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**PURCHASE SPECIFICATION FOR
PRECHARGE RESISTOR
GROUP: TRACTION ENGINEERING**

P.S NO. : PS4452543

REV. NO: 02

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REVISION HISTORY SHEET

REV. NO.	DATE	NATURE OF CHANGE	REASONS	PREPARED BY	APPROVED BY
00	22.12.2015	FIRST ISSUE	--	PURUSHOTTAMA	R.SHEKAR
01	06.01.2016	RESISTOR MATERIAL CHANGE	As per Existing Material	PURUSHOTTAMA	R.SHEKAR
02	12.03.2018	Clarification note on Testing	--	PURUSHOTTAMA	R.SHEKAR

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Note:

Reference document :
Material Code :

REVISIONS 02 DT: 12.03.2018

APPROVED BY: R.SHEKAR

PREPARED BY:

Purushottama Rao

ISSUED BY

TRACTION ENGG

DATE

12.03.2018

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SPECIFICATION FOR PRECHARGE RESISTOR

Brief description

The pre-charge resistor is used to pre-charge the HV-capacitors before closing the main contactor. The charge resistor is designed to charge a short circuited DC-link capacitor 2 times in one minute.

Detailed Specification

1. Technical Parameters

- | | | | |
|----|--|---|---------------------------|
| a) | Nominal Resistance Value at 20°C (1-2) | : | 50Ω ± 10% |
| b) | Maximum common mode Voltage | : | AC 3500V |
| c) | Maximum Voltage | : | AC 1650 V |
| d) | Rated Voltage | : | AC 1500V |
| d) | Insulation Test Voltage | : | AC 6900V/50Hz/1min |
| e) | Continuous Power Rating | : | 20KW_s |
| f) | Maximum Peak Current | : | 47 A |
| g) | Worst case load cycle | : | 150KW_s |

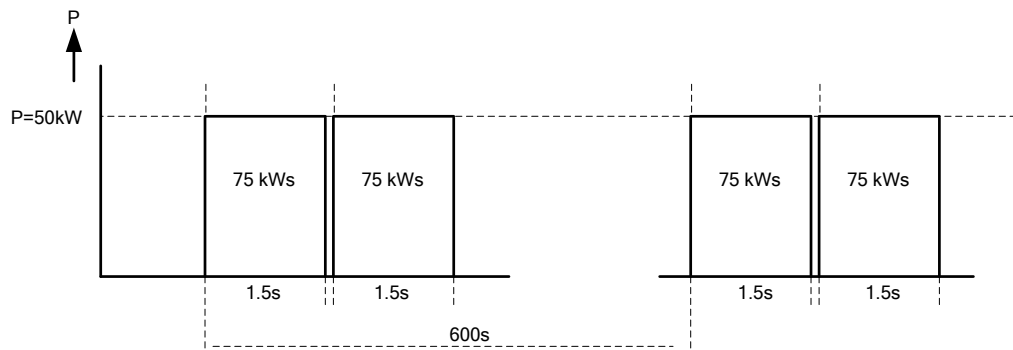


Fig1: Duty Cycle

Note: Change of duty cycle for the temperature rise test keeping energy dissipation constant is allowed with prior approval from BHEL



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The charge resistor to be designed to charge a short circuited DC-link capacitor 2 times in one minute After 2 pulses there's a cooling down time of 10 minutes

h)	Maximum Temperature of the Resistive Material:	250°C
i)	Minimum Creeping Distance	: 75 mm
j)	Minimum Air Clearance	: 40 mm
k)	Cooling	: Natural Convection
l)	Inductance	: ≤ 1000μH
m)	Degree of Protection	: IP 20
n)	Total Weight of the Resistor	: 12 Kg ± 10%
o)	Thermal Capacity	: 870 J/K
p)	Thermal Resistance	: 0.150 K/W
q)	Cooling Time Constant	: 720 s
r)	Material of Resistor Element	: Constantan (Ni- 45% Cu-55%)
s)	Material of Enclosure	: AISI 304 (1.4301)
t)	Over Voltage Category	: OV2
u)	Degree of Pollution	: PD4
v)	Earth Connection	: Yes



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2. Standards

Standard	Description	Notes
EN50125-1	Environmental conditions	
EN50124-1	Railway applications Isolation co-ordination, Basic requirements.	
IEC60077	Electric equipment for rolling stock	
IEC61287	Power converters	
IEC61376	Creepage and clearance	
IEC61373	Shock and vibration test	
IEC60322	Rules for ohmic resistors	

3. Functional requirements

Description	Value	Unit	Notes
operating hours traction converter	8640	hours/year	
operating hours resistor	≤ 7300	hours/year	normal operation

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4. Ambient conditions / operating conditions

Description	Value	Unit	Notes
operation	-25..+75	°C	
temperature distribution over the year	+75	°C	10 days/year
	+65	°C	20 days/year
	+55	°C	90 days/year
	+40	°C	100 days/year
	< +40	°C	130 days/year
storage	-25..+70	°C	
average year temperature	+ 40	°C	
relative humidity	< 95	%	during app 3 - 4 months (rainy season) per year frequent condensation can occur
altitude	<1200	m	
pollution levels			
operation in coastal areas			
maximum PH	8.5		of water damp
max. concentration of sulphate	7	mg/liter	of water damp
max. concentration of chlorine	6	mg/liter	of water damp
maximum conductivity	130	μS/cm	of water damp
operation in desert terrain			
dust content in air	1.6	mg/m3	

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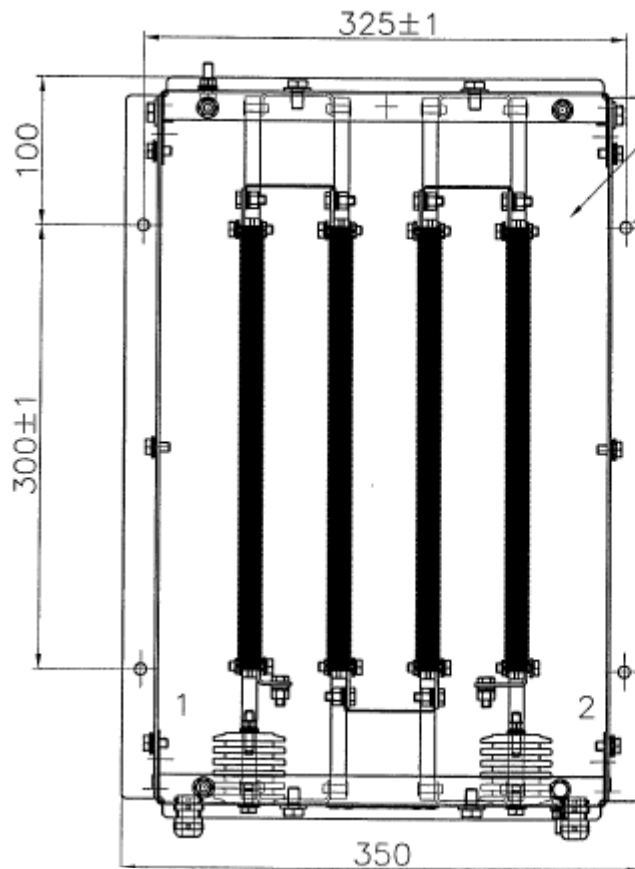
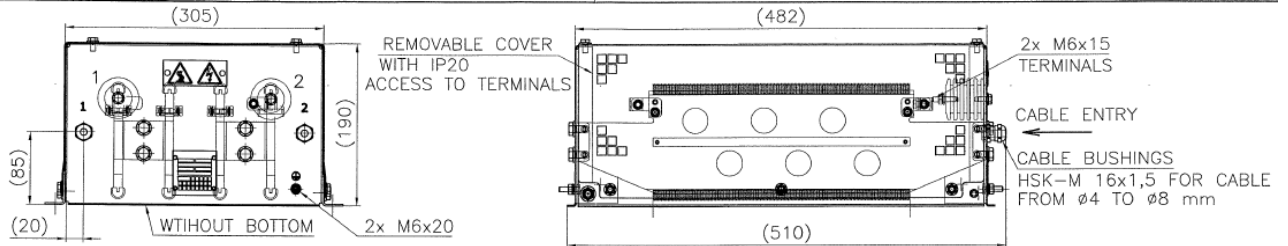
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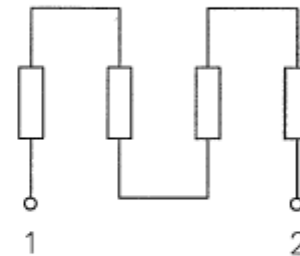
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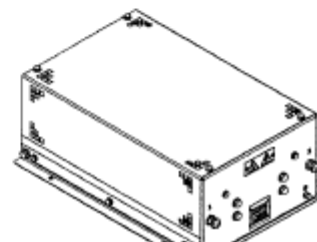
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ASSEMBLY HOLES

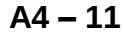
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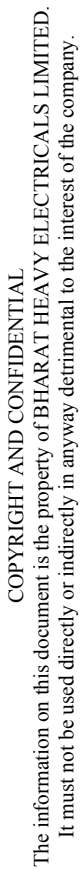
50 Ω ±10 %



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6. Testing: Type tests required for prototype when developed for the first time

Sl No	Test	Acceptance criteria
1	Dimensional check	Dimensions to comply with the drawing
2	Check on creepage and clearance distances	Min. creepage 75mm and clearance 40 mm
3	Check on rating label	Rating plate to have Make, Type no, Rated voltage, Rated Resistance, Sl no, year of manufacture and weight
4	Check on Ingress protection	The enclosure is IP 20 that means the cover protects against the incursion of foreign objects and is also used as a protection against accidental touch
5	Check on weight	12 Kg $\pm$ 10%.
6	Measurement of Resistance	
6.1	Measurement of cold Resistance before temperature rise test	50 Ω $\pm$ 5% i.e. within range of 47.5 Ω -52.5 Ω at an ambient temperature of 20 Deg.
6.2	Measurement of cold Resistance after temperature rise test	Readings should not differ from the first values Indicated in clause 6.1 by more than 3%.
7	Check on Inductance	$\leq$ 2000 μ H
8	Dielectric test (Ref: 60077)	Carried out between the connection and earth terminals of the resistor with a voltage of AC 6900 V/ with a frequency of 50 Hz, for a period of 1 minute. No disruptive discharge or breakdown occurred during the test
9	Insulation resistance test	The measurement to be carried out with 1000 V megger tester connected across terminals and frame of the resistor. Required minimum value: 5 M Ω
10	Temperature Rise Test: Repeated duty cycles (Refer Page 1) (Corrected for Ambient Temp of 75 Deg)	Max temp of Active Material $\leq$ 250 Deg Max temp of the connection terminals $\leq$ 115 Deg Max Air temp 200mm above the resistor $\leq$ 110 Deg
11	Vibration and shock withstand test ^{A)}	To be done as per the standard IEC 61373. No visual damage and no change in resistance value should occur. Also the specimen has to pass insulation test.

A) Visual inspection, Di electric test needs, measurement of cold resistance to be performed before and after the test.

B) Critical hot spot points needs to be identified before the test to monitor and record the temperature during the test.

Note:

i) All the above tests are to be conducted on the proto type developed.

ii) Tests under Clause 1(only mounting pitch and outer envelope dimensions), Clause 3, Clause 6.1, Clause 8 and Clause 9 are sufficient to be conducted on the resistors manufactured after prototype.