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USER MANUAL

Model No. **20-150**

Power Relay Module

Designed & Manufactured by:-

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HELP!!!

If you need assistance with your Pickering Interfaces Switching System: *Switching problems, Programming or Integration within your Test System. – Please ring Pickering Interfaces and ask for "Technical Support".*

Alternatively you may fax, email or connect to our Internet Web Site.

A full set of operating manuals, application notes and software drivers is available on CD ROM.

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Section 1
Power Relay Module

1.1 Features

- Up To 16 Power Relays Per Module
- Choice of 13A or 30A Power Relays
- Switch Up To 250V a.c.
- Front Panel LED Indicators For Each Relay
- 8 Additional Control Lines For Operating External Relays

1.2 Description

The 20-150 range of Power Switching Modules are available with a choice of medium power 13A relays or heavy duty 30A relays.

The standard version (module type 20-150-001) has 16 SPDT Power Relays which will switch up to 13A at 30V d.c. or 250V a.c. and are suitable for switching highly inductive/capacitive loads. The relay is socket mounted with the switch contact taken directly from the socket (no vulnerable PCB tracks).

Further versions are available which have combinations of 13A and 30A Power Relays for applications requiring greater current capability.

20-150-001	16 x SPDT Medium Power Relays, 13 A.
20-150-101	12 x SPDT Medium Power Relays, 13A and 2 x SPST High Power Relays, 30A.
20-150-201	8 x SPDT Medium Power Relays, 13A and 4 x SPST High Power Relays, 30A
20-150-301	2 x SPDT Medium Power Relays, 13A and 8 x SPST High Power Relays, 30A

1.2.1 Connectors

Connections to the 20-150 series modules are made via front panel mounted AMP CPC connectors. See Section 4 for connection details.

1.2.2 Built-in Self Test

Self Test is always performed at power up and may also be exercised either by using the modules individual RS-232 interface or under program control. Any service or error indications can be diagnosed using the DIAGNOSTIC? command, refer to Section 2 for further details.

1.2.3 Front Panel

A typical front panel is comprised of four elements, please refer to Fig 1.2.

Status Display, 5 LED Indicators:-

Power LED. Connected to system power supply.

Active LED. On whenever one or more relays are selected. Use the VIEW? command for a list of all active channels.

Self-Test LED. Active while the self-test is in progress.

Warning LED. Indicates that the self test has detected a relay parameter drifting towards out of range.

Error LED. Indicates that an error was found during self-test.

Internal RS-232 Connector. Allows the module to be connected to a terminal or PC via the serial cable provided to enable configuration details to be set up by the user.

Switch Contact Connectors, AMP CPC connectors.

Relay Status Indicators, Each relay has its individual LED status indicator which is on when the relay is energised.

1.2.4 Width and Dimensions

The Power Relay Module conforms to the 6U height (262mm) Eurocard standard and is housed in a 160mm deep screened plug-in module. Panel width is 15HP (3.0 inches, 76.2mm).

This is a double height module and **must** be mounted into a double height (6U) case.

20-110 Power Relays		
Product Code	**No. of Medium Power Relays**	**No. of High Power Relays**
20-150-001	16	0
20-150-101	12	2
20-150-201	8	4
20-150-301	2	8

Table 1.1 20-150 Order codes

1.3 SPDT Medium Power Switch

A summary of the capability of these modules is given in table 1.2.

Contact Type	AgCdO
Contact Current Rating	
Resistive Load	13A at 250V a.c. 13A at 30V d.c.
Inductive Load	13A at 250V a.c. 5A at 30V d.c. 5A at 30V d.c.
Max Standoff Voltage	600V d.c.
Max Switching Voltage	250V r.m.s.
Max Switch Current	13A
Max Carry Current	13A
Contact Resistance	
On:	150mΩ
Off:	$> 10^8$ Ω
Bandwidth (50Ω)	10MHz
Max Operate Time†	15ms
Max Relay Close Settling Time	10ms
Max Relay Open Settling Time	7ms
Expected Life (Operations)	
Low power load	$> 10^7$
Full power load	$> 10^5$

† This is the time taken from the start of the IEEE-488 or RS-232 message to the closure of the relay (assuming fast IEEE-488 / RS-232 communication and no pending operations.

Table 1.2 Medium Power Relay Specifications

1.4 SPST High Power Switch

A summary of the capability of these modules is given in table 1.3.

Contact Type	Silver Alloy
Contact Current Rating	
Resistive Load	30A at 250V a.c. 30A at 30V d.c.
Max Standoff Voltage	600V d.c.
Max Switching Voltage	270V a.c. r.m.s.
Max Switch Current	30A
Max Carry Current	30A
Contact Resistance	
On:	5mΩ
Off:	$> 10^8$ Ω
Bandwidth (50Ω)	10MHz
Max Operate Time†	30ms
Max Relay Close Settling Time	20ms
Max Relay Open Settling Time	5ms
Expected Life (Operations)	
Low power load	$> 5 \times 10^6$
Full power load	$> 10^5$

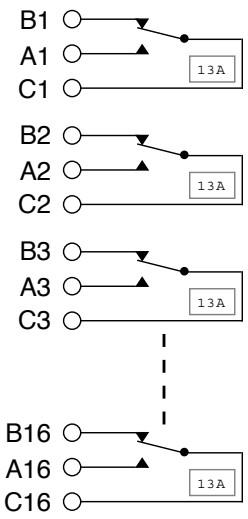
Table 1.3 High Power Relay Specifications

1.5 Digital Output Lines

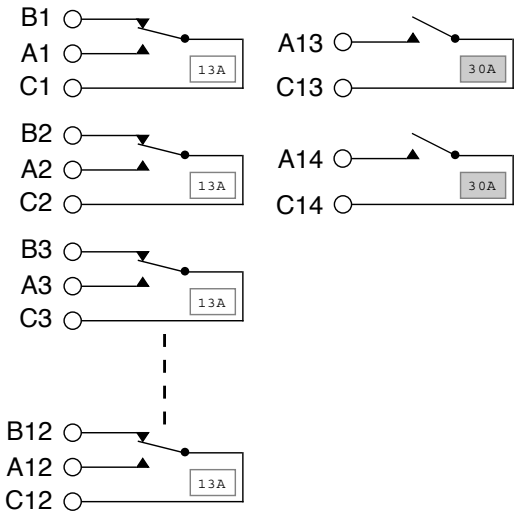
A summary of the capability of these modules is given in table 1.4.

Device Type	ULN2803
Output Type	Open Collector Driver
Max Standoff Voltage	50V
Max Sink Current	500mA
Max Power Each Output	1.0W
Max Power All Outputs	1.6W

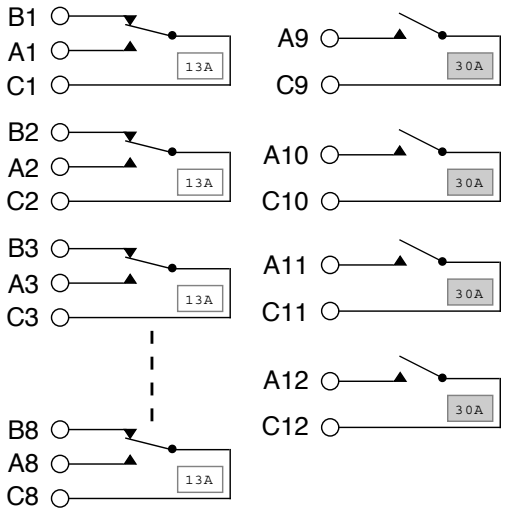
Table 1.4 Digital Output Specifications



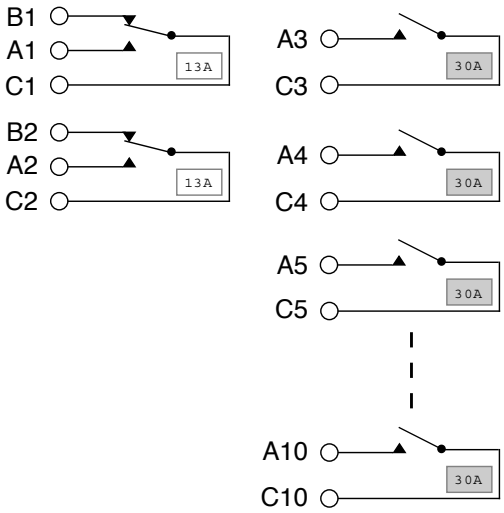
20-150-001



20-150-101



20-150-201



20-150-301

Fig 1.1 Power Relay Schematics



Fig 1.2 Standard 20-150-001 Power Switch Module

Section 2
Self Test

2.1 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 Fig 2.1:-

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 relay coils are checked.

Note: In the unlikely event of a relay needing replacement **a**dditional relays are available from Pickering Interfaces.

2.2 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**).

2.3 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 6 for details on how to reconfigure the driver card to your application.

2.4 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.
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).

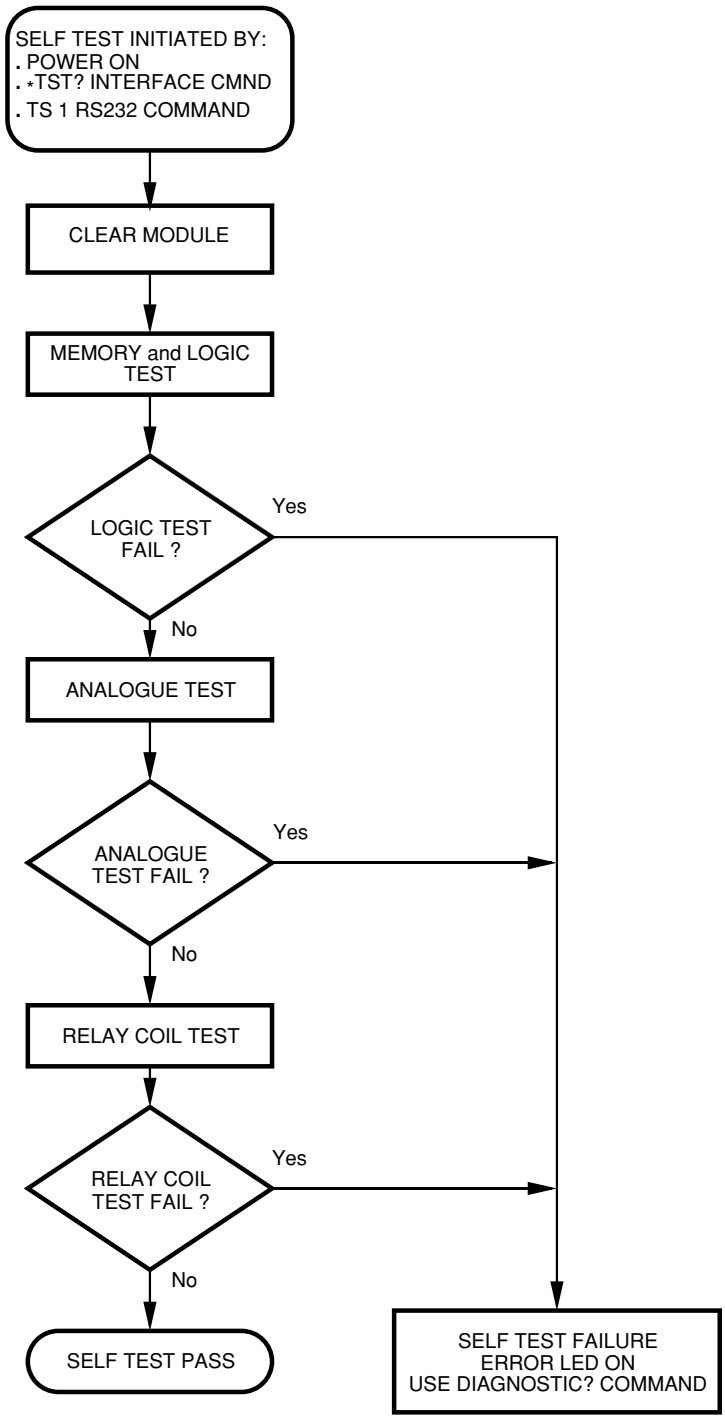


Fig 2.1 Self-Test: Basic Flow Diagram

3.1 Select Module Address

The module internal address is factory pre-set, please refer to case schematic diagram at front of manual. To change the internal address please refer to section 6, Reconfiguring Driver Card to Your Application.

3.2 Programming Using the Intelligent GPIB/RS-232 Interface

The 20-150 module is simple to program either by single bit, byte (8 bits) or word (16 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,c,w Send word **w** to module **a** block position **c**

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

To close relay number 5 on module 11.

CLOSE 11,5

Or to close first 16 relays on module 8.

SIZE 2 (this selects byte length words)

WRITE 8,1,65535

For more details on programming see the programming manual for the IEEE-488.2/RS-232 interface module.

3.3 Operating Speed

Multiplexer 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.

Connector A	
Front Panel Pin No.	Description
1	Digital Com.
2	Digital Gnd.
3	Digital O/p 1
4	Digital O/p 2
5	Digital O/p 3
6	Digital O/p 4
7	Digital O/p 5
8	Digital O/p 6
9	Digital O/p 7
10	Digital O/p 8
11	not used
12	not used
13	not used
14	not used
15	not used
16	RL1 no
17	RL1 com
18	RL1 nc
19	RL2 no
20	RL2 com
21	RL2 nc
22	RL3 no
23	RL3 com
24	RL3 nc

Connector B	
Front Panel Pin No.	Description
1	RL4 no
2	RL4 com
3	RL4 nc
4	RL5 no
5	RL5 com
6	RL5 nc
7	RL6 no
8	RL6 com
9	RL6 nc
10	RL7 no
11	RL7 com
12	RL7 nc
13	RL8 no
14	RL8 com
15	RL8 nc
16	RL9 no
17	RL9 com
18	RL9 nc
19	RL10 no
20	RL10 com
21	RL10 nc
22	RL11 no
23	RL11 com
24	RL11 nc

Connector C	
Front Panel Pin No.	Description
1	RL12 no
2	RL12 com
3	RL12 nc
4	RL13 no
5	RL13 com
6	RL13 nc
7	RL14no
8	RL14 com
9	RL14 nc
10	RL15 no
11	RL15 com
12	RL15 nc
13	RL16 no
14	RL16 com
15	RL16 nc
16	not used
17	not used
18	not used
19	not used
20	not used
21	not used
22	not used
23	not used
24	not used

Fig 4.1 20-150-001 CPC Connector Pin Out Diagram.

Connector A	
Front Panel Pin No.	Description
1	not used
2	Digital Com.
3	Digital Gnd.
4	Digital O/p 1
5	Digital O/p 2
6	Digital O/p 3
7	Digital O/p 4
8	Digital O/p 5
9	Digital O/p 6
10	Digital O/p 7
11	Digital O/p 8
12	not used
13	RL1 no
14	RL1 com
15	RL1 nc
16	RL2 no
17	RL2 com
18	RL2 nc
19	RL3 no
20	RL3 com
21	RL3 nc
22	not used

Connector B	
Front Panel Pin No.	Description
1	RL13 no
2	RL4 no
3	RL4 com
4	RL4 nc
5	RL5 no
6	RL5 com
7	RL5 nc
8	RL6 no
9	RL6 com
10	RL6 nc
11	RL7 no
12	RL7 com
13	RL7 nc
14	RL8 no
15	RL8 com
16	RL8 nc
17	RL9 no
18	RL9 com
19	RL9 nc
20	not used
21	not used
22	RL13 com

Connector C	
Front Panel Pin No.	Description
1	RL14 no
2	RL10 no
3	RL10 com
4	RL10 nc
5	RL11 no
6	RL11 com
7	RL11 nc
8	RL12no
9	RL12 com
10	RL12 nc
11	not used
12	not used
13	not used
14	not used
15	not used
16	not used
17	not used
18	not used
19	not used
20	not used
21	not used
22	RL14 com

Fig 4.2 20-150-101 CPC Connector Pin Out Diagram.

Connector A	
Front Panel Pin No.	Description
1	RL3 com
2	Digital Com.
3	Digital Gnd.
4	Digital O/p 1
5	Digital O/p 2
6	Digital O/p 3
7	Digital O/p 4
8	not used
9	Digital O/p 5
10	Digital O/p 6
11	Digital O/p 7
12	Digital O/p 8
13	not used
14	not used
15	RL1 no
16	RL1 nc
17	not used
18	RL2 no
19	RL2 nc
20	RL1 com
21	RL2 com
22	RL3 no

Connector B	
Front Panel Pin No.	Description
1	RL4 com
2	RL4 no
3	RL5 com
4	RL5 no
5	RL10 com
6	RL6 com
7	RL6 no

Connector C	
Front Panel Pin No.	Description
1	RL7 com
2	RL7 no
3	RL8 com
4	RL8 no
5	RL10 no
6	RL9 com
7	RL9 no

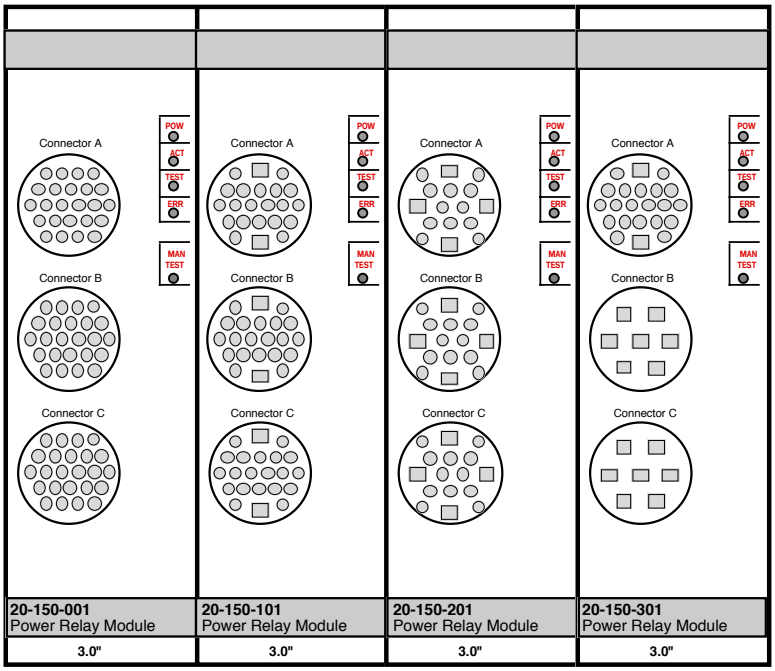
Fig 4.3 20-150-301 CPC Connector Pin Out Diagram.

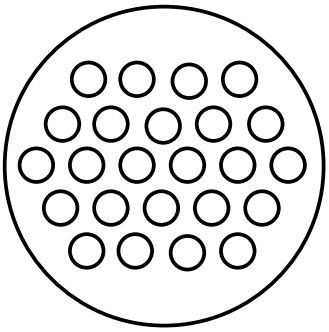
Connector A	
Front Panel Pin No.	Description
1	Not used
2	Digital Com.
3	Digital Gnd.
4	Digital O/p 1
5	Digital O/p 2
6	Digital O/p 3
7	Not used
8	Digital O/p 4
9	Digital O/p 5
10	Not used
11	Digital O/p 6
12	Digital O/p 7
13	Digital O/p 8
14	Not used
15	Not used
16	Not used

Connector B	
Front Panel Pin No.	Description
1	RL9 com
2	RL1 no
3	RL1 com
4	RL1 nc
5	RL2 no
6	RL2 com
7	RL9 no
8	RL2 nc
9	RL3 no
10	RL10 com
11	RL3 com
12	RL3 nc
13	RL4 no
14	RL4 com
15	RL10 nc
16	RL4 no

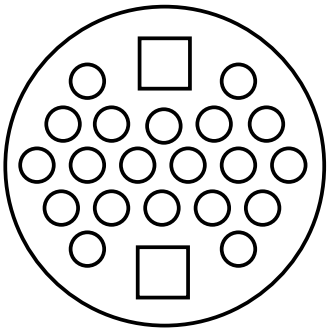
Connector C	
Front Panel Pin No.	Description
1	RL11 com
2	RL5 no
3	RL5 com
4	RL5 nc
5	RL6 no
6	RL6 com
7	RL11 no
8	RL6 nc
9	RL7 no
10	RL12 com
11	RL7 com
12	RL7 nc
13	RL8 no
14	RL8 com
15	RL12 nc
16	RL4 no

Fig 4.4 20-150-201 CPC Connector Pin Out Diagram.

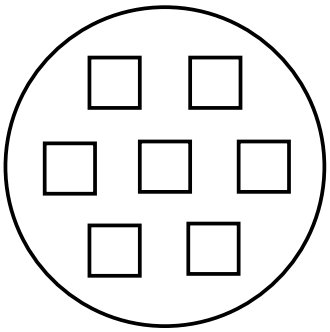




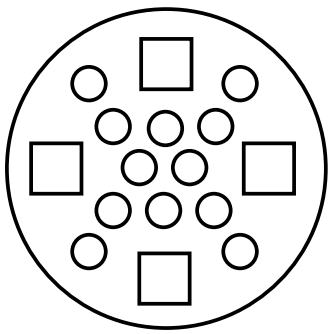
Shell type 23 - 24



Shell type 23 - 22M



Shell type 23 - 7



Shell type 23 - 16M

Connector Utilisation

20-150-001 = 3 x 23-24
20-150-101 = 3 x 23-22M
20-150-201 = 3 x 23-16M
20-150-301 = 2 x 23-7 + 1 x 23-22M

Fig 4.5 CPC Connectors used in 20-150 Series modules.

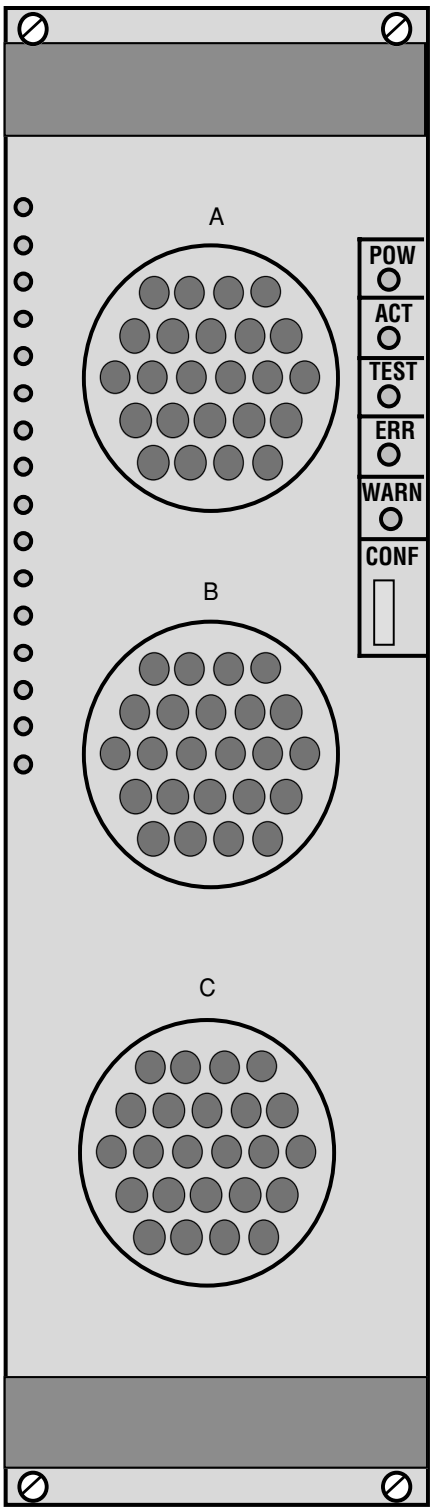


Fig 5.1 Front Panel Layout for 20-150-001 using 24 Way CPC Connectors.

Section 6
Reconfiguring Driver Card to Your Application

6.1 Driver Card Configuration

The module is configured using the internal RS-232 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 RS-232 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.

6.2 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.

6.3 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		Selftest 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

Configuration modes for the 20-150 series of modules are;

CF 12 1	20-150-001 module.
CF 12 2	20-150-101 module.
CF 12 3	20-150-201 module.
CF 12 4	20-150-301 module.

6.4 Factory Instruction Set

The Factory Instruction Set is used to set the selftest threshold levels for the 20-150 series of 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.

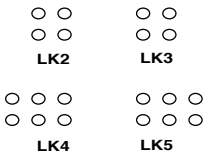
Limit Command

Ascii		Description	Default
ZL	1	Minimum coil threshold.	ZL 1 32
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 13 160
ZL	10	Maximum LED voltage threshold.	ZL 14 208
ZL	11	Minimum Panel LED voltage threshold.	ZL 15 128
ZL	12	Maximum Panel LED voltage threshold.	ZL 16 176
ZL	13	12V low threshold.	ZL 9 192
ZL	14	12V high threshold.	ZL 10 240
ZL	15	Selftest retries before failure.	ZL 11 3
ZL	16	Settled delay, in 10us.	ZL 12 25 (250us)

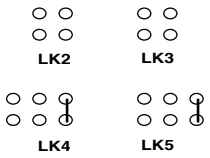
6.5 Link Settings

The links on the PCB are set at the factory to configure the module for the specific type of 20-150 series of modules. The information is shown for information only and should not need to be altered.

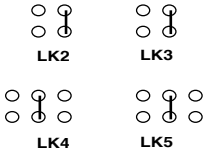
Link Settings for Power Module Options



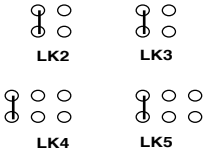
20-150-001
16 x 16 Amp Relays



20-150-101
12 x 16 Amp Relays
2 x 30 Amp Relays



20-150-201
8 x 16 Amp Relays
4 x 30 Amp Relays



20-150-301
2 x 16 Amp Relays
8 x 30 Amp Relays

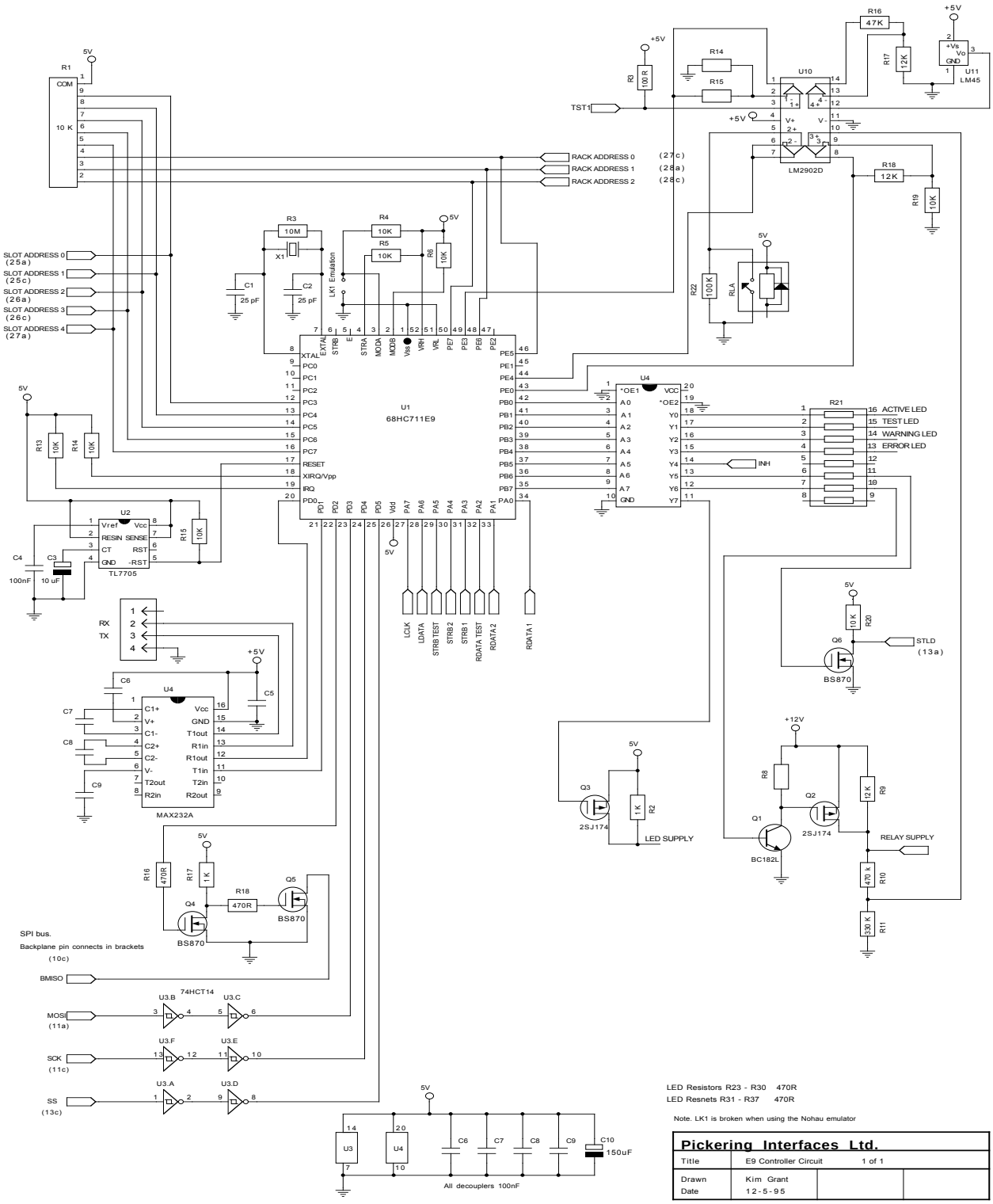


Fig 7.1 Driver Circuit Diagram

Relay Number on Connector	Reference on PCB
1	RL1
2	RL2
3	RL3
4	RL4
5	RL5
6	RL6
7	RL7
8	RL8

Relay Number on Connector	Reference on PCB
9	RL9
10	RL10
11	RL11
12	RL12
13	RL13
14	RL14
15	RL15
16	RL16

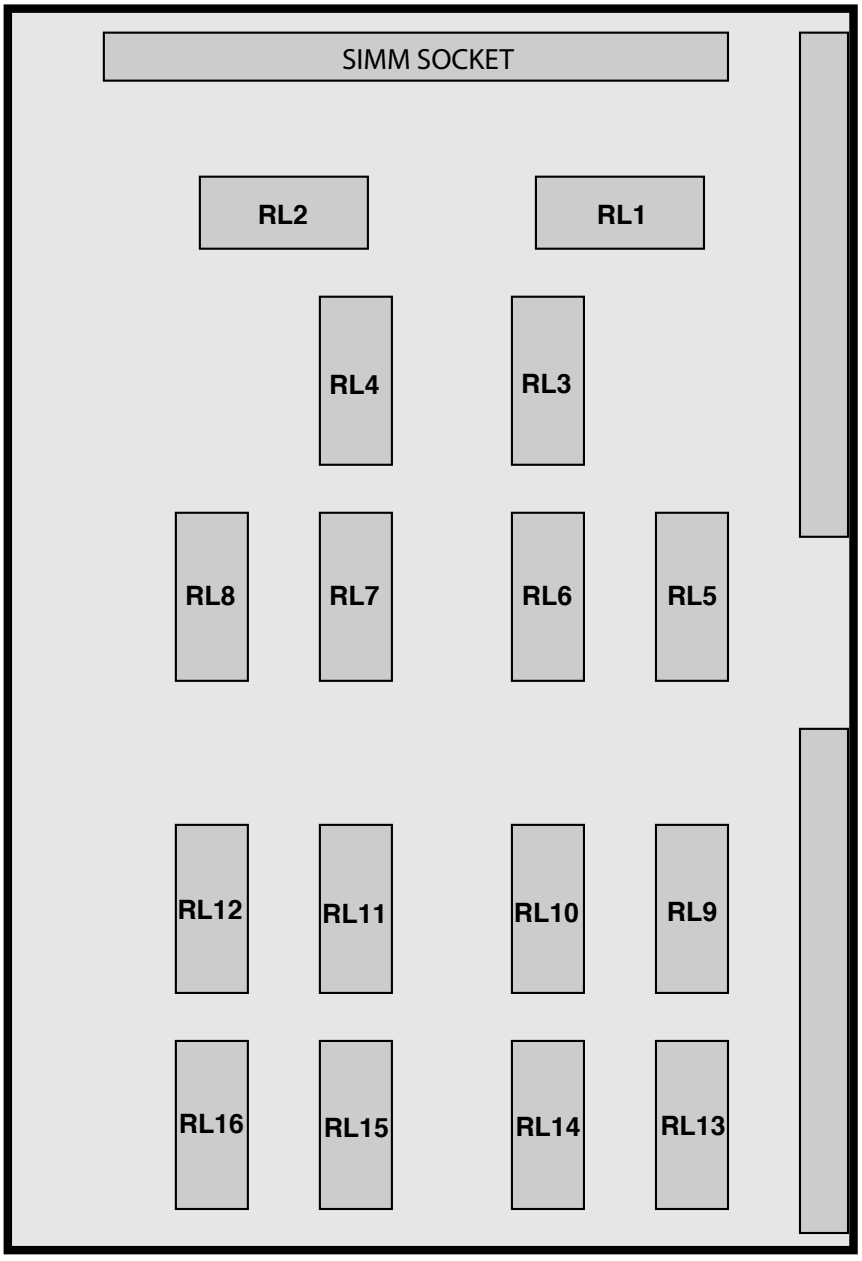


Fig 7.2 20-150-001 Board Layout Diagram.

Relay Number on Connector	Reference on PCB
1	RL1
2	RL2
3	RL3
4	RL4
5	RL5
6	RL6
7	RL7

Relay Number on Connector	Reference on PCB
8	RL8
9	RL9
10	RL10
11	RL11
12	RL12
13	RL23
14	RL24

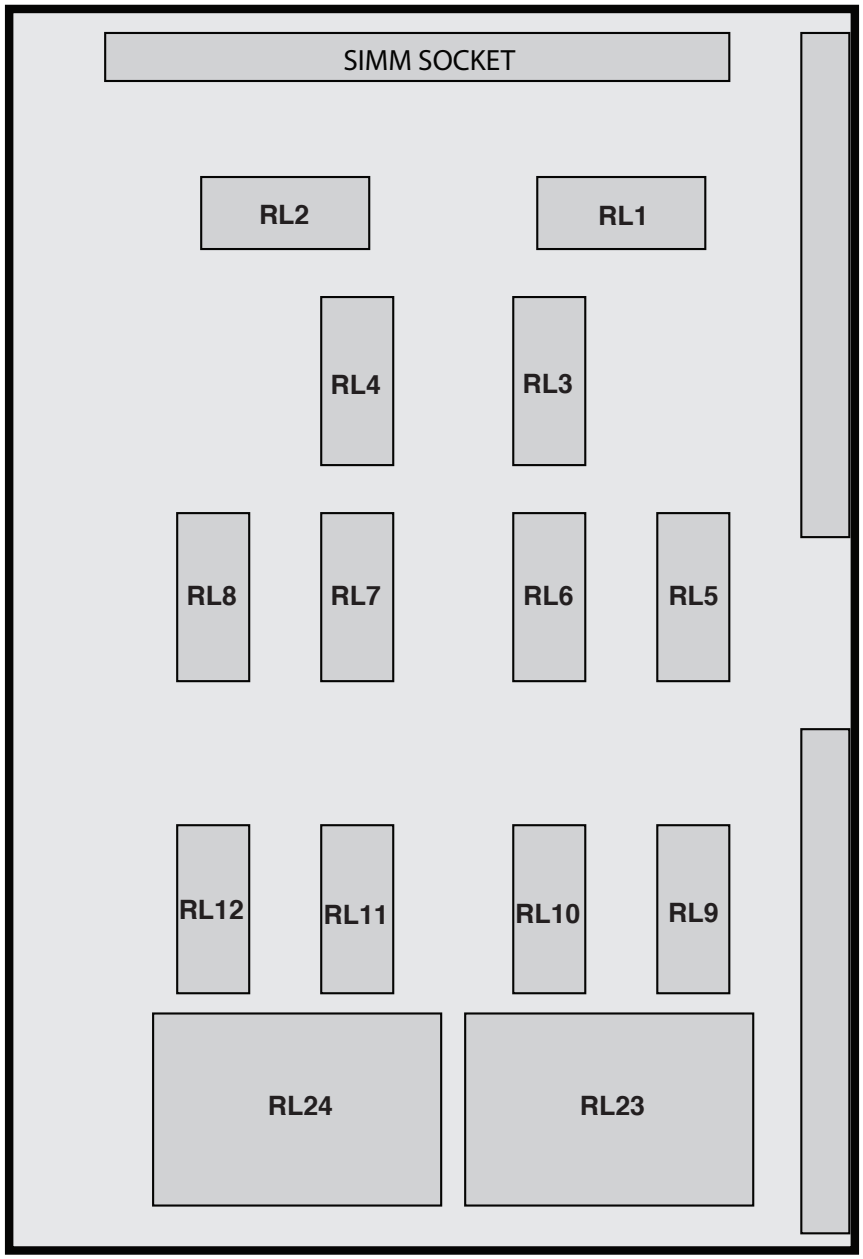


Fig 7.3 20-150-101 Board Layout Diagram.

Relay Number on Connector	Reference on PCB
1	RL1
2	RL2
3	RL3
4	RL4
5	RL5
6	RL6

Relay Number on Connector	Reference on PCB
7	RL9
8	RL10
9	RL21
10	RL22
11	RL23
12	RL24

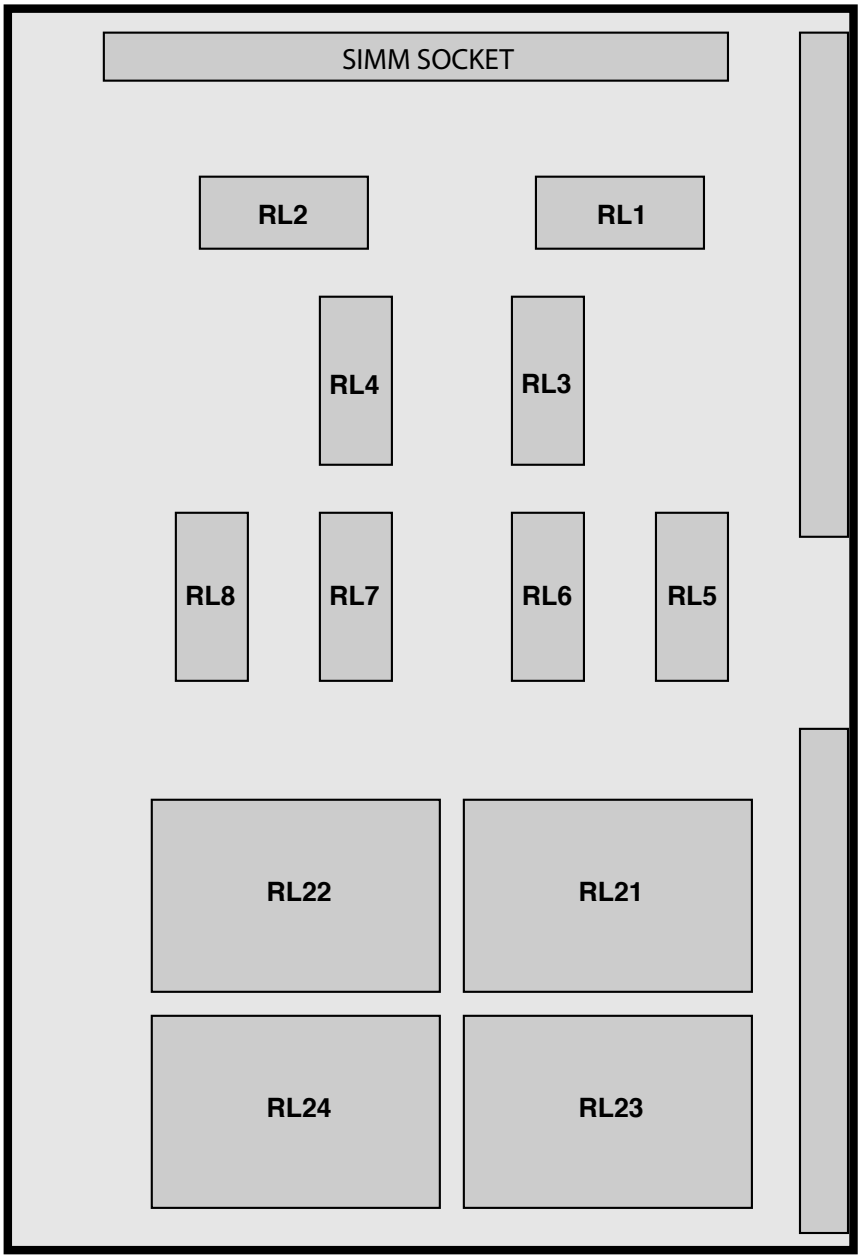


Fig 7.4 20-150-201 Board Layout Diagram.

Relay Number on Connector	Reference on PCB
1	RL1
2	RL2
3	RL17
4	RL18
5	RL19

Relay Number on Connector	Reference on PCB
6	RL20
7	RL21
8	RL22
9	RL23
10	RL24

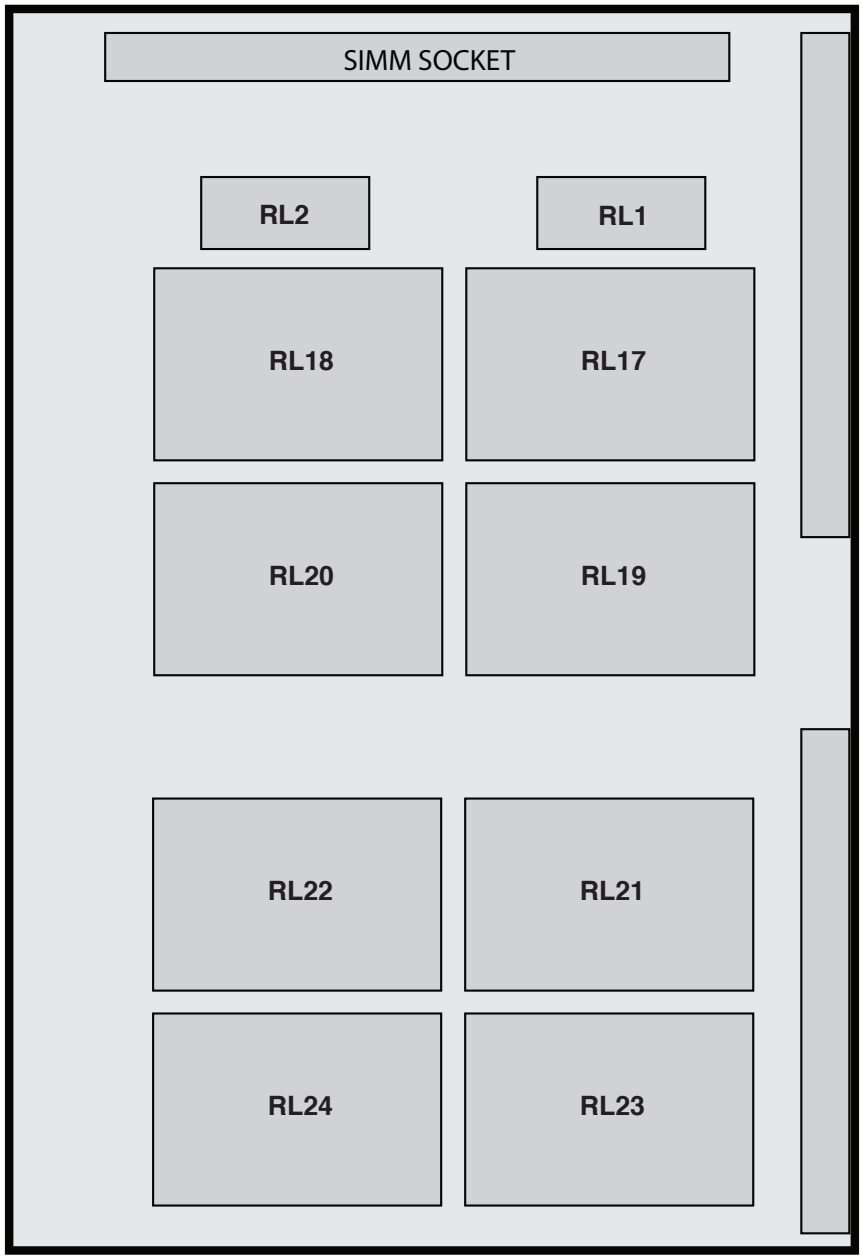
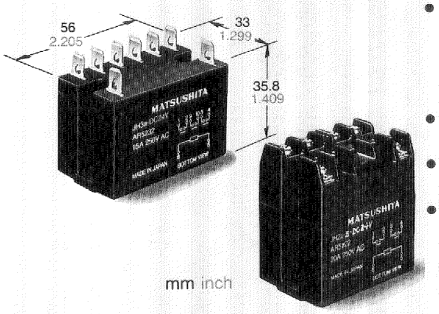


Fig 7.5 20-150-301 Board Layout Diagram.

NAiS — 30 AMP (1 Form X) POWER RELAY WITH SPACE SAVING DESIGN — JH-RELAYS

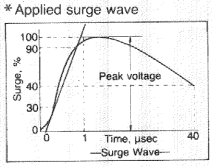
UL File No.: E43028; CSA File No.: LR26550; TÜV File No.: 84041645503; VDE File No.: VDE-Reg.-Nr. 1669



mm inch

- Many safety-oriented characteristics incorporated
  Contact gap: more than 3 mm for 1 Form A and 2 Form A
  Breakdown voltage for N.O. contact: 2,000 V AC between contacts
  5,000 V AC between coil and contact
  Molded materials: all 94 V-0
- Various contact arrangements
  1 Form A, 2 Form A, 3 Form A, 2 Form A 1 Form B
- High dielectric strength for transient protection
  10,000 V surge is μsec. between coil and contact
- High inrush resistance
  1 Form A type: 117 A (meets TV-8 requirement)
  2 Form A type: 91 A (meets TV-6 requirement)

* Applied surge wave



SPECIFICATIONS

Contacts

Arrangement	1 Form A	2 Form A	3 Form A	2 Form A 1 Form B
Initial contact pressure	Approx. 80 g (2.82 oz)	Approx. 40 g (1.41 oz)	Approx. 30 g (1.06 oz)	N.O.: 30 g (1.06 oz); N.C.: 20 g (0.71 oz)
Initial contact resistance, max. (By voltage drop 6 V DC 1 A)	100 mΩ			
Contact material	Silver alloy			
Rating (resistive load)				
Nominal switching rating	30 A 250 V AC	20 A 250 V AC	15 A 250 V AC	N.O.: 15 A 250 V AC; N.C.: 5 A 250 V AC
Max. switching power	7,500 VA	5,000 VA	3,750 VA	N.O.: 3,750 VA; N.C.: 1,250 VA
Max. switching voltage	277 V AC			
Max. switching current	30 A	20 A	15 A	N.O.: 15 A; N.C.: 5 A
UL/CSA rating	1 HP 125 V AC 2 HP 250 V AC 30 A 277 V AC	1 HP 125 V AC 2 HP 250 V AC 20 A 277 V AC	1/2 HP 250 V AC 10 A 277 V AC 15 A 125 V AC	N.O.: 1/2 HP 250 V AC 10 A 277 V AC 15 A 125 V AC N.C.: 1/4 HP 250 V AC 10 A 277 V AC 5 A 125 AC
Expected life (min. operations)				
Mechanical	5×10⁶ at 180 cpm (10⁶ at 180 cpm for latching and AC types)			
Electrical (at nominal resistive load)	10⁵ at 180 cpm			

Coil

Minimum operating power	1.23 W (DC) Approx. 2.0 VA (AC)
Nominal operating power	1.92 W (DC) Approx. 3.2 VA (AC)

Characteristics

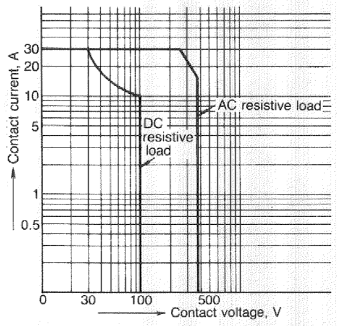
Contact arrangement	1 Form A	2 Form A	3 Form A	2 Form A 1 Form B
Maximum operating speed	20 cpm			
Operate time	Approx. 20 msec. at nominal voltage (DC)			
Release time	Approx. 5 msec. at nominal voltage (DC)			
Initial insulation resistance	More than 100 MΩ at 500 V DC			
Breakdown voltage				
Beteeen open contacts	2,000 Vrms			N.O.: 2,000 Vrms; N.C.: 1,500 Vrms
Between contact sets	—	4,000 Vrms	3,000 Vrms	
Between contacts and coil	5,000 Vrms			N.O.: 5,000 Vrms; N.C.: 3,000 Vrms
Surge voltage	More than 10,000 V between contacts and coil			
Temperature rise (at nominal voltage)	DC: Max. 65°C; AC: Max. 85°C			
Ambient temperature	−50° to +55°C (−58°F to +131°F) (Not freezing and condensing at low temperature)			
Shock resistance	Functional: min. 98 m/s² (10 G); Destructive: min. 980 m/s² (100 G)			Functional: Approx. 49 m/s² (5 G) Destructive: min. 980 m/s² (100 G)
Vibration resistance	Functional: 10 to 55 Hz at 1 mm double amplitude Destructive: 10 to 55 Hz at 1.5 mm double amplitude			
Molded materials used	94 V-0			
Unit weight	Approx. 90 g 3.17 oz (Approx. 115 g 4.06 oz)	Approx. 96 g 3.39 oz (Approx. 129 g 4.55 oz)		Approx. 100 g 3.53 oz (Approx. 130 g 4.59 oz) ( ): screw type

303

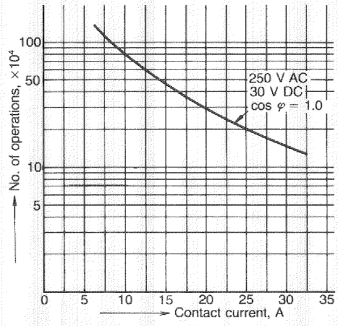
DATA

1 Form A

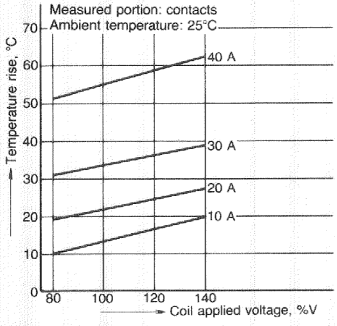
1. Maximum switching power



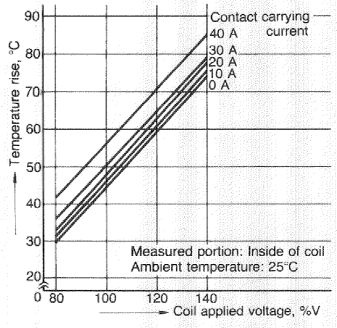
2. Life curve



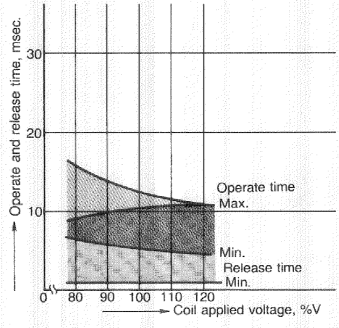
3.1 Contact temperature rise (DC type)



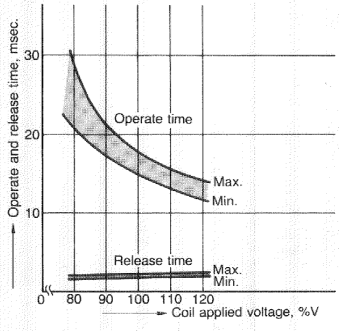
3.2 Coil temperature rise (DC type)



4. Operate and release time (1a,2a) AC type

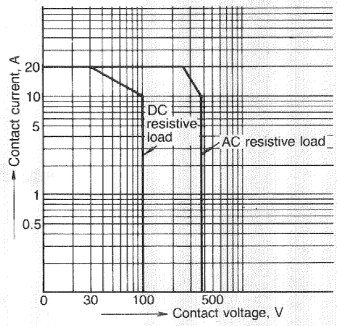


5. Operate and release time (1a,2a) DC type

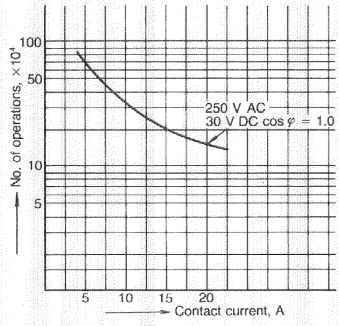


2 Form A

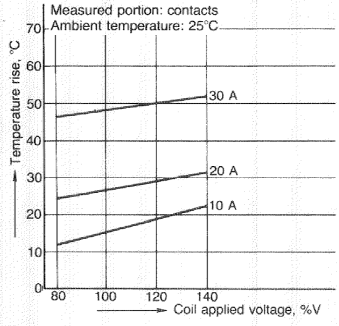
1. Maximum switching power



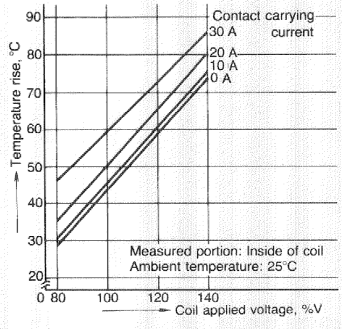
2. Life curve



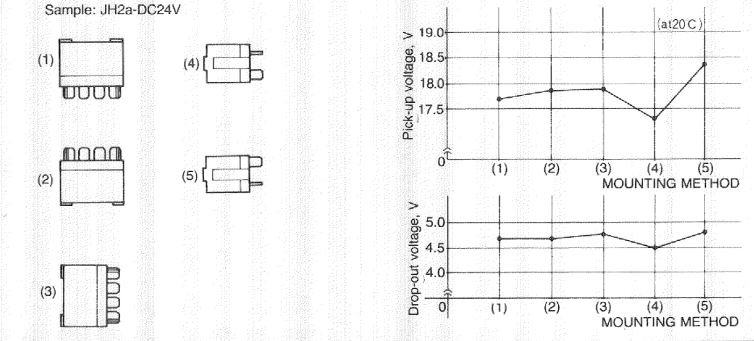
3.1 Contact temperature rise (DC type)



3.2 Coil temperature rise (DC type)



4. Pick-up and drop-out voltage change by mounting method



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