RMS Mors Smitt
A Wabtec Company

Features

CONTROL SYSTEM FEATURES

- Simple system wiring
- Scaleable up to 4 transformers
- Flexible control configuration
- Set transformers in any combination of:
  - Independent control
  - Parallel follower
  - Parallel master
  - Off
  - Manual local control
  - Manual remote control
- Self diagnosis & fail alarm
- All standard features of μMATRIX relays
- Draw out case
- Made in Australia

CONTROL MONITORING

- Tap change out of step alarm
- SCADA control interface
- Local manual control interface

DATA DISPLAY

- Tap position indicator input for up to 4 transformer tap changers
- Tap position indicator output
- Transformer “In Step” status

COMMUNICATION

- Non platform specific PC programming software
- Optically isolated network communication ports
- MODBUS RTU compatible network protocol

Technical Bulletin

1M122A

Transformer Parallel Control System

1M122A Transformer Parallel ‘Master / Follower’ Control System

Description

Made in Australia

The 1M122A Parallel Control System is a complete solution for the control of up to four (4) transformers in either independent or parallel mode or in any combination using the proven master / follower technique.

Each transformer is fitted with an identical 1M122A sub rack which communicate with each other over a hard wired BUS for simplicity, reliability and ease of expansion.

Using the integrated 1X200 Transformer Control Panel any transformer may be set to operate as the MASTER locally or via SCADA.

The 1M122A comprises 3 main elements which are supplied fully configured & wired in 19” sub rack frames ready for integration into each transformer control panel.

Each 1M122A sub rack comprises:

- a 1X200 Transformer Control Panel;
- a 2V164 AVR;
- a 2V165 Parallel Control Relay.

All units are draw out modules allowing simple changeover in the unlikely event of failure or system re-configuration.

In addition a 2V200 TPI transducer is required at each transformer.

Full details on these relay models may be obtained from the respective technical bulletins.

This approach allows a scaleable configuration which can be initially very simple & low cost. As new transformers are added the control scheme can be readily expanded to suit.

1M122A Sub-Rack

Typical System Configuration
The typical system configuration depicted at right allows for the control of up to four (4) transformers in either independent or parallel mode using a master / follower scheme.

Transformers should ideally be matched to minimize circulating currents.

Communications BUS
A 1M122A is required for each transformer control cubicle. Signaling between each 1M122A is accomplished via a conventional hard wired BUS for simplicity, flexibility & reliability. The number of wires in the communications BUS is determined by the number of parallel transformers:

No. Transformers	Number of Communications BUS wires
1	-
2	13
3	18
4	23

Single Transformer Installation
A single 1M122A may be used in a stand alone transformer installation. In this instance it will not be operated in MASTER or FOLLOWER mode & so the 2V165 Parallel Control Relay may be omitted & a 1X300 Follower Module fitted to save cost.

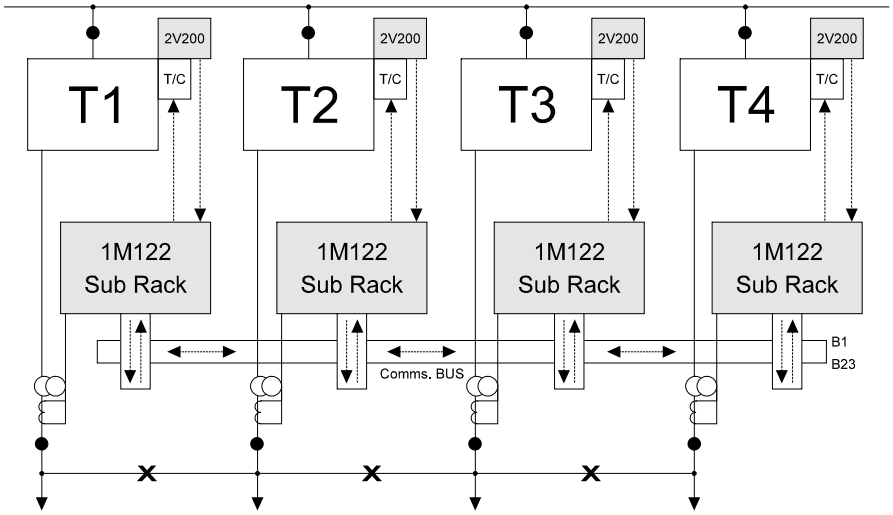
Adding a Second Transformer
The addition of a second transformer is achieved by simply connecting the communications BUS wiring to the second control cubicle. At least one 2V165 Parallel Control Relay is required & may be fitted into the new 1M122A or swapped with the 1X300 in the existing 1M122A. Alternatively both 1M122A sub racks may have a 2V165 installed in which case either transformer can be set as the MASTER with a single button operation or SCADA control input to the 1X200.

Follower Only Operation
Where a transformer is required to operate in FOLLOWER mode only, the 2V164 AVR may also be omitted & replaced with a 1X400 Follower Module.

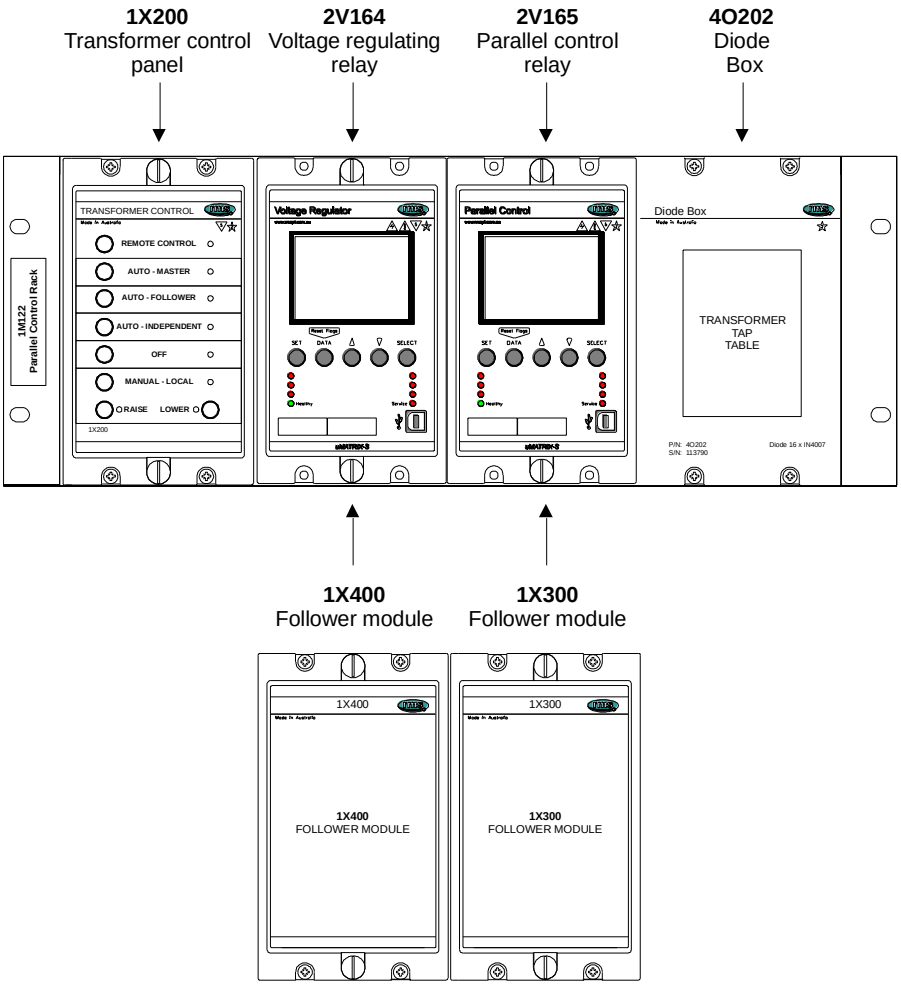
Where a 1X400 is fitted the 2V165 serves no function & may be replaced with a 1X300.

Adding a Third & Forth Transformer
Up to four (4) transformers may be connected on the communications BUS. These may then be set to operate in parallel, independently or in any combination bearing in mind that for a transformer to be set to MASTER it must have both a 2V165 & 2V164 relay fitted.

Typical System Configuration for up to four (4) transformers



1M122 Parallel Control Sub Rack



These modules may be fitted in place of the 2V164 & 2V165 in accordance with the schemes depicted in diagrams 1 - 6.

Operating Modes

Description of Operating Modes
While the control of up to four (4) transformers is possible using the 1M122A system, the diagrams at right are based on a three (3) transformer installation for simplicity.

Diagram 1

All transformers are set to OFF or LOCAL - MANUAL.

All BUS ties & isolators are open.

Legend

X BUS tie open

● Isolator open

Tap raise / lower commands

2V165 Parallel Control — Not required for this configuration 1X300 may be fitted

Power flow

2V164 AVR — Not required for this configuration 1X400 may be fitted

Diagram 2

All transformers are set to AUTO - INDEPENDENT.

All BUS ties are open & isolators closed.

Each 2V164 AVR initiates AUTO tap raise & lower commands which are relayed through the 1X200 to the tap changer.

Diagram 3

Transformer 1 is set to AUTO - FOLLOWER.

Transformer 2 is set to AUTO - MASTER.

Transformer 3 is set to AUTO - INDEPENDENT.

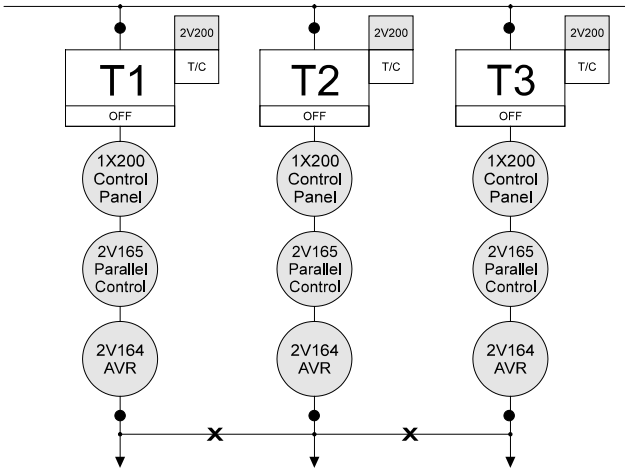
The BUS ties is closed between transformer 1 & 2.

All Isolators are closed.

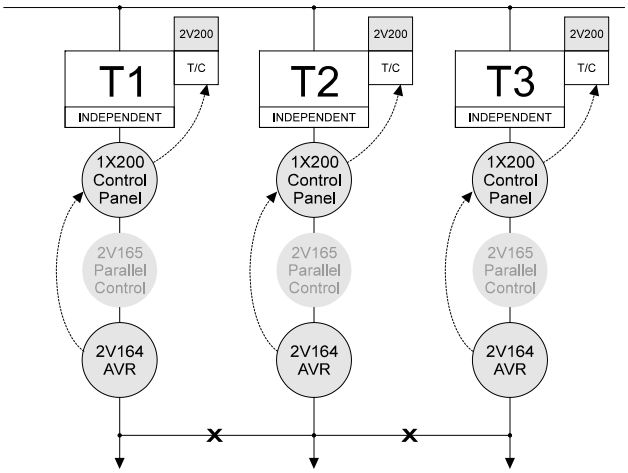
The T2 2V164 initiates AUTO tap raise & lower commands which are relayed through the 2V165 to both the T1 & T2 1X200's & onto their respective tap changers.

T3 operates as per diagram 2.

All transformers out of service
All BUS ties & isolators open



T1, T2 & T3 operating independently
No MASTER control selected



T1 & T2 in parallel & T3 operating independently
T2 selected as MASTER

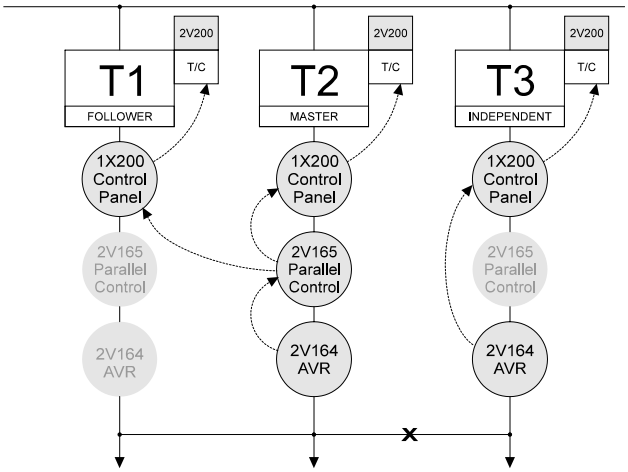


Diagram 4
Similar to diagram 3 but this time:

Transformer 1 is set to AUTO - INDEPENDENT.

Transformer 2 is set to AUTO - FOLLOWER.

Transformer 3 is set to AUTO - MASTER.

The BUS tie is closed between transformer 2 & 3.

All isolators are closed.

The T3 2V164 initiates AUTO tap raise & lower commands which are relayed through the 2V165 to both the T2 & T3 1X200's & onto their respective tap changers.

Diagram 5

Transformer 1 is set to AUTO - FOLLOWER.

Transformer 2 is set to AUTO - MASTER.

Transformer 3 is set to AUTO - FOLLOWER.

All BUS ties & isolators are closed.

The T2 2V164 initiates AUTO tap raise & lower commands which are relayed through the 2V165 to the T1, T2 & T3 1X200's & onto their respective tap changers.

Diagram 6

Similar to diagram 5 but this time:

Transformer 1 is set to AUTO - MASTER.

Transformer 2 is set to AUTO - FOLLOWER.

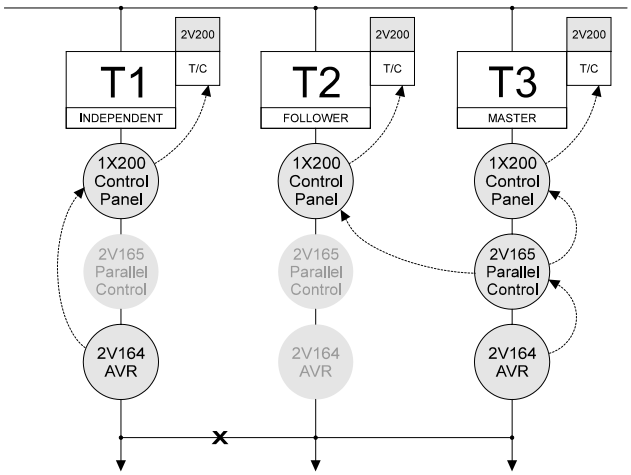
Transformer 3 is set to AUTO - FOLLOWER.

All BUS ties & isolators are closed.

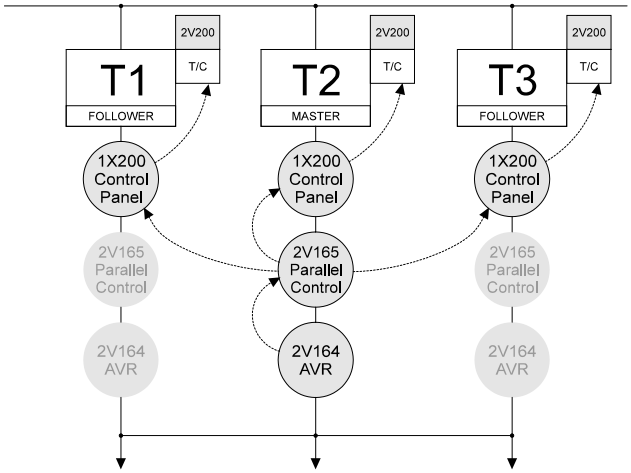
The T1 2V164 initiates AUTO tap raise & lower commands which are relayed through the 2V165 to the T1, T2 & T3 1X200's & onto their respective tap changers.

Operating Modes

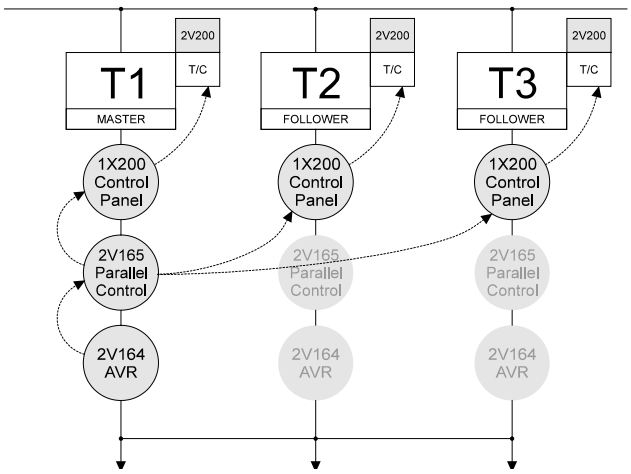
T2 & T3 in parallel & T1 operating independently
T3 selected as MASTER



T1, T2 & T3 operating in parallel
T2 selected as MASTER



T1, T2, & T3 operating in parallel
T1 selected as MASTER



Transformer Control Panel

1X200 TRANSFORMER CONTROL PANEL
The 1X200 transformer control panel provides an interface between:

- The automatic voltage control system;
- Local manual control;
- Remote manual control.

Local Control
Each 1X200 has front panel push buttons to allow a specific transformer to:

- be set to **OFF**;
- be set to **MANUAL - LOCAL**;
- tap to **RAISE** or **LOWER** volts when in local;
- be set to **AUTO - INDEPENDENT**;
- be set to **AUTO - FOLLOWER**;
- be set to **AUTO - MASTER**;
- be placed in **REMOTE** control mode from any auto mode.

The **LOCAL** – **OFF** – **AUTO** sequence is designed to mimic the three position rotary switch often employed on transformer control panels.

Safety interlocks are built in such that manual & remote tap raise / lower command inputs are inhibited when the OFF position is selected.

The REMOTE push button is a no cost option. The REMOTE status input can be controlled directly from the RTU when the transformer is set to any of the AUTO positions.

Remote Control via SCADA
Each 1X200 incorporates binary status inputs to allow remote control of each transformer via SCADA to:

- be placed in **REMOTE** control mode from any auto mode;
- tap **RAISE** or **LOWER** when in remote;
- be set to **AUTO - INDEPENDENT** from remote or auto mode;
- be set to **AUTO - FOLLOWER** from remote or master mode;
- be set to **AUTO - MASTER** from remote or auto mode;
- be set to **OFF**.

Safety interlocks are built in such that a transformer cannot be remotely controlled once the 1X200 panel has been placed in the OFF or MANUAL - LOCAL mode.

Repeat Signaling Contacts
Each 1X200 provides repeat contact outputs to indicate a transformer is in:

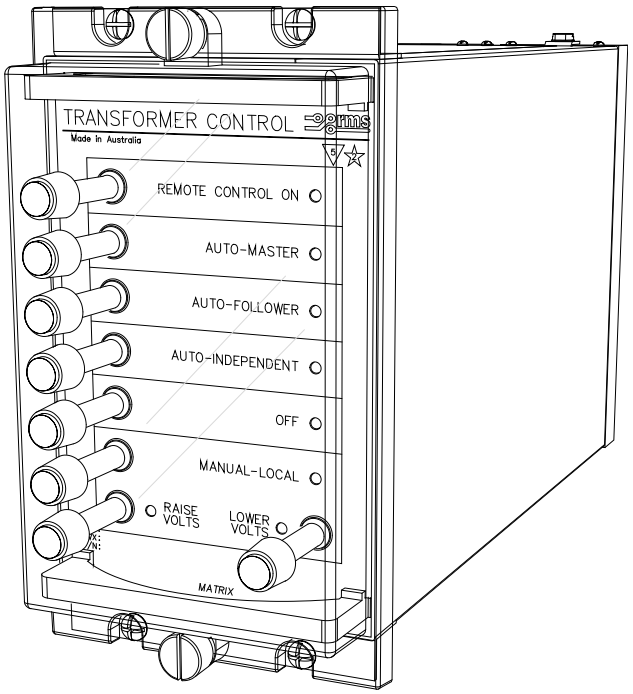
- **REMOTE** control mode;
- **AUTO - INDEPENDENT** or **REMOTE - INDEPENDENT** mode;
- **AUTO - FOLLOWER** or **REMOTE – FOLLOWER** mode;
- **AUTO - MASTER** or **REMOTE - MASTER** mode;
- **OFF** mode;
- **MANUAL - LOCAL** mode.

1X300 FOLLOWER MODULE (Use in place of 2V165)
Where a 1M122A will not be used in MASTER mode, the 2V165 (Position X2), may be replaced with a type 1X300 Follower Module. This provides the following advantages:

- Reduced system cost;
- 2V165 relays installed in 1M122A sub racks that are set to FOLLOWER may be used to replace a 2V165 in another 1M122A (System spare).

When a 2V165 (Position X2) is removed from a 1M122A sub rack, it should be replaced with a 1X300 Follower Module. The 1X300 provides an interlock signal to the 1X200 Transformer Control Panel such that the AUTO - MASTER mode cannot be inadvertently selected on that sub rack.

1X400 FOLLOWER MODULE (Use in place of 2V164)
Where a 1M122A is to be used in FOLLOWER mode only, the 2V164 (Position X3), may be replaced with a type 1X400 Follower Module. This option can be taken to further reduce the system cost. Module changeover is possible due to the draw out case system.



1X200 Transformer Control Panel

1X200 AUXILIARY SUPPLY
20-70V DC switchmode supply or
40-275V AC / 40-300V DC switchmode supply
Burden: Less than 7 watts during timing

1X200 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

1X200 OUTPUT CONTACT RATINGS
Make & carry
30A AC or DC (Limits L/R=40ms & 300V max.) for 0.2s
20A AC or DC (Limits L/R=40ms & 300V max.) for 0.5s
5A AC or DC continuously

Break (Limits 5A & 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

Minimum recommended load
0.5W, 10mA or 5V minimum.

OPERATING TEMPERATURE RANGE
-5 to +55 degrees Celsius ambient operating temperature range.

Communications BUS

COMMUNICATIONS BUS
A 1M122A sub rack is required for each transformer control cubicle. Signaling between each 1M122A is accomplished via a conventional hard wired BUS as per the following schedule.

TRANSFORMER CONTROL SYSTEM CONFIGURATION
Each 1M122A sub rack system must be configured to operate with a specific transformer number in the parallel control scheme. This is achieved by fitting wire links between the Communication BUS connections & the 1M122A terminals as depicted by the shaded blocks of paired terminals shown below.

e.g. For configuration of a 1M122A in a T2 control cubicle, fit links between terminals:
X1-9 & X4-36
X2-36 & X1-15
X2-38 & X1-17
X2-39 & X3-45
X2-41 & X3-47

1M122 Communications BUS Wiring Schedule

		BUS #	1M122				Description		
			T1	T2	T3	T4			
	Aux.	B1	X1-30	X1-30	X1-30	X1-30	Vx 2 Control +Ve	Aux.	
		B2	X1-32	X1-32	X1-32	X1-32	Vx 2 Control -Ve		
		B3	X4-10	X4-10	X4-10	X4-10	Set follow er interlock		
	T1	B4	X1-7 X4-36	X1-7	X1-7	X1-7	T1 on line signal	T1	
		B5	X2-30 X1-15	X2-30	X2-30	X2-30	T1 raise volts command		
		B6	X2-32 X1-17	X2-32	X2-32	X2-32	T1 low er volts command		
		B7	X2-35 X3-45	X2-35	X2-35	X2-35	T1 2V200 output		2 Transformer BUS
		B8	X2-37 X3-47	X2-37	X2-37	X2-37	T1 2V200 output		
	T2	B9	X1-9	X1-9 X4-36	X1-9	X1-9	T2 on line signal	T2	
		B10	X2-36	X2-36 X1-15	X2-36	X2-36	T2 raise volts command		
		B11	X2-38	X2-38 X1-17	X2-38	X2-38	T2 low er volts command		
		B12	X2-39	X2-39 X3-45	X2-39	X2-39	T2 2V200 output		
		B13	X2-41	X2-41 X3-47	X2-41	X2-41	T2 2V200 output		
	T3	B14	X1-11	X1-11	X1-11 X4-36	X1-11	T3 on line signal	T3	
		B15	X2-42	X2-42	X2-42 X1-15	X2-42	T3 raise volts command		
		B16	X2-44	X2-44	X2-44 X1-17	X2-44	T3 low er volts command		Add 3rd Transformer
		B17	X2-43	X2-43	X2-43 X3-45	X2-43	T3 2V200 output		
		B18	X2-45	X2-45	X2-45 X3-47	X2-45	T3 2V200 output		
	T4	B19	X1-13	X1-13	X1-13	X1-13 X4-36	T4 on line signal	T4	
		B20	X2-48	X2-48	X2-48	X2-48 X1-15	T4 raise volts command		
		B21	X2-50	X2-50	X2-50	X2-50 X1-17	T4 low er volts command		Add 4th Transformer
		B22	X2-47	X2-47	X2-47	X2-47 X3-45	T4 2V200 output		
		B23	X2-49	X2-49	X2-49	X2-49 X3-47	T4 2V200 output		

Wiring Schedules

The RMS manufactured 1M122A sub racks are supplied with all internal sub rack wiring in place. However customers may choose to purchase relay modules separately & wire them into their own panels using the following wiring schedule.

Terminals sharing the shaded areas depicted must be connected to achieve the functionality described in this technical bulletin.

VT CONNECTIONS
VT connections should be made on the low voltage side of the transformer before the isolator as depicted in the typical system diagram on page 2.

CT CONNECTIONS
The CT input is used for the LDC function & should be positioned such to measure the total supply current for the default operating configuration.

Example 1: If a transformer is normally set to operate INDEPENDENTLY then the CT should be positioned to measure its total INDEPENDENT load current.

Example 2: If a number of transformers are normally operated in parallel then the CT ('s) should be positioned to summate the total load current. The summated current is used by the MASTER AVR to calculate the appropriate LDC for the paralleled system.

ALTERNATE LDC SETTING GROUP
When the transformer control system is changed from an INDEPENDENT to a PARALLEL configuration it may not always be easy or desirable for the CT connections to be arranged & connected to summate the total load current. For such 'abnormal' operating conditions it may be preferable to operate the LDC with the normal CT configuration & different settings (Or OFF).

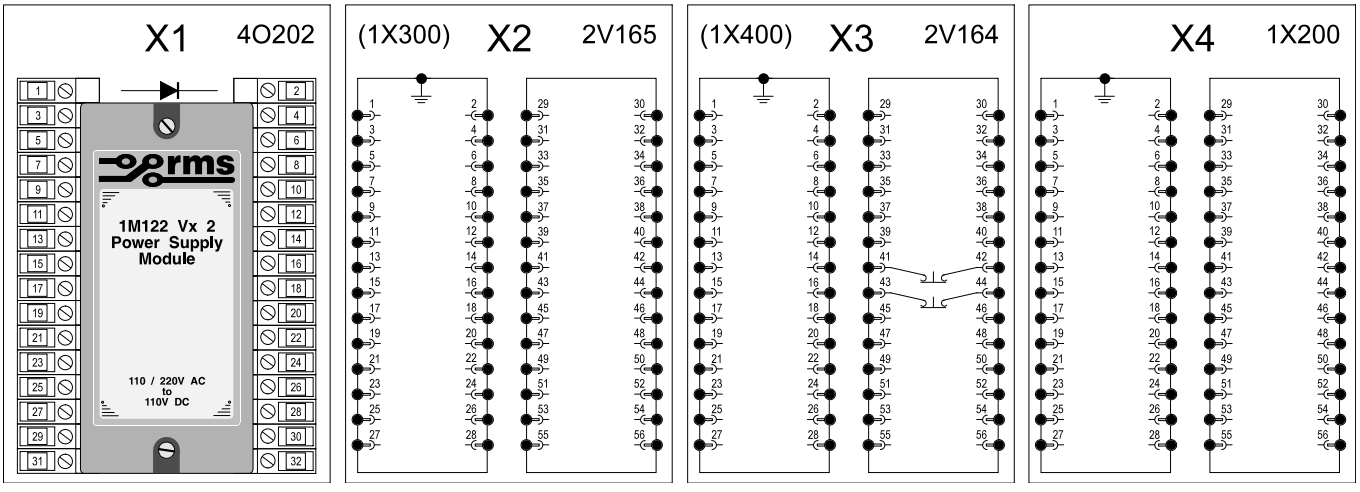
An alternate LDC setting group is provided for this purpose on each 2V164 AVR & is activated through a status input. If the alternate LDC group settings are set to zero then the LDC function is turned OFF when the status input is true.

When the LDC 2 Group is selected output contact 7 will pick up to signal this operational mode.

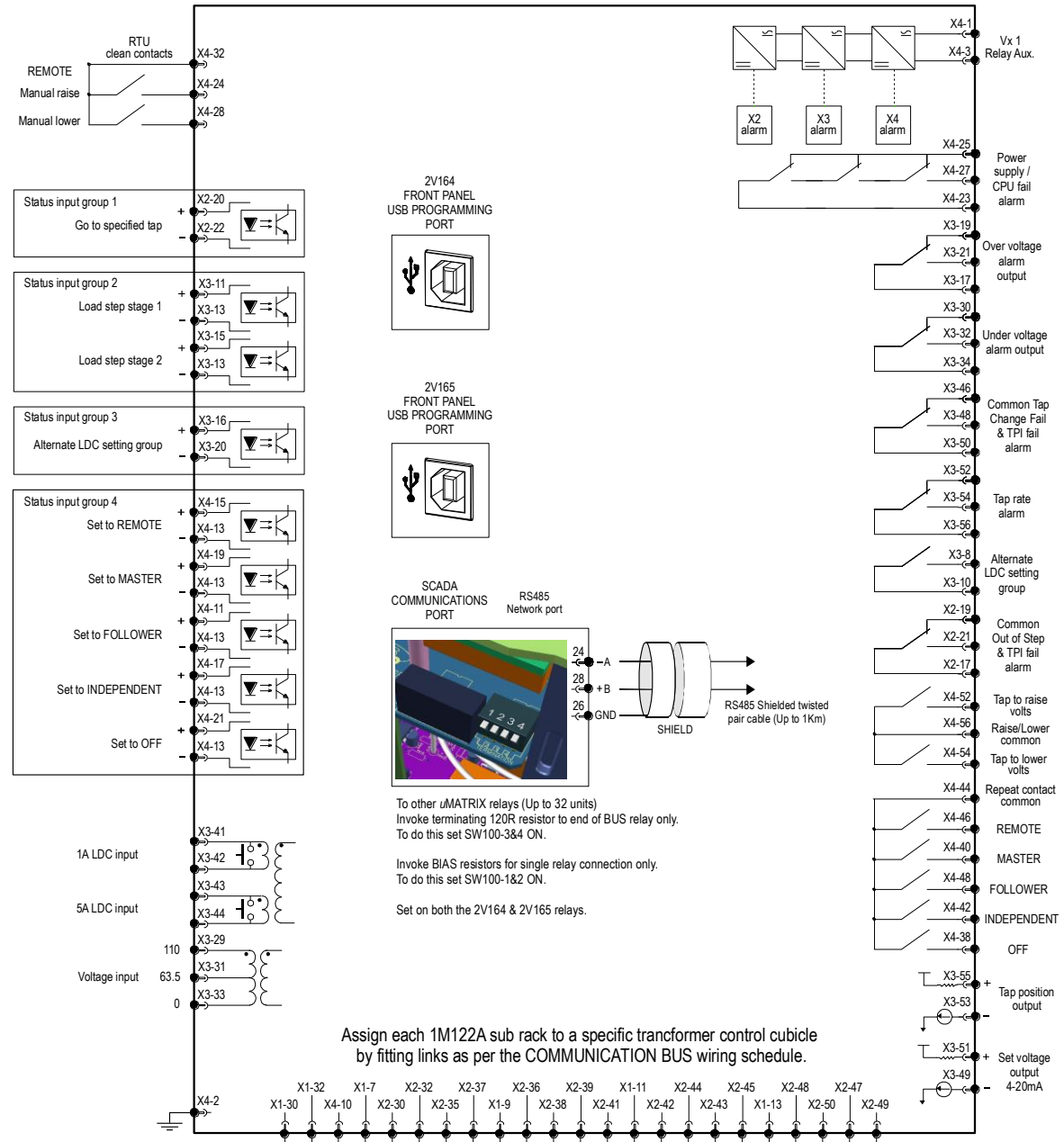
1M122A Sub Rack Internal Wiring Schedule

X1 4O202	X2 2V165	X3 2V164	X4 1X200	Description
	X2-1	X3-1	X4-1	Vx 1 Aux supply active
	X2-3	X3-3	X4-3	Vx 1 Aux supply common
X1-30	X2-8	X3-40	X4-32	Vx 2 Control supply +Ve
	X2-12	X3-39		
	X2-34	X3-18		
	X2-40			
	X2-46			
	X2-52			
X1-32		X3-7	X4-13	
			X4-14	Vx 2
			X4-26	Control supply -Ve
			X4-49	
	X2-23	X3-23	X4-23	Power supply fail common
	X2-25	X3-25	X4-25	Power supply fail N/C
	X2-27	X3-27	X4-27	Power supply fail N/O
	X2-24	X3-24		RS485 comms. A-
	X2-28	X3-28		RS485 comms. B+
X1-1	X2-7			
	X2-13			Indp. tap command inhibit
	X2-22			
X1-25		X3-22		T/C feedback mode
X1-2			X4-50	Indp. tap command inhibit
X1-26				
X1-4	X2-16			Independent tap raise volts
X1-3		X3-37		AVR raise
X1-21				
X1-22			X4-16	Independent raise
X1-6	X2-18			Independent tap lower volts
X1-5		X3-38		AVR lower
X1-19				
X1-20			X4-12	Independent lower
X1-23	X2-14			Never master
X1-24			X4-18	Never master
	X2-10	X3-5		Tap change feedback
		X3-9	X4-30	2V164 inhibit
			X4-10	Set follower
			X4-34	
X1-16			X4-24	Parallel raise
X1-18			X4-28	Parallel lower
X1-8	X2-5			T1 on line
X1-10	X2-9			T2 on line
X1-12	X2-11			T3 on line
X1-14	X2-15			T4 on line

1M122 Rear Terminal View



1M122A Wiring Diagram



Ordering Information

2V200 Tap Position Indicator V to F Sender Unit

Generate the required ordering code as follows: e.g. 2V200-AA

2V200 [1] [2]

1 AUXILIARY SUPPLY RANGE

A 110V AC B 240V AC

2 DIN RAIL MOUNTING CLIP

A Not required B Required

Note that one 2V200 is required per transformer tap changer & therefore each can be specified independently.

Refer to the 2V200 technical bulletin for further details.

TAP CHANGER INTERFACE

Refer to the 2V200 application diagram below & Technical Bulletin for further details. For parallel transformer control schemes the binary or BCD interface is recommended for reliable operation of the out of step function.

1M122A Parallel Control Scheme

Generate the required ordering code as follows: eg 1M122A-BBAAAA

1M122A [1] [2] [3] [4] [5] [6]

1 CONTROL SYSTEM CONFIGURATION

A With 2V164 & 2V165 fitted
B Without 2V165 module fitted (1X300 fitted)
C Without 2V164 or 2V165 module fitted (1X300 & 1X400 fitted)

2 AUXILIARY SUPPLY RANGE (Vx 1)

A 20-70V DC
B 40-300V DC / 40-275V AC

3 STATUS INPUTS (Vx 2)

DC Vx 2 auxiliary

A 24-80V DC
B 75-150V DC
C 150-300V DC

AC Vx 2 auxiliary

D 110V or 220V AC

4 REAR COMMUNICATIONS PORT

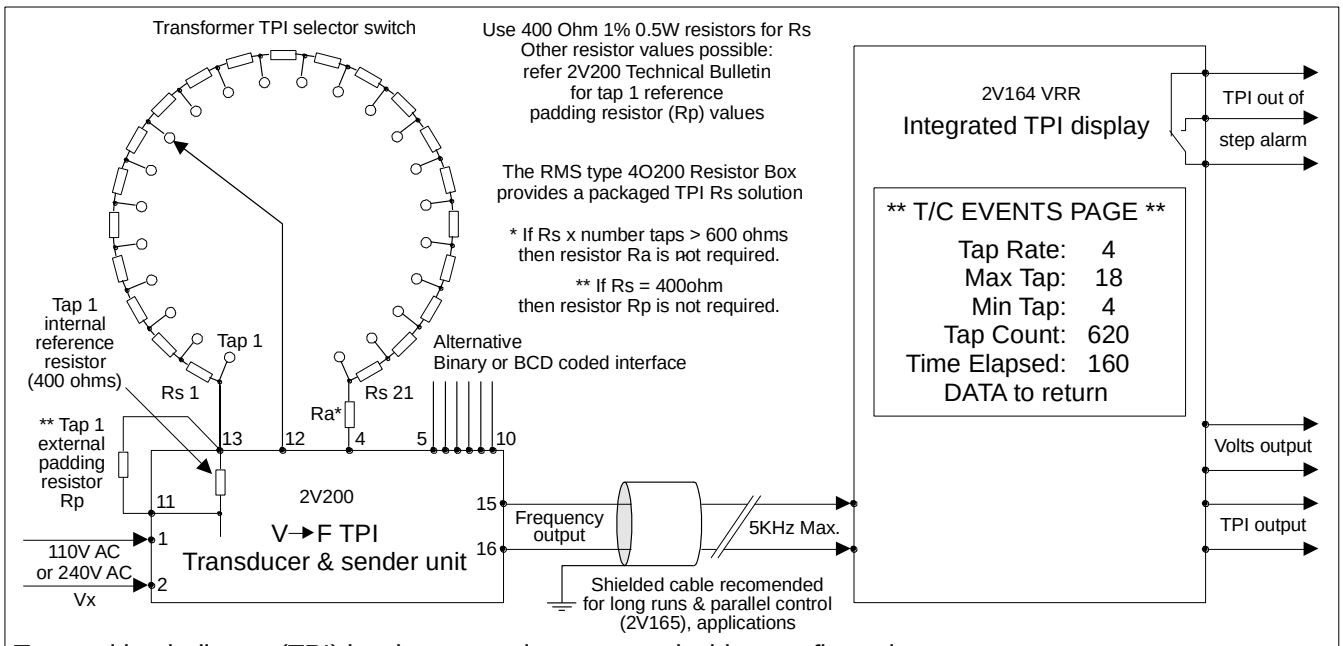
A Required – Modbus protocol
B Not required

5 ANALOGUE OUTPUTS 4 to 20mA

A Not required B Required on 2V164 only
C Required on 2V165 only D Required on 2V164 & 2V165

6 TAP POSITION LOGIC TABLE FIRMWARE

A Matched tap changers



Tap position indicator (TPI) hardware requirements and wiring configuration.

2V200 to 2V165 application diagram

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