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User Manual

SYSTEM 10/20

Microwave Multiplexer Module
(Model Nos. 20-785/785A)



Issue 5.0 July 2015

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PRODUCT SAFETY

SAFETY SYMBOLS

The following safety symbols may be used on the product and throughout the product documentation.

MEANING / DESCRIPTION	SYMBOL
PROTECTIVE EARTH (GROUND) To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth (ground) electrode.	
DANGEROUS VOLTAGE To indicate hazards arising from dangerous voltages.	
WARNING / CAUTION An appropriate safety instruction should be followed or caution to a potential hazard exists. Refer to the relevant instructions detailed within the product manual.	
HEAVY If this product is heavy reference should be made to the safety instructions for provisions of lifting and moving.	
STATIC SENSITIVE To indicate that static sensitive devices are present and handling precautions should be followed.	

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WARNINGS AND CAUTIONS

WARNING - HAZARDOUS ENVIRONMENTS	SYMBOL
This product is not specifically designed for use in hazardous environments, for example in explosive atmospheres. If the product is to be used in hazardous environments we recommend that the user ensures suitable protective measures are taken.	

WARNING - DANGER OF ELECTRIC SHOCK	SYMBOL
This module may contain hazardous voltages. Before removing the module from the rack remove all supplies and disconnect user I/O signals. Unused slots in the System 10/20 chassis are populated with blanking plates to prevent access to user I/O signals that may be present. Blanking panels are available to order from Pickering in a variety of slot widths. If the product is not used in this manner for example by using an extender card then additional care must be taken to avoid contact with exposed signals.	

CAUTION - HANDLING OF ELECTROSTATIC-SENSITIVE DEVICES	SYMBOL
Certain semiconductor devices used in this equipment are liable to damage due to static voltage. Observe the following precautions when handling these devices in their unterminated state, or sub-assemblies containing these devices: 1. Persons removing sub-assemblies from 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.	

CAUTION - PRODUCT DOCUMENTATION	SYMBOL
Suitably qualified & trained users should ensure that the accompanying documentation is fully read and understood before attempting to install or operate the product.	

SAFETY INSTRUCTIONS

SAFETY INSTRUCTIONS
All cleaning and servicing requires the equipment to be isolated and disconnected from the power source and user I/O signals (refer to the Maintenance Section). • Appropriate manual handling procedures should be followed as dictated by the weight of the individual module or the combined weight of the modules & chassis. • Should a fault occur with the module or chassis, immediately isolate and disconnect the incoming power to the chassis and the user I/O signals. • Ensure the equipment is installed, operated and maintained by trained and authorised personnel.

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SECTION 1 - TECHNICAL SPECIFICATION

20-785/785A
18GHz Microwave Multiplexer Module

- Dual or Quad 6 Channel Multiplexer
- 18GHz Bandwidth With Options for 26.5 and 40GHz
- Self Terminating Option Available
- 50Ω SMA Connectors
- Microwave Relays Are Quickly Replacable For Minimum Downtime
- Pickering Interfaces Can Construct and Test Custom Microwave Switching Networks



System 20 Microwave multiplexer modules are suitable for switching 50Ω signals up to 18GHz, optionally to 26.5 or 40GHz. Available in a choice of formats as dual or quad 6 channel Multiplexer, they are suitable for constructing complex microwave switching networks.

The 20-785 microwave multiplexer modules provide a range of switching configurations to suit most applications, they will switch up to 18GHz, or optionally to 40GHz, using high performance front panel mounted SMA connectors.

These modules give you the highest RF & Microwave switching performance available within a Pickering Switching System. Applications are mainly in the Microwave region, however there are many uses in the RF spectrum where extremely low insertion loss and ultra high isolation are critical.

Model 20-785 has either dual or quad six channel multiplexers, this model is particularly suitable for constructing large switching networks (please refer to diagram overleaf).

The 20-785 now features “hot” replacable relays. These may be replaced without removing the module from the mainframe, while the other relays are still operating.

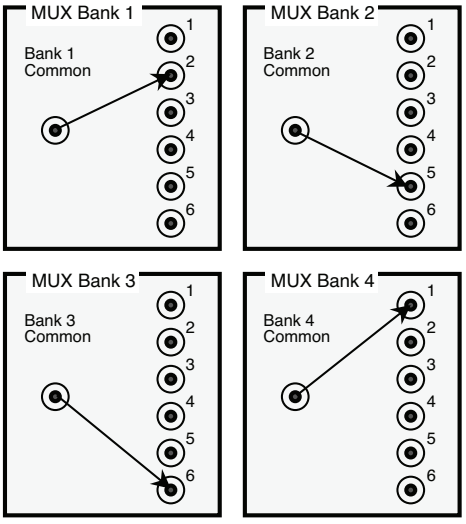
Automatic Termination Option

Automatic termination into a built-in 50Ω matched load (for non-selected channels) is available for 50Ω multiplexers, please specify option -T. There is a maximum power rating of 1W per channel or 3W per 6 channel multiplexer.

20-785 (6 Channel Multiplexer) Programming

Microwave Multiplexer modules are simple to program:-

`ARESET a`	Open all channels on device a
`DELAY t`	Force a minimum delay of t milliseconds between two instructions
`DIAGNOSTIC?`	Report any Self Test errors
`RESET`	Open all switches on all modules
`VIEW? a`	View status of device a
`CHAN a,b,c`	Select channel c on multiplexer a. The address is prefixed by bank number b by 1, 2, 3 or 4 to indicate the bank number



Model 20-785-524 Features 4 Separate 6 Channel RF Multiplexers (model 20-785-522 has 2 multiplexer banks)

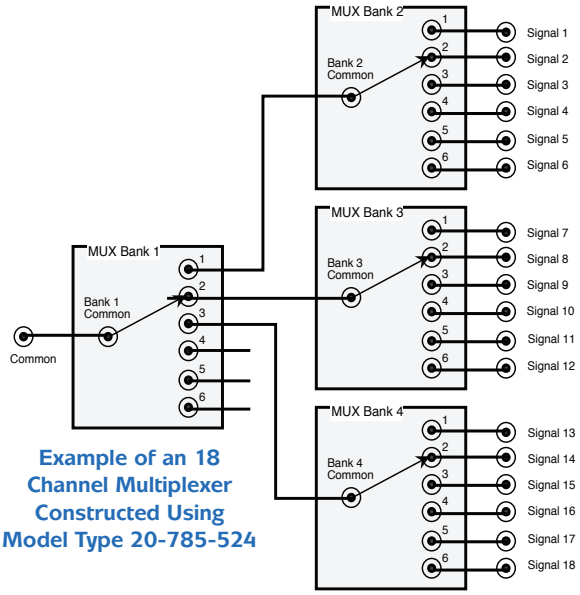
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Specification (18GHz Version)

Characteristic Impedance:	50Ω
Maximum Frequency: Rise Time:	18GHz <3ps
Insertion Loss (<18GHz): V.S.W.R. (<18GHz): Isolation (<18GHz):	<0.5dB <1:1.5 >60dB
Maximum Power (<3GHz): Maximum Power (3-12GHz): Maximum Power (12-18GHz):	100W 60W 30W
Maximum Voltage: Maximum Switch Current:	100V DC 1A
On Path Resistance: Off Path Resistance:	<200mΩ $>1x10^{10}$Ω
Vibration:	Sine 1mm, 5-60Hz Sine 10g, 60-2000Hz
Switching Time:	15ms
Expected Life (Low power): Expected Life (Full power):	$>2x10^{7}$ operations $>3x10^{5}$ operations

Additional Specification (26.5GHz & 40GHz Version)

Insertion Loss (<26.5GHz): V.S.W.R. (<26.5GHz): Isolation (<26.5GHz):	<0.7dB <1:1.7 >55dB
Expected Life:	$>2x10^{6}$ operations
Insertion Loss (<40GHz): V.S.W.R. (<40GHz): Isolation (<40GHz):	<1.1dB <1:2.2 >50dB
Expected Life:	$>2x10^{6}$ operations



Example of an 18 Channel Multiplexer Constructed Using Model Type 20-785-524

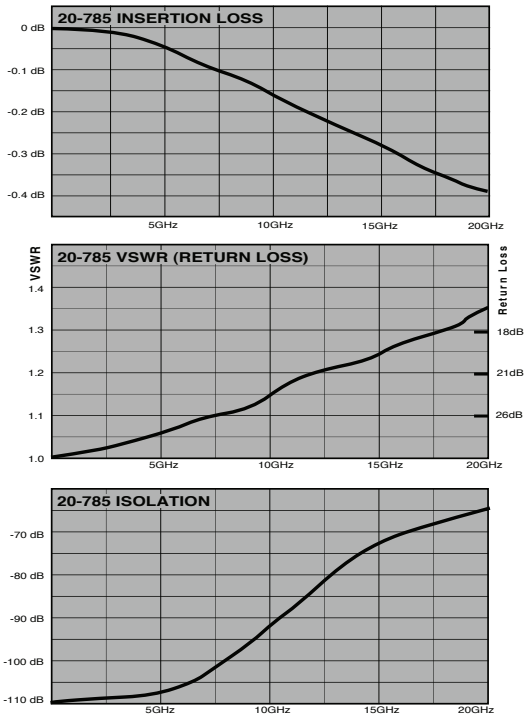
Operating/Storage Conditions

Operating Conditions

Operating Temperature:	0°C to 55°C
Humidity:	Up to 95% non-condensing
Altitude:	5000m

Storage and Transport Conditions

Storage Temperature:	-20°C to +75°C
Humidity:	Up to 95% non-condensing
Altitude:	15000m



Typical RF Performance Plots for 20-785

Self Test

Self-Test is invoked at power on and may also be operated under software (*TST?) or via a recessed push button. Self-Test pass is indicated on a front panel LED with a full pass/fail description available using the DIAGNOSTIC? command. Self-Test comprises 2 levels:-

1. **Logic Test**
2. **Relay Coil Test**

Please note that the relay contacts themselves are not tested.

Easy Repair

To allow fast in field repair all relays may be individually replaced without removing the module from the switching system case.

Width and Dimensions

All modules conform to the 6U height (262mm) Eurocard standard and are 160mm deep, panel width is 2.4 Inches (60.9mm), except the -T version which is 3.6" (91.5mm).

Product Order Codes

†Dual 6-chan MUX, 18GHz, SMA, 50Ω	**20-785A-522**
Quad 6-chan MUX, 18GHz, SMA, 50Ω	**20-785A-524**
†Dual 6-chan MUX, 26.5GHz, SMA, 50Ω	**20-785-532**
Optional Terminating Version (50Ω) (only available for the 3 codes shown above)	**-T**
Quad 6-chan MUX, 26.5GHz, SMA, 50Ω	**20-785-534**
†Dual 6-chan MUX, 40GHz, SMA-2.9, 50Ω	**20-785-542**
Quad 6-chan MUX, 26.5GHz, SMA-2.9, 50Ω	**20-785-544**
†Dual 6-chan MUX, 1GHz, 1.6/5.6, 75Ω	**20-785-752**
Quad 6-chan MUX, 1GHz, 1.6/5.6, 75Ω	**20-785-754**

† Dual versions are upgradable to the Quad version.

Mating Connectors & Cabling

50Ω SMA to SMA Lead, 1m length	**10-981-510**

Other cables are available - please consult sales office.

Voltage Supplies

Logic Supply 5Vdc ±5%. Relay Supply 12Vdc ±10%

Latest Details

Please refer to our Web Site for Latest Product Details.
www.pickeringtest.com

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SECTION 2 - TECHNICAL DESCRIPTION

FUNCTIONAL DESCRIPTION

A Functional Diagram is provided in Figure 2.1. The module is powered via the chassis connector J1 with +12V relay and +5V logic supplies. The interface to the user test equipment is via the front panel mounted connectors. The module comprises a Versatile SIMM Motherboard, a Microprocessor Control SIMM card and a Microwave Multiplexer Driver SIMM card. Microwave Multiplexer relays are fitted to the Front Panel.

The relay driver on the Microwave Multiplexer Driver SIMM card is fed with serial data via the SIMM controller. Relay switching is determined by operator programming, with LEDs on the front panel indicating when the relays are energised via control signals from driver card.

General Status LEDs and an RS232 port used for configuration purposes are fitted in the front panel.

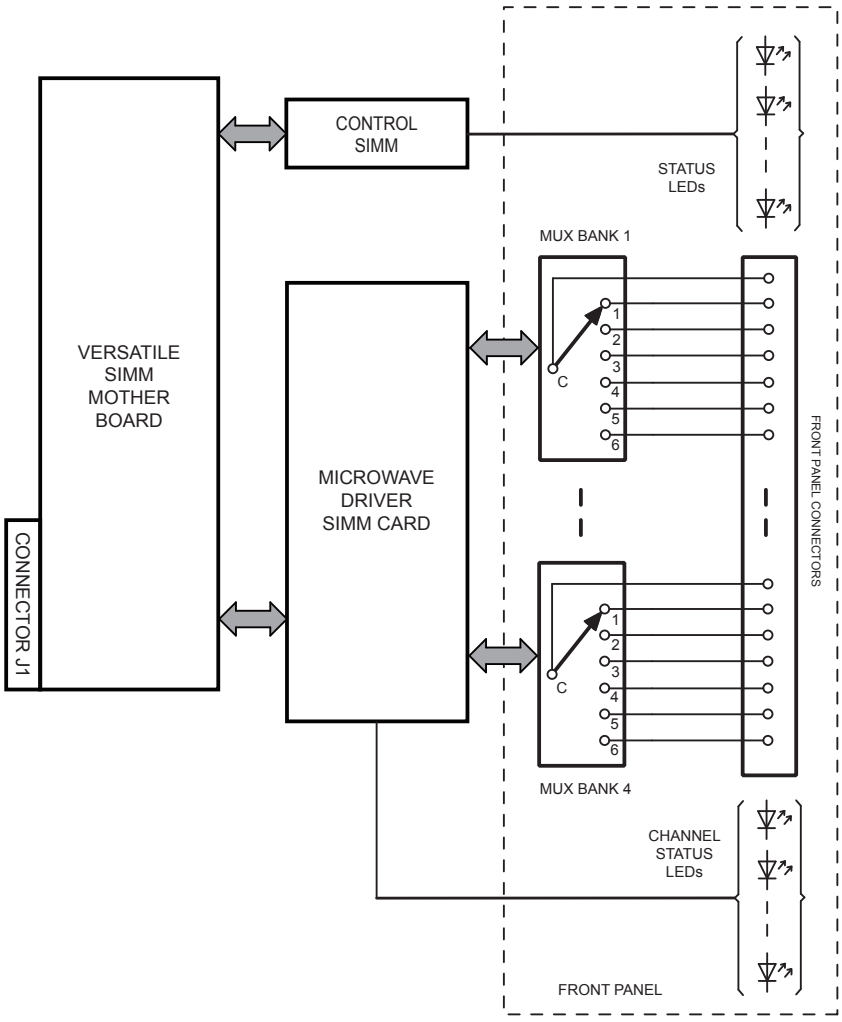


Figure 2.1 - Microwave Multiplexer Module: Functional Block Diagram

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SECTION 3 - INSTALLATION

Refer to the Warnings and Cautions at the front of this manual

Modular products require installation in a suitable System 10/20 chassis.
The module is designed for indoor use only.

PRE-OPERATION CHECKS (UNPACKING)

1. Check the module for transport damage and report any damage immediately to Pickering Interfaces. Do not attempt to install the product if any damage is evident.
2. Position the chassis relative to any other equipment the module(s) will connect with. Ensure the chassis is not connected to the electrical supply.
3. Ensure that the designated area for the chassis containing the module is of flat and solid construction to withstand and support the combined weight of the module(s) and chassis.

HARDWARE INSTALLATION
ELECTRICAL CONNECTION (CHASSIS)

1. The chassis must be electrically installed in accordance with local regional electrical codes by a qualified engineer.
2. Ensure the power supply lead provides the necessary integrity of chassis ground.

Electrostatic discharge can damage the components on the module. To avoid such damage in handling the board refer to page VII.

Ensure that there is adequate ventilation.

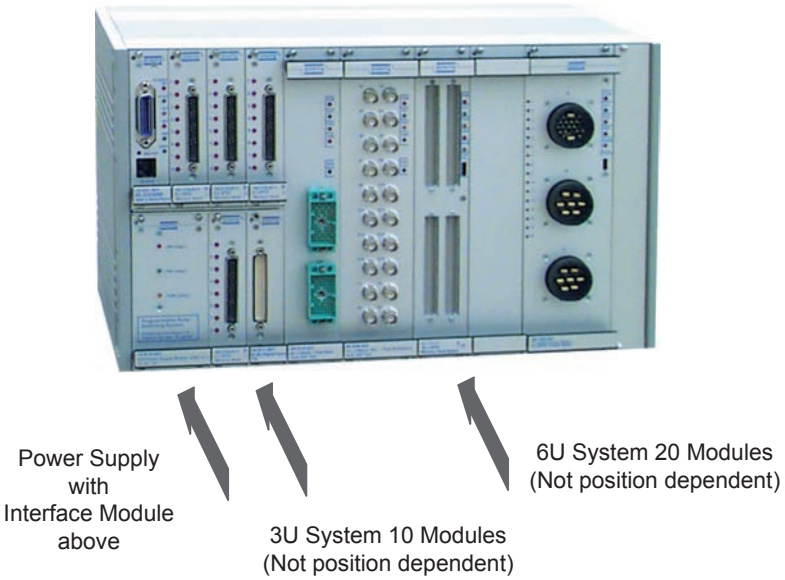


Figure 3.1 - System 10/20 Front Access Case Split 24/60 with Various Modules Fitted.

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MODULE INSTALLATION

The module should be installed in accordance with the following procedure:

1. Ensure that the system is turned OFF but still connected to mains so that it remains grounded.
2. If the module has address switches ensure they are set to the appropriate position. (See Section 4).

   Note individual modules are not sent out with a system drawing detailing their address.
3. Choose an appropriate slot in the rack and remove the blanking plate (if fitted).

   (See the Pickering **10-910M** IEEE-488 GPIB System 10/20 Ancillaries manual for further details).

   (When fitted, additional modules will be automatically recognised by the interface card. See Figure 3.1).
4. If necessary fit the module guide rails as supplied with the module to both the top and bottom of the chassis in that slot position. One guide rail slot should be to the left of the connector as shown in Figure 3.2.
5. Align the module with the backplane and screw holes at the front of the chassis.

   Hold the handle whilst slowly sliding the module into the card guides until the module seats firmly into the backplane. See Figure 3.4. The front panel of the module should be flush with the front or rear panel of the chassis.
6. Screw the front panel of the module to the chassis front panel mounting rails.
7. Ensure all necessary modules including the power supply are fitted to the rack and other slots blanked off before powering up.

   To achieve the correct initialisation of the sytem, ensure any slave chassis are powered up before the master chassis.

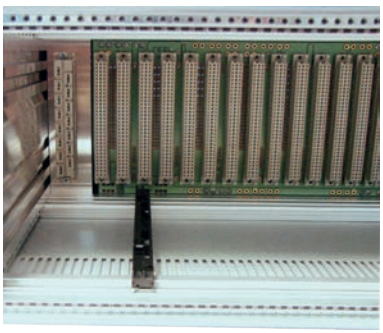


Figure 3.2 - Module Guide Rail Position

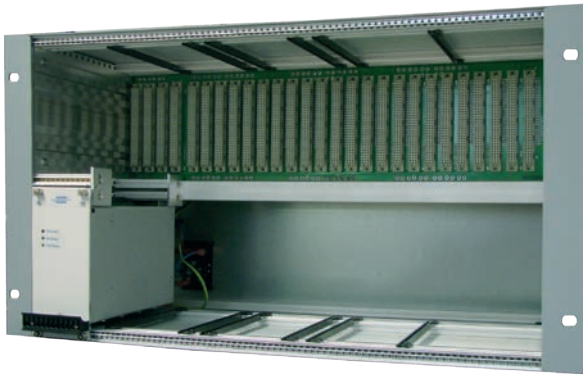


Figure 3.3 - A Partially Built System 20 Front Access Chassis

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Figure 3.4 - Module Insertion in a Pickering 20-935A-001 Front Access Chassis

SOFTWARE INSTALLATION

Refer to the Pickering manual **10-921M**.

For the latest version of the driver please refer to our web site **pickeringtest.com** where links to our Software Download page will provide the driver software for the various programming environments encountered.

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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. Any test parameter that is seen from previous test data to be drifting towards out of specification, but does not at present warrant an error alarm, will turn on the Service LED on the front panel. A full pass/fail description is available using the DIAGNOSTIC? command.

Self-Test comprises 3 levels, see Figure 3.5:

1. **Logic Test:** Checks all logic including on-board microprocessor RAM, ROM, and EEPROM, relay drivers etc.

2. **Analogue Test:** Checks voltage levels are correct for all the power supplies and front panel LED's.

3. **Relay Coil Test:** The resistance of all reed relay coils are checked.

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 low values).

Configuring Self-Test

Self-Test can be configured so that some or all of the test functions are disabled. This is achieved by setting the appropriate bit in the test configuration byte. Refer to Section 6 for details on how to reconfigure the driver card 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:	Microprocessor, RAM, EPROM, Relay Drivers, Invalid Link Settings etc.
Analogue:	5 Volt supply low 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).

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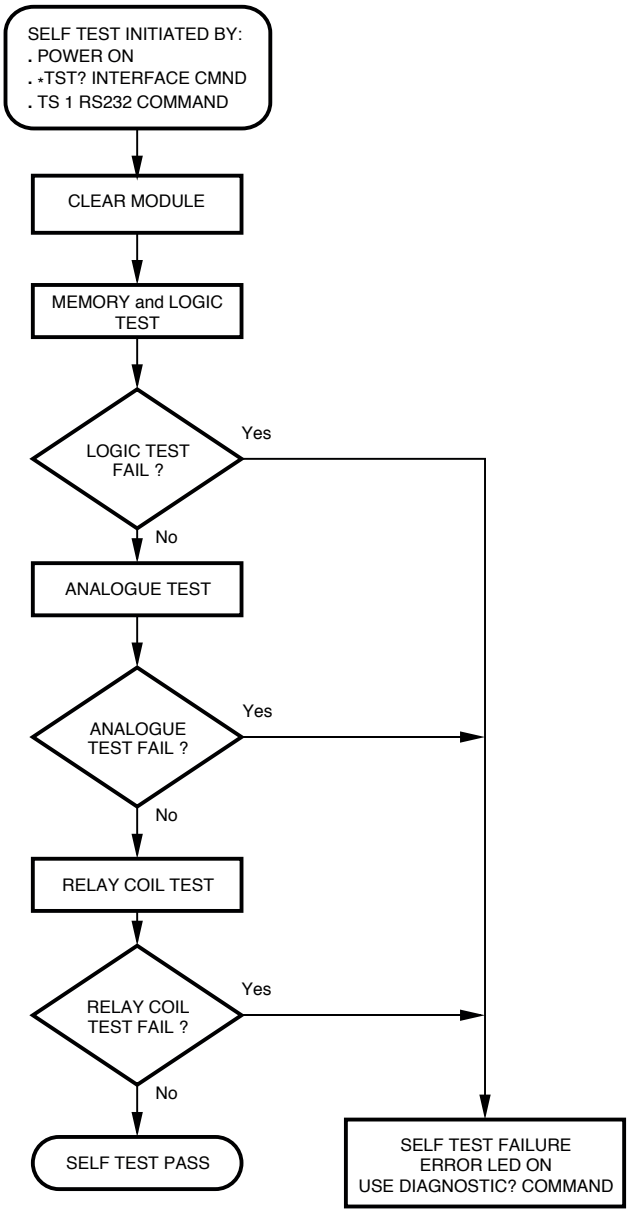


Figure 3.5 - Self-Test: Basic Flow Diagram

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SECTION 4 - PROGRAMMING GUIDE

PROGRAMMING THE MODULE

Selecting the Module Address

The module internal address is factory pre-set however this can be reconfigured through the software as required.

Programming Using the Intelligent GPIB/RS-232 Interface

The programming computer will need a GPIB card, a USB to GPIB Interface (Figure 4.1) or an Ethernet connection to talk to the interface and communicate with the system depending on the type of interface fitted.

- A 10-921-001 Interface requires either a GPIB or RS-232 connection.
- A 10-922-001 Interface requires an Ethernet connection.



Figure 4.1 - A USB/GPIB Interface Lead

The 20-785 module is simple to program either by single bit or by word (8 bits).

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
SIZE	s	This is used to specify the word size: s = 1 for byte, s = 2 for 16 bit word and s = 3 for 32 bit word (*16 bit is usually the factory default*).
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 word w to module a

The module is programmed as an output port using either single bit or word:

To close relay number 5 on module 11. CLOSE 11,5

For more details on programming see the manual for the Interface used.

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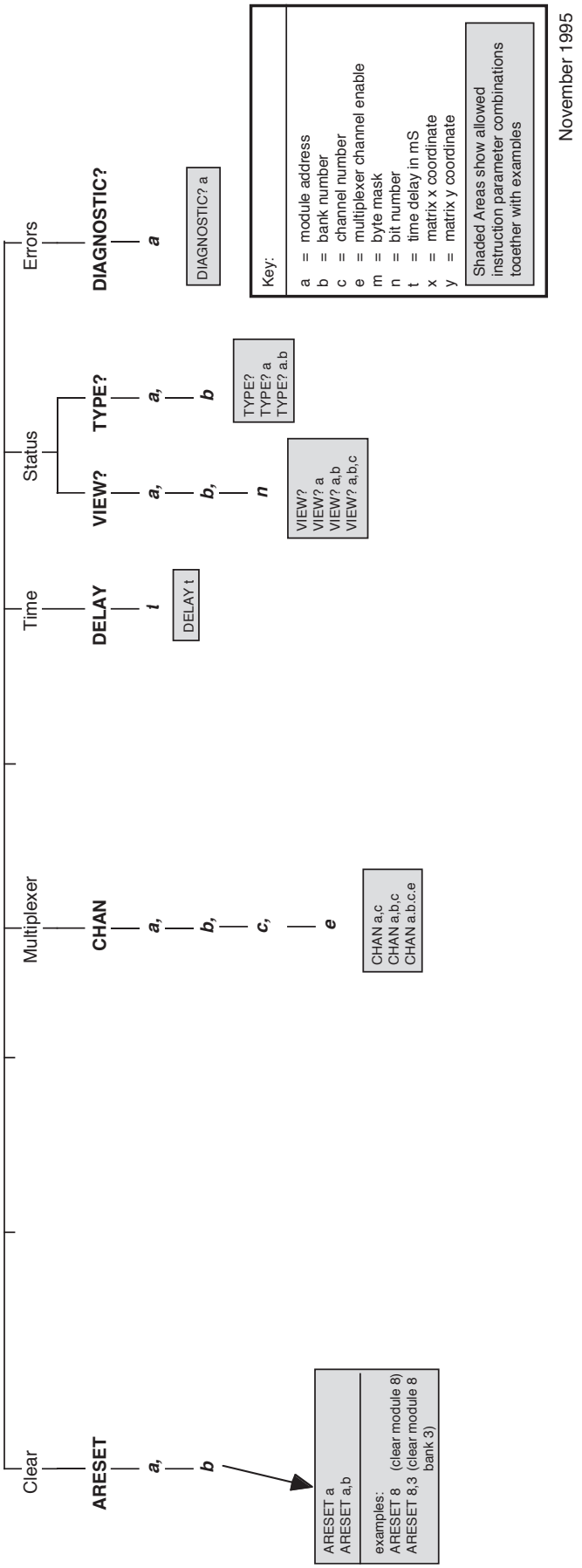


Figure 4.2 - Multiplexer Instruction Set (20-785)

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DRIVER CARD CONFIGURATION

The module is configured using the internal RS232 Serial port connected via the 4 pin Datamate connector on the front panel with the supplied lead. Configuration data is stored within the module in EEPROM and may be altered using a dedicated 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.

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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	Example
CF	1 x	x = Module address.	CF 1 5
CF	2 x	x = Number of multiplexer banks in module.	CF 2 4
CF	3 x	x = Number of pods in module.	CF 3 0
CF	4	Switch Mode	
	0	For I/O Modules mode is always 0.	CF 4 0
	0 or 1	MUX modules, 0 = normal, 1 = multi channel	CF 4 1
	0 or 1	Matrix modules, 0 = RF, 0 or 1for others.	
CF	5	Switch Type.	
	0	Ruthenium.	CF 5 0
	1	Mercury.	CF 5 1
CF	6	Panel Width. For future use.	
CF	7	Self-test Options	
		Each bit enables a specific test. Bit 0 = Spare. LSB. Bit 1 = RAM test. Bit 2 = Panel LED test. Bit 3 = Coil test. Bit 4 = LED test. Bit 5 = Switch Contact test. Bit 6 = Temperature test. Bit 7 = Selftest at start up. MSB. Standard Configuration setup.	CF 7 125
CF	8	Module data 1	
CF	9	Module data 2	
CF	10	Module data 3	
CF	11	Module data 4	
CF	12	Configuration mode	

Module data is dependent upon Module type as follows;

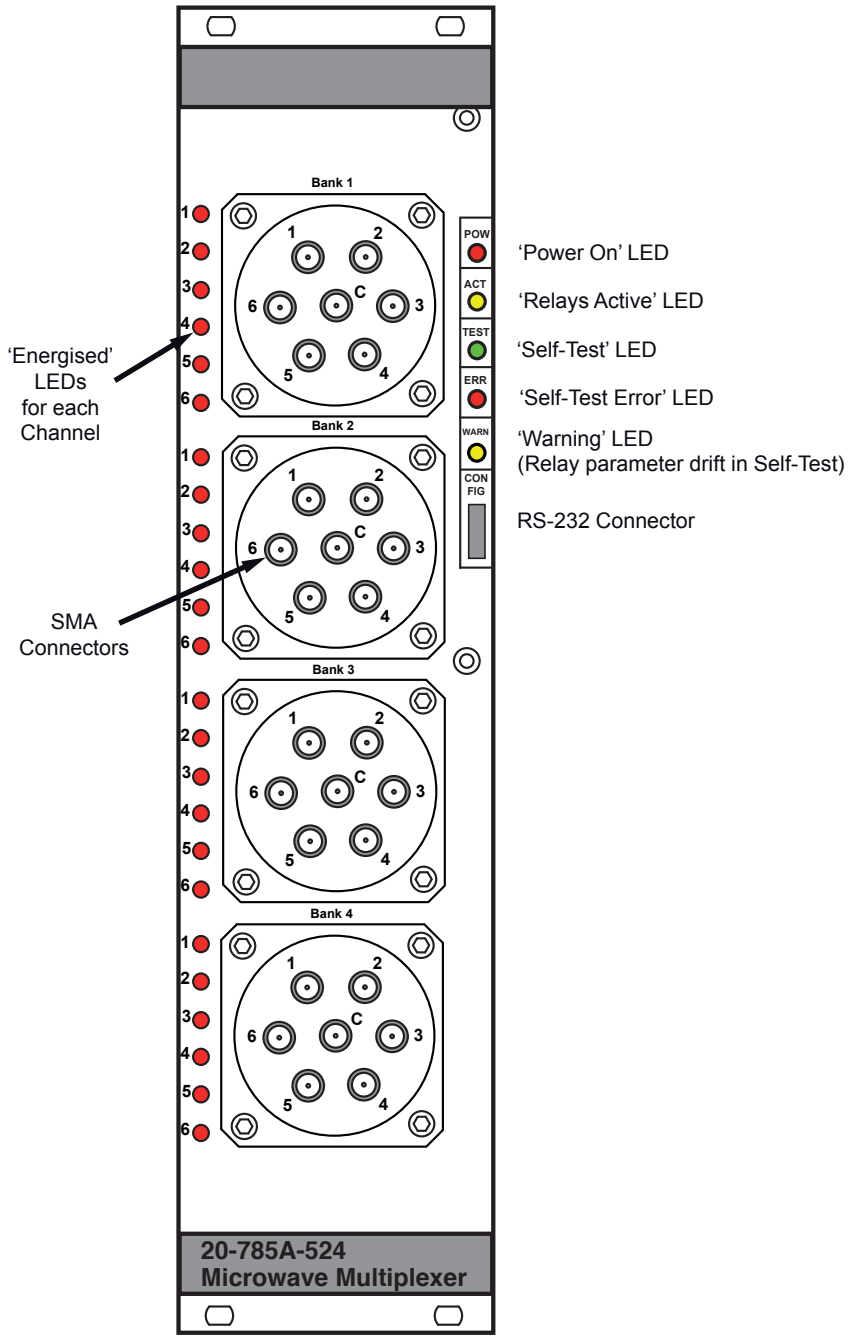
Module data byte	I/O Module	MUX Module	Matrix Module
1	Bits Out	Size	X Size
2	Bits out start	Start	Y Size
3	Bits in	Not used	X Start
4	Not used	Not used	Y Start

For details of the Configuration modes for the 20-785A series of modules please contact the factory.

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SECTION 5 - CONNECTOR INFORMATION

Figures 5.1 to 5.5 show the front panel layout for most of the modules in the 20-785/785A range. Front panel connections are normally SMA, however connection to the 20-785-754 module is via Type 43 connectors.

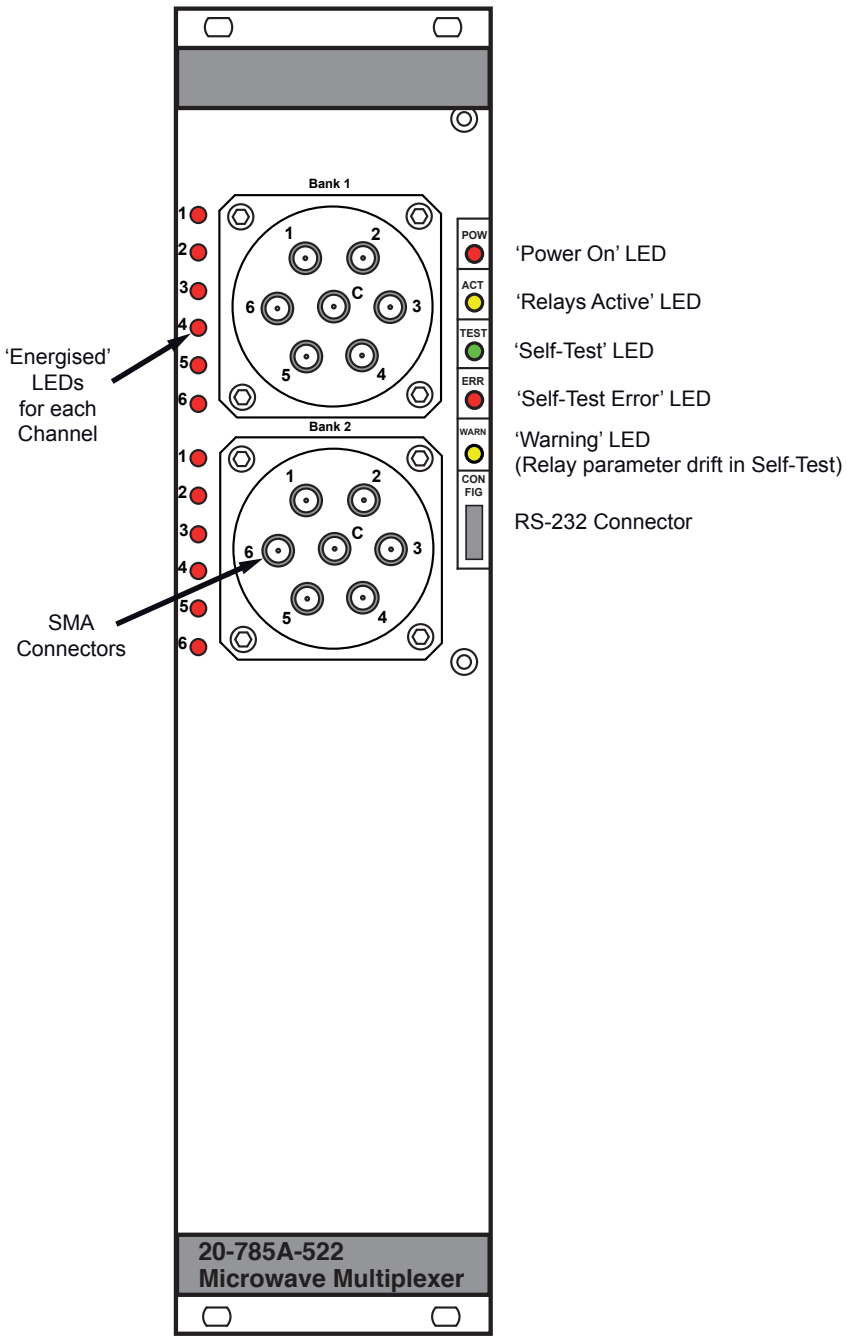


20-785A-524

Figure 5.1 - Front Panel Layout

Note: Radiall relays with clockwise numbering are used on this product.

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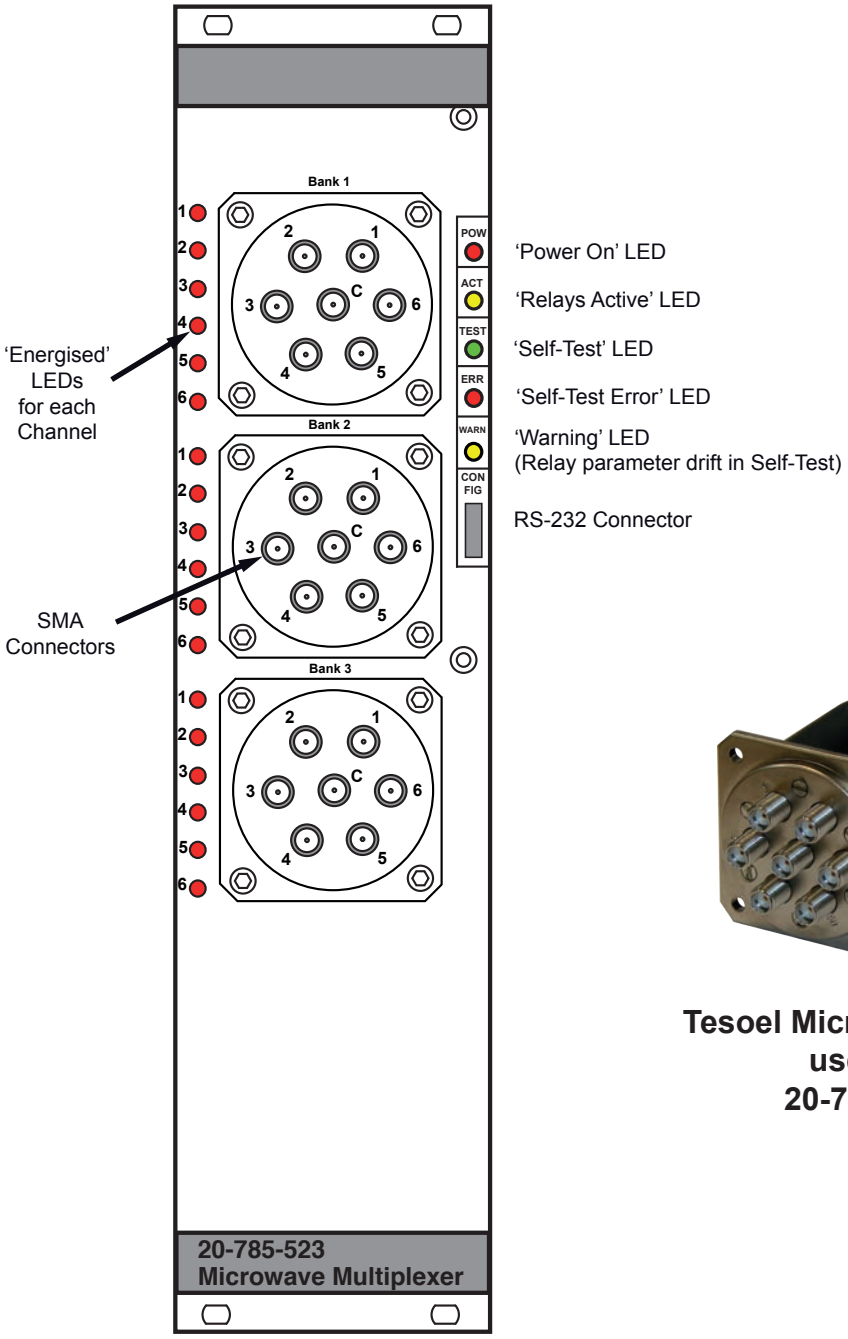


20-785A-522

Figure 5.2 - Front Panel Layout

Note: Radiall relays with clockwise numbering are used on this product.

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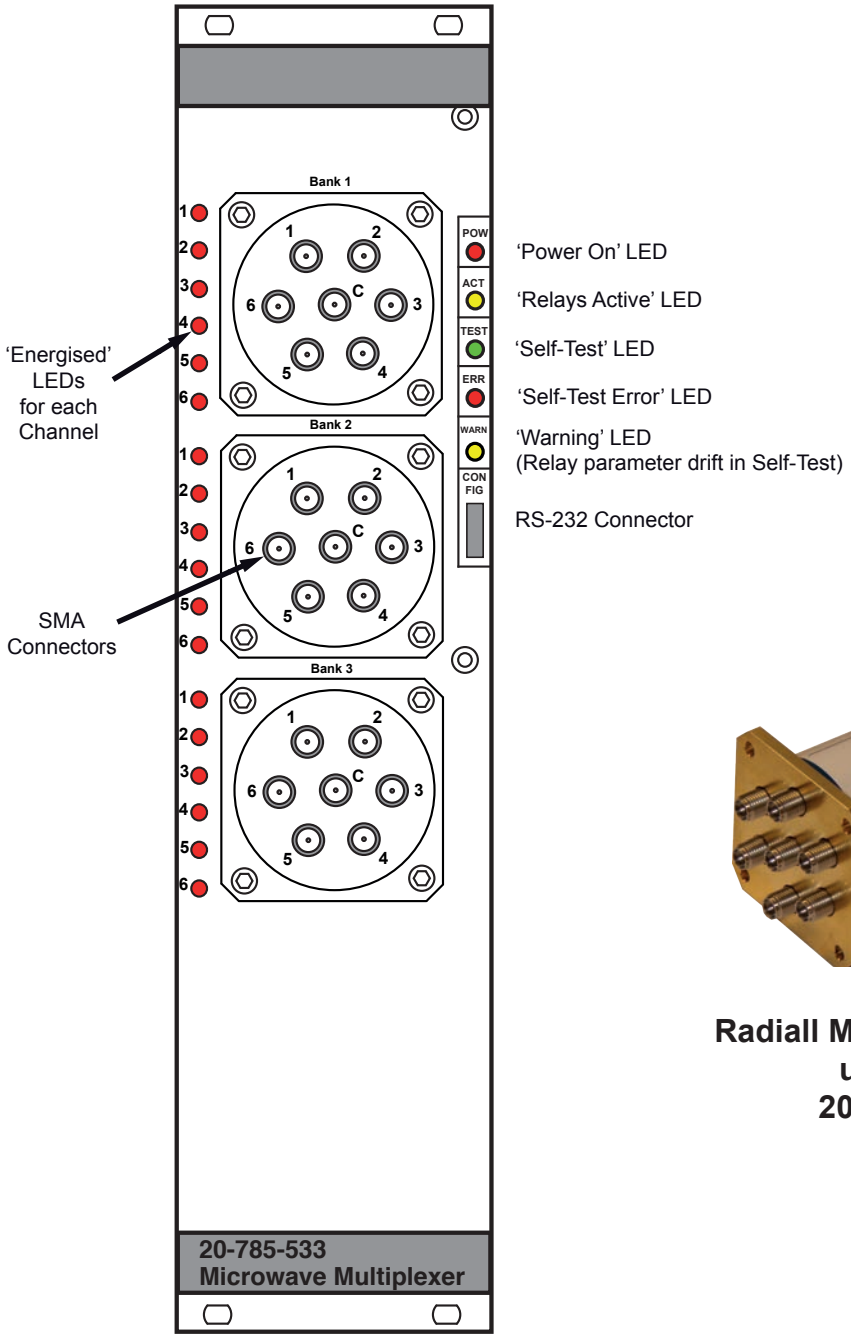
20-785-523



Tesoel Microwave Relay used on 20-785-523

Figure 5.3 - Front Panel Layout

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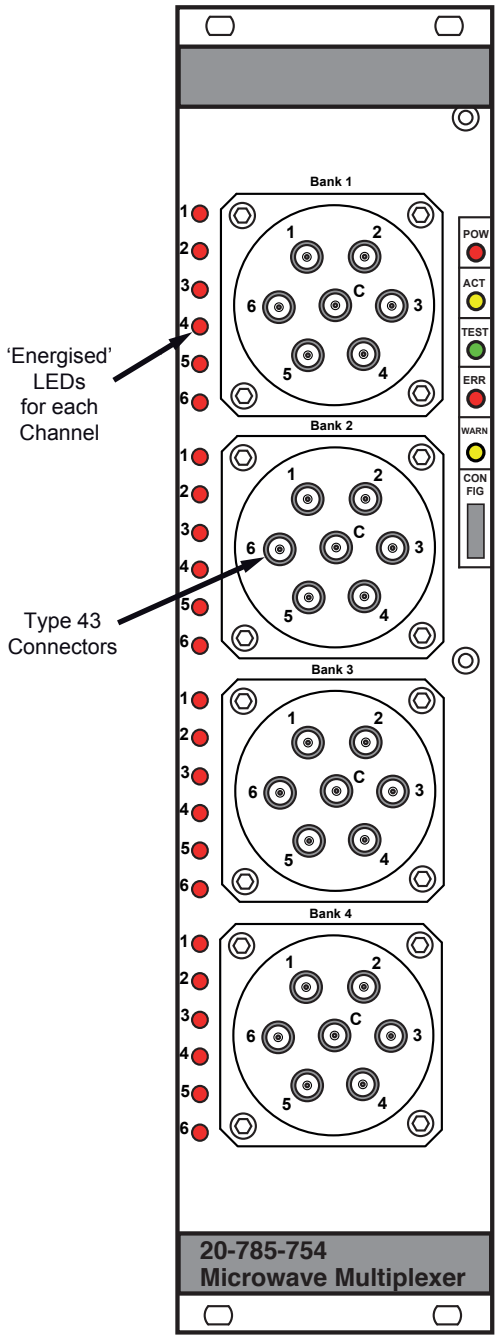
20-785-533



Radiall Microwave Relay used on 20-785-533

Figure 5.4 - Front Panel Layout

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20-785-754



Radiall Microwave Relay used on 20-785-754

Figure 5.5 - Front Panel Layout

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Table 5.1 - Front Panel Connections (Radiall Relays)

Front Panel Connections - Bank 1					
Connector	Signal	Connector	Signal	Connector	Signal
1	1.1			2	1.2
6	1.6	C	Com 1	3	1.3
5	1.5			4	1.4

Front Panel Connections - Bank 2					
Connector	Signal	Connector	Signal	Connector	Signal
1	2.1			2	2.2
6	2.6	C	Com 2	3	2.3
5	2.5			4	2.4

Front Panel Connections - Bank 3					
Connector	Signal	Connector	Signal	Connector	Signal
1	3.1			2	3.2
6	3.6	C	Com 3	3	3.3
5	3.5			4	3.4

Front Panel Connections - Bank 4					
Connector	Signal	Connector	Signal	Connector	Signal
1	4.1			2	4.2
6	4.6	C	Com 4	3	4.3
5	4.5			4	4.4

Table 5.2 - Front Panel Connections (Tesoel Relays)

Front Panel Connections - Bank 1					
Connector	Signal	Connector	Signal	Connector	Signal
2	1.2			1	1.1
3	1.3	C	Com 1	6	1.6
4	1.4			5	1.5

Front Panel Connections - Bank 2					
Connector	Signal	Connector	Signal	Connector	Signal
2	2.2			1	2.1
3	2.3	C	Com 2	6	2.6
4	2.4			5	2.5

Front Panel Connections - Bank 3					
Connector	Signal	Connector	Signal	Connector	Signal
2	3.2			1	3.1
3	3.3	C	Com 3	6	3.6
4	3.4			5	3.5

Front Panel Connections - Bank 4					
Connector	Signal	Connector	Signal	Connector	Signal
2	4.2			1	4.1
3	4.3	C	Com 4	6	4.6
4	4.4			5	4.5

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SECTION 6 - TROUBLE SHOOTING

Refer to the Warnings and Cautions at the front of this manual 

INSTALLATION PROBLEMS

The Plug & Play functionality of Pickering switch cards generally ensures trouble-free installation, however for the GPIB/RS-232 Interface to work correctly there must be at least one switching module present in the rack.

If you do experience any installation problems you should first ensure that all cards are properly seated in their slots. Improperly mated cards may go undetected by the operating system, or may be detected as a card of an unknown type. They can also cause the computer to freeze at various stages in the boot sequence.

If your system employs a remote control interface you should check the integrity of all remote control interface links. When the system is powered up, and during Windows start-up, you should expect to see periodic activity on the remote control interface front panel LEDs.

Customers may prefer to keep Higher voltage modules separate from sensitive switching models to help in terms of noise and voltage spikes.

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SECTION 7 - MAINTENANCE INFORMATION

Refer to the Warnings and Cautions at the front of this manual 

PERIODIC MAINTENANCE

This product and its corresponding chassis do not require any periodic maintenance.

GENERAL CLEANING

- Isolate the electrical power from the chassis and ensure that no user I/O signals are being applied.
- Wipe the product & chassis surfaces with a clean dry anti-static cloth only.

SOFTWARE UPDATE

For System 10/20 modules operating in a System 10/20 chassis, no software updates are required. For the latest version of the driver please refer to our web site **pickeringtest.com** where links to our Software Download page will provide the latest version of the driver software for the various programming environments encountered.

RELAY LOOK-UP TABLES

The following pages provide a cross reference between the programmable bits for each channel of the Relay Module and the physical relays on the PCB. The tables can be used in the fault finding process and should be used in conjunction with the corresponding Front Panel and PCB layout diagrams to identify the position of faulty relays.

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RELAY LOOK-UP TABLES

Table 6.1 - Relay Look-up Table

Relay	Signal Path (with relay energised)	Connection Number
Bank 1 (All Versions)	1.1 to Com 1	1
	1.2 to Com 1	2
	1.3 to Com 1	3
	1.4 to Com 1	4
	1.5 to Com 1	5
	1.6 to Com 1	6
Bank 2 (All Versions)	2.1 to Com 2	1
	2.2 to Com 2	2
	2.3 to Com 2	3
	2.4 to Com 2	4
	2.5 to Com 2	5
	2.6 to Com 2	6
Bank 3 All Versions except 20-785A-522	3.1 to Com 3	1
	3.2 to Com 3	2
	3.3 to Com 3	3
	3.4 to Com 3	4
	3.5 to Com 3	5
	3.6 to Com 3	6
Bank 4 20-785A-524 20-785-534 20-785-754 20-785-924	4.1 to Com 4	1
	4.2 to Com 4	2
	4.3 to Com 4	3
	4.4 to Com 4	4
	4.5 to Com 4	5
	4.6 to Com 4	6

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PCB AND COMPONENT LAYOUT

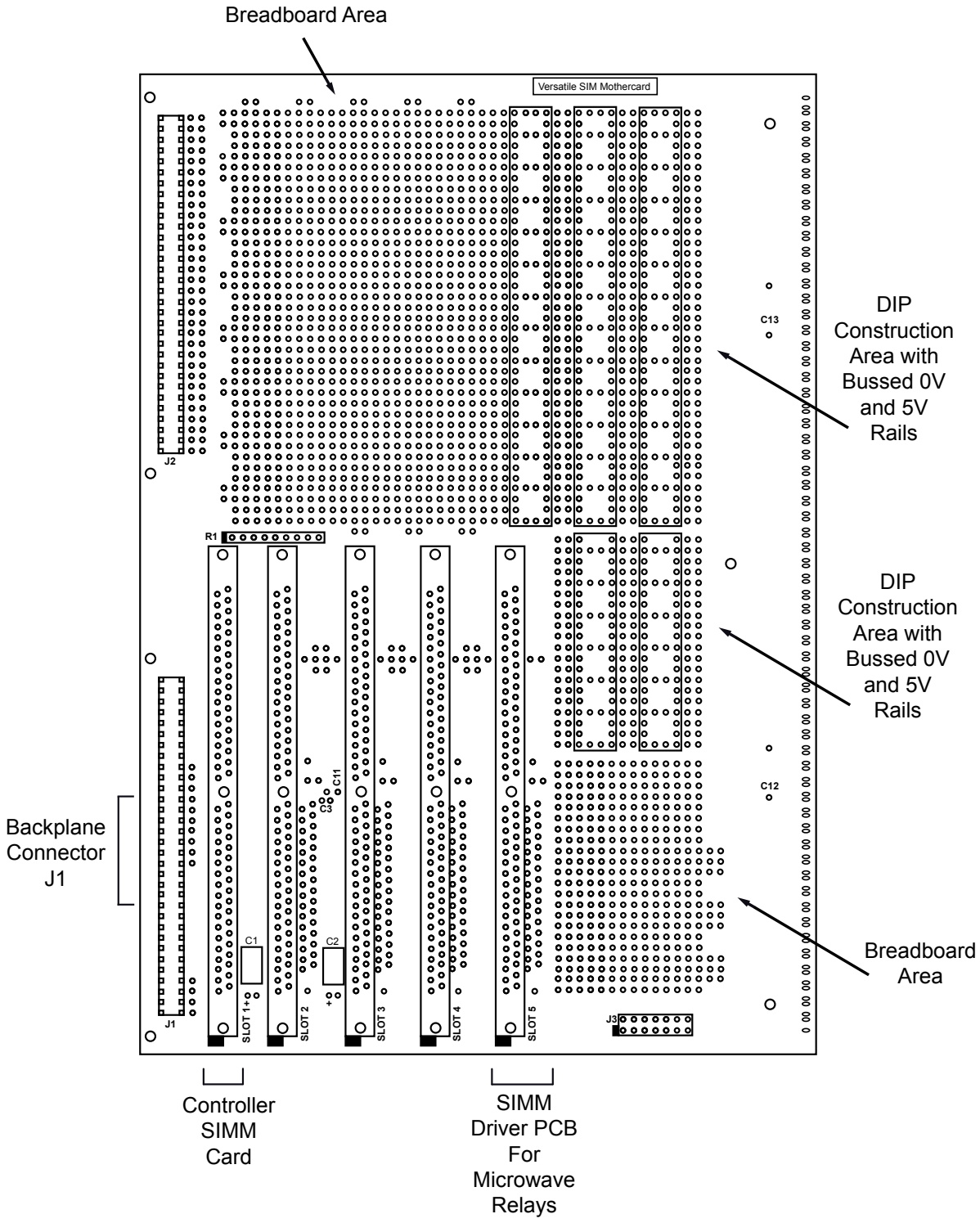


Figure 7.1 - Versatile SIMM Mothercard Layout ((C/PC/170)

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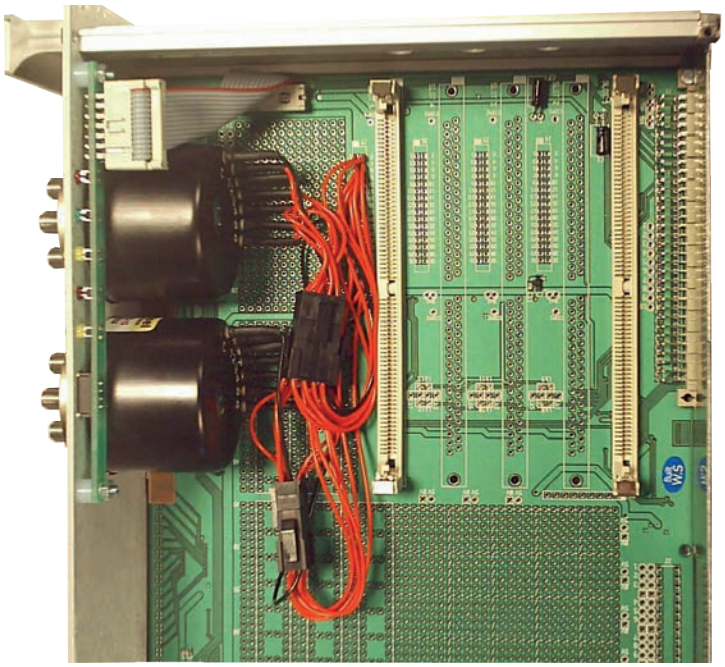


Figure 7.2 - A Section Showing the Relay Assembly on the 20-785-522 Module

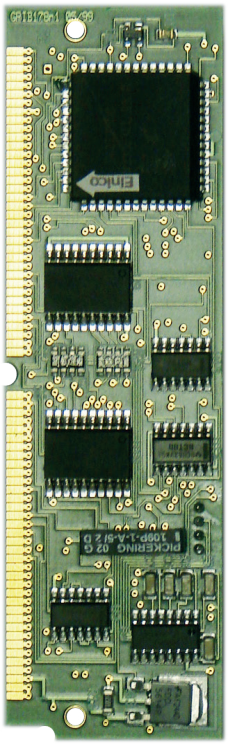


Figure 7.3 - SIM Controller (A/PC/178)

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