



(ISO 9001:2000 COMPANY)

**Automatic
Voltage Regulating
Relay
EE-303**

INSTRUCTION MANUAL

Instruction Manual
for
Automatic
Voltage Regulating Relay
Type EE-303

EMCO ELECTRONICS

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I GENERAL DESCRIPTION

EMCO's Microcontroller based Automatic Voltage Regulating Relay type EE-303 is a new generation Relay used for regulating the secondary voltage of Power Transformers with a motor driven On Load Tap Changer (OLTC).

A single control pulse to the motor causes a change in voltage by one step. When step by step function is inactive, the motor drive is controlled by a continuous control pulse.

A "Raise" or "Lower" control signal is generated by the voltage regulator when the measured voltage deviates from preset conditions.

The parameters are programmable through a front panel keyboard and are stored in Non-Volatile Memory.

Time Delay Setting (T1), for deviation from deadband to the first control pulse can be set in. Linear or Integral mode (ie. Inversely proportional to the deviation). Where the voltage correction requires more than one control pulse, the time delay between consecutive control pulses (T2) is also programmable.

Relays with potential free contacts are provided for signaling 'Manual Mode', 'Undervoltage', 'Overvoltage' & Control Fail' (voltage remaining outside the deadband for more than 5 minutes) conditions. The OLTC is blocked for these conditions.

The regulated voltage can be displayed in volts or kilovolts. LED annunciators are provided for presignal conditions and Relay operations.

The Auto / Manual selection allows the Relay to operate in the Auto mode or in the Manual mode. In the Manual mode, the "Raise" and "Lower" pulses can be manually given through key switches.

In 'Test' mode the relay can be checked functionally on the panel. The relay contacts are blocked in the 'Test' mode.

Facility for disabling AVR remotely & indication of Tap change in progress, sensed through potential free contacts are provided.

A built-in Tap Position Indicator with 1K Ω step resistance is provided to indicate the Tap No. of the Power Transformer upto a maximum of 35 Taps.

II TECHNICAL SPECIFICATIONS

Settings

Nominal Voltage Setting (NS)	:	85 to 140V in steps of 0.1V. 335 to 550V for 433V PT display (optional).
Lower Voltage Setting (LS)	:	+0.5 to +9% of NS in steps of 0.1%
Raise Voltage Setting (RS):	:	-0.5 to -9% of NS in steps of 0.1%
Under Voltage Blocking (UV)	:	60 to 95% of NS in steps of 0.1%
Over Voltage Blocking (OV)	:	105 to 140% of NS in steps of 0.1%
Primary Voltage Factor (KV)	:	0 - 999.9KV corresponding to NS in steps of 0.1KV
Time Delay (T1) between deviation & first Pulse	:	10 to 180 secs, Linear or Inverse response
Time Delay (T2) between consecutive pulses	:	0-11secs. 0 - continuous operation, 11 - T2 = T1
Control Fail Delay (CF)	:	300 to 900 secs. in steps of 0.1secs
Automatic / Manual Mode (A/M)	:	Selects Automatic or Manual mode of Tap changer. In manual mode, Tap can be manually Raised / Lowered through front panel keys.
Maximum Tap No. (MT)	:	1 to 35 with 1K Ω step resistance.
Test Mode (TEST)	:	Allows AVR to be tested for all conditions through indication by LEDs. Contacts are blocked during 'TEST' mode.

Display

PT Voltage	:	4 digit, 7 segment LED display, LV side (110.0V) or HV side (as per KV setting).
Min. PT Voltage	:	Minimum PT Voltage reached after the last cleared value. 'MIN' LED indication indicates minimum value display.
Max. PT Voltage	:	Maximum PT Voltage reached after the last cleared value. 'MAX' LED indication indicates maximum value display.
Tap No.	:	Indicates 1 to 35 taps.
LED Indications	:	For parameter units, min, max PT value & Control Relays Operation

Keys

SET	:	Selects & displays parameter for reading & modification in a predefined sequence
®	:	Flashes digit to be modified & rotates from MSB towards LSB
-	:	Increments value of flashing digit
ENT	:	Saves the modified value if within acceptable limits & returns to PT display

Input, Output

Auxiliary Supply	:	110V/230V AC \pm 15% 50Hz, 15VA
PT Supply	:	110V , 50Hz, 1.5VA (can be displayed as 433.0V)
TPI Input	:	1K ω step resistor chain for a maximum of 35 steps
Relays Output	:	1 pair of NO contacts(5A @ 240V AC or 24V DC) for Raise, Lower, UV, OV & CF blocking condition & 1 pair of NC contacts for A/M
Relays ON time	:	2 secs pulse.
Operating Temperature	:	0°C - 45°C
Overall Size	:	92mm X 192mm X 220mm (H X W X D)
Weight	:	2 Kgs. (approx.)
Panel Cutout	:	90mm X 184mm(H X W)

Options

1. PT display of 433V instead of 110V.
2. Auxiliary Fail Relay with a pair of NO contacts to indicate Auxiliary Supply Failure.
3. 4 - 20mA TPI output for SCADA.
4. Any other easily achievable non-std requirement.

III FRONT PANEL INDICATIONS / CONTROLS

INDICATIONS (Refer Drg. No. 06-ED-02)

1) Para No. Display (1digit)	:	Displays the no. corresponding to the parameter being displayed in the next 4 digits
L	:	LV side PT value
H	:	HV side PT value
0	:	Min/Max value of PT (M/M).
1	:	Auto/Manual mode (A/M).
2	:	Lower volts setting (LS)
3	:	Nominal voltage setting (NS)
4	:	Raise volts setting (RS)
5	:	Undervoltage limit (UV)
6	:	Overvoltage limit (OV)
7	:	Primary side factor (KV)
8	:	Linear/ Integer mode (L/I)
9	:	Initial time delay (T1)
A	:	Time delay between consecutive pulses (T2)
B	:	Control Fail delay (CF)
C	:	Max tap no. (MT)
D	:	Test mode (TEST)

- | | | |
|-------------------------------|---|---|
| 2) 4digit Display | : | Displays the PT voltage / parameter values / mode of operation. |
| 3) Tap No. Display (2 digits) | : | Displays the Tap no. of the Transformer from 1 to 35. 00 indicates wiper open. |
| 4) 'MIN' LED | : | Lights when the displayed value is the stored minimum PT voltage after the last reset. |
| 5) '> BW' LED | : | Lights when the PT voltage goes outside the bandwidth. |
| 6) 'MAX' LED | : | Lights when the displayed value is the stored maximum PT voltage after the last reset. |
| 7) 'V' LED | : | Lights when the displayed value is in volts. |
| 8) 'KV' LED | : | Lights when the displayed value is in kilovolts. |
| 9) '%' LED | : | Lights when the displayed value is in % of nominal value. |
| 10) 'S' LED | : | Lights when the displayed value is in seconds. |
| 11) 'TC' LED | : | Lights when the Tap changer is in progress (sensed through NO contacts on OLTC). |
| 12) 'RR' LED | : | Lights when the Raise control pulse is given. |
| 13) 'LR' LED | : | Lights when the Lower control pulse is given. |
| 14) 'UV' LED | : | Lights when the Undervoltage blocking occurs. |
| 15) 'OV' LED | : | Lights when the Overvoltage blocking occurs. |
| 16) 'CF' LED | : | Lights when the Control Fail blocking occurs. |
| 17) 'MAN' LED | : | Lights when Manual mode of OLTC operation is selected. |
| 18) 'TEST' LED | : | Lights when Test mode is selected. |
| 19) 'REMOTE' LED | : | Lights when AVR is disabled & OLTC is operated remotely (sensed through NO contacts at remote end). |

CONTROLS

- | | | |
|----------------------|---|--|
| 1. Power - ON switch | : | Switches Auxiliary supply & PT supply to the unit. Display lights when switched 'ON'. |
| 2. 'SET' Key switch | : | Allows setting of parameters as per parameter number display(0 to d). |
| 3. '@' Key switch | : | Selects MSB for editing the displayed digit(blinking). Subsequent key press rotates the blinking digit to RHS. |
| 4. '_' Key switch | : | Increments the value of the selected digit (blinking). |
| 5. 'ENT' Key switch | : | Saves the edited value in the NOVOL RAM if within limits and returns to the PT voltage. If edited value is outside the permissible limits, display remains same with MSB blinking. |

REAR PANEL

FUSES

PT Fuse	:	100 ma
Auxiliary Fuse	:	300 ma

REAR PANEL CONNECTIONS

INPUTS

Auxiliary Supply	:	110V / 230V AC, 50Hz, 15VA.
PT Supply	:	110V AC, 50Hz, 1.5VA
TPI Inputs (+, W, -)	:	3 wires input from resistor chain on OLTC
AVR Disable I/P (Remote mode)	:	AVR can be disabled by closing a pair of (NO) potential free contacts remotely for remote operation
Tap change in progress I/P	:	Indication of tap change in progress is available when a pair of (NO) potential free contacts are closed during OLTC operation.

OUTPUTS

Relay Contacts	:	1pair of (NO) contacts for Raise, Lower, Undervoltage, Overvoltage and Control Fail 1pair of (NC) contacts for Auto / Manual 1pair of (NC) contacts for Auxiliary Supply Fail (available optionally).
Contact rating	:	5A @ 240V AC or 24V DC resistive load
Relay 'ON' time	:	2 seconds pulse for Lower and Raise. Continuous operation for other alarm relays (UV, OV, CF, A/M).

IV. OPERATING PROCEDURE

Connect the Auxiliary & PT supply at their respective inputs. Connect the 3 wires (Min, Wiper, Max) to the resistor chain on the OLTC for Tap No. indication. Connect the respective output contacts (NO) to OLTC or alarm. Switch on the AVR. The first digit (Parameter No.) indicates whether the PT voltage is
L - Lower voltage side or H - Higher voltage side
along with the actual 4 digit value. The LEDs also indicate V or KV as units. On pressing _ key the display toggles from LV to HV & vice versa.

On pressing SET key, 0 is displayed in Parameter No. & the stored Minimum PT value is displayed, with 'MIN' LED ON. The stored value can be cleared to PT value by pressing ® key.

On pressing _ key the stored Maximum PT value is displayed with 'MAX' LED ON. The stored value can be cleared to PT value by pressing ® key.

Once again pressing _ key the stored TC Count is displayed with no indication. The stored value can be cleared to 0 by pressing ® key.

"ENT" key returns back to PT display.

The last 2 digits indicate the Tap No. of Transformer.

Parameters can be displayed & modified in the following sequence by pressing 'SET' key.

The Parameter No. is indicated on the 1st digit along with the stored value of the parameter.

Set the parameter values as per the requirement.

Para. No.

0	-	Minimum / Maximum PT Voltage/ Tap changer Count (M/M)
1	-	Auto / Manual Mode (A/M)
2	-	Raise Setting (RS) (-0.5 to -9.0% of NS)
3	-	Nominal Value Setting (NS) (85 to 140V or 335 to 550V)
4	-	Lower Setting (LS) (+0.5 to +9.0% of NS)
5	-	Undervoltage Blocking (UV) (60 to 95% of NS)
6	-	Overvoltage Blocking (OV) (105 to 130% of NS)
7	-	Primary Voltage Setting (KV) (000.0 to 999.9 KV)
8	-	Linear /Integral Time Delay Mode (L / I)
9	-	Time Delay (T1) between Deviation & First Pulse (10 to 180secs).
A	-	Time Delay (T2) between consecutive pulses.(0 to 11secs) 0 - Continuous Pulse, 11 - T2 = T1
B	-	Control Fail Delay (CF) (300 to 900secs).
C	-	Maximum tap no. of transformer (MT) (1 to 35 nos.)
D	-	TEST Mode of operation

To modify any parameter value press,

® key - MSB starts blinking.

_ key - Increments value of blinking digit. If selected digit is not required to be edited move to next digit with ® key & modify value as per requirement.

Press ENT key to store modified value in NVRAM & return to PT display. If modified value is not within the specified range, display remains same with MSB blinking.

Depending on the PT voltage & the set parameters, the AVR will give control pulses for Raising & Lowering the tap. When the PT voltage is outside the bandwidth, '>BW' LED is ON. For either of the UV, OV or CF conditions, OLTC is blocked & the respective pair of contacts close.

When Min / Max tap position is reached, further Lower / Raise command is inhibited.

In manual mode of operation, tap can be manually raised by _ key & lowered by ® key.

'Test' mode is executed by pressing ® key & can be terminated by 'ENT' key.

V. TEST PROCEDURE

1. Check that there is no damage to the unit during transportation.
2. Check PT & Auxiliary fuses are properly tightened.
3. Connect 110V / 230V A.C. to the Auxiliary Supply pins 1 and 2 on the Rear Panel Terminal Block and 110V AC through a variac to the PT Supply pins 3 and 4 on Rear Panel Terminal Block. Connect resistor chain between pin no. 12 & 14 on Rear Panel Terminal Block and Wiper pin no.13 to tap 1.
4. Switch on Power to the unit.
5. Make the following settings by selecting the parameters
NS=110V, LS=2%, RS=2%,
UV=80%, OV=120%, KV=22KV,
L/I=Lin, T1=30 secs, T2=5 secs,
CF=300 secs, MT=17, A/M=AUTO (MAN LED off).
6. Set the PT voltage within the deadband (i.e. 110V \pm 2%), and note that under this condition none of the presignal or relay LEDs are ON. Only the 'S' LED is ON.
7. **LOWER VOLTS OPERATION CHECK**
Increase the PT voltage above 112.2V, '>BW' LED will become ON. After 30 secs 'LR' LED will become ON for 2 secs and then remain off for 5 secs. The 'LR' pulse will again come for 2 secs and then remain off for 5 secs. Check the contacts close on pins 6,7 on Rear Panel Terminal Block when the 'LR' indication is ON and open when the 'LR' indication is off. Reduce the PT voltage to come back to the deadband. Both the '>BW' and 'LR' LEDs should go off.
8. **RAISE VOLTS OPERATION CHECK**
Reduce the PT voltage below 107.8V, '>BW' LED will become ON. After 30 secs 'RR' LED will become ON for 2 secs and then remain off for 5 secs. The 'RR' pulse will again come for 2 secs and then remain off for 5 secs. Check the contacts close on pins 5,6 on Rear Panel Terminal Block when the 'RR' indication is ON and open when the 'RR' indication is off. Increase the PT voltage to come back to the deadband. Both the '>BW' and 'RR' LEDs should go off.
9. **TIME DELAY T2 CHECK**
Change the value of T2 to 11 and repeat steps 7 and 8, the control pulses will come after thirty secs delay. Change the value of T2 to 0 and repeat steps 7 and 8, the 'LR' and 'RR' LEDs should permanently remain ON respectively along with the contacts closed. Change the value back to 5 seconds.
10. **UNDER VOLTAGE CHECK**
Reduce the PT voltage below 88V. The 'UV' LED becomes ON and 'UV' contacts on pins 8,9 on the Rear Panel Terminal Block close. Note that after 30secs 'RR' LED will not become ON as the 'RR' pulse is blocked. Increase the PT voltage above 93.5V but below 107.8V. 'UV' LED will go off and the contacts will open. 'RR' pulse will start coming after the T1 time delay is over.
11. **OVER VOLTAGE CHECK**
Increase the PT voltage above 132V. 'OV' indication becomes ON and contacts on pins 19,20 on the Rear Panel Terminal Block will close. Note that after 30secs 'LR' LED will not become ON as the 'LR' pulse is blocked. Reduce the PT voltage below 126.5V but above 12.2V. 'OV' LED will go off and the contacts will open. 'LR' pulse will start coming after the T1 time delay is over.

12. CONTROL FAILURE CHECK

Repeat steps 7 and 8 and let the condition exist for more than 5 minutes. After 5 minutes, the Control Fail 'CF' LED becomes ON and the contacts on pins 21,22 on Rear Panel Terminal Block close. The 'LR' & 'RR' relays are blocked i.e. there is no control action. Bring the PT back within bandwidth, the 'CF' LED goes off.

13. KV CHECK

Adjust PT voltage to read 110V. Press ' _ ' key to display 22KV. Reduce PT voltage by 10% to 99V (read with ' _ ' key) and again press ' _ ' key. It should display 19.8KV (10% less). Increase PT to 121V (10% more and read with ' _ ' key) and again press ' _ ' key. It should display 24.2KV (10% more). Check for other values of PT voltage.

14. AUTO / MANUAL CHECK

Select manual mode in parameter no. 1. 'MAN' LED should turn ON & contacts on the Rear Panel Terminal Block pin no.10 & 11 should close. Repeat steps 7 and 8, and check the contacts between pins 5,6 and 6,7 on the Rear Panel Terminal Block will not close. Press ' _ ' to give Raise pulse manually, the relay pins 5,6 on the Rear Panel Block should be closed for two secs, and at the same time the 'RR' LED will be ON. Similarly press '® ' to give Lower pulse manually, the relay pins 6,7 on the Rear Panel Block should be closed for two secs, and at the same time the 'LR' LED will be ON. Go back to AUTO mode & check that contacts between pins 10 & 11 are open.

15. TAP POSITION INDICATOR CHECK

Connect the wiper to tap no.1 and check the display reads properly. Change the tap from 1 to 17 and verify that the tap no. displayed is correct. Reduce the PT Voltage to get 'R' condition, 'RR' pulse should not come as the maximum tap position is reached. By reducing tap recheck the tap nos. from 17 to 1. Increase the PT voltage to get the 'L' condition, 'LR' pulse should not come as the minimum tap is reached.

16. TEST MODE CHECK

Select 'TEST' mode by selecting parameter no 'd', 'TEST' LED should glow. Press '® ' key to start the test. Observe the display and the LEDs. All LEDs are off except 'V' LED. The PT voltage starts increasing from 110V to 134V. When the voltage increases above 112.2V, the '>BW' LED comes ON. After 10 secs 'LR' LED comes ON for 2 secs and goes off and repeats after every 5 secs. When the voltage further increases above 132V, 'OV' LED comes ON and 'LR' LED stops coming (blocking activated). The PT voltage then starts decreasing, when it decreases below 127.5V, the 'OV' LED goes off and 'LR' LED starts coming after 10 secs. When the voltage crosses 112.2V, both the '>BW' and 'LR' LEDs goes off. The PT voltage then starts reducing from 110V to 86V, when the voltage decreases below 107.8V, '>BW' LED comes ON. After 10 secs 'RR' LED comes ON for 2 secs and goes off and repeats after every 5 secs. When the voltage further decreases to 88V, the 'UV' LED comes ON and 'RR' LED stops coming (blocking activated). The PT voltage then starts increasing, When the voltage crosses 93.5V, the 'UV' LED goes off and 'RR' LED starts coming after 10 secs. When the voltage crosses 107.8V, both '>BW' LED and 'RR' LED goes off. When the voltage reaches 110V, all the LEDs starts blinking and the display returns back to the PT value. During the test mode the TPI displays 88.

17. MIN / MAX PT VOLTAGE CHECK

Let PT voltage be more than 110V. Select parameter '0' for reading the Minimum and Maximum values of PT. 'MIN' LED glows and minimum value of the PT voltage after the last clear is displayed. Press 'Ⓜ' key to clear the minimum value. The display reads 110V, Reduce the PT input to less than 110V. The minimum PT will be the same value. Further reduce the PT, the minimum value will also change to the same as actual PT value. Increase the PT voltage and once again check the minimum PT, it should not change. Press ENT to display the actual PT voltage. Reduce the PT input to less than 110V. Select '0' and press '_' key to display the maximum PT value. 'MAX' LED glows and the maximum PT voltage after the last clear is displayed. Press 'Ⓜ' key to clear the maximum value. The display reads 110.0V. Increase the PT voltage to greater than 110V, the maximum PT will read the same as actual value. Further increase the PT and the maximum value will also change to the same value. Reduce the PT and check the maximum value, it should not change.

18. TAP CHANGE IN PROGRESS CHECK

Short pins 17 and 18 on Rear Panel Terminal Block. The 'TC' LED glows. Increase and decrease PT voltage to get L / R conditions respectively. No 'LR' or 'RR' pulses should come (blocking activated). This operation is counted for every TC input contacts closure and stored. This count is displayed in the parameter no. '0', and displayed by toggling along with MIN / MAX PT voltage. Remove short, 'TC' LED goes off. Again check for 'LR' and 'RR' pulses, this time the pulses will come respectively.

19. REMOTE CHECK

Short pins 15 and 16 on Rear Panel Terminal Block. The 'REMOTE' LED glows. Increase and decrease PT voltage to get L / R conditions respectively. No 'LR' or 'RR' pulses should come (blocking activated). Remove short, 'REMOTE' LED goes off. Again check for 'LR' and 'RR' pulses, this time the pulses will come respectively.

OPTIONS :

1. AUXILIARY FAIL RELAY CHECK

Check contacts on Rear Panel Terminal Block, pins 23 and 24 are closed when auxiliary supply is not connected. Connect the auxiliary supply and check that the contacts should open.

2. 4-20 ma TPI O/P for SCADA

Check 4 - 20ma output corresponding to the tap position. Connect a 100 ohms resistor between Rear Panel Terminal Block pins 25 and 26 and measure the dc current in series. Check TPI, for taps 1 to 17 & measure O/P current varies from 4 to 20ma (1ma/tap) i.e. tap1 = 4ma, tap2 = 5ma & so on till tap17 = 20ma. In case the number of taps are more or less than 17, the change in current per tap change = $16\text{ma} / \text{no. of step resistance}$ eg. for 21 taps = $16 / 20 = 0.8\text{ma/step}$. Thus tap1 = 4ma, tap2 = 4.8ma, tap3 = 5.6ma & so on

3. 433V PT DISPLAY

433V is displayed instead of 110V PT. All voltage values displayed will be with respect to 433V Nominal Voltage Setting. However PT input should be 110V only.

VI. FUNCTIONAL DESCRIPTION OF VARIOUS MODULES

The Automatic Voltage Regulating Relay Type EE-303 has the following modules :

1. **MAINS TRANSFORMER** : It steps down the voltage from 110V or 230V to 16V, 10V and 9VAC for generating +12V and $\pm 5V$ DC outputs.
2. **SENSE TRANSFORMER** : It steps down the PT voltage from 110V to 1.1VAC which is used as the signal voltage.
3. **DISPLAY PCB (Front Panel)** : This module displays the parameters, PT voltage and the tap position. It consists of 7 x 7 segment LED display with their driver circuit. Single LEDs are used as indicators for presignal conditions, relay operation and units of display. There are 4 keys available for setting the parameters.
4. **MAIN PCB** : This module converts the stepped down PT voltage to DC volts. This DC voltage is fed to the Analog to Digital converter to get the digital value. Then this is compared with the preset settings by the microcontroller. The software is stored in the microcontroller's internal ROM itself and the programmable parameters are stored in a Nonvolatile Memory. The control signals are outputted by the microcontroller to the the control relays on the same board. Signals for display are also outputted by the microcontroller, & taken to the display PCB.
5. **AUXILIARY FAIL RELAY PCB (OPTIONAL)** : Provides NC contacts for detecting failure of Auxiliary supply to the unit.
6. **4 TO 20 ma TPI O/P PCB (OPTIONAL)** : This module gives an output of 4 to 20 ma current responding to the Tap no.w

VII FAULT FINDING PROCEDURE

Sr. No.	FAULT	POSSIBLE CAUSES	REMEDIAL ACTION
1.	No DisplayAuxiliary	Supply not proper. Auxiliary Fuse blown. Power on Switch bad. Mains transformer not functioning. DC voltages not OK.	Ensure proper supply. Replace Fuse (300ma). Replace Switch. Replace Mains transformer. Replace Main board.
2.	Zero Display	PT fuse blown. Sense transformer not functioning. AD to DC or A to D Convertor not functioning.	Replace PT fuse . Replace Sense transformer. Replace Main PCB.
3.	Any random or fixed display	DC voltages not OK. AC to DC or Analog to Digital converter not functioning. Micro-controller not functioning. Display drivers not functioning..	Replace Main board. Replace Main board. Replace Main board. Replace display PCB.
4.	PT Display and presignal indications not proper.	Sense transformer not functioning. Analog to Digital ,or A to D converter not OK. Display PCB not OK.	Replace Sense transformer. Replace Main board. Replace Display PCB.
5.	Control relays not operating	Control signal not O.K. Control signal O.K but relays are not functioning	Replace Main board. Replace Main board.
6.	Indefinable response of voltage regulator	Electrical disturbance or Electromagnetic interference. Parameters stored in NOVOL corrupted	Replace Main board. If problem still exists return unit to EMCO ELETRONICS the voltage Re-Enter all the parameters or replace NOVOL

Note:

Test points on main board are available for checking DC voltages, PT voltage and TPI voltages.

Power Supply

TP1=+5V

TP2=-5V

TP3=+5V

TP4=DG (GND)

TP5=+12V

PT Supply

TP6=1.1VAC(for PT 110V)

TP7=AG(GND)

TP8=DC O/P(2.2 VDC)

TPI

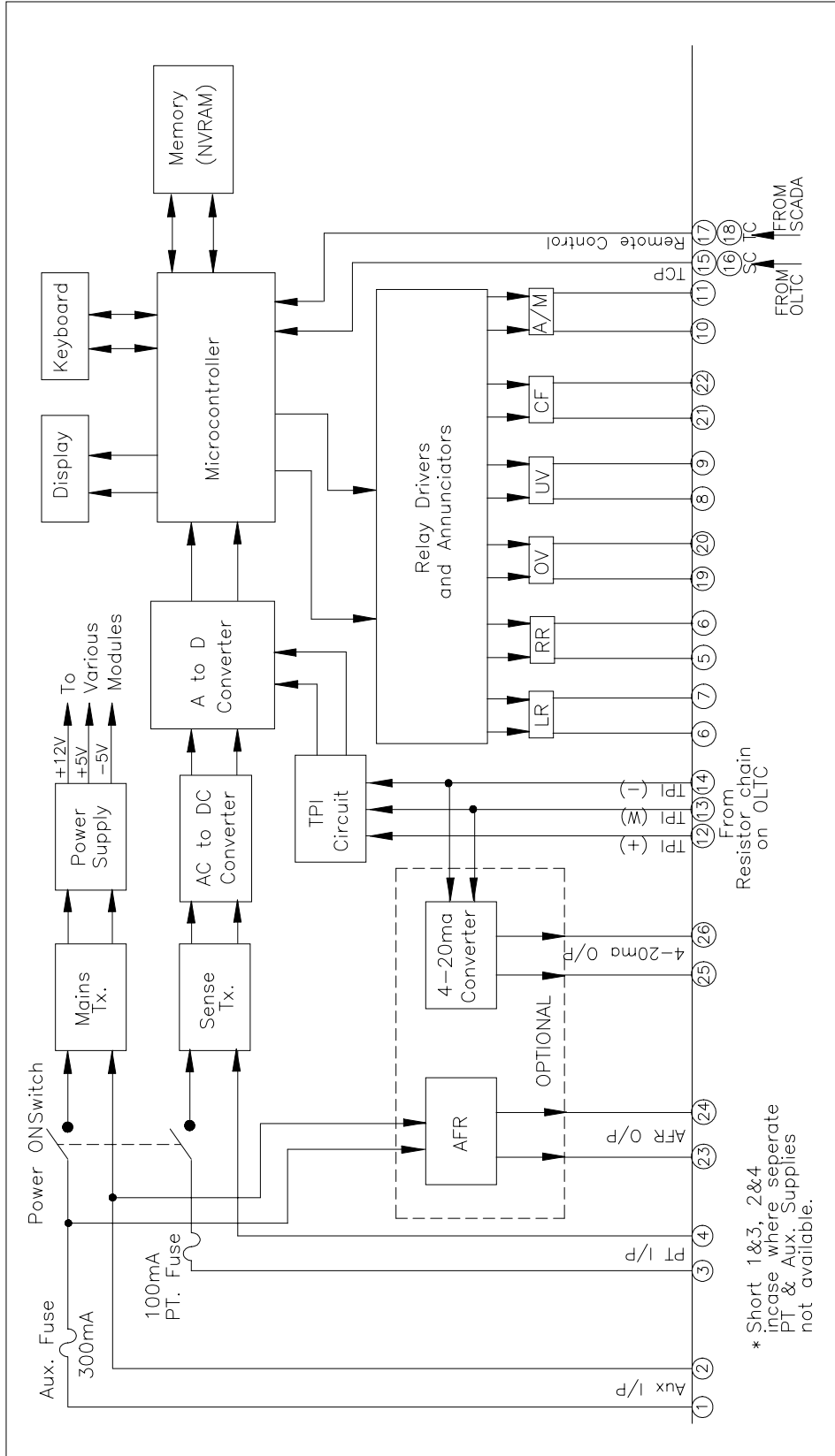
TP9=TPI O/P (between W & GND) (varies from 0.15V to 1.75V in steps of 100 mv / tap)

RECOMENDED SPARES

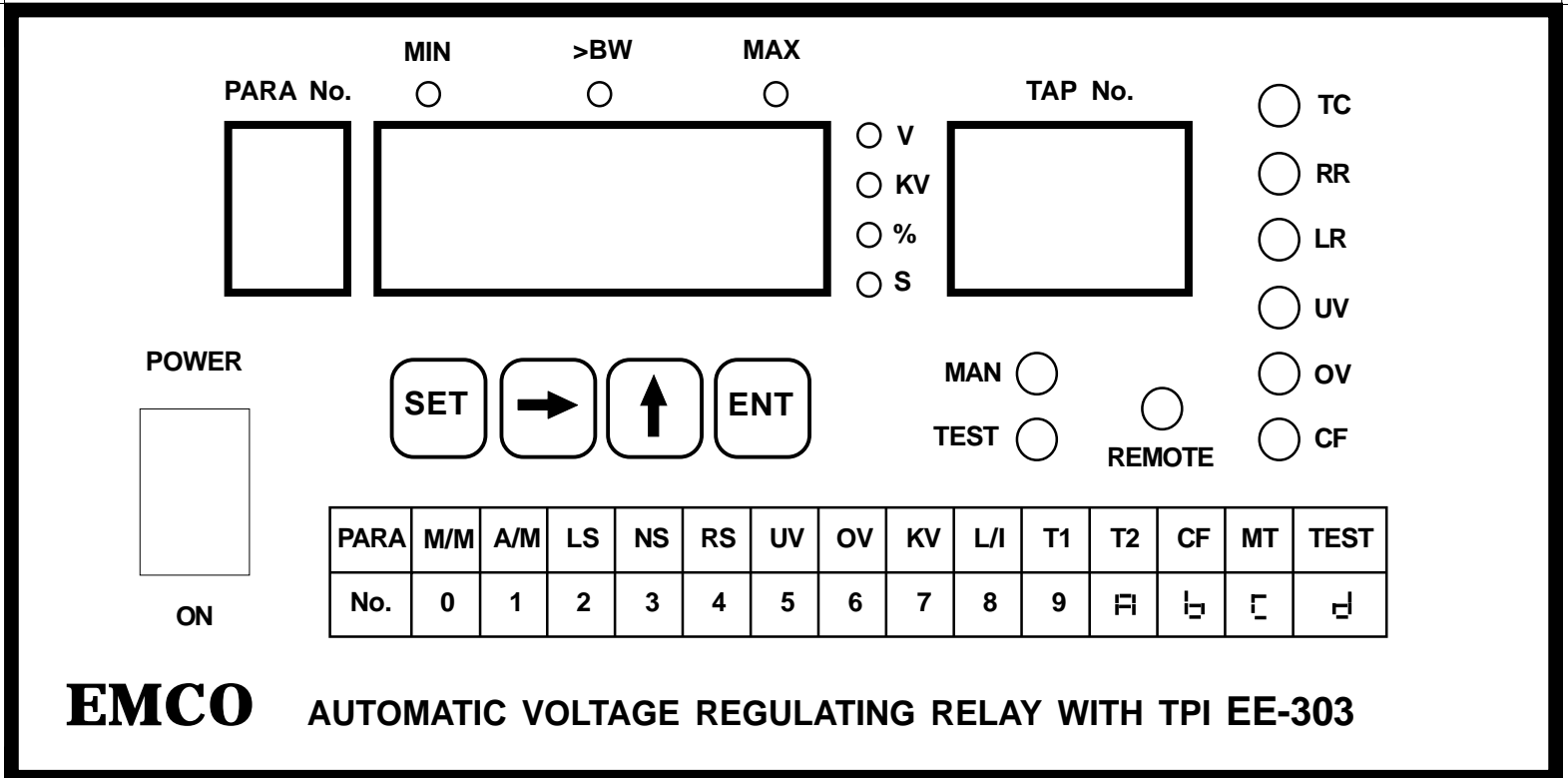
1. Main PCB
2. Display PCB
3. Mains Transformer
4. Sense Transformer

VIII LIST OF DRAWINGS

1. Block Diagram Drg. No. 06-ED-01
2. Front Panel Label Drg. No. 06-ED-02
3. Panel Cutout & Rear Panel Connections Drg. No. 06-MD-06
4. Integral Time Delay Response Drg. No. 06-ED-04



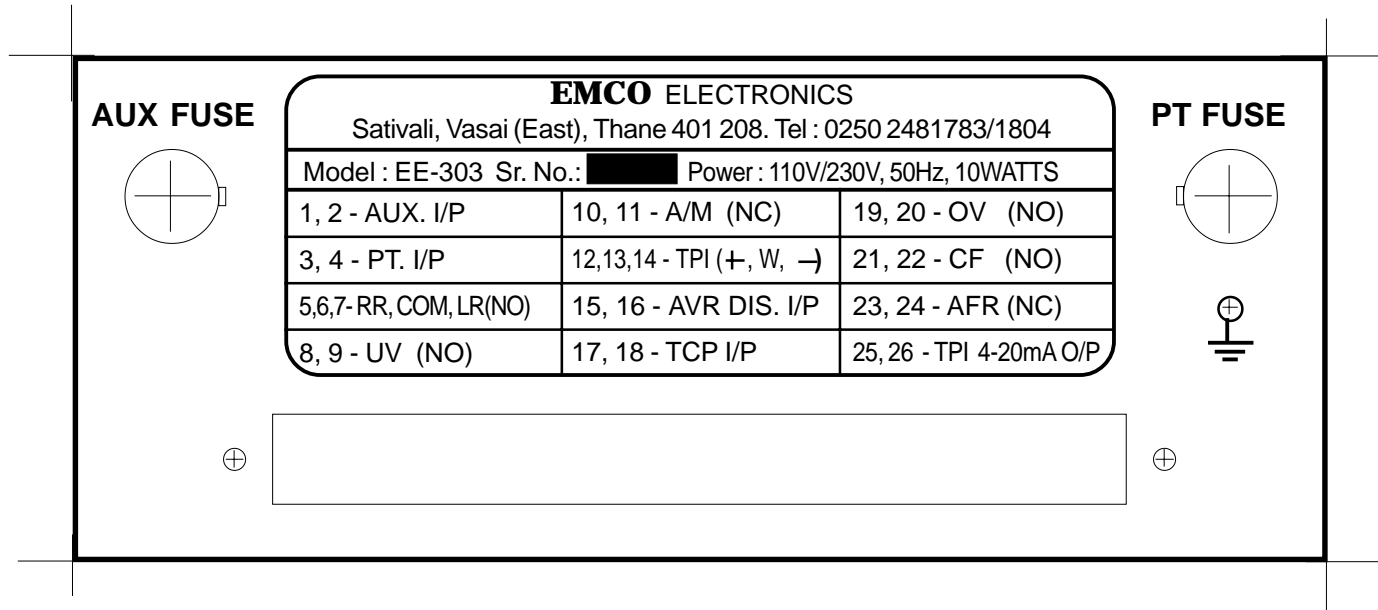
4		ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE	
3	PRODUCT : EE-303	EMCO ELECTRONICS	
2	ASSEMBLY : -	TITLE : BLOCK DIAGRAM	
1	MATERIAL : -	SCALE : -	
ISS.	DATE	APPR. BY	DRN. BY : J.J.P.
DOC No.: DC00-405/ISS.1		DATE : 30-03-04 DRG. No. : 06-ED-01/ISS.1	



EMCO AUTOMATIC VOLTAGE REGULATING RELAY WITH TPI EE-303

4			ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.		
3			PRODUCT : AVR EE-303	EMCO ELECTRONICS	
2			ASSEMBLY : -	TITLE : FRONT PANEL LABEL	
1			MATERIAL : POLYCARBONATE	SCALE: 1:1	
ISS.	DATE	APPR. BY	DRN. BY : J.J.P.	DATE: 30-03-04	DRG. No. : 06-ED-02/ISS.1

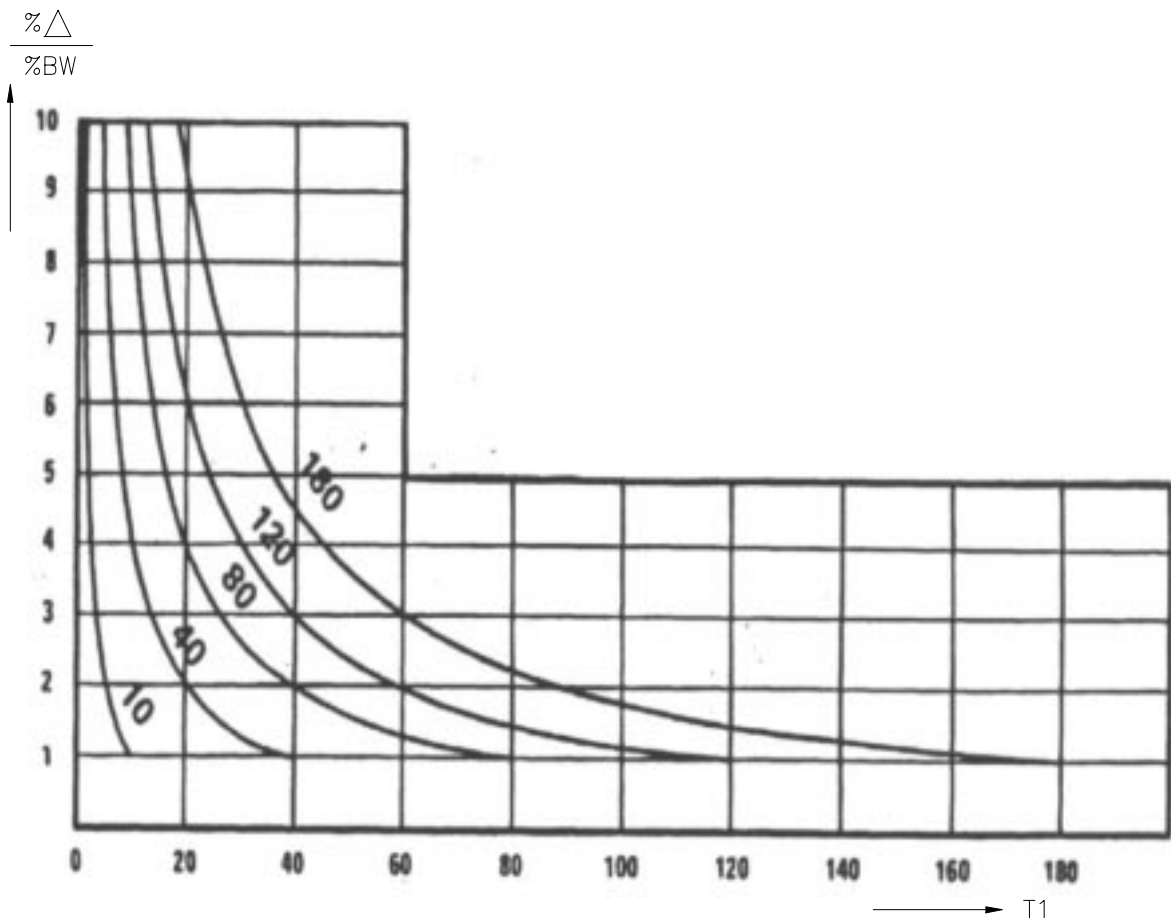
FOR TOLERANCES NOT SPECIFIED, REFER DIMENSION TOLERANCE CHART PD00 - 606



4			ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE.		
3			PRODUCT : EE-303	EMCO ELECTRONICS	
2			ASSEMBLY : -	TITLE REAR PANEL LABEL	
1			MATERIAL : POLYCARBONATE	SCALE: 1:1	
ISS.	DATE	APPR. BY	DRN. BY : J.J.P.	DATE: 15-11-03	DRG. No. : 06-ED-03/ISS.1

DOC NO. : DC00-405/ISS.1

FOR TOLERANCE NOT SPECIFIED REFER DIMENSION TOLERANCE CHART PD00-606



$$T_{INV} = \frac{T1}{\% \Delta / \% BW}$$

Where,
 T1 = Set Time Delay
 %Δ = %Deviation
 %BW = Average of Raise & Lower settings

4			ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE	
3		PRODUCT : μC AVR 303	EMCO ELECTRONICS	
2		ASSEMBLY: -	TITLE : INTEGRAL TIME DELAY RESPONSE	
1		MATERIAL :-	SCALE: N.T.S.	
ISS. DATE	APPR. BY	DRN. BY : J.J.P.	DATE: 15-11-03	DRG. No. : 06-ED-04/ISS.1

IX. WARRANTY

This product from **EMCO ELECTRONICS** is warranted against defects in materials and workmanship for a period of 12 months from the date of despatch to the first buyer/purchaser of this equipment, this being essentially limited by warranties given to **EMCO ELECTRONICS** on the component used in equipment.

During the warranty period **EMCO ELECTRONICS** will at its option, either repair or replace the product which prove to be defective provided the product has been used with reasonable care and in accordance with the manuals / product specification. Consequently this warranty shall also not apply to defects/damages in transit or resulting from misbehaving, misuse, unauthorised modifications or repairs operations outside the environmental, electrical and/or other specification, improper or inadequate maintenance of the product, or site conditions as required/recommended and damages arising from accidental or abnormal causes.

The warranty period for items repaired/replaced shall not exceed the period for which the equipment was originally warranted and also the liability of **EMCO ELECTRONICS** to the purchaser shall not in any case, exceed the original purchase price of the equipment.

For warranty service or repair, the equipment must be returned to **EMCO ELECTRONICS** securely packed on Freight paid basis and accompanied by a certificate stating that the equipment is being returned for warranty repairs and also a note giving details of the purchase (Purchaser's Name and address, invoice No. and Date of purchase) and details of the equipment failure, fault conditions, other useful information to facilitate early repair / rectification of the equipment.

Return of equipment duly repaired can be arranged on payment of the packing and forwarding charges together with any other taxes, duties, other miscellaneous expenses incurred, alternatively the purchaser may arrange to collect the equipment from **EMCO ELECTRONICS**. In case the repairs are not covered under warranty, the charges for the same must also be paid before collection of the equipment.

Our engineer's services are available at site for instruments during warranty or out of warranty period, on chargeable basis, details of which are available on request.

In the interest of development and improvement, **EMCO ELECTRONICS** reserve the right to amend without notice details contained in this publication. No legal liabilities will be accepted by **EMCO ELECTRONICS** for any errors, omissions or amendments.