

## Chapter 11

# Power Supply Unit

The following figure shows the front of the Power Supply Unit (PSU).

**Figure 184: Power Supply Unit Front Panel**



### 11.1

## Power Supply Unit (PSU) – Theory of Operation

Dependent on its configuration the MTS is equipped with one or two high efficiency switch mode Power Supply Units (PSU). The PSU has a nominal AC input of 100VAC/240VAC (45-66 Hz) as well as a DC input of 48VDC.

The PSU:

- has the capability to charge a 48V backup battery during AC operation mod.
- provides several DC output voltages to supply Base Radios, Site Controller, ATCC and Fans
- complies with the appropriate CE marking, EMC, EMI and safety requirements.

There is an ON/OFF switch on the front panel of the PSU module which connects/disconnects DC output voltages.

The PSU operates in the following modes:

- DC only operation at -48VDC (within -41VDC to -60VDC).



**NOTICE:** DC operation mode does not allow any battery controlling.

- AC only operation at 100/240VAC (within 90 VAC to 264 VAC;) without battery charging.
- AC operation (within 90 VAC to 264 VAC;) and automatic switch over to DC backup battery operation when AC fails.



**WARNING:** Input Reverse Voltage Protection: The PSU is protected from damage due to a reverse polarity input connection. If the input polarity is reversed, the DC In Status LED will be solid red.

The MTS cabinet itself is wired to positive ground earth. The Power Supply Unit has a floating DC ground concept.

For more information on PSU technical specifications, see [Power Supply Unit Specifications on page 441](#).

#### 11.1.1

### PSU CAN Bus Monitoring, Alarms, and Controls

The PSU is monitored and controlled by the Site Controller. All monitoring outputs, alarm outputs, PSU ID number and control inputs are available through a CAN Bus. It is also possible to update the PSU firmware through the CAN Bus while the PSU is operational.

A unique identification of up to 4 PSUs is achieved by means of software. The assigned ID is used to identify the PSU on the CAN Bus for commands and alarms. For more information on CAN Bus, see [Site Controller on page 317](#).

PSU monitoring parameters that can be measured through the CAN Bus:

- PSU temperature: -30 °C to +100 °C, tolerance:  $\pm 2$  °C.
- Battery current: -20 A to +10 A, tolerance:  $\pm 1\%$ .
- Battery voltage: 30 V to 60 V, tolerance:  $\pm 1\%$ .
- Battery temperature: -30 °C to +100 °C, tolerance:  $\pm 2$  °C.
- 7 V output voltage: 0 V to 10 V, tolerance:  $\pm 2\%$ .
- 7 V output current: 0 A to 10 A, tolerance:  $\pm 2\%$ .
- 28.5 V output voltage: 0 V to 30 V, tolerance:  $\pm 2\%$ .
- 28.5 V output current: 0 A to 10 A, tolerance:  $\pm 2\%$ .
- PSU output power: 0 W to 1100 W, tolerance:  $\pm 2\%$ .
- Fan output voltage: 0 V to 30 V, tolerance:  $\pm 2\%$ .
- PSU input air temp.: -30 °C to +100 °C, tolerance:  $\pm 2$  °C.

PSU alarms available through CAN Bus:

- DC Source Fail: Indicating DC input voltage outside limits (below 43 V).
- DC Out Fail: DC output voltages out of limits.
- AC Source Fail: Early warning, indicating that the AC input is interrupted and the PSU starts to operate from DC input source in 15 ms. (if a backup source is present).
- Software Fail: Indicating software is corrupted or unable to initialize.

- Over Temperature: Indicating over temperature detected 5 °C to 10 °C before shutdown.
- Fan 1 alarm: Fan 1 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 1 through fan connector 1.
- Fan 2 alarm: Fan 2 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 2 through fan connector 2.
- Fan 3 alarm: Fan 3 not operating (fan has stopped or its running speed is below specification), PSU has received a high signal (open collector) from fan tray 3 through fan connector 3.

PSU Controls available through CAN Bus:

- FORCE DC: Controls the PSU to force the usage of the DC input if usable, disregard presence of AC. If DC is outside the usable range for the PSU, the PSU shall indicate an alarm using the DC-fail output. If DC input voltage comes below 43 V  $\pm$ 2% and if AC is usable the PSU shall take the input power from AC, disregarding a Force-DC control input.



**NOTICE:** Force DC operation on a bad DC supply PSU or Battery: Bad DC supply is defined as a DC source where the voltage drops below 43 V for a few milliseconds when the PSU is forced to operate on DC. In case of a force DC command and bad DC supply the 28.5 V output voltage is allowed to drop down to 27 V for a maximum of 5 second, while the PSU automatically switches back to AC mode and the 28.5 V rises from 27 V to 28.5 V. During this sequence the DC out alarm is suppressed.

- Fan supply output voltage is also controlled by the CAN Bus in 5 steps from 24 V to 12 V. The highest value is set by CAN Bus or automatically.
- DC operation only: Prevents AC fail alarms (and associated LED) from the PSU on CAN Bus when the PSU is supplied from DC only. If the AC supply becomes present during DC operation, the AC Source Fail alarm circuit is automatically be reactivated.
- AC operation only: Prevents DC fail alarms (and associated LED) from the PSU on CAN Bus when the PSU is supplied from AC only. If the DC supply becomes present during AC operation, the DC-Fail alarm circuit is automatically reactivated.
- No Fan 1: Prevents Fan 1 alarm (and associated LED) when no fan 1 is connected. If the Fan1 becomes present during operation, the Fan1 alarm circuit is automatically reactivated.
- No Fan 2: Prevents Fan 2 alarm (and associated LED) when no fan 2 is connected. If the Fan2 becomes present during operation, the Fan2 alarm circuit is automatically reactivated.
- No Fan 3: Prevents Fan 3 alarm (and associated LED) when no fan 3 is connected. If the Fan3 becomes present during operation, the Fan3 alarm circuit is automatically reactivated.
- Fan Factor: Fan factor is used to determine automatically calculated Fan supply voltage - the higher factor is specified the higher voltage is calculated. The Fan Factor range is 0.5 - 2.0 (by default 1.0). In systems with only one BR this factor is typically set to 1.0.

See the *MMI Commands* manual for additional information on commands and parameters.

### 11.1.2

## Backup Battery

The Power Supply Unit (PSU) handles the automatic switchover to a backup battery in the event of AC power supply failure. The MTS charges a backup battery during normal AC operation. The backup battery normally is located near to the cabinet.

This battery is connected to the DC connector on the front panel of the PSU through Junction Panel. Refer to [Hardware Installation on page 89](#) and [Interconnection and Internal Cabling on page 163](#) for more information.



**NOTICE:** The recommended batteries to be used are a Valve Regulated Lead Acid (VRLA) recombination type, with -48 VDC nominal. Such as Enersys Power safe VFT type.

### 11.1.2.1

## Backup Battery Charging Procedure



**NOTICE:** Selected Operation Mode: AC Operation

The backup battery charging output voltage is 40.5VDC to 57VDC and output current 0 to 6A.

A temperature sensor monitors the backup battery temperature to ensure optimum charging.

Available charge current is reduced linearly with increasing temperature from 6A to 0A when the PSU input air temperature increases from +30 °C to +60 °C

Charge voltage decreases with increasing battery temperature with the ratio of -72mV/C, starting with 56.88VDC +/-1% at -10 °C and ending with 52.56 VDC +/-1% at +50 °C

The PSU charges the backup batteries on the following conditions (**DC In Status** LED is flashing fast (0.5 s) red-green):

- Temperature range\*:-10 °C to +50 °C
- Battery Low Voltage start up:40V -5%/+1%
- Battery Low Voltage Warning:43V ±2%

The PSU stops charging the backup battery on the following conditions:

- Internal PSU temperature:> 100 °C
- Battery Temperature\*: -12.5 °C
- Battery Temperature\*:> 53 °C

\*When a temperature sensor is connected to the battery and PSU. If the battery sensor is not connected the battery will be charged with 54.24 ±1%VDC as if the battery temperature was 25 °C. The battery temperature monitored through CAN Bus will show 100 °C.

### 11.1.3

## Fans

The PSU supplies fans, which are located in the fan trays under the module cage. For more information on fans, see [Cooling Fans on page 367](#). The PSU DC output voltage dedicated for fans is 12 to 24VDC and the output current is 1 A for each fan.

Three fan output connectors supply three fan trays with two fans connected in parallel in each fan tray.

Fan supply output voltage can be automatically regulated as a function of PSU internal (ambient) temperature and its output power. Fan supply output voltage can also be controlled by the CAN Bus in 7 steps from 24V to 12V. The highest value wins – automatic control versus CAN control.

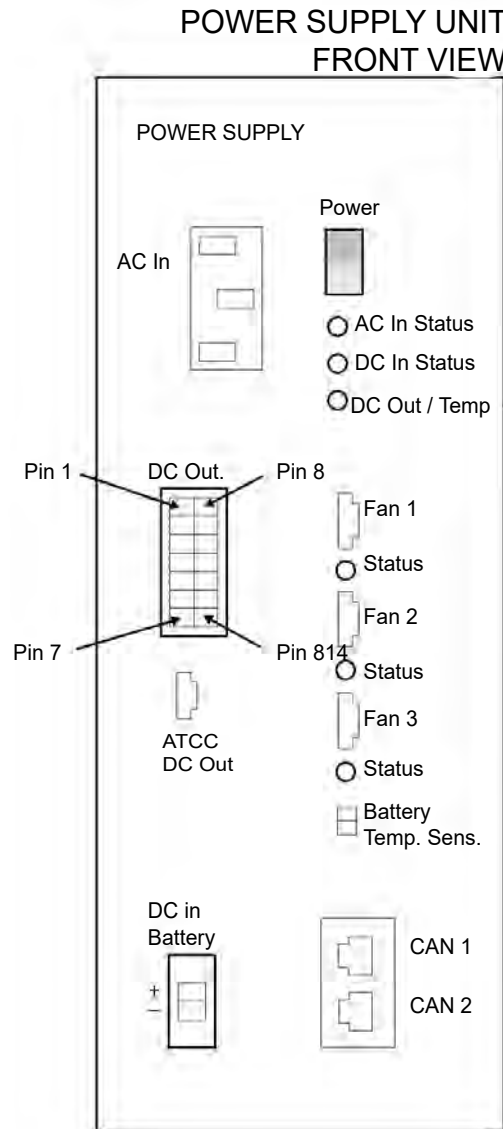
At an ambient temperature below -10 °C the fans are stopped and restarted again at -8 °C. The fan supply ramps up to 24V output for a few seconds in all start up situations.

### 11.2

## Power Supply Unit (PSU) Indicators, Switches, and Connectors

The following figure shows the positions of indicators, switches and connectors on the PSU front panel.

Figure 185: PSU Front Panel



11.2.1

**PSU LED Indicators**

The following table lists and describes the PSU LED indicators and [Figure 185: PSU Front Panel on page 361](#) shows their position.

Table 101: Power Supply Unit LED Indicators

LED Name	Color	Condition	Indications
<b>AC In Status</b> (AC input indicator)	dual color: LED green/red	AC input voltage is present and within limits	Green - solid
		AC input voltage is not present or below limits	Red - solid

LED Name	Color	Condition	Indications
		DC operations only mode	LED off or Orange – solid <sup>1</sup>
<b>DC In Status</b> (DC input and charging indicator)	dual color LED: green/red	PSU is supplied from DC input	Green - solid
		battery is being charged	Green/red flashing fast (2Hz)
		backup battery or a DC source supplies the PSU and the source voltage drops below 43VDC $\pm 3\%$	Green/red flashing slow (0.5Hz), shifting between red and green
		No source connected to DC input or the DC voltage is below 40,5V	Red - solid
		AC operations only mode	LED off or Orange – solid <sup>1</sup>
<b>DC Out / Temp.</b> (DC output and temperature indicator)	dual color LED: green/red	DC output voltages are present and within limits	Green - solid
		One or more of the output voltages failed	Red - solid
		Over temperature is detected, 5 -10 C before shutdown	Red - flashes
		PSU is in standby mode	LED off
<b>Fan # Status</b> (Fan indicator # near fan connector #)	dual color LED: green/red	Fan # programmed to operate and Fan # connected, operating and fan failure signal is high	Green - solid
		Fan # connected but programmed not to operate or Fan # voltage is out of limits or the fan failure signal is low	Red - solid
		Fan # not connected and programmed not to operate	No light
		Fan # not connected, at start up, but should have been as per CAN command	Red - flashing
<b>LED indication in boot mode</b> (firmware update through CAN)			

<sup>1</sup> in kits GMPN4227A and earlier

LED Name	Color	Condition	Indications
<b>Upper 3 LEDs</b> (AC In Status, DC In Status and DC Out/ Temp.)	3 dual color LEDs: green/red	only boot loader is running (meaning that the boot loader waits for an .exe file)	3 LEDs blinking together: R (red) R R -> G (green) G G, with 1 Hz frequency
		boot loader is loading a new hex file: (loading status)	R R G -> R G R-> G R R->... (circulating green LED)
<b>Fan indicators</b> 1 to 3		always	Red - solid

### 11.2.2

## PSU Switch

Table 102: Power Supply Unit Controls on page 363 describes the PSU switch and Figure 185: PSU Front Panel on page 361 shows its position.

Table 102: Power Supply Unit Controls

Control	Description
ON/OFF Switch	This switch disconnects DC outputs and charging currents.



#### NOTICE:

When the power switch is turned off the PSU still consumes 2 mA.

If left connected to the battery for a very long time with no mains power, it could discharge the battery.

### 11.2.3

## PSU Connectors

Table 103: Power Supply Unit Connectors on page 363 lists and describes the PSU connectors and Figure 185: PSU Front Panel on page 361 shows their position. For more information on PSU cabling, see Interconnection and Internal Cabling on page 163.

Table 103: Power Supply Unit Connectors

Name of Connector	Type	To/From	Comment
CAN1	RJ45	Site Controller	CAN Bus interface
CAN2	RJ45	Duplexer/ Post Filter/ ATCC/ Site Controller/ Terminator	CAN Bus interface
DC In Battery	Phoenix (2 pin)	Junction Panel	DC input and backup battery charging
AC In	IEC (high temperature version, male)	Junction Panel	AC input

Name of Connector	Type	To/From	Comment
Battery Temp. Sens.	MOLEX (2 pin)	Junction Panel	Connection with the backup battery temperature sensor
ATCC Out	MOLEX (2 pin)	ATCC	DC power supply for ATCC
DC Out	MOLEX (14 pin)	2 Base Radios and Site Controller	DC power supply
	Pin 1 - 3	GND	Base Radio
	Pin 8	+7 V	
	Pin 10 - 11	+28.5 V	
	Pin 4 - 6	GND	Base Radio
	Pin 9	+7 V	
	Pin 12 - 13	+28.5 V	
	Pin 7	GND	Site Controller
	Pin 14	+28.5 V	
Fan 1	MOLEX (4 pin, male)	Fan 1	DC supply for Fan 1
	Pin 1	+Vfan	
	Pin 1	-Vfan	
	Pin 1	-Vfan	
	Pin 1	Alarm	
Fan 2	MOLEX (4 pin, male)	Fan 2	DC supply for Fan 2
	Pin 1	+Vfan	
	Pin 1	-Vfan	
	Pin 1	-Vfan	
	Pin 1	Alarm	
Fan 3	MOLEX (4 pin, male)	Fan 3	DC supply for Fan 3
	Pin 1	+Vfan	
	Pin 1	-Vfan	
	Pin 1	-Vfan	
	Pin 1	Alarm	

### 11.3

## Replacing the Power Supply Unit (PSU)

See the PSU power up sequence in [Powering Up the MTS on page 154](#).



For a list of available FRUs, see [Field Replaceable Units \(FRUs\) on page 478](#).

**Process:**

- 1 Remove the PSU, see [Removing the Power Supply Unit \(PSU\) on page 365](#).
- 2 Install the Power Supply Unit into the cabinet, see [Installing the Power Supply Unit \(PSU\) on page 365](#).
- 3 Update the mapping list with the new unit TrackID, see [Updating the Mapping List with the New PSU TrackID on page 365](#).

11.3.1

## Removing the Power Supply Unit (PSU)

**Procedure:**

- 1 Switch OFF the Power Supply Unit.



**WARNING:**

Make sure that the facility power outlet is off to prevent accidental contact with high energy and injury to personnel.

- 2 Remove all cables.
- 3 Remove two M4x10 Torx 20 screws which secure the PSU front panel to the module cage. Save screws and washers for reuse. The washers are required in [Installing the Power Supply Unit \(PSU\) on page 365, step 2](#).
- 4 Pull out the Power Supply Unit from the module cage.

11.3.2

## Installing the Power Supply Unit (PSU)

**Procedure:**

- 1 Place the Power Supply Unit on the slide rails in the module cage and push it to the back.
- 2 Secure the Power Supply Unit to the module cage with the two M4x10 Torx 20 screws.
- 3 Connect the power supply cables and optional backup battery cables (AC in, DC in / battery).
- 4 Connect remaining cables according to labels attached before PSU removal.
- 5 Switch ON the Power Supply Unit.
- 6 Check the LED indicators to verify the PSU is operating correctly. See *MTS LiTE, MTS 2 and MTS 4 Installation, Configuration and Basic Service Manual*.

11.3.3

## Updating the Mapping List with the New PSU TrackID

**Procedure:**

- 1 Log on to the Site Controller.
- 2 Use the following MMI command to view the mapping list: `can check_mapping`.

**Step example:**

```
SC> can check_mapping
Units are present:
Device Track ID
DPM 1 JTH0500101
```

```
DPM 2 JTH0500105
Units are not present:
PSU 1 JTH0500200
Track ID not mapped:
JTH0500102
```

- 3 On the list, locate the unit that you have removed and that is indicated as `Units are not present`.
- 4 Delete old CAN Bus unit from the CAN Bus unit mapping list. Use `can remove_mapping <Device>`, where `<Device>` is the old unit name.

**Step example:**

```
SC> can remove_mapping psu 1
```

- 5 Add new CAN Bus unit to the CAN Bus unit mapping list.



**NOTICE:** The new unit Track ID is present on the replaced unit label and indicated as `Track ID not mapped` in the list shown in [step 2](#).

Use `can add_mapping <Device><TrackID>`, where `<TrackID>` is a Track ID of the new unit and `<Device>` is the new unit name: `psu X`, where X denotes a digit between 0 and 2.

**Step example:**

```
SC> can add_mapping psu 1 JTH0500102
```

- 6 View the updated mapping list using the `can check_mapping` command and check that there are no units labeled as `Track ID not mapped` or `Units are not present`.