Fax : (0522)-2452581
Telephone: (0522)-2465715
Telegram : 'RAILMANAK',LKO
Email:dell7@rdso.railnet.gov.in

सत्यमेव जयते

भारत सरकार – रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ – 226011
Government of India - Ministry of Railways
Research, Designs & Standards Organization,
LUCKNOW - 226011

No. EL/11.5.5/2 Dated: 15.12.2009

Chief Electrical Engineer,

1. Northern Railway, Baroda House, New Delhi – 110 001
2. East Central Railway, HQ Office, Hajipur (Bihar)-844 101
3. Central Railway, HQ office, 2nd floor, Parcel Office Bldg., Mumbai CST-400 001
4. South Central Railway, HQ office, Rail Nilayam, Secunderabad-500 371
5. West Central Railway, Opp. Indira Market, Jabalpur-482001
6. South East Central Railway, Bilaspur-495004

SPECIAL MAINTENANCE INSTRUCTION No. RDSO/2009/EL/SMI/0261 (Rev. '0'), Dtd. 15.12.2009

1.0 TITLE

Repairing and Testing of WRE modules of auxiliary converter for three phase electric locomotives.

2.0 Background

Railways have been reporting failures of WRE modules of auxiliary converter. The components which generally fail in WRE module are GTOs, Diodes and Gate Driver cards. As per investigation of the failed modules, following reasons have been attributed to the failure of above components:

- Looseness of crimping of power cable between knife contact and power devices.
- Dry soldering of opto-coupler and burden resistance in gate driver card.
- Mal functioning of optical transmitter (QFBR1478C).
- Looseness of stack of power devices.

Railways have been finding it difficult to check the defective components and repairing of WRE modules due to unavailability of any standard document in this regard.

3.0 Objective:

Identification of failed components in WRE module, repairing and testing of WRE module and assembly of WRE module. The scope is limited to replacement of GTO, free wheeling diode and Gate Drive Unit only of WRE module.

4.0 WRE module configuration:

Each auxiliary converter (BUR) consists of three nos. of WRE modules. The circuit diagram of WRE module is attached at **annexure-I**. WRE module consists of following items:

1) WRE Gate Drive Unit – For signal interfacing and GTO firing pulse generation.
2) Two numbers of GTOs (V_1 & V_2) in H-bridge configuration.
3) Free wheeling diode (V_3 & V_4) connected in anti parallel with each GTO.
4) Snubber circuits: R-C-D- snubber circuits with each GTO.
5) DC Current Transducer (DCCT): Hall Effect current sensor is there to measure output currents of each WRE module.
6) Knife contacts male: To connect the module in BUR power system.

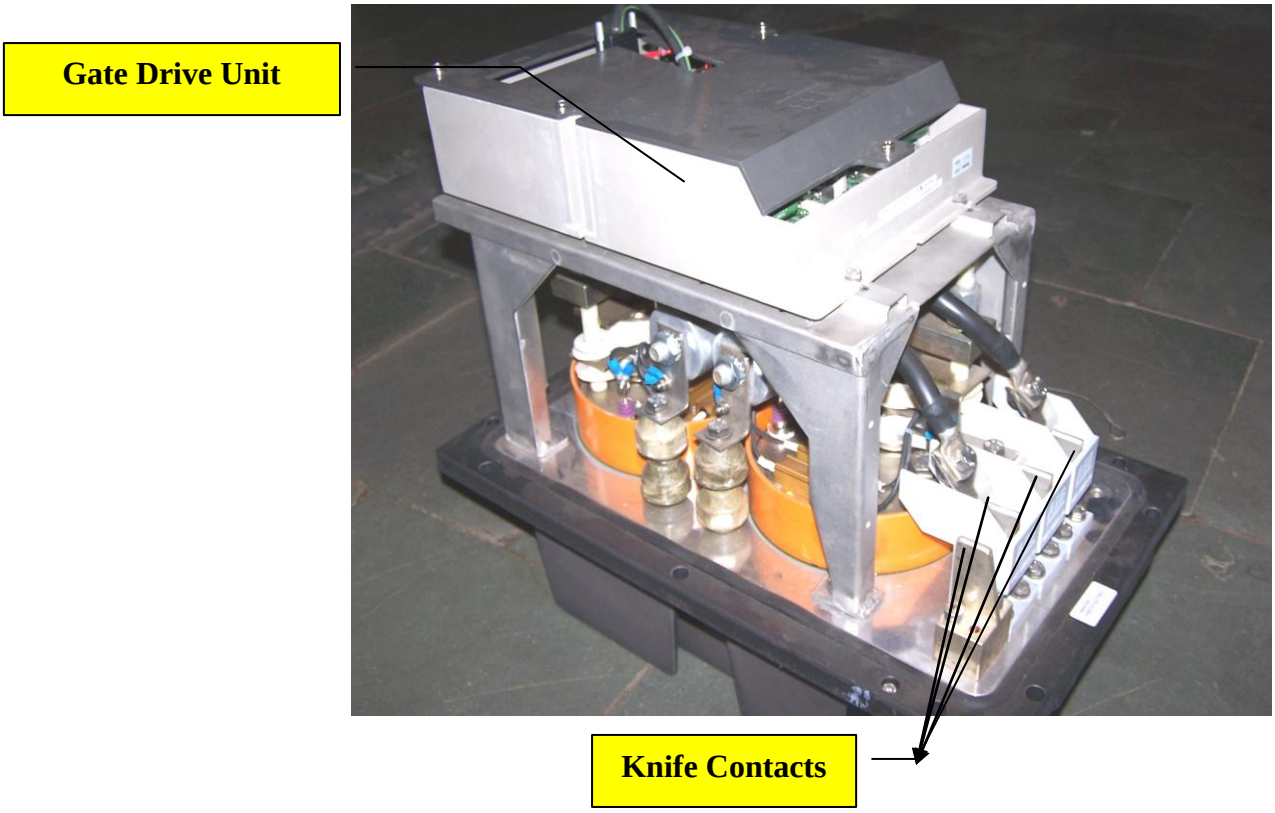

Figure: WRE module assembly

5.0 Testing of WRE module

The testing of WRE module includes: -

- Testing of GTO
- Testing of free wheeling diode
- Testing of Gate Drive Card

5.1 The following messages of DDS are helpful in identification of failed WRE module and based on symptom, action should be taken as given in following table:

Sl. No.	Problem Symptom in BUR	Action Identification of Module
1	Inverter fault	Identify module on the basis of DDS message or rack LED blinking status (F & G slot card).
2	Inverter Over current	- Identify module - Check the GTO & F/W diode (V3 & V4) of the failed module
3	O/P voltage unbalance / MCB 100 trip	- Identify module - Replace WRE gate driver card - Check healthiness of GTOs and diodes (F/W)

5.2 Testing of GTOs

In fully assembled condition* of WRE module

(i) Measure the resistance between G (+) & K (-) by multimeter in Resistance mode. Multimeter reading should initially vary from 100 ohm to 2 K ohms and finally go to out of limit (OL).

(ii) Measure the resistance between G (-) & K (+) by multimeter in Resistance mode. Multimeter reading should show out of limit (OL).

Above symptom shows healthiness of the GTOs. In case of faulty GTO (short); the reading shows low value fixed resistance (<2 ohm).

5.3 Testing of free wheeling diode

Put the diode on clean surface, press by hand** and measure the voltage drop between anode and cathode terminals by multimeter (Diode Mode). The diode drop value of healthy diode should be between 160 mV to 250 mV.

Note: * Free wheeling diodes and GTO's are connected in antiparallel. Hence in case of any of the device failed the resistance value or diodes drop value (diode mode) will show zero (short). Therefore it is required to identify faulty GTO first by the process described above. Thereafter open the WRE module and check GTO and Diode separately.

****** Diode & GTO of WRE module are press pack type. Therefore, in case of checking the healthiness separately of these, it is essential to press the device keeping it on a clean and smooth surface.

5.4 Testing of WRE gate unit card

Refers to Special Maintenance Instruction No. RDSO/2009/EL/SMI/0256 (Rev. '0') dated 19.05.09.

Note: Certain components used in WRE gate drive unit are sensitive to static electricity and can be damaged by its discharge. Therefore, care should be taken as per RDSO Technical Circular no. ELRS/TC/0091, Rev. '0', dated 16.02.2005, while handling WRE gate drive unit.

6.0 Repairing of WRE module

After identification of faulty component, replace the same and assemble the WRE modules as per procedure given in para 6.1 below. In WRE module, GTOs of M/s ABB (Type SSGA0645D0001), M/s Toshiba (Type SG600GXH26) and M/s Mitsubishi (Type FG600 EX-50) make and diodes of M/s ABB (Type DSD 625-25D) and M/s Westcode (Type SM 25 CXC 524 F7S) make are approved. These GTOs and diodes should be purchased from TOT partners only. It should be ensured that GTOs and diodes are replaced by same make only.

6.1 Assemble the WRE module as per following procedure: -

(Please refer to figures at annexure II & III)

(i) Replace the nylon stud (Part No. HIET430110P). These nylon studs should be purchased from TOT partners only.

(ii) Connect DC Current Transducer (DCCT) terminals carefully with respect to +/- 15V and midpoint M as indicated in drawing in annexure-I. (Upper part assembly)

(iii) Clean Heat sink island using wipe blue paper followed by degreaser liquid applied by brush and then by cotton after drying.

(iv) Anode of both GTOs (V1 & V2) will rest on heat sink. Diode (V3 & V4) polarities will be same as GTO, i.e. upside Cathode. A thin coat of silicon grease to be applied on device surfaces.

(v) The GTO and diodes are connected back to back. Ensure that the nut is tightened by ½ turn one by one on clamp till the height from island to yoke plate upper edge is 94.5 ± 0.5 mm. This measurement is to be done by using vernier calliper. This can also be cross checked by ensuring that spring column head and yoke plate are at same level.

(vi) Apply red mark on nut and bolt to show their tight location.

(vii) Ensure polarities of GTO and Diode (V1, V2, V3 and V4) before mounting them.

(viii) Check Snubber circuit (V11, V21, C11, C21, R11, R12, R21 and R22) connection and ensure proper fixing of terminals during assembly of lower part.

(ix) Connect X25 connection for CT carefully.

6.2 Following shall be ensured before finalising the assembly of Inverter module: - (Refers to ABB drg. No. HIET402987 at annexure-I)

(i) Heat sink is free from crack on surface or body damages.

(ii) Care is taken while securing the cables; it does not get damaged in service.

(iii) Polarity of GTO and diodes checked prior to assembly as per drawing.

(iv) Gate and cathode connections of GTO to gate circuit are as per drawing.

(v) Snubber circuit R&C is connected as per drawing.

(vi) Cable connections are tight.

(vii) Earthing knife contact is provided.

(viii) Male contacts are plated and fully tight.

(ix) Male contact numbers are marked in line with drawing.

(x) All busbars are properly plated and connected as per drawing.

(xi) All hardwares screw (M6 and above) are red marked in fully tightening condition.

(xii) Stainless steel captive type mounting hardware is provided.

(xiii) Labels for device reference are provided as per drawing.

(xiv) Module is provided with serial number.

7.0 No load testing of assembled WRE module

No-load testing at low voltage shall be done to ensure proper GTO turn on / turn off.

7.1 Set up and test equipments requirement for no load testing.

a. System cable (X20) - 37 pin sub-D connector.
b. DC supply 20V to 100V (2 Amp).
c. Resistance 200 Ω, 300 watt.
d. CRO probe 10:1.
e. Dual channel CRO
f. Change over switch
g. Electronics rack with Bur test EPROM (3EHE424488)
h. Electronic rack measurement card (XB B699A01) in E slot.

7.2 Connection diagram: For connection set up, please refer to annexure-IV.

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7.3 Procedure:

With this test set up any one GTO can be tested at a time with selection switch

Selection	Knife Contact	V_{DC} Supply (20 to 100 volts)
Upper GTO	3	+ through resistor
	4	- Common
Lower GTO	4	+ through resistor
	2	- Common

Connect CRO probe to knife contacts between 3 & 4 or 4 & 2, upper and lower GTO turn on / turn off can be observed. It should be square pulse with peak at supply voltage.

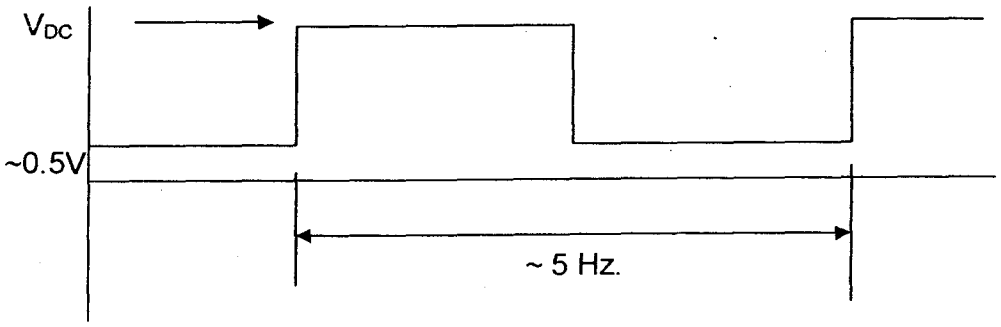


Figure: GTO anode-cathode voltage

8.0 Application to:

WAP5, WAP7, WAG9 and WAG9H 3-phase electric locomotives.

9.0 Agency of implementation:

All sheds holding WAP5, WAP7, WAG9 and WAG9H 3-phase electric locomotives.

15/12/05
(Sandeep Srivastava)
for Director General /Elect

DA: As above

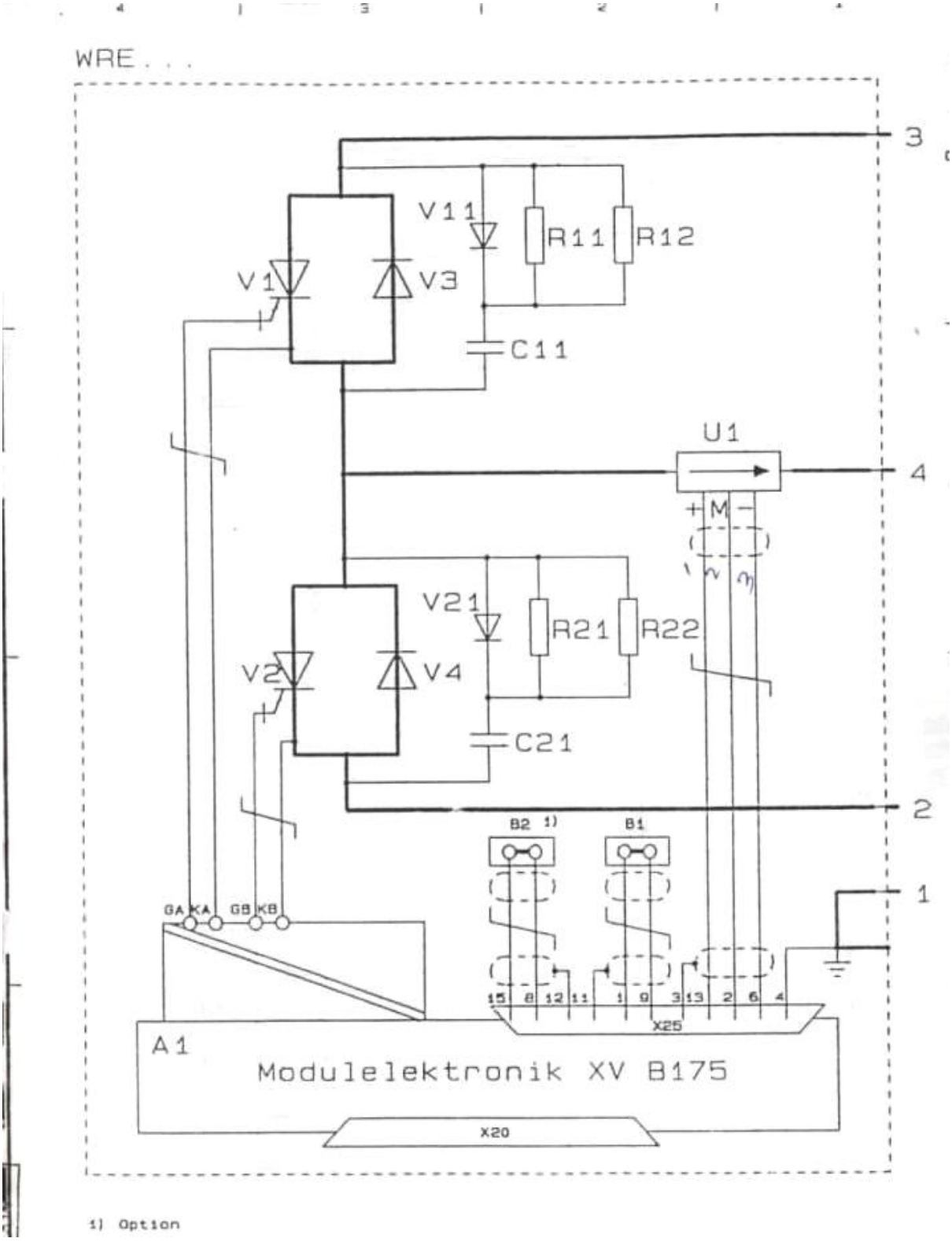
Copy to:

1. Secretary (Elec. Engg./RS), Railway Board, Rail Bhawan, New Delhi-110 001
2. Chief Works Manager, Electric Loco Workshop, Central Railway, Bhusawal
3. Sr. DEE (TRS), Electric Loco Shed, East Central Railway, Gomoh-828 401
4. Sr. DEE (RS), Electric Locc Shed, Northern Railway, Ghaziabad-201 001
5. Sr. DEE (TRS), Electric Loco Shed, Central Railway, Ajni, Nagpur-440 008
6. Sr. DEE (TRS), Electric Loco Shed, South Central Rly., Lallaguda, Secunderabad
7. Sr. DEE (TRS), Electric Loco Shed, West Central Railway, Tuglakabad, New Delhi
8. Sr. DEE (TRS), Electric Loco Shed, South East Central Rly., Bhilai, Durg-490 025

15/12/05
(Sandeep Srivastava)
for Director General/Elect.

Encl: As above.

O/C


WRE . . .
3
V11
R11
R12
V1
V3
C11
U1
4
+ M −
V21
R21
R22
V2
V4
C21
2
B2 1)
B1
1
GA KA GB KB
15 8 12 11 1 9 3 13 2 6 4
X25
A1
Modulelektronik XV B175
X20

1) Option

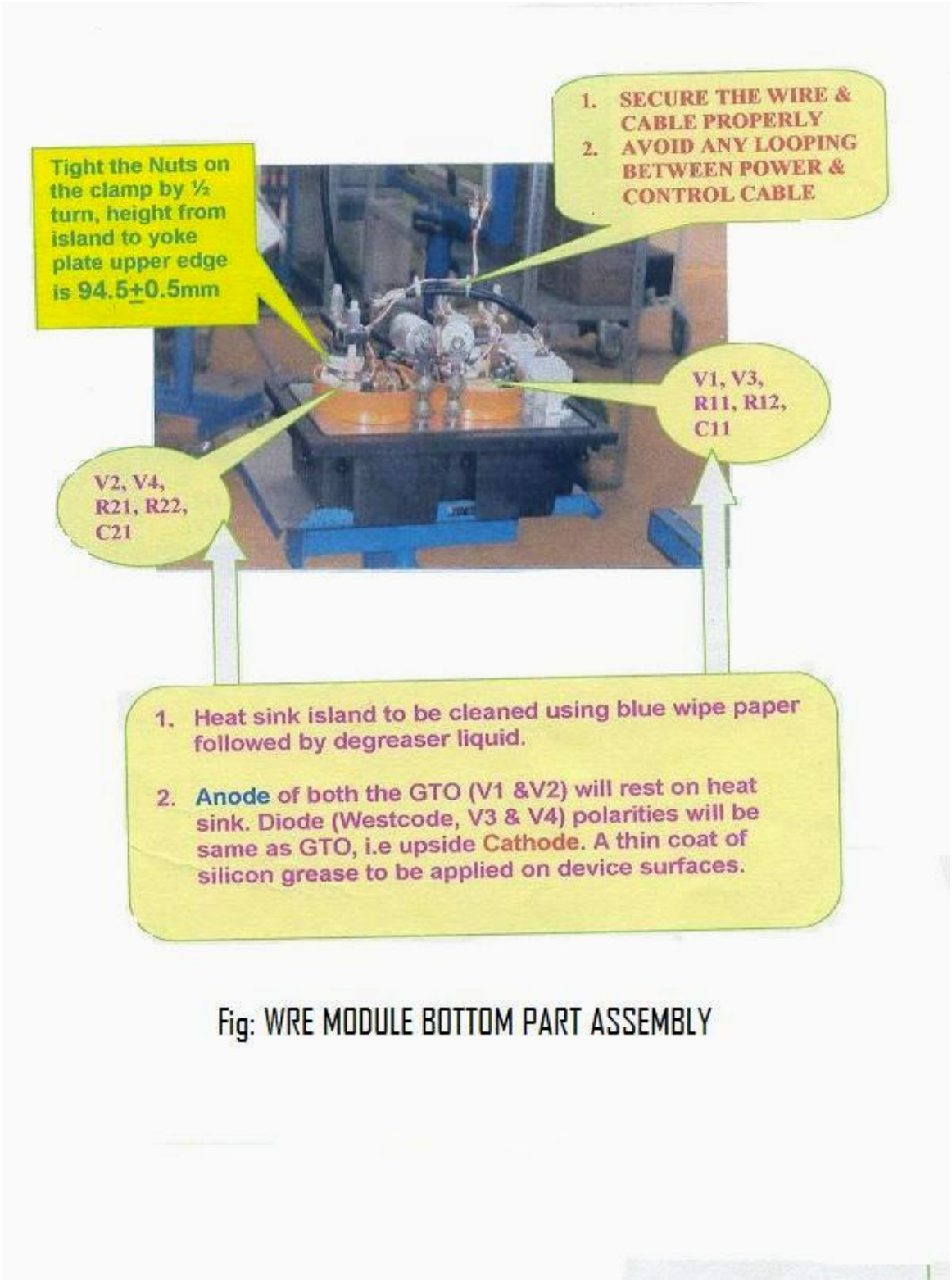


Fig: WRE MODULE BOTTOM PART ASSEMBLY

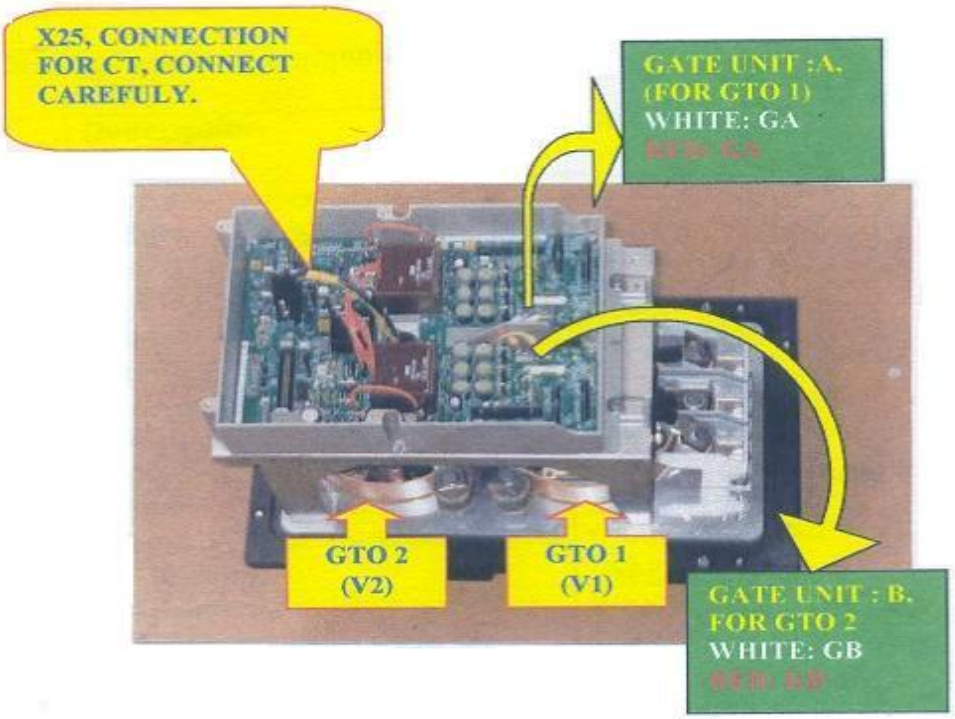
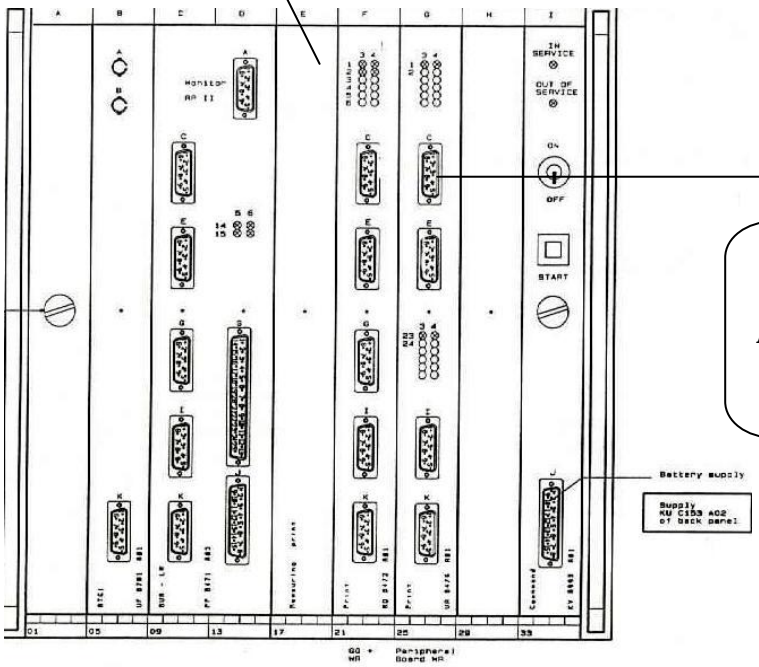


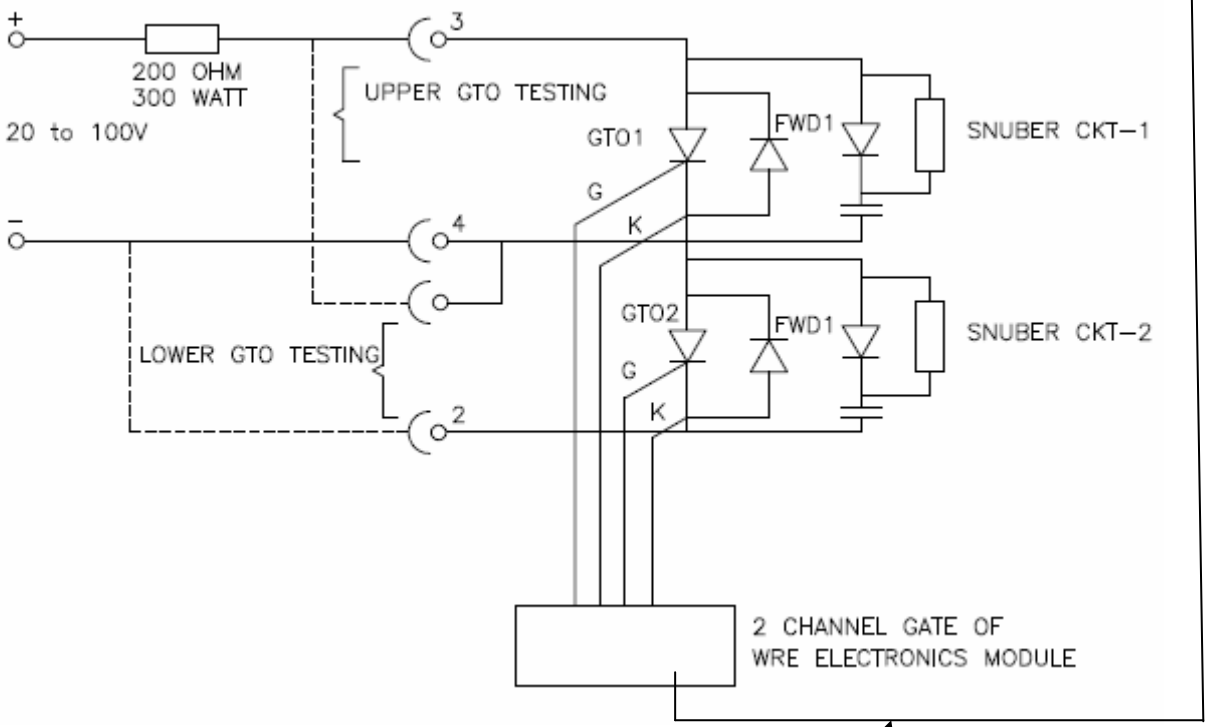
Fig: WRE MODULE UPPER PART ASSEMBLY

Put Measurement card (XB B699A01) in E slot



Cable X20 of WRE module Any of following locations: F/E, G/C, G/E

Enable WRE pulse by interconnecting 1a30 to 2c16 of Measurement card



Connect WRE module X20 Connector (37Pin Sub-d)