Innovative Circuit Technology Ltd.

Hybrid Power Series
INSTRUCTION MANUAL
855-350-000

Models:

ICT-IPS-DC12-BMM	**ICT-IPS-DC12-BMMP**
ICT-IPS-DC12-BMMD	**ICT-IPS-DC12-BMMDP**
ICT-IPS-DC24-BMM	**ICT-IPS-DC24-BMMP**
ICT-IPS-DC24-BMMD	**ICT-IPS-DC24-BMMDP**

⚠ WARNING

Risk of serious personal injury or damage to equipment and property! Always observe the following:

- Install and operate unit in a restricted access location. A restricted access area is an area to which access can be gained only by service personnel through the use of a special tool, lock and key, or other means of security and which is controlled by the authority responsible for the location
- Install unit in locations where children are likely not to be present.
- Install Earth connection to the unit before connecting AC input due to high leakage current.
- Use caution when handling unit under load as surface can reach hot temperature.
- Operate the supply from a grounded 3 wire 120Vac or 230/240Vac source (50 or 60Hz) with a branch circuit breaker rated 30A or less.
- **The DC-DC converter module is NOT hot pluggable**. Do not open unit. Module maybe service only by qualified personnel due to hazardous voltage inside.

Always observe the following for applications requiring a backup battery:

- Use only a Lead-Acid or Lithium-Ion battery with rating and capacity appropriate for the model of supply in use
- If a Lithium-Ion battery is used, it must have an integrated battery management system (BMS) to protect the battery cells from inappropriate voltage or current levels
- Use an appropriate DC over-current protection device in line with the back-up battery connection
- Use a disconnect switch or circuit breaker in series with the battery connection, to ensure installation and service is done with the battery de-energised
- Use wire and connectors rated for the maximum load current
- Ensure battery polarity is correct before connecting
- Do not attempt to charge a frozen battery
- Handle batteries with care, never short circuit battery terminals
- Always install batteries in a well-ventilated area
- Always consult with battery manufacturer and observe all battery manufacturer recommendations.

⚠ CAUTION

Risk of personal injury or damage to equipment! Always observe the following:

- Install in a protected environment, keep sources of moisture away from unit
- Ensure the total power consumption of the load does not exceed the continuous rated capacity of the power supply output or the DC-DC converter output and input
- Do not block air inlet or outlet openings in the unit
- Do not place the power supply directly above or below an exposed battery, due to possible presence of corrosive and/or flammable gasses

Rev 0 (2023)
Hardware version: 04

Contents

INTRODUCTION

The Hybrid Power Series is a complete and flexible 1RU DC power system with intelligent networked monitoring and control, advanced battery management, and 12 V or 24 V integrated DC output converter option in a 19" chassis. The power shelf can accommodate a factory-installed Intelligent Control Module (ICM) with front graphic display and up to three hot-swappable 700 W or 1500 W 24 or 48 V primary DC output power modules. One slot will be configured with a factory-installed Battery Management Module (BMM) with low voltage disconnect (LVD) contactor, with one or two 100 A circuit breakers.

Primary DC output power module specifications:

Power Module	24V 25A ICT700-24PM	48V 12A ICT700-48PM	24V 54A ICT1500-24PM	48V 27A ICT1500-48PM
Output Voltage adjustment range (V)	23.0 – 31.0	46.0 – 62.0	23.0 – 31.0	46.0 – 62.0
Default Output Voltage (V)	27.6	55.2	27.6	55.2
Output Current Limit adjustment range (A)	5 – 25	2.5 – 12.5	5 – 54	3 – 27
Default Current Limit (A) (+5%, -0%)	25	12.5	54	27

A typical configuration is illustrated below. This unit consists of a power shelf with an Intelligent networked Control Module (ICM), two primary DC output power modules, a dual input Battery Management Module (BMMD), and an integrated DC Output Converter module. This single 1RU hybrid power system provides up to 3000 watts of DC power with built-in Ethernet, LVD, advanced battery management, and a DC converter providing up to 700 watts of 12 or +/- 24 VDC output.

Figure 1: Typical Hybrid Power Series Configuration

INSTALLATION

Check Unit

Perform a physical check of the unit as it is being taken out of the box to ensure it has not been damaged during shipping. Check that the system configuration matches the version ordered, and that the following accessories were shipped with your unit:

- Instruction Manual
- Removable 3 pin AC input wire clamp connector plug (in bag)
- Removable 7 pin alarm and temp sensor wire clamp connector (in bag)
- Removable 3 pin Form-C alarm relay connector (in bag)
- Plastic u-shaped cover with four 6-32x1/4" screws for output bus bars (in bag)
- Two rack mounting ears (installed)
- Two bolt/washer/nut sets for connections to the output bus bars (in bag)
- Two bolt/washer/nut sets for connections to the Battery Management Module bus bars (in bag)
- Remote battery temperature sensor (ICT-TMP) included when a BMM is installed in the shelf

Configure a System

A complete Hybrid Power Series system will consist of at least one power shelf with the Intelligent Control Module (ICM), one to two matching 700W or 1500W Primary DC output power modules, one integrated DC output converter and Battery Management Module (BMM). A secondary shelf may also be used to add up to an additional four modules to a system, two of which may utilize a Load Distribution Module (LDM). The ICM, BMM, and LDM are factory-installed options, but the primary DC power modules are hot-swappable and can be used in any of the remaining slot locations in a power shelf.

Standard Hybrid Power Series Versions:

Description	Model No. (negative V output)	Model No. (positive V output)
Intelligent Power Shelf with integrated Ethernet controller. Factory-installed 100 A Battery Management Module with LVD and 700 W 12 V integrated DC converter output.	ICT-IPS-DC12-BMM	ICT-IPS-DC12-BMMP[1]
Intelligent Power Shelf with integrated Ethernet Controller. Factory-installed 200A Battery Management Module with LVD and 700 W 12V integrated DC converter output.	ICT-IPS-DC12-BMMD	ICT-IPS-DC12-BMMDP[1]
Intelligent Power Shelf with integrated Ethernet Controller. Factory-installed 100A Battery Management Module with LVD and 700W 24W integrated DC converter output.	ICT-IPS-DC24-BMM	ICT-IPS-DC24-BMMP[1]
Intelligent Power Shelf with integrated Ethernet Controller. Factory-installed 200A Battery Management Module with LVD and 700W 24V integrated DC converter output.	ICT-IPS-DC24-BMMD	ICT-IPS-DC24-BMMDP[1]

Contact ICT for other possible Hybrid Power Series configurations

Primary DC Output Power Module Models

Description	Model No.
24V 700W primary DC output power module (27.6V, 25A)	ICT700-24PM
48V 700W primary DC output power module (55.2V, 12.5A)	ICT700-48PM
24V 1500W primary DC output power module (27.6V, 54A @ 230Vac)	ICT1500-24PM
48V 1500W primary DC output power module (55.2V, 27A @ 230Vac)	ICT1500-48PM

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[1] Suffix "P" denotes shelf configured for positive battery voltage. Blank denotes negative battery voltage (i.e., for use with a -48 V system)

Available Accessories:

Description	Model No.
Blanking plate for unused power shelf positions (snap-in)	ICT-BPM
Remote battery temperature sensor (1pc included with power shelf/BMM)	ICT-TMP
Secondary power shelf parallel output bus bar jumper strap (for two power shelves)	ICT-PAR
Secondary power shelf parallel RJ11 control cable jumper (4")	ICT-JMP

Set Up the 1 RU Hybrid Power Shelf:

Ensure you have the correct power shelf, with the BMM factory configured for positive or negative battery voltage (See shelf model numbers above). Check that you have the correct number of matching power modules for your application.

- Install one to three matching hot-swappable power modules - with the same voltage and power rating - in any remaining open shelf positions. The primary DC output power modules will share the total output load, automatically disconnecting from the internal power bus in the event of an internal failure, and may be "hot-swapped" (you can insert or remove a module while the shelf is powered) If you need "N+1" redundancy, ensure the combined power rating of all the installed primary DC output power modules exceeds the total requirement of the planned load by at least 700 W (for 700 W power module) or 1500 W (for 1500 W power module). (N+1 operation requires excess power module capacity to ensure that the load can be fully powered, even if one power module should fail or be removed)

- Carefully align each power module with the internal shelf guides. Firmly push the module into the connectors in the slot. When the latch clicks and the module is flush with the front plate, it is fully installed (see Figure 2). Note that Power Modules can be easily removed by pressing the release latch located under the module handle to the right while firmly pulling the module from the Power Shelf.

    [NOTE] (The shelf may be left powered on while swapping modules)

- Snap (do we want "snap" or "install") in a shelf blanking plate (ICT-BPM) into any unused shelf positions to prevent accidental access to the internal circuitry of the shelf.
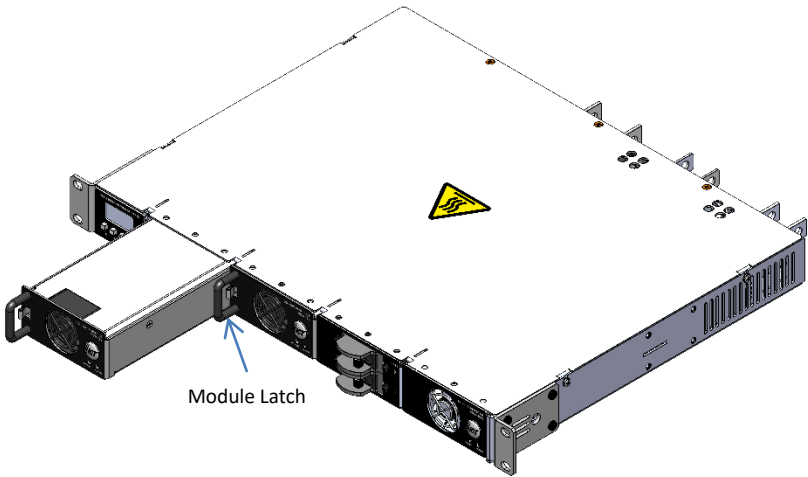
Figure 2: Installing Power Module in a Hybrid Power Shelf

Install Unit

⚠ WARNING

Risk of serious personal injury or damage to equipment and property! Always observe the following!

- When using a backup battery ensure the nominal battery voltage is correct for the model of power modules installed, and that the battery positive is connected to the positive (+) terminal and the battery negative is connected to the (-) terminal. **Note that the BAT terminal on the BMM may be internally tied to the (+) or (-) shelf output through the LVD contactor, depending on the polarity of the power shelf used (see the application note of DN-113v3, "Understanding -Polarity")**
- Use an appropriate DC over-current protection device such as a fuse or circuit breaker in-line with and near to the battery connection
- Do not tie either power shelf main output to the BAT terminal on the BMM, as this may short circuit the battery or bypass the internal LVD circuitry in the BMM
- Make any earth ground connection to only a single LOAD or BAT terminal if required. Do not ground both the load and battery as this may bypass the internal LVD circuitry
- AC input wiring to the Hybrid Power Series unit must be protected using an outlet with a branch rated circuit breaker of 30 A or lower value

Check that the system Output Voltage and Current Limit match the requirements of the battery and the loads to be connected (see the section of "System Status" for details on setting your voltage and current limits).
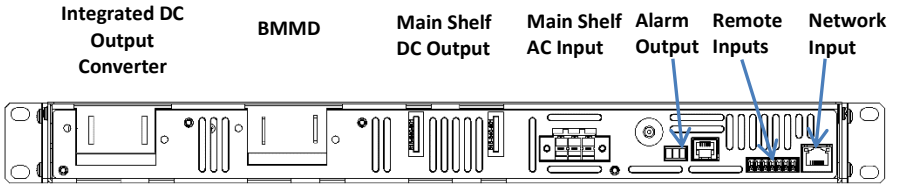

Figure 3: Typical Rear View (Showing BMM, DC Output Connectors)

Mount the unit in an enclosed standard 19" equipment rack or other restricted access location, using rack mounting screws (not supplied). Support the rear of the unit with rack shelf supports or back rail if desired.

Make connections to the load using wire and connectors appropriately rated for the maximum output current capability of the unit. The load may be powered two different ways:

Load Connection Point	Features
Directly from main shelf DC output bus bars	Full current rating of the shelf is available to operate the load, limited only by the maximum output capability of the combined power modules
Integrated DC Output converter bus bars	Fully isolated, 12 V or 24 V, 700 W maximum

- The integrated **DC output converter** output has **POS** and **NEG** terminals. Ensure polarity is correct when connecting the load.
- Connect a ground bonding wire from the chassis ground stud to the rack.

See the following Hybrid Power Series block diagram for internal details on connection options.

[NOTE] Note that a **NEGATIVE BATTERY** voltage (typically -48V) system shelf is shown. A **POSITIVE BATTERY** voltage (+12V or +24V) system power shelf will have the BMM and internal back plane power connection made to the **DC+** bus.
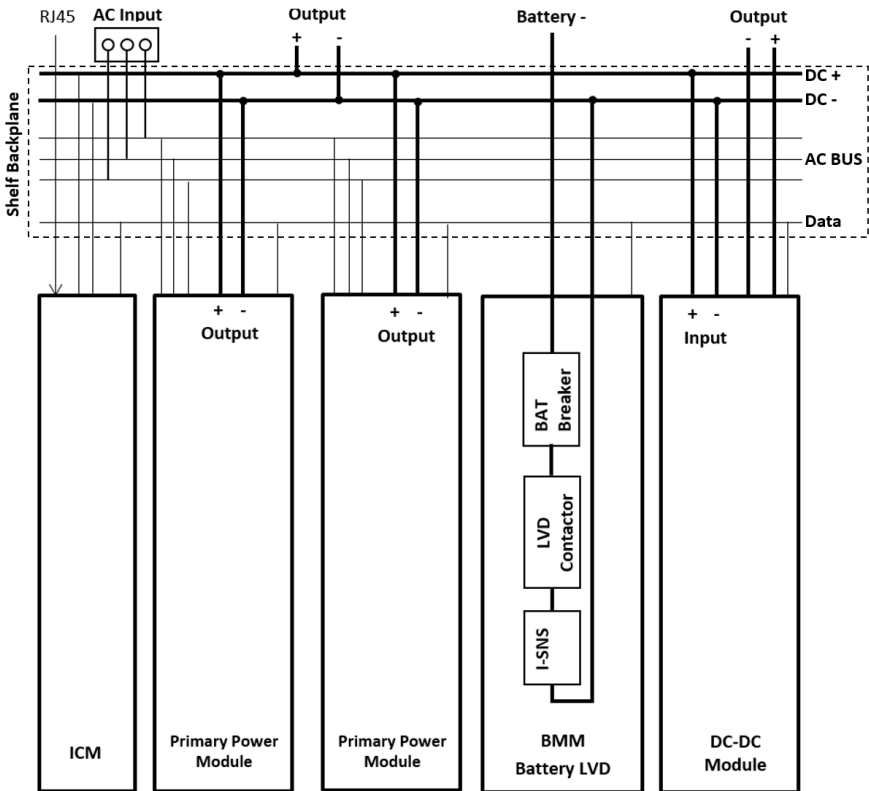
Figure 4: Battery Backed Hybrid Power Shelf – Internal Block Diagram (NEG. V Output)

Make Sensor and Alarm Connections

- Connect the Form-C alarm contact monitoring wiring to the ALARM Output connector if needed, as shown in the following table. On a dual-shelf system the primary shelf contacts are flagged for all system alarms while the secondary shelf contacts indicate secondary power module faults only.

Pin Number	Name	Function
1	NC	Alarm NC (alarm state)
2	NO	Alarm NO (alarm state)
3	Common	Alarm output common

Alarm Output Connector: (use 22-26 AWG wire)

- Connect the external Battery Temperature Sensor (ICT-TMP, included with a BMM equipped shelf, for use with lead-acid batteries only) to the REMOTE input plug on the back panel (see Remote input table, below), to compensate the shelf output voltage according to the battery temperature. Mount the sensor to the mid-level side of the middle battery in a battery

string using the adhesive backed clip, as shown in Figure 5. The rate of voltage compensation can be adjusted via the ICM front panel interface, or the WEB GUI in the Battery Backup Settings & Control tab. The default compensation is 0mV/C per cell (no compensation adjusts this according to the battery manufacturer's recommendation to enable charge voltage temperature compensation. Battery temperature is assumed to be 25° C if no sensor is installed.
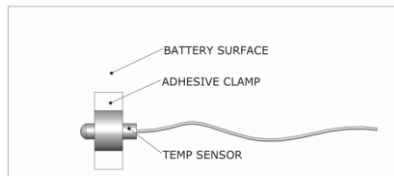

Figure 5: Battery Temperature Sensor Installation

- Install wiring to monitor up to four external voltage free alarm contacts, typically for external sensors such as a door or window switch, smoke detector output, or water detector etc. Enable the alarm inputs and set the contact logic (normally open or contact normally closed) in the WEB GUI, Alarms Settings & Control tab.

Pin Number	Name	Function
1	Alarm 1	Remote alarm 1 input
2	Alarm 2	Remote alarm 2 input
3	Alarm 3	Remote alarm 3 input
4	Alarm 4	Remote alarm 4 input
5	Alarm Return	Common remote alarm return point
6	Bat Temp	Remote Battery Temperature sensor
7	Bat Temp	Battery temp sensor return

Remote Input Connector: (use 22-26 AWG wire)

Make Battery Connections to BMM
The BMM provides a convenient and safe way to connect an external lead-acid or lithium-ion back-up battery to the Hybrid Power Series. A 100 A high current hydraulic-magnetic circuit breaker provides over current protection, while an internal LVD contactor will disconnect the battery should it discharge below a safe level. Internal battery current monitoring provides a full suite of remote battery charge monitoring features.

⚠ **WARNING**

Risk of serious personal injury or damage to equipment and property! Always observe the following!

- When connecting a battery ensure the nominal battery voltage is correct for the model of power modules installed, and that the battery positive is connected to the positive (+) terminal and the battery negative is connected to the (-) terminal. Note that the BAT terminal on the BMM may be internally tied to the (+) or (-) shelf output through the LVD contactor, depending on the polarity of the power shelf used. **Check shelf model polarity before connecting a battery to the BMM! (see the application note of DN-113v3, "Understanding -Polarity")**

- Only use the Equalize Charge setting for flooded lead-acid batteries in a well-ventilated location. **Do not use Equalize Charge on sealed batteries!** Always consult with battery manufacturer and observe all battery manufacturer recommendations.

- If a lithium-ion battery is used, it must utilize an integrated battery management system (BMS) to protect the battery cells from inappropriate voltage or current levels.

- Do not tie either of the power shelf main outputs to the BAT terminal on the BMM, as this may short circuit the battery or will bypass the internal LVD circuitry in the BMM.

- Make any earth ground connection to only a single LOAD or BAT terminal if required. Do not ground both the load and battery as this may bypass the internal LVD circuitry.

- Use wire and connectors appropriately rated for the highest possible system current when making connections to the battery, BMM, and power shelf

Note: Check that the default system output voltage and current limit match the requirements of the battery and the loads to be connected. Adjust the system Output Voltage and Current Limit (see System Settings & Control tab) to match the combined battery and system load requirements before making final connections, if required. **Use only identically rated battery strings for the dual battery BMMD option** to ensure equal charging of each battery set.

Verify the polarity of the BMM installed in your power shelf by noting the label under the rear BMM BAT bus bar input. ("**BAT +**" indicates a positive battery voltage system with the LVD contactor and battery breaker internally connecting this terminal to the shelf **"POS" output**, while "**BAT –** "indicates a negative battery voltage system, with the LVD contactor and battery breaker internally connecting this terminal to the shelf **"NEG" output**)

Use wire and connectors appropriately rated for the highest possible system current when making connections to the battery, BMM, and power shelf. Connect the battery hot lead (see comment on polarity, above) to the BMM BAT bus bar, and the battery return lead to the main shelf output bus bar of the corresponding polarity. (i.e.: a **positive voltage** system will have the battery (+) tied to the BMM terminal, with the battery (-) tied to the main NEG output busbar, a **negative voltage** system will have the battery (-) tied to the BMM terminal, with the battery (+) tied to the main POS output busbar.
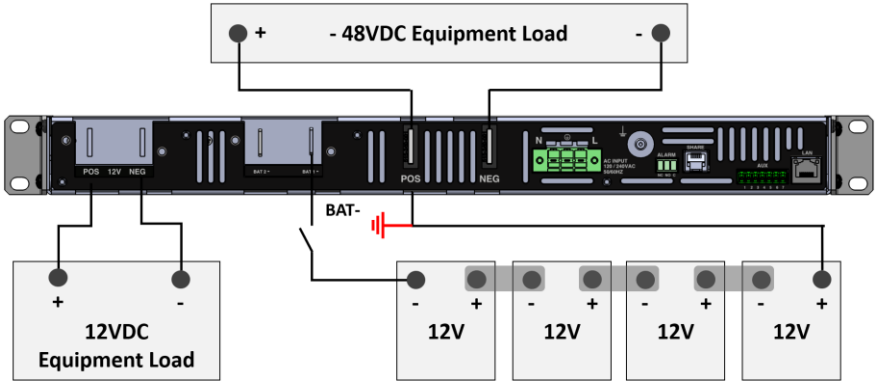

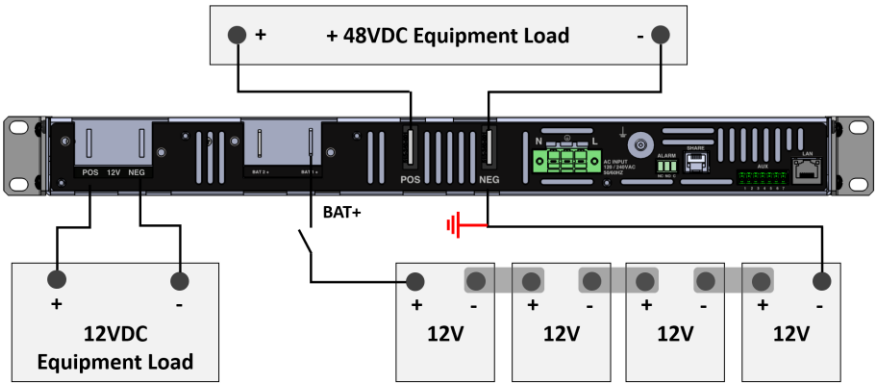Figure 6: Negative voltage (positive ground)

Figure 7: Positive voltage (negative ground)

Available BMM Variations:

-V BAT	+V BAT	Description	Connections
BMM	BMMP	Single 100 A battery circuit breaker with LVD contactor with advanced battery management capability	Single BAT input bus bar (+ or – polarity, see note above)
BMMD	BMMDP	Dual 100 A battery breakers to connect two identical battery strings through an LVD and current sensor with advanced battery management capability for the combined battery	BAT 1 and BAT 2 input bus bars (both either + or – polarity, see note above)

Finalize all Shelf Wiring

Make a network connection: Connect a 10/100Base-T Ethernet cable to the RJ45 LAN port on the back panel to allow for remote monitoring and control of the power shelf.

(See the Network Monitoring and Control section for information on configuring and using the built in Web-GUI, e-mail, or SNMP functions)

Check that all connections to the power shelf are correct and tight; install the plastic bus bar cover(s) using the original screws provided.

Connect the AC power source: De-energise the AC source by switching off its circuit breaker. Create a power cable using 3 conductor cord rated for the maximum possible input current of the unit (up to 27 A for a 2800 W configuration operating from a 120 VAC line) by stripping and terminating the three wires in the Line, Neutral, and Ground terminals of the removable AC input connector provided with the unit (AC line labeled "L", neutral labeled "N" and safety ground to the middle pin).

Plug the AC connector into the AC input on the power shelf back panel, and tighten the captive retaining screws.

Wire the source end of the cord to the de-energised AC supply equipped with a branch rated circuit breaker of 30A or less.

Optional Parallel Shelf Installation
Use a secondary power shelf for applications that require up to an additional two or three power modules. The secondary shelf has no internal ICM, as it is

controlled and monitored by the ICM on the primary unit, requiring only an additional AC line input connection, a control jumper cable (ICT-JMP) connection, and the installation of tie bars (ICT-PAR) to parallel the shelf outputs. **Do not attempt to connect shelves in series, they are meant for parallel operation only!**

The master and the secondary power shelf must be installed as a set into adjacent rack locations to ensure the output power tie bars and control cable jumper will correctly fit.
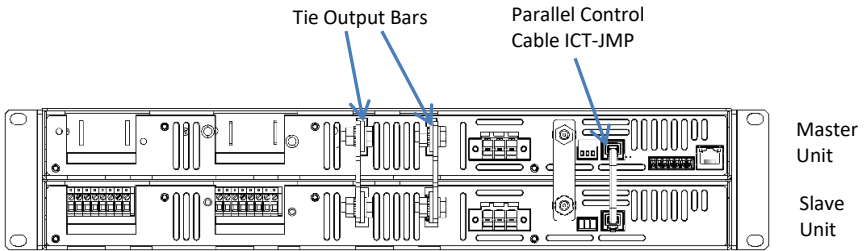

Figure 8: Primary and Secondary Shelf connected in Parallel

⚠ CAUTION

Risk of damage to equipment!
- Do not use the internal BMM battery LVD contactor for parallel applications where load current can exceed the 150A maximum rating of the LVD contactor
- Do not parallel BMM modules. A battery connection may be made to a single BMM module, with maximum battery current not to exceed the rating of the individual BMM unit (150A)

Install the Shelf Paralleling Bus Bars (ICT-PAR) and plastic bus bar covers as shown in Figure 8, using the hardware included with the Hybrid Power Series.

Install the Parallel Control Cable (ICT-JMP) connecting the two RJ-11 style SHARE ports as shown in Figure 8 to allow the Primary ICM to control the secondary shelf. (Shelf slots 1 to 4 (front, L to R) are on the main shelf, slots 5 to 8 (front, L to R) on the secondary shelf)

Connect alarm monitoring wiring to the Form-C contacts on the secondary shelf if desired, to remotely monitor for secondary shelf module alarm conditions.

Connect a load to the parallel shelf outputs to utilize the combined power of all power modules installed in the two shelves, or connect the loads to the back panel output ports of any installed LDM modules for built in intelligent power distribution.

Connect a separate AC power cord to each shelf, using independent AC circuits rated for the full power operation of each shelf.

OPERATION (Front Panel)

Switch on the external AC power source circuit breaker, and check that the green POWER LED is lit on each power module, and that the ICM front graphic display is lit.

Your Hybrid Power Series will start up and operate at the factory default settings when AC power is connected, generally requiring no other set up or adjustment for basic operation.

Use the web-GUI or the front graphic display on the ICM to monitor the unit operation and to make changes to settings such as output voltage, current limit, and battery low voltage disconnect points. (The display will go off after approximately 60 minutes of no use, and can be re-activated by momentarily pressing any of the front control buttons.)

Figure 9: ICM Front Control Interface – System Status Screen

The ICM Interface panel consists of the following elements:

System Display screen: Default System Status screen shown in Figure 9 displays the shelf output voltage, the AC input voltage, and the total output current. (Numerically, and with a graphical indication of relative magnitude of system output current level) The screen will also show any active alarm conditions, and the current reading will flash to indicate when the unit is operating at its current limit.

Up/Down ▲ ▼ Buttons: Use to scroll through display screens, and to adjust selected settings

Enter ◀┘ Button: Press to select a screen for adjustment, or to enter a new value after adjustment

Back X Button: Press to return to the previous higher level menu item, or to exit from a setting without making any change

See the complete menu structure in the following diagram. Navigate through the various screens using the up and down arrows, the back button, and the Enter button.

Note that output voltage and current limit settings apply to the combined output of all installed power modules. The ICM treats the combined modules as a single high-power supply. Adjust the system output Voltage and Current Limit (see System Settings section) to match the battery type and system load requirements if required.

System Status

The main system status screen will show most current operating conditions for the unit, primarily the Input Voltage (VAC), the Output Voltage (VDC), and the total Output Current (A) (Flashing when at the set current limit). Other information will be shown depending on the operating state of the unit:

- A small thermometer symbol to indicate that the remote temperature sensor is installed and may be compensating the output voltage
- A bar graph indicating relative output current
- Indication that the output has been disabled (off)
- Indication that a battery discharge test is in process

System Settings: The Output Voltage and output Current Limit settings come with factory default values that should be adjusted to match your actual system and battery float voltage requirements, as shown below:
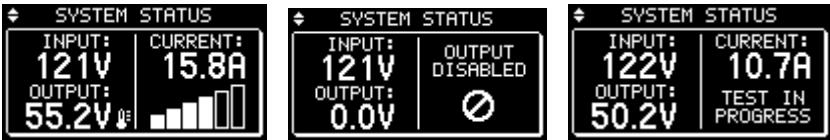
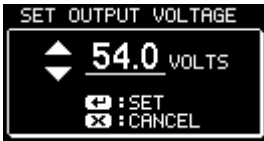Press Enter to move to the System Settings
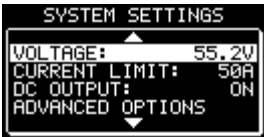
Scroll to highlight the parameter to change

- System Voltage
- Max total Output Current Limit
- Output Enable ON/OFF (default = ON)
- Advanced Options (Set screen Password, Clear Password, Set screen Lockout timer, Reset Comm settings to defaults)

Press Enter to select

Scroll to adjust parameter (Output V shown), press Enter ◄┘ to set value. Press Back **X** to return to System Settings Screen


Alarms will be shown as they occur, press Back **X** button to return to the Status screen, press Enter ◄┘ for Alarm History info

Once the Output Voltage and Current Limit values are configured to suit the connected battery and loads, switch on the BMM battery breaker 1, and battery breaker 2 (if installed) to connect the backup battery string(s) to the system.

Battery Management Module

The Battery Management Module (BMM) provides a convenient and safe way to connect an external back-up battery (or 2 matching battery strings with the BMMD) to the Hybrid Power Series. A 100 A high current hydraulic-magnetic circuit breaker (two breakers on the BMMD) provides over current protection, while an internal LVD contactor will disconnect the battery should it discharge below a safe level. Internal battery current monitoring provides a full suite of remote battery charge monitoring features.

The BMM Status Screen indicates the Battery Voltage (VDC), the combined Battery Current (+ A for charging, -A for discharging), the approximate battery State of Charge (SOC %), and a bar graph showing relative magnitude of the total battery current. A battery graphic marked with **X** indicates the battery is disconnected, replacing the SOC reading, as shown below.
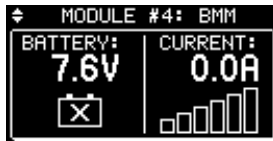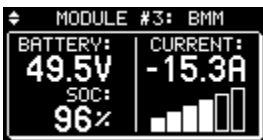
BMM Status Screen with Battery-Disconnected icon

The SOC% is estimated by counting the ampere-hours (Ah) flowing into and out of the battery while knowing the nominal rated capacity of the battery (See **BMM Settings** Screen below to adjust the battery Ah capacity) The system resets the SOC to 100% whenever it detects that the battery is at the rated Float Voltage with minimal charge current for at least 24 hr.

BMM Settings (All Battery Types): The module comes with factory default settings loaded that should be configured to match the actual battery used in the system.

⚠ WARNING

Always consult battery manufacturer's specifications when selecting battery type. Incorrect battery type setting may damage your battery.
If Lithium-Ion type battery is selected, it must utilize an integrated battery management system (BMS) to protect the battery cells from inappropriate voltage or current levels.

Configure the **Battery Type** of the battery used in the system (Lead-Acid or Lithium-Ion). If Lithium-Ion type battery is selected, the following battery parameters and settings will be unavailable: Battery State of Charge, Run-time Remaining, Voltage Temperature Coefficient / cell, Equalize Charge, and Battery Discharge Test; these should be available from the li-ion battery's integrated BMS.

Adjust the **LVD** contactor **Disconnect** and **Reconnect Voltage** according to the battery manufacturer's recommendations.

Set the **Battery Charge Current Limit** to limit the maximum battery charge current provided, while still allowing the full rated current to be drawn from the main output.

Set the **Battery Overcurrent** Alarm level (A) to trigger an Alarm for excessive discharge current or charge current. (set to 0 A to disable this alarm)

Configure the combined **Battery Capacity** (Ahr) as well as the **Battery Rate** (hrs) used in the battery specification to determine the battery capacity. (Usually, will be 20 hr or 10 hr rate.) If a lead-acid battery is connected to the system, this information is used to estimate the battery state of charge. Note that series connected batteries have the Ahr capacity of a single battery, while connecting batteries in parallel increases the total Ahr capacity.

BMM Settings (Lead-Acid Batteries only): The following additional settings are only available if the system is configured for use with a lead-acid type battery:

Set the **Low SOC Alarm** (%) if desired, to raise an alarm when the battery is nearly discharged.

Ensure the Battery Temperature Sensor (ICT-TMP) is installed and connected to the battery case (see **Make Sensor and Alarm Connections** in the Installation section) for optimal lead-acid battery charging and best battery life. Set the **Temperature Compensation/°C** level per battery cell to match the recommendation of the battery manufacturer. (-4 mV/°C per cell is typical)

Configure the **Battery Equalize Charge** voltage, duration, and automatic repeat interval if desired <u>when using flooded lead-acid type batteries only</u>. The system will step up the output voltage to the Equalize Voltage for the Equalize Duration time whenever the Equalize Status is set to Enable.

⚠ **WARNING**

Use the Equalize Charge setting for flooded lead-acid batteries in a well-ventilated location only. **Do not use Equalize Charge on sealed batteries!**

Configure the Battery **Discharge Test** to check on the battery's ability to power the system for a set duration. Set Max Discharge Time, minimum Stop Voltage, and the automatic repeat Interval if desired. Each time the test is run the output voltage from the power modules will be reduced so that the external battery will power the system load until either the Max Discharge Time limit or the Stop Voltage is hit. A **Discharge Test Complete** notification (on the front display and with an e-mail if messaging is configured via the Network GUI) will indicate a **Test Failure** if the Stop Voltage is hit before the Max Time limit, as the battery was not able to power the load for the desired duration.

A Battery Discharge Test of a fully charged battery can be manually initiated by changing the discharge test Status parameter to **Enabled**.
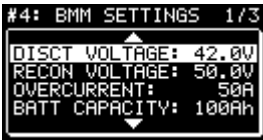
Optional BMM versions are available which have the status screens shown below:
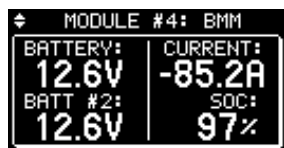
Dual Battery String BMMD Status Screen
- Battery 1 Voltage
- Battery 2 Voltage
- Combined Battery Current
- Combined SOC%

Press Enter to move from the Status screen to the BMM Settings screen

```
#4: BMM SETTINGS  1/3
▲
DISCT VOLTAGE: 42.0V
RECON VOLTAGE: 50.0V
OVERCURRENT:     50A
BATT CAPACITY: 100Ah
▼
```

Scroll to highlight parameter to change

▲ ▼

- LVD Disconnect V
- LVD Reconnect V
- Charge Current Limit
- Over Current Alarm level
- Battery Type
- Battery Capacity (Ahr) rating
- Battery discharge rate (hrs) used for capacity spec. (typically either 10 or 20hrs)
- Low SOC Alarm
- V Temp-co/cell (default = 0, typ = -4mV/°C)
- Equalize Charge & Discharge Test settings

⬅ Press Enter to select parameter to adjust

```
BMM DISCHARGE TEST
▲
MAX TIME:     60 min
STOP VOLTAGE: 44.0V
STATUS:        READY
▼
```
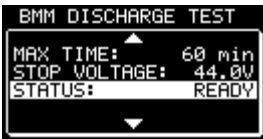
▲ ▼ Scroll to choose parameter in selected sub-menu. Press Enter ⬅ to select that item for adjustment

```
DISCHARGE TEST
STATUS:    COMPLETE
DISCH TIME:   60 min
END VOLTAGE: 46.18V
AH DISCHARGED:   6Ah
    ✖:BACK
```

A notification will automatically appear indicating the results of a Discharge Test at completion of the test

Integrated DC Output Converter Module

The Integrated DC Output Converter Status screen shows the input and output voltage of the integrated DC Output Converter, the output current, and indicates if the output has been switched OFF.

Integrated DC Output Converter Settings: Changes can be made to the Output Voltage, Current Limit, and Output Enable (ON/OFF) settings of the integrated DC output Converter.

From integrated DC output Converter Status screen, press **Enter** to move to the Settings screen. Scroll to choose a setting to change, then press Enter to adjust the setting.
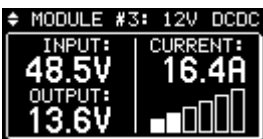
```
⬍ MODULE #3: 12V DCDC
INPUT:   | CURRENT:
48.5V    | 16.4A
OUTPUT:  |
13.6V    | ▄▄▄□□□
```

Integrated DC output Converter Status screen
Press Enter to move from the Status screen to the integrated DC output Converter Settings screen

```
#3: 12V DCDC SETTINGS
VOLTAGE:          13.8V
CURRENT LIMIT:      50A
OUTPUT:             ON
```

Scroll to highlight parameter to change

- Output Voltage
- Current Limit
- Output Enable (ON/OFF)

▲ ▼

Press Enter to select parameter to adjust

```
SET OUTPUT VOLTAGE
  ▲ 13.6 VOLTS
  ▼
     ⏎ : SET
     ⊗ : CANCEL
```

▲ ▼
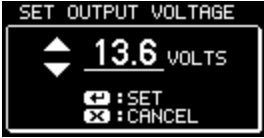
Scroll to change setting. Press Enter ⏎ to set, press Back ✗ button to exit without changing

Alarm Inputs

The Alarm Inputs Status screen displays the current status of the four alarm inputs provided on a power shelf equipped with the ICM. Use these inputs to monitor voltage-free external contact closures such as door sensors, smoke alarm outputs or a water sensor.

The Alarm Input Status screen shows the state of these contacts, changing from OK to ALARM when a contact activates. Configure the logic of the external contact type selecting Normally Open (NO) or Normally Closed (NC) to activate the alarm inputs using the web-GUI Alarms Settings & Control tab. The factory default setting has the alarm inputs disabled; you must select a contact type for each input to enable it.

```
⬍ ALARM INPUT STATUS
INPUT #1: | INPUT #2:
   OK     |  ALARM
INPUT #3: | INPUT #4:
   OK     |   OK
```

Alarm Input Status screen

▲ ▼

Press Enter or scroll to see the Alarm History log

Alarm History

Scroll through the Alarm History screens to see a log of the 20 most recent alarm events. These alarms may have been raised by any module experiencing an alarm, or by one of the four external Alarm Inputs being triggered.

```
ALARM HISTORY   1/6
MODULE #3 ALARM
Ch. #4 Breaker Open
Set: 04/13/16 16:40
Clr: 04/13/16 17:25
```

▲ ▼

Scroll through the history screens to see the 20 most recent alarm events. Shows the module that raised the alarm, date, and time when set, and cleared

Note: The system date and time are normally set by the network. These may be manually set, see web-GUI Communications Basic Setup tab.

Network Status and Advanced Options

Scroll to the Network Status screen to check the network connectivity, **IP address** of the system, and the assigned MAC address. Access the Advanced Options screen by pressing the Enter button when on the Network Status screen to set or clear a 4 digit **LCD Password** (to lock out the ICM Display adjustments after the LOCKOUT TIMER has expired), set the display **Lockout Timer** duration (0 to 60minutes), **Comm Control Restart** to restart the controller without affecting any of the device settings and without interrupting DC power to the output terminals, or **Reset Comm Settings** (sets GUI password, Communication settings, and IP address to the factory defaults).

Note: You will be prompted to enter the LCD PASSWORD once it is activated, when attempting to change any of the power system settings.

```
⬍    NETWORK STATUS
Modular Power System
100 Base-Tx
192.168.0.116
D8:80:39:18:0C:73
```
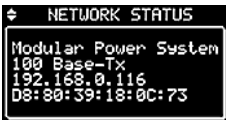
Network Status screen

Press Enter to move to the Advanced Options screen

```
ADVANCED OPTIONS
LCD PASSWORD SETUP
COMM CONTROL RESTART
RESET COMM SETTINGS
```

▲ ▼

Scroll to choose parameter or sub-menu

```
LCD PASSWORD SETUP
SET LCD PASSWORD
CLEAR PASSWORD
SET LOCKOUT TIMER
```

▲ ▼

Scroll to setting to be changed

```
ENTER PASSWORD
⬍  0 * * *
⏎ : SET
⎋ : CANCEL
```

▲ ▼

Scroll to adjust setting (Display Password setting shown) Press Enter ⏎ to save each setting, or Back **X** to exit with no change

Password Reset (Front panel)

Always record the display password when set, as it must be entered to change any power shelf settings. To clear the display password in cases where it is lost, switch off the AC power to the unit, then simultaneously press the ENTER ⏎ and BACK ✗ buttons for more than 15s while restoring the AC power. A new password will then have to be re-entered as shown above if password protection is required.

Reset the web-GUI password back to the factory default (user: admin, no pw) by selecting **RESET COMM SETTINGS** in the Network Status, Advanced Options front panel display menu shown above.

OPERATION (No ICM)

Power Modules installed in a basic shelf without an Intelligent Control Module (ICM) will behave as a fixed output power supply, with the output voltage and current limit set to the factory default levels. Modules may still be hot-swapped with identical replacement units, and the output load will share across all active power modules.

Check that each module's green "POWER" LED is lit, indicating normal operation. A lit red "ALARM" LED indicates a faulted module. Momentarily withdraw the faulted module then re-insert once the LED is off to check if the fault can be re-set. If the fault persists while other modules are operating normally the faulted module must be replaced.

DC-DC Converter modules installed in a basic shelf without an Intelligent Control Module (ICM) will behave as a fixed output converter, with the output voltage and current limit set to the factory default levels. During normal operation the DC-DC Converter module's green "POWER" LED will be lit. A lit red "ALARM" LED indicates a module fault.

Alarm indications can be monitored remotely using the Form-C alarm relay contacts accessible via the back panel ALARM connector. (See the Installation section for connection information)

OPERATION (web-GUI)

Connect to your Intelligent Hybrid Power Series via the Ethernet for full access to all system settings, status, and alarm conditions. Units with the ICM installed are equipped with a built-in web server that can be accessed via any standard web browser on a network connected computer or phone. No additional software is required on your device.

Log In to the Unit

1) Connect to the Hybrid Power Series by entering the IP address of the unit in the location/address field of your browser as shown:
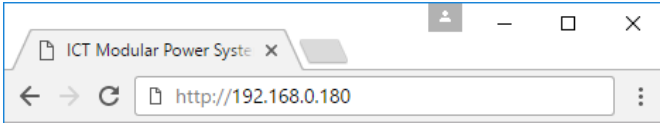
The default IP address of the unit is **192.168.0.180**, but any Hybrid Power series connected to a network with a DHCP server will be assigned a different IP address automatically. To find the assigned address use the front graphic display interface on the power shelf, and navigate to the Network Status screen. Note the assigned IP address displayed, and use this in your browser address field to access the unit remotely.

NOTE: You can also find the IP address of any ICT unit on a local network by running the ICT **IP Address Discovery tool.** After installing the tool on your Windows computer connected to the same network (tool available for download from ICT https://www.ict-power.com/tools-utilities/)

2) You will be prompted for a user name and password to log into the Hybrid Power Series' built in server. The default user name is **admin,** and no password is required as the factory default.

To log out of the Hybrid Power Series web-GUI, click on the Logout link on the top right of your browser window. The system will also automatically log off the user after 20 minutes of inactivity.

System

Once successfully logged in the **System** Status tab will be shown in your browser:

Modular Power System
Hybrid Power Series 48V
IP Address: 192.168.0.180
Firmware: v2.02
[Logout]

ICT — *The Power of Reliability*

STATUS | SETTINGS & CONTROL

System Status

System
Power Modules
DC Converter
Battery Backup
Alarms
Communications
Help

DC Output

Output Status:	Enabled
Output Voltage:	55.2 VDC
Total System Current:	0.0 A

AC Mains

| Input Voltage: | 118 VAC |

System Alarms

Form C Alarm:	Alarm
Power Module #1:	OK
Power Module #2:	OK
Alarm Input #1:	OK
Alarm Input #2:	OK
Alarm Input #3:	OK
Alarm Input #4:	OK

Module #3 : Battery Management

Battery Voltage:	55.2 VDC
Battery Current:	0.0 A
Battery Temperature:	25 °C
Net Ah Count:	0 Ah
Run-time Remaining:	-
Battery State of Charge:	-
Alarm Status:	OK

Module #4 : 12V DC Converter

Output Voltage:	13.8 VDC
Output Current:	0.0 A
Output Status:	Enabled
Alarm Status:	OK

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The **Status** tab provides an overview of the operating status of the unit, showing the output voltage and current, the AC input voltage, the Battery Management Module parameters, and the Alarm states of the internal alarm relay, and the four remote alarm inputs.

Click on the **SETTINGS & CONTROL** tab, to access the following functions:

- Use the **On/Off** buttons to remotely disable the system output by shutting off all power modules
- Use the **Auto-Restart** button to momentarily shut off the main output, and then restart automatically after a time delay (set in the **Auto-Restart Delay** field). This feature can be used to remotely force connected equipment to re-boot.
- Set the system **Output Voltage** (to match the float voltage requirement for your external battery).
- Set the system output **Current Limit**, to limit the total current that can be drawn by all the external loads

Power Modules

Use this page to see the current status of all installed power modules in the system. The combined maximum output capacity of all active power modules is shown here. Use the **System**, **SETTINGS & CONTROL** tab to make any changes to the Output Voltage and Current Limit of the combined modules.

Battery Backup (- All Battery Types)

Select the **Battery Backup** tab to observe the status of the external battery (which may consist of 2 battery strings with the dual breaker BMMD versions). You may check battery string voltage, combined current (+ is charging, - is discharging), temperature (if ICT-TMP probe installed), Net Ah count (approximate Ah discharged from the battery, where 0Ah denotes full charge), LVD status, and the LVD threshold voltage settings.

Click on the **SETTINGS & CONTROL** tab to configure most battery related settings. Click on the **Save Settings** button at the bottom of the page to store your configuration.

Configure Battery

Configure the **Battery Type** of the battery used in the system (Lead-Acid or Lithium-Ion).

⚠ WARNING

Always consult battery manufacturer's specifications when selecting battery type. Incorrect battery type setting may damage your battery.

If Lithium-Ion type battery is selected, an integrated battery management system (BMS) must be used to protect the battery cells from inappropriate voltage or current levels.

Set the rated **Battery Capacity** in Ah (50 to 2000 Ah) of the total battery pack connected to the power system, and the discharge **Rate** (in hours) used by the

battery manufacturer to determine the battery capacity. Normally the 10 or 20 hour rate is used. If a lead-acid battery is connected to the system, this information is used to help determine the battery state of charge, and remaining battery capacity when in use.

[Note] that connecting two batteries in parallel will double the total Ah capacity, while connecting batteries in series will increase the voltage with no change to the Ah capacity.

Battery Charge Current Limit
Set the **Charge Current Limit** to limit the maximum battery charge current provided through the battery terminals, while still allowing the full rated current to be drawn from the main output. This setting should be set to the value recommended by the battery manufacturer.

LVD Settings
Set the LVD **Disconnect Voltage** threshold to a level that will protect the battery from excessive discharge (default is 21/42 V) as recommended by your battery manufacturer. The LVD contactor will open when the battery discharges to this level for at least 3 s.

Set the **Reconnect Voltage** to a level at least 1.5 V more than the disconnect voltage to prevent the LVD contactor repeatedly cycling on and off. This setting will be used when charging the battery from an external DC source (such as a solar system), otherwise once AC power returns the LVD contactor will automatically close so that the power modules can charge the battery directly.

Battery Over-Current Alarm
Set the shelf output **Over-Current Threshold** to receive an alarm notification when the battery discharge or charge current exceeds a set over-current level. Set the threshold to 0A to disable this alarm. (default setting)

Alarm Reporting
Configure how you would like to be notified of the BMM alarms. Select the **Activate Form-C Contact** check box (default) to have the back panel alarm contacts change state for an alarm condition, and/or select the **Send E-mail** check box to have an alarm e-mail sent to the e-mail addresses set up on the communications page.

For Battery Management Modules with dual battery breakers (BMMD version), select the **Ignore Circuit Breaker 2 Status** check box if the system is used with a single battery string and the BAT 2 terminal is unused. This will mask the open circuit detection for battery breaker 2, to prevent false alarms if the breaker is left open on the unused channel.

Battery Backup (- Lead Acid Batteries only)

The following additional settings are only available if the system is configured for use with a lead-acid type battery:

Output Voltage Control, Temperature Coefficient/Cell:
This setting is only available if the system is configured for use with a lead-acid type battery.

Make adjustments to the battery voltage Temperature Coefficient/cell to optimize the automatic control of the battery charging voltage, and to keep your battery in a good state of health.

Adjust this setting to match the battery manufacturer's recommended compensation value in –mV/°C per cell. This value will typically be -4mV/°C for a flooded lead-acid battery (i.e. will compensate output voltage -24mV/°C for a 6 cell 12V battery) to help ensure the battery is fully charged in cold locations, and is not overcharged when warm. The default setting is 0mV, assumes 25°C operation.

[Note] that the system must have the battery temperature sensor (ICT-TMP) installed on the battery for this setting to have an effect.

Equalize Charge Settings
This setting is only available if the system is configured for use with a lead-acid type battery.

Set up manual or automatic equalize charge cycles for flooded lead-acid batteries.

⚠ WARNING

Risk of serious personal injury or damage to equipment and property! Always observe the following: Equalize charging is intended for flooded lead-acid batteries only, and may produce higher than normal levels of hydrogen gas. Ensure the battery compartment is well ventilated to avoid any risk of explosion! Always consult with battery manufacturer and observe all battery manufacturer recommendations.

Equalize Voltage: Adjust this setting to the battery manufacturer's recommended value for an equalize (or boost) charge (for flooded lead-acid batteries only). A regular high voltage equalize charge will help prevent stratification of the electrolyte in your battery, and can help extend its life.

Equalize Duration: Set the duration time (10-240 minutes) for the equalize charge voltage to be applied (as recommended by your battery manufacturer).

Equalize Interval: Set the equalize charge interval (0 – 180 days) so the system will perform an automatic equalize charge once every interval time has elapsed. Set this time to 0 (default) to disable the automatic equalize charge.

Day of Week: Select the day of the week that the automatically recurring equalize charge should take place, or select "Any" to allow an Equalize charge to take place on any day of the week.

[note] Day of Week takes precedence over Equalize Interval.

Start Time: Set the time of day for automatically recurring equalize charges to start. The time must be entered using 24-hour time format.

NTP Time Synchronization must be enabled on the **Communications Basic Setup** page to enable automatically recurring equalize charges.

[Note] that an equalize charge can only be initiated when the battery is fully charged. If the system is unable to start an equalize charge at the selected Start Time, it will attempt again at the same time next day, or next week if a specific Day of Week is selected.

Click the Manual Equalize Charge button to manually initiate an equalize charge for the set duration once the battery is fully charged.

[note] System will state that Manual Equalize Charge is Not Ready, if battery is not yet fully charged

The date of the last equalize charge and the duration of that charge is noted here, along with the scheduled date and time of the next automatic equalize charge, if an Equalize Interval or Day of Week has been set. This information is to help track where the system is within the automatic charge cycle.

Battery Low SOC Alarm
This setting is only available if the system is configured for use with a lead-acid type battery.

Set the **SOC Threshold** to receive an alarm notification when the battery state of charge falls below the specified level. Set the threshold to 0 to disable this alarm. (default setting)

Battery Discharge Test
Configure the Battery Discharge Test settings in this section, so that you may either manually or automatically perform a partial discharge test to gauge the relative capacity of the external battery. You should generally limit the depth of discharge to no more than 50% of the nominal battery capacity to avoid stressing the battery due to a deep discharge. The Battery Discharge Test is only available if the system is configured for use with a lead-acid type battery.

Each time the test is run the output voltage from the power modules will be reduced so that the external battery will power the system load until either the **Max Discharge Time** limit or the **Discharge Voltage Limit** is hit. A **Discharge Test Complete** notification (on the front display and with an e-mail if messaging is configured via the Network GUI) indicates the battery is able to power the connected load for the set test duration while maintaining its voltage above the Discharge Voltage Limit. The system will indicate a **Discharge Test Failure** if the minimum Voltage Limit is hit before the Max Discharge Time limit, as the battery was not able to power the load for the desired duration.

⚠️ NOTE:

This test must only be done when AC power will be present during the test and for an adequate time after the test to allow for a full recharging of the battery. Otherwise, the battery may not have sufficient remaining capacity to power the load during an AC power outage.

> **Set Discharge Time:** The time in minutes that the test is to run (10-240)
>
> **Set Discharge Voltage Limit:** Set the minimum voltage threshold to shut off the test.
>
> **Discharge Test Interval:** Set the discharge test interval (0 – 180 days) so the system will perform an automatic discharge test at the scheduled interval, once the battery reaches 100% SOC. Set this time to 0 (default) to disable the automatic equalize charge.
>
> **Day of Week:** Select the day of the week that the automatically recurring discharge test should take place, or select "Any" to allow an Equalize charge to take place on any day of the week.

Start Time: Set the time of day for automatically recurring discharge test to start. The time must be entered using 24-hour time format.

[note] Day of Week takes precedence over Discharge Test Interval.

NTP Time Synchronization must be enabled on the **Communications Basic Setup** page to enable automatic discharge tests.

[Note] that a discharge test can only be initiated when the battery is fully charged. If the system is unable to start a Discharge Test at the selected Start Time, it will attempt again at the same time next day, or next week if a specific Day of Week is selected.

You may alternatively manually initiate a Battery Discharge Test of a fully charged battery by pressing the **Manual Discharge Test** button. (System will state that the discharge test is **Not Ready** if the battery SOC is less than 100%)

The most recent discharge test results are shown here, with fields for days since the **Last Battery Discharge Test**, **Status** (Pass or Fail), **Discharge Time**, **End Voltage** at the completion of the test, and the **Amp-Hours Discharged** during the test. The scheduled date of the next automatically repeating test will also be shown if this feature has been enabled.

Integrated DC Output Converter

Select the **DC Converter** tab to observe the alarm status; output voltage; and output current of the integrated DC output converter module.
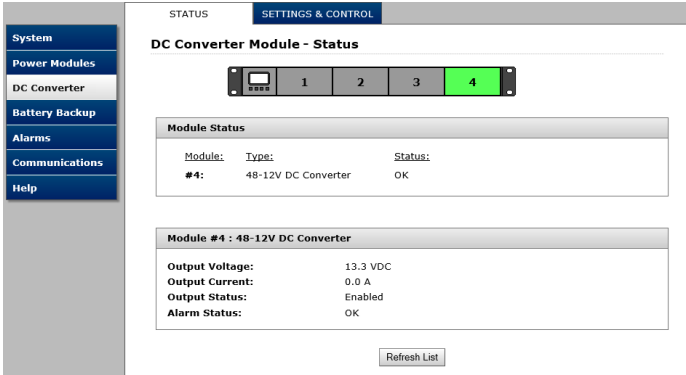
Click on the **SETTINGS & CONTROL** tab to configure the settings for DC Converter module.
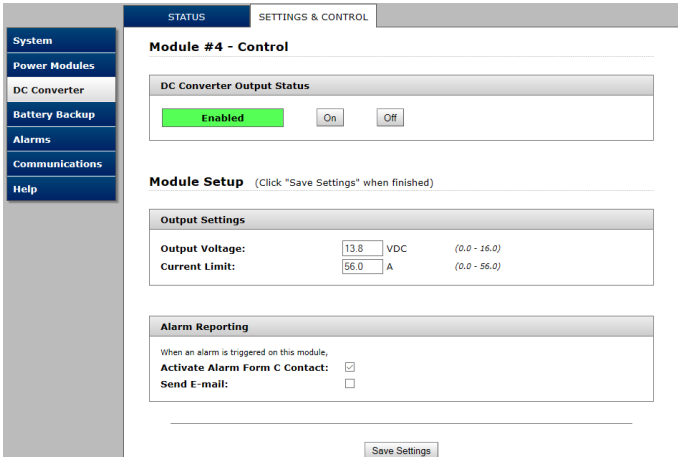
Integrated DC Output Converter Output Status:
Use the **On/Off** buttons to remotely disable the DC output converter.

Module Setup:
Set the integrated DC Converter **Output Voltage** and **Current Limit**.

Select the Alarm Reporting **Send E-mail** checkbox to configure the system to send an e-mail to the address set up on the communications page whenever an alarm is triggered on the integrated DC output converter module.

Alarms

Click on the **Alarms** tab to review the status and alarm history of the unit.

Click on the **SETTINGS & CONTROL** tab to set up the four remote alarm monitoring inputs.

> **Alarm Name:** Give each input a meaningful name to suit the installation (these will be used for e-mailed alarm messages
>
> **Contact Type:** select a Contact Type of either Normally Open (NO) or Normally Closed (NC) for each device to be monitored. Set alarm Contact Type to Not Used for all unused alarm input channels (default setting).

Configure how you would like to be notified of the alarms. Select the **Activate Form-C Contact** check box (default) to have the back panel alarm contacts change state for an alarm condition, and/or select the **Send E-mail** check box to have an alarm e-mail sent to the e-mail addresses set up on the communications page.

Communications

Click the **Communications** tab to configure the Basic Setup, Network Settings, E-mail Settings, User Setup, and Maintenance. Click the Save Settings button at the bottom of each tab to apply any changes you have made.

Click the **BASIC SETUP** tab to configure the device name, set the date and time and enable the watchdog timer and data logging features.

Power System Device Info

   Device Name: for the system (used in all email messages), and view the Model and hardware version.

   Date and Time Settings:

   Check the system internal clock settings here, and select the tick box to **Synchronize with NTP Server** (default), then Enter an **NTP Server** address (i.e., time.nist.gov) to automatically load network time. You may choose to **Set Time Manually** by selecting the tick box, and then enter the correct **Date** and **Time**.   (24 hour clock)

[note] NTP server required for equalization charge and discharge test

Network Watchdog

Enable the Network Watchdog to cycle power output on loss of communications. The watchdog can monitor one or two external IP addresses.

Watchdog Enabled: Tick this box to enable the network watchdog.

Primary IP Address: Set an IP address for the unit to ping to determine if the network is functioning.

Secondary IP Address: Set a second IP address if desired.

Watchdog Timeout: Enter the time (1-60 minutes) for the system will wait with no ping response from either IP address before initiating a reset.

Reset Target: Select what output to power cycle if the watchdog times out. Set the Auto-Restart Delay time on the System, Settings & Control tab to define how long the system will be off when the watchdog timeout is triggered.

[note] Selecting LDM Channel Outputs on a Hybrid Series 1RU units will have no affect as there are no LDM channels on these products.

Data Logging:
Enable **Data Logging** to keep a running record of all the key system parameters and alarms, recorded once per minute. The log will save the last 30 days. Click on the **Download Log (CSV)** button to store the CSV format log file on your computer for further analysis.

NETWORK SETUP
Configure network settings on the **NETWORK SETUP** page.

⚠️ **NOTE**:

Saving any changes to the network settings will cause the ICM to re-start, causing momentary loss of communications

Network:

 MAC Address: Displays the MAC address assigned to the power system. It is also shown on line four of the LCD Network Status screen.

 Enable DHCP: Turn on this setting if your network uses a DHCP server to automatically assign IP addresses. (Enabled as default setting). To manually assign a static IP address to the unit uncheck this box, then set the following parameters.

 IP Address: Specify a unique IP address for the unit.

 Subnet Mask: Specify the mask for the subnet the power system is located on

 Gateway: Specify the IP address of the default router (Gateway) used for connecting attached devices to different networks.

Primary DNS: Specify the IP address of the Primary DNS Server for your network.

Secondary DNS: Specify the IP address of the Secondary DNS Server for your network.

Web Server:

⚠️ **CAUTION**:

Changing the web server port numbers may cause loss of communication with the power system.

The following ports may be changed within a range of 1 to 65565, if required.

HTTP Port: This port is used for HTTP traffic between the power system and your browser. The default HTTP port is **80**, and if you change this the new HTTP Port number must be appended to the URL used to access the system. (e.g. use URL **http://192.168.0.180:8000** for IP address **192.168.0.180**, port **8000)**

HTTPS Port: The HTTPS (HTTP Secure) protocol uses encrypted data transfer between web browsers and servers for higher security. The default HTTPS port is **443**. Append any changed HTTPS port to the end of the URL for the power system.

To access the power system through a secure HTTPS connection, use **https://** at the start of the unit's URL. (e.g. **https://192.168.0.180:8888** for IP address **192.168.0.180**, HTTPS port **8888**)

SNMP:

Configure these settings if you would like to use Simple Network Management Protocol (SNMP) based monitoring. SNMP is an industry standard protocol for network management software. Enabling the SNMP function on the power system will allow standard SNMP management software to connect to the SNMP agent running on the system and read real time system information such as bus voltage, and channel currents. The system can send SNMP traps to the external management software when an alarm or fault occurs.

The information available from the SNMP agent is described in a Management Information Base (MIB) file, which can be downloaded from:
- the link at the bottom of the SNMP box on this web-GUI page; or
- on the web-GUI's **Help** page; or
- can be downloaded from the ICT Website:
    https://www.ict-power.com/tools-utilities/

The unique power system MIB file must then be imported into your external SNMP management software.

Enable SNMP: Check this box to enable the SNMP agent.

SNMP Version: Sets the SNMP version supported by the SNMP agent. If **All** is selected, all SNMP versions will be supported simultaneously. The appropriate settings for the selected SNMP version will need to be configured.
- **v1/v2c**,
- **v3**, or
- **All**

Enable SNMP Write Access: Check this box to allow remote SNMP control of the system output and individual LDM output channels. If this box is unchecked, all information available from the SNMP agent will be read-only.

SNMP Control Access: Sets the level of device control that is allowed through SNMP. This setting is only available if Enable SNMP Write Access is enabled.
- **Output Control:** Allows remote SNMP control of the system output and LDM channel outputs only.

Full Device Control: Allow SNMP clients to set all device settings through SNMP. MIB files for full SNMP device control

    SNMP Contact Information: Assign contact information, such as an operator name and phone number for the power system, which can be read via SNMP queries. (This information is optional)

    SNMPv1/v2c Settings:

        Read Community: Enter the community string/password here for read-only SNMP access. The default read community string is "public".

        Write Community: Enter the community string/password here for read/write SNMP access. The default write community string is "write".

        [NOTE:] The community strings should be changed to unique passwords before enabling SNMP, as the defaults are well known.

    SNMPv3 Settings:

        User Name: Enter the user name for SNMPv3 access.

- **Authentication Protocol:** Select the SNMPv3 authentication protocol **None**,
- **MD5**, or
- **SHA**.

        Authentication Password: If an authentication protocol is selected, enter the authentication password.

        Privacy Protocol: Select the SNMPv3 privacy protocol
- **None**, or
- **AES**.

        Privacy Password: If a privacy protocol is selected, enter the privacy password.

SNMP Trap Settings:

    Trap Version: Sets the SNMP version (v1 or v3) for SNMP traps sent from the system. The appropriate settings for the selected SNMP version will need to be configured.

Trap Community: Assign the community string/password that will be sent with all SNMPv1 traps. Some trap receivers are able to filter based on Trap Community.

Trap User Name: Assign the user name for SNMPv3 traps. Authentication Protocol: Select the authentication protocol for SNMPv3 traps
- **None**,
- **MD5**, or
- **SHA**.

Authentication Password: If an authentication protocol is selected, enter the authentication password for SNMPv3 traps.

Privacy Protocol: Select the privacy protocol for SNMPv3 traps
- **None**, or
- **AES**.

Privacy Password: If a privacy protocol is selected, enter the privacy password for SNMPv3 traps.

Trap IP Addresses: Enter the IP addresses for up to two devices that will receive SNMP traps from the power system.

E-MAIL SETUP
Select the **E-MAIL SETUP** tab to configure all e-mail settings to enable automatic e-mail notifications directly from the unit. The information required for this is available from your network administrator, or internet service provider. (ISP)

E-mail:

SMTP Server: Enter the name or the IP address of your SMTP server used for sending outgoing e-mail. (e.g. "smtp.gmail.com")

SMTP Port: Enter the port used by your SMTP server. (Normally 25)

SMTP Server requires SSL: Check this box if your SMTP server requires an encrypted SSL connection. This box should normally be checked if the SMTP port used by the SMTP server is 465. If the SMTP server uses STARTTLS (normally port 587), this box should be unchecked.

Sender E-mail Address: Enter an e-mail address that will appear as the sender for all e-mail notifications sent from the power system.

Recipient E-mail Addresses: Enter one or more e-mail addresses that are to receive all e-mail notifications from the power system. Use commas to separate multiple addresses. This field can also be used to send a text message notification to a phone; see the **Text Message Notifications** section for further information.

SMTP User Name: Enter a SMTP user name here, if required by your SMTP server. Leave this field blank if the server does not require authentication.

SMTP Password: Enter a SMTP password here, if required by your SMTP server. Leave this field blank if the server does not require authentication.

Minimum E-mail Interval: Specify a minimum interval required between e-mail notifications. (Default 1 minute, range 0 to 60 minutes) This time interval is used to prevent an un-intended flood of e-mail alarm notifications that could occur when an alarm limit is incorrectly configured, for example.

General E-mail Notifications:
Select these options to receive an e-mail when one or more of these events occurs:

AC Input Power is lost: Check this box to receive an e-mail notification when the ac input drops below a functional level.

Power Module failure occurs: Check this box to receive an e-mail notification when any of the installed power modules stop functioning.

A Module is offline: Check this box to be notified when a module loses communication with the ICM.

System Current Limit is triggered: Check this box to get a notification each time the system output current hits the maximum current limit value

Intelligent Controller Module reset: Check this box for notification of an ICM reset for any reason.
The Network Watchdog triggers: Check this box to receive an e-mail notification after the Network Watchdog triggers due to a loss of the network connection and the network has then come back online.

USER SETUP:
Select the **USER SETUP** tab to set up and configure the password for up to 10 users, with the ability to limit who has access to the power system settings. Click on the **Save User Settings** button at the bottom of the page to save any password changes.

The unit has no password assigned by default, so an Administrator password should be assigned to your power system for improved security.
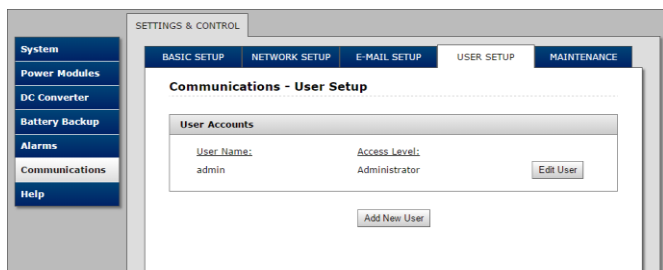
⚠️ NOTE:

Record your new password(s) for future access! If the Administrator password is lost the unit must be reset to return the password to the blank default setting, causing loss of all other user settings. See the **Password Reset** section for more details.

Select a User to Edit: Choose which of the user accounts to edit. Set the access level to be appropriate for the amount of control each user requires.

- **Administrator:** This level has full access to the power system settings, and can set up users and change passwords ("admin" is the default user)

- **Control:** User has read-only access to the power system, but can enable or disable the outputs, and change some of the basic settings.

- **View-Only:** User can only view status, cannot change any settings

New Password: Use these fields to change the password of the selected user.

New Password: Enter the new password for the chosen user.

Confirm New Password: Re-enter the new password to confirm the entry.

Confirm Changes: Enter the current **Administrator Password** to confirm the new password changes, prior to saving the settings.

MAINTENANCE
Use the **MAINTENANCE** tab to reset the power system (soft reset), restore the system default settings, or send a test e-mail to verify e-mail functionality.

Reset Intelligent Controller Module: Clicking the **Reset** button will restart the controller. Settings are maintained during the reset.
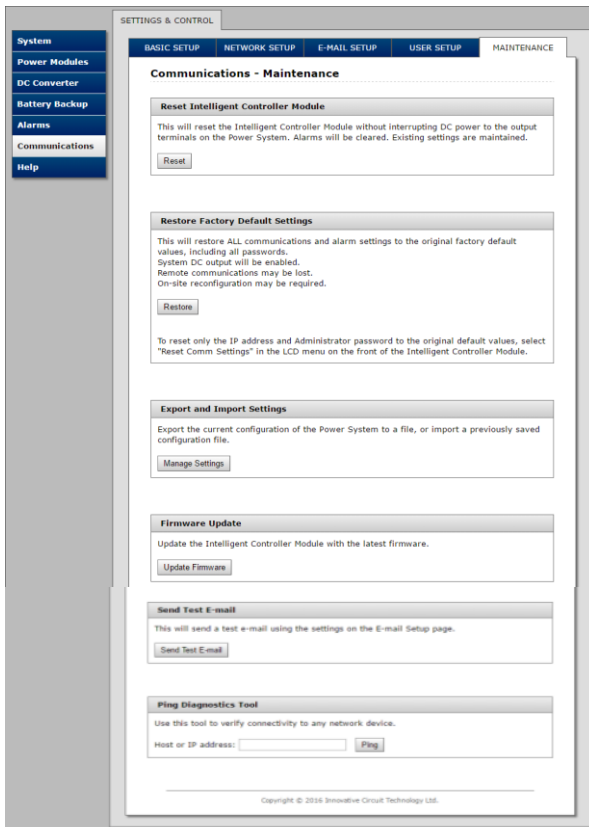
Restore Factory Default Settings: Clicking the Restore button will restore **ALL** settings to the original factory default values, including the user passwords. To only restore the network settings and passwords see the **Password Reset** section. (This feature is only available to the system Administrator)

Note: Restoring the unit to Factory Default settings may cause loss of network communications due to loss of custom changes to any network settings

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To reset only the IP address and Administrator password to the original default values, select **Reset Comm Settings** in the NETWORK STATUS screen on the front panel of the Hybrid Power Series.

Export and Import Settings: The **Manage Settings** button will take you to the Export and Import Settings page, where you may export all the system settings (other than the Administrator password, Network and Web Server settings) to an encrypted **.cfg** file on the local computer. Use the **Import Settings** section on

other systems to locate this file and then import it to any other MPS you are logged in to, greatly simplifying the configuration of multiple identical units.

Firmware Update: Download the latest Hybrid Power Series firmware file from the ICT website (ict-power.com) to your local computer. De-compress this **.cry** file then press the **Update Firmware** button, and link to this file. Update the firmware on the power system control module by clicking the **Update Now** button. Note that the system settings will not be changed. Do not remove AC power during the update process!

Send Test E-mail: Click the **Send Test E-mail** button to send a test e-mail to the listed e-mail recipients using the e-mail settings on the **E-mail Setup** page.

Ping Diagnostics Tool: Use this feature to verify connectivity of any network connected device. Enter the hostname or IP address of the target device, and then click the **Ping** button to check if the device is active.

Router Configuration

Use this section to help you set up your Hybrid Power Series with remote Internet access when it is located behind a router.

A router allows multiple PC's to share a single Internet connection, and must be configured correctly to forward incoming remote data to the local IP address of your power system.

Example configuration using a Linksys WRT54G router: (others will be similar)

1. Log into your router and go to the port forwarding screen. In the example Linksys WRT54G router this is located in the Applications and Gaming tab. The location of the port forwarding fields may be different on your particular router. (consult the router manual for instructions)

2. Configure HTTP forwarding:
    a. Enter a unique name in the **Application** field
    b. Enter the HTTP port number that the power system is using in the **Start** and **End** fields. The default HTTP port for the system is **80**.
    c. Select **Both** under **Protocol** (TCP and UDP)
    d. Enter the local IP address of the power system (e.g. 192.168.0.180) in the **IP address** field. (see step 2 of the **Operation (Network GUI)** section to verify the system IP address)
    e. Check the **Enable** box, and then click on **Save Settings**

⚠ **NOTE:**

Many ISP blocks access to port 80, so if your ISP does block this port you must change the HTTP port the power system uses from 80 to something else, such as 8000. (Valid port numbers are in the range of 1 to 65535) See the **Network Setup** section for information on assigning new network ports.

You must also change the system's HTTP port from 80 if your local network has another device (such as a system, or web server) already using port 80.

3. Configure HTTPS forwarding by repeating steps 2a to 2e with the HTTPS port number that the power system is using. The default HTTPS port number is **443**.

Router Port Forwarding Screen

4. Determine the WAN IP address of your router assigned by the ISP. With the example router this information is on the **Status** tab, listed as **IP Address**.

⚠ **NOTE:**

When using a dynamic IP address the router's WAN IP address may change from time to time without warning, depending on your ISP. In this case you should obtain a Static IP address from your ISP (it will not change) which will ensure more predictable access to the power system from a remote location. If a static IP address is not available you can use a Dynamic DNS

service such as Dyn (www.dyn.com) to provide a stable address for the router.

5. To access the power system over the internet type the WAN IP address of the router in the location/address field of your browser, followed by a colon and the HTTP port number the system is using. (e.g. **http://209.123.10.33:8000** for a router address **209.123.10.33**, port **8000**)
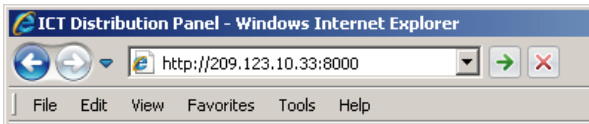
Power System Access with Router Address

Text Message Notifications

The power system can send alarm notifications as text messages to a cell phone by configuring the alarm e-mails to be sent to your mobile phone service provider.
On the **E-mail Setup** page of the web-based utility enter the address of your phone in the **Recipient E-mail Address** field.

Example with an AT&T phone: enter the recipient address *cellnumber***@txt.att.net**, replacing *cellnumber* with your 10-digit cell phone number.

Cell address formats for some common North American mobile phone providers:

AT&T	*cellnumber*@txt.att.net
Verizon	*cellnumber*@vtext.com
Sprint	*cellnumber*@messaging.sprintpcs.com
T-Mobile	*cellnumber*@tmomail.net
Virgin Mobile	*cellnumber*@vmobl.com
Nextel	*cellnumber*@messaging.nextel.com
Bell Mobility	*cellnumber*@txt.bell.ca
Rogers	*cellnumber*@pcs.rogers.com
Telus	*cellnumber*@msg.telus.com
Virgin Mobile (Can)	*cellnumber*@vmobile.ca

Troubleshooting Network Communications

I am unable to access the web-based configuration utility:
- Check that you are using the correct IP address for the system by downloading and running the **ICT IP Address Discovery tool** **http://www.ict-power.com/tools-utilities/**
- Check the network cable connections to the power system and the network

- Ensure the network card settings on your computer are configured for accessing the IP address of the MPS. To access a power system with the default IP address of 192.168.0.180 the typical network settings for your computer are:
  - o IP Address: 192.168.0.180
  - o Subnet Mask: 255.255.255.0
  - o Gateway: 192.168.0.1

- If the HTTP port of the power system has been changed, you must append the new port number to the URL used to access the system. (See the **Network Setup** section) See the **Password Reset** section for details on how to reset the port number to the factory default value.

- If your network switch allows you to manually configure port speed and duplex settings, turn-on "**Auto Negotiation**" for the switch port that the power system is connected to.

I forgot my password:
- See the Password Reset section of the manual

I am not receiving e-mails from the power system:
- Verify that the **Send-E-mail** checkboxes are ticked for any alarm conditions for which you wish to receive e-mail notifications.

- Verify your e-mail settings by going to the **Communications/Maintenance** page on the unit's web GUI and clicking on the **Send Test E-mail** button, to send a test message to your designated recipient addresses. The **Send Test E-mail** box will show an error message if the system is unable to send the e-mail.

- Check on the **Communications/E-mail Setup** page and ensure the **SMTP Server** field is the correct address for your e-mail provider, and the **SMTP Port** is correct. (Port should be 25 for most servers)

- If your SMTP server requires SSL encryption, ensure the **SMTP Server requires SSL** checkbox is ticked. Otherwise leave blank.

- If your SMTP server requires authentication ensure that the **SMTP User Name** and **SMTP Password** fields are correctly entered.

STATUS INDICATORS AND ALARMS

The status of the Hybrid Power Series is indicated on the front display screen, or via the web-GUI on remotely monitored units. Green "POWER" and red "FAULT" LED's on the power modules, along with the Form-C alarm contacts on the back panel indicate the status of power shelf.

There is an option on the Setup page in the web-GUI for most alarms to make a selection to have the system send an e-mail to designated addresses for remote notification.

All alarms and warnings will be displayed on the ICM front screen Hybrid Power Series systems, and entered in the Alarm History log. (Most recent 20 alarms listed)

Alarms generally reset automatically when the trigger condition is removed. Major alarms such as a Module DC Output Failure or Module Configuration Error require that the module be temporarily removed to cycle input power and clear the fault.

Power Module Alarms:

Alarm Condition	Trigger Condition	Module Output[2]	Red LED	Green LED	Alarm Relay	Send E-mail[3]
Power Failure	Loss of AC power to module	Disabled	Off	Off	Active	Yes
Module Operating	Normal operation	On	Off	On	No	-
Configuration Error	Different voltage modules in shelf	Off	On	Off	Active	Yes
Current Limit (Warning only, display will flash)	Output current approaches within 1A of the max current limit setting	On	Off	On	No	-
Fan Failure	Fan is not operating to spec	On	Off	On	No	Yes
Manual Disable	Output switched off by ICM or GUI	Disabled	Blink	Off	No	-
Module Removal	Module shelf connections open	Disabled	On	Off	No	-
PFC Shutdown	Internal bus voltage out of range	Disabled	On	Off	Active	Yes
Module Fault	Internal aux voltages out of range	Disabled	On	Off	Active	Yes
Over Temp Shutdown	Internal temp too high	Disabled	On	Off	Active	Yes
DC Output Failure	Output above set point (Manually re-enable dc output to reset)	Disabled	On	Off	Active	Yes

Battery Management Module (BMM) Alarms:

Alarm Condition	Trigger Condition	LVD Contactor	ICM Required	Alarm Relay	Send E-mail[3]
Module Power Failure	Loss of AC, and battery disconnected	Open	No	-	Yes
No Alarms	Normal Operation	Closed	No	No	-

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[2] Other power modules are not affected when one module has its output disabled.

[3] E-mail notifications only sent if enabled in the unit's Communications E-mail Setup tab, and either AC or DC power is available for the system to be operational.

Alarm Condition	Trigger Condition	LVD Contactor	ICM Required	Alarm Relay	Send E-mail[3]
Battery Low SOC	SOC drops below Low SOC setting	Closed	Yes	Active [4]	Yes
Battery Overcurrent	Battery I rises above OC setting for 10s	Closed	Yes	Active [4]	Yes
Circuit Breaker Open	Circuit breaker trips or manually opened	Open	Yes	Active [4]	Yes
Battery Over Temperature	Optional TMP probe temp >50C for 5s	Open	Yes	Active [4]	Yes
LVD	Battery V at LVD or Overvoltage setting	Open	No	Active	Yes
Configuration Error	Mixed polarity modules, or installed in slot 1, 2, 5, or 6	Open	No	Active	Yes

DC-DC Converter Module Alarms:

Alarm Condition	Trigger Condition	Module Output	Red LED	Green LED	Alarm Relay	Send E-mail[3]
Module Power Failure	Loss of AC and DC bus connection	Disabled	Off	Off	Active	Yes
Module Operating	Normal operation	On	Off	On	No	-
Current Limit (Warning only, display will flash)	Output current approaches within 1A of the max current limit setting	On	Off	On	No	-
Fan Failure	Fan is not operating to spec	On	Off	On	No	Yes
Output Under-Voltage	Low output voltage	On	Off	On	No	Yes
Manual Disable	Output switched off by ICM or GUI	Disabled	Blink	Off	No	-
Input Voltage Failure	DC input voltage out of range	Disabled	On	Off	Active	Yes
Module Fault	Internal aux voltages out of range	Disabled	On	Off	Active	Yes

[4] Contact active only if alarm enabled in the Battery Backup Settings & Controls tab

Alarm Condition	Trigger Condition	Module Output	Red LED	Green LED	Alarm Relay	Send E-mail[3]
Over Temp Shutdown	Internal temp too high	Disabled	On	Off	Active	Yes
Output Over-Voltage	Output above set point (Manually re-enable dc output to reset)	Disabled	On	Off	Active	Yes

Intelligent Control Module (ICM) Alarms:

Alarm Condition	Trigger Condition	Alarm Relay	Send E-mail[3]
Alarm Input	Contact open or close on any Alarm input 1 to 4	Active (if set up on Alarm Input page)	Yes
AC Input Failure	AC input falls below 90Vac	Active	Yes
Shelf Overcurrent	Total output current on shelf is >150Adc for 20s	Active	Yes
System Current Limit	ALL power modules in system at their current or power limit for 15s	Active	Yes
Communication Bus Error	Internal communication bus error condition	Active	-

PRODUCT SPECIFICATIONS

AC Input Nominal Rating: 120/240 VAC 50/60 Hz
AC Input Operating Range: 108 to 264 VAC
AC Input Maximum Range: 100 to 300 VAC

Input Power Factor: 0.99 typ (120 VAC input)

Efficiency (typical):   90%

Model:	Power Shelf	ICT700-24PM	ICT700-48PM	ICT1500-24PM	ICT1500-48PM
Output Voltage[5] (Nominal battery float Voltage) (+/- 0.5%)	Set by power modules installed	27.6V	55.2V	27.6V	55.2V
Max Current Limit (+5%, -0%)	150 ADC	28 A	14 A	54 A	27 A
Continuous Current Rating	150 ADC	25 A	12.5 A	54 A	27 A
Output Power (max)	3000 W	700 W	700 W	1500 W [7]	1500 W [7]
Output Noise (max mVrms)	-	30 mVrms	60 mVrms	40 mVrms	60 mVrms
Output V Load Regulation		1.70%	1.20%	1.70%	1.20%
Input Current	< 24 Arms	6.6 Arms	6.6 Arms	8 Arms	8 Arms
BMM Max Battery Current (per input)	100 A	-	-	-	-
BMM Max total Battery Current through LVD	150 A	-	-	-	-
BMM LVD Threshold V (Default)	-	21.0 V	42.0 V	21.0 V	42.0 V
BMM LVD Reconnect V (Default setting)	-	25 V	50 V	25 V	50 V
BMM idle DC Power Draw [6]	<1 W	-	-	-	-

Integrated DC Output Converter Module Specifications:

Model	ICT700-DC12	ICT700-DC24
Input Voltage	20 – 60 VDC	20 – 60 VDC
Output Voltage Adjustment Range (VDC)	10.5 –15.5 VDC	21.0 – 31.0 VDC
Default Output Voltage (VDC)	13.8 VDC	27.6 VDC
Output Current Limit Adjustment Range (A)	10 – 50 A	5 – 25 A
Default Current Limit (A)	50 A	25 A
V-output Line Regulation	+/- 0.2%	
V-output Load Regulation	+/- 0.5%	

[5] Actual operating point may be lower due to battery charge requirement
[6] AC mains power off; backup battery connected; LVD open [7] Output power on 1500 W modules is derated by 50% under 115 VAC

Efficiency	92% (Typical)
Operating Temperature	-30°C to 50°C
Output Grounding	Positive, negative or floating
Safety	Designed to meet EN60950-1

Output Grounding: Power Modules are floating, may be connected with Positive or Negative ground[8]

Alarm Output: Form-C contact, 0.5 A 60 VDC max

DC Connectors: (Output, Battery)   Bus Bar, 5/16" bolt hole

Alarm Output Connector: 3 pin removable plug, cage clamp type 16 –24 AWG

Alarm input, Bat temp sense Connector: 7 pin removable plug, cage clamp type 16 –24 AWG

Operating Temperature Range: -30 C to +60° C[9]
Storage Temperature Range: -40 to +70° C

Humidity: (Operating)   10 – 90% (non-condensing)
           (Storage)   5 – 95% (non-condensing)

Cooling: Load controlled fan on power modules

Regulatory Compliance (700W Module): UL/CSA60950-1, UL/CSA 62368-1, ICES-003, FCC Part 15/B, EN 61000-6-2 and EN 61000-6-3
Regulatory Compliance (1500W Module): UL/CSA60950-1, UL/CSA 62368-1, ICES-003, FCC Part 15/A, EN 61000-6-2 and EN 61000-6-3

[8] Optional BMM and LDM modules are available in positive (-48V) or negative (+12/24V) ground configuration. Specify at time of ordering
[9] De-rate output 2% per°C above 50°C

Network Communication:	RJ45 10/100-T port (IPv4, HTTP, HTTPS, SMTP, DNS, TCP, UDP, ICMP, DHCP, ARP, SNMP, SNTP Protocols)
Network Security:	Password protection, SSL encryption for HTTPS and SMTP (TLS 1.2)

Dimensions (inches):
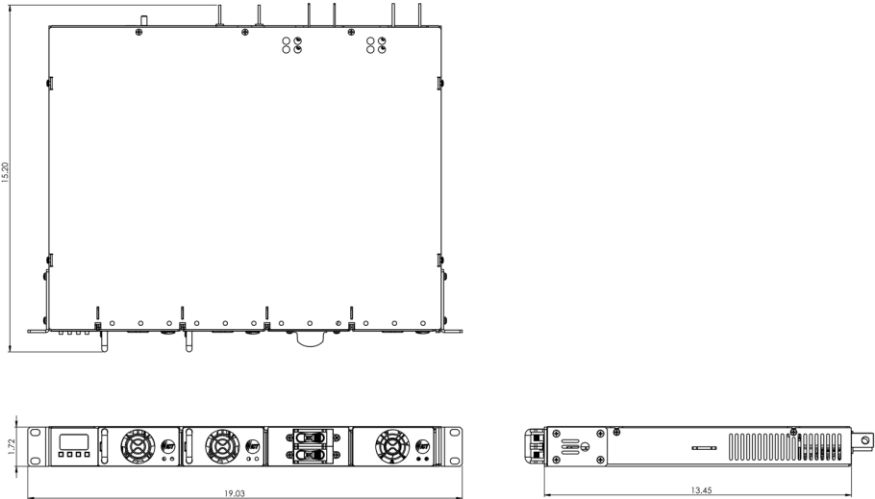
Weight:	21lbs/9.4kg (maximum)

EMC Note: This equipment has been tested and found to comply with the limits for a Class A digital device (pursuant to part 15 of the FCC Rules and ICES 003) or Class B digital device (pursuant to part 15 of the FCC Rules and ICES 003). These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced RF technician for help.

Caution: Changes or modifications to this equipment not expressly approved by ICT Ltd. could void the user's authority to operate the equipment.

ICT LIMITED WARRANTY

The warranty period on ICT products is two (2) years from date of purchase from an authorized ICT reseller or OEM with valid proof of purchase, or from date of shipment from the ICT manufacturing facility. The warranty period for a repaired product or part is ninety (90) days or the remainder of the unexpired term of the new product warranty period, whichever is greater. Repair or replacement of a defective product or part does not extend the original warranty coverage period.

ICT Limited Warranty is only intended for the benefit of the original purchaser and user of this product. This Warranty is not transferable or assignable without the prior written permission of ICT. ICT's sole obligation and liability under this warranty is limited to either repairing or replacing defective products at the sole discretion of ICT. When repairing or replacing the products, ICT may use products or parts that are new, equivalent to new or re-conditioned. Parts repaired or replaced during the warranty period will be under warranty for the remainder of the warranty period.

No claim will be accepted unless written notice of the claim is received by ICT in accordance with ICT's Return Material Authorization (RMA) procedure, as soon as reasonably possible after the defect is discovered. A valid product serial number must be provided with the RMA claim to prove eligibility. The RMA procedure is available on the ICT website at www.ict-power.com/support/warranty-repair/.

The Purchaser shall at their own risk and cost return the defective product to ICT's factory or designated repair center once an RMA is issued by ICT. Return of the products to the customer after repair is completed shall be prepaid by ICT unless otherwise mutually agreed between the parties. Products shipped to ICT which have incurred freight damage will not be covered by this Warranty and any repairs or replacement parts, components or products needed will be invoiced in the full current price amount and returned freight collect to Purchaser. It is the Purchaser's responsibility to check the product upon receipt for any damage during shipping and to contact the carrier or shipper regarding such damage. Product that is returned as defective, which is determined to operate within published specifications will be returned to the Purchaser freight collect.

ICT assigns to Purchaser any warranties which are made by manufacturers and suppliers of components of, or accessories for, the ICT product and which are assignable. ICT makes no representations as to the effectiveness or extent of such warranties, assumes no responsibility for any matters which may be warranted by such manufacturers or suppliers and extends no additional coverage under this Warranty to such components or accessories.

In no event shall ICT be liable for any special, indirect or consequential damages such as, but not limited to, loss of use, business or goodwill, loss of revenue, or loss of profits, which may result, either directly or indirectly, from defects in products provided by ICT.

This Warranty will be void if the product has been subjected to misuse, neglect, accident, exposure to environmental conditions not conforming to the products' limits of operation, improper installation or maintenance, improper use of an electrical source, defects caused by sharp items or by impact pressure, a force majeure event, has been modified or repaired by anyone other than ICT or its authorized representative, has been subjected to unreasonable physical, thermal or electrical stress, improper maintenance, or causes external to the unit including but not limited to general environmental conditions such as rust, corrosive atmospheres, sustained temperatures outside the specified operating range of the equipment, exposure to power surges and/or electrical surges, improper grounding, mold or dust, animal or insect damage, water damage or immersion in liquid of any kind, or if the serial number has been altered, defaced, or removed.

ICT does not control the installation and use of any ICT product. Accordingly, it is understood this does not constitute a warranty of performance or a warranty of fitness for a particular purpose. This Warranty represents the entire agreement between ICT and Purchaser with respect to the subject matter herein and supersedes all prior verbal or written communications, representations, understandings or agreements relating to this subject.