GPIB TO RELAY INTERFACE

GPIB 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 accept contact closures and CMOS / TTL logic levels.
  Eliminates ground loops.

- IEEE-488.2 compatible unit uses SCPI commands.
  Meets the latest GPIB specifications.

- Includes a menu-driven configuration program.
  Steps user through configuration choices.

- HP VEE Driver available on ICS's web site.
  Head start on HP VEE program.

- Metal case provides full EMI/RFI protection
  Proven EMI/RFI Compliance.

CE *Approved*

DESCRIPTION

The Model 4864 is an IEEE 488.2/GPIB/HP-IB to Relay Interface that provides 16 form 'A' contacts or 16 relay drivers for switching signals or for driving external relays. The 4864's versatile commands let the user control the relays individually, step them as a single or multipole scanner, or step in any programmed sequence. The 4864 also includes eight isolated digital inputs that can be used to read 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 4864 can also monitor the digital inputs and generate an SRQ and when the signals change state.

The Model 4864 is a member of ICS's Mini-Box line of IEEE 488.2 interfaces which provide many new features while using less than one third the space of earlier designs. All Mini-Box interfaces are IEEE 488.2 compatible and use SCPI and short-form commands for ease of programming. All Mini-Box interfaces are packaged in a CE compliant metal case that is less than 1.6 inches (39 mm) high and 7.3 inches (186 mm) wide and can be rack mounted in a 1U high space.

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 4864-11 are for switching low level signals up to 0.5 amperes. The relay contacts in the 4864-12 are rated for switching currents up to 1.0 amperes. The 4864-14 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.

Digital Inputs

The 4864 provides eight isolated digital inputs for TTL/CMOS signals or contact closures. Each signal has a pullup resistor to a common line that can be connected to the 4864's internal 5 Vdc power or to an external voltage source. The signals have >500 volts of isolation from the 4864 when driven by an external source.
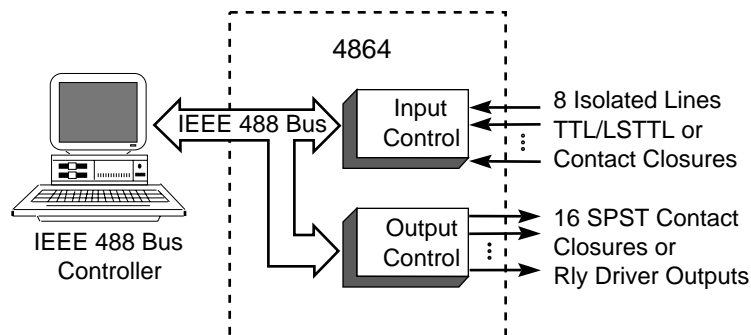
Programmability

The 4864 includes commands for direct relay actuation, for signal scanning and for random relay sequences. The user has his choice of using SCPI commands for easy program documentation or short-form commands for reduced typing when controlling the unit from a keyboard. The 4864 also responds to all of the IEEE-488.2 required common commands.

All of the relay setup values, digital input enabling, operating mode and GPIB Bus address are programmable from the GPIB Bus. These configuration values can be saved in the 4864's Flash memory and are automatically recalled as the default settings at power turn-on time.

Figure 1   4864 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**

4864 SCPI Commands

Table 1 shows the 4864's SCPI Commands and their short-form command equivalents. SCPI commands are a tree and branch structure that start from the main command and work out to a value, action or query at the end of the branch. An example is the command which sets the 4864's GPIB address:

SYST:GPIB:COMM:ADDR 4 Sets 4864 to address 4

The 4864's SCPI command set allows for individual control of each relay, simultaneous control of multiple relays and the use of designated relays as a multipole scanner. SCPI commands can use the short version indicated by the capital letters or the whole command word. In the above example, the address command word could be ADDR, addr, or address. Colons are required between command words. SCPI commands that set a parameter can also be used to query the parameter. Spaces are required before a parameter but not before the question mark. The following is the query form of the GPIB address command:

SYST:COMM:GPIB:ADDR?

The 4864 short-form commands minimize typing and GPIB bus traffic but they do not duplicate all of SCPI commands. New programs should use the SCPI commands where possible as they are self documenting and easier to maintain. The following paragraphs apply to both command sets.

Controlling the Relays

The simplest way to control the 4864'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:

ROUT:CLOS 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 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. The scanner can be advanced with either the IEEE-488.1 GET command or with a 488.2 *TRG command. The scanner operates as a break-before-make scanner. Unused relays can be controlled individually and used for other non-scanning applications. The scan relay

TABLE 1   4864 SCPI Command Tree

SCPI Tree		Short-Form Commands
SYSTem	**System Setup and Query**	
:COMM		
:GPIB		
:ADDRess	<numeric>	
:ERRor?		
:VERSion?		
STATus		
:OPERation	not used in 4864	
[: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		Sn
INITiate	**Scan Control**	
[:IMMediate]		I
:CONTinuous	1(On)| 0(Off) [0]	N
CALibrate	**Calibrate**	
:IDN	<string>	
:DATe	mm/dd/yy	
:DEFault		
:LOCK	1(On)| 0(Off) [0]	

list is stored in the 4864's Flash memory with the *SAV command. The maximum list size is 16 relays x 32 steps. Figure 2 shows the commands to setup a 2 pole, 3 position scanner.

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

Figure 2   4864 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 defined as an position that does not close any relay. The maximum length of the channel list is 32 entries. Figure 3 shows an example involving four relays. The 4864 steps once in both lists each time it is triggered.

```
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 or GET       Turns relay 1 on
*TRG or GET       Turns relay 1 off, relays 2 and 3 on
*TRG or GET       Turns relay 2 off
*TRG or GET       Turns relay 3 off, relay 4 on
*TRG or GET       Turns relay 4 off
                  (back to initial position)
```

Figure 3   Control Function Example

Digital Inputs

The 4864 has eight isolated inputs that are pulled high by a 1 Kohm resistor by a 5 to 30 Vdc. Open or high inputs appear as a logic '1'. For contact closures or non-isolated TTL/CMOS inputs, jumper the 4864's +5 Vdc output to the V Pullup Low input pin. Use an external voltage source to completely isolate the signal inputs.

Reading and Monitoring the Digital Inputs

The 4864's eight digital inputs are read by querying the Questionable register in the 4864's Status Reporting Structure. The Questionable register is a two tier register structure with a real time Condition 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 with a 1 KHz sample rate.

Enable bits allow the corresponding bits in the Questionable Event Register to be summarized in the 4864's Status Byte Register and to generate an SRQ 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 setting are automatically recalled at power turn-on time. Figure 4 shows how bit 1 is set to generate an SRQ when an external contact is closed.

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

Figure 4   Setup to Sense a Contact Closure

TABLE 2   4864 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	External Relay Ground Return
V Common	42	External Relay Voltage Input
Logic Gnd	18	
Logic Gnd	43	
+ 5 Vdc	19	
+ 5 Vdc	44	Jumper +5 V to pin 46 for floating
-	20	contacts or for non-isolated inputs
-	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 Relay Interfaces are available in a board versions 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 50-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 4864 and 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.
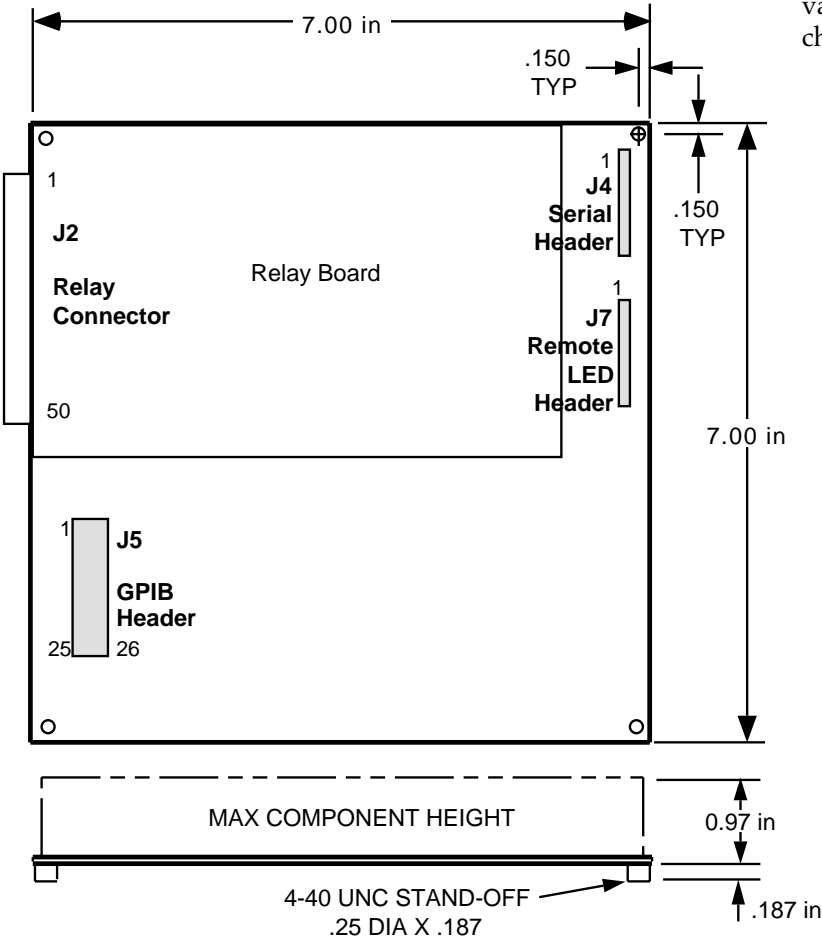
TABLE 3   OEM BOARD CONFIGURATIONS

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

IEEE 488 Bus Interface

The 4864's 488 Bus interface meets IEEE STD 488.1-1987 and has the following capabilities.

SH1, AH1, T6, L4, SR1, PP0, DC1, RL0, DT1, C0 and E2 drivers.

Address Capability
Primary addresses 0-30

SRQ Generation
SRQs are generated if the unit is not a talker, if SRQs are enabled and if an Enabled Event Status Register bit or an monitored digital input change occurs. Digital inputs are monitored by the Questionable register.

488.2 Common Commands
*CLS, *ESE, *ESE?, *ESR?, *IDN?, *OPC, *OPC?, *PSC, *RCL, *RST, *SAV, *SRE, *SRE?, *STB, TST? and *WAI

SCPI Commands
Used to set and query all programmable functions. The 4864 conforms to SCPI 1994.0 Specification.

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 (SRQ).

Data lines	8
Input signals	TTL/CMOS or contact closure to ground
Input Levels	Low = 0±0.5 V @ 2 mA High=>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.	4864-11	4864-12
Usage	Lo level	Hi Power
No. of Relays	16	16
Contact form	Form A (SPST)	Form A (SPST)
Contact mat'l	Ruthenium	-
Contact ratings:		
(Restive 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 Ω	0.2 Ω

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.	4864-14
Usage	External relays
No. of Drivers	16
Current	300 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
SRQ	Unit is asserting SRQ
ERR	Unit sensed 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 approved AC power adapters provided for:
    US - 115±10% Vac, 60 Hz (std)
    Europe - 230±10% Vac, 50/60 Hz
    UK - 230±10% Vac, 60 Hz
    Japan - 100±10% Vac, 50/60 Hz
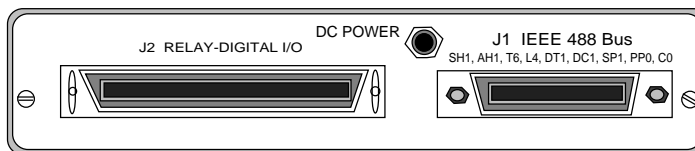
4864 Rear Panel

ORDERING INFORMATION

	Part Number
Relay Interface with 16 SPST low-level relays	4864-11
Relay Interface with 16 SPST high-power relays	4864-12
Relay Interface with 16 relay/solenoid drivers	4864-14
2364/4864 Terminal Strip Assembly with 60 cm cable (See separate data sheet)	114534-60