



**Amara Raja Power Systems Limited, Tirupati**

**DRAWINGS**  
**FOR**  
**APPROVAL**

**Rating : 48VDC/100A DUAL FLOAT CUM BOOST  
CHARGER WITH IN-BUILT DCDB & ACDB  
(Suitable for 2 x 48V/425AH VRLA Battery of 24cells)**

**CONTRACTOR : KALPATARU POWER TRANSMISSION LIMITED**

**PROJECT : 400/220/132kV SUBSTATION AT RACHAGANNERI,  
CHITTOOR DISTRICT.**

**CLIENT : TRANSMISSION CORPORATION ANDHRA PRADESH**

**S.O. NO : PDELS/000054/18-19**

**PO No : 2000037610, Dt: 18/06/2018**

**JOB No : 18-0979**

**Manufacturer : AMARA RAJA POWER SYSTEMS LIMITED**

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## **GENERAL DESCRIPTION**

The Battery Charger is for charging the Battery in various modes and at the same time, to supply the load requirement. The system basically consists of Two Float cum Boost Chargers, One DC Distribution Board and One AC Distribution Board. Each Charger consists of Double Wound Input Transformer, Rectifier Bridge Circuit, Filter Circuit, AC Input Circuit Breaker and DC Output Fuse.

The Battery Chargers works from 160-270V AC, Single Phase, 50Hz Supply. The Chargers are capable of delivering the full rated load at the specified voltage at output terminals. This voltage is maintained for AC Input variation of 160 to 270V AC and Load variation from 10 to 100% of rated full load.

## **PRINCIPLE OF OPERATION**

During normal operation, one of the Chargers will be in ON condition, supplying to Load and Battery charging requirements and other charger is made OFF. If main charger fails to supply DC power, then standby will automatically come into picture and take over the functions of failed charger without interruption to the load.

## **BATTERY CHARGING**

Provision is there to select the type of Battery being charged and according to selection, charging voltages and current limit values can be adjusted using potentiometers.

Suppose if the Battery Selector Switch is at VRLA position, provision is there to change the Battery either in Auto Mode or in Manual Float or in Manual Boost depending upon AUTO/FLOAT/BOOST Selector Switch position. In auto mode, battery can be charged automatically either in float or boost depending upon the current drawn by the battery. Provision is also there to select float or boost manually through the same AUTO/FLOAT/BOOST Selector Switch.

Suppose if the battery selector switch is at Station Battery position, then provision is there to select float or boost or equalize modes manually through FLOAT/BOOST/EQUALIZE Selector Switch. Battery current limit can be adjusted to desired value from 20 to 100% of charging current through battery current limit potentiometer, provided inside the cubicle.

**IT IS RECOMMENDED TO ISOLATE THE LOAD DURING EQUALIZING CHARGING OF THE BATTERY.**

## **DROPPER DIODE CIRCUIT**

Adequately rated dropper diodes are provided in the load path to limit the output voltage to load acceptable level i.e. 52V DC. Necessary shorting contactors are provided to bypass the dropper diodes during Mains failure and battery float charging. The no. of dropper diodes which are to be connected can be controlled by a master voltage detector card, which is provided before the dropper diode circuit, which senses the load path voltage continuously.

All the above components are housed in three different cubicles of equal height and depth, constructed with sheet steel of CRCA. The cabinets are provided with front and back door for easy accessibility and maintainability. All the meters, meter selector switches, control switches and mimic panel are provided on the front door. Terminations for AC Input, DC Output and Battery Input are provided at the bottom of the cabinet.

# **TECHNICAL SPECIFICATION OF THE BATTERY CHARGER**

**Type :** DUAL FLOAT CUM BOOST CHARGER WITH DROPPER DIODE  
CIRCUIT, AC DISTRIBUTION & DC DISTRIBUTION BOARDS

**Rating :** 48V/100A Dual FCBC (FCBC-1 and FCBC-2)  
(Suitable for 2 x 48V/425AH VRLA Battery of 24 Cells)

## **1. AC INPUT**

- a. Voltage : 160 – 270V AC (230V AC + 18%, -31%)
- b. Frequency : 50Hz  $\pm$  5%
- c. Phase, Wire : Single Phase

## **2. DC OUTPUT**

### **a. Float cum Boost Charger – 1 & 2 for VRLA Battery**

- i. Float Voltage : 48V to 54V DC adjustable
- ii. Boost Voltage : 50V to 56V DC adjustable
- iii. Regulation : Better than  $\pm$  1% of set value for line variation of 230V AC  $\pm$  10%
- iv. Ripple : Less than 5mV Psophometric without Battery
- v. Current : 100A

### **b. Float cum Boost Charger – 1 & 2 for NVRLA Battery**

- i. Float Voltage : 48V to 52V DC adjustable
- ii. Boost Voltage : 50V to 58V DC adjustable
- iii. Equalize Voltage : 56V to 65V DC adjustable
- iv. Regulation : Better than  $\pm$  1% of set value for line variation of 230V AC  $\pm$  10%
- v. Ripple : Less than 5mV Psophometric without Battery
- vi. Current : 100A

**c. System O/P voltage:** Max. 52V (VRLA)/54V (NVRLA) DC + 1% at load terminals after Dropper Diode Circuit

**c. Efficiency :** Not less than 75% at full load at nominal AC Input

**3. METERS :** Following analog type meters of 96 x 96 with 90° deflection and  $\pm$ 1.5% accuracy class will be provided in the system for measuring the respective parameters:

DC Voltmeter with Selector Switch  
DC Ammeter with Selector Switch  
Battery Charge / Discharge Ammeter

**4. INDICATIONS :** Clustered LED Lamps will be provided at AC Input for Mains ON condition. LED Indicators will be provided for the following conditions with audio alarm for abnormal conditions:

#### **In FCBC – 1 & 2**

- a. Rectifier Fuse Blown
- b. DC Over Load
- c. Charger Fail
- d. Filter Capacitor Fuse Blown

#### **Common**

- a. DC Over Voltage
- b. DC Under Voltage / Battery Low
- c. AC Mains Fail

**5. PROTECTIONS :** Following protections will be provided in the system:

- a. AC Input Circuit Breaker (MCB) for both FCBC-1 & 2
- b. Fast acting Semiconductor fuses for the rectifier bridge for both FCBC-1 & 2
- c. DC OV Cutback protection for both FCBC - 1 & 2
- d. Charger DC Output fuses for both FCBC - 1 & 2
- e. Under Voltage Protection (i.e. Isolation of Battery from Load)
- f. Battery Path Current Limit with Potentiometer.
- g. DC Over Load for both FCBC - 1 & 2
- h. Filter Circuit Fuses

**6. CONTROLS & :  
SWITCHES**

- a. AC input MCB for both FCBC - 1 & 2
- b. Float/Boost Selector switch for both FCBC - 1 & 2
- c. Float, Boost & Equalize Voltage variable POTs
- d. Battery Current limit adjustment POT.
- e. Battery Current limiting ON/OFF Selector Switch.
- f. Battery Input ON/OFF Rotary Switch
- g. DC Over Voltage Reset Push Buttons.
- h. Lamp Test Push Button
- i. Door Lamp Push Button for both FCBC - 1 & 2
- j. Alarm Silence Push Button

**7. SPECIAL FEATURES**

- a. Soft start on DC side
- b. Class-F insulation for all Magnetics
- c. Automatic Voltage Regulation using digital controlled logic.
- d. Filter circuit to limit ripple
- e. Separate Battery path current limiting
- f. Automatic changeover from float to boost and vice versa, based on current drawn by the battery for VRLA Battery.

**8. DC DISTRIBUTION BOARD**

**Outgoing Feeders : 6A - 1P - MCB - 18 Nos.**

**9. AC DISTRIBUTION BOARD**

**Outgoing Feeders : 6A - SPN - MCB - 6 Nos.**

**10. GENERAL**

- a. Cabinet : Free Standing, Floor Mounting Type, Sheet Steel Construction, easy access for Installation and Maintenance, Cable Entry at bottom.
- b. Colour : Silver Ash
- c. Protection : IP - 30
- d. Temperature : 0 to 50°C  
range of Operation
- e. Relative humidity : 0% to 95% non-condensing.

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A/S  
Chlor*

Chief Engineer / Telecom & IT  
APTRANSCO, Vidyut Soudha,  
Gunadala, Vijayawada-520 004.

## **CHARGER THEORY**

The system basically consists of two similar Float cum Boost Chargers and a Battery Bank. The both chargers are similar in nature and works on the same principle. These chargers are rated to meet the requirement of Load and Battery charging current as specified. For clear understanding of system description, refer schematic drawing enclosed.

The Float cum Boost Charger - 1 & 2 are of full wave half controlled configuration and having constant voltage/current limit characteristic depending upon the mode of operation. Each Float cum Boost chargers consist of double wound input step down transformer, SCR/Diode rectifier bridge, charger control board, Auto/Float/Boost selector switch, LC filter circuit, AC Input Circuit Breakers, Battery input ON/OFF switch, Blocking diode, DC output fuse and Alarm Circuit.

The Float cum Boost chargers - 1 & 2 are connected to the AC input power through (CB 401/501). The Input transformer (T401/501) step down the input AC Voltage to the required level and is connected to the rectifier bridge (SCR/V 401-402/501-502) through Fast acting Semiconductor Fuses (FU 401/501). The charger control board PC 401/501 provides gate signals to these SCR's at appropriate timing depending on the output voltage/current feed back. The Rectifier DC is connected to DC filter (L 401 & 402/ 501 & 502and C 403 & 405/ 503 & 505/C 1) which in turn filters out all Harmonics and provide DC voltage with low ripple content as specified. The Blocking diode (V404/504) prevents reverse current flow into the charger. The output voltage of Float cum Boost Charger is adjusted using the potentiometer R 401-402/501-502 respectively.

The shunt SH 401/501 provides the current feedback to the charger control board PC 401/501 which causes the unit to go into current limit beyond the set value. This characteristics causes the output voltage to go down when the battery is run down, so as to maintain a constant level of charging current.

The Battery ammeter P2 with shunt SH 1 provided monitor the battery charge and discharge current. The DC voltmeter P1 monitor the output voltages FCBC-1/FCBC-2/Load/Battery through selector switch(S1).The DC ammeter (P 3) monitor output currents of FCBC-1/FCBC-2. Battery current limit adjust potentiometer (R13) is provided with selector switch to limit the Battery current.

The system is having LED indicators for different operating conditions. An audio alarm is provided which can be heard during any fault conditions. All fault conditions and indicators are derived through the alarm control board (PC 6). This PC 6 consists of triggering and reset circuit for alarm. For any indication of fault condition this board supplies power to the corresponding LED and activate the alarm for faulty condition.

Alarm can be disabled by pressing the alarm silence pushbutton (PB 2), however, the LED will be glowing continuously until the fault is rectified. Lamp test push button (PB 1) is provided to test the alarm and LEDs connected through PC 6.



## **PRINCIPLE OF OPERATION**

During normal operation Float cum Boost Charger - 1 is in ON condition and Float cum Boost Charger - 2 is made OFF. During this operation FCBC - 1 supplies the Load current and battery charging current. If FCBC - 1 fails FCBC - 2 will automatically come into operation without interruption to Load. During mains failure condition, load is supplied by the Battery Bank.

During normal operation the FCBC-1 supplies load current as well as trickle (Float) current to the battery. At this stage the output of FCBC-2 is made OFF. The common mode selector switch (SW 4) is kept in Auto Mode (FCBC-1 in Auto position) to select the battery-charging mode (Float or Boost) automatically based on battery condition.

The Master Auto current detector board PC 1 senses the battery charging current, through Relay board and whenever the Float charging current is more than the preset value, it changes the status of its Relay potential FCBC-1ee contacts and the batteries starts getting charged in Boost mode. Whenever the battery is fully charged and charging current comes down the preset value the current detector board PC 1 changes its Relay contacts status and makes the boost charger OFF.


Provision is available to put the batteries in Boost Charge mode manually by using the selector switch SW 4. This manual mode overrides the battery condition and switches ON the boost charger and the batteries will be kept in boost mode. Whenever the FCBC-1 fails the FCBC-2 goes into Float mode automatically and starts supplying the load and battery charging current.

### AMARA RAJA SUB-VENDOR LIST

SL. NO.	ITEM / COMPONENT	SUB-VENDOR / SUPPLIER
1.	AC CONTACTORS (POWER & CONTROL)	L&T / ABB
2.	DC CONTACTORS (POWER & CONTROL)	POWNIX / ABB / ANDREW YULE / C&S
3.	COPPER BUS BARS	COPPRROD / HARINAM
4.	CONTROL SWITCHES	SALZER (L&T) / RG KESHWANI
5.	CABLES / WIRES	ANY IS OR BIS APPROVED MAKES
6.	ELECTROLYTIC CAPACITORS	ALCON / SARADA
7.	FUSES (HRC / HBC / SEMICONDUCTOR) & FUSE BASES	BUSSMANN
8.	FUSES (GLASS)	PROTECTRON
9.	FUSE TERMINALS (GLASS)	CONNECTWELL
10.	MIMIC PANEL	AMARA RAJA
11.	HEAVY DUTY SWITCHES	SALZER (L&T) / KAYCEE
12.	HEAT SINKS	GLOBAL ALUMINIUM
13.	SPACE HEATERS	ENCORE / PYRO
14.	INDICATING LAMPS (CLUSTER LED TYPE)	ESBEE (L&T) / SIEMENS
15.	LEDs	SANKEN / KWALITY
16.	MEASURING METERS	BEEMET/RISHABH
17.	METAL OXIDE VARISTORS (MOV <sub>s</sub> )	EPCOS
18.	CONTROL CARDS (POPULATED PCBs)	AMARA RAJA
19.	PUSH BUTTONS	RG KESHWANI
20.	POTENTIOMETERS	POTEL / BOURNS / PANKAJ
21.	POLYESTER CAPACITORS	EL-CI-AR
22.	PANELS / CABINETS	AMARA RAJA



SL. NO.	ITEM / COMPONENT	SUB-VENDOR / SUPPLIER
23.	SHUNTS	BEEMET / RISHABH
24.	TOGGLE SWITCHES	R.G. KESWANI / RECOM
25.	THYRISTORS (SCRs)	SEMIKRON / HIRECT / RIR
26.	POWER DIODES	SEMIKRON / HIRECT / RIR
27.	CONTROL DIODES	KHEL / MIC
28.	TERMINAL BLOCKS	ELMEX
29.	THERMAL SWITCHES	UTILITY APPLIANCES
30.	TRANSFORMERS / CHOKES	AMARA RAJA
31.	WIRE WOUND / CF / MF RESISTORS	DEL / PEC / VEPL / WATTS
32.	DOOR LAMPS	PHILIPS / WIPRO / BAJAJ
33.	DOOR LAMP HOLDERS	ANCHOR / STD
34.	FUSE TRIP INDICATORS	BUSSMANN / GEC
35.	MCCBs (AC & DC)	C&S
36.	MCBs (AC & DC)	LEGRAND / SIEMENS/SCHNEIDER /C&S
37.	AUXILIARY RELAYS	PLA / OEN
38.	LED HOLDERS	LALWANI
39.	DOOR LAMP PUSH BUTTON	ELICO / ANCHOR / STD
40.	ROTARY & CAM OPERATED SWITCHES	SALZER (L&T) / KAYCEE / RECOM
41.	BUZZER	METRONIX
42.	FUSE TRIP INDICATORS	BUSSMANN / GEC

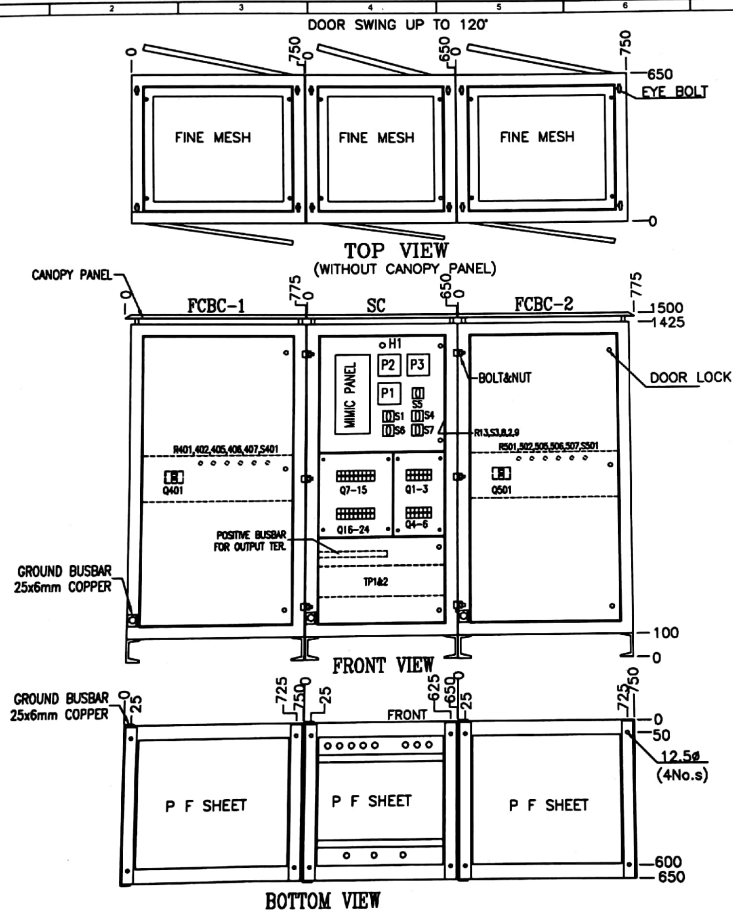
 <b>AMARA RAJA</b> <small>Quality is a better policy</small>		<b>POWER SYSTEMS Pvt. Ltd.</b>		<b>Bill Of Material Report</b>			<b>Doc Ref No : ENG-SFS-08/REV 0</b>												
<b>Sale Order No</b>		PDELS/000054/18-19		<b>Line No</b>		9	<b>Configuration No</b>		1	<b>Customer Name</b>		KALPATARU POWER TRANSMISSION LTD-I		<b>Rev No</b>		0.00			
<b>Item Code</b>		DFCB048100Q		<b>Variant Code</b>		EG33	<b>Description</b>		48V/100A DFCBC+DCDB:1PH-2W		<b>Jobno</b>		18-0979	<b>Qty</b>		2	<b>UOM</b>		NOS
<b>Sl.No</b>	<b>Rev</b>	<b>Circuit Designation</b>		<b>Input Item Code</b>		<b>Description</b>		<b>Variant</b>		<b>Variant Description</b>		<b>Qty / System</b>		<b>UOM</b>		<b>Sub</b>	<b>Remarks</b>		
1	0	CABINET		49010000148		Cab-Transco-48V,100A Dfcbc-SILVER ASH		M075		MIL		1.000		NOS					
2	0	FCBC-1		FCBC-048-100-A		48V/100A FCBC		ST42		1PH-2W-FCBC-1		1.000		NOS		yes			
3	0	FCBC-2		FCBC-048-100-A		48V/100A FCBC		ST43		1PH-2W-FCBC-2		1.000		NOS		yes			
4	0	PACKING CASE		51501010051		Pack Case-Domestic-1575(H)x2250(W)x750(D		A010		ARPSL-PSESTCPK001		1.000		NOS					
5	0	Switching Cubicle		SWDDACDC000		48V Switching Cubicle+DD Ckt+ACDB+DCDB		ST44		48V/100A SWC		1.000				yes			

checked

2/8/18

Chief Engineer / Telecom & IT  
APTRANSCO, Mayut Soudha,  
Gunadla, Vijayawada-520 004.

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# FRONT PANEL DESCRIPTION DETAILS

CKT DES	DESCRIPTION
Q401/501	AC INPUT ON/OFF CIRCUIT BREAKER (FCBC-1/2)
Q1-6	ACDB OUTPUT ON/OFF CIRCUIT BREAKERS.
Q7-24	DCDB OUTPUT ON/OFF CIRCUIT BREAKERS.
H1	MAINS ON NEON LAMP
P1	DC VOLTMETER
P2	BATTERY AMMETER
P3	CHARGER OUTPUT AMMETER
R401/501	VRLA BATT. FLOAT VOLTAGE ADJUST POT (FCBC-1/2)
R402/502	VRLA BATT. BOOST VOLTAGE ADJUST POT (FCBC-1/2)
R405/505	LA BATT. FLOAT VOLTAGE ADJUST POT (FCBC-1/2)
R406/506	LA BATT. BOOST VOLTAGE ADJUST POT (FCBC-1/2)
R407/507	LA BATT. EQUALISE VOLTAGE ADJUST POT (FCBC-1/2)
R13	CURRENT LIMIT ADJUST POT
S1	DC VOLTS SELECT SWITCH
S2,9	BATTERY INPUT-1/2 ON/OFF SWITCH.
S3	BATTERY CURRENT LIMIT SELECT SWITCH
S4	AUTO/FLOAT/BOOST SELECT SWITCH.
S5	AMMETER SELECT SWITCH
S6	BATTERY SELECT SWITCH
S7	MODE SELECT SWITCH FOR CONVENTIONAL BATTERY.
S401,501,8	DOOR LAMP POWER ON/OFF SWITCH

## NOTES:

1. MATERIAL OF THE CABINET IS CRCA MS SHEET. FRAME, FRONT DOORS ARE 2mm THICK & REMAINING DOORS AND PANELS ARE 1.25mm THICK.
2. CABINET WILL BE PAINTED WITH SILVER ASH.
3. BACK DOORS SHALL BE PROVIDED WITH SLOTS.
4. PROTECTION CLASS SHALL BE IP-30 AS PER IS:2147.

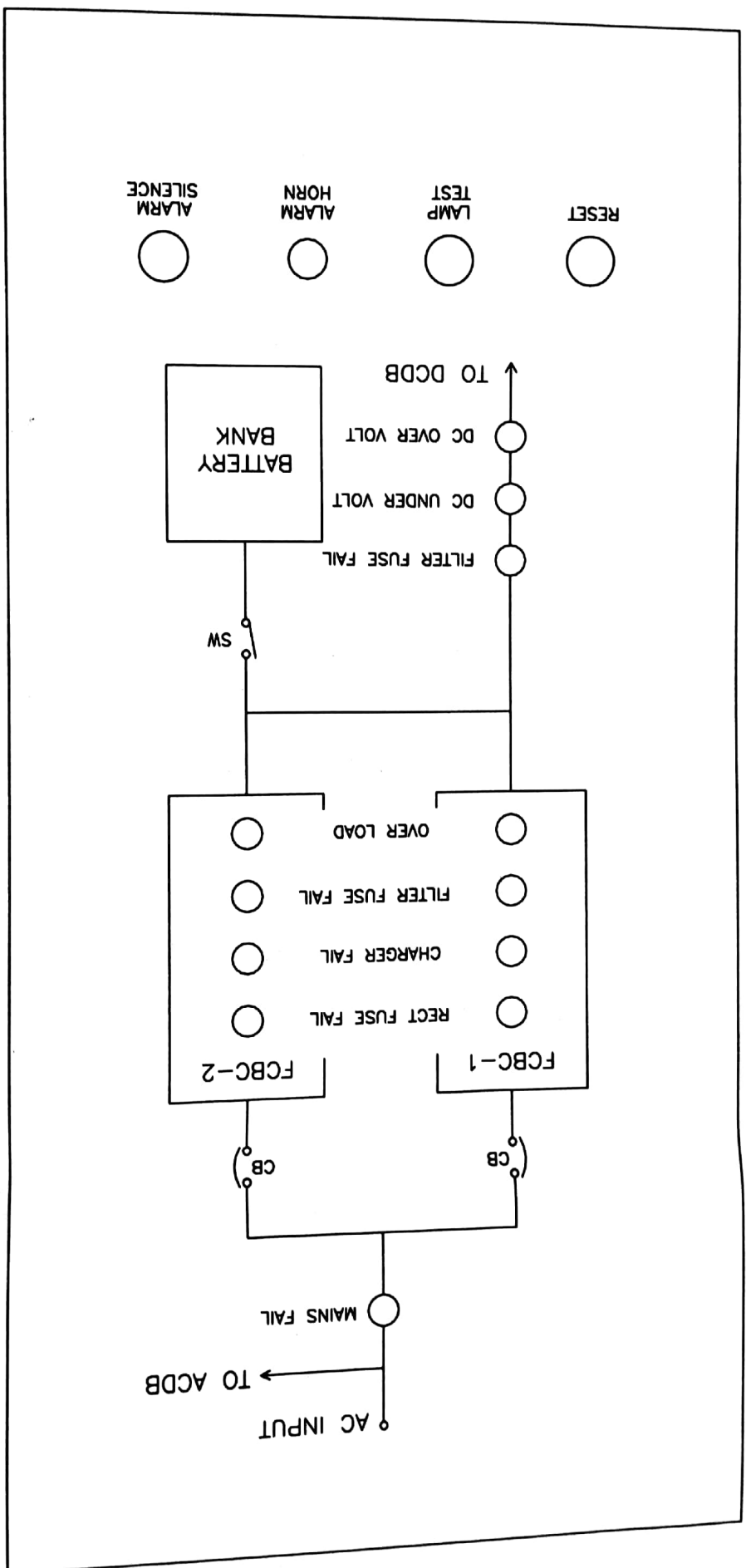
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Chief Engineer / Telecom & IT  
AP Transco, Vidyut Soudha,  
Guntur, Andhra Pradesh-520 004.

Best

All Dimensions are in mm.				DATE	18.09.15	SIGN	PROJECT	—	<p>AMARA RAJA POWER SYSTEMS LTD. Registered Office &amp; Works Koravangudi-517320 Tirupati (AP) India Ph: (0877) 2265000</p>	<p>TITLE : DIMENSIONAL DRAWING OF 48V/100A DUAL FCBC WITH ACDB &amp; DCDB</p>	DRG No. : DIO-PSEAP00007	
General Tolerance as per ISO 2768 - c				DRAWN	KVS	CHECKED	CUSTOMER	: AP TRANSCO			SALE ORDER No. : —	
REV	ECO	REMARKS	DATE	APPD	APPD	GR	CONSULTANCY	: —			REV. : 0	THIS 1

ENG-SFS-06 REV.01

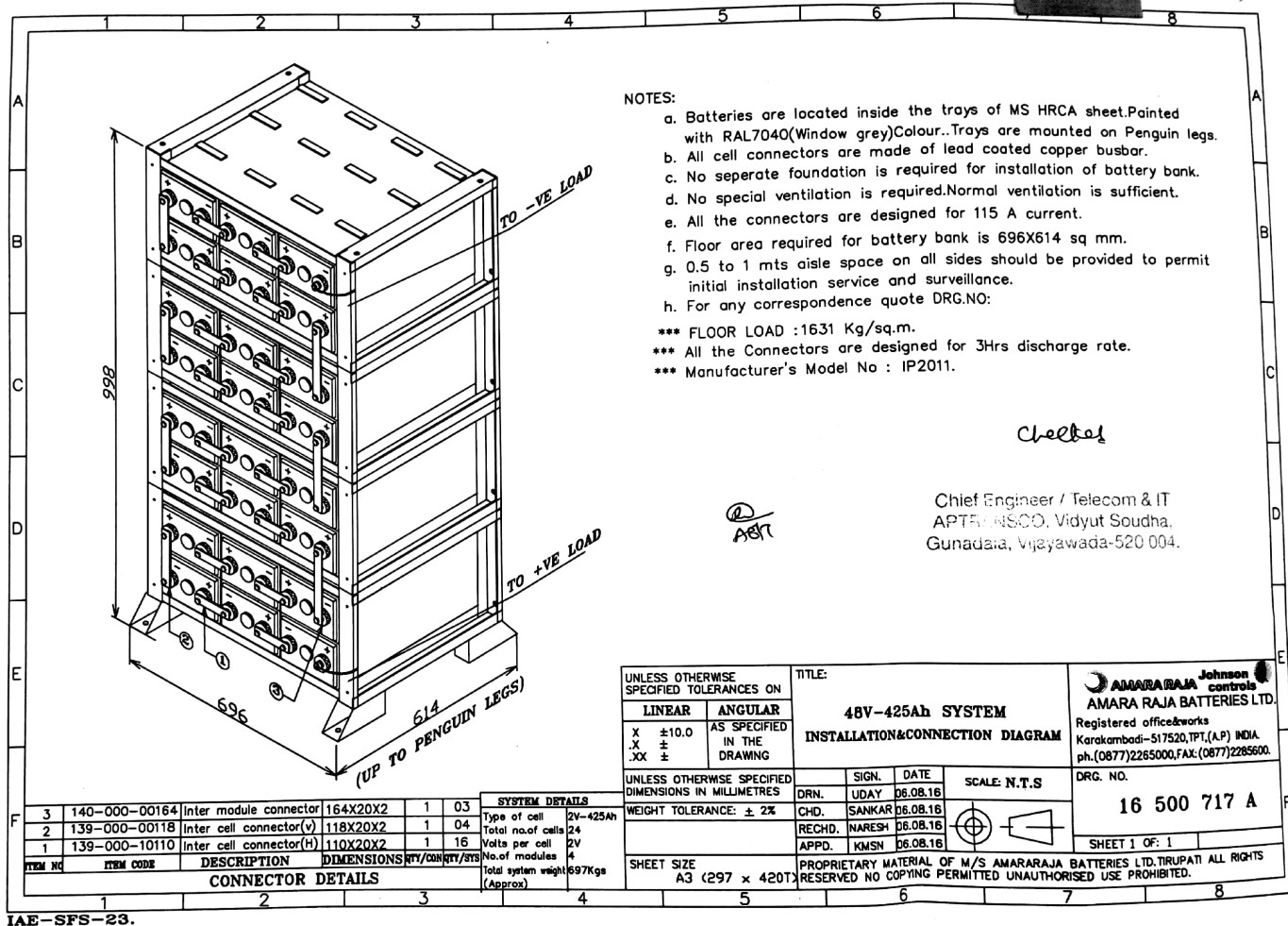


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Chief Engineer / Telecom & IT  
APTRANSCO, Vidyut Soudha,  
Gunadala, Vijayawada-520 004.

All Dimensions are in mm.		DATE	9.09.16	SIGN	PROJECT : —		TITLE : MIMIC PANEL DRAWING OF 48V/100A DUAL FCBC WITH ACDB & DCDB		DRG No. : PSEAPM007	
General tolerance as per ISO 2768 - c		DRAWN	KVS		CUSTOMER : AP TRANSCO		MIMIC PANEL DRAWING OF 48V/100A DUAL FCBC WITH ACDB & DCDB		SALE ORDER NO. : —	
REV	ECO	REMARKS	DATE	APD	APD	GR	CONSULTANCY : —	PO No. : —		REV : 0 THIS
										LOC : NEXT





## Guaranteed Technical Particulars

DOCREF: IAE/ GTP - PS/ 2016-17; Rev : 00

### Battery Particulars

- Battery Type : Maintenance Free Valve Regulated Lead Acid (MF-VRLA)
- Battery Rating : 48 V - 425 AH to 1.75 ECV @ C10 at 27°C
- Manufacturers Cell Designation : IP2011
- No. of cells : 24 No.s
- Cell dimensions : (198.5 x 532 x 92.8) mm Approx.
- Single cell weight : 25.7 kg. Approx
- Battery bank dimensions : (696 x 614 x 998) mm Approx.
- Battery bank weight : 697 Kg. Approx.

### Charge Regime

- Float Charging Voltage : Batteries shall be charged in constant potential mode with Current Limit.
- Boost charging voltage : 2.23 - 2.25 Volts per Cell @ 27°C
- Current Limit : 2.30 - 2.32 Volts per Cell @ 27°C
- Recommended Voltage Compensation : 42.5 Amps minimum to 85 Amps maximum.
- Recommended Voltage Compensation : For every 1°C rise in temperature reduce the float voltage by 0.003VPC & Vice versa, ensure the extension of temperature sensor upto battery.

### Product Details

- AH efficiency : Above 95%
- WH efficiency : Above 85%
- Self Discharge/Week : < 1% of rated capacity
- Max. allowable Ambient Temp. at which cell can safely operate : 60°C continuous and 70°C short time.
- Recommended Max Period of Storage : 6 months from the date of dispatch before first use and battery should be stored in a covered area at 27°C.
- Material of Container : Polypropylene co-polymer.
- Type of separator : Highly absorbent Micro porous spun glass matrix.(AGM)
- Type of +ve & -ve plates : Flat pasted
- Material of tray & color : Mild steel coated with acid resistant powder coating.
- Method of connection between cells : Bolted
- Voltage ripple allowable : <2% of the RMS. Value
- Type of connectors : Lead coated Heavy duty copper strips
- Cycle Life of battery at 27°C : 4000 cycles at 20% Depth of Discharge(DOD) (or) 2000 cycles at 50% DOD (or) 1200 cycles at 80% DOD
- Time required for Boost charge from fully discharged condition at 27°C : 8 Hrs for 90% State of Charge (SOC) (or) 16 hrs for 100% SOC

### Applicable Standards

- Batteries generally conforms to
  - (i) IS15549:2005
  - (ii) IEEE1188 & 1189
  - (iii) BS-6290, PART-IV.
  - (iv) IEC 60896-21&22:2004, PART-II.

Proprietary Material of M/s.AMARA RAJA GROUP OF COMPANIES, Tirupall.

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\*\*Due to on going improvement the specifications are subjected to modification without prior notice

Authorized signature  
COM-SFS-64

*checked*

*AST*

Chief Engineer / Telecom & IT  
APTRANSCO, Vignath Soudha,  
Gunadala, Vilaspuram-520 004.



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**DOCUMENT TITLE**

**QUALITY ASSURANCE PLAN  
(FINAL INSPECTION & ACCEPTANCE  
OF VRLA BATTERIES)**

Doc.Ref. : IAE-STD-04  
Pg. : 1 of 7  
Pg. Rev. : 0  
Date. : 05.07.2017

**TEST PLAN FOR ACCEPTANCE TESTING OF MAINTENANCE  
FREE VALVE REGULATED LEAD ACID BATTERIES**

**1.0 SCOPE:**

This standard specifies physical, constructional and performance requirements and tests for Maintenance Free Valve Regulated lead acid type with immobilized electrolyte.

**2.0 TERMINOLOGY:**

- 2.1 Acceptance tests – Tests carried out on samples selected from a lot for the purpose of verifying the acceptability of the lot.
- 2.2 Lot – All batteries of the same type, design and rating, manufactured by the same factory during the same period, using the same process and materials, offered for inspection at a time shall constitute a lot.
- 2.3 Routine Tests – Tests carried out on every battery by manufacturer before offering to final inspection by inspection agency /Customer.

**3.0 REQUIREMENTS FOR TESTS:**

- 3.1 Temperature for testing – the temperature range within which the tests are carried out shall be 19°C – 40°C
- 3.2 Test Equipment:
  - 3.2.1 Voltmeter – The voltmeter used for tests shall be of an accuracy class not inferior to 0.5 in accordance with IS-1248 – 1968. The range of the voltmeter used shall be such that the magnitude of the voltage to be measured falls in the third part of the scale in the case of analogue meters. Where digital meters are used the meter shall be capable of displaying up to two decimals in 0-99V range and one decimal in 100 and above volts range.
  - 3.2.2 Ammeter – The analogue ammeter if used shall have an accuracy class not inferior to 1.0 (as per IS: 1248 – 1968). The range of ammeter shall be such that the magnitude of the current to be measure falls in the last third part of the scale. Where the digital ammeter is used, the meter shall be capable of displaying at least up to one decimal value of the current to be measured.

**QUALITY ASSURANCE PLAN  
(FINAL INSPECTION & ACCEPTANCE  
OF VRLA BATTERIES)**Doc.Ref. : IAE-STD-04  
Pg. : 2 of 7  
Pg. Rev. : 0  
Date. : 05.07.2017**4.0 TESTS:****4.1 ACCEPTANCE TESTS**

The following shall constitute the acceptance tests. Acceptance tests shall normally be carried out at the discretion of the purchaser and the date and place of testing shall be subject to agreement between the purchaser and supplier. For conducting acceptance testing the samples shall be selected as per IS 15549:2005

- 4.1.1 Visual Examination
- 4.1.2 Checking of Dimensions as per manufacturer drawing
- 4.1.3 Electrical Tests

**4.1.1 VISUAL EXAMINATION:**

- 4.1.1.1 General visual inspection for cracks damages and finish.
- 4.1.1.2 Material and its construction
- 4.1.1.3 Marking on the cell/battery/battery module/Identification Plate
  - a. Manufacturer name
  - b. Cell Designation
  - c. Cell Ah capacity
  - d. Month and year of manufacture

**4.1.2 CHECKING OF DIMENSIONS AS PER MANUFACTURER DRAWING**

- 4.1.2.1 Length, width & height of the cells/modules
- 4.1.2.2 Inter connector Dimensions
- 4.1.2.3 Rack/Tray Dimensions if any.

**4.1.3 ELECTRICAL TESTS:**

- 4.1.3.1 Capacity (AH) Test
- 4.1.3.2 Voltage during discharge test

**Note:** The detailed sequence of all above tests, sampling quantity, Std formats used for recording the test results, applicable clause and performing, verifying & witnessing agencies are clearly indicated in Annexure-I of this document.

**5.0 TEST PROCEDURES:****5.1 Test for capacity.**

- 5.1.1 The cell / battery shall be discharged not earlier than 12 hrs and not later than 24 hrs from the completion of full charge.



**QUALITY ASSURANCE PLAN  
(FINAL INSPECTION & ACCEPTANCE  
OF VRLA BATTERIES)**

- 5.1.2 The cell/battery shall be discharged at a constant current of  $I = 0.1 C_{10}$  amperes. This current shall be maintained within  $\pm 1\%$  throughout the whole discharge time.
- 5.1.3 The discharge shall be discontinued when one cell voltage across battery bank falls to 1.75 volts per cell
- 5.1.4 During the discharge at 10-hour rate, the voltmeter and ammeter reading shall be recorded every 5 minutes for first 15 minutes, thereafter every one hour upto 8-hours and every 15 minutes upto the end voltage.
- 5.1.5 The time in hours elapsing between the beginning and end of discharge shall be taken as the period of discharge.
- 5.1.6 Unless otherwise agreed, capacity test as described above is normally to be treated as the test discharge for the purpose of acceptance of the cell. On the first discharge the cell shall give not less than 90% of the rated capacity. The cell/battery shall give 100% rated capacity of the battery within three discharges. Once the 100% of the rated capacity has been met on any discharge, further discharge cycles for capacity shall not be continued. The discharge may be carried out at ambient temperature and the discharge capacity of the cell/battery shall be corrected to 27°C (design temp.).
- 5.1.7 Test for capacity may be agreement between the purchaser and the supplier, be carried out at rates other than 10 hour rate. The test shall be done at either the 5-hour rate or 3 hour rate provided the max. Discharge rate those not exceed 1000A. Capacities at various rates of discharge and to the stop-of closed circuit voltage of 1.75 volts per cell are given in Table-2. For the purpose of acceptance, the capacity test shall be carried out at any one rate only.

The capacity to 27°C shall be calculated by the following formula as per IS15549: 2005 specification:

$$\text{The Capacity at } 27^{\circ}\text{C} = C_t + \frac{C_t \times R (27-t)}{100}$$

Where:

$C_t$  = Obtained capacity at  $t^{\circ}\text{C}$ .

$R$  = Variation factor chosen from Table-1

$t$  = Hourly average discharge temperature  $^{\circ}\text{C}$ .



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For example

**DOCUMENT TITLE**

**QUALITY ASSURANCE PLAN  
(FINAL INSPECTION & ACCEPTANCE  
OF VRLA BATTERIES)**

Doc.Ref. : IAE-STD-04  
Pg. : 4 of 7  
Pg. Rev. : 0  
Date. : 05.07.2017

Capacity at  $C_{10}$  measure at  $24^{\circ}\text{C}$  = 1000AH

$$\begin{aligned}\text{Capacity at } (C_a) \text{ } 27^{\circ}\text{C} &= 1000 + \frac{1000 \times 0.43 \times (27-24)}{100} \\ &= 1012.9 \text{ AH.}\end{aligned}$$

**Table 1 'R' Temperature corrections factor versus Rate of discharge**

Discharge Rate	Value of 'R'
$C_{10}$ and above	0.43
$C_8$	0.47
$C_5$	0.58
$C_4$	0.62
$C_3$	0.68
$C_2$	0.76
$C_1$	0.90

**NOTE:** Capacity – temperature correction is not a true linear relationship.

(OR)

The correction of the capacity to  $27^{\circ}\text{C}$  shall be calculated by the following Formula as per IEC 896-part: 2:

$$\text{Corrected capacity at } 27^{\circ}\text{C } (C_a) = \frac{C_t}{1 + 0.006(t-27)}$$

**TABLE 2 Percentage of Capacity at Different Discharge Rates.**

Rate of Discharge	Capacity expressed as percentage of $C_{10}$ capacity rating	End Cell Voltage (V)
$C_1$	50.0	1.70
$C_2$	63.3	1.70
$C_3$	71.7	1.74
$C_4$	78.2	1.74
$C_5$	83.3	1.75
$C_8$	95.0	1.75
$C_{10}$	100.0	1.75

**Requirement – The actual capacity corrected to  $27^{\circ}\text{C}$  shall not be less than 90% of the rated capacity in first cycle. The rated capacity shall meet in 5 cycles. The capacity shall not exceed 120% of the rated capacity**





**QUALITY ASSURANCE PLAN  
(FINAL INSPECTION & ACCEPTANCE  
OF VRLA BATTERIES)**

**5.2 Test for Voltage during discharge.**

The cell voltages shall not be less than the following values

- |  |         |
|--|---------|
| a) After six minutes from the start of discharge | : 1.98V |
| b) After six hours of discharge                  | : 1.92V |
| c) After ten hours of discharge                  | : 1.75V |

**5.3 Recharge the batteries in Constant voltage mode with 2.30 VPC for 18 Hrs with 20% of rated Ah current (or) 24 Hrs with 10% of rated Ah current.**

(or)

Recharge the batteries after Test discharge in constant current mode (CC)  
with

- |     |                                   |
|-----|-----------------------------------|
| i)  | 10% of rated Ah current for 10Hrs |
| ii) | 3% of rated Ah current for 8Hrs.  |

**NOTE:** Due to the company's on going improvement process, the design and Specifications are subject to change without prior notice.