

# RS-232/RS-485 SERIAL INTERFACES

## 2364 RS-232/RS-485 TO RELAY INTERFACE

### DESCRIPTION

The 2364 is a compact, RS-232/RS-485 to Relay Interface that provides 16 form 'A' contacts or 16 relay drivers for switching signals or driving external relays. The 2364's versatile commands let the user control the relays individually, configure the relays as a single or multipole scanner, or configure the relays in a preset pattern as a device controller. The 2364 also has eight isolated digital inputs that can be used to sense external signals or contact closures. In control applications, these signals can be used to verify the response of the external system to the control outputs. The 2364 can also monitor the input signals and generate an Service Request Message when the signals change state.

The 2364's serial interface provides all of the functionality of the GPIB interface in the Model 4864 but allows for control of the 2364 by any PC's COM port or over an RS-485 network. A user settable address lets multiple 2364s be operated on a RS-485 network with other RS-485 devices.

An OEM board version of the 2364 is available for applications requiring an internal relay board.

### Relays and Driver Outputs

Models with relays contain 16 form 'A' (SPST) relays with both sides of each relay contact brought out to the rear panel connector. The connector pin assignments are arranged to minimize signal cross talk. The relay contacts in the Model 2364-11 are for switching low level signals up to 0.5 amperes. The relay contacts in the 2364-12 are rated for switching currents up to 1.0 amperes. The 2364-14 has relay driver outputs that sink 300 mA to activate external relays or solenoids. The relays and drivers are on a plug-in relay PCB which simplifies relay maintenance and contact type changes.



2364 Serial Relay Interface

### Digital Inputs

The 2364 provides eight isolated digital inputs for inputting TTL/CMOS signals or contact closures. Each signal has a pullup resistor to a common line that can be connected to the 2364's internal 5 Vdc power or to an external voltage source. The signals have >500 volts of isolation from the 2364 when driven by an external source.

### Monitoring Capability

The 2364 can monitor the digital inputs for signal changes and generate a Service Request Message when the specified condition(s) occurs. Monitoring is accomplished by setting the 2364's Questionable transition registers to detect positive and/or negative signal transitions. When the enabled condition is detected, the 2364 generates a Service Request Message to alert the Computer which can then query the 2364's Questionable condition or event register to determine the exact signal condition and change.

- Serially Controlled relays and isolated digital inputs
- Multiple configurations:
  - 16 low-level SPST relays
  - 16 hi-power SPST relays
  - 16 relay drivers*Choose the correct contact for your application.*
- Multiple relay programming modes:
  - individual relays
  - single or multipole scanning*Flexible relay programming.*
- Isolated digital inputs that can be read or monitored.
 *Eliminates ground loops and reduces serial traffic.*
- IEEE-488.2 compatible unit uses SCPI commands.
 *GPIB functionality with a serial interface.*
- User settable addresses for RS-485 interface.
 *Supports multiple units on one RS-485 network.*
- Includes a menu-driven configuration program.
 *Steps user through configuration choices.*
- Small 1U high metal case provides full EMI/RFI protection
 *Proven EMI/RFI Compliance.*

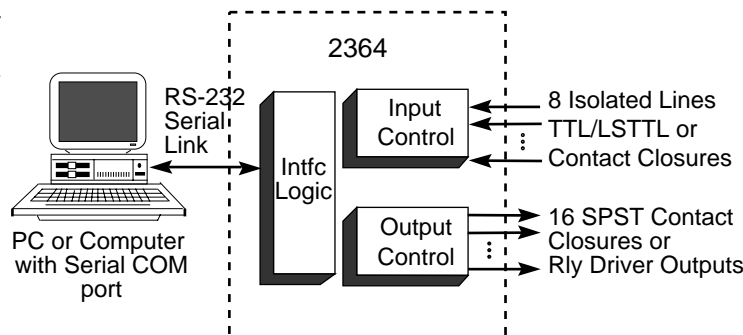


Figure 1 2364 Block Diagram

**ICS ELECTRONICS**  
 division of Systems West Inc.  
 7034 Commerce Circle  
 Pleasanton, CA 94588  
 Phone: 925.416.1000  
 Fax: 925.416.0105  
 Web: www.icselect.com

**RS-232/RS-485 Interfaces**

The 2364 provides both RS-232 and RS-485 signals on its 25-pin rear panel connector. The RS-232 interface is a full-duplex, three wire interface. The 2364's RS-485 interface is a two wire, half duplex interface for point-to-point or network connections.

**RS-485 Address Detection**

The Serial address detection capability in the 2364 enables the user to control up to sixteen 2364s on a single RS-485 network or to mix 2364s with other RS-485 devices. When address recognition is enabled, the 2364 looks for presence of the STX character followed by its address character before acting upon the remainder of the attached command string. The address character is set and saved in the 2364's flash memory with the NETWORK:ADDRESS command.

**Configuring the 2364**

The 2364's configuration and data transfer commands are shown in Table 1. Each function has a SCPI (Standard Commands for Programmable Instruments) command and some have Short-form commands for quick programming. Most of the functions can be queried to verify the command setting by adding a question mark to the command. i.e. ROUT:CLOSE:STATE? reads back the status of the relays.

The SYSTEM branch sets the unit's serial parameters and enables the serial address function for RS-485 networks. The STATUS branch is used to setup and query the Questionable registers so that changes in the digital inputs can be used to generate Service Request messages. The Questionable registers can be used to monitor and query the eight digital I/O lines. The ROUTE branch controls the relays. The INITATE branch controls the relays assigned to the scanner function.

**Controlling the Relays**

The simplest way to control the 2364's relays (or relay driver outputs) is individually using the relay's CLOSE or OPEN commands. Unspecified relays remain in their current state. This satisfies most users who are controlling other device(s) or are switching signals. An example is:

ROUTE:CLOSE 5      Closes relay number 5

Multiple relays can be opened and closed at the same time by entering the relay numbers in the list form. List are in parenthesis and are identified with the ASCII AT '@' character. Examples are:

ROUT:CLOS (@1,3,4) Closes relays 1,3 and 4  
 ROUT:OPEN (@11:13) Opens relays 11 through 13

For data acquisition applications, groups of the relays can be configured to operate as a single or multipole, as a break-before-make scanner. The relays are selected as a list with the ROUT:SCAN command. The INIT:IMMEDIATE command sets the relays to the first position and enables the scanner. The INIT:CONT command enables or disables the scanner.

TABLE 1 2364 SCPI Command Tree

| SCPI Tree                | Short-Form Commands  |
|--------------------------|----------------------|
| SYSTEM                   | Serial Configuration |
| :COMM                    |                      |
| :SERial                  |                      |
| :BAUD <numeric>          | [9600]               |
| :BITS                    | 7   8                |
| :PARITY                  | ODD   EVEN   NONE    |
| :SBITs                   | 1   2                |
| :NETwork                 | 0   1                |
| :ADDRess                 | 0-15                 |
| :ERRor?                  |                      |
| :VERSion?                | (1996.0)             |
| STATus                   |                      |
| :OPERation               | not used in 2364     |
| [:EVENT]?                |                      |
| :CONDition?              |                      |
| :ENABle <numeric>        |                      |
| :ENABle?                 |                      |
| :QUESTionable            | Digital Inputs       |
| [:EVENT]?                | E?                   |
| :CONDition?              | D?                   |
| :ENABle <numeric>        | M                    |
| :ENABle?                 | M?                   |
| :PTRansistion <numeric>  | P                    |
| :PTRansistion?           | P?                   |
| :NTRansistion <numeric>  | N                    |
| :NTRansistion?           | N?                   |
| ROUTE                    | Relay Control        |
| :CLOSE <channel list>    | Cn                   |
| :STATe?                  | Q?                   |
| :OPEN <channel list>     |                      |
| On                       |                      |
| :ALL                     | A                    |
| :SCAN <channel list(s)>  | Sn                   |
| INITate                  | Scan Control         |
| :CONTinuous <boolean>    | N                    |
| :IMMEDIATE Home position | I                    |

The scanner can be advanced with the \*TRG command. Unused relays can be controlled individually and used for other non-scanning applications. The scan relay list is stored in flash memory by the \*SAV command. Figure 2 shows the commands to setup a 2 pole, 3 position scanner.

ROUTE:SCAN (@1,3,5), (@2,4,6)  
 Defines scanner relays  
 INIT:IMM  
 Closes initial pole (Relays 1 and 2)  
 \*TRG  
 Steps the scanner to the next position.

Figure 2 2364 Scanner Command Example

**Using the Scanner for Control Functions**

The scanner relay lists can be random selections of relays that are used for sequential control functions. Repeated relays are left on. Relay 0 is a place-mark value and does not close any relay. The maximum length of the channel list is 32 entries. Figure 3 shows an example involving four relays.

```
ROUT:SCAN (@0,1, 2, 0, 4), (@0, 0, 3, 3, 0)
    Sets relay pattern
INIT:IMM      Sets scanner to initial position
              (No relays enabled)
*TRG         Turns relay 1 on
*TRG         Turns relay 1 off, relays 2 and 3 on
*TRG         Turns relay 2 off
*TRG         Turns relay 3 off, relay 4 on
*TRG         Turns relay 4 off
              (back to initial position)
```

**Figure 3 Control Function Example**

**Digital Inputs**

The 2364 has eight isolated inputs that are pulled high by a 1 Kohm resistor to an external voltage supplied by the user. The external voltage can be 5 to 30 Vdc. Open inputs appear as a logic '1'. For contact closures, jumper the 2364's +5 Vdc output to the V Pullup Low input and connect one side of the contacts to Logic GND.

**Reading and Monitoring the Digital Inputs**

The 2364's eight digital inputs are read from the Questionable register in the 2364's Status Reporting Structure. The Questionable register is a two tier register structure with a real time register and an event register. The Questionable Condition register reports the current value of the digital inputs. The Questionable Event register reports the bits that have changed since its last reading. Positive and negative filter masks let the Questionable Event register capture bits that go high, go low or move in either direction.

Enable bits allow the corresponding bits in the Questionable Event Register to be summarized in the 2364's Status Byte Register and to generate a Service Request Message (SRM) when an enabled bit is set in the Questionable Event Register. The filter and enable bit settings are stored in flash memory by the \*SAV command. These settings are automatically recalled at power turn-on time. Figure 4 shows how bit 1 is set to generate an SRM when an external contact is closed.

```
STAT:QUES:NTR 1 Selects low going transition
STAT:QUES:ENAB Enables bit 1
*SRE 8         Enables Questionable Summary bit
              to generate an SRM
```

**Figure 4 Setup to Sense a Contact Closure**

**TABLE 2 2364 Signal-Pin Assignments**

| Signal        | Pin | Description   |
|---------------|-----|---|
| Relay 1 NO    | 1   | Relay Driver 1 Output   |
| Relay 1 Arm   | 26  |   |
| Relay 2 NO    | 2   | Relay Driver 2 Output   |
| Relay 2 Arm   | 27  |   |
| Relay 3 NO    | 3   | Relay Driver 3 Output   |
| Relay 3 Arm   | 28  |   |
| Relay 4 NO    | 4   | Relay Driver 4 Output   |
| Relay 4 Arm   | 29  |   |
| Relay 5 NO    | 5   | Relay Driver 5 Output   |
| Relay 5 Arm   | 30  |   |
| Relay 6 NO    | 6   | Relay Driver 6 Output   |
| Relay 6 Arm   | 31  |   |
| Relay 7 NO    | 7   | Relay Driver 7 Output   |
| Relay 7 Arm   | 32  |   |
| Relay 8 NO    | 8   | Relay Driver 8 Output   |
| Relay 8 Arm   | 33  |   |
| Relay 9 NO    | 9   | Relay Driver 9 Output   |
| Relay 9 Arm   | 34  |   |
| Relay 10 NO   | 10  | Relay Driver 10 Output  |
| Relay 10 Arm  | 35  |   |
| Relay 11 NO   | 11  | Relay Driver 11 Output  |
| Relay 11 Arm  | 36  |   |
| Relay 12 NO   | 12  | Relay Driver 12 Output  |
| Relay 12 Arm  | 37  |   |
| Relay 13 NO   | 13  | Relay Driver 13 Output  |
| Relay 13 Arm  | 38  |   |
| Relay 14 NO   | 14  | Relay Driver 14 Output  |
| Relay 14 Arm  | 39  |   |
| Relay 15 NO   | 15  | Relay Driver 15 Output  |
| Relay 15 Arm  | 40  |   |
| Relay 16 NO   | 16  | Relay Driver 16 Output  |
| Relay 16 Arm  | 41  |   |
| V Return      | 17  | Ext Relay Ground Return   |
| V Common      | 42  | Ext Relay Voltage Input   |
| Logic Gnd     | 18  |   |
| Logic Gnd     | 43  |   |
| + 5 Vdc       | 19  |   |
| + 5 Vdc       | 44  | Jumper to pin 46 for floating contacts or for non-isolated inputs |
| -             | 20  |   |
| -             | 45  |   |
| V Pullup High | 21  | External 16-30 Vdc Input  |
| V Pullup Low  | 46  | External 5-20 Vdc Input   |
| Digital In 8  | 22  |   |
| Digital In 7  | 47  |   |
| Digital In 6  | 23  |   |
| Digital In 5  | 48  |   |
| Digital In 4  | 24  |   |
| Digital In 3  | 49  |   |
| Digital In 2  | 26  |   |
| Digital In 1  | 50  |   |

## OEM BOARD VERSION

The 4864 and 2364 are available in a board version for OEM applications. Board versions are designed to be mounted in the host's chassis and are powered from the host's 12 V to 24 V power supply. The boards are available with GPIB and Serial interface configurations listed in Table 3. On the OEM boards, the interface headers are mounted vertically to minimize the board footprint. The relay I/O connector is the same right angle 62-pin connector with lock studs.

### External GPIB Address Capability

Standard 4864's store their GPIB address in Flash memory and use a SCPI command to change it. On 4864 OEM boards, extra digital input lines are provided in the GPIB header to read the GPIB address from an external address switch at power turn-on. The external address function is enabled with a SCPI command.

### GPIB Header

On 4864 OEM boards, the 4864's GPIB connector is replaced with a 26-pin vertical header for remoting the GPIB bus and address switch signals to the rear panel. The 26 pin header mates with a flat ribbon cable from one of ICS's GPIB Connector/Address switch assemblies. These compact, business card size assemblies provide a convenient way to mount a GPIB Connector and an address switch on the rear panel.

### RS-232/RS-485 Interfaces

On 2364 OEM boards, the RS-232/RS-485 serial interface is on a 10-pin header at the front of the board. The serial interface operates at rates up to 115,200 baud and provides all of the functionality of the GPIB interface but over an RS-232 link or over an RS-485 network. Up to sixteen 2364s can be placed on a single RS-485 network. The 2364s are addressed by a two character address sequence prefixed to the normal 4864 command. The unit address and network capability are controlled by SCPI commands.

Boards with both GPIB and serial interfaces, default to using the serial interface at power turn-on time until the GPIB interface enters the Remote state. Refer to the 2364 data sheet for more information about the serial interface.

### LED Header

An 8 pin header on the OEM boards allows easy extension of the LED drive signals to the user's front panel.

### OEM Customization

The 2364's firmware allows the user to store a custom IDN message and other setup parameters in Flash memory. This effectively integrates the board into the user's system and makes the OEM board appear as part of the end product. A lock function hides the setup variables from the end user and prevents accidental changes to the setup.

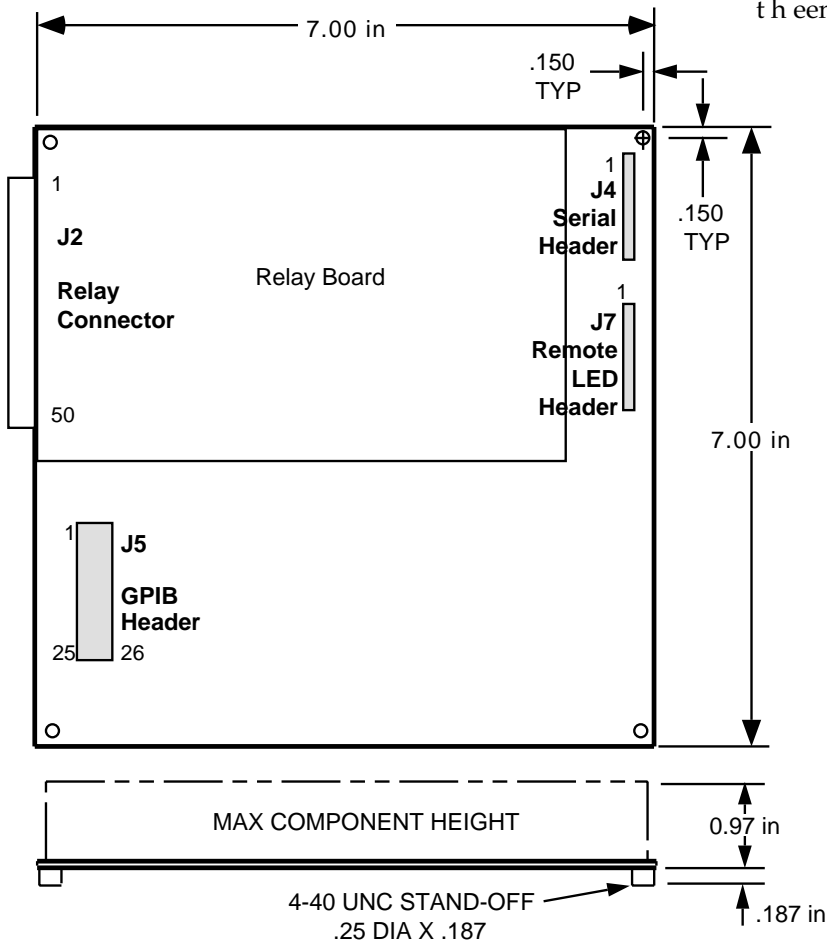


TABLE 3 OEM BOARD CONFIGURATIONS

| Part Number | Same As | Interfaces |        |        |
|-------------|---------|------------|--------|--------|
|             |         | GPIB       | RS-232 | RS-485 |
| 114521-11   | 4864-11 | Yes        | Yes    | Yes    |
| 114521-12   | 4864-12 | Yes        | Yes    | Yes    |
| 114521-14   | 4864-14 | Yes        | Yes    | Yes    |
| 114681-11   | 2364-11 | No         | Yes    | Yes    |
| 114681-12   | 2364-12 | No         | Yes    | Yes    |
| 114681-14   | 2364-14 | No         | Yes    | Yes    |

OEM Boards have the same specifications as the 'same as' model number. OEM boards include the Instruction Manual, Configuration disk and Mating connector. GPIB Connector/Switch Assemblies, serial cables or serial cable kits must be ordered separately.

Figure 5 OEM Board Dimensions

## 2364: SPECIFICATIONS

### Serial Interface

Provides RS-232 and RS-485 (RS-422) asynchronous serial interfaces. Unit responds to the serial interface that receives the command.

#### RS-232 Interface

Signals: AB, BA and BB  
Mode: Full Duplex

#### RS-485 (RS-422) Signals

Signals: TX/RX pair  
Mode: Half duplex with or without address detection  
Addresses: 0 to 15  
Termination: 220 ohm load resistor and 1 K $\Omega$  pullup/pulldown resistors.

### Common Specifications

Baud Rate: 1200 to 38.4 Kbaud  
Data bits: 7 or 8  
Stop bits: 1 or 2  
Parity: Odd, Even or None

### Command Sets

SCPI and short form commands listed in Table 1 plus the following IEEE 488.2 Common Commands:  
\*CLS, \*ESE, \*ESE?, \*ESR?, \*IDN?, \*OPC, \*OPC?, \*PSC, \*PSC?, \*RCL, \*RST, \*SAV, \*SRE, \*SRE?, \*TRG, \*TST, and \*WAI.

### Digital Inputs

Eight isolated inputs that can be queried and/or monitored for selected bit changes. Detected changes are saved and can be used to generate a Service Request Message (SRM).

Input signals TTL/CMOS or contact closure to ground  
Input Levels Low =  $0 \pm 0.5$  V @ 2 mA  
High =  $\geq 2.4$  V or open  
Pullups 1.5 Kohm to +5 Vdc or to user furnished external voltage  
External Voltage 5 to 32 Vdc  
Isolation 500 Vdc to internal logic with external pullup voltage.  
Monitoring 1,000 samples/sec

### Relay Contacts

All relay contacts are brought out to individual pins on the relay connector. Guard lines are provided between adjacent relay contacts

|                                      |               |               |
|--------------------------------------|---------------|---------------|
| Model No.                            | 2364-11       | 2364-12       |
| Usage                                | Lo level      | Hi Power      |
| No. of Relays                        | 16            | 16            |
| Contact form                         | Form A (SPST) | Form A (SPST) |
| Contact mat'l                        | Ruthenium     | -             |
| Contact ratings:<br>(Resistive load) | 0.5 A         | 1.0 A         |
| Switching V                          | 200 Vdc       | 200 Vdc       |
| Power                                | 10 W          | 50 W          |
| Breakdown V                          | 300 Vac       | 300 Vac       |
| Resistance                           | 0.15 $\Omega$ | 0.2 $\Omega$  |

### Relay/Solenoid Driver Outputs

In -14 version, the relays are omitted and the relay drivers are brought directly out to the connector. Drivers are open collector type with an internal snubber diode. User supplies the external voltage for the diodes.

|                |                 |
|----------------|-----------------|
| Model No.      | 2364-14         |
| Usage          | External relays |
| No. of Drivers | 16              |
| Current        | 350 mA max      |
| Switching V    | 48 Vdc max      |

### Scanner-Sequence Memory

16 relays x 32 steps

### Front Panel Indicators

|      |                                   |
|------|-----------------------------------|
| PWR  | Indicates power on                |
| RDY  | Unit has passed self test         |
| TALK | Unit is addressed to talk         |
| LSTN | Unit is addressed to listen       |
| SRM  | Unit is asserting SRM             |
| ERR  | Unit has detected a command error |

### Physical

Size W x H x D  
7.29 x 1.52 x 7.45 inches  
(1185.2 x 38.6 x 189.2 mm)

Weight 3 lbs (1.4 kg)

Temperature  
-10°C to +55°C Operating  
-40°C to +70°C Storage

Humidity 0-90% RH, no condensation

Construction All metal case

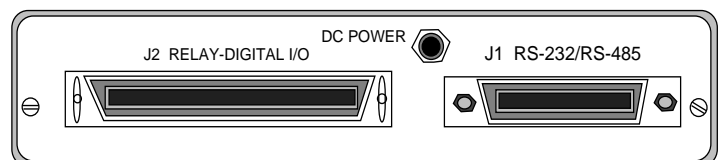
#### Connectors

IEEE bus-Std 24 pin w/metric studs  
I/O-Amphenol 57-30500 50-pin connector w/spring locks

Power 12 to 24 Vdc @ 100 mA  
plus 10 mA per closed relay

### Included Accessories

Instruction Manual  
Mating Connector  
3.5 in Configuration Program Disk.  
UL/CSA/VDE/CE approved AC power adapters provided for:  
US -  $115 \pm 10\%$  Vac, 60 Hz (std)  
Europe -  $230 \pm 10\%$  Vac, 50/60 Hz  
UK -  $230 \pm 10\%$  Vac, 60 Hz  
Japan -  $100 \pm 10\%$  Vac, 50/60 Hz



2364 Rear Panel

## ORDERING INFORMATION

Relay Interface with 16 SPST low-level relays  
Relay Interface with 16 SPST high-power relays  
Relay Interface with 16 relay/solenoid drivers

### Part Number

2364-11  
2364-12  
2364-14

Rack Mounting Kits (holds 1 or 2 units)

Single - 114212, Dual - 114213