



A4-12

**PURCHASE SPECIFICATION**  
**GROUP: TRACTION ENGINEERING**

P.S NO.: PS/445/2467

REV. NO: 00

PAGE 00 of 06

**SPECIFICATION FOR 550uF SINE WAVE FILTER CAPACITOR**

**REVISION HISTORY SHEET**

REV. NO.	DATE	NATURE OF CHANGE	REASONS	PREPARED BY	APPROVED BY
00	01.02.2023	First Issue		Girish Chand	Devanand V

REVISIONS

00

APPROVED BY

Devanand V

PREPARED BY

Girish Chand

ISSUED BY

TRACTION ENGG.

DATE

01.02.2023



A4 – 10

PURCHASE SPECIFICATION  
GROUP: TRACTION ENGINEERING

P.S NO.: PS/445/2467

REV. NO: 00

PAGE 01 of 06

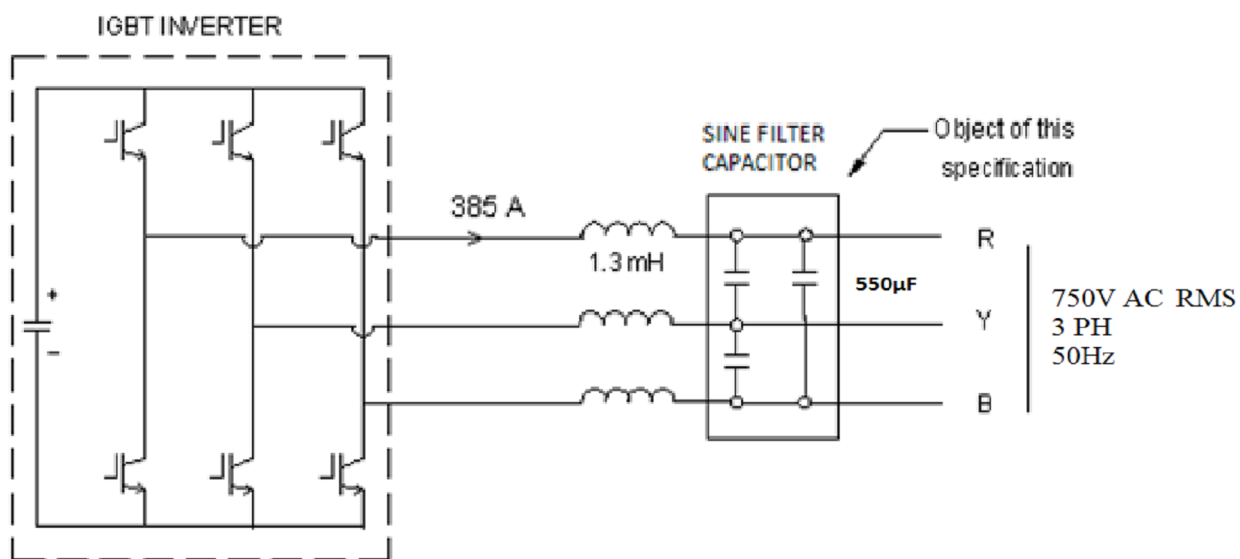
**SPECIFICATION FOR 550 $\mu$ F SINE WAVE FILTER CAPACITOR**

**1.0 Introduction**

This document covers specification of a Sine wave filter capacitor, to be used at the output of an IGBT based inverter. The capacitor will be mounted in a cabinet/enclosure and will be used in traction applications for on board mounting.

**2.0 Functional requirements:**

The proposed capacitor will be connected in DELTA mode as shown in the block diagram shown below.



IGBT Switching Frequency: 450H to 1200Hz  
Fundamental Output Frequency: 50Hz

REVISIONS

00

APPROVED BY

K. Venkateshalu

PREPARED BY

ISSUED BY

DATE

Lakshmi Narayana K

TRACTION ENGG.

10.08.2012

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

## PURCHASE SPECIFICATION

GROUP: TRACTION ENGINEERING

P.S NO.: PS/445/2467

REV. NO: 00

PAGE : 02 of 06

### SPECIFICATION FOR 550 $\mu$ F SINEWAVE FILTER CAPACITOR

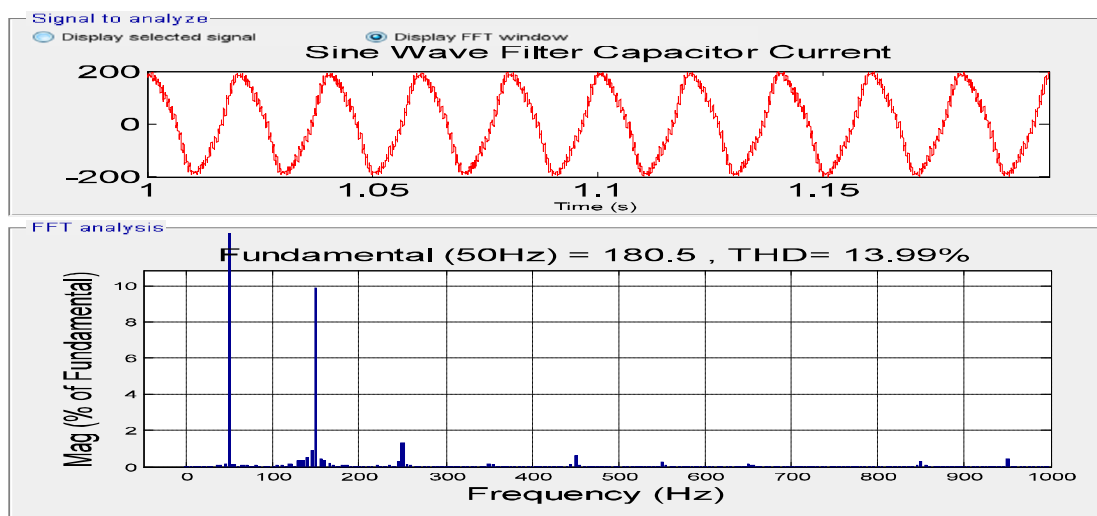
#### 3.0 Electrical requirements:

##### 3.1 Capacitance :

- 3.1.1 Nominal capacitance: 550 $\mu$ F each phase
- 3.1.2 Tolerance limit: +5%.
- 3.1.3 Connections : Capacitors will be formed in DELTA for 3 Phase application

##### 3.2 Current:

- 3.2.1 Maximum current (rms) : 130 rms Amps
- 3.2.2 Peak to peak current : 184 Amps
- 3.2.3 Current Harmonic : Simulated results are tabulated below



Harmonic Order	1	2	3	5	7	8	9	11	13	15	17	19
Peak Value	180.5	0.06	17.76	2.24	0.32	0.03	1.10	0.46	0.31	0.42	0.55	0.74

#### 3.3 Voltage :

Maximum voltage: 750VRMS, +/- 5%

#### 3.4 Frequency :

- 3.4.1 Frequency (nominal): 50 Hz.
- 3.4.2 Switching frequency: 450 Hz to 1200Hz..

#### 3.5 Cooling Type:

Natural air cooling

#### 4.0 Temperature class :

- Maximum operating temperature (qmax) : 70°C
- Minimum operating temperature (qmin) : -10°C



A4 – 11

## PURCHASE SPECIFICATION

### GROUP: TRACTION ENGINEERING

P.S NO.: PS/445/2467

REV. NO: 00

PAGE : 03 of 06

#### SPECIFICATION FOR 550uF SINEWAVE FILTER CAPACITOR

##### 5.0 Tests to be conducted at supplier's workspace.

##### 5.1 Routine Tests: ( Shall be carried out by the manufacturer on every capacitor as per IEC 61881)

- i. External Inspection
- ii. Voltage test between terminals
- iii. Voltage test between terminals and case
- iv. Capacitance & Tan  $\delta$  measurement
- v. Test of internal discharge device.
- vi. Sealing Test as per IEC61881

##### 5.2 Type Tests on one capacitor (as per IEC 61881)

- i. Visual and dimension inspection
- ii. Voltage test between terminals
- iii. Voltage test between terminals and case
- iv. Mechanical tests  
The capacitor terminals tests shall be conducted according to IEC 61881. A thorough visual examination shall be used to check for high quality finish and markings.
- v. Surge discharge test  
Surge discharge test must be carried out according IEC61881 using a test voltage of 1.1times of rated voltage
- vi. Self-healing test  
Self-healing test should be done in accordance with IEC 61881
- vii. Measurement of Capacitance and capacitor tangent of the loss angle (tan  $\delta$ )
- viii. Thermal stability test  
The test must be conducted according to IEC 61881.  
Test current shall be  $1.1 \times I_{max}$ ,  $I_{max} = 130A$  rms
- ix. Test of internal discharge device
- x. Resonance frequency measurement
- xi. Endurance test between terminals
- xii. Disconnection test on fuses, if applicable
- xiii. Destruction test
- xiv. Series resistance
- xv. Weight measurement
- xvi. Shock and vibration tests  
The capacitor will comply in accordance with either IEC 61373

##### 6.0 Test protocol

Supplier shall submit test protocol for Routine & Type tests along withl offer. List of tests are as per clause 5.0 of this specification.



A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP: TRACTION ENGINEERING**

P.S NO.: PS/445/2467

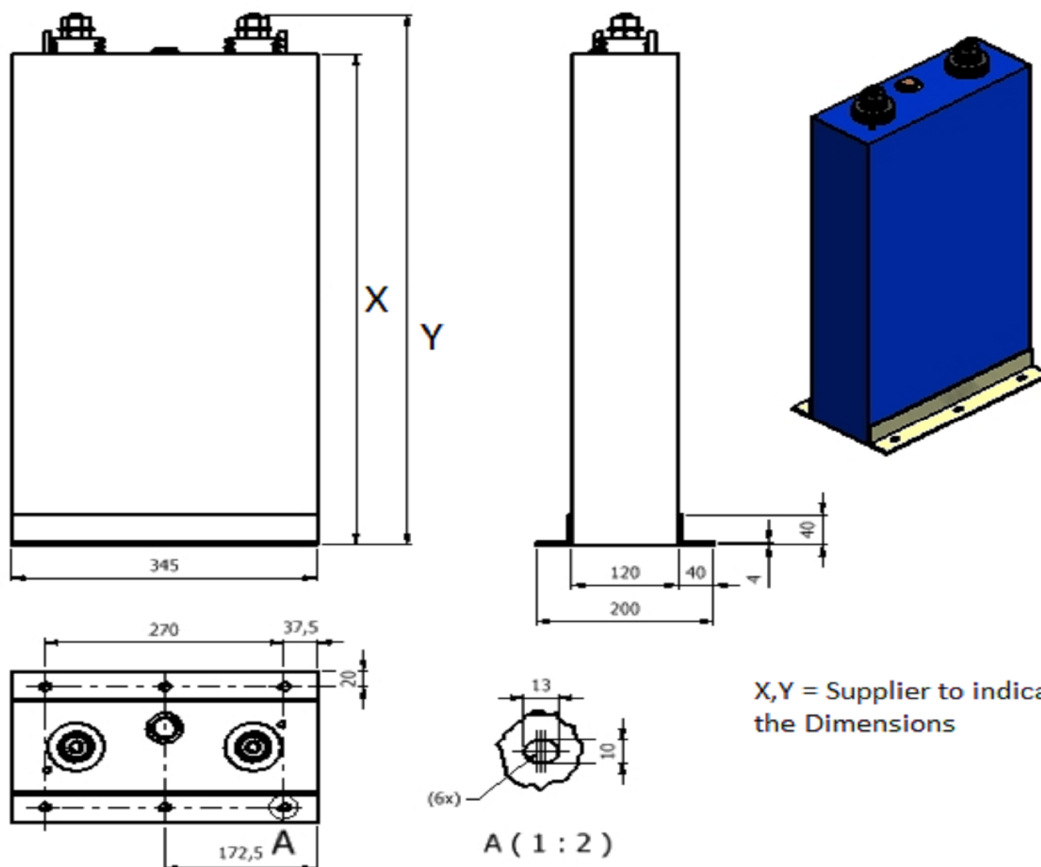
REV. NO: 00

PAGE 04 of 06

**SPECIFICATION FOR 550uF SINEWAVE FILTER CAPACITOR**

**7.0 Mechanical Dimension limitation**

The capacitor dimensions (overall & mounting and terminations) shall not exceed the dimensions indicated in the drawing below.



This drawing is for indicative purpose only. Overall dimensions shall not exceed 350mmX205mmX460mm (LXWXH). Supplier has to submit drawing with exact dimension for BHEL approval.

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.



A4 – 11

# **PURCHASE SPECIFICATION** **GROUP: TRACTION ENGINEERING**

P.S NO.: PS/445/2467

REV. NO: 00

PAGE 05 of 06

## **SPECIFICATION FOR 550uF SINEWAVE FILTER CAPACITOR**

### **8.0 Documentation**

#### **8.1 Information required along with techno commercial offer without which offer is liable for rejection.**

8.1.1 Supplier shall furnish clause wise confirmation/comments to the technical specification in the typical format given below. Deviation, if any, shall be clearly brought out indicating the clause number, original specification, deviation sought with proper technical backup (catalogue, technical brochure, international standards, calculations etc.

If no deviations required, then supplier shall furnish certificate indicating “NO DEVIATION REQUESTED” and we comply fully with all the technical requirements of this specification“

8.1.2 Supplier shall take a copy of this specification and sign on each page and submit the signed copy along with offer.

8.1.3 Supplier shall furnish the type of dielectric used along with technical details.

8.1.4 Curves of lifetime versus dielectric temperature

8.1.5 Curve of capacitor operating voltages versus lifetime

#### **8.2 Information required after the placement of order**

8.2.1 Detailed dimensional drawing for BHEL approval

8.2.2 Test protocol for BHEL approval.

#### **8.3 Information required along with material supply.**

8.3.1 Two sets of Test certificates of tests as per clause 5.0.

### **9.0 Rating Plate (with following information) shall be fixed at a suitable position.**

9.1 BHEL Specification No.

9.2 Rated Capacitance

9.3 Rated Voltage

9.4 Rated Current

9.5 Serial no.

9.6 Month & Year of Manufacture

9.7 Weight

### **10.0 Reference Standard**

IEC 60077	Railway applications – Electric equipment for rolling stock
IEC 61071	Power electronic capacitors
IEC 61373	Railway applications – Rolling stock equipment – Shock and vibration tests
IEC 61881	Railway applications – Rolling stock equipment – Capacitors for power electronics
EC 60068-2-11	Test - Salt Mist Test
EN 50124	Railway applications – Insulation coordination
EN 50125	Railway applications – Environmental conditions for equipment
NF F 16-102	Rolling stock – Fire behavior – Material selection, application for electric equipment's

COPYRIGHT AND CONFIDENTIAL  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.





A4 – 11

**PURCHASE SPECIFICATION**  
**GROUP: TRACTION ENGINEERING**

P.S NO.: PS/445/2467

REV. NO : 00

PAGE 06 of 06

**SPECIFICATION FOR 550uF SINEWAVE FILTER CAPACITOR**

**12.0 Environmental Conditions:**

- 12.1 Ambient Temperature : 55°C
- 12.2 Maximum Temperature : 70°C (when locomotive standing dead under sun)  
55°C (when locomotive working)
- 12.3 Average Temperature : 47°C
- 12.4 Humidity : Upto 100% during rainy season
- 12.5 Altitude : Upto 1200 m above mean sea level
- 12.6 Atmosphere during hot weather: Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6mg/cub meter.

**COPYRIGHT AND CONFIDENTIAL**  
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.  
It must not be used directly or indirectly in anyway detrimental to the interest of the company.