Welcome to All

Auxiliary Power Supply (APS) for TRAIN-18

Presentation by,

Aux Team.

MEDHA SERVO DRIVES PVT. LTD.
2-3-2/A, Beside Govt. Mint Compound, Cherlapally, Hyderabad - 500051.
Phone: +91-40-2726-4144 e Mail: info@medhaindia.com; marketing@medhaindia.com

Need of Auxiliary Power Supply

- U/S system in EMU all coaches are proposed to work on two different voltages for RMPU, CAB-AC, Main & Auxiliary Compressor, Cooling blowers, Txfr Radiator fan, Txfr Oil pump, Pantry loads, Mobile & Laptop charging, Toilet Loads, Wi-fi & TV, Emergency blowers, coach lights, coach Fans, Doors, Battery charging, Control supply for ACU, BCS, CCTV, LTC, PIS, relays etc..

- Converter unit is required to generate 2 different types of voltages to serve these loads. Those are
  - 415VAC, 3phase, 50Hz
  - 110VDC.

415VAC Loads on ACU

415VAC, 3phase, 50Hz loads:

- ✓ RMPU
- ✓ CAB AC
- ✓ Main Compressor
- ✓ Traction Converter Cooling blowers
- ✓ Transformer Radiator Fan
- ✓ Transformer Oil Pump
- ✓ Water Pump for Toilet Tank
- ✓ Aux converter Cooling blower.

110VDC Loads on APS

110VDC :

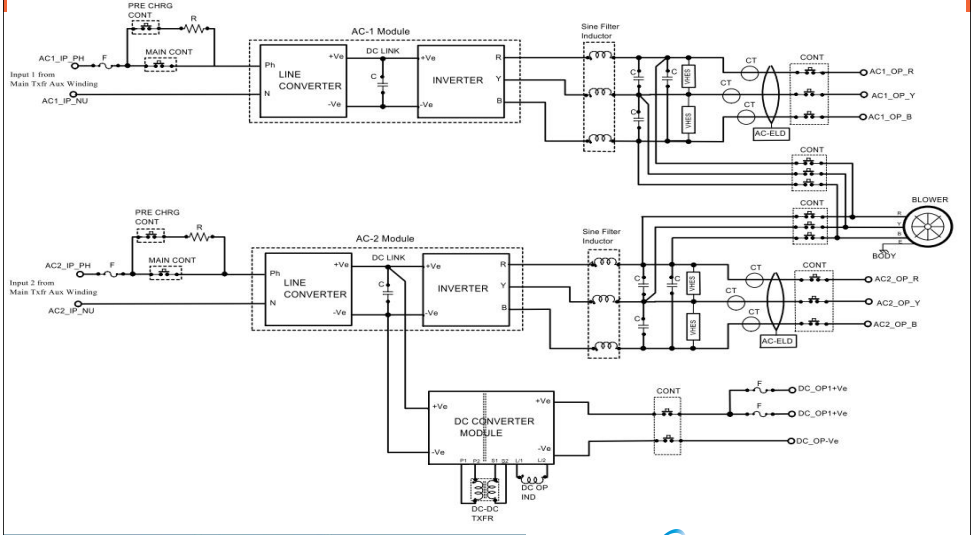
- ✓ Battery Charging
- ✓ Coach, Vestibules and Driver Cabin normal lights
- ✓ Coach and Driver Cabin Emergency lights
- ✓ Twin Beam/Auxiliary Head light, Marker Light, Tail Light, Flasher light, Cluster Light, Spot Lights, Passenger Alarm Indication Light, Electronic signal bell
- ✓ Control Electronics Loads :PIS, CCTV, Relays, Contactors, Driver desk,Brake systems and all other control units
- ✓ Auxiliary compressor for Pantograph
- ✓ Emergency Ventilation Blowers
- ✓ 110Vdc Toilet Loads, Seat Lights & Doors.

Auxiliary Power Supply (APS)

- ✓ Auxiliary Power supply consists of two Cubicles.

- ✓ **Auxiliary Converter Unit (ACU)**
  - ✓ ACU Consists of below modules
  - ✓ 1) AC1 Module
  - ✓ 2) AC2 Module
  - ✓ 3) DC Converter Module
- ✓ **Battery Charging System (BCS).**

ACU Block diagram



ACU Electrical Data

Requirements	Parameters
AC Input Voltage	1-ph,285V AC to 450V AC input from Auxiliary secondary winding of Main transformer
Control Supply	77V to 137.5VDC from battery(110Vdc Nominal)
AC-1 Output Capacity	275kVA, 415V±5% (L-L), 50Hz±3%, 3Phase, Sine wave (at >19kVac OHE) At <19kVac OHE, output voltage shall drop by maintaining V/F ratio constant.
AC-2 Output Capacity	235kVA, 415V±5% (L-L), 50Hz±3%, 3Phase, Sine wave (at >19kVac OHE) At <19kVac OHE, output voltage shall drop by maintaining V/F ratio constant.
DC Converter Output Capacity	115V to 130VDC (It is varying as per DC load sharing current requirement) DC Power: 30kW at 110V DC (BN, BD & Battery Charger loading on this).

ACU Functional Description

- Auxiliary converter is a PWM based IGBT Converter, which converts 285VAC-450VAC in to two outputs
- Output-1: 415Vac (L-L), 3-Φ, 50Hz
- Output-2: DC output is isolated from input by using DC-DC transformer. DC output is connected to BN Bus.

ACU Functional Description

ACU consists below modules/ sections:

- ✓ Input Section
- ✓ AC-1 Module (Line Converter & Inverter Section including Master)
- ✓ AC-2 Module (Line Converter & Inverter Section Including Master)
- ✓ 415Vac Output Section
- ✓ DC Converter Module
- ✓ DC Output Section
- ✓ DC Link Voltage Indicators
- ✓ Control & Communication Connectors
- ✓ Blower Section
- ✓ Isolation Switch.

Input section

- The input of the Auxiliary Converter is taken from the Independent Secondary winding's of Main transformer
- Input section consists of Input Fuse, Input Main & Pre- charging contactors & Input ac current sensor
- The purpose of input fuse is to protect DC link from over current
- The purpose of input ac current sensor is to control the Line Converter for regulating DC Link Voltage & to maintain unity power factor at input
- The purpose of Pre- charging Contactor & Resistor is to limit the DC link capacitor charging current at source sudden ON. It will be switched off when DC Link Voltage reaches to defined value
- The purpose of Input Main Contactor is to isolate the Unit from Source if any abnormalities in ACU.

AC-1 & AC-2 Modules

AC-1 & AC-2 modules consists of below sections:

- ✓ Line Converter Section
- ✓ Inverter Section
- ✓ Master & Module Control Section (both Control & Communication).

AC-1 & AC-2 Modules (Line Converter Section)

- The Line Converter section takes the input (variable Single Phase AC input) from secondary winding of main transformer and converts to fixed DC-link by controlling pulses of the IGBT's by using DSP controller
- Line converter maintains unity power factor at AC input. Full bridge architecture is used for the Line Converter
- Transformer primary, secondary,DC Link Voltages and Input AC current sensors are used for feedback control, display the parameters and protect the Line Converter
- Line converter output is connected to common DC Link.

AC-1 & AC-2 Modules (Inverter Section)

- The Inverter takes the input from Common DC Link. The IGBT based Inverter section is provided after DC Link capacitor. A three phase full bridge architecture is used for the Inverter
- An IGBT based Inverter is controlled by using DSP. Input voltage and output current sensors are used for feedback control, display the parameters and protect the inverter
- Temperature sensors are provided for sensing the heat sink temperatures of the IGBT modules and for protecting it
- DSP controller is used for PWM control of Line Converter & Inverter.

AC-1 & AC-2 Modules (Master Control Section)

- There is a controller which controls the Line converter & Inverter. It is also responsible for monitoring and protecting the complete Auxiliary Converter Unit and records the faults in the memory and also it interfaces to TCMS to get commands and to send status to display at driver cabin through Ethernet Communication
- It is also responsible for driving the contactors & to monitor it's healthiness by taking their feed backs.
- It is also responsible for handling & processing the hardwired signals which are coming from LCC.

ACU 415VAC Output section

- It consists of Sine Filter Inductor, Capacitor, Current Transformers, ELD Sensor & Output Contactor
- 3Ph 415V AC, which is passing through Sine filter Capacitors for filtering PWM Sine waveform to pure sine waveform. After filtering, the output is connecting to output terminal through output contactor
- ELD Sensor is used to measure the earth leak current if any AC Output live terminal touches to the body & to isolate the faulty section by tripping the contactor
- Current Transformer is used to feedback control, display the Output AC current and protects the Inverter
- The purpose of output contactor is to isolate the AC Module from load when AC Module fails.

ACU DC Converter Module

- DC Converter takes supply form Common DC-Link of AC2 and converts DC-Link voltage to isolated and regulated 110Vdc output by controlling pulses of IGBTs by using DSP controller
- DC Converter consists of H-bridge converter, isolation transformer, rectifier and filter
- DC converter shall also regulate output voltage to maintain current share at output
- An IGBT based DCDC Converter is controlled by using DSP. Output voltage and output current sensors are used for feedback control, display the parameters and protect the DC Converter
- Temperature sensors are provided for sensing the heat sink temperatures of the IGBT modules and for protecting it
- It is communicates with AC-2 module through CAN Communication.

ACU DC Converter Output section

- DC Converter Output section consists of DC Output Contactor, DC Output Reverse Polarity sense & BN-bus Voltage indication (for both Forward & reverse direction)
- The output of DC Converter is fed to BN (Battery Normal) loads, BD (Battery Direct) loads as well as Battery Charger
- DC Converter output is connected to BN-Bus terminals through DC Output contactor. It is used to isolate the DC Converter Module from load when DC Module fails and if any reverse connection at BN-Bus
- Contactor Driving, Monitoring, DC Output Reverse polarity check is done by AC-2 Master Controller
- Voltage indication card is used for visual indication of BN-Bus voltage availability & if any Reverse connections on BN-Bus.

ACU DC Link Voltage Indicators

- ✓ Voltage Indicators are used to indicate voltage availability at DC Link of AC-1, AC-2 & Input of DC Converter module by visual to avoid touching the power modules while servicing.

ACU Control & Communication Connectors

ACU consists of 2 types of Harting Connectors.

One is 16-pin for control connections. Below are the signal names

- Control supply (+Ve & -Ve) for AC-1 & AC-2
- AC-1 & AC-2 Output Contactor feed backs (NO & COM)
- AC-1 & AC-2 ON/OFF Signal & its ground
- Main Transformer Primary Voltage(PH & NU)
- AC-1 & AC-2 External fault status & its power supply.

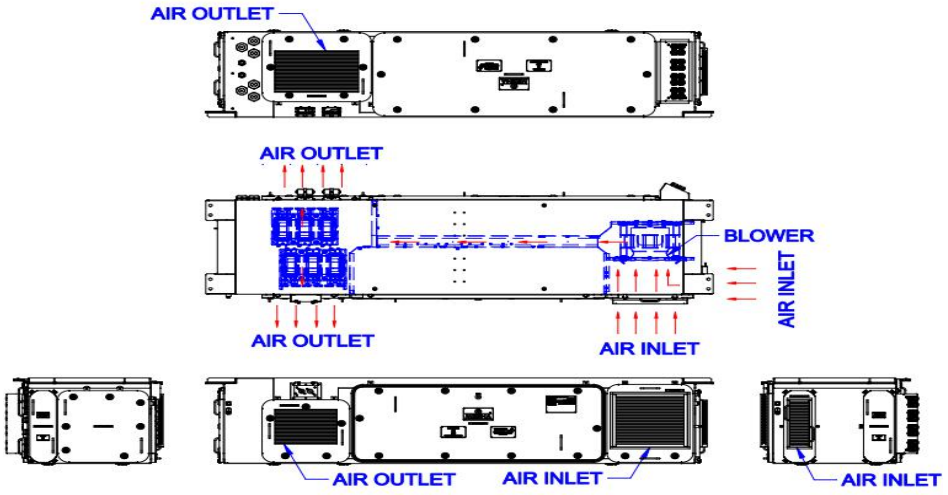
Second is Qunitax-4 type connector for Ethernet Communication. Below are the signal names

- AC-1 & AC-2 Ethernet main Tx & Rx
- AC-1 & AC-2 Ethernet Redundant Tx & Rx.

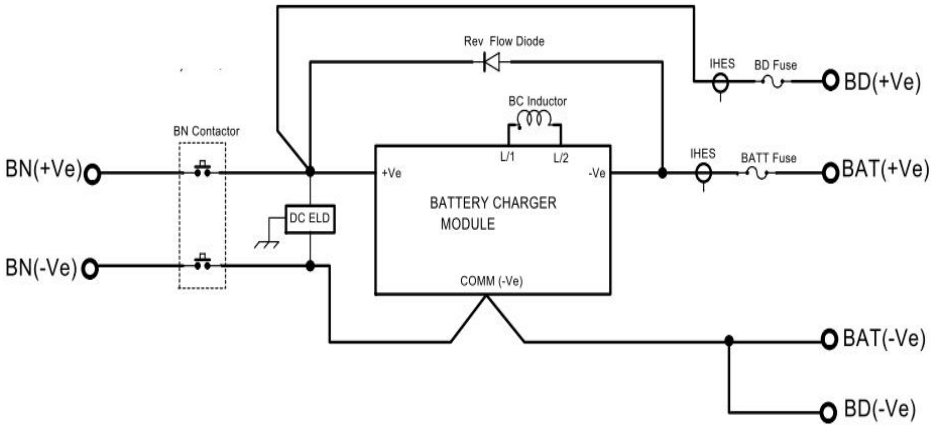
ACU Cooling system

- **ACU Cooling System:**
- Self contained blower is used for air cooling of the Auxiliary Converter. This blower takes 3phase 415Vac supply from AC-2 Inverter Output.
- Blower will take supply from AC-1 Inverter Output If AC-2 Inverter fails. This action will be done by using change over contactors based on health feed back of other AC.

AIR FLOW FOR ACU



BCS Block Diagram



BCS Electrical Data

Requirements	Parameters
DC Input Voltage	115V to 130VDC (From BN Bus i.e. from DC output of ACU)
Control Supply	77V to 137.5VDC from battery(110Vdc Nominal)
DC Output Capacity	77V to 121VDC (It is varying as per battery charging current requirement) Charging current: 33A (charging current limit is provided at 30A)

BCS Functional Description

Battery Charging System is a PWM based IGBT Converter, which is getting supply from BN Bus and charge the Battery with constant voltage & Constant current limit topology.

BCS Consists of below sections:

BN Contactor:

BCS is having one contactor called BN Contactor. It is used to isolate the BN Bus from Battery. BN contactor can be turned ON/OFF from driver cabin.

Battery charger:

Used to provide the 110Vdc Supply for battery charging by taking supply from BN-Bus (115Vdc-130Vdc).

Reverse Flow Diode:

It is used to provide the conductive path at the time of battery back up.

BCS Functional Description

Controller Section:

There is a controller used which is responsible for monitoring and protecting the complete Battery charger and records the faults in the memory and also it interfaces to TCMS to get commands and to send status to display at driver cabin

Fuses Section:

Consists of Battery Fuse,BD Fuse, Battery charger Input & Output Fuse. These are used to isolate the BCS from loads or source if any short circuit happen

Battery Charger Unit is made natural cooled design .

BCS Control & Communication Connectors

BCS consists of 2 types of Harting Connectors:

- ✓ One is 10-pin for control connections. Below are the signal names
- ✓ Control supply (+Ve & -Ve)
- ✓ BN Contactor ON,OFF & its Ground
- ✓ BN Contactor feed backs (NO & COM)

- ✓ Second is Qunitax-4 type connector for Ethernet Communication. Below are the signal names
- ✓ BCS Ethernet main Tx & Rx
- ✓ BCS Ethernet Redundant Tx & Rx

Questions please...?

Thank You