Features

SYSTEM FEATURES

- Large back lit display panel
- System status LED indicators
- Simple menu setting procedure
- Wide auxiliary supply range with fail alarm contact
- Self diagnosis and fail alarm
- Size 4M56-S draw out case
- Made in Australia

CONTROL MONITORING

- Tap change out of step alarm
- Pre-configured parallel control schemes – refer 1M122 Technical Bulletin

DATA DISPLAY

- Tap position indicator input for up to four (4) transformer tap changers
- Reference tap position indicator output
- Transformer "In Step" status

COMMUNICATION

- USB front programming port
- Non platform specific PC programming software: μMATRIXwin
- Optically isolated RS485 network communication port
- MODBUS RTU compatible network protocol

Operation

The 2V165-S relay is built on the Micro MATRIX digital platform. The standard Micro MATRIX human machine interface (HMI) is combined with fully solid-state voltage sensing and measuring circuitry to provide high accuracy, simple set up and flexible operation. Self-monitoring is carried out by hardware and software watchdogs.

The TPI inputs, output relays and opto isolated status inputs form the essential barriers against high voltage line transients while a switchmode auxiliary supply provides a wide operating range.

A USB programming port is provided for ease of establishing relay settings using a PC.
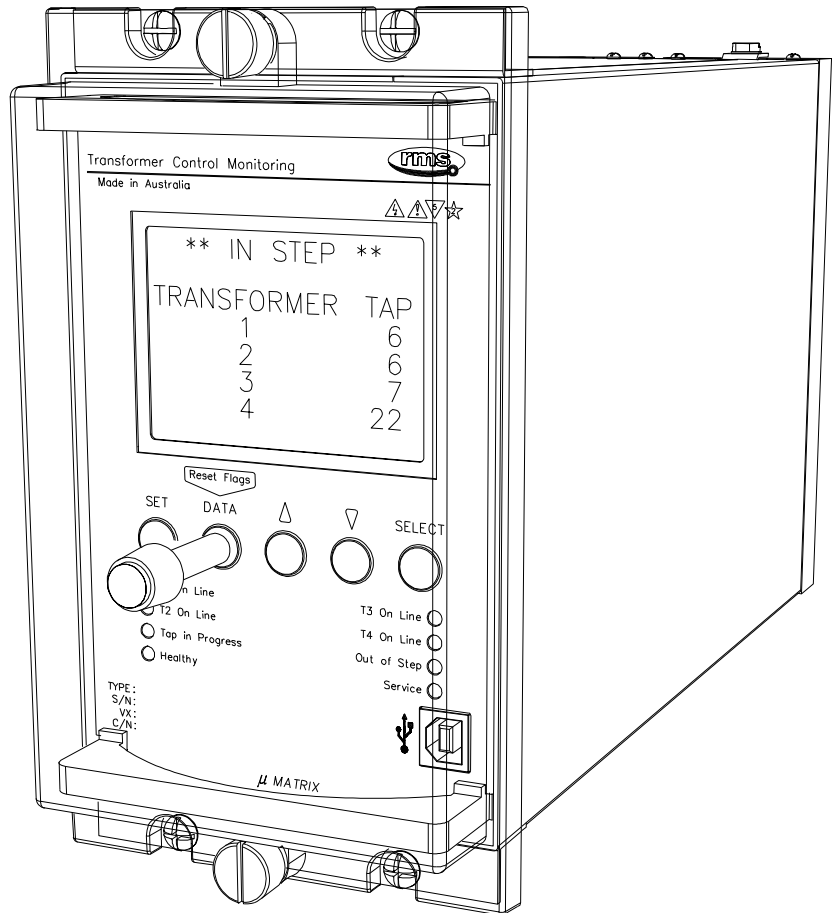
2V165-S depicted in a size 4M56-S draw out case

Application

Made in Australia

The 2V165 Series relays are designed to monitor and control the tap changers of up to four (4) transformers connected on a common bus and operating in the master slave control configuration.

Master follower 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 the design of a suitable out of step alarm can become very complex to allow for flexible transformer operating configurations.

The wiring complexity 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 2V165.

The tap position of each transformer is monitored as well as the raise / lower commands initiated by the selected master voltage regulating relay. The 2V165 responds by sending the appropriate raise / lower 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 pick up 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 signaled to the 2V165 via status inputs, which inhibit any tap change commands or alarm outputs relating to that transformer.

A status input is provided to automatically step all tap changers to a programmed position within the tap position logic table.

RMS 2V165 Relays have many in built features to simplify the interface with OLTC's to provide a reliable, effective and simple to operate voltage control system.

Refer to the 1M122A and 1M122B technical bulletins for pre-configured system solutions.

Visit *www.rmspl.com.au* for the latest product information.

Due to RMS continuous product improvement policy this information is subject to change without notice. 2V165-S/Issue G/15/10/18 - 1/6

TPI INPUTS
Four (4) TPI inputs are provided to accept frequency coded signal from the RMS manufactured 2V200 TPI transducers.

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.

TAP RAISE / LOWER INITIATE INPUTS
Two (2) separate status inputs are provided to detect tap raise and tap lower initiate signals from the master voltage regulating relay. These are used to allow the 2V165 to check that tap position changes only occur in synchronization with tap raise / lower commands. An input control signal of 1s minimum duration is required.

TAP RAISE / LOWER INITIATE OUTPUTS
When a tap raise or lower input is detected the 2V165 sends specific tap change output commands to each transformer such that the positions in the pre-defined tap position logic table are observed. A continuous contact output is provided which is reset when the corresponding tap position indicator changes position. Tap raise must be wired to provide an increase in system volts. Tap lower must be wired to provide a reduction in system volts.

OUT OF STEP ALARM
When a tap raise or lower command is output, an out of step alarm timer is initiated. If all tap changers have not moved to the specified tap within the user specified time delay (0-300s in 1s steps), the alarm contact will close and a message identifying the problem tap changer displayed.

TAP CHANGE FEEDBACK OUTPUT CONTACT
This contact is closed when a tap raise / lower command pulse is received from the 2V164 AVR and is reset when all transformers have successfully moved to the next position in the tap position logic table. This contact is wired back to the 2V164 tap change feedback status input to pause the interval timer from starting until all transformers have completed the tap change sequence.

ALL TRANSFORMERS OFF GROUP OUTPUT CONTACT
When all transformers are set to OFF GROUP via the ON GROUP status inputs, this N/O contact is closed. This function is useful to automatically inhibit the local AVR to avoid tap change fail and voltage level alarms.

IN GROUP STATUS INPUTS
A status input is provided for each transformer to signal if the transformer is operating as part of the parallel group. This is indicated by an LED on the front panel with the text IN GROUP. Tap raise and lower commands will be inhibited for transformers not IN GROUP and its tap position not used to initiate an out of step alarm.

AUTO HOME
When a transformer is put back ON GROUP it will automatically home to the Reference Tap Position to match the other transformers ON GROUP. A user specified time delay (0-300s in 1s 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.

GO TO SPECIFIED TAP
A status input is provided which may be initiated to drive all ON GROUP transformer tap changes to a user specified reference tap position. An initiate pulse of 1s minimum is required.

OPERATIONAL INDICATORS
LEDs indicate the following conditions.

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

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

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

TAP POSITION INDICATOR
A tap position indicator input is provided to enable the tap position of each transformer to be displayed on the HMI. The output from the RMS type 2V200 Tap Position Transducer is required for this function to operate. Refer to the 2V200 Technical Bulletin for details.

TAP POSITION INDICATOR INPUT
For this function to operate an RMS type 2V200 transducer / sender unit is required at the tap changer. Refer to the 2V200 Technical Bulletin for application details.

The 2V200 is designed to interface to tap changes and convert one of the following parameters:

- an analogue voltage signal proportional to the tap position
- a binary coded decimal signal
- a BCD signal

The 2V200 converts any of these inputs to a frequency signal proportional to the tap position.

The 2V165 is then programmed with the number of tap positions within the range 10 to 30. Scaling is carried out automatically so that the correct tap position for each transformer is indicated on the 2V165 display.

TAP POSITION TRANDUCER FAIL
In the event that a 2V200 TPI transducer loses connection to the 2V165 or fails, the tap position of the particular transformer affected will revert to 'TPI off line'.

If any transformer in a Master / Follower group develops a TPI transducer fault a 'TPI fail' message will display on the Master 2V165 and the TPI fail output contact set.

It should be noted that the 'TPI fail alarm' and the 'TPI out of step alarm' share a common output contact.

TPI ANALOGUE OUTPUT
A single tap position indicator analogue output signal is provided for interface to an RTU. The analogue output is linked to the transformer 1 tap position.

Output: 4 to 20mA
Compliance voltage: 5V
Maximum burden: 250 Ohms
Accuracy: +/-3%
Analogue output:

- Tap 1   4mA
- Tap N   20mA

Where N = maximum selected tap setting

RELAY CONFIGURATION USING □ μMATRIXwin

The purpose of the μMATRIXwin application is to provide display, configuration and diagnostic facilities required to support the entire family of μMATRIX digital relays. The prime functions of the application are:

Create a setting file off line
To create and view relay setting files at your PC without the need for a relay;

Relay setting
To down load a setting file (UMP) into a relay connected to a PC;

To display and change settings in a connected relay;

Relay status
To display the Status of nominated inputs and outputs of a connected relay;

Relay Control
Manual raise / lower commands and resetting functions can be performed;

Commissioning
To export reports of setting parameters and status screen to confirm correct functionality during commissioning;

Upgrade relay software
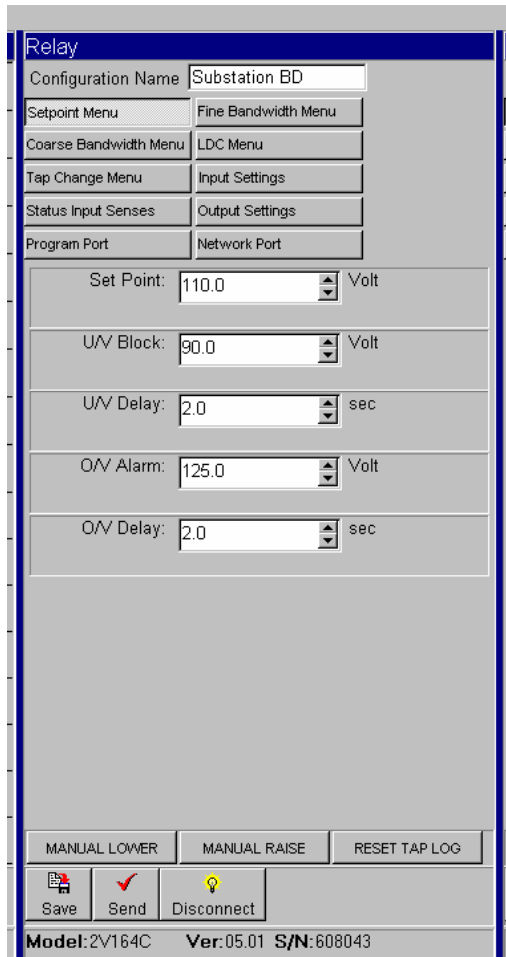To configure a μMATRIX relay for a specific customer application;

To upgrade the operational software (UMX) of a μMATRIX relay;

All current UMX software applications may be downloaded from:
www.rmspl.com.au/umatrix

Maintenance
To provide utility and diagnostic facilities at a technical level.

COMMUNICATION PORTS
Two (2) communications ports are available. The front USB programming port is provided as standard while the rear RS485 network port is available as an option.

Programming port
The programming port is accessible from the front panel of the relay via a USB physical link and PC configuration program supplied with the relay. The μMATRIXwin configuration program is designed to operate with all relays from the μMATRIX range and with all installed firmware version.

Network port
The network port is intended for applications where permanent connection to a master control system is required. An optically isolated RS485 physical layer is provided for this function.

The RS485 connection is intended for applications where multiple μMATRIX relays are to be connected on a common communications bus.

Network Port Terminating Resistor
Where multiple relays are connected in a multi-drop configuration the RS485 comms. bus must have a 120 ohm terminating resistor fitted at each end. If the μMATRX-S relay is at one end of the transmission line a terminating resistor can be added by placing SW100-3 and SW100-4 in the ON position as depicted in the wiring diagram.

Network Port BIAS Resistors
Where a single relay is connected to the network, or where the relay is a long distance from other devices on the comms. bus, BIAS resistors may need to be fitted to ensure reliable operation. To simplify this configuration, BIAS resistors are fitted to each μMATRIX-S relay and may be selected IN by setting switches SW100-1 and SW100-2 to the ON position as depicted in the wiring diagram. This bank of four switches can be accessed by withdrawing the relay module from it's case, turning upside down and looking at the centre PCB near the rear terminal blocks.

PC TO μMATRIX USB CONNECTION
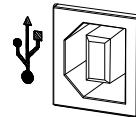
2V165-S front panel USB programming port

USB DRIVERS
The uMATRIX-S USB port is configured as a Virtual Communications Port (VCP) and is operated through a PC COM port. USB drivers must be installed on the PC to enable correct communication. A ZIP file containing the driver files needed for this process may be downloaded from:
www.rmspl.com.au/umatrix

STATUS INPUT MINIMUM OPERATING CURRENT
10 mA P/U for 1 ms then reducing to1.5 mA after 4 ms.

STATUS INPUT OPERATING TIME

Initiate input	Parameter	Delay
DC	P/U	<4 ms
	D/O	<16 ms
AC	P/U	<23 ms
	D/O	<33 ms

AUXILIARY SUPPLY
20-70V DC switchmode supply or
40-275V AC / 40-300V DC switchmode supply

Burden: Less than 10 watts with all output relays energized
using 110V DC nominal supply.

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

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.

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

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

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.

A front panel green LED is illuminated when the relay is healthy.
A separate flashing red LED indicates a software problem has been encountered which caused causing the CPU to perform a warm boot.

CASE
Size 4 draw out with 56 M4 screw terminals
Flush panel mount or 4U high 1/4 width 19 inch rack mount
IP51 rating

SHIPPING DETAILS
Each relay is supplied individually packed in pre formed cardboard cartons with internal moulded polystyrene former.

Weight: 3.5Kg
Size: 370(L) x 240(W) x 145(D)mm - Size 4 case

For large shipment individual cartons are packed in sturdy cardboard pallet boxes and surrounded by loose fill to absorb vibration and shock during transit.
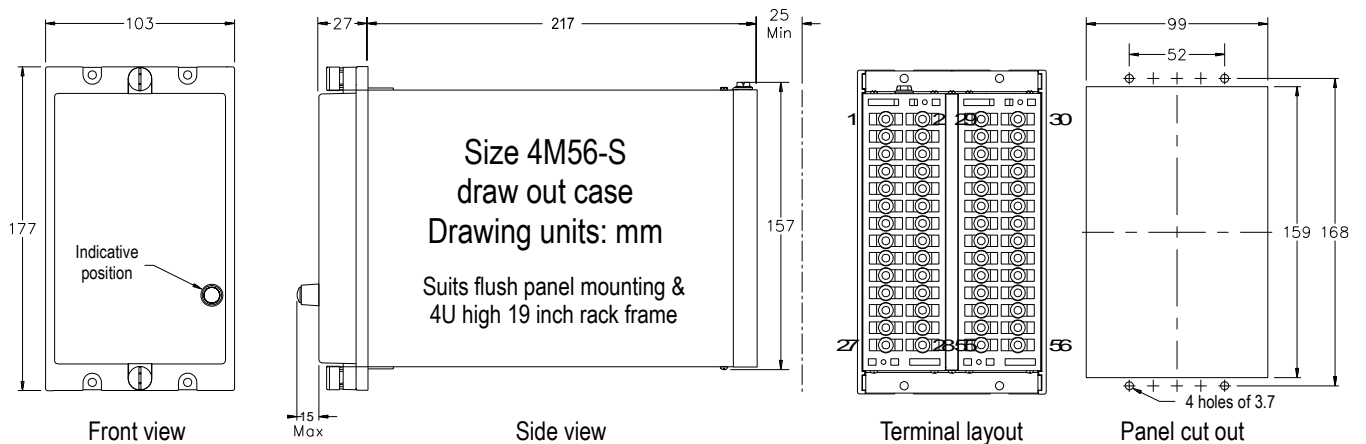
ACCESSORIES SUPPLIED
1 x M4 self threading mounting screw kit   P/N 290-406-151
2 x M4 terminal screw kit (28 per kit)   P/N 290-407-153
1 x μMATRIX User Guide per order
1 x USB cable per order
1 x CD - μMATRIXwin software, setting files & applications per order

Case Earth

4M56 Case terminations (REAR VIEW)
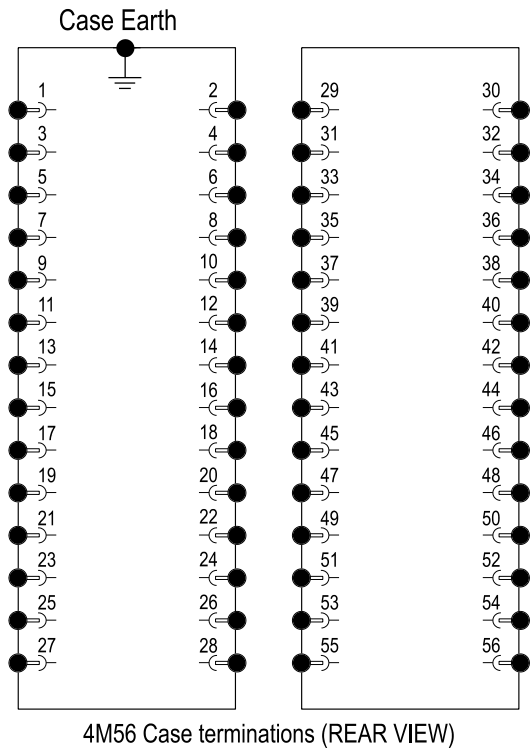
OUTPUT CONTACT RATINGS		IEC60255-0-2
Carry continuously	5A AC or DC	
Make and carry	0.5 s 20 A AC or DC	
L/R ≤ 40ms and V ≤ 300V	0.2 s 30 A AC or DC	
	AC resistive	1,250 VA
Break capacity	AC inductive	250 VA @ PF ≤ 0.4
I ≤ 5A and V ≤ 300V	DC resistive	75 W
	DC inductive	30 W @ L/R ≤ 40 ms 50 W @ L/R ≤ 10 ms
Minimum number of operations	10^6 at maximum load	
Minimum recommended load	0.5W limit 10mA / 5 V	

TRANSIENT OVERVOLTAGE   **IEC60255-5 CLASS III**
Between all terminals and earth   5 kV 1.2/50 us 0.5 J
Between independent circuits without damage or flashover   5 kV 1.2/50 us 0.5 J

INSULATION COORDINATION   **IEC60255-5 CLASS III**
Between all terminals and earth   2.0 kV rms for 1 min.
Between independent circuits   2.0 kV rms for 1 min.
Across normally open contacts   1.0 kV rms for 1 min.

AUXILIARY SUPPLY   **IEC60255-11**
Allowable breaks / dips in supply   ≤ 20 ms
Collapse to zero from nominal voltage

HIGH FREQUENCY DISTURBANCE   **IEC60255-22-1 CLASS III**
2.5 kV 1MHz common mode   ≤ 3% variation
1.0 kV 1MHz differential mode

ELECTROSTATIC DISCHARGE   **IEC60255-22-2 CLASS III**
6 kV contact discharge   ≤ 5% variation

FAST TRANSIENT   **IEC60255-22-4**
4 kV, 5/50 ns, 100 KHz repetitive   ≤ 3% variation

TEMPERATURE RANGE   **IEC68-2-1/2**
Operating: -5 to +55ºC
Storage: -25 to +75ºC

HUMIDITY   **IEC68-2-78**
40 ºC and 95% RH non condensing

Size 4M56-S
draw out case
Drawing units: mm

Suits flush panel mounting &
4U high 19 inch rack frame

Front view   Side view   Terminal layout   Panel cut out

Generate the required ordering code as follows: e.g. 2V165-S-BDDDAA

General Type	Order Code					
	1	2	3	4	5	6
2V165-S -						

1 AUXILIARY SUPPLY RANGE

A 20-70V DC B 40-275V AC (300V DC)

2 DIGITAL INPUT OPERATING VOLTAGE – GROUP 1

A 24-80V AC/DC B 80-150V AC/DC
C 150-275V AC (300V DC) D 18-275V AC (300V DC)

3 DIGITAL INPUT OPERATING VOLTAGE – GROUP 2

A 24-80V AC/DC B 80-150V AC/DC
C 150-275V AC (300V DC) D 18-275V AC (300V DC)

4 DIGITAL INPUT OPERATING VOLTAGE – GROUP 3

A 24-80V AC/DC B 80-150V AC/DC
C 150-275V AC (300V DC) D 18-275V AC (300V DC)

5 TPI ANALOGUE OUTPUTS

A Not required
B Required 4 to 20mA

6 REAR COMMUNICATIONS PORT

A Not required
B Required - Modbus protocol

### 2V165-S wiring diagram - Relay shown in de-energised condition

*Note: The status inputs & some relay outputs are assigned by the software (UMX) loaded on the relay.

Shown here are the standard assignments of the A UMX. Other UMX versions may differ. Consult the UMX data sheets for specific I/O assignments.
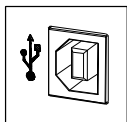
FRONT PANEL USB PROGRAMMING PORT

SCADA COMMUNICATIONS PORT

RS485 Network port

24 — A
28 — +B
26 — GND

1 2 3 4

SHIELD

RS485 Shielded twisted pair cable (Up to 1Km)
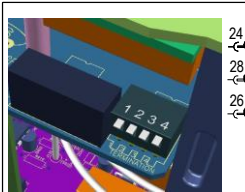
To other uMATRIX relays (Up to 32 units)
Invoke terminating 120R resistor to end of BUS relay only.
To do this set SW100-3&4 ON.

Invoke BIAS resistors for single relay connection only.
To do this set SW100-1&2 ON.

Vx 1
3

5
7 Transformer 1 IN GROUP
   Status input group 1
9
7 Transformer 2 IN GROUP

11
13 Transformer 3 IN GROUP
    Status input group 2
15
13 Transformer 4 IN GROUP

16
22 Tap raise input command
    Status input group 3
18
22 Tap lower input command
20
22 Go to specified tap

35
37 Transformer 1 tap position indicator input
39
41 Transformer 2 tap position indicator input
43
45 Transformer 3 tap position indicator input
47
49 Transformer 4 tap position indicator input

25
27 Power supply / CPU fail alarm
23

30
34 Tap raise / Transformer 1
32 Tap lower

36
40 Tap raise / Transformer 2
38 Tap lower

42
46 Tap raise / Transformer 3
44 Tap lower

48
52 Tap raise / Transformer 4
50 Tap lower

19
21 Common Out of Step & TPI fail alarm
17

10
8 Tap Change feedback

14
12 All OFF LINE

55 + Tap position output
53 -
2