EMCO
ELECTRONICS

(ISO 9002 COMPANY)

Automatic Voltage Regulating Relay

EE 301-M

INSTRUCTION MANUAL

Instruction Manaual for
Automatic Voltage Regulating Relay Type EE 301-M

EMCO ELECTRONICS

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DOC No. : MK 01 - 702 / ISS.2

C O N T E N S

I INTRODUCTION

EMCO's Solid State Voltage Regulating Relay Type EE 301- M is used for regulating the secondary voltage of power transformer with on-load tap changer . The required dead-band settings are set by setting the Nominal value and L & R levels independently. The Time Delay setting on the front panel eliminates the relay operations for momentary fluctuations of the regulated voltage, thus reducing the number of operations of the tap changer.

When the regulated voltage falls below the specified Under Voltage limit, the control relays are automatically blocked i.e. there is no voltage correction, and a pair of relay contacts is made available for alarm.

The relay uses all solid state circuitry which increases its reliability and life. The relay is of modular construction and the PCBs are plug-in type and can be easily withdrawn from the instrument for servicing without disturbing the unit. The O/P, I/P connections are made through a polarised connector which enables easy removal of the instrument without disturbing the control wiring. However all normal precautions/care in handling/storage should be observed as for a sensitive electronic instrument.

II GENERAL DESCRIPTION

EMCO 's Solid State Voltage Regulating Relay Type EE 301-M is designed for maximum operational simplicity for regulating the secondary voltage of power transformer with on-load tap changer. The dead-band (bandwidth) can be set by setting the nominal value (NVA) to the required value (110V $\pm$ 10%) and then setting the L & R limits around the NVA within 0.5V to 5V.

The desired time delay can be set on the front panel and the control action will take place only if the voltage continues to remain outside the dead-band after the time delay has elapsed. For voltage corrections requiring more than one tap change, time delay is initiated again before further tap change. The relay is reset automatically after the voltage is brought within the selected deadband. The time delay is effectively reduced to provide a voltage time integral response of the regulator for repeated short duration voltage fluctuations on the same side of the dead-band.

Operation of the Raise Control Relay is automatically inhibited when the voltage falls below the specified under voltage limit or it fails. One pair of normally open relay contacts are provided to effect the tap change during Raise and Lower operation and to trigger an alarm in case of Under voltage / P.T. fail conditions.

III SPECIFICATIONS :

Auxiliary Supply	**:**	110V / 230V AC $\pm$ 15% 50Hz, 15VA.
PT Supply (Requlated Voltage)	**:**	110V $\pm$ 10%, 50Hz, 1.5 VA.
Sensitivity (Dead Band) and Nominal value Range	**:**	1. Nominal value adjustable (NVA) between $\pm$10% of 110V and readable on DPM. 2. 'L' setting adjustable between 0.5V to 5V above the NVA and readable on DPM. 3. 'R' Setting adjustable between 0.5V to 5V below the NVA and readable on DPM. 4. Actual PT voltage also readable on DPM.

Time Delay Setting	:	Fixed (Voltage independent) Time Delay continuously adjustable from 10 to 120 seconds.
Time Delay Resetting	:	Instantaneous resetting with voltage deviation occurring in opposite direction.
Under voltage Blocking	:	Internal blocking at 80% of NVA. Restoration at 85% of NVA
Control Relays	:	One pair of normally open potential free contacts of rating 5A at 250V AC or 24V DC resistive load for each Lower, Raise and Under voltage control relays.
Control Operation	:	Single Pulse operation with 2 seconds (approx.) on-time.
Operating Temperature	:	0° - 45° C.
Overall Size	:	378 x 146 x 260 mm (HxWxD)
Mounting Details	:	Panel cutout - 330 x 135 mm, with mounting holes (1/4" Æ x 4 Nos.) @ (360 x 100) ± 2mm
Weight	:	5kg Approx.
Options	:	1) Line drop compensator with resistive and reactive compensation of either polarity upto 20% and suitable for operation with 1A/5VA current Transformer. 2) Normally closed “Auxilliary Supply Fail” relay contacts. 3) Normally open “Control Fail” relay alarm contacts in case of control failure (i.e. in case of continuous ‘L’ or ‘R' command for more than 15 minutes). 4) User defined settings for PT Supply, Time Delay & Undervoltage Blocking

IV. FAMILIARIZATION WITH VARIOUS INDICATIONS / CONTROLS :

A. INDICATIONS

1. Auxiliary Supply “ON”	:	DPM digits light.
2. ‘L’ Lamp	:	‘ON’ whenever the PT Voltage exceeds the 'LOWER VOLTS’ set limit.
3. ‘R’ Lamp	:	‘ON’ whenever the PT voltage falls below the ‘RAISE VOLTS’ set limit.
4. UV/PT FAIL Lamp	:	'ON’ whenever the PT Voltage falls below the factory set Under Voltage limit i.e. below 80% of the Nominal voltage. This lamp will turn-off only when the PT volt age raises above 85% of the Nominal voltage value. This lamp will be ‘ON’, when P.T. supply fails.

5. 'LR' Lamp : 'ON' When Lower Relay is energised.

6. 'RR' Lamp : 'ON' When Raise Relay is energised.

7.'TEST' Lamp : 'ON' When instrument is in "TEST" mode.

B. CONTROLS

1. Power - ON (S1) : This is a toggle switch which when'ON' supplies Auxiliary Voltage to the instrument.

2. 'R' Set (C1) : This is a variable control varying from 0.5V to 5.0V below NVA setting. This control sets the (lower limit of the PT voltage below which if the voltage reduces, then corrective action will be taken by the instrument. The setting is to be read on DPM.

3. 'NOM' Set (C2) : This is a variable control to set the Nominal value of PT voltage varying between ± 10% of 110V. This set ting becomes the reference level around which L & R setting can be varied. The setting is to be read on the DPM.

4. 'L' Set (C3) : This is variable control, varying from 0.5V to 5.0V above NVA setting. This control sets the upper limit of the PT voltage beyond which if the voltage rises, corrective action will be taken by the instrument. The setting is to be read on DPM.

5. Time Delay (C4) : Corrective action takes place only after the Time Delay as set by this control has elapsed and the PT Voltage continues to ramain outside the set Lower or Raise limits (but does not fall below the UV limit).

6. Test/Normal Switch (S2) : It selects the Test or Normal mode of operation. In the Test mode, PT Voltage is simulated internally & can be varied through the Test Control on the front panel. An LED indication is provided to indicate that the instrument is in Test mode. In the Test mode, the control relays are "cut off" so that undesired operation of OLTC is prevented during testing. The voltage is monitoredon the DPM in PT I/P position. In the Normal mode extemal PT voltage gets connected to the instrument. This switch must be kept in ''Normal" mode when the instrument is in use.

7. Test Voltage Control (C5) : Simulates PT I/P in Test mode and can be varied from OV to 150V AC.

8. Selector Switch (S3) : Selects the voltage setting to be monitored on fhe DPM. It also enables the PT voltage to be read on the DPM.

NOTE : Before connecting Aux. Supply & PT Supply to the AVR Relay, Check-up following points.

A) **Mechanical Damage :** Remove the front acrylic cover by loosening the thumbscrews & check for any mechanical damage to the unit.

B) **Check all plug-in modules :** Open the botton panel & check M1 , M2, M3 & M4 for any damage. Insert them fully inside, to avoid problems due to loose contact.

C) **Aux fuse & P.T. fuse :** Note that Aux. fuse is 300mA (20mm) & P.T. fuse is 100mA (20mm). Do not interchange these fuses. Check them & replace with good ones if required.

D) Close the lower bottom panel.

V. OPERATING INSTRUCTION :

1. Connect the PT & Auxiliary Supply to the appropriate wires (3,4) and (1,2) respectively, of the rear panel connector as per Drg. No. 01-MD-30. In case separate Auxiliary supply is not available, then the same PT supply can be connected to both the PT & Auxiliary terminals. Check whether the Normal/Test switch is in the Normal mode.

2. **UNDER VOLTAGE BLOCKING :**

   This is factory set at 80% of the Nominal voltage. Note that between Blocking and the Release (Restoration), a hysteresis of 5% has been provided i.e. if the PT voltage falls below 80% of the Nominal value limit, UV Relay will operate and block the control action (i.e. RAISE would be inhibited). However, if the voltage rises again the RAISE control continues to remain inhibited till PT voltage reaches 85% of the Nominal voltage. Blocking (80%) and Restoration (85%) are factory set values, unless the customer has specified other values.

3. **TIME DELAY :**

   This is a variable control with variation from 10 sec. to 120 sec. The actual setting can be made as required. The corrective action will take place only after the set Time Delay interval is elapsed provided the voltage deviation persists even after the set Time Delay and that the relay is not operating in UV mode.

NOTE : Please note that for the operational safety, RAISE and LOWER relays are interlocked and hence OLTC will never receive two opposite commands simultaneously.

4. **CONTROL RELAYS :**

   Connect the respective Lower, Raise and Under voltage NO contacts to operate the respective contactors.

VI. TYPICAL INSPECTION PROCEDURE :

1. Connect 110V/230V A.C. Aux. supply to pins (1,2) of the rear panel connector.
2. Turn on the instrument by putting power switch to 'ON' position.
3. Make the following settings by changing selector switch :

   NOMINAL VALUE 110V

   LOWER VOLTS Setting 112V

   RAISE VOLTS Setting 108V

   TIME-DELAY Setting 30 Sec.

   %R & %X Setting '0' %

   (in case of relay with LDC)
4. Put the Test/Normal Switch to Test mode and selector switch to PT I/P position.
5. Increase test-control to read PT = 110V.
6. Note that under this condition all the lamps viz. L, R, LR, RR, & UV are OFF.

A. LOWER VOLTS OPERATION CHECK :

1. Increase PT supply by the Test control above 112V (at least 112.5V), 'L' Lamp should immediately turn on.
2. The 'LR' Control pulse will come on only after 30 sec. from the instant of tuming on of 'L' lamp. The control pulse will remain 'ON' for 2 sec., after which the Time Delay of 30 sec. will restart and the control pulse will come again for 2 secs. and the cycle is repeated.

B. RAISE VOLTS OPERATION CHECK :

1. Reduce PT Supply by the Test control•below 108V (at least 107.5V), but ensure that it is above UV limit (88V). 'R' Lamp should turn 'on' immediately.
2. The ' RR' control pulse will come on after 30 sec. from the instant of turning on of 'R' Lamp. The control pulse will remain on for 2 sec. after which the T.D. is initiated again. After another 30 sec., the control pulse will come again for 2 sec. and the cycle is repeated.

NOTE: The relays are cut off in the Test mode of operation to prevent any undesirable operation of the OLTC during testing. However, the lamp indications will indicate the operation of the relays. For checking the relay contacts, the PT I/P should be connected through the rear panel connector (pins 3,4) and Test/Normal switch put in Normal mode. The PT I/P can be varied externally and the relays are checked as above. The respective N0 contacts will close.

C. UNDER VOLTAGE/PT FAIL OPERATION CHECK :

1. Reduce the PT supply below 88 V, UV lamp will turn-on immediately (under this condition R lamp wiil also be 'on'). but Raise control is inhibited.
2. Raise the PT supply above 94V, UV lamp should turn off immediately.

3. 'R' lamp indication however shall remain on, if the PT voltage is still below the Raise setting. The raise control pulse will come on after the set Time Delay.

4. Disconnect extemal PT supply - the UV & R Lamp will turn on immediately. The UV relay will operate. After restoration of PT supply, the lamp wiil turn 'off' & UV relay will be deenergised.

FUSE REPLACEMENT :

1 After switching power-on, the DPM indication must come. If it does nof come, check whether AUX. fuse on the front panel is properly tightened. If the instrument still does not work, unscrew the fuse & check if it is open. Replace it by another fuse of 300mA (20mm).

Once again ensure that the fuse is not loose. The instrument should turn on now. If the fuse keeps on blowing repeatedly or the instrument does not work inspite of good fuse, proceed to identify the faulty PCB as given in fault finding procedure VIII.

2 Connect the PT supply and put the Test/Normal switch in Norrnal position. If the Instrument is turning on but you are continuously getting 'R' and 'UV' indication, check whether PT fuse is loose. If the condition persists even after tightening PT fuse, remove the same and replace by another 100mA (20mm) fuse. If 'UV' and 'R' indication still persist, proceed to identify the faulty PCB as given in fault-finding procedure VIII.

VII. FUNCTIONAL DESCRIPTION 0F VARIOUS MODULES :

1. **Mains Transformer :** This trasnformer is mounted on the rear side railing. This takes 230V/110V A.C. and steps it down to 19V, 12V, 5V, 10V A.C. voltages required generating dc power.

2. **P.T. Transformer :** This is mounted on PCB module M2 which steps down PT input from 110V A.C. to 3.3V A. C. Which is used for sensing PT voltage.

3. **Power Supply Module M1 :** This module generates +15V DC, -15V DC, +5V DC & +5V DC (for DPM) required for circuit operation. Three pin regulator ICs 7815, 7915, 7805 are used to give regulated +15V, -15V & +5V D.C. Supplies. The four LEDs mounted on front side of module M1 indicate the presence of these voltages. If all four LEDs of module M1 are glowing brightly & voltages are as given in TABLE 1 (Page No.9) then this module is OK. If any one LED is not glowing or glowing very dim, then proceed as per step No.5 given in fault finding procedure VIII.

4. **Analog Module M2 :** The PT input is stepped down in the ratio 110/3.3. This stepped down voltage is rectified. filtered and amplified by IC4 & IC5. This voltage is used for comparison with reference voltage. IC3 generates regulated +10V DC by taking +15VDC as input. This 10V DC rs used as a reference voltage for comparison. IC2 compares the input signal with L, R, UV set points & generates appropriate L, R or UV signal which are passed on to module M3.

5 **Digital Module M3 :** This card receives L, R, UV signals from card M2. On

receiving any of these signals, it generates Time Delay followed by LR, RR & UV commands for energizing appropriate relay.

6. **Relay Module M4 :** In this module , relays for L, R, & UV commands are mounted which are energized as per commands received from module M3.

7. **Digital Panel Meter :** The main function of DPM is to display PT input, Nominal setting, L, R settings through selector switch. This DPM operates on +5V supply which is supplied by P.S. Module M1.

VIII. FAULT FINDING procedure :

Before proceeding to fault finding, be familiar with the functions of each module & various test points on these modules. Study the nature of fault & try to visualise faulty module. Then Proceed step by step as follows.

Step-1 : Check for any physical damage by opening front doors.

Step-2 : Check the Aux. fuse (300mA) & PT fuse (100mA). If necessary, replace them. (Do not interchange the fuses). Tighten them properly.

Step-3 : Confirm that all four modules M1, M2, M3 & M4 are inserted fully in the backside connectors & having proper contacts

Step-4 : Connect 'Aux' supply & PT supply & Switch ON the unit. If the unit does not get switched ON, then check aux. switch.

Step-5 : Open the bottom front cover. Check the four LEDs mounted on moduleM1. If all LEDs are glowing brightly then module M1 is alright. If anyone of the LEDs is not glowing or all LEDs are glowing very dim, then measure voltages on the test points as given in table No.1. If the voltages are not as expected, then remove other modules M2, M3 & M4. Measure the voltages again (or confirm all 4 LEDs are glowing brightly). If voltages are not correct then replace M1. If the voltages are correct without M2, M3, & M4, it means M1 is alright but other module is over loading P.S. module. Insert M2, M3 & M4 one by one and find out which module is loading. Replace the faulty module. Confirm all D.C. Voltage are as per table No.1.

Step-6 : Proceed to check M2 as follows :

Please note that M3 should also be there. Put the selector switch (S3) in Nominal set position and vary the Nominal set control to read 110V $\pm$ 10% on DPM. Set Nominal control to 110V. Now keep the selector switch (S3) to 'R' set position and vary 'R' set control to read 104.5V to 109.5V on DPM. Set 'R' set control to 108V. Tum S3 to 'L' set position and vary 'L' set control to read 110.5V to 115.5V on DPM. Set 'L' set control to 112V. If any of the settings are not obtainable, it means either front panel controls are faulty or M2 is faulty. Replace M2. If problem still persists, then check front panel controls (i.e. potentiometers for their open/short conditions). If required replace them.

Step-7 : Turn selector switch S3 to PT I/P position. Put Normal/Test switch (S2) to Test position. Vary the Test control in clockwise direction to read PT I/P on DPM. If DPM does not read then measure AC Voltage at TP 3 w.r.t. GND on M2. It should vary from 0 to 5V AC. with clockwise rotation of Test Control. If the voltage is not coming, it means either S2 is faulty or 0-5V wdg. of Mains Tx. is open or Test control (CS) is faulty. If the voltage is,OK, it means M2 is faulty.

Step-8 : Vary the Test control & read PT I/P on DPM. When PT I/P is less than 88V (i.e. 80% of nominal set-UV levels), then the UV indication alongwith 'R' indication should come. Increase the voltage above 93.5V (85% of nominal set-UV restoration), then UV command goes "off". However 'R' command remains "ON". Increase PT I/P Voltage Slightly more than 108V, 'R' will go off. This is B.W. Condition. Increase PT I/P Slightly more than 112V, 'L' indication should come. If the UV, L & R indications are coming as above that means M2 is 0K. If not change M2 After changing M2 still problem persists then check M3.

Step-9 : Proceed to check M3 as follows:

Set Time Delay (TD) control to 30 sec. Vary the test control to get 'L' condition. Measure time from which 'L' indication comes to the time 'LR' indication comes. The 'LR' indication will remain 'ON' for 2 sec. afterwhich once again TD' is initiated.

(The 'TD' indication is provided on M3) Similarly get 'R' condition, "RR" should come after set Time Delay. If 'LR' & 'RR' indications are not coming after set time delay, it means M3 is faulty. In the 'Test' mode, the supply to the relays is cut. Offer Hence relays will not operate only indications for 'LR' & 'RR' will come.

Step-10 : Put switch S2 to Normal position. In this position the PT I/P comes through rear panel (actual PT Voltage). Vary PT I/P and read on DPM. If DPM does not read, measure AC Voltage at TP3 ON M2. It should be around 3.3V AC for 110V AC PT I/P. If this voltage is not coming, it means either S2 is faulty or PT fuse is faulty or PT transformer on M2 is faulty.

Step-11 : To check relay module M4, vary PT I/P to get 'L & R' conditions in Normal mode & confirm that Lower relay and Raise relay are operating, by checking continuity at rear terminals. If "RR" & "LR" indication are coming but relays are not operating then check 15V supply to relay Module M4 or check S2. If relays are operating but 'NO' contacts are not closing means relay contacts are faulty. Ensure that Relay contacts are not connected to the Tap-Changer Replace M4.

(In above description, it is assumed that DPM & LEDs are OK).

Step-12 : TO CHECK DPM

Measure following voltages on DPM back side connector.

bet '0' & 5V = 5V DC

bet Lo & Hi = 10V DC (approx) at 110 PT I/P

DPM should indicate 110.0V

If these Voltages are present and still DPM is not showing anything or some segments or digits are not glowing it means that DPM is faulty, replace it.

For LEDs (mounted on front panel) : If M2 & M3 are OK and still LEDs are not glowing for proper conditions then the LED itself may be defective, replace it.

Table No.1 On Module-M1

Test Points	Expected Voltage
betTP1 &TP3	+15V $\pm$ 0.5 V
betTP2&TP3	-15V $\pm$ 0.5 V
betTP4&TP3	+5V $\pm$ 0.25V
betTP5&CapC8-ve	+5V $\pm$ 0.25 V

On Module - M2

Bet TP3 (on M1) & TP3 (on M2) (For PT I/P = 110VA.C.)	3.3VAC $\pm$ 0.2%
Bet TP4 (on M2) & TP3 (on M1) (For PT input 110V A.C.)	+10VDC $\pm$ 0.2% (should vary with PT input)
TP7 (on M2) & TP3 (on M1) (For Nom Set = 110V)	+10V DC

Note : All the Voltagesare measured w.r.t. TP3 on module M1 .

Potentiometer P1 on Module M2 is for adjusting UV settings. Factory set value is 80% of nominal value. It can be adjusted upto 50% of nominal value.

Potentiometer P3 on Module M2 is for adjusting +10V DC at TP4 for PT input of 110V A.C.

NATURE OF FAULT	PROBABLE CAUSES
Unit not getting 'ON'	Check fuses, 'Power On Switch Connections to rear connector are OK. Check M1. If faulty, replace it.
UV indication 'ON'	Check PT supply, PT Fuse and M1. If all are OK, if faulty replace.
DPM reads '000' in all position of selector switch S3	Checked M2, if faulty replace.
No Variation in DPM reading by varying R, L set controls or normal set controls	Check M1 & M2, if faulty replace.
L or R or UV indications not coming after varying PT input beyond dead band settings.	Check M1. If OK. M2 must be faulty.
L or R indication remains permanently 'ON'	Check M2. If OK, M3 is faulty.
LR or RR not coming after varying PT I/P voltage and waiting for the set time delay.	If M1 & M2 OK then M3 faulty.
Time delay LED on module M3 remains 'ON' permanently	M3 faulty.
Time delay is not as per set value	Time delay dial might have shifted. Adjust the setting of T.D. as follows. Slightly loosen the Knob and rotate T.D. control fully anti-clockwise to match the dot with the starting dot below Tighten & check the Time Delay value for 30 secs. Readjust slightly if necessary.
LR & RR commands coming but OLTC not operating	If M1, M2 & M3 are OK and if Test/Normal switch is in Normal mode then replace M4. If problem still persists then check-up control panel wiring.
'LR' or 'RR' commands remain "ON" permanently	If M1 OK, M2-OK then M3 faulty.

IX. LINE DROP COMPENSATOR

I. DESCRIPTION

The Line Drop Compensator is an optional unit designed to match with the Automatic Voltage Regulating Relay Type EE-301 M. The unit is housed in the same enclosure. (Plug-in type module)

The LDC unit cannot be mounted afterwards at site but has to be ordered at the time of placing an order.

The Voltage at the generating end and at the receiving end are not the same due to the drop across the line. The LDC is used to compensate for this line drop, and the amount of compensation required is calculated as a % of the Nominal voltage knowing the length of the line, its resistance/unit length, its reactance/unit length and the rated current, and set on the front panel.

The line current is stepped down to 1Amp and fed to the LDC unit. The resistive and reactive drops are simulated by having 90° phase-shifted voltages and their polarity is selected by polarity switches. The net compensation is then summed with the stepped down PT voltage.

II. SPECIFICATION :

Resistive Compensation	:	0-20% of the regulating value continuously adjustable.
Reactive Compensation	:	0-20% of the regulating value continuously adjustable.
Input rated current	:	1 Amp, 50 Hz.
Powerconsumption	:	5VA max. at 1 Amp.
Accuracy	:	10%.
Max. Over current	:	50% of rated current (1.5Amp).
PolaritySelection	:	Both positive and negative Compensation.

III. OPERATING AND CONNECTION INSTRUCTION:

Connections to the LDC unit are made through the rear panel terminals (5,6). The line current is stepped down to 1Amp. 50 Hz and fed to the LDC. The net compensation is fed to the AVR ckt. internally.

The required amount of %R and %X compensation can be set on the front panel of the LDC. The polarity select switches will provide both positive and negative compensation.

The %R & %X settings can be calculated from following formulae.

$$\%X = \frac{\sqrt{3} I_L \times X_L \times 100}{V_L}$$

$$\%R = \frac{\sqrt{3} I_L \times R_L \times 100}{V_L}$$

Where I_L = the primary rated current of the line.

V_L = the voltage between lines of power transformer.

X_L = the line reactance in ohms/phase.

R_L = the line resistance in ohms/phase.

The LDC simulates the resistive & reactive drops across the line. The %R setting gives the resistive drop which is in phase with line current. The polarity switch VR selects whether the drop has to be added or subtracted from PT Voltage.

In +VR position this voltage is subtracted from the PT voltage so that its effect on AVR is to Raise the voltage equal to the resistive drop to make the voltage at the load equal to nominal tvalue. In -VR position drop is added & its effect on AVR is to 'LOWER' the voltage. In normal use, VR switch is kept on + posiiion.

The % X setting gives the reactive drop across the line. This drop is in phase quadrature to the line current. The +VX gives lagging compensation and -VX gives leading compensation. Since the reactive compensation is in quadrature, its effect on AVR magnitude is very less. However, its effect is observable for power factors bet. 0.5 & 0.7 and is similar to VR compensation i.e. +VX raises the voltage & -VX Lowers.the Voltage.

The PT I/P to the AVR is internally stepped down to 3.3V corresponding to 110V. The vector sum of resistive & reactive drops i.e. LDC 0/P is added vectorially to the stepped down PT voltage to get the sense voltage at load end.

TESTING OF LDC

a) Feed 110V PT to AVR and keep R = 105 & L = 115.

b) Keep %R & %X setting of LDC to minimum position (i.e.U%)

c) Now the AVR is in dead-band condition. Feed 1A current through the terminals 5 & 6 on rear panel.

d) Keep both polarity switches to +VR & +VX position.

e) Increase %R compensation trom 0 to 20%, 'Raise' indication should come.

f) Put polarity switch to -VR position, "Lower" indication should come.

g) Bring back %R control to zero position.

h) Set R & L settings to 108V & 112V. Increase % X control from 0 to 20%, Raise indication should come. Put polarity Switch to -Vx position, Lower indication should come.

(N.B.) - This can be observed only for a power factor of 0.5 to 0,7. For lower P.F. effect is not observable.

Note :- If above tests are not ok, then interchange CT connections at 5 & 6 and carry out same tests.

CALIBRATION CHECK OF %R

a) Assuming current in phase with voltage (i.e. P.F. = 1)

set L = 115V & R = 105V, %R = 0 & %X = 0.

Check operation of AVR without feeding 1Amp current to LDC.

b) Note down values at which R & L indications come. Let us say they come at 105V& 115 respectively.

c) Pass 1 Amp current through LDC and increase %R setting to 5%. Put polarity switches in + position.

d) Vary the PT Voltage and note value at which R & L indications come. They should be 5.5V above set Values, i.e. R = 110.5V & L = 120.5.

e) Put VR switch to -Ve position and vary voltage and check the voltages when R & L indication come. They should be 5.5V below the set values i.e. R = 99.5 & L = 109.5. Similarly check for 10% compensation. The difference will be +11V i.e. levels will be L = 126V, R = 116V, for +VR & L = 104, R = 94V for -VR.

f) The %X Compensation cannot be checked, because of its small effect on AVR. If above tests are not coming OK, then change LDC unit.

VERY IMPORTANT

1. Do not remove LDC unit when C.T. current is flowing. (This action will make CT open CKT and damage it).

   Arrange to switch off CT current or short CT before removing LDC unit.

2. When LDC is not to be used then both %X and %R dials should be kept at 0%. This position will give 0 compensation. Do not remove LDC unit from relay as AVR will not function without LDC unit inside.

X. SUPERVISORY ALARMS OPTION

Following Supervisory Alarms options also can be incorporated in the same Relay EE 301- M, if required.

1) Relay contacts to give alarm instantaneously when Auxiliary supply to the AVR Relay fails.

2) Relay contacts to give alarm if the regulated voltage remains outside the set dead band for more than 15 minutes.

SUPERVISORY ALARMS

1) This unit consists of one relay which operates on 110V A.C. It remains energised as long as 110V A.C. (Aux supply) is present at Pin No. 1 & 2 of the AVR relay. When Aux supply fails, this relay gets deenergised, the “NC” Contacts at pin No.7 & 8 can operate the alarm.

2) It also consist of a 15 minutes timer which starts counting as soon as the regulated voltage goes out of the set dead band (either Raise side or lower side). If the regulated voltage remains outside dead band for more than 15 minutes then a relay operates which closes “NO”’ Contacts at Pin 15 & 16. These contacts can be used for “Control fail” alarm. The operation of this control fail relay is indicated by a red LED marked “CFR” mounted on front panel.

This control fail alarm will operate in following circumstances:

a) failure of OLTC to raise or lower the taps.

b) incoming voltage very high or very low i.e. beyond control of the transformer and tap has reached either lowest position or highest position.

c) Mal-functioning of A.V.R. Relay.

The supervisor in the sub station should take appropriate steps to remove the above mentioned faults.

If the voltage returns in the set dead band within 15 minutes, the 15 min timer resets automatically.

TESTING PROCEDURE

1) Give Aux supply 110V A.C. to the A.V.R. Relay and check continuity at Pin No. 7 & 8. It should show open. Remove Aux supply to the relay and check the continuity at Pin No. 7 & 8, it should show short.

2) **CONTROL FAIL ALARM RELAY:**

Make the dead band settings as desired. Change the PT voltage to get either R or L indication. Keep the regulated voltage outside the set dead band; after 15 minutes (approx.). the control fail alarm relay will operate and will remain in energised condition till the voltage returns to set dead band. This operation will be indicated by red LED marked CFR mounted on front panel of AVR Relay. The relay contacts can be checked at Pin 15 & 16.

Take the regulated voltage within set dead band. The control fail Relay will get deenergised and the contacts at Pin 15 & 16 will again become open and LED will stop glowing. Similarly this operation can be checked by taking regulated voltage on other side of set dead band.

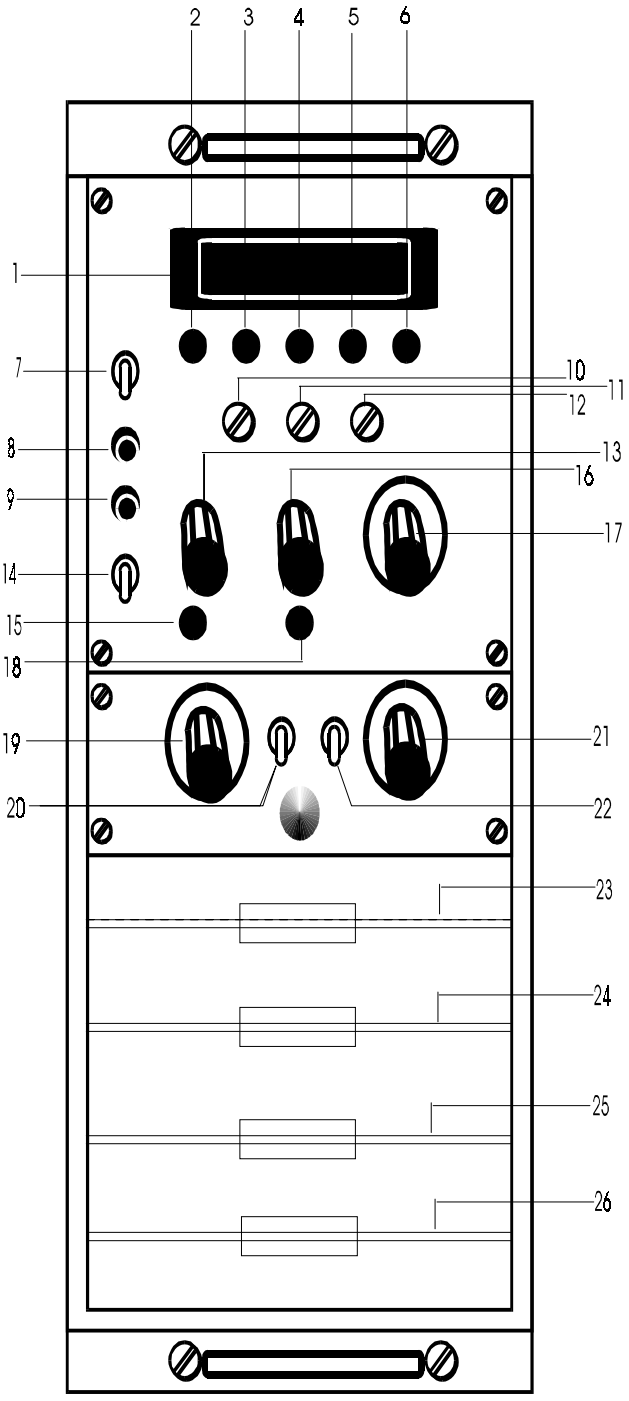
XI LIST OF DRAWINGS :

1.	Block Diagram	:	01-ED-25
2.	Front Panel View	:	01-MD-29
3.	Rear Panel View / Cutout Dimensions/AVR connections	:	01-MD-30

RECOMMENDED SPARES :

1. Power supply Mdule M1
2. Analog Card Module M2
3. Digital Card Module M3
4. Relay Module M4
5. Digital Panel Meter (DPM)
6. Mains Transformer

7 LDC Module (in case of AVR with LDC)

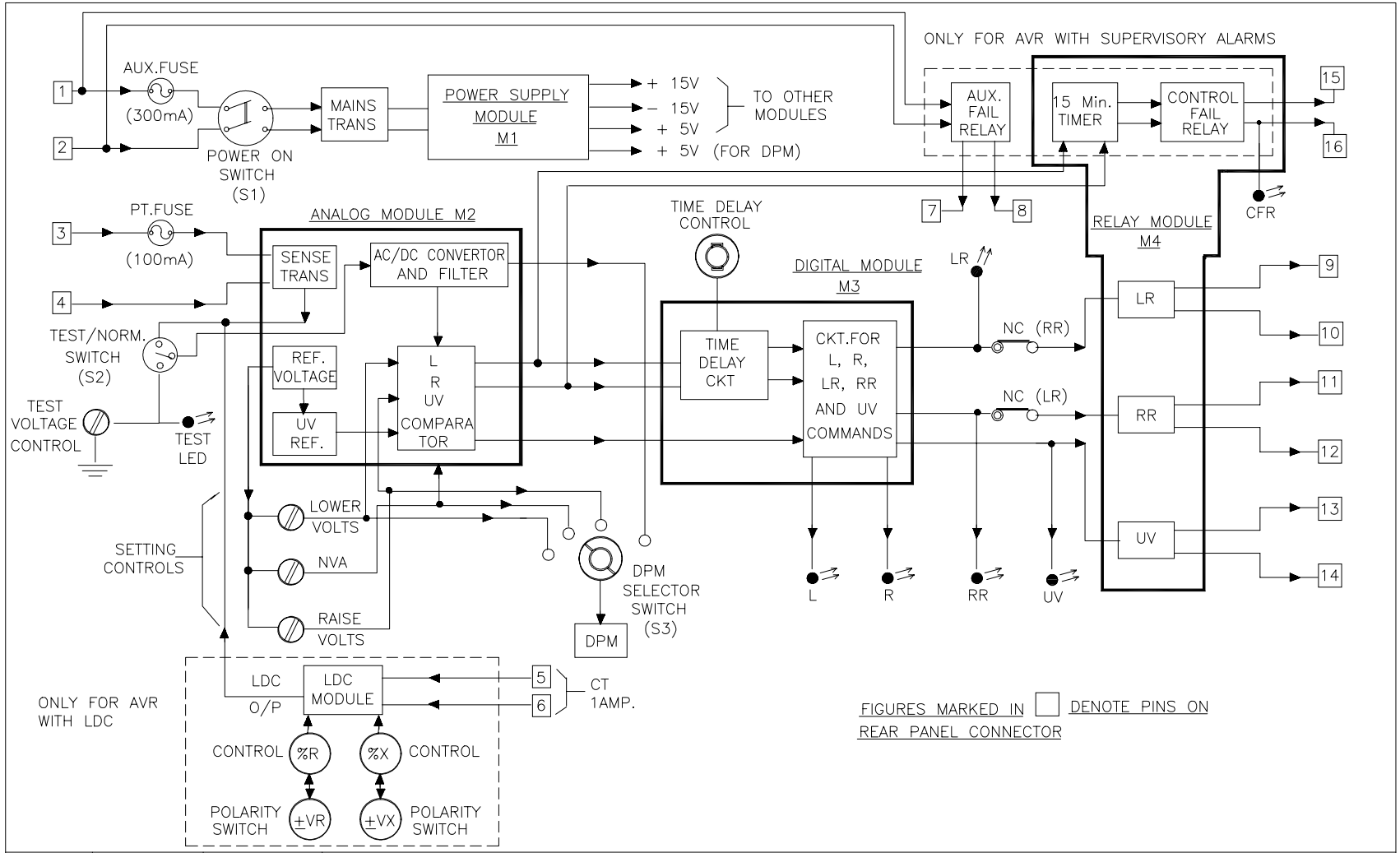


1 – Digital Display (DPM)
2 – Undervoltage Indication (UV)
3 – Presignal RAISE (R)
4 – Control Pulse RAISE (RR)
5 – Presignal LOWER (L)
6 – Control Pulse LOWER (LR)
7 – Power ON Switch (S1)
8 – Auxiliary Fuse (F1)
9 – PT Fuse (F2)
10 – RAISE Volts Setting (C1)
11 – Nominal Value Setting (C2)
12 – LOWER Volts Setting (C3)
13 – TEST Control (C5)
14 – TEST / NORMAL Switch (S2)
15 – TEST Mode Indication (TM)
16 – Display Selection Switch (S3)
17 – Time Delay Control (C4)
18 – CFR Indication (CFR)
19 – %R Control (LDC)
20 – VR Polarity Switch (LDC)
21 – %X Control (LDC)
22 – VX Polarity Switch (LDC)
23 – Power Supply Module (M1)
24 – Analog Module (M2)
25 – Digital Module (M3)
26 – Relay Module (M4)

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

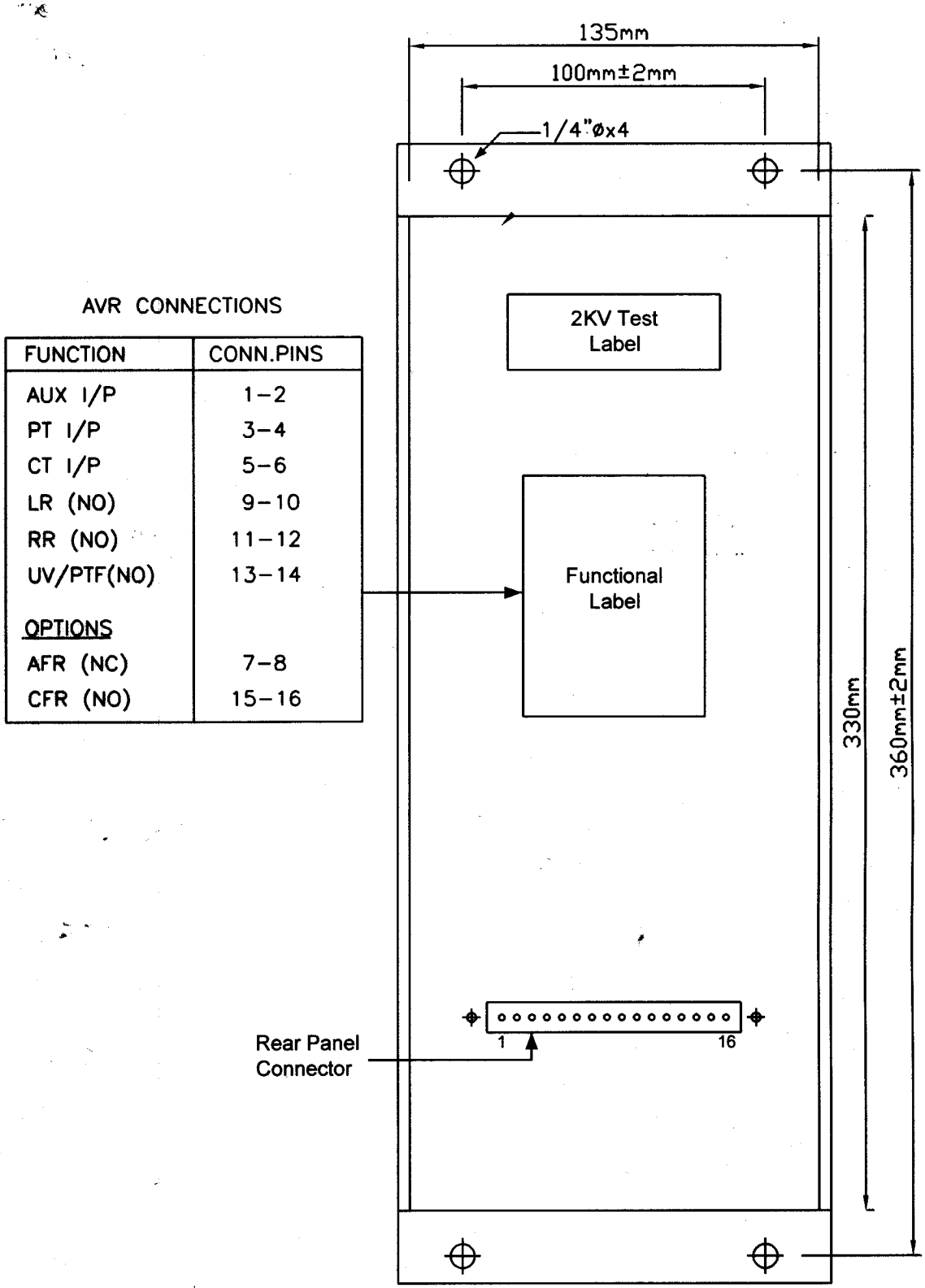
4			ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE		
3			PRODUCT :AVR (301-M)		EMCO ELECTRONICS
2			ASSEMBLY:-		TITLE : FRONT PANEL CONTROLS AND
1			MATERIAL :-	SCALE: N.T.S.	INDICATIONS
ISS.	DATE	APPR.BY	DRN. BY :J.J.P.	DATE :16-4-99	DRG. No. : 01-MD-29/ISS.1

DOC No. : DC00-405/ISS.1



4					ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE
3			PRODUCT : AVR (301−M)		EMCO ELECTRONICS
2			ASSEMBLY : −		TITLE : BLOCK DIAGRAM
1			MATERIAL : −	SCALE: N.T.S.	
ISS.	DATE	APPR.BY	DRN. BY : J.J.P.	DATE : 16−4−99	DRG. No. : 01−ED−25/ISS.1

DOC No.:DC00−405/ISS.1



AVR CONNECTIONS

FUNCTION	CONN.PINS
AUX I/P	1–2
PT I/P	3–4
CT I/P	5–6
LR (NO)	9–10
RR (NO)	11–12
UV/PTF(NO)	13–14
OPTIONS	
AFR (NC)	7–8
CFR (NO)	15–16

CUT–OUT DIMENSIONS : 330mm X 135mm

DEPTH : 260mm

MOUNTING HOLES DIMENSIONS : 360mm X 100mm ± 2mm (1/4"ø X 4)

					ALL DIMENSIONS ARE IN mm UNLESS STATED OTHERWISE
			PRODUCT : AVR (301-M)		EMCO ELECTRONICS
			ASSEMBLY:		TITLE : Rear Panel View
			MATERIAL :	SCALE: N.T.S.	
Iss	DATE	APPR.BY	DRN. BY : J.J.P.	DATE :	DRG. No. : 01-MD-30 / Iss. 2

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, electricai 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 then period for which the equipment was originaliy warranted and also the liability of **EMCO ELECTRONICS** to the purchaser shall not in any case, exceeds 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 note giving details of the purchase (Purchaser's Name. and address, invoice No. and Date of purchase) and details of the equipment failure. faults conditions, other useful information to faciliate early repair/rectification or the equipment.

Return of the equipment duly repaired can be arranged on payment of the packing and forwarding charges together with any cther taxes. duties, other miscellaneous expenses incurred, altematively the purchaser may arrange to collect the equipment from **EMCO ELECTRONICS.** In case the repairs are not covered under warranty, the charges tor 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.

CUT HERE & POST

To,
EMCO ELECTRONICS
106, Industrial Area,
Sion (East), Mumbai-400 022.
Tel. : 4096731 / 82

From : _____

FAULT REPORTING FORM FOR AVR EE301-M

Please fill this form when sending the faulty AVR / Module for repairs. This will help us to serve you better.

AVR Serial No. :_____ Supplied By :_____

Working Since :_____

Nature of problem :_____

_____

_____

Settings on AVR : L SET=_____R SET=_____NVA=_____TD=_____DPM Rdg. =_____

Check Auxillary & PT Fuses before proceeding.

Please observe the following on the faulty AVR & tick the appropriate box.

Put AVR in "TEST" Mode & vary the "TEST CONTROL" (TC.) Potentiometer.

	Yes	No
1. DPM rdg. varies with TC.	☐	☐
2. 'R' LED glows when DPM rdg.<R SET	☐	☐
3. 'RR' LED pulses after TD.	☐	☐
4. 'L' LED glows when DPM rdg.>L SET.	☐	☐
5. 'LR' LED pulses after TD.	☐	☐
6. 'UV' glows for UV condition.	☐	☐
7. ALL LEDs are off in Deadband condition.	☐	☐
Put AVR in 'NORMAL' Mode & check respective relay contacts.		
8. 'RR' contacts close & open for step 3.	☐	☐
9. 'LR' contacts close & open for step 5.	☐	☐
10 'UV' contacts close (& open when UV restored) for step 6.	☐	☐
11. Any of the LR / RR / UV contacts permanently closed.	☐	☐
12. All 4 LEDs on M1 Module ON.	☐	☐
13. T1D LED on M3 Module loggles ON/OFF for continuous LR/RR conditions.	☐	☐
*Note : Open bottom front plate to observe the LEDs.		
14. OPTIONS : LDC / CFR / AUXILIARY FAL operating properly.	☐	☐

15. Any other information :_____

_____

_____

_____

NAME OF TEST ENGINEER :_____ SIGN. :_____

DATE :_____

DOC No. : SR 01-401/ISS-1