5012
Programmable
Switch

Technical Manual

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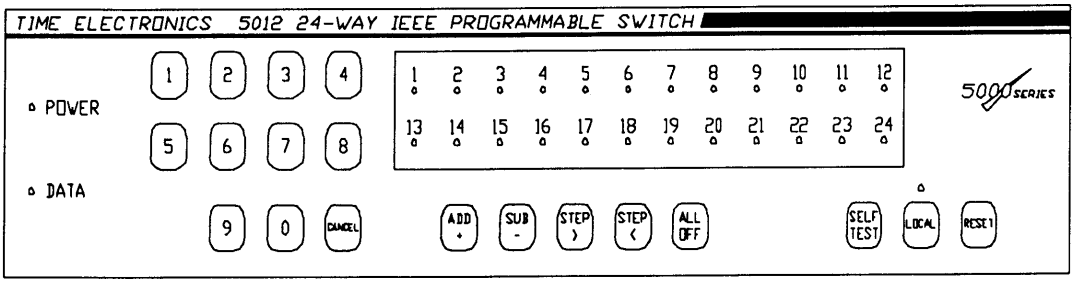


The 5012 is a microprocessor controlled, 24 channel switch which may be operated either manually or by the IEEE - 488 interface bus.

The 5012 offers a wide variety of switching solutions. Applications include A.T.E., production, process control and environmental monitoring.

Special relays with multi-layered contacts have been used to give the performance needed for applications such as thermocouple measurement to current switching.

Local operation is easily performed by entering the required channel on the keyboard. The LED's directly indicate the selected channels.

Features available in the local mode prove invaluable during system design and for troubleshooting. The step left and right keys will move all selected channels left or right one channel. An 'All Off' key will immediately turn off all selected channels and the self test function will select each channel in turn without external bus control.

Operation over the IEEE - 488 bus is also very simple. To operate a channel just send the number to the 5012. Again the LED's will indicate the selected channels.

Another feature of the 5012 is the timing feature. If timing is critical in your application, delays may be specified before a channel is turned on or off

The 5012 is constructed in a standard size 19" 2 units high metal case, suitable for rack mounting.

Installing the 5012

This section contains information about the power requirements, fuses and installation of the instrument into a 19" rack mount frame.

Grounding Requirements

The instrument is supplied with a three conductor A.C. power lead. This lead must be connected to a three conductor power supply that has its ground conductor connected to an electrical earth (safety ground). The power socket and cable both comply to IEC safety standards.

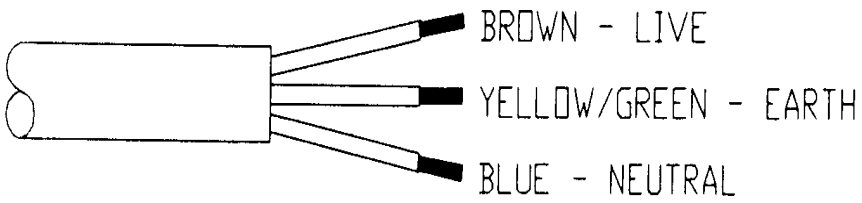
FOR CONTINUED PROTECTION AGAINST ELECTRICAL SHOCK, ALWAYS ENSURE THAT THE INSTRUMENT IS PROPERLY EARTHED.

Power Requirements
You can operate the 5012 from a single phase source rated at 100V A.C., 220V A.C., or 240V A.C. 50/60Hz.

Line voltage may vary by up to 10% but must not exceed 250V A.C.

The power lead must be wired in accordance with the diagram below.

Be sure that the voltage setting on the instrument is correct before connecting to a power source and that the correct fuse has been installed.



Setting the line voltage
To alter the line voltage setting, firstly remove the power lead from the instrument.

Remove the fuse holder/voltage setting cartridge from the power connector then locate and remove the fuse holder.

Rotate until the correct voltage setting is displayed in the window.

Install the correct fuse and replace the cartridge. (800mA for 220/240V A.C. or 1.6A for 110V A.C.)

Bench Use
The instrument may be used free standing by using the tilt feet on the base.

Removal of the transit screws is not necessary.

19" Rack Mounting
Refer to Figure 1.1, removing the feet and transit screws and Figure 1.2, rear fixing detail. To mount the instrument in a 19" rack you must first have the 19" rack mount kit. (Part No 9728).

First remove the two tilt feet and two standard feet from the base of the instrument.

Then remove the carrying handle.

Fix the two mounting 'ears' on each side of the instrument using the two fixing holes and the 2BA screws.

Remove the two large transit screws located on the base of the instrument.

Locate the rear support fixings as in Figure 1.2 on the rack and fix using the screws provided.

Mount the instrument in the rack, locating the two ‘ears’ in the rear support fixings.

Fix the front panel of the unit to the frame using the screws provided.

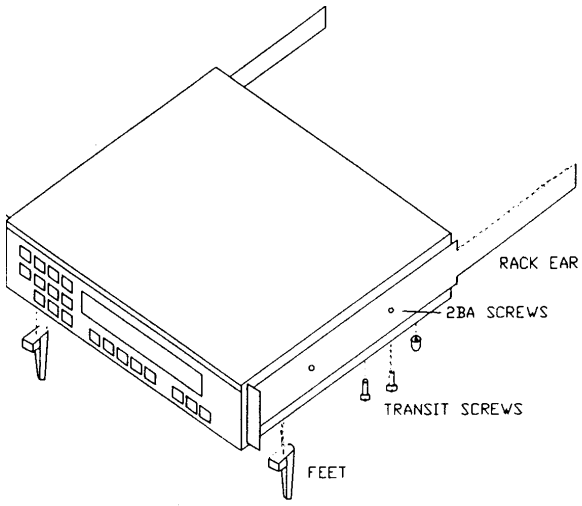


Figure 1.1

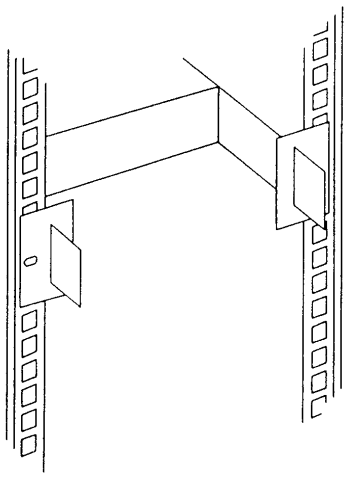


Figure 1.2

IEEE-488 Connection
This instrument implements the requirements of the IEEE - 488/1978 standard.

The connection is made by a standard 24 pin IEEE connector mounted on the rear panel. The IEEE address is selected by a DIP switch again on the rear of the instrument as shown in Figure 1.3.

Refer to Section 3 for IEEE operations.

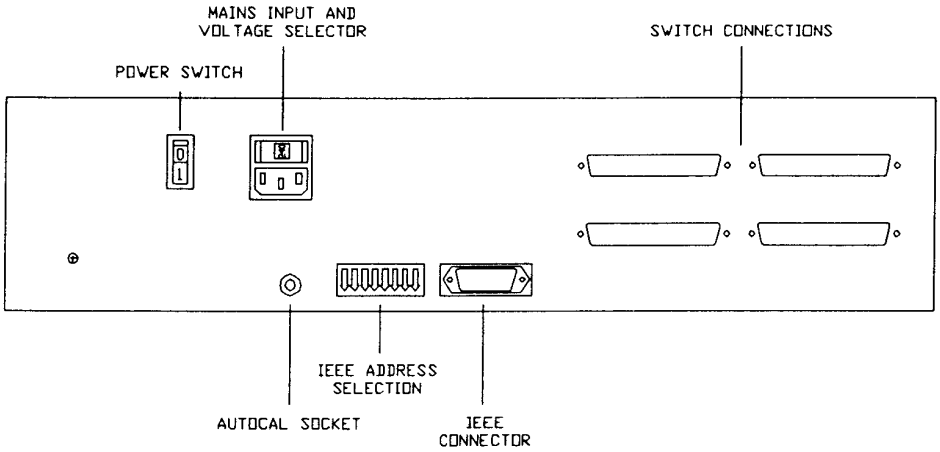


Figure 1.3

Switch Connections
Connections to the 5012 are made via four 37 way Cannon ‘D’ connectors.

Each connector is wired identically and has the contacts of 6 channels.

Each channel has two poles with change over contacts as shown in Figure 1.4.

When the channel is selected the relay contacts change over.

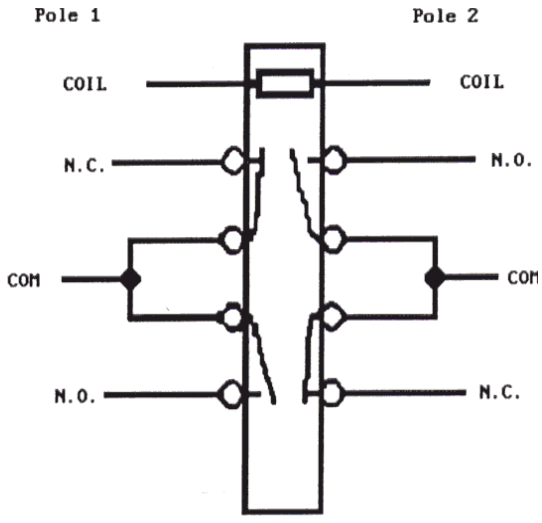


Figure 1.4

The switch connections are identical for each connector and are detailed in Table 1.1 and figure 1.5.
Wiring details of the 37 way 'D' connector is shown in Figure 1.5. To wire channels 7-24, follow the diagram replacing the appropriate channel numbers, i.e. For channels 7, 13 and 19, wire as channel 1 and for channels 8, 14 and 20, wire as channel 2, etc.

Pin 1 has been provided as a ground connection.

Pin Number	Channels	Pole	Connection
1	N/A	N/A	CHASSIS
2	1,7,13,19	1	COM
3	1,7,13,19	2	N.O.
4	1,7,13,19	2	N.C.
5	2,8,14,20	1	COM
6	2,8,14,20	2	N.O.
7	2,8,14,20	2	N.C.
8	3,9,15,21	1	COM
9	3,9,15,21	2	N.O.
10	3,9,15,21	2	N.C.
11	4,10,16,22	1	COM
12	4,10,16,22	2	N.O.
13	4,10,16,22	2	N.C.
14	5,11,17,23	1	COM
15	5,11,17,23	2	N.O.
16	5,11,17,23	2	N.C.
17	6,12,18,24	1	COM
18	6,12,18,24	2	N.O.
19	6,12,18,24	2	N.C.
20	1,7,13,19	1	N.O.
21	1,7,13,19	1	N.C.
22	1,7,13,19	2	COM
23	2,8,14,20	1	N.O.
24	2,8,14,20	1	N.C.
25	2,8,14,20	2	COM
26	3,9,15,21	1	N.O.
27	3,9,15,21	1	N.C.
28	3,9,15,21	2	COM
29	4,10,16,22	1	N.O.
30	4,10,16,22	1	N.C.
31	4,10,16,22	2	COM
32	5,11,17,23	1	N.O.
33	5,11,17,23	1	N.C.
34	5,11,17,23	2	COM
35	6,12,18,24	1	N.O.
36	6,12,18,24	1	N.C.
37	6,12,18,24	2	COM

Table 1.1

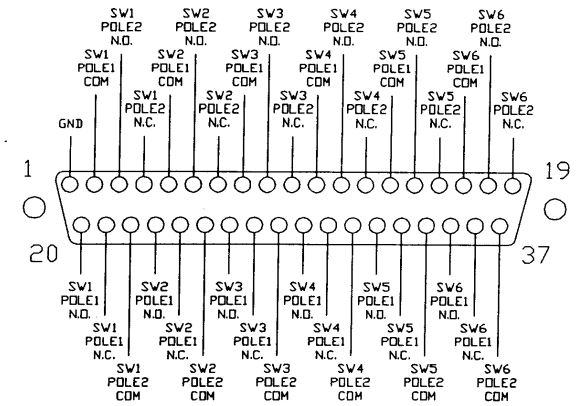


Figure 1.5

Section 2 - Specifications

Interface

Interface Type:	IEEE-488/GPIB/HPIB
Device Address:	Rear panel switch 0-31
Bus Connection:	Standard 24 pin IEEE-4888 connector
Bus Isolation:	All switches are isolated from the bus up to 350V.

Switch Specification

Type:	24 way double pole changeover, break before make.
Contact Res:	<40mΩ per switch
Contacts:	Gold Layer
Operation Time:	20 milli seconds
Operating Life:	Up to 200 million operations
Connections:	Four 37 way ‘D’ connectors
Rating:	1 Amp @ 30VDC (100VAC)
Thermal EMF’S:	Less than 5uV per switch

General Specification

Power Supply:	110V, 220V or 240V A.C. 50/60 Hz
Dimensions:	482 x 381 x 89mm

Programming

Each switch is addressed by its physical position number as shown on the front panel (1-24). Either a single switch or several may be selected by one command string. The commands to each switch are separated by a semicolon (;) and the delay option specified by ‘/X/Y’ where ‘X’ is the turn on delay and ‘Y’ is the turn off delay, both in 1/10ths of a second. The complete command string is terminated by either a carriage return (CR) or line feed (LF).

Program Modes

Decimal:

Switches to be turned on are specified by decimal commands. All other switches are turned off.

Memory +:

Switches to be turned on are specified by a positive decimal command. All other switches remain unchanged.

Memory-:

Switches to be turned off specified as a negative decimal command. All other switches remain unchanged.

Delay Option:

Delays the decimal, memory + or - commands by a specified amount (0.1s - 25s). On and Off delays are specified separately.

Hexadecimal:

Turn on switches by a hexadecimal string. All others turn off.

G.E.T.:

Sets the 5012 to execute commands after the Group Execute Trigger command has been received.

Goto Local:

Sets the 5012 into local mode for operation via the front panel.

Transmit Local:

Instructs the 5012 to send back all its settings.

Section 3 - Operation

Introduction
The 5012 may be operated in either local or remote modes which is invaluable during system design or troubleshooting.

The LED's on the front panel indicate which channel has been selected. The data LED will indicate when a command has been received by the IEEE interface or if a key has been pressed in local mode. A bleep will also be heard when a key has been pressed.

The 5012 is put into remote mode whenever a valid command is received by the IEEE Bus. To return control to the front panel, press the Local key.

Front Panel Operation
By using the keypad, any channel may be turned on or off with just a few key presses.

For example - To turn switches 1 and 22 on, press '1' and 'ADD+' for switch 1 then '22' and 'ADD+' for switch 22. The LED's will show that these channels have been selected.

To turn switch 1 off, leaving 22 on, press '1' and 'SUB-'. Alternatively to turn all switches off press the 'ALL OFF' key.

If a mistake is made during numeric entry press the cancel key.

If the channel keyed in is invalid, the unit will give a long beep.

The step keys may be used to repeatedly step all the channels selected up or down one place.

Pressing the 'Self Test' Key will initiate the self test sequence. This will step through each channel, energising the relay and also indicating the channel selected on the front panel.

The Local key will return control back to the front panel when under remote control.

The Reset key will reset the relays, IEEE interface and processor.

Remote Control Via The IEEE - 488 Interface Bus
Computer control of the 5012 via the IEEE interface is both simple and efficient.

A host of features becomes available under remote control.

Single letter or number commands will select or deselect channels, read back which channels have been selected or set delays between relays operating.

The IEEE - 488 Interface Bus
The IEEE - 488 interface, sometimes called GPIB (General Purpose Interface Bus) or the HPIB (Hewlett Packard Interface Bus) allows remote control of the instrument by a suitable computer or controller.

The 5012 is compatible with the IEEE - 488 (1978) interface bus.

The IEEE - 488 standard defines a complete interface system for the interconnection of instruments and computers using a bit parallel, byte serial bi-directional bus. Protocols, connections and cables are also defined, enabling computer controlled systems to be quickly realized.

The main limitations of the IEEE are:-

1) A maximum of 15 devices on the bus.

2) The maximum bus length should not be greater than 20m or number of devices x 2, which ever is the shorter.

Data Transfer and Device Addressing
Before a controller can send data it has to identify the recipient. Each device on the IEEE is given an address to which it will respond when called by the controller, in this way data can be transferred between selected devices in an orderly manner.

The rate at which data is transferred is controlled by hand shake signals, the speed being governed by the slowest device active on the bus.

Set baud rates are therefore unnecessary with this system.

IEEE Cables
The IEEE - 488 cable contains 24 wires terminated at both ends with identical plug/sockets which allow for daisy-chaining of additional cables to extend the bus.

Cables used on IEEE systems are available in various lengths to suit different layouts.

IEC Bus Connections
Users wishing to connect the 5012 to a European standard bus (IEC-625), must be aware of the differences in connector pin assignments from the IEEE bus and provide a suitable interface.

Table 3.1 (overleaf) compares the pin designations for each standard.

Table 3.1

PIN NUMBER	IEEE-488 STANDARD FUNCTION	IEC-625 FUNCTION
1	DIO1	DIO 1
2	DIO 2	DIO 2
3	DIO 3	DIO 3
4	DIO 4	DIO 4
5	EOI	REN
6	DAV	EOI
7	NRFD	DAV
8	NDAC	NRFD
9	IFC	NDAC
10	SRQ	IFC
11	ATN	SRQ
12	SHIELD	ATN
13	DIO 5	SHIELD
14	DIO 6	DIO 5
15	DIO 7	DIO 6
16	DIO 8	DIO 7
17	REN	DIO 8
18	GND 6	GND 5
19	GND 7	GND 6
20	GND 8	GND 7
21	GND 9	GND 8
22	GND 10	GND 9
23	GND 11	GND 10
24	LOGIC GND	GND 11

IEEE Connector

The pin connections and dimensions of the IEEE connector are illustrated in Figure 3.1 and in Table 3.1. Figure 3.2 illustrates the connections.

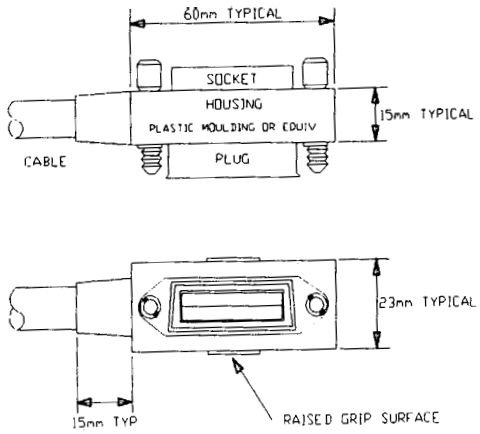


Figure 3.1

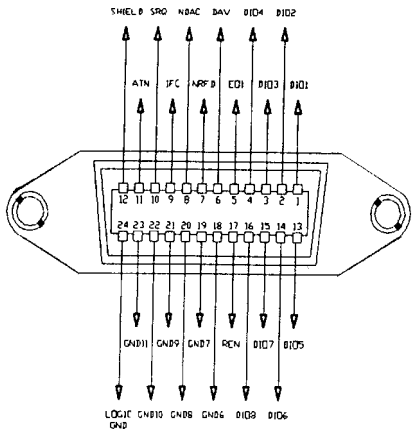


Figure 3.2

IEEE Address Section
Before operating the DMM over the IEEE bus, set the address on the rear of the unit to the required address and operating mode.

Address 31 is used to select self test mode.

The first five switches set the IEEE address and the last three switches are used to select the instruments operation mode. The last three switches are normally set off but may be used as follows:

Switch 6 - Disable IEEE talk (transmit) mode.

Switch 7 - Disable IEEE listen (receive) mode.

Switch 8 - Dual Primary Addressing mode. In this mode, the unit will respond to two primary addresses differing only in the least significant bit. For example, if the unit address selection switches are set for an address of 8, the unit will also respond to address 9.

NOTE: The instrument only reads the address switch upon power up. Therefore if the IEEE address is changed it will be necessary to switch the unit off and on again.

The 5012 may be made to display its IEEE address from the front panel by entering ‘99’ on the keypad. This will display the DIP switch positions on LED’s 1 to 8.

Local/Remote Operation
The 5012 is switched into remote operation when a valid command is received on the IEEE bus. The unit will remain in remote control until the LOCAL key is pressed from the front panel, the local command has been received by the IEEE or until the unit is switched off.

Interface Clear Command - IFC
This command initiates a complete reset of the unit, which is then unable to respond to any further IEEE commands for 1 second.

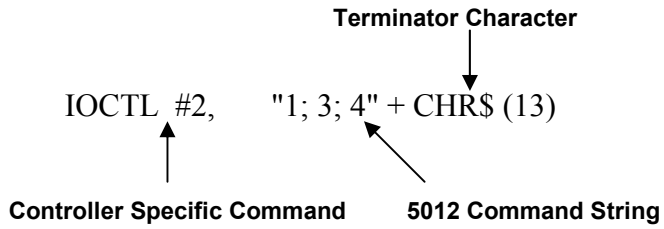
IEEE Command Format
IEEE commands are comprised of characters from the ASCII set. A series of commands can be used to simulate the manual operation of the unit.

The commands must be in one of the following formats:

1) A single upper case character (A to Z).
2) An upper case character followed by a number.

Commands may be sent individually or built into a string separated with a slash character (/).

A command string may take the form of -



The controller specific command is an instruction to the IEEE controller to read or write the following string to the device on the bus. This command may vary considerably between controllers and the example shown is a typical QuickBasic language by Microsoft command. Refer to your IEEE controller for specific commands.

The 5012 command string consists of commands from the 5012 Instruction set. These commands will instruct the 5012 to select a channel or other function.

Terminating Character
All command strings must end with a terminator character for the string to execute. This may be either a line feed or carriage return character as set by the O1, O12, O2 or O21 command.

IEEE Command Execution
Before and IEEE command can be executed the following conditions must be met.

1) The IEEE address and the talk/listen switches set correctly on the rear panel switch.

2) The command must be a valid command (invalid commands are ignored).

3) The command must be followed by a valid terminator character.

Commands
There are two formats for sending programming instructions to the unit.

Decimal Programming
The unit is programmed by sending the switch numbers which are to be operated. In the simplest form, the numbers are sent separately by semicolons and the new settings will over write the old settings.

i.e- 100 IOCTL #2, "1;4;8;21"+CHR$ (13)

This will set switches 1, 4, 8 and 21 on and all the rest off.

The switches can be operated without affecting the current settings by adding a '+' or '-' sign before sending the switch settings. If for example switches 1, 4, 8, and 21 are currently on the command string:

```
100   IOCTL  #2, " - 1;  + 6; + 22 " + CHR$ (13)
```

will turn switch 1 off and 6 and 22 on, leaving all the other switches the unchanged. Therefore after this command, switches 4, 6, 8, and 22 are all on.

If the timing of the operations is critical, delays can be specified in the command string. The delay may be specified in multiples of 100ms.

For example, if switches 1, 2, 3, 24 are currently switched on:

```
100   IOCTL  #2, " - 1; +23 / 10 / 20"
```

This command will turn switch 1 off in 1 seconds time from the command being received and turn switch 23 on in 2 seconds time.

The slash '/' figure indicates a delay and the delay value follows respectively. A maximum delay of 25 seconds may be set. If an on delay only is to be set, an off delay of zero must still be specified.

```
100   IOCTL  #2, " - 1; - 2 / 25"
```

Which will turn switch 1 and 2 off in 2.5 seconds.

```
100   IOCTL  #2, " - 1; + 7 / 0 / 2"
```

Which will turn off switch 1 now and turn 7 on in 0.2 seconds.

Hexadecimal Programming

By sending a string of six characters any pattern of relays can be set.

CHARACTER	1st	2nd	3rd	4th	5th	6th
RELAYS	24-21	20-17	16-13	12-9	8-5	4-1

The Characters 0-9 and A-F (i.e. Hexadecimal) are used to set the relay combinations in blocks of 4 relays.

In Table 3.2 W, X, Y and Z make up the block of four relays. W is the highest relay and Z the lowest.

For example, if the first hexadecimal character was to be sent it would apply to the first block of four, relays 24-21, W being relay 24 and Z being relay 21.

Table 3.2

CHARACTER SENT	RELAYS OPERATED			
	W	X	Y	Z
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

For example the following line would operate relays 1, 2 and 24.

```
100  IOCTL  #2,  "800003" + CHR$ (13)
```

If a terminator character is not received, the unit will ignore all subsequent commands until the termination character has been transmitted.

If an illegal character is received it will be ignored.

Data Format Commands

There are a number of commands to change the format of data the unit receives and transmits.

CHARACTERS SENT	EFFECT
I1	Change to Hexadecimal input mode
I2	Change to decimal mode (Default)
G1	Execute commands after G.E.T., <CR> or <LF>
G2	Execute commands after <CR> or <LF> only
L	Enter Local mode
T	Transmit the relay settings
O1	Terminate transmit and receive strings with <CR>
O2	Terminate transmit and receive strings with <LF>
O12	Terminate transmit and receive strings with <CR><LF>
O21	Terminate transmit and receive strings with <LF><CR>

Table 3.3

Group Execute Trigger
In this mode of operation, the entered data is stored until a Group Execute Trigger (G.E.T.) command is received. In this way, several instruments on the bus can be made to respond simultaneously.

To select Group Execute Trigger mode send G1 to the unit. To return to immediate mode, send data G2 to the instrument.

Readback of Switch Settings
The settings of the switches may be read back from the unit via the IEEE bus. The settings are in hexadecimal format and are terminated with the character defined by the 'O' command.

To read back the switch settings, the 'T' command is sent.

Programming Example
The following simple demonstration program has been written in Microsoft' QuickBasic.

The following program will allow the operator to send a number to the 5012 which can switch a relay on or off. Delays can also be specified and the switch settings may be read back.

```
100 REM *** 5012 IEEE CONTROL DEMO PROGRAM
200 OPEN "IEEECTRL" FOR RANDOM AS #1          'Open Control File
210 OPEN "IEEEDATA" FOR RANDOM AS #2          'Open Data File
220 T$ = CHR$ (13)  +  CHR$ (10)              'Set the terminator character
230 CLS
240 INPUT "Enter IEEE Address of 5012 ";IE$   'Select IEEE address
250 IOCTL #1, IE$                             'Send IEEE address
300 INPUT "ENTER COMMAND
(X TO EXIT, R TO READ SWITCH SETTINGS ";C$
310 IF C$  =  "x" THEN END
320 IF C$  =  "R" THEN GOSUB 400 : GOTO 300
330 IOCTL #2, C$ + T$                         'Send command to IEEE
340 GOTO 300                                  'Transmit switch settings
410 FOR DLY  =  1 TO 1000 : NEXT DLY           Delay
420 R$ = IOCTL$ (2)                           'Readback from IEEE
430 PRINT R$                                  'Display Readings
440 RETURN
```

Section 4 - Technical Description

Introduction

This section is a brief introduction to the technical description of the 5012.

The 5012 consists of four boards with plug in modules. -

The Digital Board
The Relay Boards. (2 off)
The LED Display Board

Digital Board

This board can be examined in three sections.

PSU Section

The transformer has three primary tappings on one winding and three secondary windings, of which one is centre tapped. One side of the 110V and 9V windings are taken to a common reference point and then to mains earth and the chassis of the instrument. The 22V-0V-22V winding has its centre tap taken to earth via a neon and capacitor. This will ensure that the 0V line does not drift above approximately 90V but still remains isolated from the other supplies.

The power supply section supplies five outputs. It has two unregulated supplies ; +10V and an unregulated +5V supply which may be pulsed up to 12V for latching relays. A regulated +5V supply is derived for the TTL circuits.

A regulated +15V/0V/-15V output is also supplied from the separate 22V-0V-22V winding. These supplies are not used in the 5012.

Both the +5V and +15V/-15V supplies have zener protection in case of over voltage.

Processor Section

The heart of the unit is the 6802 processor with its support I.C.'s. The main ROM is a 128k device, the 27128.

The board has 64k of RAM, (the 6264) for processor operation.

32 lines of I/O provided by two 68A21 Peripheral Interface Adaptors connected to the uP bus. These lines are used to select the relay channels.

A stall circuit will reset the board if the processor hangs and stops the PIA giving a low frequency pulse from its CA2 output.

Additional address decoding is used to select the IEEE chip, RAM, ROM, etc.

The membrane keyboard is read by an encoder, I.C.19, a 74LS923 addressed by IC8.

An additional PIA is used to provide the processor with information of installed options.

The IEEE Interface
The IEEE interface section is built around the Motorola 68488 General Purpose Interface Adapter (GPIA). The I/O lines of the 68488 are driven through MC3448 drivers. IEEE address selection is by an 8 digit switch whose condition is gated to the uP bus via a 74LS244 tristate buffer, I.C. 17.

The Relay Board
Both relay boards are identical in respect of their operation. However a connector is relocated between boards to obtain two banks of twelve relays.

The relays are turned on or off by the PIA lines from the digital board via a ULN2803 buffer I.C.

The LED Board
The LED's are driven directly by the PIA lines via current limiting resistor networks.

Also the local LED is driven by a spare PIA line.

Section 5 - Fault Diagnosis

Operations involve removal of the top cover. Before proceeding, ensure that the mains supply and any inputs have been disconnected. Failure to do so may expose live terminals and present an electric shock hazard.

Introduction
This section gives details of some possible problems and how to correct them.
Spare parts are available from Time Electronics and are listed in Section 6.
If the fault is not listed or if parts required are not listed, please enquire quoting instrument type and serial number.

Fault Check List

If the unit is completely dead with no front panel lights, check the following:

1) Mains supply.
2) Mains fuse blown in plug.
3) Mains fuses blown in appliance inlet.
4) Internal fuses have blown. (See fuse replacement).

The unit responds to manual controls but not to IEEE operation.

1) Defective IEEE cable.
2) Incorrect IEEE cable.
3) Incorrect terminator characters.
4) Incorrect IEEE commands.

The unit powers up but operates incorrectly.

1) Run the self test.

The 5012 occasionally resets to power on state.

1) Excessive mains interference is causing the uP to stop. The watchdog circuit is causing the reset. Add additional mains filtering.

Fuse Replacement
The 5012 has three types of fuse fitted. The mains fuse must be of the 20mm, HBC, Sand filled and ceramic body type.
The internal D.C. supplies have two 1A, 20mm anti-surge for the +15V and –15V rails and two 2A, 20mm semi-delay (type T) fuses for the 5V and 5/12V rail.

Replacement of the mains fuse.
The main fuse is located in the mains inlet socket. To replace this fuse, first remove the power lead from the instrument.
Remove the fuse holder / voltage setting cartridge from the power connector, then locate and remove the fuse holder.
Install the correct fuse and replace the cartridge. (800mA for 220V/240V A.C. or 1.6A for 110V A.C.)

Replacement of the D.C. Fuses
The D.C. fuses are located inside the instrument, on the processor / PSU circuit board, by the mains transformer.

Removal of the top cover is only recommended by qualified personnel as live parts are exposed. Ensure that the mains supply cable and any input leads have been disconnected before attempting the replacement of any fuses.

They are marked on the board as FS1 to FS4 with their appropriate rail voltages. See Figure 5.1 for fuse locations.

When replacing the fuses always replace with the same type and rating of fuse.

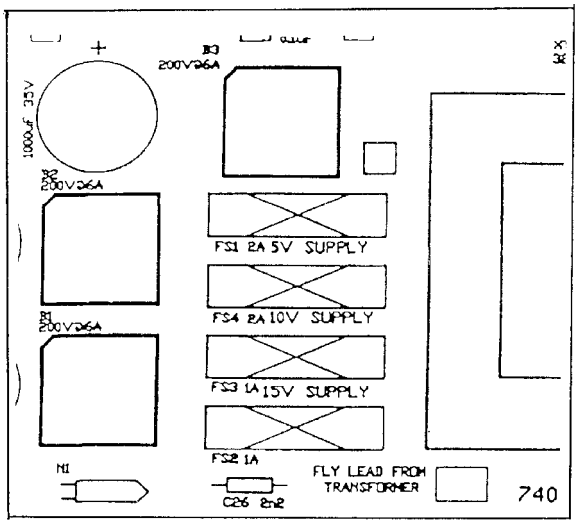


Figure 5.1

Replacement of the Digital/Relay or LED Boards
Only qualified personnel should attempt replacement of the relay, digital or LED display circuit boards.

Disconnect the mains supply cable before removing the top cover.

Digital Board
The digital board may be replaced by first removing the mains power connector fitted to the back panel. Unplug the mains power switch. The earth lead (yellow/ green) must also be removed from its earthing point. Remove all the ribbon cables and other connectors, noting their polarity.

The 3 regulators may now be unscrewed from the side panels, put the ceramic washers to one side. The 2 transit bolts, if still fitted, may now be removed from the underside of the chassis.

After removal of the seven 6BA screws, the board may be removed.

Fitting of the new board is in the reverse order. The 5V regulator (REG3) is screwed directly to the case and does not need a washer. Heatsink compound must be applied between the regulators' surfaces. Run self test to ensure correct operation of the new board.

Relay Boards
The relay boards may be replaced by removing the rear panel fixing screws and the five 6BA fixing screws located on the base of the 5012.

The cable assembly may now be unplugged and the boards removed.

Unscrew the boards and reassemble with the replacement.

Refit the boards in the reverse order. Run the self test to ensure correct operation of the 5012. (i.e. A click should be heard as each relay energises and de-energises.)

LED Boards
The LED board may be replaced by removing the bus connector and removing the six 6BA nuts and washers from the front panel.

The board may be easily removed and the new boards fitted in place. Replace the bus connector.

Run the self test to ensure correct operation of the board. (i.e. All LED’s should light in sequence.)

Section 6 - Spare Parts

Introduction

Time Electronics holds a comprehensive list of spare parts in stock. Please contact our Sales Office for prices or for parts not listed.

Main Parts

Order Code	Description
2519	Rear Panel Label
2599	Front Panel Label
2748	Technical Manual
6251	Mains IEC Socket
6356	Mains Rocker Switch
7511	Mains Transformer
9039	Front Feet
9035	Top Cover
9551	Digital Board

Relay Board Parts

4568	ULN2803 Driver I.C.
6240	37 Way ‘D’ Connector (Male)
6314	S2 12V Relay

LED Board Parts

1865	220R Resistor Network
4601	Red LED
6213	40 Pin Header Socket

Digital Board Parts

1243	100MΩ Resistor
1865	220Ω Resistor Network
3502	1000μF 63V Capacitor
3519	2200μF 63V Capacitor
3523	4700μF 35V Capacitor
4050	6V8 5W Zener Diode
4051	16V 5W Zener Diode
4103	1N4005 1A 50V Diode
4111	200V 3A Bridge Rectifier
4200	BC184L Transistor
4323	78T05CT 5V 3A Regulator
4324	LM7815CT+15V 1A Regulator
4325	LM7915CT-15V 1A Regulator
4532	74LS244 Octal Buffer
4555	MC3448 Bus Transciever
4556	MC68488 IEEE488 Adapter
4559	3.2768MHz uP Crystal
4578	X2864BD-18 Non-Volatile RAM
4579	UM6264-12L RAM
4583	6802 Processor
4585	68A21 PIA I.C.
4595	74C923 Keyboard Encoder I.C.
4647	Bridge Rectifier Heatsink
6111	2A 20mm Fast Blow Fuse
6132	1A 20mm Semi Delay Fuse
6203	IEEE Connector
7526	Piezo Buzzer

Section 7 - Guarantee and Servicing

Guarantee Period
The 5012 is guaranteed against defects in materials and workmanship for a period of one year from its delivery to the customer.

We maintain comprehensive after sales facilities and the unit can, if necessary be returned to us for servicing.

During this period, we will at our discretion repair or replace the defective item.

For servicing under guarantee, the instrument type and serial number must always be quoted, together with details of any fault and the service required. The purchaser of the instrument must pay all shipping charges to manufacturer. We will pay return shipping charges.

This guarantee is void if servicing has been attempted by an unauthorised person or agent.

If during the guarantee period, failure is due to misuse or abuse of the unit, the repair will be put in hand without delay and charged unless other instructions are received.

We guarantee that the software and firmware for this instrument will execute its programmed function. We do not guarantee that the operation will be uninterrupted or error free.

Please note that if you require a new UKAS Certificate during the warranty period, this will be charged at the current rate on our price list.

Service After Guarantee Period
Even after the guarantee period has expired, we can still recalibrate and service your instrument.

As the manufacturer, we have the specialised knowledge needed to keep your instrument in peak condition and we also maintain a comprehensive spare parts service.

Please enclose details of the service required and your full company details including a contact name.

Returning Instruments
When returning instruments, please ensure that they have been adequately packed, preferably in the original packing supplied. **We will not accept responsibility for units returned damaged.**

Please ensure that all units have details of the service required and all relevant paperwork including contact name, address and telephone number.

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