the module and the connector so that they can be connected together securely. It is recommended that, for modules so equipped, the keys on each succeeding module in the rack be rotated one posistion to the right of the keys on the preceeding module.

If you use this method, the keys on a particular connector will be positioned in such a way as to fit together only with a specific module, and there will be little chance of the wrong connector being attached to a module.

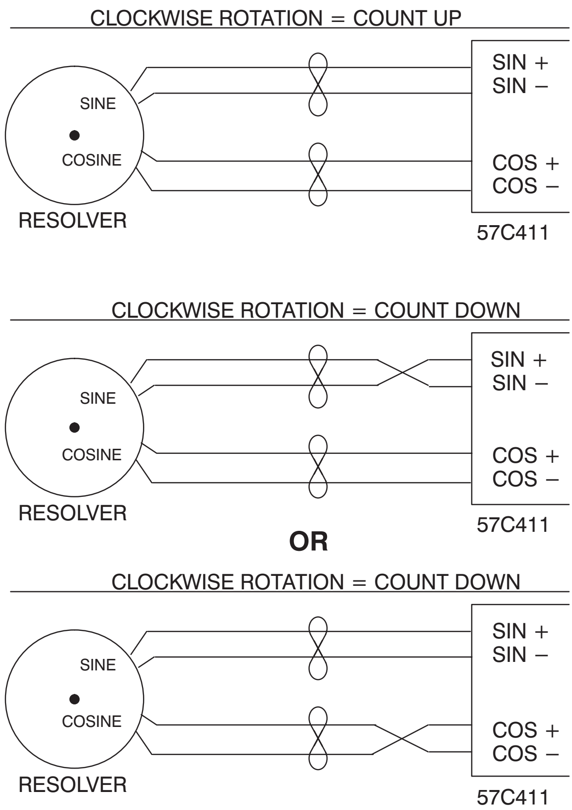
Step 7. Check the wiring and be sure all connections are tight.

Step 8. With the resolver mechanically disconnected from the motor, turn on power to the rack. Use an oscilloscope to test the sine and the cosine signals from the resolver. These signals, measured at the terminal strip, should be a sine wave of approximately 33.4 Vp-p (11.8 Vrms +/− 10%).

Step 9. Verify the installation by using the Programming Executive Software. Refer to the AutoMax Programming Executive Manual (J-3630 or J-3684) for more information.

Use the I/O MONITOR function for local I/O or remote I/O, depending upon where the module is located. Set register 4 to a value of 1. Read register 2 and verify that bit 10 is set. If it is not, set register 3 to a value of 64.

Monitor register 0. Verify that it contains numbers proportional to the shaft position of the resolver and that the numbers increase as the resolver is rotated clockwise. The direction of rotation can be reversed by switching the polarity of either the sine or the cosine wires. See figure 3.4.



NOTE 1: All wires should be twisted pairs.

NOTE 2: Reversing the polarity of the wires as shown will also change the perceived shift angle by 180 electrical degrees.

Figure 3.4 - Changing the Direction of Rotation

Step 10. If the external strobe input is being used, the shaft should be rotated to a fixed position and stopped. The external strobe input should now be closed. Verify that register 1 contains the same data as register 0.

Step 11. Turn off power to the rack. Connect the mechanical coupling between the resolver and the motor. Turn on power to the system.

3.3 Module Replacement

> **WARNING**
>
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Use the following procedure to replace a module:

Step 1. Turn off power to the rack and all connections.

Step 2. Use a screwdriver to loosen the screws holding the connector to the module. Remove the connector from the module.

Step 3. Loosen the screws that hold the module in the rack. Remove the module from the slot in the rack.

Step 4. Place the module in the anti-static bag, being careful not to touch the connectors on the back of the module. Place the module in the cardboard shipping container.

Step 5. Take the new module out of the anti-static bag it came in, being careful not to touch the connectors on the back of the module.

Step 6. Insert the module into the desired slot in the rack. Use a screwdriver to secure the module into the slot.

Step 7. Attach the field terminal connector (M/N 57C373) to the mating half on the module. Make certain that the connector is the proper one for this module (see step 6 in 3.2 Initial Installation). Use a screwdriver to secure the connector to the module.

Step 8. Turn on power to the rack.

4.0 PROGRAMMING

This section describes how the data is organized in the module and provides examples of how the module is accessed by the application software. For more detailed information refer to the DCS 5000 Enhanced BASIC Language Instruction Manual (J-3600).

4.1 Register Organization

The input module contains a total of five 16-bit registers. Registers 0 and 1 contain resolver position data. The resolver-to-digital converter provides 12 bits of resolution. Register 0 is updated with new position information at the rate specified in register 4. Register 1 is updated whenever the EXTERNAL STROBE goes from false to true. These registers are read only. Refer to figure 4.1.

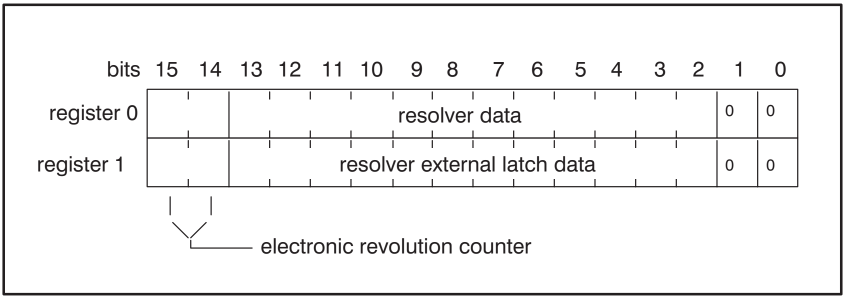


Figure 4.1 - Resolver Data Registers

Registers 2 and 3 are the interrupt status and control registers. Both registers contain the same information. Register 2 is read only. Register 3 is read/write. If the module is located in a remote rack, you must read the status from register 2. With the exception of bit 6 and bit 12, this register is controlled by the operating system and must not be manipulated by the user. Refer to figure 4.2.

For this module to operate properly, the common clock signal must be present on the backplane. The common clock signal is a 4 mhz clock that can be connected to all the I/O modules in the rack. It can be generated from a number of DCS 5000 I/O modules. If this module is to drive the common clock, bit 6 must be set.

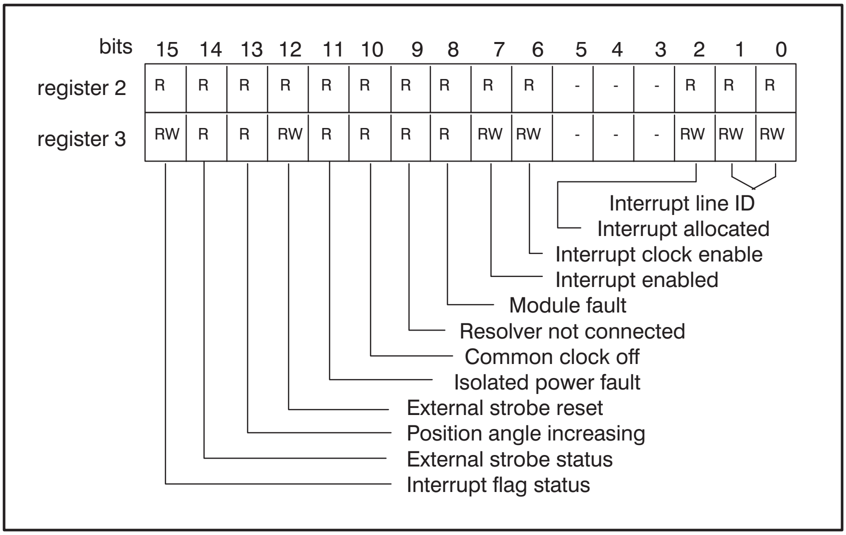


Figure 4.2 - Interrupt Control Registers

Register 4 contains the update period for reading the resolver position. Each count in this register is equivalent to 500 microseconds. The update period may range from 500 microseconds to 32.7675 seconds. Refer to figure 4.3.

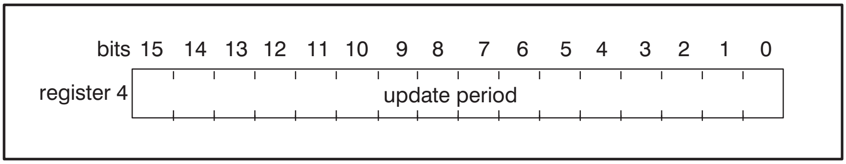


Figure 4.3 - Resolver Update Register

4.2 Local I/O Definition

Before any application program can be written, it is necessary to configure, or set, the definitions of system-wide variables, i.e. those that must be globally accessible to all tasks. This section describes how to configure the input module when it is located in the same rack as the processor module that is referencing it. Refer to figure 4.4.

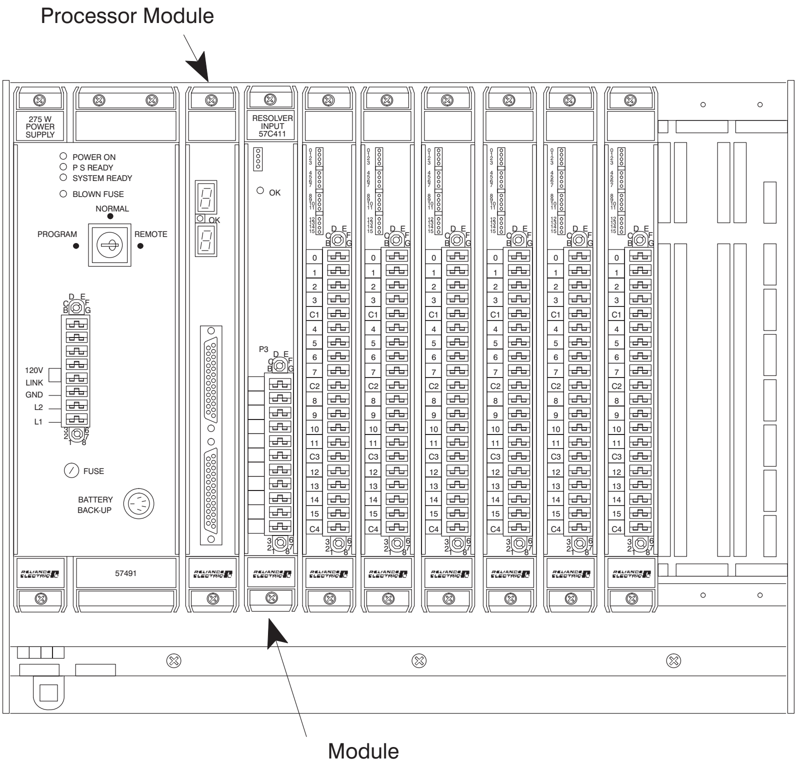


Figure 4.4 - Module in a Local Rack

4.2.1 Single Register Reference

Use this method to reference a 16-bit register as a single input. Resolver input data, update period, and interrupt control registers are typically referenced using this method. The symbolic name of each register should be as meaningful as possible:

nnnnn IODEF SYMBOLIC_NAME%[SLOT=s, REGISTER=r]

4.2.2 Bit Reference

Use this method to reference individual inputs on the module. Common clock status and control bits are typically referenced using this method. The symbolic name of each bit should be as meaningful as possible:

nnnnn IODEF SYMBOLIC_NAME@[SLOT=s, REGISTER=r, BIT=b]

where:

nnnnn - BASIC statement number. This number may range from 1-32767.

SYMBOLIC_NAME% - A symbolic name chosen by the user and ending with (%). This indicates an integer data type and all references will access register “r”.

SYMBOLIC_NAME@ - A symbolic name chosen by the user and ending with (@). This indicates a boolean data type and all references will access bit number “b” in register “r”.

SLOT - Slot number that the module is plugged into. This number may range from 0-15.

REGISTER - Specifies the register that is being referenced. This number may range from 0-4.

BIT - Used with Boolean data types only. Specifies the bit in the register that is being referenced. This number may range from 0- 15.

4.2.3 Examples of Local I/O Definitions

The following statement assigns the symbolic name POSITION% to register 0 of the input module located in slot 4:

```
1020    IODEF POSITION%[ SLOT=4, REGISTER=0]
```

The following statement assigns the symbolic name CCLK_ON@ to bit 6 of register 3 on the input module located in slot 7:

```
2050    IODEF CCLK_ON@[ SLOT=7, REGISTER=3, BIT=6]
```

4.3 Remote I/O Definition

This section describes how to configure the module when it is located in a rack that is remote from the processor module referencing it. Refer to figure 4.5.

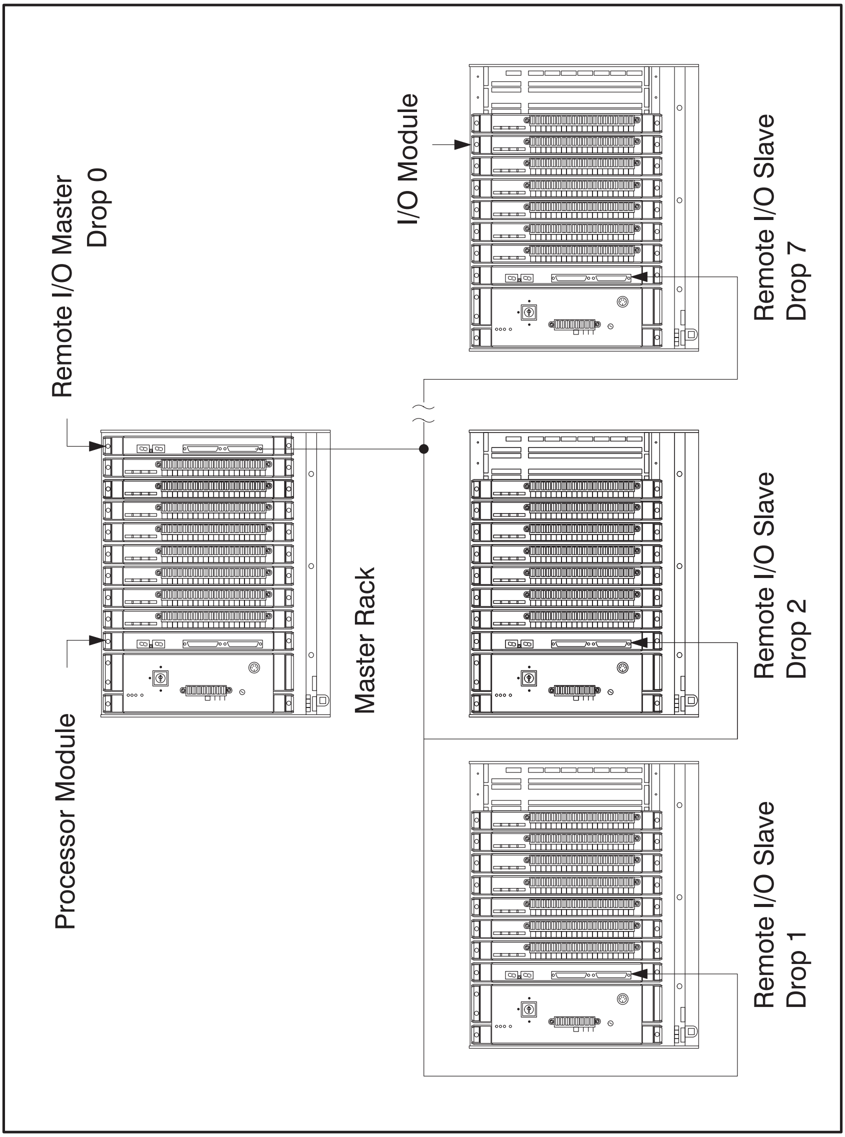


Figure 4.5 - Module in a Remote Rack

4.3.1 Single Register Reference

Use this method to reference a 16-bit register as a single input. Resolver input data and update period registers are typically referenced using this method. The symbolic name of each register should be as meaningful as possible:

```
nnnnn    RIODEF SYMBOLIC_NAME%[ MASTER_SLOT=m,
      DROP=d, SLOT=s, REGISTER=r]
```

4.3.2 Bit Reference

Use this method to reference individual inputs on the module. Common clock status and control bits are typically referenced using this method. The symbolic name of each bit should be as meaningful as possible:

```
nnnnn   RIODEF SYMBOLIC_NAME@[ MASTER_SLOT=m,
        DROP=d, SLOT=s, REGISTER=r, BIT=b]
```

where:

nnnnn - BASIC statement number. This number may range from 1-32767.

SYMBOLIC_NAME% - A symbolic name chosen by the user and ending with (%). This indicates an integer data type and all references will access register "r".

SYMBOLIC_NAME@ - A symbolic name chosen by the user and ending with (@). This indicates a boolean data type and all references will access bit number "b" in register "r".

MASTER_SLOT - Slot number that the master remote I/O module is plugged into. This number may range from 0-15.

DROP - Drop number of the slave remote I/O module that is in the same rack as the input module. This number may range from 1-7.

SLOT - Slot number that the module is plugged into. This number may range from 0-15.

REGISTER - Specifies the register that is being referenced. This number may range from 0-4.

BIT - Used with boolean data types only. Specifies the bit in the register that is being referenced. This number may range from 0-15.

4.3.3 Examples of Remote I/O Definitions

The following statement assigns the symbolic name SHAFT% to register 0 on the input module located in slot 4 of remote I/O drop 3. This remote drop is connected to the remote I/O system whose master is located in slot 15 in the master rack:

```
1020   RIODEF SHAFT%[ MASTER_SLOT=15, DROP=3,
       SLOT=4, REGISTER=0]
```

The following statement assigns the symbolic name CLCK_EN@ to bit 6 of register 3 on the input module located in slot 7 of remote I/O drop 2. This remote drop is connected to the remote I/O system whose master is located in slot 6 in the master rack:

```
2050   RIODEF CLCK_EN@[ MASTER_SLOT=6,
       DROP=2, SLOT=7, REGISTER=3, BIT=6]
```

4.4 Reading and Writing Data in Application Tasks

In order for an input module to be referenced by application software, it is first necessary to assign symbolic names to the physical hardware. This is accomplished with either IODEF or RIODEF statements in the configuration task.

Each application program, or task, that wishes to reference the symbolic names assigned to the input module may do so by declaring those names COMMON.

The frequency with which tasks read their inputs and write their outputs depends on the language being used. Control block tasks read inputs once at the beginning of each scan and write outputs once at the end of scan. BASIC tasks read an input and write an output for each reference throughout the scan.

The following is an example of a configuration task for the input module:

```
1000    !
1001    ! resolver input
1002    !
1005    IODEF RESOLVER_IN%[SLOT=4, REGISTER=0]
1006    IODEF RESOLVER_IN_EXT%[SLOT=4, REGISTER=1]
1010    !
1011    ! common clock enable
1012    !
1015    IODEF CCLK_EN@[SLOT=4, REGISTER=3, BIT=6]
1020    !
1021    ! A/D update period
1022    !
1025    IODEF UPDATE_TIME%[SLOT=4, REGISTER=4]
1050    !
1051    ! Place any additional configuration  statements here
1052    !
2000    END
```

4.4.1 BASIC Task Example

This example will read the resolver input once every second and store the value in the symbol “CURRENT_VALUE”. The resolver position will be sampled every 100 milliseconds.

```
1000    COMMON RESOLVER_IN%              \!Resolver data(periodic)
1010    COMMON CCLK_EN@                  \!common clock enable
1020    COMMON UPDATE_TIME%              \!Update period for resolver conversion
1400    !
1500    LOCAL CURRENT_VALUE%             \!Current value of analog input
1900    !
2000    UPDATE_TIME% = 200               \!0.1 second conversion
2010    CCLK_EN@ = TRUE                  \!turn on the clock
4000    !
4001    ! Place any additional initialization software here
4002    !
5000    START EVERY 1 SECONDS
5010    CURRENT_VALUE% = RESOLVER_IN%
10000   END
```

The symbolic names defined as “COMMON” reference the inputs defined in the sample configuration task above. The symbolic name CURRENT_VALUE% is local to the BASIC task and does not have I/O associated with it. Refer to the DCS 5000 Enhanced BASIC Language Instruction Manual (J-3600) for more information.

4.4.2 Control Block Task Example

The following example will read the resolver data every 55 milliseconds and store the inverted value in the symbol “READING”. The resolver’s shaft position will be sampled every 500 microseconds.

```
1000    COMMON RESOLVER_IN%              \!Resolver data (periodic)
1010    COMMON CCLK_EN@                  \!Common clock enable
1020    COMMON UPDATE_TIME%              \!Update period for resolver conv.
1400    !
1500    LOCAL READING%                   \!Current negative value of input
1600    !
```

```
2000    UPDATE_TIME% = 1                    \!500 microsecond conversion
2010    CCLK_EN@ = TRUE                     \!Turn on the clock
4000    !
4001    ! Place any additional initialization software here
4002    !
4998    ! Scan every 55 msec.
4999    !
5000    CALL SCAN_LOOP( TICKS=10)
5010    CALL INVERTER( INPUT= RESOLVER_IN%,OUTPUT=READING%)
10000   END
```

The symbolic names defined as “COMMON” reference the inputs defined in the sample configuration task above. The symbolic name “READING%” is local to the BASIC task and does not have I/O associated with it. Refer to the DCS 5000 Control Block Language Instruction Manual (J-3601) for more information.

4.5 Using Interrupts in Application Tasks

The input module supports an interrupt on the periodic resolver-to-digital conversion. Interrupts are used to synchronize software tasks with the resolver-to-digital conversion. Conversion rates may be specified from 500 microseconds up to a maximum of 32.7675 seconds in increments of 500 microseconds.

In order to use interrupts on the input module, it is necessary to assign symbolic names to the interrupt control register. This is accomplished with IODEF statements in the configuration task. Note that interrupts cannot be used with modules located in remote racks.

Only one task may act as a receiver for a particular hardware interrupt. That task should declare the symbolic names assigned to the interrupt control register on the input module as COMMON. Once this has been done, any reference to those symbolic names within the task will reference the bits or register defined in the configuration task.

The following is an example of a configuration task for an input module using interrupts:

```
1000    !
1001    ! resolver data
1002    !
1005    IODEF RESOLVER_IN%[SLOT=4, REGISTER=0]
1006    IODEF RESOLVER_IN_EXT%[SLOT=4, REGISTER=1]
1010    !
1011    ! interrupt status and control register (used by the operating system)
1012    !
1014    IODEF STROBE_STATUS@( SLOT=4, REGISTER=2,BIT=14)
1015    IODEF ISCR%[SLOT=4, REGISTER=3]
1016    IODEF STROBE_ACK@( SLOT=4, REGISTER=3,BIT=12)
1020    !
1021    ! common clock enable
1022    !
1025    IODEF CCLK_EN@[SLOT=4, REGISTER=3,  BIT=6]
1030    !
1031    ! resolver conversion period
1032    !
1035    IODEF UPDATE_TIME%[SLOT=4, REGISTER=4]
1050    !
1051    ! Place additional configuration statements here
1052    !
2000    END
```

This configuration defines all of the information most commonly used on the module. Unused definitions should be deleted by the user.

4.5.1 BASIC Task Example

The following is an example of a BASIC task that handles interrupts from the input module defined in section 4.4.

```
1000   COMMON RESOLVER_IN%                \!Resolver data
1005   COMMON ISCR%                       \!Interrupt status & control
1010   COMMON CCLK_EN@                    \!Common clock enable
1020   COMMON UPDATE_TIME%                \!Resolver conversion time
1200   LOCAL RESOLVER_VALUE%              \!Resolver value
2000   !
2001   ! Define the conversion parameters
2002   !
2010   UPDATE_TIME% = 1000                \!Convert every .5 seconds
3000   !
3001   ! The following statement connects the name RESOLVER_EVENT to the
3002   ! interrupt defined in ISCR%. The event name chosen should
3003   ! be as meaningful as possible. The watchdog timeout has
3004   ! been set to 120 clock ticks (660 msec). If the time between
3005   ! interrupts exceeds this value, a severe error will be declared
3006   ! and the system will be stopped. For more information refer to the
3007   ! DCS 5000 Enhanced BASIC Language Instruction Manual (J-3600).
3008   !
3010   EVENT NAME=RESOLVER_EVENT,
3011     INTERRUPT_STATUS=ISCR%,TIMEOUT=120
4000   !
4001   ! The following statement enables common clock from this module
4002   ! If there is more than one interrupt task in a chassis, the task
4003   ! that enables common clock should always be the lowest priority
4004   ! task.
4005   !
4010   CCLK_EN@ = TRUE                    \!Common clock enable
5000   !
5001   ! Place additional initialization software here
5002   !
6000   !
6001   ! The next statement synchronizes the task with the external
6002   ! event via the interrupt. Task execution will be suspended
6003   ! until the interrupt occurs. If this task is the highest
6004   ! priority task waiting to execute at the time of the
6005   ! interrupt, it will become active. If it is not the
6006   ! highest priority task, it will remain suspended until
6007   ! all higher priority tasks have executed, at which point
6008   ! it will become active.
6009   !
6010   WAIT ON RESOLVER_EVENT
7000   !
7001   ! The next statements perform the interrupt service routine
7002   !
7010   RESOLVER_VALUE% = RESOLVER_IN%
10000  END
```

4.5.2 Control Block Task Example

The following is an example of a control block task that handles interrupts from the input module defined in section 4.4.

```
1000   COMMON RESOLVER_IN%                \!Resolver data
1005   COMMON ISCR%                       \!Interrupt status & control
1010   COMMON CCLK_EN@                    \!Common clock enable
1020   COMMON UPDATE_TIME%                \!Resolver conversion time
1200   LOCAL RESOLVER_VALUE%              \!Resolver value
2000   !
2001   ! Define the conversion parameters
2002   !
2010   UPDATE_TIME% = 100                 \!Convert every 50 milli-seconds
3000   !
3001   ! The following statement connects the name RESOLVER_EVENT to
3002   ! the interrupt defined in ISCR%. The event name chosen should
3003   ! be as meaningful as possible. The watchdog timeout has
3004   ! been set to 12 clock ticks (66 msec). If the time between
3005   ! interrupts exceeds this value, a severe error will be declared
3006   ! and the system will be stopped. For more information refer to the
3007   ! DCS 5000 Enhanced BASIC Language Instruction Manual (J-3600).
3008   !
3010   EVENT NAME=RESOLVER_EVENT, &
3011     INTERRUPT_STATUS=ISCR%, TIMEOUT=12
```

```
4000    !
4001    ! The following statement enables common clock from this module.
4002    ! If there is more than one interrupt task in a chassis, the task
4003    ! that enables common clock should always be the lowest priority
4004    ! task.
4005    !
4010    CCLK_EN@ = TRUE                          \!Common clock enable
5000    !
5001    ! Place additional initialization software here
5002    !
6000    !
6001    ! The next statement synchronizes the task with the external
6002    ! event via the interrupt. Task execution will be suspended
6003    ! until the interrupt occurs. If this task is the highest
6004    ! priority task waiting to execute at the time of the
6005    ! interrupt, it will become active. If it is not the
6006    ! highest priority task, it will remain suspended until
6007    ! all higher priority tasks have executed, at which point
6008    ! it will become active.
6009    !
6010    CALL SCAN_LOOP(TICKS=9, EVENT=RESOLVER_EVENT)
7000    !
7001    ! The next statements perform the interrupt service routine
7002    !
7010    CALL PULSE_MULT(INPUT= RESOLVER_IN%, MULTIPLIER=16385, &
                   OUTPUT= RESOLVER_VALUE%)
10000   END
```

4.6 Using the External Strobe Input

At the time of the external event, the resolver position is transferred to register 1, where it will remain until the next event occurs. If your application software is reading the resolver position at a periodic rate (register 0), the difference between register 0 and register 1 represents the amount of travel from the time that the event occurred until the current scan of the application software. A typical application would be detecting the leading edge of an object moving on a conveyor.

The data captured by the strobe input will be as accurate as the external device driving the input. Note that when a strobe input has occurred, you must reset the input so that another one can occur. This is accomplished by writing a “1” to bit 12 of register 3.

The following is an example of a control block task that handles the strobe input from the input module defined in section 4.4.

```
1000    COMMON RESOLVER_IN%                      \!Resolver data
1001    COMMON RESOLVER_IN_EXT%                  \!Strobe resolver data
1005    COMMON ISCR%                             \!Interrupt status  & control
1010    COMMON CCLK_EN@                          \!Common clock enable
1020    COMMON UPDATE_TIME%                      \!Resolver conversion time
1030    COMMON STROBE_STATUS@                    \!Strobe status
1040    COMMON STROBE_ACK@                       \!Strobe acknowledge
1200    LOCAL RESOLVER_VALUE%                    \!Resolver value
1210    LOCAL STROBE_RESET@                      \!Strobe state
1220    LOCAL PERIOD_DISTANCE%                   \!Resolver travel scan/scan
1230    LOCAL EVENT_DISTANCE%                    \!Resolver travel from event to scan
2000    !
2001    ! Define the conversion parameters
2002    !
2010    UPDATE_TIME% = 100                       \!Convert every 50 milliseconds
3010    EVENT NAME=RESOLVER_EVENT,INTERRUPT_STATUS=ISCR%, &
             TIMEOUT=12
4010    CCLK_EN@ = TRUE                          \!Common clock enable
6008    !
6010    CALL SCAN_LOOP( TICKS=9, EVENT=RESOLVER_EVENT)
7000    !
7001    ! The next statements catch the occurence
7002    ! of the strobe and reset it.
7003    !
7010    CALL TRANSITION (  INPUT= STROBE_STATUS @, &
                           OUTPUT=STROBE_RESET@)
7020    STROBE_ACK@= NOT STROBE_RESET@
```

```
7025    !
7026    ! The next statement calculates the distance
7027    ! traveled from the occurrence of the external
7028    ! event until this scan.
7029    !
7030    CALL PULSE_MULT( INPUT=RESOLVER_IN%,       &
                         RESET=−STROBE_RESET@,    &
                         INITIAL_VALUE =RESOLVER_IN_EXT%, &
                         MULTIPLIER=16385,                &
                         OUTPUT=EVENT_DISTANCE%)
7036    ! The next statement calculates the distance traveled
7037    ! from the last scan until this scan.
7039    !
7040    CALL PULSE_MULT( INPUT=RESOLVER_IN%, &
                         MULTIPLIER=16385,       &
                         OUTPUT=PERIOD_DISTANCE%)
7046    !
7047    ! The next statement calculates the correction
7048    ! required to synchronize the external event to
7049    ! the program.
7050    !
7060    CALL DIFFERENCE( INPUT1=PERIOD_ DISTANCE%, &
                         INPUT2=EVENT_DISTANCE%,   &
                         OUTPUT=RESOLVER_VALUE%)
10000   END
```

4.7 Restrictions

This section describes limitations and restrictions on the use of this module.

4.7.1 Writing Data to Registers

Registers 0-2 are read only and may not be written to by the application software. Attempts to write to them will cause a bus error (severe system error). The following are examples from programs that write to the module and should therefore be avoided:

a. Referencing the module on the left side of an equal sign in a LET statement in a control block or BASIC task.

b. Referencing a resolver input as an output in a control block function.

4.7.2 Interrupts in Remote I/O Racks

This module cannot be used in the interrupt mode in a remote rack.

4.7.3 Feedback Element in a Drive System

When this module is used with a resolver in a drive control system, you must incorporate an independent method of determining that this module is actually reading proper motor RPM. It is necessary to determine this because this module is not capable of detecting a loss of feedback in all situations, such as, for example, a broken coupling between the motor and resolver.

WARNING

LOSS OF, OR OTHERWISE IMPROPER, RESOLVER SIGNAL CAN RESULT IN UNCONTROLLED MOTOR SPEED. PROVIDE AN INDEPENDENT METHOD OF SHUTTING DOWN EQUIPMENT IF THIS SHOULD OCCUR. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY AND IN DAMAGE TO, OR DESTRUCTION OF, THE EQUIPMENT.

You must also determine the maximum safe operating speed for the motor, connected machinery, and material being processed. Then, either verify that the system is incapable of reaching that speed, or else incorporate the necessary hardware/software to ensure that this limit will never be exceeded.

WARNING

THE PURCHASER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE TRAIN MECHANISMS, AND THE WORKPIECE IN THE MACHINE ARE CAPABLE OF SAFE OPERATION AT MAXIMUM SPEEDS. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND IN DAMAGE TO, OR DESTRUCTION OF, THE EQUIPMENT.

5.0 DIAGNOSTICS AND TROUBLESHOOTING

This section explains how to troubleshoot the module and field connections.

5.1 Incorrect Data

Problem: The data is either always off, always on, or different than expected. The possible causes of this error are a module in the wrong slot, a programming error, or a malfunctioning module. It is also possible that the input is either not wired or wired to the wrong device. Use the following procedure to isolate the problem:

Step 1. Verify that the input module is in the correct slot and that the I/O definitions are correct.

Refer to figure 3.1. Verify that the slot number being referenced agrees with the slot number defined in the configuration task. Verify that the register number and the bit number are correct.

For remote I/O installations, also verify that the master slot and drop numbers are defined correctly. Refer to the DCS 5000 Remote I/O Instruction Manual (J-3629) for more detailed information on configuring your remote I/O system.

Step 2. Verify that the module can be accessed.

Connect the programming terminal to the system and run the ReSource Software. Use the I/O MONITOR function to display the four registers on the input module. Repeat steps 7 and 8 in section 3.2.

Step 3. Verify that the user application program is correct.

Review the programming examples in sections 4.4, 4.5, and 4.6. Make certain that the I/O definitions in your configuration task are correct and that the task(s) using this module have declared these variables COMMON.

Verify that an update period has been written to register 4. Recall that each count is 500 microseconds (.0005 seconds). This value specifies the frequency with which the resolver position will be converted to digital numbers.

Verify that the common clock has been turned on. The “CCLK OK” LED on the faceplate of the module should be lit. If the common clock is not present on the backplane, the module will not convert the resolver position to digital values. If the common clock is being generated from this module, remember that bit 6 in register 3 must be set.

Step 4. Verify that the resolver is wired correctly.

Remove power from the system. Disconnect the mechanical coupling between the resolver and the motor.

Confirm that all the terminal strip connections are tight. Refer to figures 3.2 and 3.3. Appendix C also lists the terminal strip connections.

Apply power to the rack only.

If everything is working properly but the direction of rotation is backwards, it may be reversed by switching the polarity of either the sine or the cosine wires as shown in figure 3.4.

Step 5. Verify that the input circuit is working properly.

Connect an oscilloscope to the proper points on the terminal strip and confirm that the voltages are correct.

The resolver reference voltage across TB 1 and 2 should be a nominal 26 Vrms.

If it is 26 Vrms, check the jumpers on the terminal strip. One jumper should connect TB 1 and 3. Another jumper should connect TB 2 and 4. Rotate the resolver's shaft and measure the sine voltage (TB 5 and 6) and cosine voltage (TB 7 and 8). Both voltages should range from 0 volts to approximately 11.8 Vrms.

If the resolver reference (TB 1 and 2) is not a nominal 26 Vrms, measure the D-C resistance of the resolver. Disconnect the resolver cable from the terminal strip (TB 1 and 2) and measure the resistance across the disconnected wires.

The resistance should be in the range of 35 to 125 ohms. If the resistance is within this range, the input module is malfunctioning and should be replaced. If the resistance is not within this range, disconnect the cabling from the resolver and measure the resistance directly on the resolver.

If this resistance is reading within the 35 to 100 ohm range, the resolver is operating properly. Check the cabling for a possible short. If the resistance is not within the 35 to 100 ohm range, the resolver is malfunctioning and should be replaced. If the problem is still present, check the cable for a possible short.

Reconnect the resolver cable at TB 1 and 2.

Remove power from the rack. Reconnect the mechanical coupling between the resolver and the motor. Reapply power to the system.

Step 6. Verify that the hardware is working properly.

WARNING

INSERTING OR REMOVING THIS MODULE OR ITS CONNECTING CABLES MAY RESULT IN UNEXPECTED MACHINE MOTION. POWER TO THE MACHINE SHOULD BE TURNED OFF BEFORE INSERTING OR REMOVING THE MODULE OR ITS CONNECTING CABLES. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

If all of the proper signals are present and the values are still not correct, the problem lies in the hardware. Verify the hardware functionality by systematically swapping out modules. After each swap, if the problem is not corrected, replace the original item before swapping out the next item.

To test local I/O, first replace the input module. Next, replace the processor module (s). If the problem persists, take all of the modules except one processor module and the input module out of the backplane. If the problem is now corrected, one of the other modules in the rack is malfunctioning. Reconnect the other modules one at a time until the problem reappears. If none of these tests reveals the problem, replace the backplane.

To test remote I/O, first verify that the remote I/O system is communicating with the drop that contains the input module being tested. Next, by systematically swapping out modules, determine whether the input module is the only module that is not working.

If more than one module is not working correctly, the problem most likely lies in the remote I/O system. Refer to the the DCS 5000 Remote I/O Instruction Manual (J-3629) for additional information. If the problem does not lie in the system, it probably involves the remote rack.

To test the remote rack, first replace the input module. If the problem persists, take all of the modules out of the remote backplane except the slave remote I/O module and the input module. If the problem is now corrected, one of the other modules in the rack is malfunctioning. Reconnect the other modules one at a time until the problem reappears. If the problem proves to be neither in the remote I/O system nor in the remote rack, try replacing the backplane.

5.2 Bus Error

Problem: A "31" or "16" appears on the processor module's LED. This error message indicates that there was a bus error when the system attempted to access the module. The possible causes of this error are a missing module, a module in the wrong slot, or a malfunctioning module. It is also possible that the user has attempted to write to the wrong registers on the module. Use the following procedure to isolate a bus error:

Step 1. Verify that the input module is in the correct slot and that the I/O definitions are correct.

Refer to figure 3.2. Verify that the slot number being referenced agrees with the slot number defined in the configuration task. Verify that the register number is in the range of 0-4.

For remote I/O installations, also verify that the master slot and remote drop number are defined correctly.

Refer to the DCS 5000 Remote I/O Instruction Manual (J-3629) for more information on configuring your remote I/O system.

Step 2. Verify that the module can be accessed.

Connect the programming terminal to the system and run the ReSource Software. Use the I/O MONITOR function to display the four registers on the input module. If the programmer is able to monitor the inputs, the problem lies in the application software (refer to step 3). If the programmer cannot monitor the inputs, the problem lies in the hardware (refer to step 4).

Step 3. Verify that the user application program is correct.

Registers 0 through 2 of the input module cannot be written to. If a BASIC task caused the bus error, the error log will contain the statement number in the task where the error occurred. If a control block task caused the error, you will need to search the task for any instances where you wrote to an input.

Step 4. Verify that the hardware is working correctly.

Verify the hardware functionality by systematically swapping out modules. After each swap, if the problem is not corrected, replace the original item before swapping out the next item.

To test local I/O, replace the input module, the processor modules (s), and finally the backplane.

For remote I/O, determine whether the input module is the only module that is not working. If it is not, the problem most likely lies in the remote I/O system. Refer to the DCS 5000 Remote I/O Instruction Manual (J-3629) for additional information. If the problem does not lie in the remote I/O system, it probably involves the remote rack.

To test the remote rack, systematically swap out the input module, the slave remote I/O module, and finally the backplane. After each swap, if the problem is not corrected, replace the original item before going on to the next swap. If none of these actions correct the problem, troubleshoot the remote I/O system.

5.3 Interrupt Problems

Problem: No interrupts at all or too many (unexpected) interrupts, signified by error codes on the screen. Note that this module must be in the same rack as the processor module that is to receive the interrupts. Go through the following steps first before going on to the more specific troubleshooting steps.

Step 1. Verify that the input module is in the correct slot and that the I/O definitions are correct.

Refer to figure 3.2. Verify that the slot number being referenced agrees with the slot number defined in the configuration task.

Verify that the configuration task contains the proper interrupt control definitions. Refer to the example in section 4.6.

Step 2. Verify that the user application program is correct.

Verify that the application program that uses the symbolic names defined in the configuration task has defined those names as COMMON.

Compare your interrupt task with the examples given in sections 4.5.1 and 4.5.2. Make certain that the actions shown in the examples are performed in the same order in your task.

5.3.1 No Interrupts

Problem: The program does not execute, but no error codes are displayed on the processor module faceplate. If interrupts are never received by the application program and the timeout parameter in the event definition was disabled, the task will never execute.

The watchdog timer for this module should never be disabled. Before you can determine why the program did not execute, you must first set the timeout parameter in the event definition. Run the program again and proceed to section 5.3.2.

5.3.2 Hardware Event Time-Out

Problem: All tasks in the chassis are stopped and error code “12” appears on the faceplate of the processor module. The interrupt has either never occurred or is occurring at a slower frequency than the value specified in the timeout parameter in the event definition. Use the following procedure to isolate the problem.

Step 1. Verify that the timeout value is set correctly.

Check the value specified in the timeout parameter in the event definition. The unit is in ticks. Each tick is equal to 5.5 msec. The timeout value should be at least 2 ticks greater than the interrupt frequency. It can reasonably range up to 1.5 times the interrupt frequency.

Step 2. Verify that the user application program is correct.

Review the examples in section 4.5. Make certain that common clock has been enabled.

Step 3. Verify that the hardware is working correctly.

Systematically swap out the input module, the processor module (s), and the backplane. After each swap, if the problem is not corrected, replace the original item before swapping out the next item.

5.3.3 Hardware Event Count Limit Exceeded

Problem: All tasks in the chassis are stopped and error code “1b” appears on the faceplate of the processor module. A hardware interrupt has occurred but no task is waiting. Use the following procedure to isolate the problem:

Step 1. Verify that the user application program is correct.

Verify that your interrupt response task contains either a “WAIT ON event” or “CALL SCAN_LOOP” statement that will be executed. Check carefully to determine whether a higher priority task is preventing the interrupt response task from running. Make certain that the ordering of your statements agrees with the examples in section 4.5.

Step 2. Verify that the hardware is working correctly.

Verify the hardware functionality by systematically swapping out the input module, the processor module (s), and the backplane. After each swap, if the problem is not corrected, replace the original item before swapping out the next item.

5.3.4 Illegal Interrupt Detected

Problem: All tasks in the chassis are stopped and error code “1F” appears on the faceplate of the processor module. A hardware interrupt has occurred but no event has been defined.

Step 1. Verify that the user application program is correct.

Verify that your interrupt response task contains an “EVENT” statement that will be executed. Check carefully to determine whether a higher priority task is preventing the interrupt response task from running. Make certain that the ordering of your statements agrees with the examples in section 4.5.

Step 2. Verify that the hardware is working correctly.

Verify the hardware functionality by systematically swapping out the input module, the processor module (s), and the backplane. After each swap, if the problem is not corrected, replace the original item before swapping out the next item.

Appendix A

Technical Specifications

Ambient Conditions

- Storage temperature: $-40°$ C - $85°$ C
- Operating temperature: $0°$ C - $60°$ C
- Humidity: 5-90% non-condensing

Maximum Module Power Dissipation

- 10 Watts

Dimensions

- Height: 11.75 inches
- Width: 1.25 inches
- Depth: 7.375 inches

System Power Requirements

- 5 Volts: 1700 ma
- $+12$ Volts: 95 ma
- -12 Volts: 95 ma

Resolver Specifications

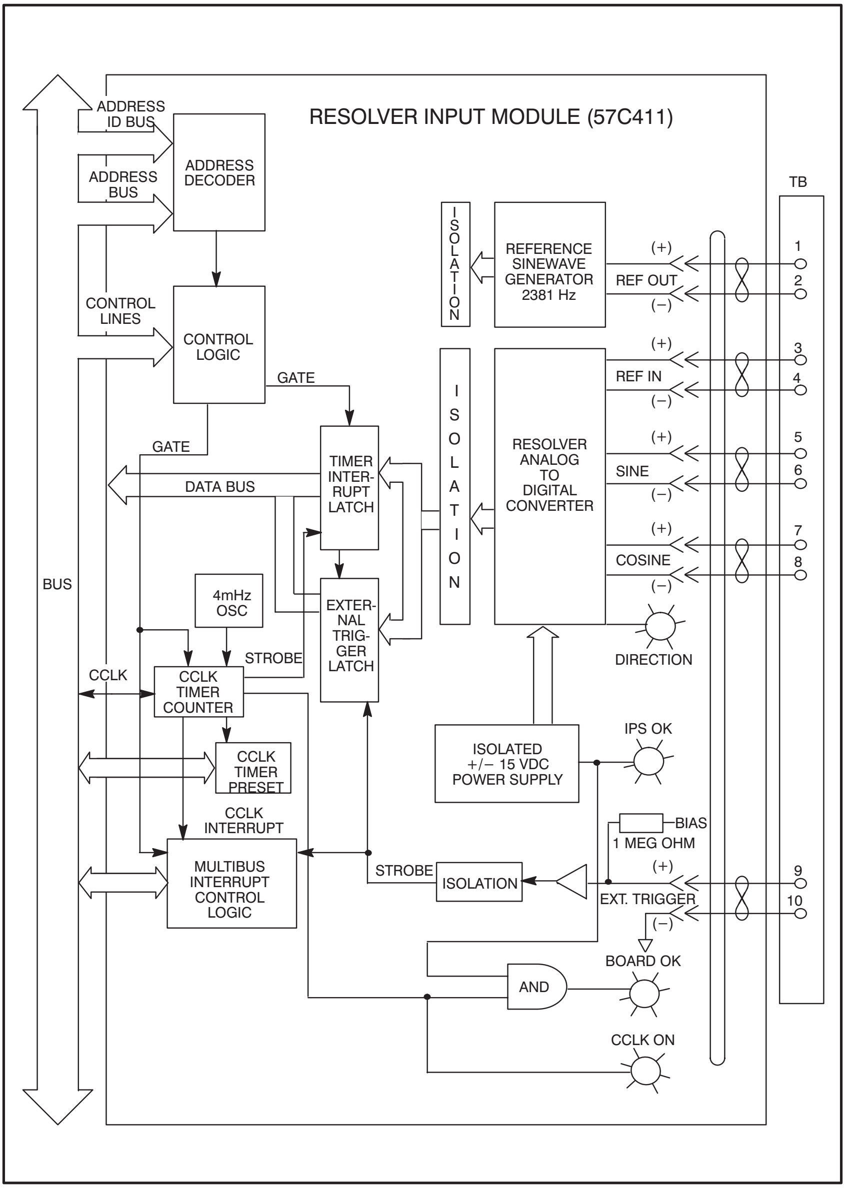
- Frequency of operation: 2381 Hz
- Minimum rotor impedance: 400 Ohms
- Transformer ratio: 26/11.8

External Strobe Minimum Trigger Time

- 1 millisecond

Appendix B

Module Block Diagram



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Appendix C

Field Connections

Pin No.	Function		Wire Color Code
1	Reference Output	(+)	Brown
2	Reference Output	(−)	White/Brown Stripe
3	Reference Input	(+)	Red
4	Reference Input	(−)	White/Red Stripe
5	Sine Input	(+)	Orange
6	Sine Input	(−)	White/Orange Stripe
7	Cosine Input	(+)	Yellow
8	Cosine Input	(−)	White/Yellow Stripe
9	External Trigger	(+)	Green
10	External Trigger	(−)	White/Green Stripe

Appendix D

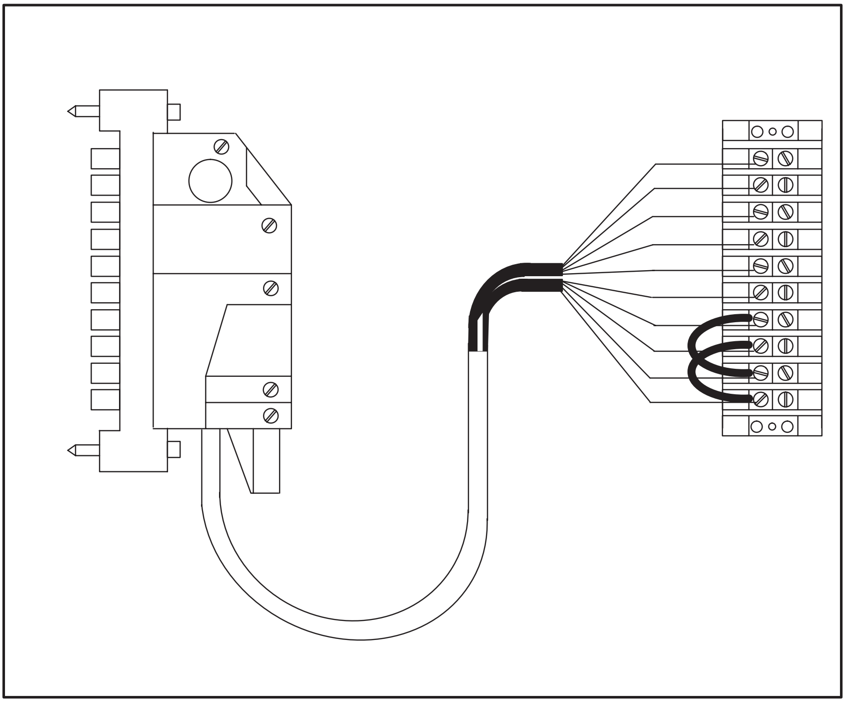
Related Components

800123-R - Resolver (X1) (57C360)
800123-S - Resolver (X2)
800123-T - Resolver (X5)
Designed for both foot-mounting and C-face mounting.

800123-2R - Resolver (X1) (57C361)
800123-2S - Resolver (X2)
800123-2T - Resolver (X5)
Designed for direct-coupling.

57C373 - Terminal Strip/Cable Assembly

This assembly consists of a terminal strip, cable, and mating connector. It is used to connect field signals to the faceplate of the input module.



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