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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/3.1.35/17

Date: 11/09/2018

**Chief Electrical Engineer,**

- Central Railway, HQs Office, 2<sup>nd</sup> floor, Parcel Office Bldg., Mumbai-400 001
- East Central Railway, Hajipur (Bihar)-844 101
- Eastern Railway, Fairlie Place, Kolkata – 700 001
- East Coast Railway, Railway Complex, Bhuvneshwar – 751 023
- Northern Railway, Baroda House, New Delhi-110 001
- North Central Railway, Allahabad – 211 001
- South East Central Railway, Bilaspur-495 004
- South Central Railway, HQs Office, Rail Nilayam, Secunderabad-500 071
- South Eastern Railway, Garden Reach, Kolkata- 700 043
- Southern Railway, Park Town, Chennai – 600 003
- West Central Railway, HQs Office, Opp. Indira Market, Jabalpur-482 001
- Western Railway, Churchgate, Mumbai – 4000 020
- Chittaranjan Locomotive Works, Chittaranjan- 713 331 (W.B.)

**MODIFICATION SHEET NO. RDSO/2018/EL/MS/0473, REV-0 DATED 11/09/2018**

**1.0 Title:**

Conversion of GTO based locomotive into IGBT based 3-phase electric locomotives.

**2.0 Object:**

Railways imported 22 WAG9 locomotives and 11 WAP5 locomotives from M/s. ABB, Switzerland in 1997-98. Later on, CLW started manufacturing these locomotives by procuring Power Converter, Auxiliary Converter & Control Electronics from ABB, Switzerland. These equipments were subsequently indigenized by M/s. BTIL, M/s. NELCO (Now M/s CGL), and M/s. BHEL through ToT to Indian manufacturers (IR received Technology from M/s. ABB, Switzerland).



The Traction Converter and Auxiliary Converter provided in these locomotives were based on Gate Turn-Off Thyristor (GTO) and Control Electronics was based on ABB's Proprietary MICAS-S2 based communication Protocol.

Due to obsolescence of GTO, Thyristors and the inherent technological advantages of Insulated Gate Bipolar Transistors (IGBTs), Indian Railway has introduced IGBT based propulsion system in 3-phase electrical locomotives.

CLW has developed the indigenous design of TCN based VCU as per IEC 61375 through Centre for Development of Advanced Computing (C-DAC)/TVC. These VCUs have been offered to manufacturers on basis of Transfer of Technology (ToT) to manufactures and supply to IR.

Presently, procurement of IGBT based traction propulsion equipments is being done by CLW and other production units in the form of set comprising Traction Converter & Auxiliary Converter with TCN based VCU.

Vide Railway Board letter no. 2009/Elect(TRS)/720/1 Pt.2 dated 18/11/2015, Indian Railway has decided to change the locomotives fitted with GTO based propulsion system into IGBT based propulsion system during Mid-Term Rehabilitation. This Modification Sheet entails the requirements of conversion of GTO based locomotive into IGBT based 3-phase electric locomotives.

### **3.0 Replacement of GTO based Traction Converter**

The mechanical, control and power interface of the IGBT based traction converter are in general backward compatible with GTO based. However, certain modifications mandated due to inherent requirements of the new technology.

#### **3.1 Control Cables**

All the control cables used in GTO locomotives with their connectors shall be retained. Only change is in the speed sensor cable configuration and their connectors. The speed sensor cable configuration shall be as per CLW letter no. C-D&D/T/25 dated 19.03.18 (Annexure-1).





### 3.2 Speed Sensor

Active type/Weigand speed sensors are used in GTO bases converter. The speed sensor signal configuration in the IGBT traction converters is different. Therefore, the existing speed sensor to be removed and speed sensor supplied with the IGBT traction converter shall be used.

### 3.3 Sensor Plate

Due to change in the connectors of the speed sensors, the layout of the sensor plate has changed. Therefore, the existing sensor plate to be removed and new sensor plate as per CLW drg. no. CLW/es/3/sk-2/0153 Rev-04 dated 10.04.2013 (**Annexure-2**) shall be used.

### 3.4 TFP to Traction Converter connection

There is no change in the TFP terminal to traction converter connection in M/s BHEL, BTIPL and CGL make converters. However, M/s Medha and M/s ABB supply their own flexible link for connection with the TFP.

### 3.5 Traction Converter oil Pump removal

In the GTO based traction converter oil cooling system is being used for cooling of valve sets, whereas IGBT based traction converter is water cooled. The existing oil cooling pump shall be removed and same power cable shall be used for water cooling pump fitted in IGBT based traction converter.

### 3.6 Traction Converter to Traction Motor connection

In GTO based locomotive there is bogie control system whereas in IGBT based locomotives individual axle control system is being used. Therefore, cable connection of traction motor in IGBT based traction converter is different. The traction motor connection with 120 sq mm shall be followed as per **annexure-4**. The make wise detail of cable length shall be follows as below:

Traction motor no.	BHEL	CGL	BTPIL	Medha	ABB
TM-1,6	9.0 mtr	9.0 mtr	9.0 mtr	9.0 mtr	9.5 mtr
TM-2,5	7.0 mtr	7.0 mtr	7.0 mtr	7.0 mtr	7.5 mtr
TM-3,4	5.5 mtr	5.5 mtr	5.5 mtr	5.5 mtr	6.0 mtr





The cable connection at the traction converter side shall be as per clause no 4.2.17 of RDSO specification no. RDSO/2008/EL/ SPEC/0071, Rev-05.

### **3.7 MCB for coolant pump operation**

The oil cooling pump used in GTO based traction converter is of 11KW power rating while in IGBT based traction converter small pump of 1.5 to 2.0 KW is used for circulating water coolant. Hence MCB provided in HB panel for oil cooling pump of GTO based converter is to be replaced with 6.3-10 Amp rating MCB with provision of different settings for protection of cooling pump/fan.

### **3.8 Traction Converter to Traction Converter connection**

There is a nine core cable which connects both the traction converters to share the information of GTO/IGBT firing instances. Except, M/s ABB all the make converter use the same 9 core cable. Only M/s ABB use Optical Fibre Cable (OFC) for this purpose which shall be supplied by the firm.

### **3.9 Radiator Cleaning**

Existing GTO based traction converter is oil cooled and the oil is circulated in the radiator fitted in Oil Cooling Unit (OCU). Existing cooling radiator shall be retained for cooling the IGBT based traction converter. As the IGBT traction converter is water cooled, thorough cleaning of the radiator shall be required. Cleaning of cooling radiator shall be done as per clause no. 4.0 of SMI no. RDSO/2018/EL/SMI/0325 dated 11/09/2018 issued by RDSO.

### **4.0 Ballast**

Due to reduction of the weight of converters, the loco weight of WAG-9/9H has been maintained by using extra ballast weight. Therefore, the existing ballast shall be removed and ballast as per **annexure-3** shall be fitted in WAG9/9H. No ballast weight shall be used in WAP-5 and WAP-7.

### **5.0 Replacement of GTO based BUR**

The mechanical, control and power interface of the IGBT auxiliary converter are backward compatible with GTO based auxiliary converter. Therefore, GTO based





auxiliary converter shall be removed and IGBT based auxiliary converter shall be installed without any change.

## 6.0 Replacement of MICAS VCU

The mechanical, control and power interface of the TCN VCU are backward compatible with MICAS VCU. Therefore, MICAS VCU shall be removed and TCN VCU shall be installed without any change.

## 7.0 Interconnection of Converters and VCU

The interconnection topology as in existing GTO locomotive shall be retained. It is shown in fig-1 below:

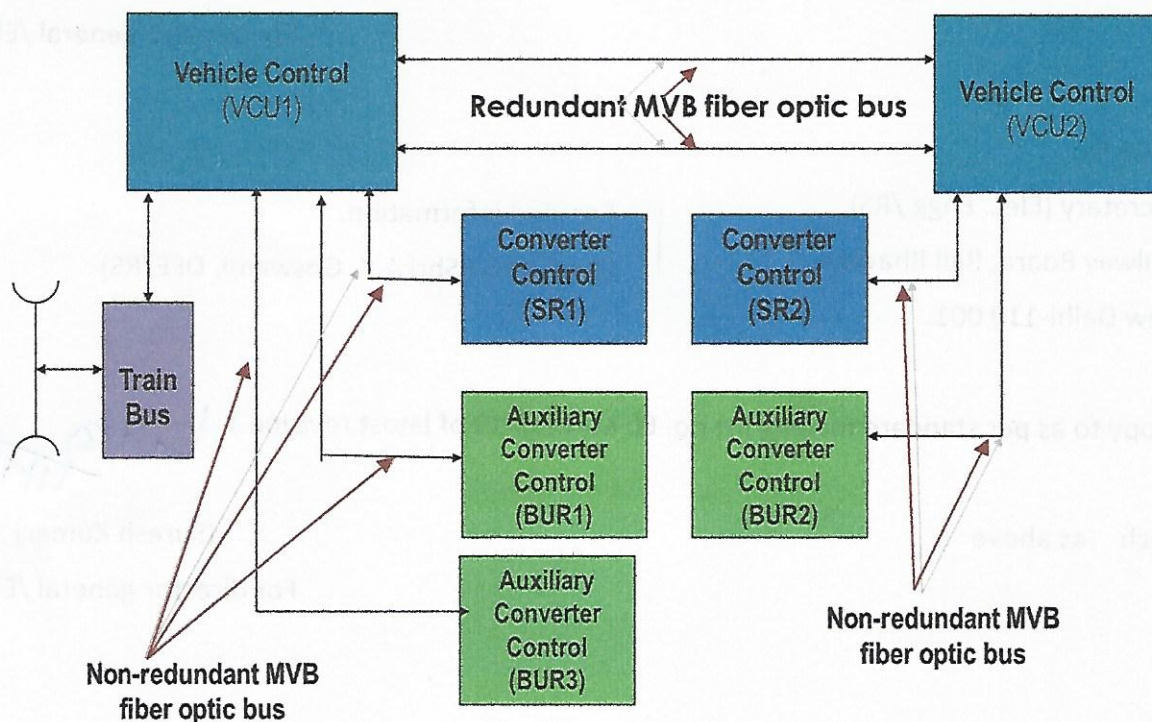


Fig-1: Interconnection of different units

## 8.0 Application to class of locomotives

WAP-5/WAP-7/WAG-9/WAG-9H three phase electric Locomotives.

## 9.0 Material required

Propulsion system and it's accessories as per RDSO specification no. RDSO/2008/EL/SPEC/0071, Rev-05

*Handwritten signature*

## 10.0 Material rendered surplus

- a. One locoset GTO based traction and auxiliary converter and MICS VCU
- b. Six numbers speed sensors and
- c. Two numbers traction converter oil cooling pumps.

## 11.0 Agency of implementation:

All workshops undertaking mid-term rehabilitation of three phase electric locomotives.

  
(Suresh Kumar)

DSE-TPS

For director general /Elect

Encl: as above

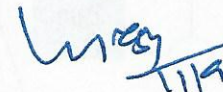
### Copy to:

Secretary (Elec. Engg./RS),  
Railway Board, Rail Bhawan,  
New Delhi-110 001.

For kind information.

(Kind Attn.: Shri A.K. Goswami, DEE/RS)

(Copy to as per standard mailing list no. EL-M-4.2.3-19 of latest revision.)

  
11/9/18

Encl: as above

(Suresh Kumar)

For director general /Elect



**INDIAN RAILWAYS**  
**CENTRE FOR DESIGN & DEVELOPMENT**  
**CHITTARANJAN LOCOMOTIVE WORKS**  
 PO: Chittaranjan, West Bengal. PIN: 713331  
 Fax: (+91) 341-2526153. Ph: (+91) 341-2525550



No.C-D&amp;D/T/25

Date: 19.03.2018

M/s. Bombardier Transportation India Private Ltd., ERDA Road, Maneja, Vadodara- 390 013. Fax: 0265-2649688, 2649669, 2640249, 0341-2532623, Ph.-0265-2637297, 2648763.

M/s. BHEL, Electronics Division, PB 2606, Mysore Road, Bangalore – 560 026, Ph: 080-6998622, Fax: 080 - 26989217

M/s. Compton Greaves Limited, CG House, 6th floor, Dr.Anniebesant Road, Worli, Mumbai – 400 030, Ph – 022-6739 9228/2768 1880, Fax – 022-27686797 / 033-22121520,09223903249 (Mobile), Email: sanjay.ostwal@cgglobal.com

M/s M/s.ABB Ltd.Survey No.88/3-4, Basavanahalli,Kasaba Hobli,Nelamangala Taluk,Bangalore Fax – 080 – 22946560.

M/s Medha Servo Drives Pvt. Ltd., P-4/5B,I.D.A.Nacharam, Hyderabad – 500 076, Ph – 040-27264144, Fax – 040-27174908/27260005.

Dear Sir(s)

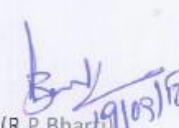
**Sub: Revised Connection details for active Speed Sensor with IGBT based Traction Converter.****Ref: i) CLW's specification no. CLW/ES/3/IGBT/0486 Alt.E.**

ii) RDSO specification no. RDSO/2008/EL/SPEC/0071 Rev.5.

- 1.0 IR has modified the clause of active speed sensor in the specification under reference (i) and (ii) above to standardized the same among the different supplier of IGBT based traction converter. In this regard the pin connection for the active speed sensor has also been modified.
- 2.0 Connection details for Speed Sensor with 3-Pin circular connector for power supply and 5-Pin circular connector for sensor signal with IGBT based Traction Converter is attached herewith.

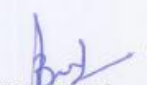
DA: As above.

Thanking you,

  
 (R.P. Bharti)  
 Dy.CEE/D&D.

Copy to:

Dy.CEE/EL/CLW - For kind information and necessary action please.

  
 (R.P. Bharti)  
 Dy.CEE/D&D.

**Pin connection for active speed sensor of IGBT based Traction Converter**

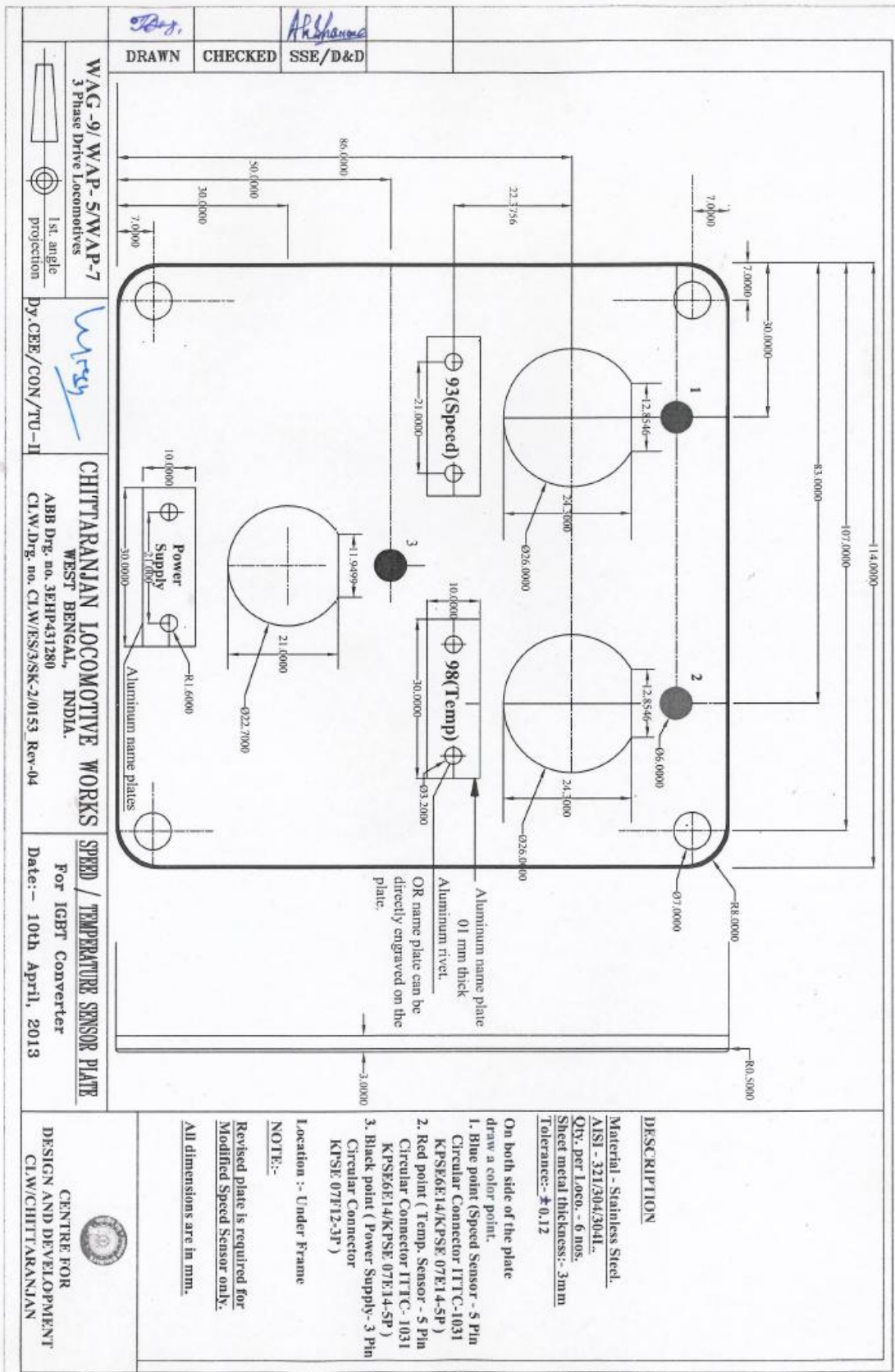
Pin Layout for power Supply connector			Circular connector (3 pin)	Sub-D pin connection at converter end.
Motor 1	A	10 --- 30 V	Pin A	HA/1- Pin 6
	B	Negative	Pin B	HA/1- Pin 7
Motor 2	A	10 --- 30 V	Pin A	HC/1- Pin 6
	B	Negative	Pin B	HC/1- Pin 7
Motor 3	A	10 --- 30 V	Pin A	HE/1- Pin 6
	B	Negative	Pin B	HE/1- Pin 7
Pin Layout for speed sensor signals			Circular connector (5 pin)	Sub-D pin connection at converter end.
Motor 1	A	Signal	Pin A	HA/2- Pin 6
	B	Signal	Pin B	HA/2- Pin 7
	C	Signal	Pin C	HA/2- Pin 3
	D	Signal	Pin D	HA/2- Pin 4
Motor 2	A	Signal	Pin A	HC/2- Pin 6
	B	Signal	Pin B	HC/2- Pin 7
	C	Signal	Pin C	HC/2- Pin 3
	D	Signal	Pin D	HC/2- Pin 4
Motor 3	A	Signal	Pin A	HE/2- Pin 6
	B	Signal	Pin B	HE/2- Pin 7
	C	Signal	Pin C	HE/2- Pin 3
	D	Signal	Pin D	HE/2- Pin 4

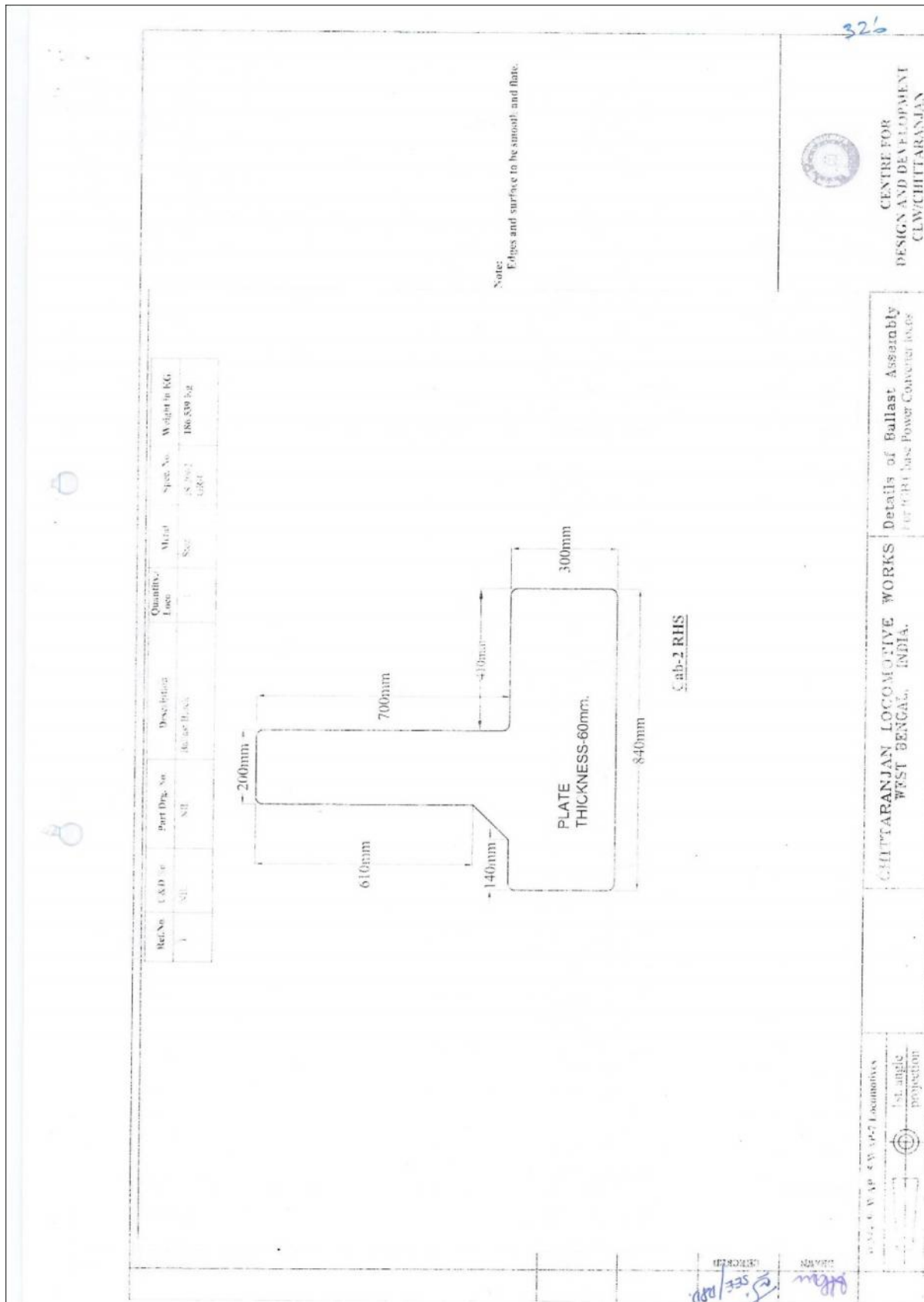
*AS*

वीरेंद्र अनुभाग अभियंता,  
वि.रे.का./चितरंजन  
Sr. Section Engr. (D & D)  
CLW/Chittaranjan

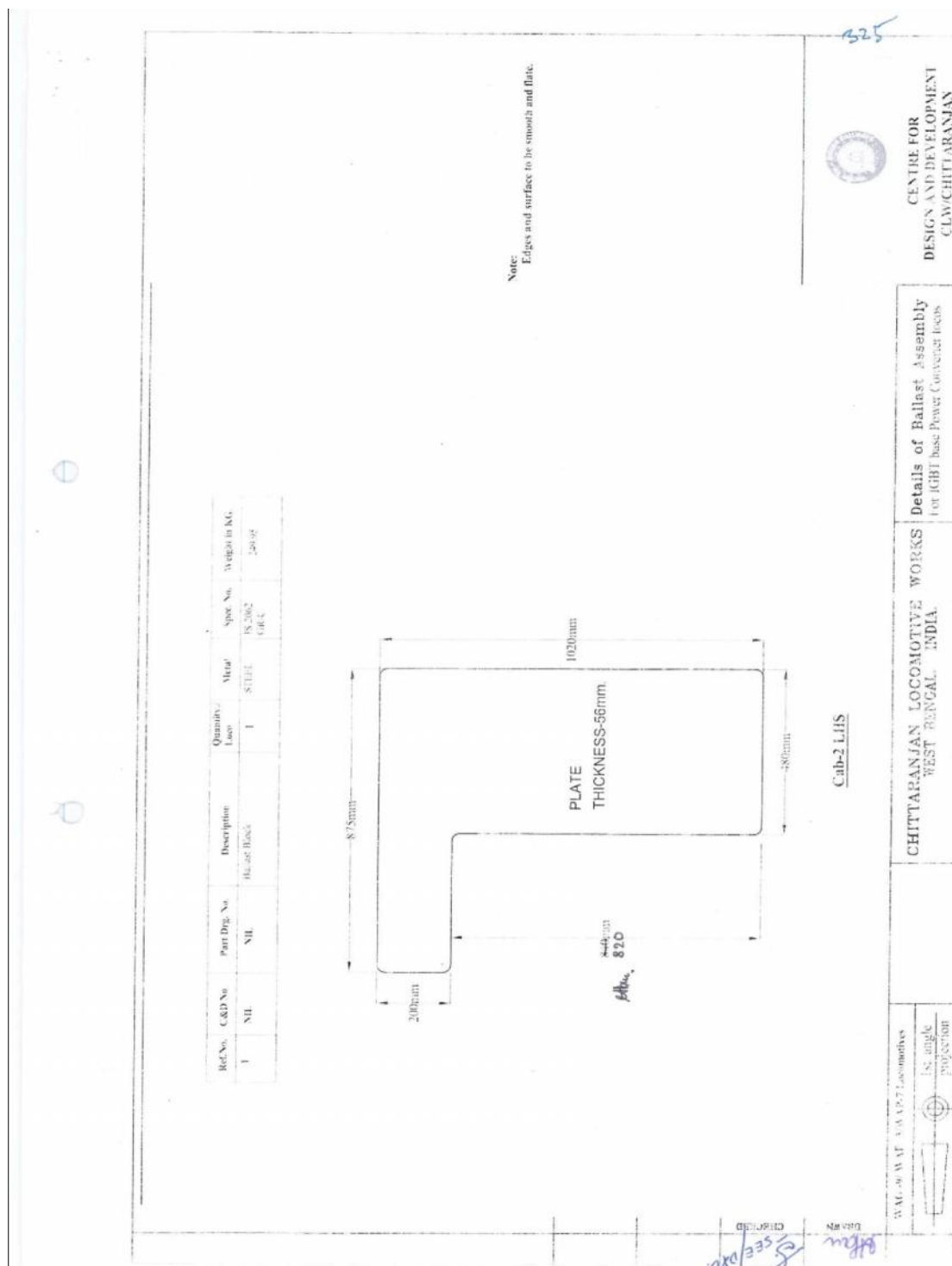
स. वि. अभि. / एण्ड डी.  
AEE/D&D  
अभि. एवं वि. केन्द्र / C - D&D  
वि.रे.का./चितरंजन / CLW/Chittaranjan











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CENTRE FOR  
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CLW CHITTARANJAN

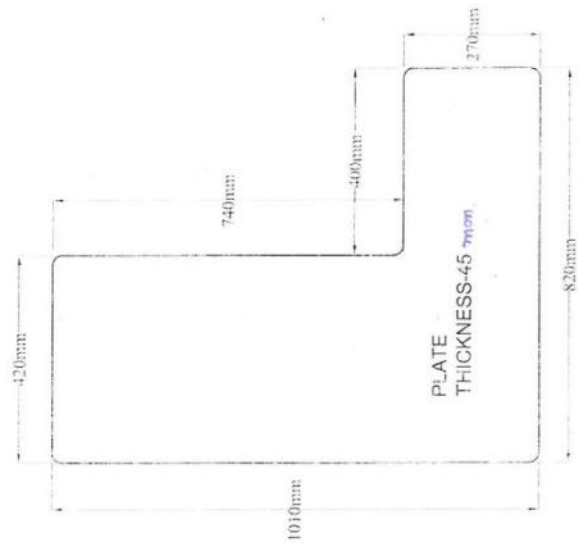
Details of Ballast Assembly  
For IGBT base Power Converter loco

CHITTARANJAN LOCOMOTIVE WORKS  
WEST BENGAL, INDIA.

W.C. & W.P. SWAP/loc. motives

1st angle  
projection

Ref. No.	C&D No.	Part Dwg. No.	Description	Quantity Loco	Material	Spec. No.	Weight in Kg.
1	NIL	NIL	Ballast Bench	1	SS-304	IS 2062 CR-C	187.99 Kg

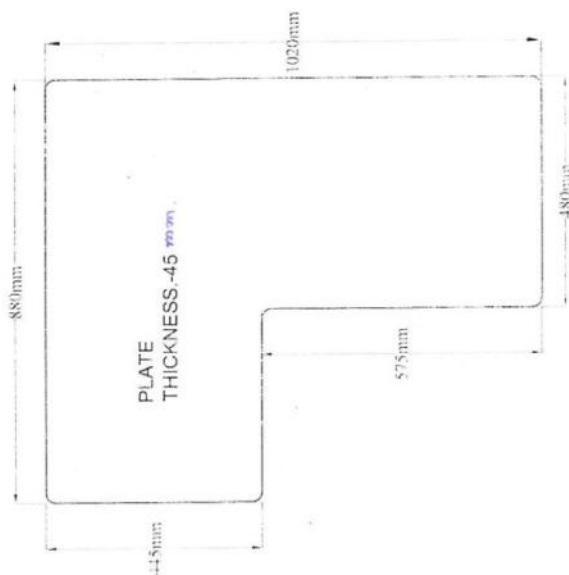


Note:  
Edges and surface to be smooth and flat.

APPROVED  
SSE/APD



Ref. No.	C & D No.	Part Drg. No.	Description	Quantity/ Lot	Metal	Spec. No.	Weight in Kgs.
1	NIL	NIL	Bullseye Base	1	Steel	IS-2062 GR-C	238.82 kg



**Note:**  
Edges and surface to be smooth and flat.

Cub-1\_LHS

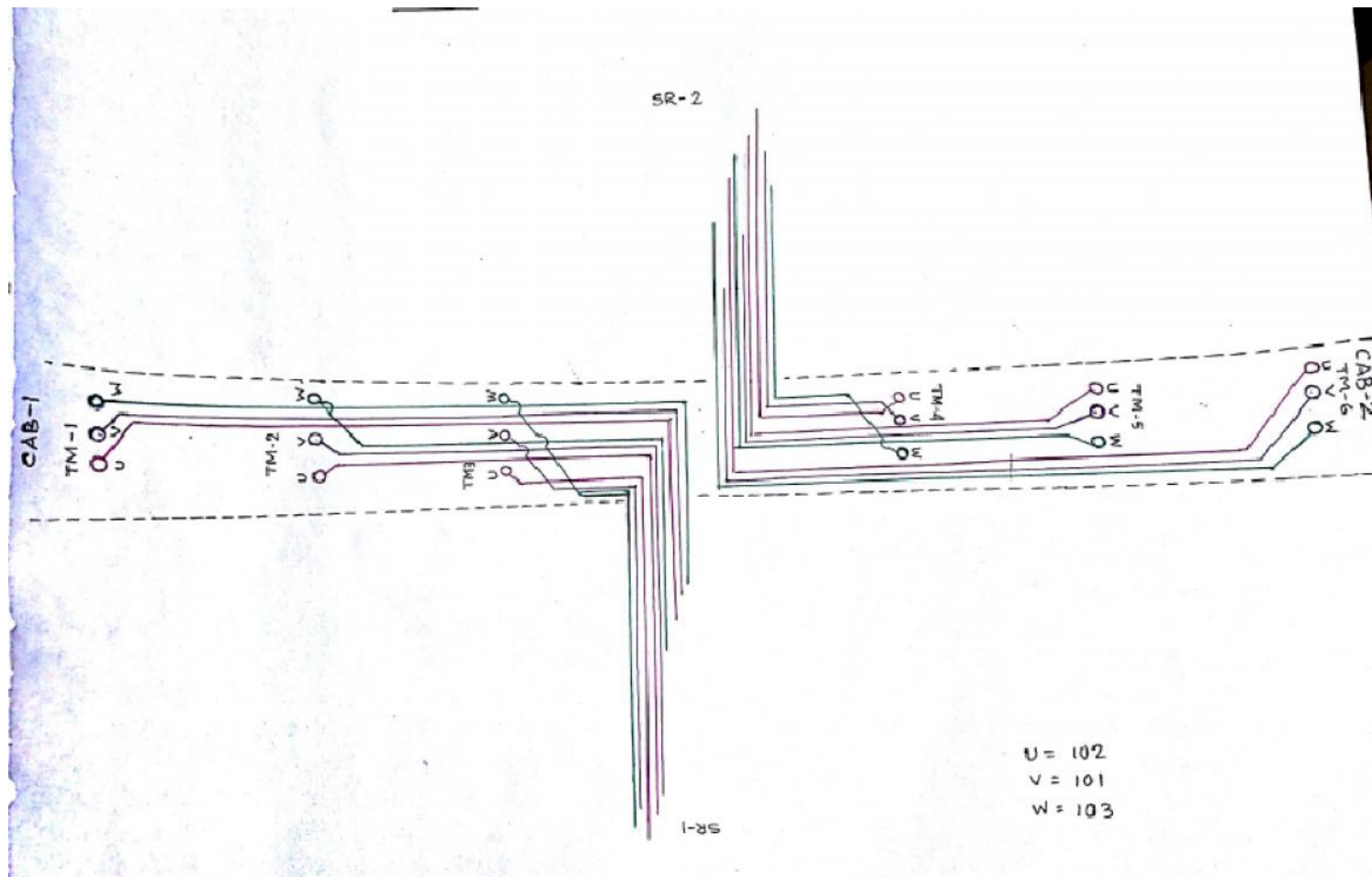
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CLW/CHITTARANJAN

### Details of Ballast Assembly For IGBT base Power Converter locos

CHITTARANJAN LOCOMOTIVE WORKS  
WEST BENGAL, INDIA

W. A. J. VAN DER WAALP, Locomotives

1st angle projection

**Cable layout for IGBT Traction Converter of ABB,BHEL and CGL**



# Cable layout for IGBT Traction Converter of Medha and BTPIL

