PRODUCT/TEST MANUAL

1M122K1

TRANSFORMER PARALLEL CONTROL SYSTEM

Order Number	Factory Loaded UMX	Serial Number

Issue	Date	Summary of changes
A	31/10/2002	Initial issue.
B	06/03/2003	Revision of tap position logic table & steady state input to 1X200 remote input.
C-D	26/03/2003	Reference tap function now not displayed. Reference is set to lowest number ONLINE transformer. All tap positions now displayed except if a transformer is out of step.

Author	Checked and Registered	.pdf file created	Released
ARF	DG	DG	Digitally signed by David Greenwood cn=David Greenwood, c=AU Date: 2003.03.31 10:05:17 +11'00' Reason: Document is released

1.0 SYSTEM OVERVIEW

1.1 Basic Operation

The 1M122K1 system is designed to monitor and control the tap changers of four (4) transformers using A simultaneous parallel control technique. Two parallel control groups are available such that the low voltage BUS may be opened to allow independent control of transformers on Group A and transformers on Group B.

Parallel control schemes traditionally use auxiliary switches on the tap changers to determine out of step errors. While this is a reliable and proven technique there are two significant drawbacks:

1. Wiring complexity between the tap changer auxiliary switches
2. Requirement for matched tap changers

The first issue is overcome by replacing each tap changer auxiliary switch with a TPI transducer (2V200), which sends a frequency signal proportional to the tap position. This requires only two wires for each tap changer and is simply wired back to the 1M122 Parallel Control System.

The second issue is overcome with a user specified tap position logic table in the Parallel Control Relay (2V165) to allow non-matched tap changers to operate together.

The tap position of each transformer is monitored as well as the raise / lower commands initiated by the selected Voltage Regulating Relay (2V164). The 2V165 responds by sending the appropriate raise / lower commands to a Transformer Control Panel (1X200) which relays these commands to each tap changer in accordance with the tap position logic table.

If any tap changer moves outside the limits established in the tap position logic table, an out of step alarm contact will time out and all further tap change commands inhibited.

Any or all of the transformers may be taken off the parallel scheme and operated independently. This is signalled to the 2V165 via status inputs, which inhibit any tap change commands or alarm outputs relating to that transformer.

1.2 An Integrated Solution

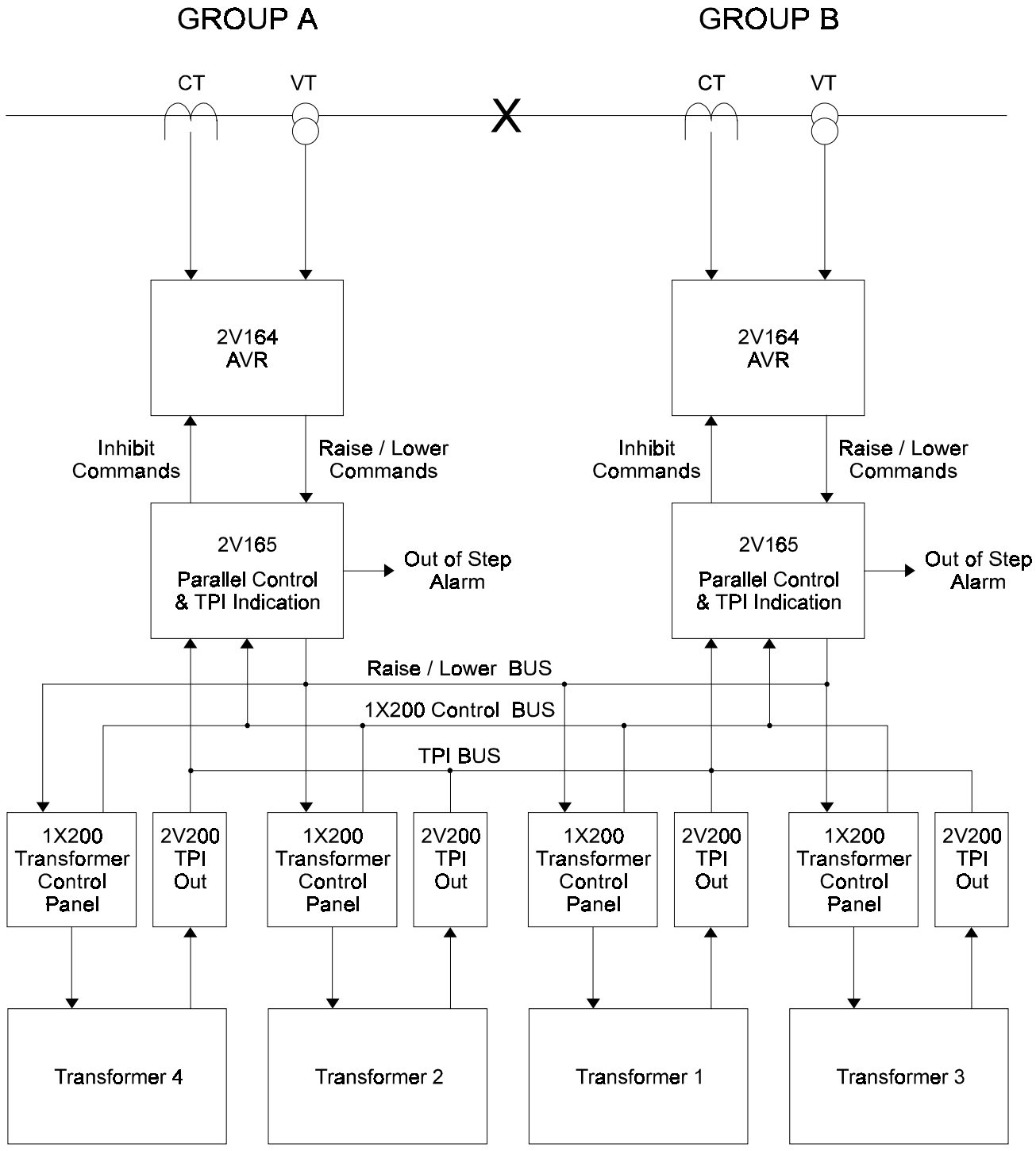
The 1M122K1 system provides an integrated solution to a potentially complex parallel control scheme. The centralized architecture is modular, compact and cost effective. The draw out case system allows simple changeover of relay modules in the event of failure. Communication ports on the front panel allow field upgrades to control firmware and parameter setting while the rear network port and Modbus RTU compatibility provide SCADA integration capability.

Control panels for each transformer replace traditional push buttons, pilot lights, annuciators and interwiring. Status inputs and repeat output contacts provide simple integration to existing RTU control schemes.

The 1M122 system is available in various configurations to suit the number of transformers and parallel control groups required. Distributed systems are also possible for those users requiring a separate control cubicle for each transformer.

2.0 1M122K1 SYSTEM ARCHITECTURE

1M122K1
System Architecture

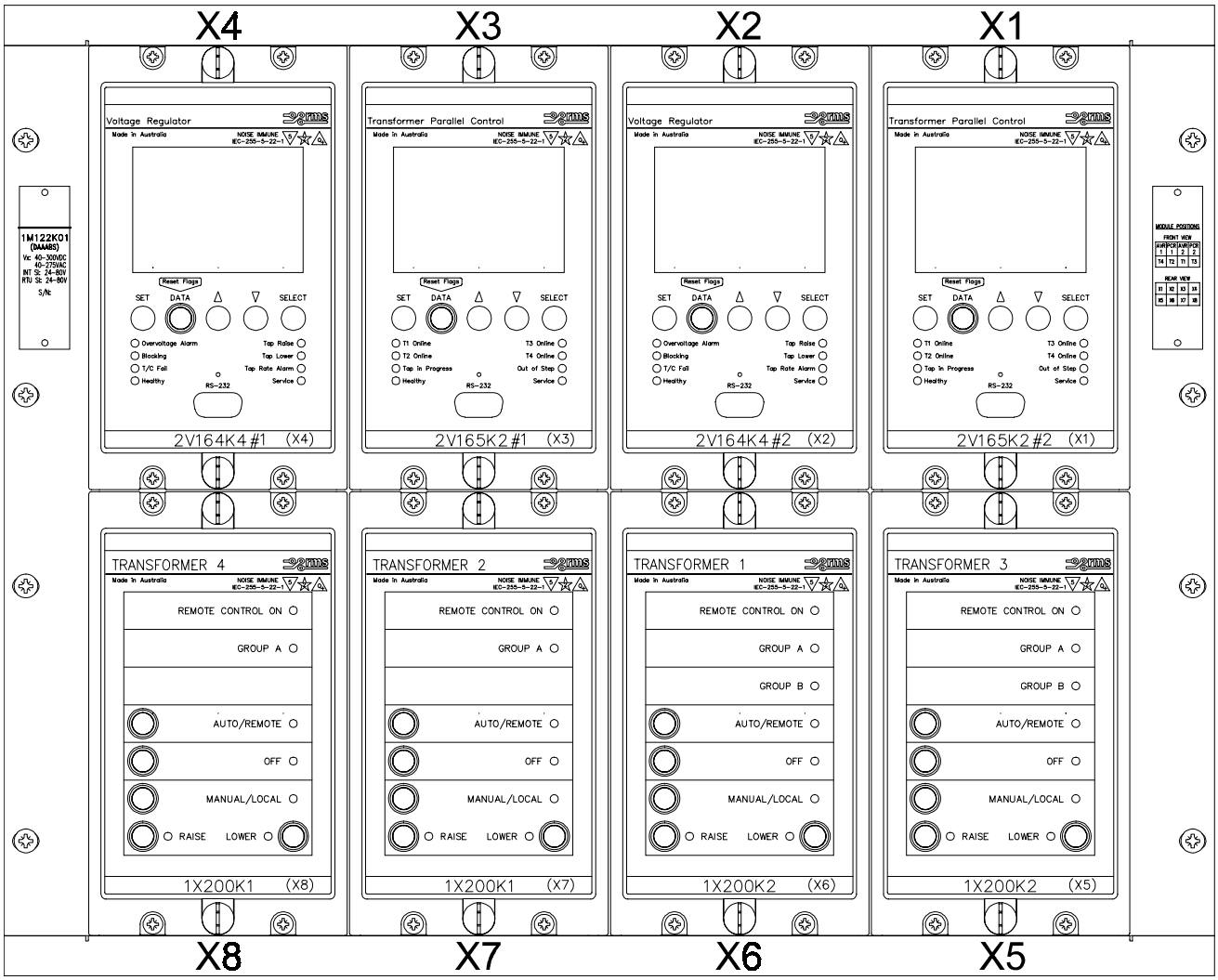


3.0 1M122K1 COMPONENTS

The 1M122K1 comprises 8 draw out modules pre wired in 2 rows of 4U high 19 inch sub rack frames. The different elements are as follows:

2 units of:	2V164K4	Voltage Regulating and Tap Change Control Relay
2 units of:	2V165K2	Transformer Parallel Control Relay
2 units of:	1X200K1	Transformer Control Panel (Group A only)
2 units of:	1X200K2	Transformer Control Panel (Group A and B)

Plus: 4 units of: 2V200 TPI Transducers located at the tap changers.



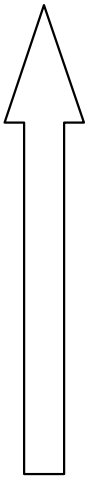
4.0 TAP POSITION INDICATOR (TPI) INPUTS

Four (4) TPI inputs are provided to accept a 0 to 5K HZ frequency coded signals from the RMS manufactured 2V200 TPI transducers. The 2V165 is programmed with the number of taps and direction for each transformer as per the following table:

IMPORTANT NOTE:

Voltage Raise Command = Tap Change Command that will result in an increase in system voltage.

Voltage Lower Command = Tap Change Command that will result in a reduction in system voltage.

REFERENCE	TRANSFORMER NO.				
TAP	4	2	1	3	
					
17	17	17	17	17	
16	16	16	16	16	
15	15	15	15	15	
14	14	14	14	14	
13	13	13	13	13	
12	12	12	12	12	
11	11	11	11	11	
10	10	10	10	10	INCREASING VOLTAGE
9	9	9	9	9	
8	8	8	8	8	
7	7	7	7	7	
6	6	6	6	6	
5	5	5	5	5	
4	4	4	4	4	
3	3	3	3	3	
2	2	2	2	2	
1	1	1	1	1	

If the tap of any transformer steps outside the pre-defined band the out of step contact will pick up. A user specified time delay (1-30s in 0.5s steps), is provided to allow for differences in tap changer operate times.

It should be noted that this table is only required when tap changers are not matched. The tap position logic table template on this page should be completed and supplied with the 2V165 ordering code where unmatched tap changers are to be used. The 2V165 will then be supplied pre-programmed with the specified configuration.

5.0 1X200K1 and 1X200K2 TRANSFORMER CONTROL PANELS

5.1 The 1X200 Transformer Control Panels provide an interface between:

- The automatic control system provided by the 2V164 / 2V165 combination;
- The remotely operated SCADA control;
- The local operator intervention panel on the front of the1X200.

5.2 Operation from the Front Panel Push Buttons

All front push buttons are momentary action and latching LED's are employed to provide status indication.

Each transformer has a 1X200 control panel to allow:

- A transformer to be placed in Group A (Only from Group B in any mode) – 1X200K2 only;
- A transformer to be placed in Group B (Only from Group A in any mode) – 1X200K2 only;
- A transformer to be placed in OFF mode (From any mode);
- A transformer to be placed in LOCAL mode (Only from OFF mode);
- Manual raise or lower of the system voltage in LOCAL mode only;
- A transformer to be placed In AUTO mode (Only from OFF mode);
- A transformer to be placed in REMOTE control mode (Only from AUTO mode).

5.3 Operation Via the Remote Status Inputs

Separate inputs and status output repeat contacts are provided for each button for RTU integration.

An additional status input is provided to place the 1X200 into remote mode (From AUTO mode only).

Refer to section 14.0 for the system wiring and functional listing.

6.0 OPERATIONAL OVERVIEW

6.1 On Line / Off Line Status Inputs

A status input is provided for each 1X200 Transformer Control Panel to signal if the transformer is operating as part of the parallel group or is OFF LINE. Voltage raise and lower commands will be inhibited for OFF LINE transformers and its tap position not used to initiate an out of step alarm.

6.2 Voltage Raise / Lower Initiate Inputs

Two (2) separate status inputs are provided on the 2V165 to detect voltage raise and voltage lower initiate signals from the 2V164 voltage regulating relay. These are used to allow the 2V165 to check that tap position changes only occur in synchronization with voltage raise / lower commands.

6.3 Voltage Raise / Lower Initiate Outputs

When a voltage raise or lower command is detected, the 2V165 sends specific tap change output commands to each transformer 1X200 module such that the positions in the pre-defined tap position logic table are observed. Provided the 1X200 is set to AUTO, a continuous contact output is sent to the tap changer which is reset when the corresponding tap position indicator changes position.

The voltage raise output must be wired to provide an increase in system volts. The voltage lower output must be wired to provide a reduction in system volts. Voltage raise does not necessarily mean tap raise for a particular transformer tap changer (Refer section 4).

6.4 Reference Tap Position

The parallel control system uses a Reference Tap Position to determine the correct tap position for each transformer. No single transformer can be used as the reference as it may not always form part of the parallel scheme. For example when it is OFF LINE or when part of another parallel group.

The Reference Tap Position is established when a transformer is first bought ON LINE. If more than one transformer is bought ON LINE together, say during power up conditions, then the tap position of the lowest ON LINE transformer number is used. For example if all four transformers were placed ON LINE simultaneously then the tap position of transformer number one would be used to establish the Reference Tap Position.

The Reference Tap Position may be reset to another tap position in two ways:

1. Take all transformers OFFLINE, manually change a transformer (or group of transformers) to the desired Reference Tap and place back ONLINE.

2. Set the Go To setting to the desired tap position and activate the Go To status input.

6.5 Out Of Step Alarm

When a voltage raise or lower command is output, an out of step alarm timer is initiated in the 2V165. If all ON LINE tap changers have not moved to the specified tap within the user specified time delay (1-30s in 1s steps), the out of step alarm contact will close and a message identifying the problem transformer tap changer displayed.

6.6 Tap Change Feedback Output Contact

This contact is closed when a Tap Raise / Lower command is received from the 2V164 AVR & is reset when all transformers have successfully moved to the tap next position. The contact is wired back to the 2V164 Tap Change Feedback status input to pause the interval timer until all transformers have completed the tap change sequence.

6.7 All Transformers Off Line Output Contact

When no transformers in a group are selected ONLINE (Hard wire interface to the 1X200), this N/O contact is closed. This function is used to automatically inhibit the AVR's to avoid tap change fail and voltage level alarms occurring.

6.8 Go To Specified Tap

A status input is provided on the 2V165 which may be initiated to change the Reference Tap Position to a user specified position. All ON LINE transformers will then be driven to this position. An initiate pulse of 1s minimum is required. Taking all transformers OF LINE and then placing at least one back ON LINE will reset the Reference Tap Position to that of the lowest numbered ON LINE transformer.

6.9 Auto Home

When a transformer is put back ON LINE it will automatically home to the Reference Tap Position to match the other transformers already ON LINE. If no other transformer is currently ONLINE then the Reference Tap Position will be set to the tap position of that transformer.

During the Auto Home sequence the ON LINE LED for the homing transformer will flash and then go solid when it has reached the Reference Tap position.

A user specified time delay (10-300s in 5s steps), is provided to allow for the tap changer to reach the specified target position during which period the Out of Step alarm is inhibited.

6.10 Power up Conditions

At initial system power up, more than one transformer may be bought back on line at the same time. In this instance the Reference Tap Position will be set to the tap position of the lowest numbered transformer (Refer section 6.4 above). Tap change commands will then be output to bring any other ON LINE transformers to the same tap position.

If some transformers require raise commands while others require lower commands, the lower commands will take priority followed by the raise commands.

6.11 Operational Indicators – 2V165

LEDs indicate the following conditions.

- Transformer 1 ONLINE
- Transformer 2 ONLINE
- Transformer 3 ONLINE
- Transformer 4 ONLINE
- Tap change in progress
- Out of step alarm
- Healthy
- Service

6.12 Data Display – 2V165

During normal operation the front panel LCD provides the following information:

- The tap position of each transformer
- Transformer out of step status

7.0 REFERENCE INFORMATION

7.1 2V164K4 Voltage Regulating And Tap Change Control Relay

Refer to the Technical Bulletin and Product Test Manual for detailed functionality of the 2V164.

7.2 2V165K2 Transformer Parallel Control Relay

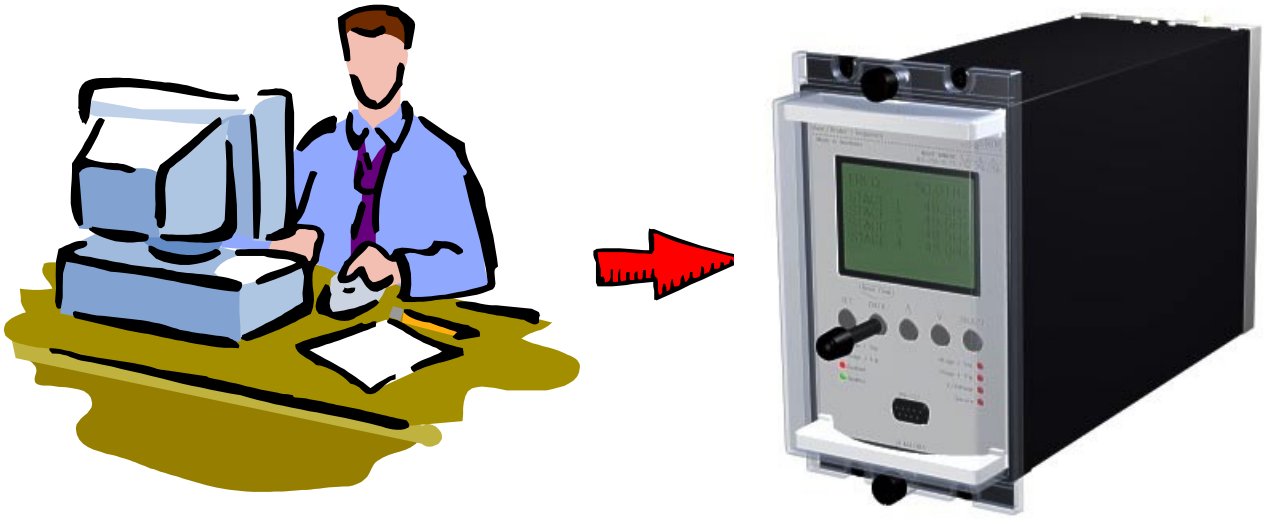
Refer to the Technical Bulletin and Product Test Manual for detailed functionality of the 2V165.

8.0 USER INTERFACE

Refer to the μMATRIX Users Guide for detailed instructions on the operation of the user interface.

To download a PDF version of the guide:
www.rmspl.com.au/digital/uMATRIXInfo.pdf

To download further μMATRIX software and documentation:
www.rmspl.com.au/uMATRIX.htm



9.0 SOFTWARE

9.1 Compatible Software UMX

The 2V164K4 and 2V165K2 μMATRIX relays have a number of software programs called UMX available, which can be installed by the user. Each UMX provides a different functional configuration to suit specific applications. They must be however, compatible with your hardware.

Download the UMX compatibility list from the RMS website:

http://www.rmspl.com.au/digital/compatibility.pdf

9.2 Factory Default Software

The 2V164K4 and 2V165K2 relays are ordered with a customer specified default UMX so that it is ready for operation when received. To achieve this, an ordering code may be sought at time of quotation and specified on your order.

9.3 Determining Software UMX

Determining which UMX is loaded onto a μMATRIX relay may be done in three ways:

9.3.1 New relays received from the factory have a label located on the side of the draw out module. This label is printed with information specific to the relay and includes the UMX type that was loaded during production.

9.3.2 Press the DATA and SET page buttons on the relay simultaneously to bring up the DIAGNOSTICS page. Now press SELECT to view the versions page and you will see:

** VERSION PAGE **

a)	BIOS Version:	Vxx.xx	The version of the low level BIOS code loaded by the factory.
b)	S/W Version:	Vxx.xx	The version of the software UMX.
c)	CBD:	RMS Default	The .ump parameters file saved to the relay from MATRIXwin.
d)	Model:	xxxxxS	The xxxxx is the relay hardware code. The “S” is the software UMX code.
e)	S/N:	xxxxxx.xx	The production tracking serial number also found on the front label.
f)	H/W Config:	xx	This number is related to the PCB loading and is auto detected.

9.3.3 Or connect to the relay through the front panel RS232 configuration port using MATRIXwin and a PC. Now select OPTIONS and UTILITIES and you will get the same information as above.

9.4 Determining UMX Functionality

Now that you have determined the UMX loaded in the relay you need to obtain the Software Functional Description Document which relates to it.

The document is provided with the relay and should append this Manual.

If you don’t have it or need a different one, it may be obtained from our web site as follows:

Document name is: UMX2V164x.pdf using the code from the version page above.

The location is: *www.rmspl.com.au/uMATRIX.htm*

10.0 SPECIFICATIONS

10.1 Burdens

Auxiliary Supply Voltage	40 - 275 V AC , 40 - 300 VDC
Auxiliary Supply Burden (at 48V)	<50W

10.2 Initiates

Status Inputs Group 1	24 - 80 V DC
Status Inputs Group 2	24 - 80 V DC

10.3 Output Contact Ratings

10.3.1 Make and carry

30A AC or DC (Limits L/R=40ms and 300V max.) for 0.2s
20A AC or DC (Limits L/R=40ms and 300V max.) for 0.5s
5A AC or DC continuously

10.3.2 Break (Limits 5A and 300V max.)

1,250VA AC resistive
250VA at 0.4PF AC inductive
75W DC resistive
30W DC inductive L/R = 40ms
50W DC inductive L/R = 10ms

10.3.3 Minimum recommended load

0.5W, 10mA or 5V minimum.

10.4 Relay Fail Alarm

A C/O alarm contact is maintained in the energized state when all of the following conditions are met:

- The auxiliary supply is applied
- The internal 24V DC rail is within acceptable limits
- The CPU hardware watchdog maintains a pulsing output

A CPU software watchdog records “suspect” events to an assert register and if necessary performs a soft restart.

10.5 Ambient Operating Temperature Range
-5 to 55 degrees C.

10.6 Insulation Withstand

IEC60255-5 2KV RMS and 1.2/50 5KV impulse between:
all input terminals and frame
all output terminals and frame
all input and output terminals
each input group
each output group

10.7 High Frequency Disturbance

IEC60255-22-1 2.5KV 1MHz common mode
1.0KV 1MHz differential mode

10.8 Electrostatic Discharge

EN61000-4-2:1995 8KV Level 3

10.9 Radio Frequency Interference

EN61000-4-3:1995 10V/m Level 3

10.10 Fast Transient Disturbance

EN61000-4-4:1995 4KV Level 4

11.0 AUXILIARY SUPPLY

11.1 Inputs

A high efficiency switchmode power supply is incorporated which provides a low burden to the auxiliary supply.

11.2 Input Transients

Withstands multiple high-energy transients and ring waves in accordance with IEEE28 - ANSI C26.1 Cat. II, accordingly:

- 0.5uS 100KHz 6KV O/C, 500A S/C, 4J
- 1.2/50uS 6Kv O/C
- 8/20uS 3KA S/C, 80J clamped at 1,000V

Mains conducted EMI within limits specified by AS 3548 Class B.

11.3 Isolation

The inputs are isolated from the outputs in accordance with AS3260 Class II Limited Current Circuitry, accordingly:

- Withstand voltage of 2.5Kv RMS 50Hz for one minute
- Creepage and clearance distance greater than 4mm
- Output leakage current less than 0.25A to earth

11.4 Output Protection

Outputs will withstand continuous short circuit. Output regulators and switching control regulator are thermally protected.

12.0 COMMUNICATION PORTS

Two (2) communications ports are available.

12.1 Programming port

The programming port is accessible from the front panel of the relay via an RS232 physical link and PC configuration program supplied with the relay. The μMATRIXwin configuration program is designed to operate with all relays from the Micro MATRIX range and with all installed firmware version.

12.2 Network port

The network port is intended for applications where permanent connection to a master control system is required. An optically isolated RS232 or RS485 physical layer is provided for this function.
The RS485 option is intended for applications where multiple μMATRIX relays are to be connected on a common communications bus.
The RS232 option is intended for interface to an RS232 to optic fibre converter in environments subject to extreme electrical interference.
The default option is RS485. The customer is able to select RS232 via internal connection changes. (See data sheet.)

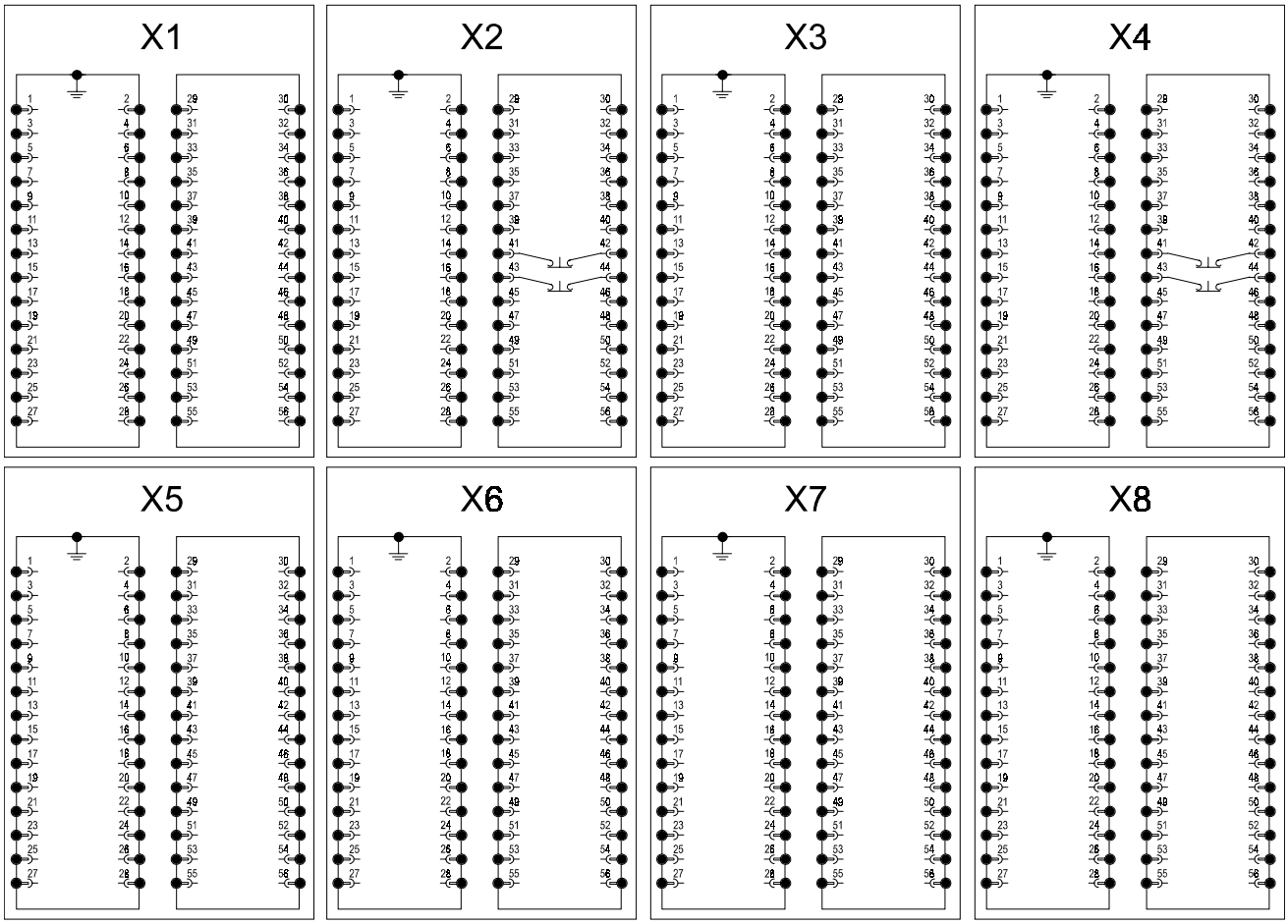
The network port may be used for a permanent link to a modem, remote PC, data concentrator or SCADA system. The standard communications protocol is MODBUS RTU.

12.3 PC to μMATRIX serial cable

One cable supplied with each order.
P/N 997-000-042

13.0 **TERMINAL LAYOUT** (Rear view)

M4 screw terminals.



14.0 WIRING AND FUNCTION SCHEDULE

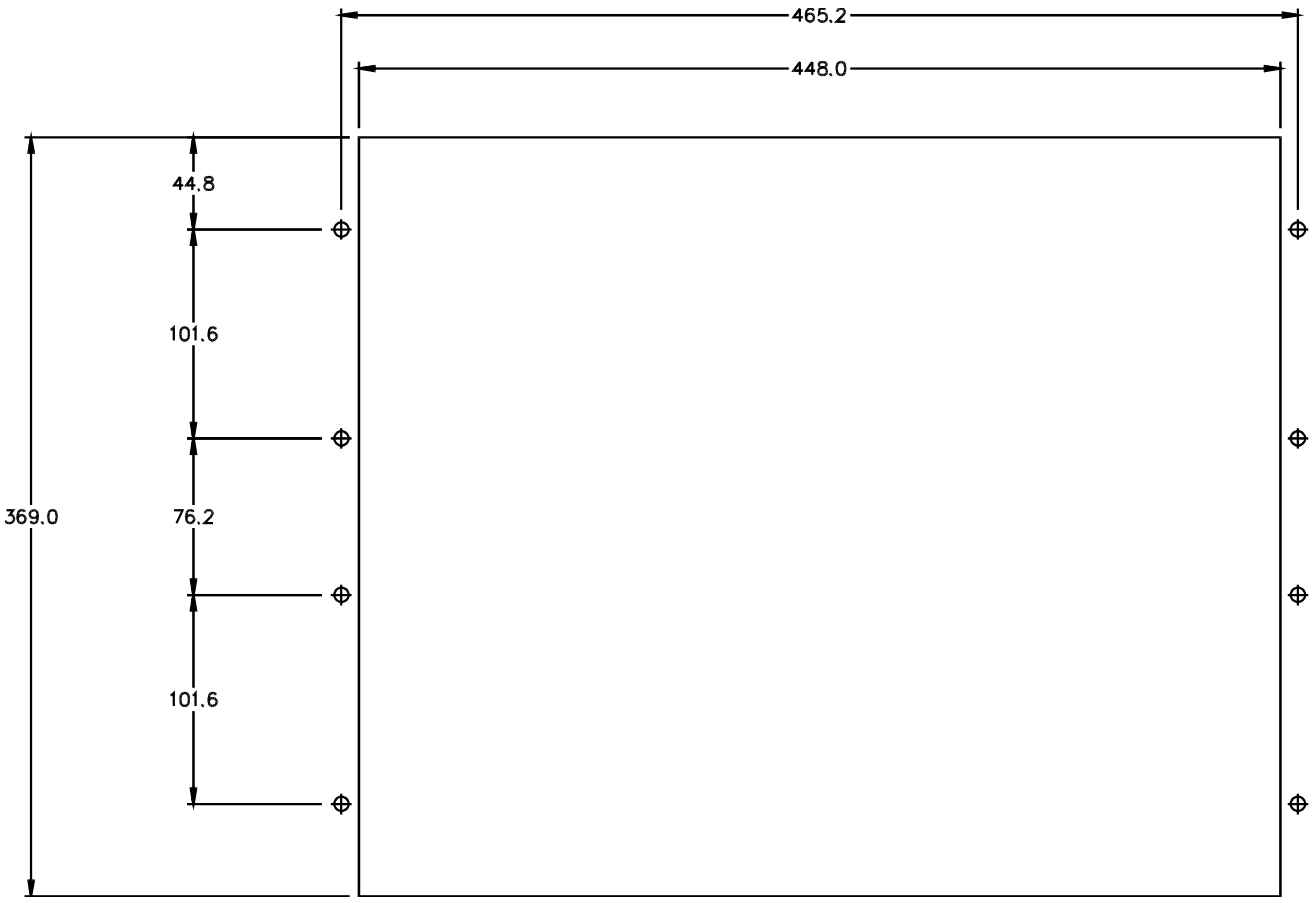
Terminals and Function Description			Operating Parameters	Logical Functions
2V165 Group B				
X1	20	Go to specified tap position	Steady state input	
X1	19	Out of step alarm N/C	Self reset output contact	
X1	21	Out of step alarm N/O	Self reset output contact	
X1	17	Out of step alarm common	Self reset output contact	
X1	39	TPI input from T2 2V200 transducer	0-5KHz frequency signal	
X1	41	TPI input from T2 2V200 transducer	0-5KHz frequency signal	
X1	43	TPI input from T4 2V200 transducer	0-5KHz frequency signal	
X1	45	TPI input from T4 2V200 transducer	0-5KHz frequency signal	
2V164 Group B				
X2	41	1A LDC CT		
X2	42	1A LDC CT		
X2	43	5A LDC CT		
X2	44	5A LDC CT		
X2	29	110V AC VT		
X2	31	63.6V AC VT		
X2	33	VT common		
X2	19	Over voltage alarm N/C	Self reset output contact	
X2	21	Over voltage alarm N/O	Self reset output contact	
X2	17	Over voltage alarm common	Self reset output contact	
X2	30	Under voltage alarm N/C	Self reset output contact	
X2	32	Under voltage alarm N/O	Self reset output contact	
X2	34	Under voltage alarm common	Self reset output contact	
X2	46	Tap change fail alarm N/C	Self reset output contact	
X2	48	Tap change fail alarm N/O	Self reset output contact	
X2	50	Tap change fail alarm common	Self reset output contact	
X2	52	Tap rate alarm N/C	Self reset output contact	
X2	54	Tap rate alarm N/O	Self reset output contact	
X2	56	Tap rate alarm common	Self reset output contact	
2V165 Group A				
X3	20	Go to specified tap position	Steady state input	
X3	35	TPI input from T1 2V200 transducer	0-5KHz frequency signal	
X3	37	TPI input from T1 2V200 transducer	0-5KHz frequency signal	
X3	43	TPI input from T3 2V200 transducer	0-5KHz frequency signal	
X3	45	TPI input from T3 2V200 transducer	0-5KHz frequency signal	
X3	19	Out of step alarm N/C	Self reset output contact	
X3	21	Out of step alarm N/O	Self reset output contact	
X3	17	Out of step alarm common	Self reset output contact	
2V164 Group A				
X4	41	1A LDC CT		
X4	42	1A LDC CT		
X4	43	5A LDC CT		
X4	44	5A LDC CT		
X4	29	110V AC VT		
X4	31	63.6V AC VT		
X4	33	VT common		
X4	19	Over voltage alarm N/C	Self reset output contact	
X4	21	Over voltage alarm N/O	Self reset output contact	
X4	17	Over voltage alarm common	Self reset output contact	
X4	30	Under voltage alarm N/C	Self reset output contact	
X4	32	Under voltage alarm N/O	Self reset output contact	

X4	34	Under voltage alarm common	Self reset output contact	
X4	46	Tap change fail alarm N/C	Self reset output contact	
X4	48	Tap change fail alarm N/O	Self reset output contact	
X4	50	Tap change fail alarm common	Self reset output contact	
X4	52	Tap rate alarm N/C	Self reset output contact	
X4	54	Tap rate alarm N/O	Self reset output contact	
X4	56	Tap rate alarm common	Self reset output contact	
X4	24	RS485 network port	A-	
X4	26	RS485 network port	Shield	
X4	28	RS485 network port	B+	
1X200 Transformer 3 Control Panel				
X5	11	T3 remote raise input	Pulse input	Only operative when T3 remote control ON
X5	12	T3 remote lower input	Pulse input	Only operative when T3 remote control ON
X5	15	Set T3 to REMOTE control operation	Steady state input	Only operative when T3 set to AUTO control
X5	17	Set T3 to AUTO control	Pulse input / button	Only operative when T3 set to OFF
X5	19	Set T3 to LOCAL control	Pulse input / button	Only operative when T3 set to OFF
X5	21	Set T3 to OFF	Pulse input / button	Always operative
X5	16	Set T3 to Group A	Pulse input	Always operative
X5	18	Set T3 to Group B	Pulse input	Always operative
X5	44	Repeat contact output common	Self reset output contact	
X5	42	T3 set to AUTO control output	Self reset output contact	
X5	38	T3 set to OFF repeat output	Self reset output contact	
X5	40	T3 set to LOCAL repeat output	Self reset output contact	
X5	46	T3 set to REMOTE repeat output	Self reset output contact	
X5	48	T3 set to Group A repeat output	Self reset output contact	
X5	50	T3 set to Group B repeat output	Self reset output contact	
X5	52	T3 raise volts output	Pulse output	
X5	54	T3 lower volts output	Pulse output	
X5	56	T3 raise / lower output common	Pulse output	
		T3 manual raise button	Push button	Only operative when T3 set to LOCAL control
		T3 manual lower button	Push button	Only operative when T3 set to LOCAL control
1X200 Transformer 1 Control Panel				
X6	11	T1 remote raise input	Pulse input	Only operative when T1 remote control ON
X6	12	T1 remote lower input	Pulse input	Only operative when T1 remote control ON
X6	15	Set T1 to REMOTE control operation	Steady state input	Only operative when T1 set to AUTO control
X6	17	Set T1 to AUTO control	Pulse input / button	Only operative when T1 set to OFF
X6	19	Set T1 to LOCAL control	Pulse input / button	Only operative when T1 set to OFF
X6	21	Set T1 to OFF	Pulse input / button	Always operative
X6	16	Set T1 to Group A	Pulse input	Always operative
X6	18	Set T1 to Group B	Pulse input	Always operative
X6	44	Repeat contact output common	Self reset output contact	
X6	42	T1 set to AUTO control output	Self reset output contact	
X6	38	T1 set to OFF repeat output	Self reset output contact	
X6	40	T1 set to LOCAL repeat output	Self reset output contact	
X6	46	T1 set to REMOTE repeat output	Self reset output contact	
X6	48	T1 set to Group A repeat output	Self reset output contact	
X6	50	T1 set to Group B repeat output	Self reset output contact	
X6	52	T1 raise volts output	Pulse output	
X6	54	T1 lower volts output	Pulse output	
X6	56	T1 raise / lower output common	Pulse output	
		T1 manual raise button	Push button	Only operative when T1 set to LOCAL control
		T1 manual lower button	Push button	Only operative when T1 set to LOCAL control
1X200 Transformer 2 Control Panel				
X7	11	T2 remote raise input	Pulse input	Only operative when T2 remote control ON
X7	12	T2 remote lower input	Pulse input	Only operative when T2 remote control ON
X7	15	Set T2 to REMOTE control operation	Steady state input	Only operative when T2 set to AUTO control

X7	17	Set T2 to AUTO control	Pulse input	Only operative when T2 set to OFF
X7	19	Set T2 to LOCAL control	Pulse input / button	Only operative when T2 set to OFF
X7	21	Set T2 to OFF	Pulse input / button	Always operative
X7	16	Set T2 to Group A	Pulse input / button	Always operative
X7	44	Repeat contact output common	Self reset output contact	Always operative
X7	42	T2 set to AUTO control output	Self reset output contact	
X7	38	T2 set to OFF repeat output	Self reset output contact	
X7	40	T2 set to LOCAL repeat output	Self reset output contact	
X7	46	T2 set to REMOTE repeat output	Self reset output contact	
X7	48	T2 set to Group A repeat output	Self reset output contact	
X7	52	T2 raise volts output	Pulse output	
X7	54	T2 lower volts output	Pulse output	
X7	56	T2 raise / lower output common	Pulse output	
		T2 manual raise button	Push button	Only operative when T2 set to LOCAL control
		T2 manual lower button	Push button	Only operative when T2 set to LOCAL control
1X200 Transformer 4 Control Panel				
X8	1	Vx Active	48V DC	
X8	3	Vx Common		
X8	32	Vx Internal control supply active	48V DC	
X8	26	Vx Internal control input common		
X5		Chassis earth		
X8	13	RTU input common		
X8	11	T4 remote raise input	Pulse input	Only operative when T4 remote control ON
X8	12	T4 remote lower input	Pulse input	Only operative when T4 remote control ON
X8	15	Set T4 to REMOTE control operation	Pulse input	Only operative when T3 set to AUTO control
X8	17	Set T4 to AUTO control	Pulse input	Only operative when T4 set to OFF
X8	19	Set T4 to LOCAL control	Pulse input	Only operative when T4 set to OFF
X8	21	Set T4 to OFF	Pulse input	Always operative
X8	16	Set T4 to Group A	Pulse input	Always operative
X8	25	Power supply / relay fail alarm N/C	Self reset output contact	Always operative
X8	27	Power supply / relay fail alarm N/O	Self reset output contact	
X8	23	Power supply / relay fail alarm comm.	Self reset output contact	
X8	44	Repeat contact output common	Self reset output contact	
X8	42	T4 set to AUTO control output	Self reset output contact	
X8	38	T4 set to OFF repeat output	Self reset output contact	
X8	40	T4 set to LOCAL repeat output	Self reset output contact	
X8	46	T4 set to REMOTE repeat output	Self reset output contact	
X8	48	T4 set to Group A repeat output	Self reset output contact	
X8	52	T4 raise volts output	Pulse output	
X8	54	T4 lower volts output	Pulse output	
X8	56	T4 raise / lower output common	Pulse output	
		T4 manual raise button	Push button	Only operative when T4 set to LOCAL control
		T4 manual lower button	Push button	Only operative when T4 set to LOCAL control

Refer RMS drawing 157-122-201 for the 1M122K1 internal wiring details.

15.0 PANEL CUT OUT DETAILS



16.0 TEST PROCEDURE

16.1 Test Equipment Required
High Voltage Test Equipment.
Calibrated Test Set (Volts, Amps, Timing and Phase Angle)
A PC with Windows 98 or later and at least one COM port.
UMatrixWin and Wincal software.
The correct serial cable.

16.2 Drawings

157-122-201 1M122K1 internal wiring drawing

16.3 Module Testing

Ensure that test procedures have been completed for each individual relay module:

2 units of:	2V164K4	Voltage Regulating and Tap Change Control Relay
2 units of:	2V165K2	Transformer Parallel Control Relay
2 units of:	1X200K1	Transformer Control Panel (Group A only)
2 units of:	1X200K2	Transformer Control Panel (Group A and B)

16.4 General Function Tests

a) Verify system wiring.

b) Verify firmware loaded into μMATRIX relays:

2V164	UMX2V164E
2V165	UMX2V165A

c) Test operation and function of 1X200 push buttons as described in section 5.

d) Place all transformers in Group A and AUTO then manually step the TPI inputs to match the Tap Position indicated for lowest transformer number. Verify that transformers are all ON LINE and IN STEP.

e) Set Group A input voltage below the 2V164 set point and wait for the voltage raise commands to be output to each transformer. Manually step the TPI inputs up a single tap position and verify that all transformers remain IN STEP and that the interval Timer is kicked off.

g) Repeat for an input voltage above the 2V164 set point to generate voltage lower commands.

g) Place transformers 1 and 3 into Group B and repeat tests d) and e) for the Group B voltage inputs.

h) Place a transformer in REMOTE mode and check that both Group A and Group B 2V164 relays go to MANUAL mode (i.e. inhibited). Repeat for each transformer.

16.5 High Voltage Testing

a) Apply 2KV RMS between groups as per table 1 for 1 minute.

b) Apply three 5KV 1/50usec pulses of each polarity between groups as per table 1.

For these tests the terminals have been formed into the following groups,

	Name	Terminals
Group 1	AVR 2 raise A bus	X3-16
	AVR 2 lower A bus	X3-18
Group 2	AVR 2 raise B bus	X1-16
	AVR 2 lower B bus	X1-18
Group 3	T1 raise	X1-30
	T1 lower	X1-32
	T2 raise	X3-36
	T2 lower	X3-38
	T3 raise	X1-42
	T3 lower	X1-44
	T4 raise	X3-48
	T4 lower	X3-50
Group 4	AVR inhibit bus	X1-14
Group 5	Tap change feedback	X1-10
Group 6	T1 grp B online	X1 - 5
	T3 grp B online	X1 -11
	T1 grp A online	X3 - 5
	T2 grp A online	X3 - 9
	T3 grp A online	X3 -11
	T4 grp A online	X3 -15
Group 7	PS fail Bus common	X1-23
	PS fail Bus norm closed	X1-25
	PS fail Bus norm open	X1-27
Group 8	TPI f in T1 A	X1-35
	B	X1-37
	TPI f in T2 A	X1-43
	B	X1-45
	TPI f in T3 A	X3-39
	B	X3-41
	TPI f in T4 A	X3-47
	B	X3-49

Table 1 A	B
X3-16, X3-18, X1-16, X1-18, X1-30, X1-32, X3-36, X3-38, X1-42, X1-44, X3-48, X3-50, X1-14	X1-10, X1-5, X1-11, X3-5, X3- 9, X3-11, X3-15, X1-23, X1-25, X1-27, X1-35, X1-37, X1-43, X1-45, X3-39, X3-41, X3-47, X3-49
X3-16, X3-18, X1-30, X1-32, X3-36, X3-38, X1-42, X1-44, X3-48, X3-50, X1-10, X1-23, X1-25, X1-27	X1-16, X1-18, X1-14, X1-5, X1-11, X3-5, X3-9, X3-11, X3-15, X1-35, X1-37, X1-43, X1-45, X3-39, X3-41, X3-47, X3-49
X3-16, X3-18, X1-16, X1-10, X1-5, X1-11, X3-5, X3-9, X3-11, X3-15,	X1-30, X1-32, X3-36, X3-38, X1-42, X1-44, X3-48, X3-50, X1-14, X1-23, X1-25, X1-27, X1-35, X1-37, X1-43, X1-45, X3-39, X3-41, X3-47, X3-49
All terminals except VX#1, VX#2 & VX#3 neg commons	Frame

TESTED BY :_____DATE :_____