

Specification No. : ICF/ELEC/172  
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**SPECIFICATION FOR 750 VA, 110V DC/415V AC  
NATURAL COOLED INVERTER FOR  
WATER RAISING PUMP LOAD IN TRAINSET COACHES.**

**ISSUED BY**

**INTEGRAL COACH FACTORY, CHENNAI - 38**

CORRECTION SLIP No.	-	CS-01				
REVISION No.	00	00				
PREPARED BY	RFB AEE/D	SRK SSE/D				
VERIFIED BY	JM Dy.CEE/D-II	RFB AEE/D				
APPROVED BY	PKC CDE/Elec	BR Dy.CEE/D-II				
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#### 1.0 SCOPE:

- This specification covers the design, construction, performance, testing, supply and commissioning of three phase on board natural cooled static Isolated Inverter unit suitable for Input voltage 110 VDC (nominal) varying from 84 V DC to 140 V DC with 5 % ripple content and producing a pure sine wave output of 415 VAC  $\pm$  5% at frequency 50  $\pm$  3% Hz to feed the supply to water raising pump of 0.375 KW.
- Inverter shall be DSP based with high frequency, double conversion technology. IGBT semiconductors shall be used as power devices in the output Inverter stage. Each power stage and its associated control electronics is preferred on a single board to reduce the risk of loose wiring connections caused by vibrations. Galvanic Isolation between input and output is considered essential.
- Total one number Inverter is to be provided in each coach to operate water raising pump. The Inverter shall be so designed that it shall be able to take the instantaneous starting load of water raising pump of 0.375 KW.
- The Inverter shall be capable to operate at any load between no load to full load for any duration and shall be suitable for operating voltage available i.e. 84 VDC to 140VDC with 5% ripple contents.

#### 2.0 SCOPE OF SUPPLY:

The scope of supply of inverter shall be as under:

- Isolated Inverter along with LED indicators suitable for on-board mounting along with input/output mating connectors - 1 set per coach.

#### 3.0 SERVICE CONDITIONS:

The equipment shall be sturdy and suitable for the following service conditions normally to be met in service in Indian Railways:

Ambient	5 °C to 55 °C
Train speed	160Kmph (upgradable to 200 kmph)
Humidity	upto 98% during rainy season
Altitude	Max 1000 m above sea level
Vibration & shocks	Shall be tested as per IEC 61373

#### 4.0 GOVERNING SPECIFICATIONS:

IEC-60571	Rules for electronics equipment used on rail vehicles; General requirements and tests for electronic equipment.
IEC-61287-1	Edition 3.0 2014-07 Railway applications - Power converters installed

		
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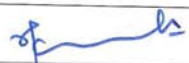


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IEC 61000	on board rolling stock- Part 1: Characteristics and test methods.
RDSO Spec.No. ELRS/SPEC/SI/0015-Oct. 2001	EMC/EMI compatibility test Reliability of Electronics used in rolling stock applications
IS: 2026 (Part-2)-1977	Power transformer : Temperature rise
IS: 13730 (Pt.13)-1993	Specification for winding wires
IS: 1573-86	Specification for electroplating coating of zinc on iron and steel
ELRS/SPEC/ELC/0019 Rev.1	Specification for E-beam cables with copper conductor (only from the RDSO approved vendors)
IEC 60068	Specification for Environmental testing.
IEC 61373	Railway applications - rolling stock equipment shock and vibration test
IEC 62236-3-2	Railway applications Electro-magnetic compatibility part 3-2: rolling stock apparatus

**Note:** Latest version of IS/IEC shall be followed.

#### 5.0 TECHNICAL PARAMETERS:

SN	Description	Technical features
a	Input voltage Min/max	84V to 140 V DC with 5% ripple.
b	Short term rating	200 % for 5 sec and shall be suitable to withstand for DOL starting current of water raising pump of 0.375 KW
c	Nominal input	110V DC
d	Output	3 phase 415 V AC (LINE to LINE) $\pm 5\%$ , 50Hz $\pm 3\%$ for input voltage range of 84 to 140V DC from no load to full load.
e	Rated capacity	0.75 KVA at 0.67 PF (0.5 KW)
f	Connected load	water raising pump of 0.375 KW.
g	Wave form	Pure Sine wave, THD voltage not exceeding 5%
h	Cooling	Natural air cooled.
i	Efficiency at 90V DC	Greater than 80% at full kVA
j	Protection	IP 54.
k	Indications (LED type)	<ul style="list-style-type: none"> <li>Input DC 'ON' ( Amber LED)</li> <li>Output 'ON' ( Green LED)</li> <li>Inverter fault (RED LED)</li> </ul>
l	Special feature	Soft start feature shall be adopted.
m	Over Voltage	Shall be able to withstand 200 VDC for two minutes
n	Weight	Not to exceed 20 kg
o	Protection requirement	As per clause 7.0
p	Mounting	On-board mounting( Inside End wall).
q	Inverter status signal	110V DC output signal for TCMS

		
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## 6.0 CONSTRUCTIONAL REQUIREMENTS:

- 6.1 The Material of enclosure shall be fabricated from 1.6 mm thick SS304 grade stainless-steel sheet.
- 6.2 (i) The overall dimensions of the inverter unit shall be not more than 350(W)x215(H)x150(D) mm, however lesser dimensions shall be preferred. Exact dimension shall be derived in consultation with ICF duly considering the space availability in the endwall area inside the coach.  
(ii) The tenderer shall submit the drawings for the inverter unit duly furnishing the dimensional and weight details for approval.
- 6.3 Inverter shall employ IGBT as power device of adequate rating and the thermal margin of the device shall be of minimum 25 degree C less than the junction temperature over the declared value by the manufacturer.
- 6.4 Potential free Heat sinks shall be provided for dissipation of heat from the power components. The heat sinks should be so located as to reject heat outside directly. The heat sink shall be designed for natural ventilation. For better heat rejection, the heat sink shall be black anodized or extruded aluminium. It shall be possible to attend /replace the components from front side.
- 6.5 Fasteners used in the inverter shall be of stainless steel material.
- 6.6 All the wiring inside the equipment shall be done with e-beam cable to RDSO specification ELRS/SPEC/ELC/0019 (latest).
- 6.7 The components and assembly of the unit shall conform to RDSO's reliability Specification ELRS/SPEC SI/0015 OCT. 2001.
- 6.8 Two earthing boss to SS304 grade shall be provided diagonally on top and bottom half side of the Inverter with M-6 tapping with Stainless steel hardware set.
- 6.9 Inverter shall be capable of withstanding Direct Online Loading (DOL) inrush starting current of water raising pump of 0.375 KW.
- 6.10 The PCB used shall be of glass epoxy, with thickness not less than 1.6mm. The current carrying paths (tracks) shall be tinned copper. Finished PCB shall be treated with transparent conformal coating and the rating of all the components shall be clearly visible.
- 6.11 Hylam PCBs are not acceptable since the Insulation level reduces drastically in rainy season. Use of silicon coated wire wound resistors and metal film resistors are recommended for high reliability. Heat dissipating high wattage resistors or components shall not be mounted close to control PCB. The workmanship shall be highest grade and due care shall be taken for every item. All the components used shall be of Industrial grade or better.
- 6.12 It shall be possible to change the operational and protection parameters by attaching a external interface unit on the main card. The firm shall be responsible to observe the

		
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operational/protection parameters during initial run in field, unit shall accordingly change/modify the set values for satisfactory performance in coaches.

#### 7.0 **PROTECTION REQUIREMENTS:**

The inverter shall be provided with following protection functions.

- Protection against Ingress of dust and Ingress of water IP54
- Input over voltage set (trip at 145 VDC and recovery at 140 VDC)
- Input under voltage set (trip at 82 VDC and recovery at 90 VDC)
- Output short circuit protection preferably with IGBT pulse block.
- Overload protection.
- Polarity reversal at input side.
- Over temp. of power semiconductor devices.
- It should be protected from input surge voltage.
- Capability to withstand Input of 200V DC for two minutes without any damage to any part of the Inverter.
- After removal of intermittent fault in above cases, the inverter should start on its own.

#### 8.0 **TESTS:**

All type & Routine Tests shall be conducted as per IEC 61287 & IEC60571 including test for withstanding high outrush current and environmental tests. Test Protocol shall be submitted for approval from ICF before commencement of testing. Material will be accepted on WTC also in case of any contingency from ICF.



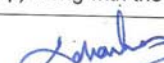
#### 9.0 **INFRASTRUCTURE FOR QUALITY ASSURANCE:**

Infrastructure facilities for quality assurance as per STR(Schedule of technical Requirements) No. RDSO/PE/STR/AC/0013-2004 Rev. '0' dt. 1.11.2004 are considered. Firm shall submit the above details along with the offer and firms having facilities as per this STR shall only be considered.

#### 10.0 **INFORMATION TO BE SUBMITTED BY TENDERER:**

The tenderer must submit the following information with the offer in printed form and neatly compiled in a booklet form. Offer with incomplete information may not be considered.

- a) Detailed specification of the offered Inverter, transformer (if any), Inductor, input fuses, input MCB and data sheets of components used.
- b) Details of protections provided and their effectiveness /proposed set values, range and working principle.
- c) Details of semiconductor devices used and their specification and data sheets.
- d) Circuit diagrams along with bill of material and circuit description and working principle.
- e) Safety margins in voltage, current, thermal (for junction temp) along with the limit values for

		
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power devices, Inductors and transformer (if any).

f) Drawings and details of dimensions, mounting arrangement and weight.

g) Detailed description /explanation of circuit adopted and its salient advantages.

**11.0 MARKING:**

The inverter shall be marked with the following information:

- Name of the manufacturer.
- Type.
- S.No, month and year of manufacture.
- Rated input voltage range.
- Nominal voltage.
- Frequency.
- Rated output at nominal voltage.
- Rated output current at nominal voltage.

**12.0 GUARANTEE:**

Each unit shall be guaranteed against manufacturing defects, for its satisfactory performance for a period of 24 months from the date of commissioning or 36 months from date of supply whichever is earlier. Any design defect, defective material, under rated component used etc., have to be corrected and merely replacement of defective parts will not be considered adequate. Complete investigation report of each defect/failure shall be submitted to ICF for each case. In case of repeated failures, necessary changes in design on the units put in service or in production line are to be made by the manufacturers. Investigation tests, if considered necessary, are to be arranged /conducted by the manufacturer. The Inverter shall be successfully commissioned at ICF as well as user Railways.

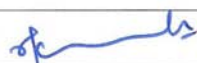


**13.0 SPARES AND MAINTENANCE MANUAL:**

A list of spares required for maintenance, if required, shall be submitted with the offer in printing form and neatly compiled in a booklet form. The operating and maintenance manual giving instructions for Installation, maintenance and circuit diagram with voltages at salient points to locate faults, list of components with brief specifications and suppliers etc. trouble shooting and testing procedure after repair shall be supplied. In addition to above, working principle, precautions to be taken, fault diagnostic up to component level, component testing before its fitment, component handling etc. shall be Included In the maintenance manual. The original numbers on ICs, transistors, and other components shall not be erased or painted. Moulded blocks with hybrid circuits are not acceptable.

**14.0 SERVICE ENGINEERS:**

The successful tenderer shall be required to make availability of service engineers free of cost to watch performance of the equipment in service periodically and also carryout necessary repairs or replacements under warranty obligations. The performance of equipment and warrantee cases attended by them shall be submitted to ICF in quarterly report.

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**CORRECTION SLIP NO. 01 TO ICF SPECIFICATION NO. ICF/ELEC/172**

**A. Clause 1.0 (b) may be read as under:**

Inverter shall be DSP based with high frequency, double conversion technology. IGBT/SiC MOSFET semiconductors shall be used as power devices in the output Inverter stage. Each power stage and its associated control electronics is preferred on a single board to reduce the risk of loose wiring connections caused by vibrations. Galvanic Isolation between input and output is considered essential.



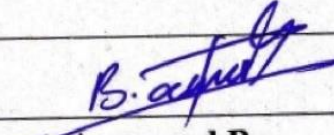
**B. Clause 6.3 may be read as under:**

Inverter shall employ IGBT/SiC MOSFET as power device of adequate rating and the thermal margin of the device shall be of minimum 25 degree C less than the junction temperature over the declared value by the manufacturer.

**C. "Output short circuit protection preferably with IGBT pulse block" under "PROTECTION REQUIREMENTS" of Clause 7 may be read as:**

Output short circuit protection preferably with IGBT/SiC MOSFET.

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