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USER MANUAL

SYSTEM 20

DUAL 16 CHANNEL RF MULTIPLEXER MODULE (MODEL No. 20-730-802)



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Observe the Electrostatic Sensitive Device Caution detailed in Section 8.

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CONTENTS

Copyright Statement ii

Technical Support and Warranty iii

Contents (this page) v

Section 1
Introduction 1.1

Section 2
Connector Pin Outs 2.1

Section 3
Fault Diagnosis 3.1

Section 4
Programming 4.1

Section 5
Reconfiguration 5.1

Section 6
Technical Specification 6.1

Section 7
Parts List and Accessories 7.1

Section 8
Warnings and Cautions 8.1

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SECTION 1 - INTRODUCTION

GENERAL

The Dual 16Ch RF MUX 200MHz Multiplexer Module 20-730-802 forms part of the System 20 Programmable Switching system and uses a standard IEEE-488.2/RS-232 message based interface. The module is designed for switching 2 wire 120Ω telecommunications traffic with signal frequencies up to 34MBit with good insertion loss, return loss and isolation performance. The schematic diagram of the multiplexer showing the channel numbering is shown in Figure 1.1.

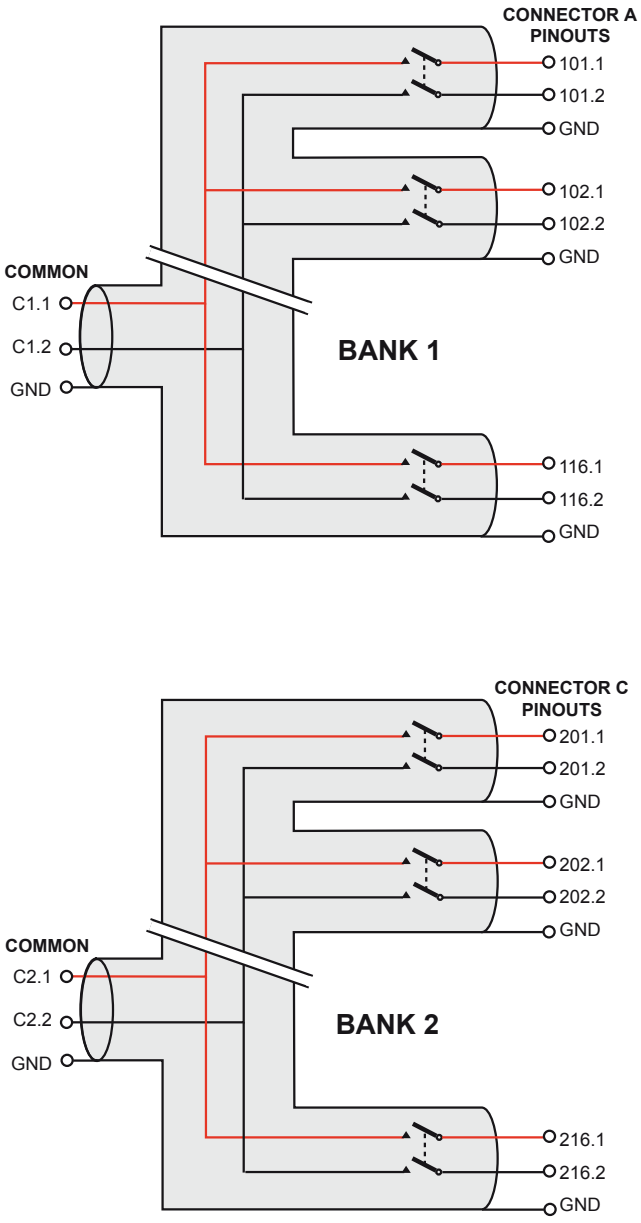


Figure 1.1 - Dual 16 Channel RF Multiplexer Module 20-730-802

SELF TEST

Full self-test down to component level is performed both at power up and at any other time, either manually or under program control. Module status is indicated by front panel mounted LEDs as follows:



Power LED - Connected to power system supply.
Active LED.- On whenever one or more switches are closed.
Test LED. - Active when self-test in progress.
Error LED. - Indicates that an error has been found during self-test.
Warning LED. - Not used in this version.

The 20-730-802 module is provided with a built-in RS-232 port (9600 baud software handshake) which is used for error diagnosis and configuration.

MECHANICAL DESCRIPTION

The 20-730-802 module conforms to the 6U height (262mm, 10.3 inches) Eurocard standard and comprises a PCB housed in a 160mm (6.3 inches) deep screened plug-in module. Panel width is 60.96mm (2.4 inches). The module comprises:

- 4 Front Panel Mounted 50-way D-type Male Connectors (connectors B and D are not used).
- Five Front Panel Mounted Status LEDs.
- One Front Panel Mounted RS232 Connector.
- One Rear Mounted 64-Way DIN 4162 Connector.
- 45 Screened Reed Relays.

FUNCTIONAL DESCRIPTION

The 20-730-802 Module, is powered by +5V and +12V supplies from the variable input power supply.

The module's interface to the device under test is via 2 front panel mounted 50-way D-type connectors. The module provides mounting for 45 screened reed relays and associated drive circuitry.

A Microprocessor Control SIM card (Figure 1.2) accepts control signals from the System 20 backplane connector J1. These signals are processed by microprocessor U1 and distributed around the card. Control signals generated by the Microprocessor Control SIM card are applied to the Power Relay Module (Figure 1.3) which is connected at J2. The control signals are passed via a bus to Relay Drivers U1 to U4 which in turn provide drive signals for the LEDs and relays. A PROM mounted on the SIMM Module identifies that module as a Power Relay module.

The Module also has a built in RS-232 port (9600 baud, XON/XOFF, 8 bit, no parity). This is provided on a 4 pin Molex datamate connector on the front panel. A separate adaptor lead to allow use with a standard 9 pin D-type is available. The RS-232 port allows the module to be configured, controlled and monitored from any RS-232 terminal.

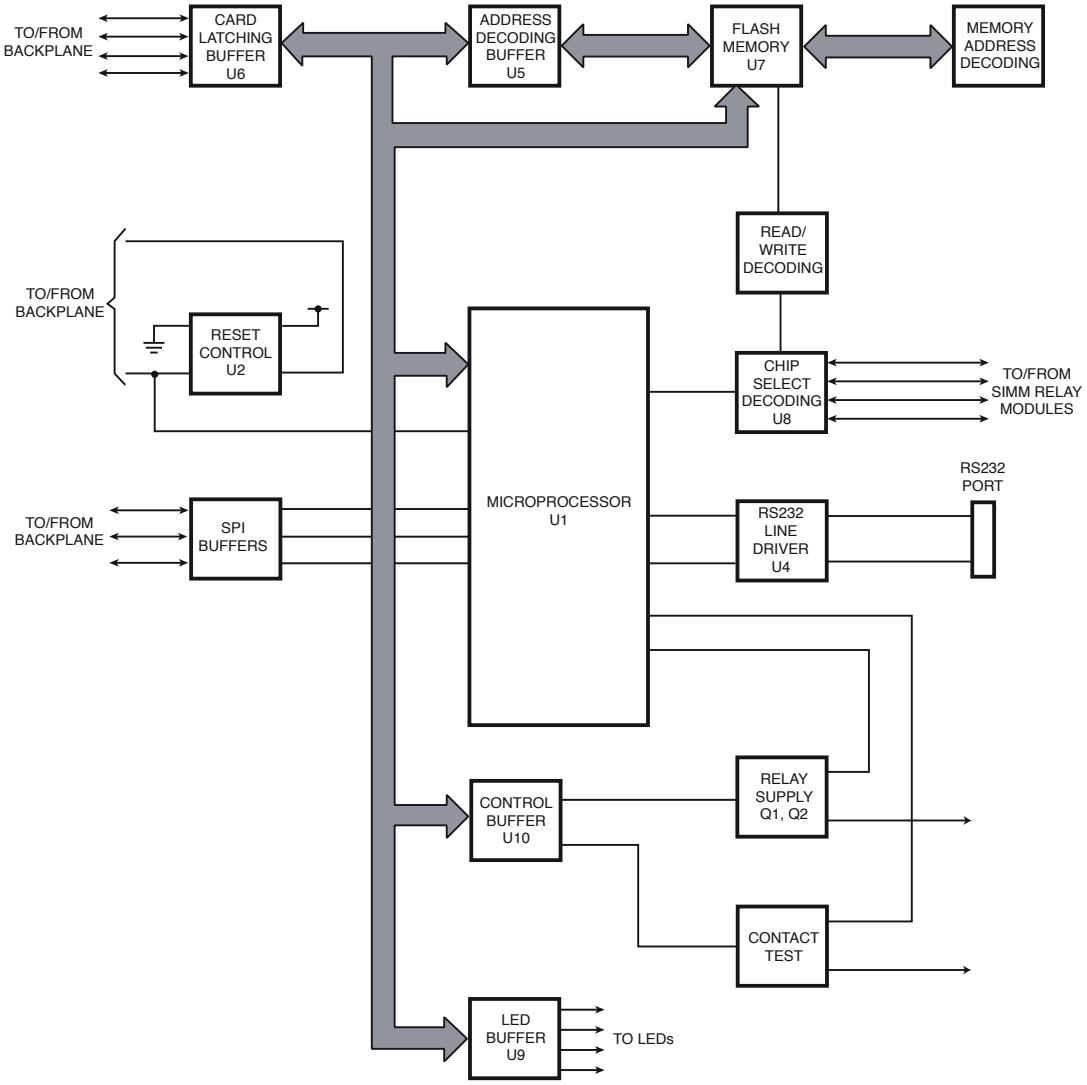


Figure 1.2 - SIM Module: Functional Block Diagram

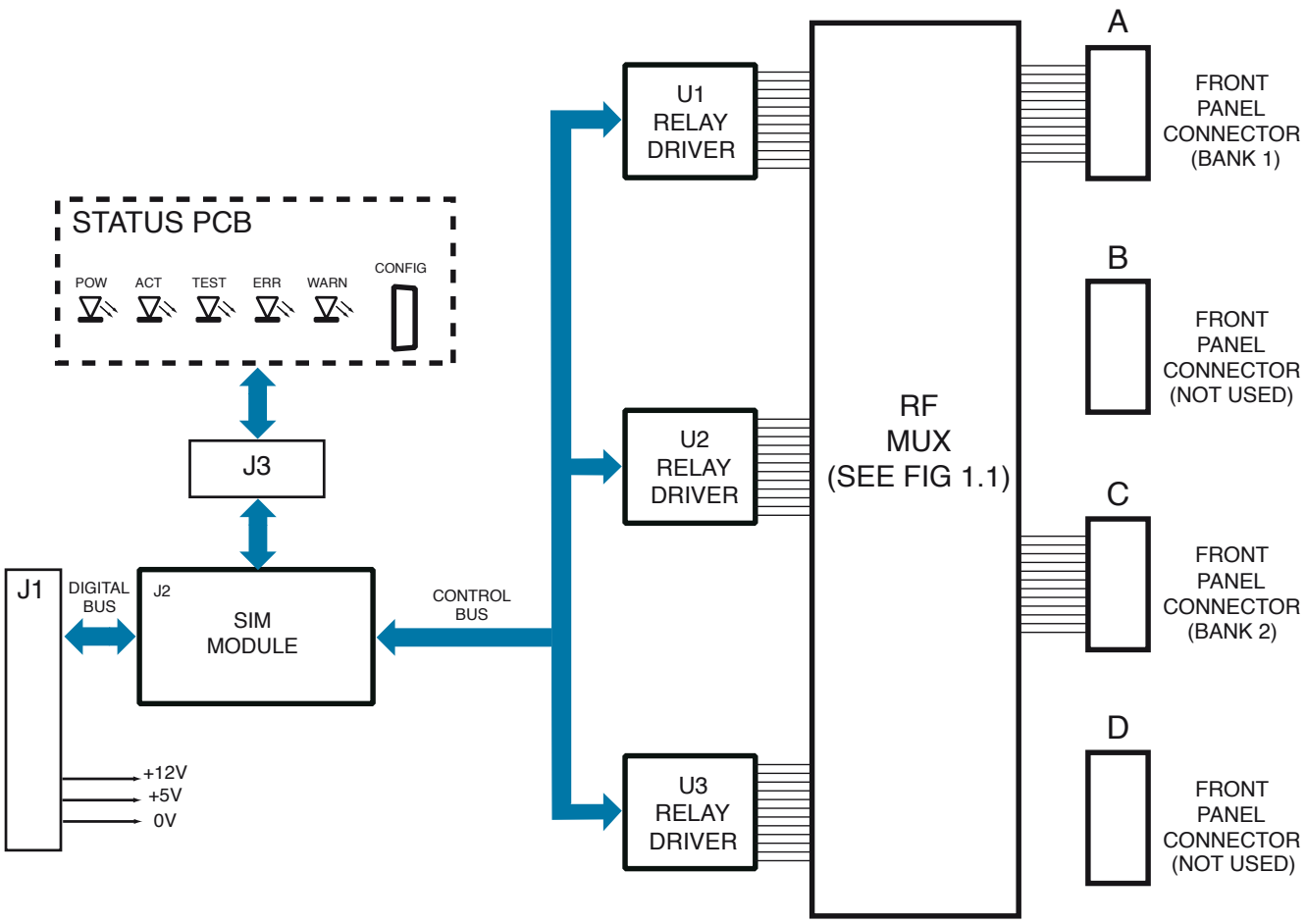


Figure 1.3 - Dual 16 Channel RF Multiplexer Module: Functional Block Diagram

SECTION 2 - PIN OUTS

Figure 2.1 provides pinouts for the 20-730-802 16 Channel RF Multiplexer Module.

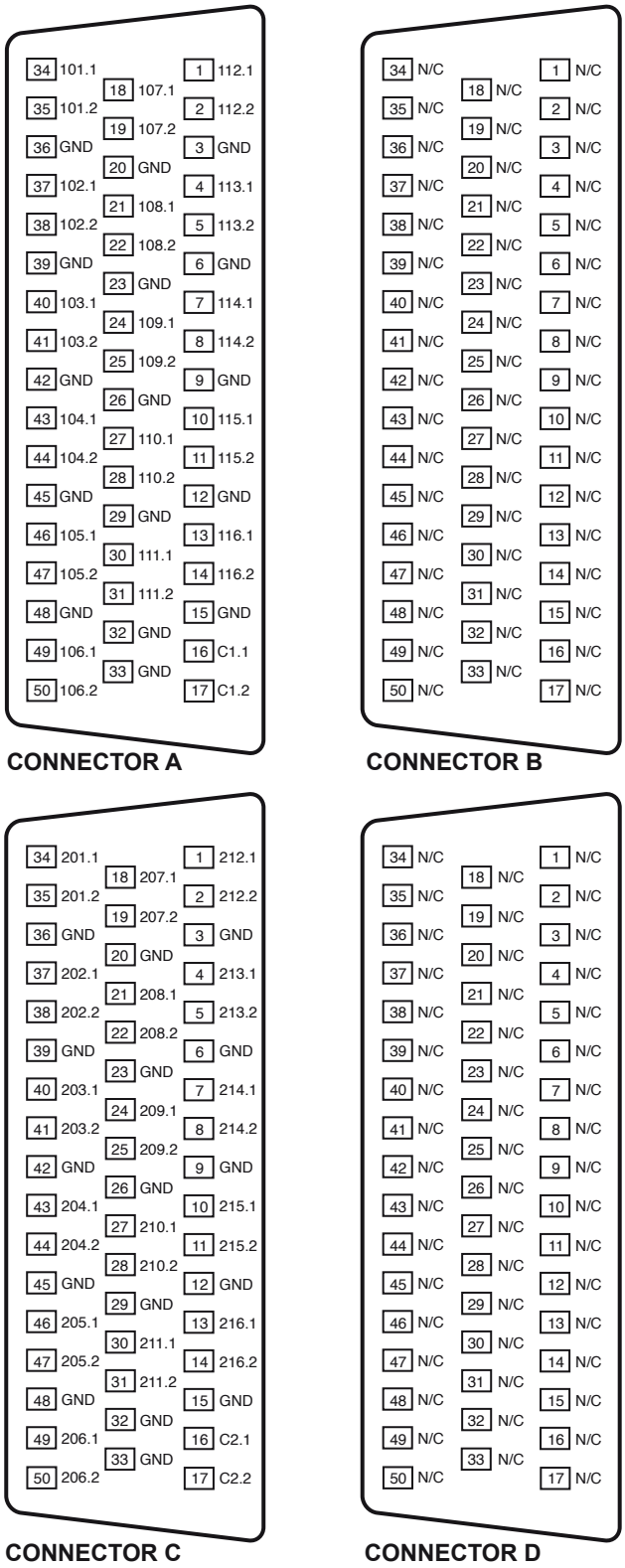
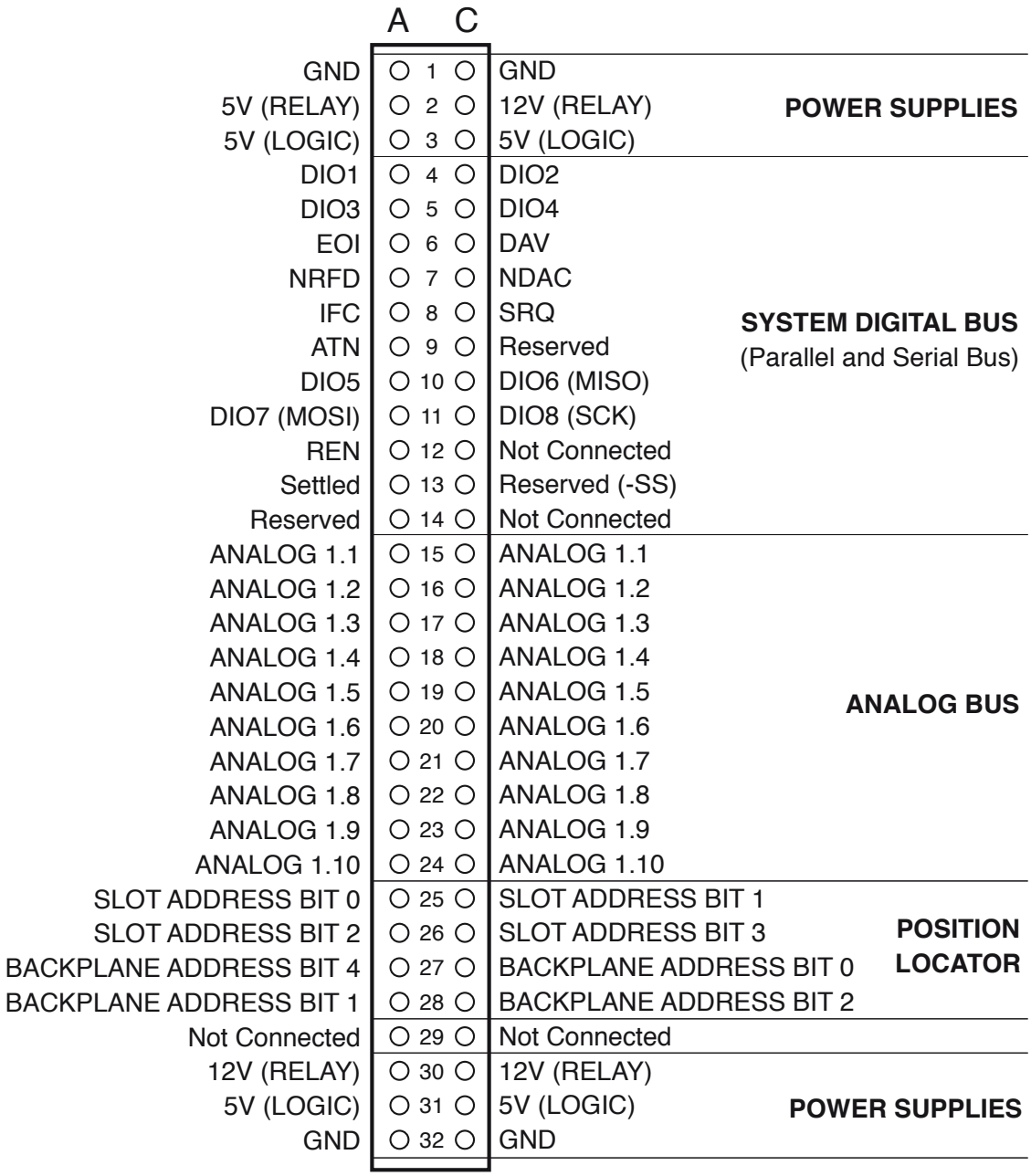


Figure 2.1 - Dual 16 Channel RF Multiplexer Module 20-730-802: Pinouts
Connectors are 50-way Male D-types Note: Connectors B & D are not used



Note:
The analog bus is not used.

Figure 2.2 - System 20 Top Backplane Connector: Pin Outs

SECTION 3 - FAILURE DIAGNOSIS

SELF-TEST FUNCTION

Self-Test is invoked at power on and may also be operated under software control using the *TST? command. If the Self-Test fails the Error LED on the front panel will be turned on. A full pass/fail description is available using the DIAGNOSTIC? command.

Self-Test comprises 2 levels, see Figure 3.1:

1. **Logic Test**: Checks all logic including on-board microprocessor RAM, ROM, and EEPROM, relay drivers etc.
2. **Relay Coil Test**: The resistance of all reed relay coils are checked.

Note: In the unlikely event of a relay needing replacement **Spare Reed Relays** are built onto the module circuit board to facilitate easy maintenance with minimum downtime. Additional reed relays are available from Pickering Interfaces.

SELF-TEST OPERATION

Self Test is always run at power on, taking approximately 5 seconds.

If self test is run under software control it will firstly **clear the whole module**. So it is very important to prepare your external instruments and U.U.T. for this. During self-test all switches are opened so your external circuitry will see only very high resistance inputs.

When the self-test has finished the relays will be returned to an all clear state (i.e. the previous state will not be remembered!).

Please note that because of the long self-test time your computer may time out waiting for the test result (many PC's have default timeouts set to **10 seconds**).

CONFIGURING SELF TEST

Self Test may be configured so that some or all of the test functions can be disabled. This is achieved by setting the appropriate bit in the test configuration byte. Refer to Section 5 for details on how to reconfigure modules to your application.

DETAILED SELF TEST REPORTING USING THE DIAGNOSTIC? QUERY

The DIAGNOSTIC? query will give an ASCII string detailing any self test failures. These will include:

Logic:	μP, RAM, EPROM, Relay Drivers, Invalid Link Settings etc.
Relay Coils:	Open Circuit Coil.

This string is not intended to be processed by the user's software, it is suitable for copying directly onto the screen of your control computer. This information will then indicate maintenance required (please contact Pickering for further help).

Note:

If the interface module locks up while running high speed programs check the setting of the SPI bus. Refer to Section 5.

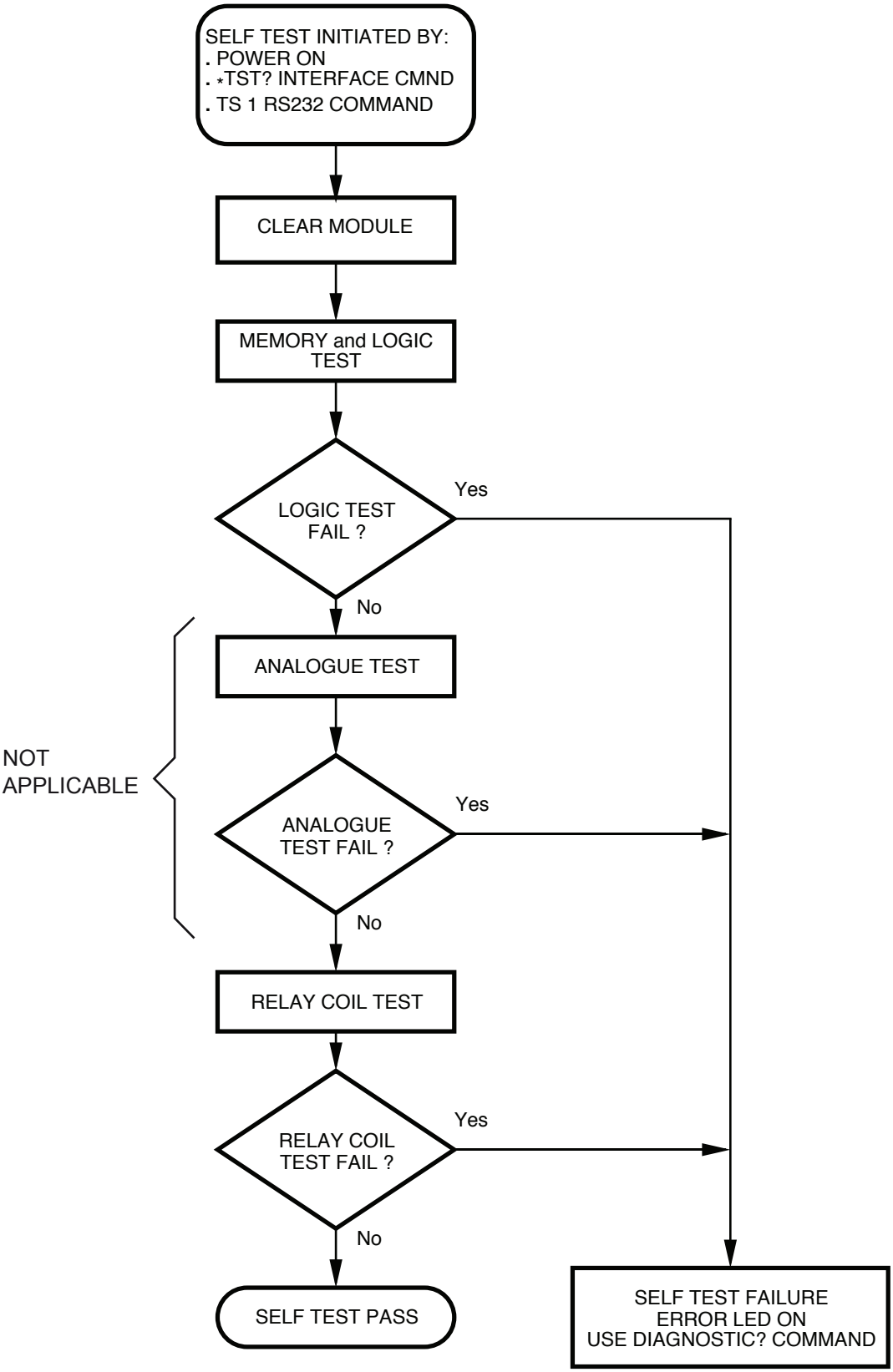


Figure 3.1 - Self-Test Flow Chart

SECTION 4 - PROGRAMMING

SELECT MODULE ADDRESS

All programming commands, etc are provided in the programming manual for the IEEE-488.2/RS-232 interface module.The module internal address is factory pre-set, please refer to case schematic diagram supplied with the System 20 case. To change the internal address please refer to Section 5, Reconfiguring Modules to Your Application.

PROGRAMMING USING THE INTELLIGENT GPIB/RS-232 INTERFACE

The 20-160 Module is simple to program either by single bit or by word.

ARESET a	Clear all outputs on module **a**
CLOSE a,b	Set bit number **b** on module **a**
DELAY t	Force a minimum delay of **t** milliseconds between two instructions
OPEN a,b	Clear bit number **b** on module **a**
RESET	Clear all bits/switches on all modules
VIEW? a[,b]	View status of module **a**, can be viewed at any time either as a word or by bit **b** as a logical value (1 or 0)
WRITE a,w	Send byte **w** to module **a**.

The module is programmed as an 8 bit output port using either single bit, byte (8 bits), 16 bit word or 32 bit word.

OPERATING SPEED

Module operating speed, i.e. the time taken to open or close a channel, is approximately 10ms using the 10-921 IEEE-488.2/ RS-232 interface module.

PROGRAMMING EXAMPLES

Example 1 (with reference to the front panel pin out diagram provided inn Section 2)
To operate Channel 4 of Bank 2, type: CH 1,2,4
Where:
1 = the module number
2 = the bank number
4 = the channel number
The output is at Connector C, pin 43 (204.1) and pin 44 (204.2)

Example 2 (with reference to the front panel pin out diagram provided inn Section 2)
To operate Channel 6 of Bank 1, type: CH 1,1,6
The output is at Connector A, pin 49 (106.1) and pin 50 (106.2)

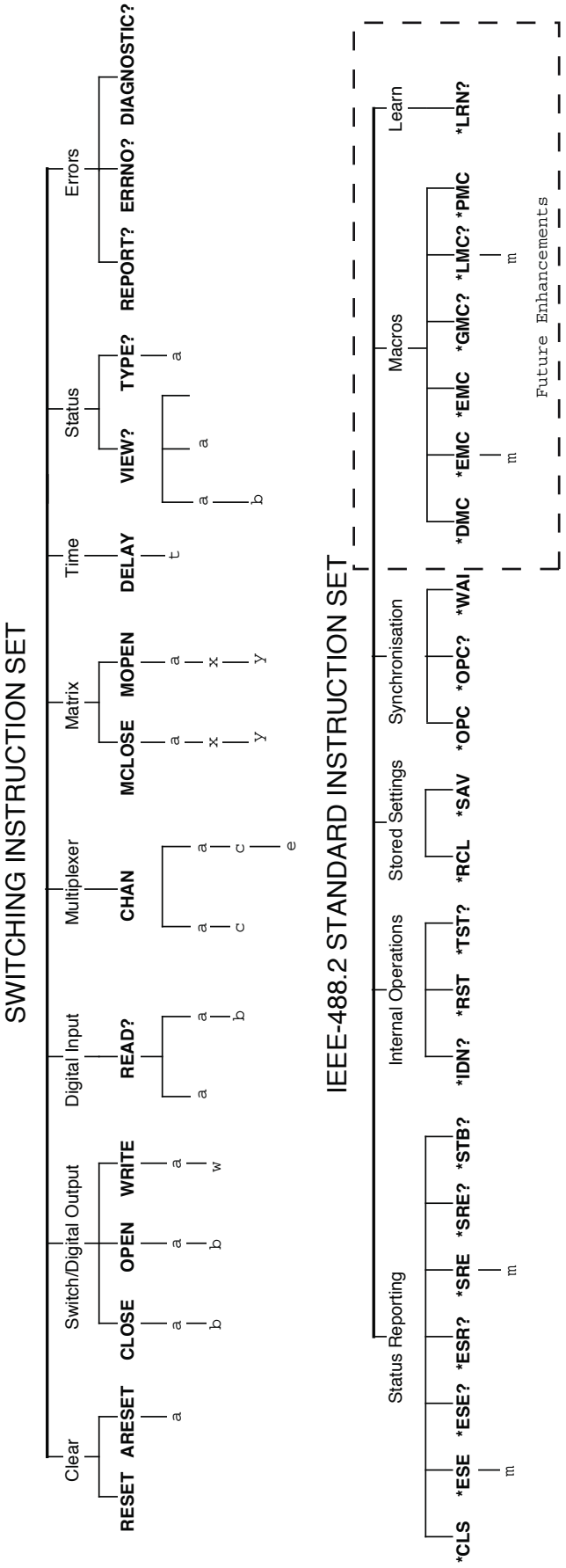


Figure 4.1 - Interface Module Instruction Set

SECTION 5 - RECONFIGURING MODULES

MODULE CONFIGURATION

Normally, modules are supplied configured to the customer's requirements. Configuration data is stored within the module in EEPROM. The module configuration (e.g the module address) may be altered via the internal RS232 Serial port. The serial port is accessed via a 4 pin Datamate connector located on the front panel. In order to change the configuration, a dedicated connection cable (available on request) must be connected between the 4 pin Datamate connector and a terminal or a computer terminal program, set up as follows:

Baud rate: 9600
8 Data bits
1 Stop bit
No parity.

There are three groups of commands available via the internal RS232 interface, which are used to operate and configure the module. The groups are;

1. **User Instruction Set**: Commands to operate switches, provide relay status and module information.
2. **Configuration Instruction Set**: Commands to set up the module to a specific configuration.
3. **Factory Instruction Set**: Commands to set the module self test limits.

All instructions must be entered as shown for the command to operate correctly.

USER INSTRUCTION SET

Command	Ascii	Bytes	Description	Example
Relay Block	BL	8 bytes of data	64 bit block of relay data.	
Block View?	BV		View status of all relays.	
Diagnostic?	DI		Report self test errors.	
Dump	DU	0	Relay test history dump.	DU 0
		1	Dump even if data is invalid.	DU 1
Close	CL	relay	Close a relay contact.	CL 7.
Close	CL	bank,channel	Close a MUX channel.	CL 1 4.
Close	CL	x axis, y axis	Close a matrix crosspoint.	CL 7 3.
Open	OP	relay	Open a relay contact.	OP 7.
Open	OP	bank,channel	Open a MUX channel.	OP 1 4.
Open	OP	x axis, y axis	Open a matrix crosspoint.	OP 7 3.
Reset	RS		Reset all relays to off.	
Service?	SR		Report all service warnings.	
Test	TS	0	Return result of last self test.	TS 0
		1	Initiate self test and return result.	TS 1
Type?	TY		Returns module type data string.	
Who?	WH		Module introduction string.	
MUX Clear	XC	bank	Reset an individual mux bank.	XC 01.

CONFIGURATION INSTRUCTION SET

The Configuration instruction allows a module to be set up for a specific application by setting up its address, bank and self test options etc.. To view the current configuration settings without altering any parameters simply type "CF".

Config Command

Ascii	Bytes	Description	Default
CF	1 x	x = Module address.	CF 1 x
CF	2 x	x = Number of multiplexer banks in module.	CF 2 5
CF	3 x	x = Number of pods in module.	CF 3 0
CF	4	Switch Mode	CF 4 1
CF	5	Switch Type.	CF 5 0
CF	6	Panel Width. For future use.	CF 6 0
CF	7	Selftest	CF 7 94
CF	8	Module data 1	CF 8 30
CF	9	Module data 2	CF 9 0
CF	10	Module data 3	CF 10 0
CF	11	Module data 4	CF 11 0
CF	12	Configuration mode	CF 12 0

Module data is dependent upon Module type as follows;

Module data byte	I/O Module	MUX Module	Matrix Module
1	Bits Out	Size	X Size
2	Bits out start	Start	Y Size
3	Bits in	Not used	X Start
4	Not used	Not used	Y Start

FACTORY INSTRUCTION SET

The Factory Instruction Set is used to set the selftest threshold levels for the modules. The parameters are shown for information only and should not be altered without contacting Pickering Interfaces as they are primarily for factory use only.

Limit Command

Ascii		Description	Default
ZL	1	Minimum coil threshold.	ZL 1 30
ZL	2	Maximum coil threshold.	ZL 2 144
ZL	3	Contact closed error threshold.	ZL 3 69
ZL	4	Contact closed service threshold.	ZL 4 48
ZL	5	Contact open error threshold.	ZL 5 128
ZL	6	Service temperature threshold.	ZL 6 136
ZL	7	Fail temperature threshold.	ZL 7 168
ZL	8	5V low threshold.	ZL 8 244
ZL	9	Minimum LED voltage threshold.	ZL 9 160
ZL	10	Maximum LED voltage threshold.	ZL 10 208
ZL	11	Minimum Panel LED voltage threshold.	ZL 11 128
ZL	12	Maximum Panel LED voltage threshold.	ZL 12 176
ZL	13	12V low threshold.	ZL 13 192
ZL	14	12V high threshold .	ZL 14 254
ZL	15	Selftest retries before failure.	ZL 15 10
ZL	16	Settled delay, in 10us increments.	ZL 16 25 (250us)

SPI BUS

To set the SPI bus proceed as follows:

Connect a terminal to the interface module RS232/RJ45 connector using the cable supplied.

Configure the terminal program as detailed in the module configuration paragraph on page 5.1.

To confirm set-up is correct type the following:

VI?

The display shows modules fitted in the system.

To change the SPI delay setting type the following:

SPI?

The display shows the current SPI delay setting.

The setting should be 65.

If the setting is incorrect proceed as follows:

Type SPI 65 and press enter.

Confirm the setting as being accepted by typing SPI?

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SECTION 6 - SPECIFICATION

SWITCHING SPECIFICATION

Contact Type:	Ruthenium Reed
Characteristic Impedance:	120Ω balanced
Maximum Frequency:	200MHz
Rise Time:	< 1ns
Insertion Loss:	< 3dB
Return Loss:	< 11dB (1:1.8 VSWR)
Isolation (at max frequency):	> 60dB
Crosstalk (at max frequency):	> 55dB
Maximum Voltage:	100V DC
Maximum Power:	10W
Maximum Switch Current:	0.5A
Maximum Carry Current:	1.2A
On Path Resistance:	500mΩ
Off Path Resistance:	> 10^{10} Ω
Differential Thermal Offset:	< 10µV
Expected Life (Low Power):	> 10^{8}
Expected Life (Max power):	> $5x10^{6}$
Switching Time:	10ms

POWER CONSUMPTION SPECIFICATION

5V d.c.	< 0.5A
12V d.c.	< 0.7A
Total Power	< 11W
Power Up Delay	< 5s (required for self-test)

ENVIRONMENTAL SPECIFICATION

Operating Temperature	0 to 45ºC
Storage Temperature	-20 to +75ºC
Humidity	95% Non Condensing
Cooling Requirements	Forced ventilation advised

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The following pages provide parts lists and component location diagrams for the Dual 16 Channel RF Multiplexer Module 20-730-802.



Table 7.1 provides a parts list and Figures 7.1 and 7.2 a component layout diagram for the 20-730-802 Dual 16 Channel RF Multiplexer Module.

TABLE 7.1 - Dual 16 Channel RF Multiplexer Module 20-730-802 Parts List

Circuit Ref	Pickering Part No.	Description	Qty
RL23 to RL44, RL67 to RL89	C/PC/220	DPST RELAY 109-2-A-12/421/D	45
C1	C/CP/003	Cap Tant 22uF 16v	1
C2, C3	C/CP/009	Cap Elect 10uF 16v	2
C4 to C9	C/CP/001	Cap Cer 10nF 63v	6
J1	C/CN/001	DIN PLUG 41612C R/A 64 WAY A/C	1
J2	C/CN/276	SIM CONNECTOR 72 WAY AU STRT	1
J3	C/MS/079	14 way fem Skt to 14 way Trans	1
U1 to U3	C/IC/035	UCN5818EPF 32-bit SMT Driver	3

NOTE: Only relays in locations 23-44 & 67-88 are fitted, relay 89 is a spare relay.

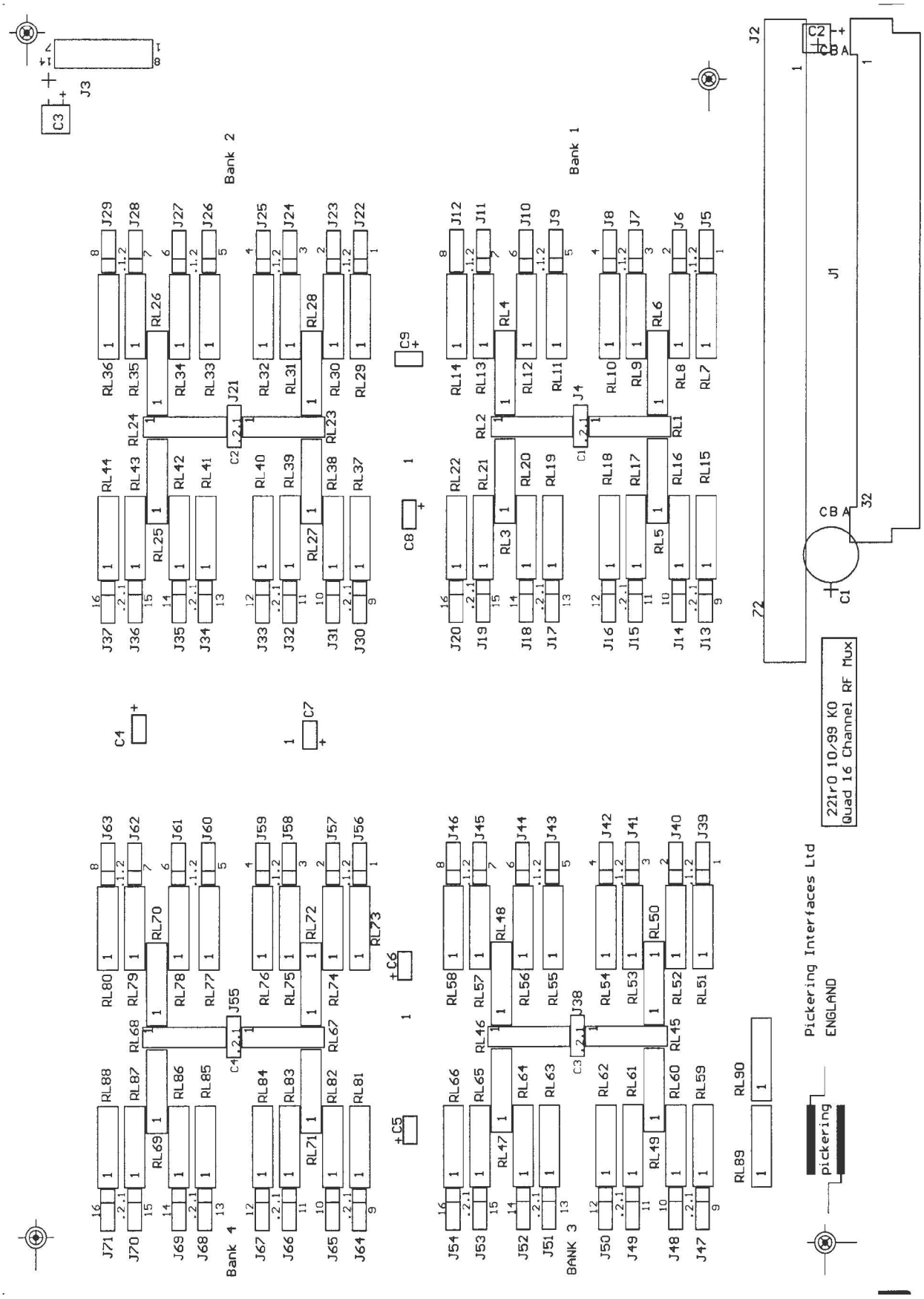


Figure 7.1 - Dual 16 Channel RF Multiplexer Module 20-730-802: Top Component Layout

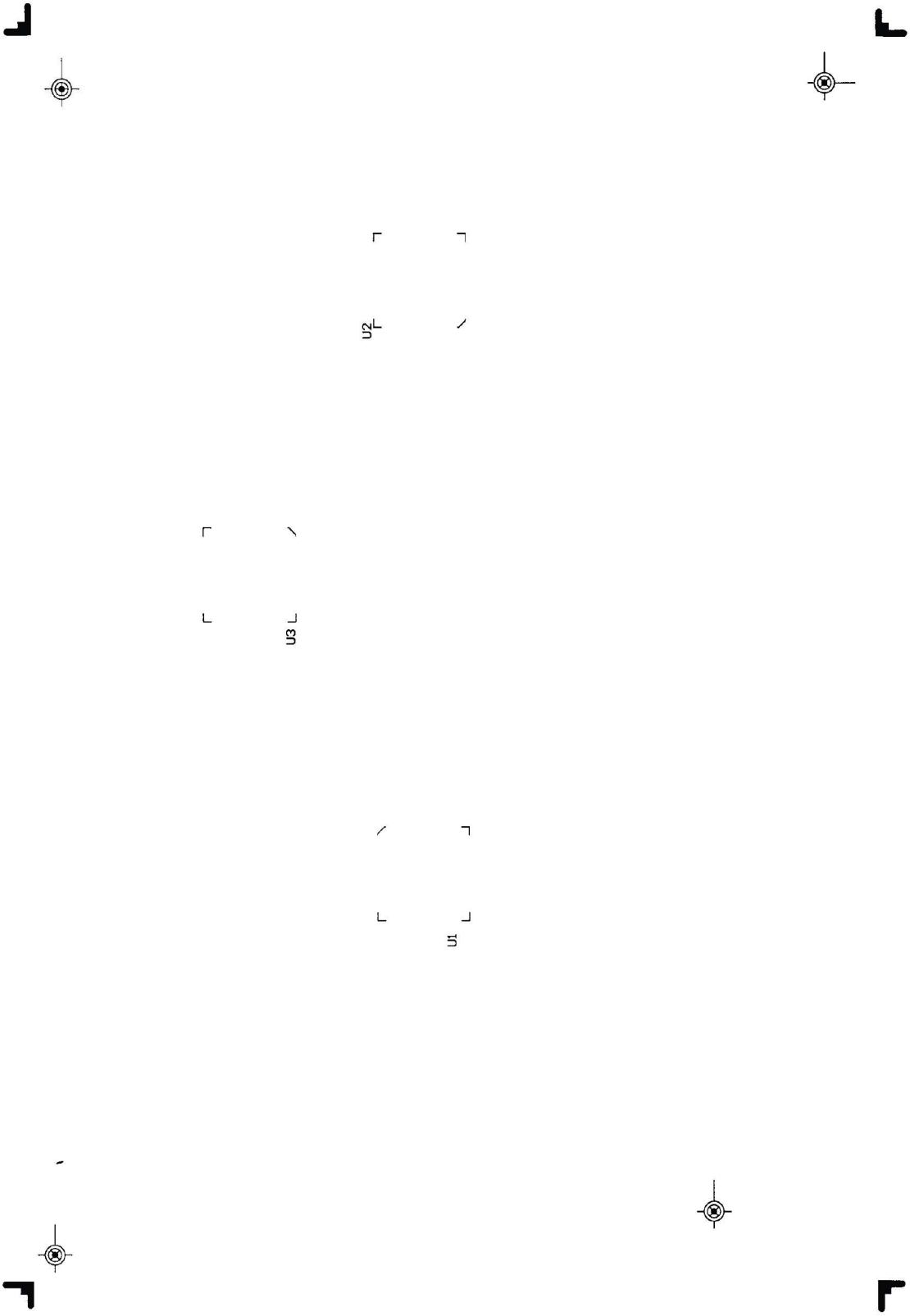
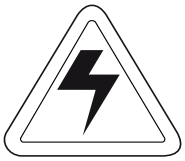


Figure 7.1 - Dual 16 Channel RF Multiplexer Module 20-730-802: Rear Component Layout

SECTION 8 - WARNINGS AND CAUTIONS



WARNING - DANGER OF ELECTRIC SHOCK

THIS MODULE MAY CONTAIN HAZARDOUS VOLTAGES. BEFORE REMOVING THE MODULE FROM THE RACK REMOVE ALL SUPPLIES.



CAUTION
Handling of Electrostatic-Sensitive Semiconductor Devices

Certain semiconductor devices used in the equipment are liable to damage due to static voltage. Observe the following precautions when handling these devices in their unterminated state, or sub-units containing these devices:

(1) Persons removing sub-units from an equipment using these devices must be earthed by a wrist strap and a resistor at the point provided on the equipment.

(2) Soldering irons used during the repair operations must be low voltage types with earthed tips and isolated from the mains voltage by a double insulated transformer.

(3) Outer clothing worn must be unable to generate static charges.

(4) Printed Circuit Boards (PCBs) fitted with these devices must be stored and transported in anti-static bags.

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