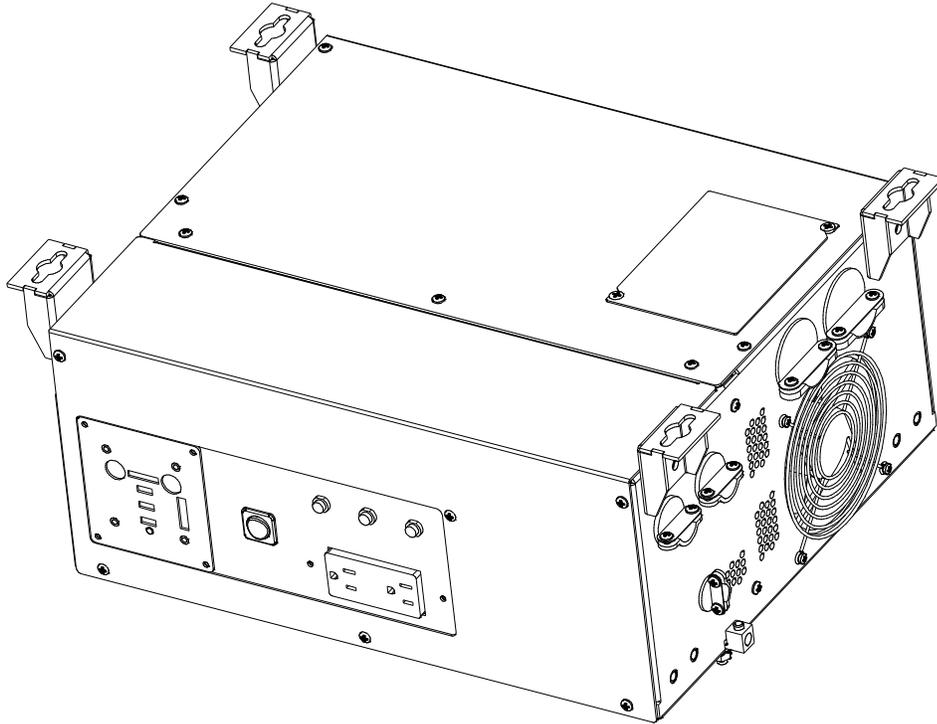


ITC-Series Inverter/Charger System



Models

ITC12-2100, SP00175

ITC12-3200, SP00176

Notes

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Introduction

Thank you for purchasing the Havis ITC-Series inverter/charger system. We are confident that you will be satisfied with its performance and its many features. With proper installation and care, you can look forward to years of service from this high-performance product.

This document will describe the operation, technical specifications and installation procedures for the ITC-Series inverter/charger system. If you require additional information please contact your dealer or contact Havis directly.

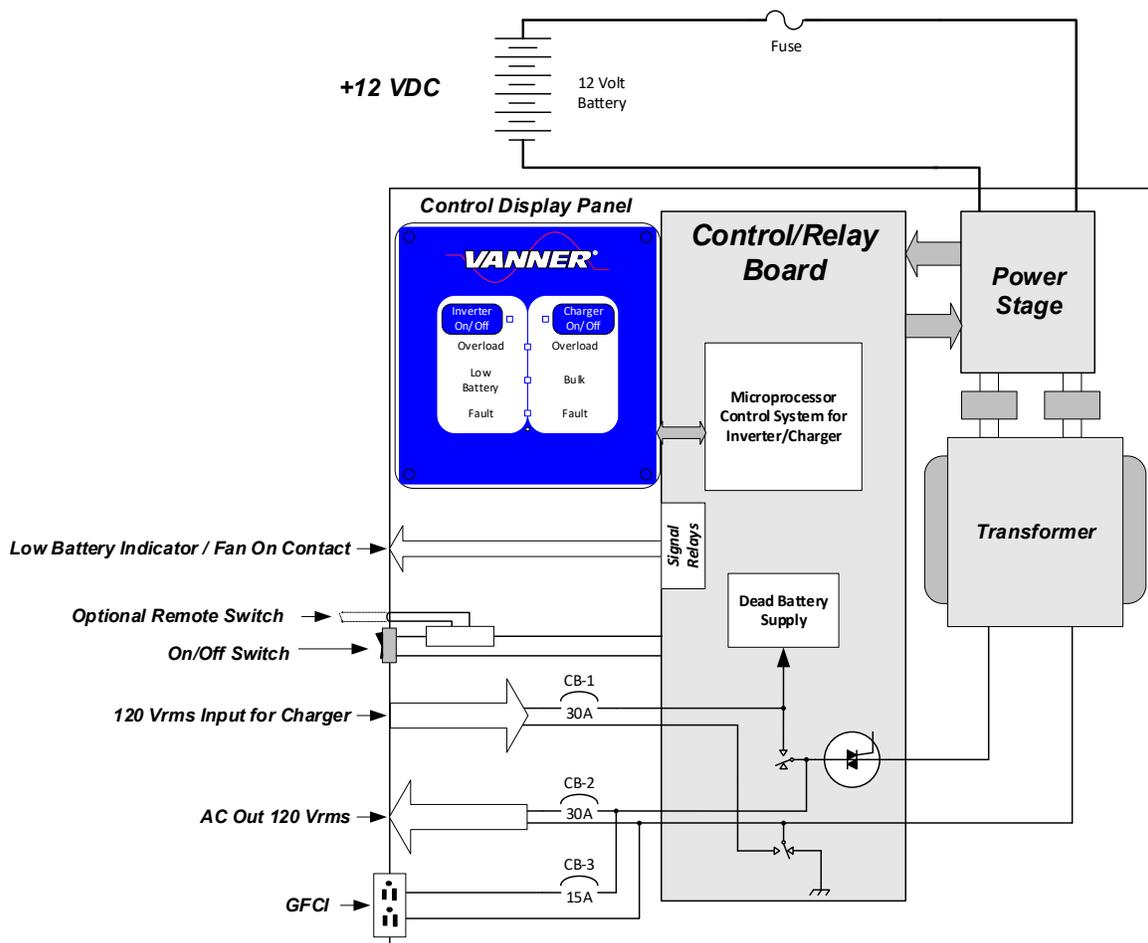
Standard model numbers have a charger system capable of 80Adc output, the SP model numbers have a charger system capable of 110Adc output. All other specifications are the same between standard and SP units.

System Features and Specifications

General Description

The ITC-Series system consists of a DC to AC true sine wave inverter, a battery charger, an automatic AC transfer switch, and a microprocessor-based controller. An important feature of this system is the ITC-Series Control/Display Unit user interface.

ITC Series Inverter System



F 1 Figure 1.1-1 System Diagram

System Features

- **Inverter**

The inverter consists of a sine wave inverter that supplies power when AC loads are applied. Depending on your model, the inverter develops 2100 or 3200 watts of continuous power. Using TruSine® technology, a very high-quality sine wave is produced. Total harmonic distortion (THD) is less than 4.0 percent.

- **Battery Charger with Automatic Power Management**

The high efficiency, multi-stage battery charger allows automatic charging of flooded lead acid and gel type batteries. The efficient 0.85 power factor or PF, compared to typical 0.59PF on triac pulse type chargers, allows full charger output from a 30-amp AC source. The system's Bulk, Absorption, and Float charge cycle quickly charges and maintains the battery bank. An Equalization charge cycle is available for flooded lead acid battery maintenance.

Automatic Power Management (APM) monitors the AC Input current and will reduce the battery charger output as needed to keep the AC input current below the preset APM Limit.

- **Ambulance Mode Control (+12Vdc input)**

Upon loss of shore power, the inverter remains OFF until the inverter ON/OFF Switch is pressed ON, or a +12Vdc source is applied to the +12Vdc input on the options terminal strip. Applying +12Vdc to the terminal strip will override the front panel switch. Intended for ambulance and fire truck applications, in Ambulance Mode Control the system does not operate like a UPS. This is because it is common in these applications for the shore power cord to accidentally become unplugged. If the unplugged shore power cord went unnoticed this could result in a dead inverter battery, only to be discovered when the vehicle is called into service.

- **Low Battery or Fan On Contact**

The Low Battery contact allows remote monitoring of the Inverter's battery status. The contact will close when battery voltage falls below 11.0 volts. This will alert the user to take appropriate measures to avoid shutdown of the Inverter at 10.5VDC.

- **Remote Power Switch**

This loop between Options Terminal 7 and 8 (left side of Options Terminal) allow remote control of the system On/Off. Tying these two terminals together or optionally, tying the terminal 7 (*Remote Switch*) to battery ground applies power to the unit.

Note: The Front Panel switch will always overrule the remote switch in terms of disabling the unit.

- **System Control**

The ITC contains a System ON/OFF Switch located in the front of the ITC. This switch is used to turn the control power ON and OFF. This power switch also has a break out loop for a series switch that can be placed in a remote location from the unit (See **Remote Power Switch** above). A control microprocessor provides a variety of protection interlocks, system fault detection/reporting/recovery, storage of system data parameters, and high-speed data communications to the ITC Control/Display Unit. This Control/Display Unit also has individual on/off switches for independent Inverter and Charger control. The ITC will protect itself in the event of any overload, over temperature, high or low battery voltage condition.

- **ITC Control/Display Unit**

The ITC Control/Display Unit is a user interface that is connected to the ITC Control Board via a 6-wire modular cable. This Control/Display unit can be an integral part of the Inverter or can be removed and mounted in a remote area to allowing remote system operation. Two of these units can talk to the System Control Board one display would be configured as a Master, and the other as Slave. The configuration switches on top of the Master allow programming of the Charger current, Automatic Power Management

and battery type settings.

NOTE: It should be noted that if the Control Display unit is taken out of the front of the unit, the cover plate (Havis Part # D011339) must be installed in its place to ensure that debris does not enter the unit through the opening and to maintain proper airflow through the unit. The inverter must be ON for the ON/OFF controls to be operational on the Control/Display unit.

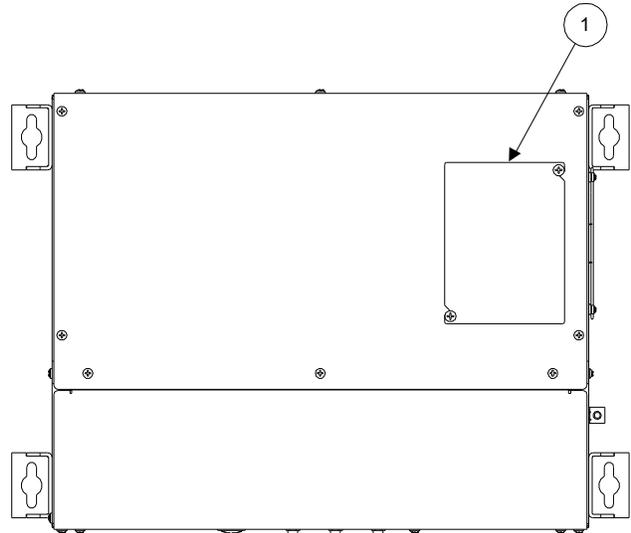
Specifications

Model	ITC12-2100 / SP00175	ITC12-3200 / SP00176
AC OUTPUT		
Voltage (RMS)	120 VAC	
Frequency	60 Hz \pm 0.5%	
AC Waveform	Sine Wave	
Total Harmonic Distortion (THD)	Less than 4.0% @ full power	
Power Factor Allowed	-1 to 1	
Continuous Output Rating @ 25°C		
Phase to Neutral	2100 watts (17.5 amps)	3200 watts (26.7 amps)
Surge Capacity @ 25°C (3 sec.)	6400 watts	
DC INPUT:		
Operating Range	10.5 to 17 Volts	
No Load, Inverter ON	4 amps	
No Load, Inverter OFF	0.30 amps	
Full power	208 amps	350 amps
INVERTER EFFICIENCY @ Nom.		
200 watts	77%	
500 watts	88%	
700 watts	88%	
1000 watts	88%	
1500 watts	86%	
2000 watts	84%	
2500 watts	NA	81%
3000 watts	NA	78%
3200 watts	NA	77%
AC INPUT		
Voltage	120 Volts nominal	
Frequency	60 Hz \pm 12.5% (52.5 to 67.5)	
AC TRANSFER SWITCH		
Power Rating	30 amps @ 120 VAC	
Transfer Time	Less than 40 milliseconds	
BATTERY CHARGER		
Charger Output Current maximum	80 / 110 amps	
AC Input Current maximum	30 amps (0.88PF @ rated output)	
SYSTEM		
Ambient Operating Temperature	-40 to +40°C (-40 to +104°F)	
Cooling Exhaust Fan	Thermostatically controlled	
Mounting	Shelf or suspended	
Dimensions - Bottom mount position	8 1/4"H x 18 7/16"W x 13 5/8"D	
Weight	66 pounds	

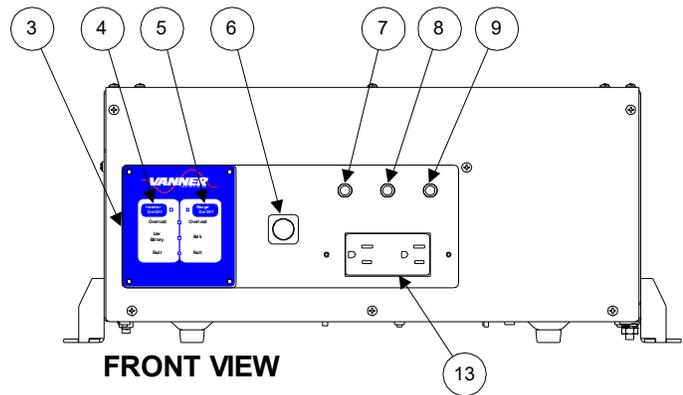
Component Identification/Location

The Figures below show the location of the various components of the ITC system.

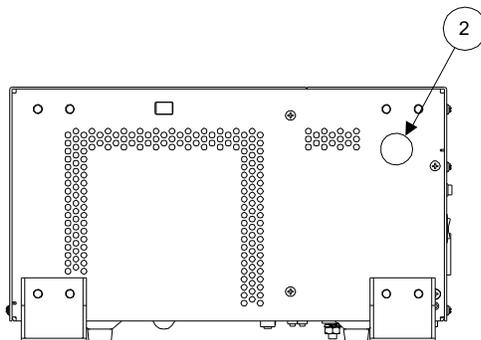
ITEM #	DESCRIPTION
1	BATTERY TERMINAL ACCESS
2	REMOTE CABLE INPUT
3	CONTROL/DISPLAY PANEL
4	INVERTER ON/OFF SWITCH
5	CHARGER ON/OFF SWITCH
6	SYSTEM ON/OFF SWITCH
7	AC INPUT BREAKER (CB-1)
8	AC OUTPUT BREAKER (CB-2)
9	GFCI BREAKER (CB-3)
10	AC INPUT CABLE ENTRY
11	BATTERY +
12	BATTERY -
13	GFCI OUTLET
14	AC OUTPUT CABLE ENTRY
15	OPTIONS CABLE ENTRY
16	CHASSIS GROUND



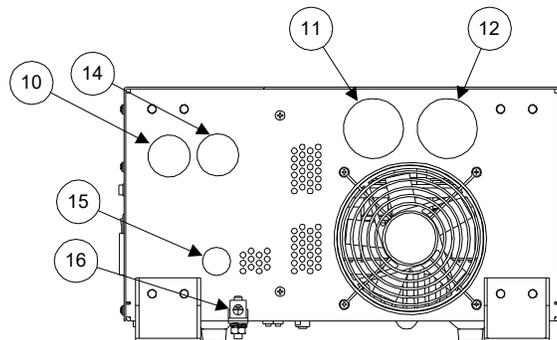
TOP VIEW



FRONT VIEW

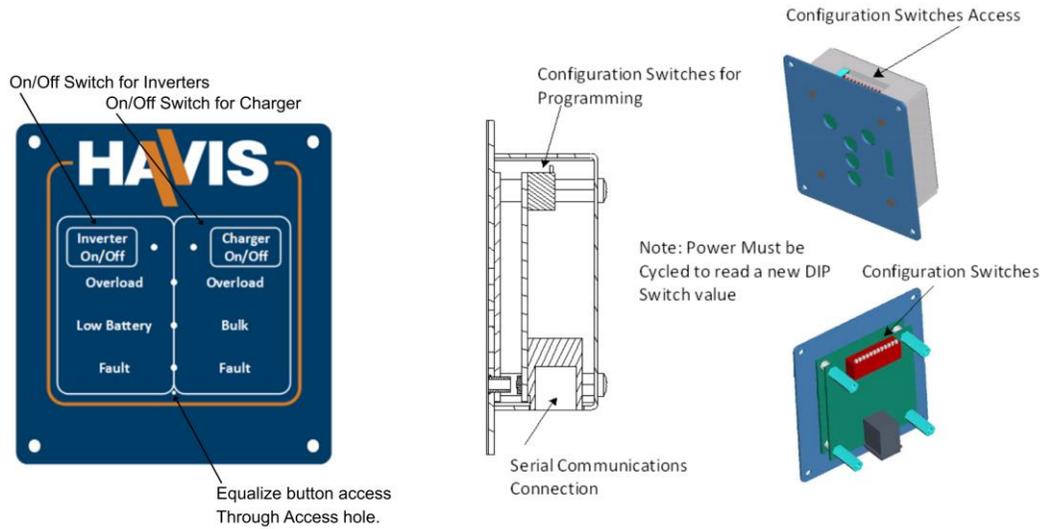


LEFT SIDE VIEW

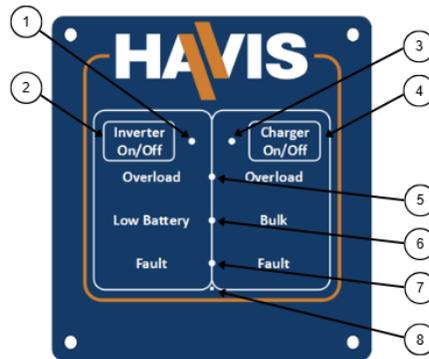


RIGHT SIDE VIEW

F 2 Figure 1.4-1 Component Location



F 3 Figure 1.4-2 ITC Control/Display Unit

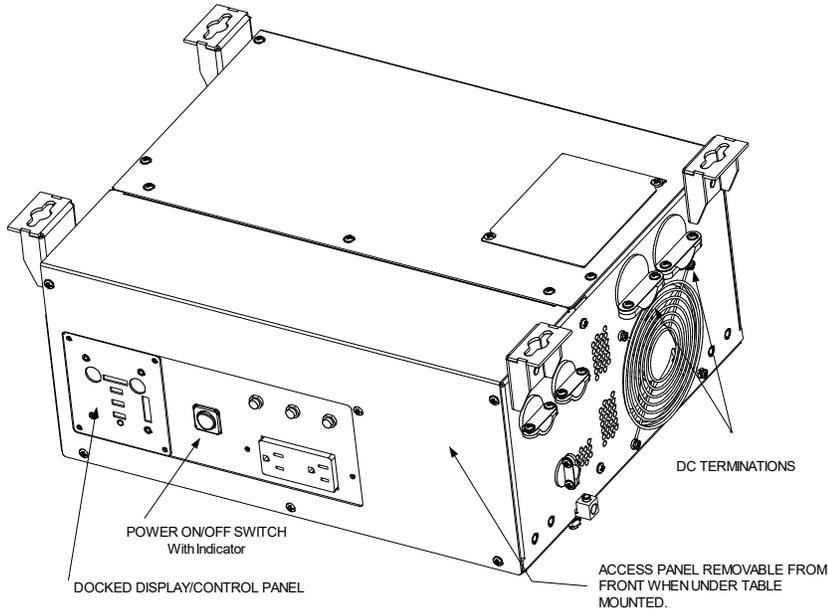


F 4 Figure 1.4-3 ITC Control/Display Unit Component Identification

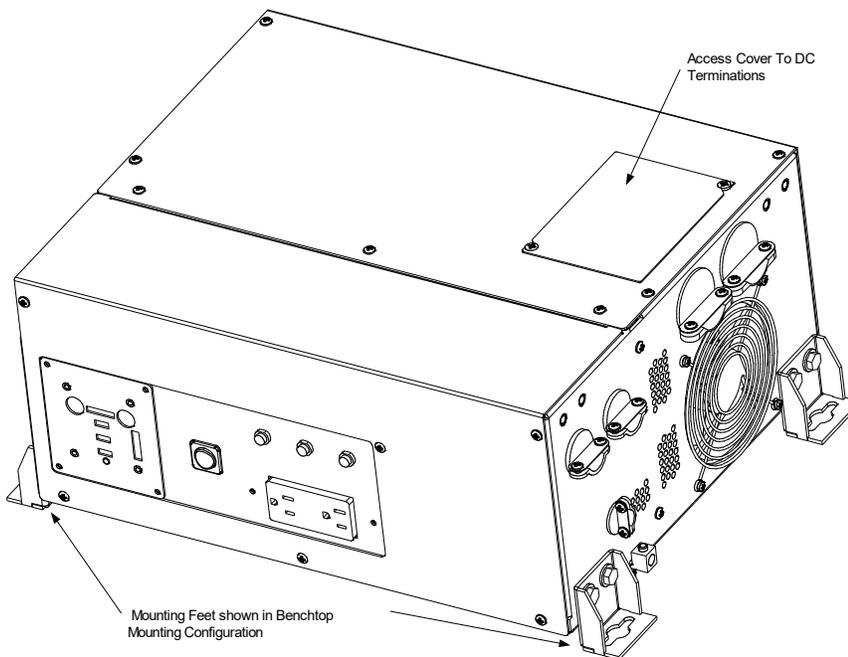
ITEM	DESCRIPTION
1	Inverter Indicator Light Solid when on, flashes when enabled but not on
2	Inverter On/Off Button Enables/Disables Inverter Function
3	Charger Indicator Light Solid when on, flashes when enabled but not on
4	Charger On/Off Button Enables/Disables Charger Function
5	Overload Light Indicates if Inverter Overloaded
6	Low Battery/Bulk Light Dual Purpose – Indicates Low Battery in Inverter Mode – In charger mode, if on indicates that Charger is in Bulk Mode and if in Equalize, this light flashes.
7	Fault Light Dual Purpose – Indicates that a fault has occurred in the inverter or Charger – Could be a Over Temperature shutdown, Low/High Battery Shutdown, Power Stage Fault.
8	Equalize Button Access This is used to enable the equalization cycle on the battery during charging.

Versatile Mounting System

The mechanical system used for mounting the ITC-Series allows both shelf and under-counter mounting, while still allowing access to user AC and control terminals through a removable front cover.

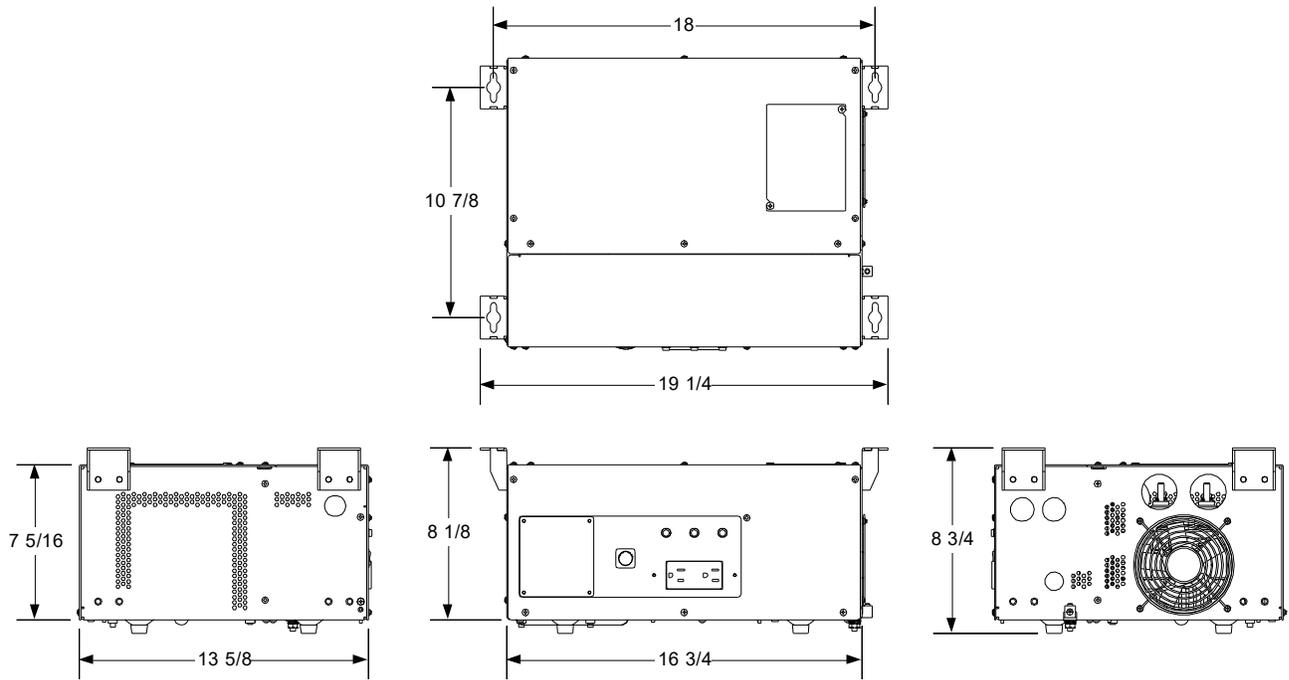


F 5 Figure 1.4-4 Suspended Mounting Configuration



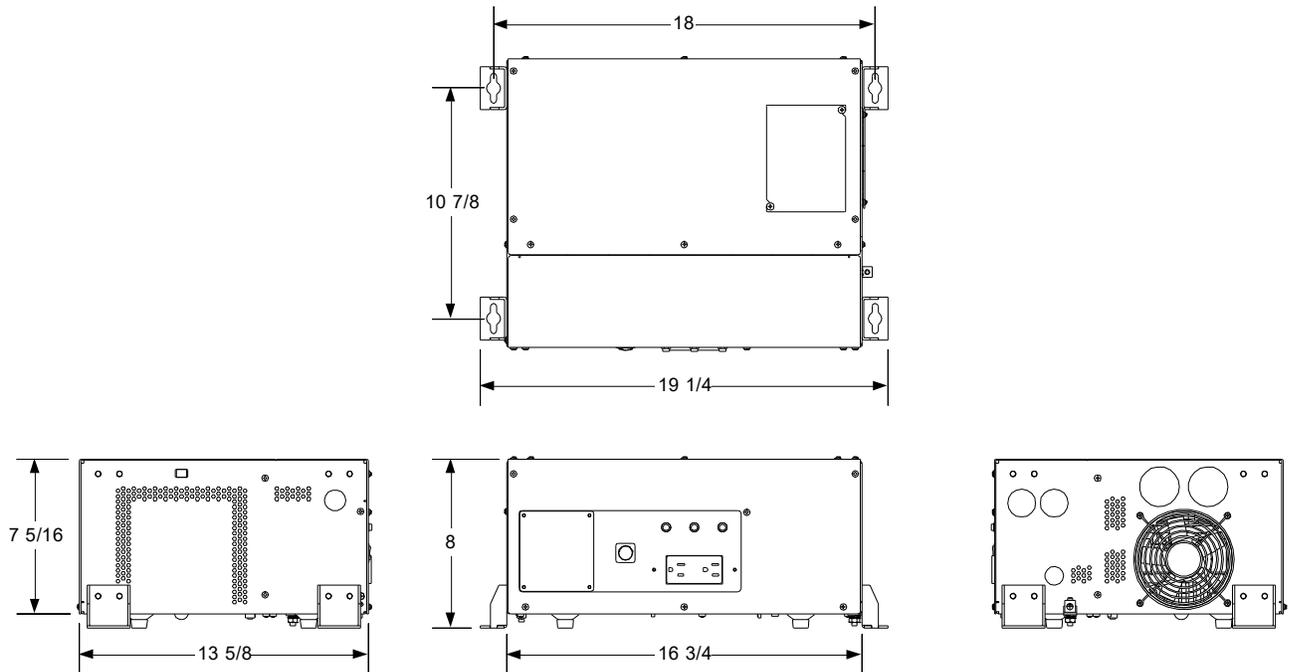
F 6 Figure 1.4-5 Bench Mount Configuration

ITC DIMENSIONS FOR SUSPENDED MOUNTING

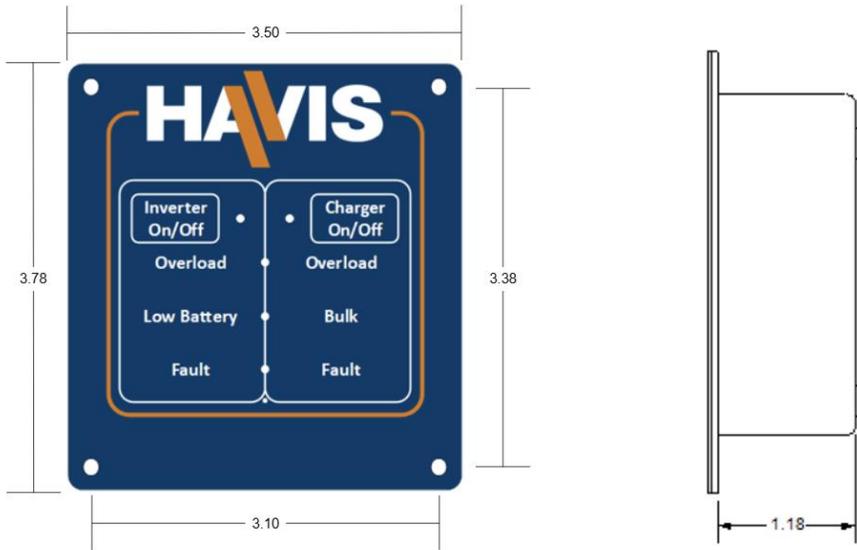


F 7 Figure 1.4-6 Suspended Dimensions in Inches

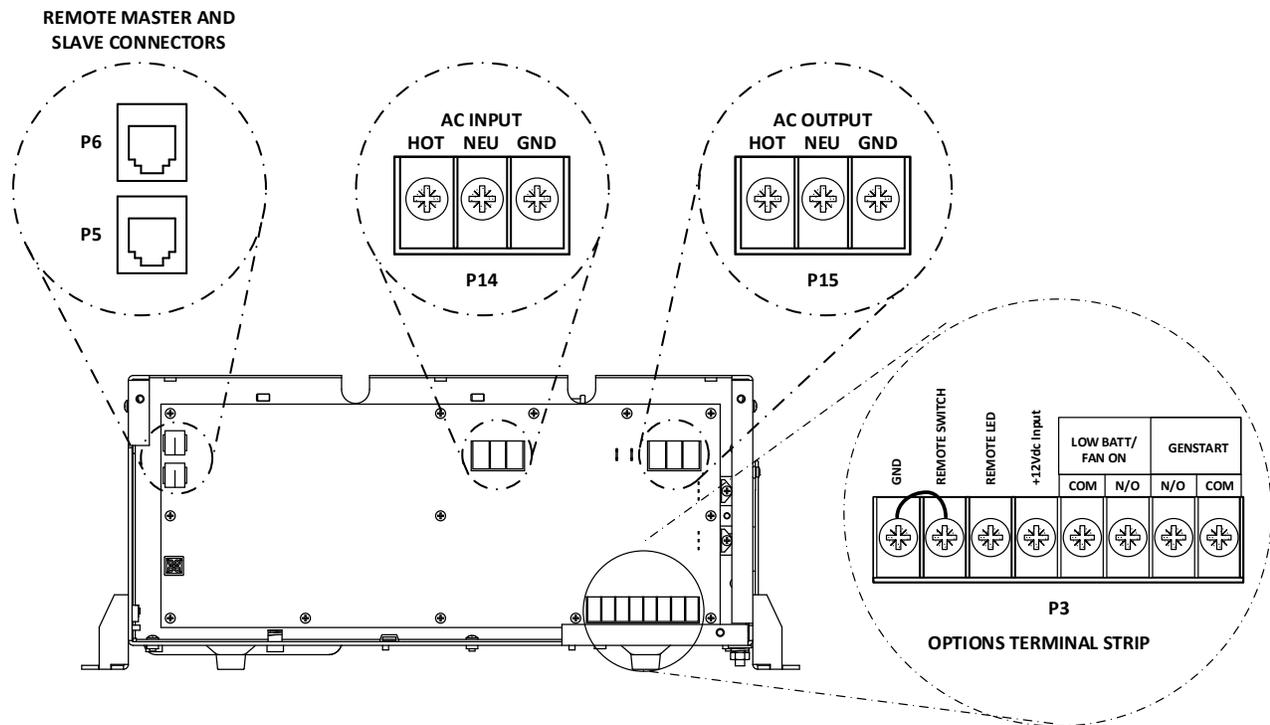
ITC DIMENSIONS FOR SHELF MOUNTING



F 8 Figure 1.4-7 Bottom Mount Dimensions in Inches



F 9 Figure 1.4-8 Control/Display Unit Dimensions in Inches



F 10 Figure 1.4-9 Customer Terminations

DESCRIPTION OF OPERATION

Inverter

The System ON/OFF Switch, located on the front panel, allows the user to turn the system power ON and OFF and to reset the system after a fault.

The Charger ON/OFF and Inverter ON/OFF buttons, located on the Control/Display Unit enable or disable the Charger or Inverter Functions. The corresponding light next to Inverter/Charger buttons will be steadily on when the unit is in the Inverter or Charger mode. These Inverter and Charger lights will blink if the mode is not currently on, but are enabled (Example: The Inverter light will blink when the Inverter is Enabled, the ITC is plugged into the utility, and the Charger is Active).

The Inverter AC Output Circuit Breaker is a 1 pole, 30-amp breaker marked “CB-2” on the front unit. The CB-2 breaker protects the Inverter AC output and a second Breaker (CB-1) protects the Battery Charger AC input against a severe overload. This CB-1 breaker also protects AC Pass through Power. If this CB-1 breaker trips during charger operation, it must be reset.

Inverter Protective Interlocks

The Inverter operation is protected by a series of safety interlocks that protect against most failures such as overloads, over-temperature conditions or other conditions where the unit may be asked to operate outside safe battery voltages. These faults will trigger a display of the “Fault” and or “Overload” Lights on the Control/Display panel and are listed below:

Low Battery	The inverter continually monitors battery voltage. If battery voltage falls below the Low Battery Shutdown 10.5 VDC setpoint the inverter will shut OFF. Auto-restart will restart the inverter after battery voltage rises above the Low Battery Warning 11.0 VDC setpoint (after 5 minutes).
High Battery	The inverter will shut OFF if battery voltage rises above the High Battery 16.0 VDC setpoint.
Over Temperature	The inverter will shut OFF if internal temperature sensors detect a high temperature condition that could damage the inverter.
Over Load	If a short circuit or an overload is applied to the inverter's output the inverter will shut down.
Battery High	The unit has shut down due to the Battery voltage is above High Battery Shutdown setpoint of 16.0 VDC.
Battery Low Warn.	Battery voltage is below Low Battery Warning setpoint and soon may reach Low Battery Shutdown setpoint of 10.5 VDC.
Current Limit	Inverter AC output current is at the Maximum Current allowed and is presently in “Surge”. The AC voltage will decrease if load increases. Overload Shutdown will occur if voltage goes below 105VAC for 3 second.
Overload	Inverter has shut down due to overload. High AC load caused inverter output voltage to fall below tolerance for three seconds.
Hardware Fault	Internal protection circuit activated or power brick high temperature will shut down system.
Overheat	The SCR plate or power brick overheating will cause the system to shutdown.

If the unit has faulted there are the two following options:

1. Auto-restart After shutting down for any of the above fault conditions, the inverter will try to restart itself every 5 minutes if Auto-Restart is Enabled and the fault condition no longer exists.
2. Manual restart You can manually restart the system after the fault conditions are removed. Reset the inverter by turning the System ON/OFF Switch OFF and then ON. Power must be

removed from option position 5 and reapplied (if used) to reset the unit.

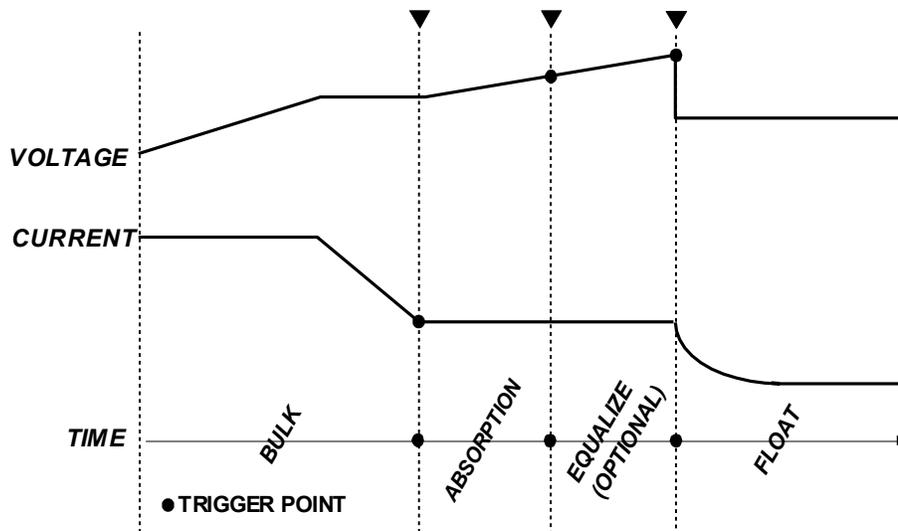
Battery Charger

The battery charger’s advanced design incorporates an automatic, multi-stage charger. This design enables the unit to automatically charge batteries, which maintains the battery’s integrity and reduces the likelihood of premature battery failure. The battery charger is designed to be used with lead-acid type batteries including sealed and gel types, but not for nickel-cadmium (Ni-Cad) or nickel-iron types.

Battery Charging Sequence

Stage 1: Bulk Charge Stage

The charger always starts in the Bulk charge stage each time shore power becomes present and/or each time the charger is turned ON. In the Bulk charge stage, the system charges at the ‘Bulk Charge Amps’ setpoint until the battery voltage rises to the ‘Bulk Charge Voltage’ setpoint. Then the voltage is held at that setpoint until charging current has fallen to 5 amps above the ‘Battery Absorption Amps’. This ends the Bulk Charge Stage and begins the Absorption Charge Stage. The charger will not enter the Bulk Stage again until shore power is re-applied, or until the charger or the system is turned ON again.



F 11 Figure 2.2-1 Charging/Voltage Curves

Stage 2: Absorption Charge Stage

The Absorption Charge Stage provides a controlled “overcharging” of the battery that is necessary to bring the battery up to full charge. The battery is charged at the ‘Absorption Charge’ until one of following three conditions occur that signals the end of the Absorption Stage;

- Time: The Absorption Maximum Time setpoint is reached
- Time: The Absorption Charge Stage time has reached ½ of the duration of the Bulk Charge Stage.
- Voltage: Battery voltage reaches the ‘Absorption Voltage’ setpoint

Stage 2A Equalize Charge Cycle

When Equalize Mode is ENABLED (by inserting a paperclip or similar device through the “master” Control/Display unit Equalize hole), one Equalize Charge Cycle will follow the Absorption Charge Stage. The Equalize Cycle will last for the ‘Equalize Time’ setpoint of 15 minutes. Equalize Mode will automatically switch

to DISABLED at the end of the Equalize Charge Cycle. During the Equalize Cycle the battery is charged at the 'Absorption Charge Amps' setpoint and the Equalize Voltage 15.5 VDC setpoint.

The Equalize Charge Cycle provides a deliberate overcharging of the battery to remove sulfate, which accumulates on the battery plates through normal use. Equalizing returns battery cells to equal performance levels, which improves battery performance and extends battery life. Consult the battery manufacturer for their recommendation regarding how often the Equalize Cycle should be performed.

CAUTION

Do not equalize sealed (valve regulated lead acid, AGM or gel) batteries! Consult battery manufacturer for equalizing guidelines. Do not equalize more often than approximately once a month. Check battery fluids after equalizing is complete, as gassing will occur. Use Equalize Mode only if batteries are in a well ventilated area!

Stage 3: Float Charge Stage - Maintenance Mode

In the Float Stage the charging voltage is reduced to the 'Float Charge Voltage' setpoint and charging current is limited to the 'Absorption Charge Amps' setpoint. The charger will remain in the Float Stage until shore power is reapplied, or until the charger or system is turned OFF and then ON again.

Charging Setpoints

The ITC's battery charger factory setpoints are for flooded batteries. Do not use GEL type batteries without changing the factory setpoints via the configuration switches.

CAUTION

Do not operate DC loads, such as DC lights, pumps, etc., during battery charging. The loads may cause overcharging by preventing the charging stages from reaching their 'trigger points' or may cause the battery to run down even though the charger is ON.

T 1 Figure 2.2-2 Battery Charger Factory Setpoints

	Guideline	Factory Setpoint Flooded Battery	Factory setpoint for Gel/AGM Battery	Units
		12V	12V	
Bulk Charge Volts		14.2	14.1	VDC
Bulk Charge Current	20% C Rate	80/110	80/110	Amps
Absorption Charge Volts		14.5	14.2	VDC
Absorption Charge Current		40	40	Amps
Absorption Maximum Time		10	10	Minutes
Float Charge Volts		13.2	13.7	VDC
Equalize Volts	Flooded only	15.5	N/A	VDC
Equalize Maximum Time	Flooded only	15	N/A	Minutes

Battery 'C Rate' is equal to battery Amp Hour capacity.

Automatic Power Management (APM)

A key feature of the battery charger operation is Automatic Power Management (APM). This feature monitors the AC input current and will reduce the battery charger output as necessary to keep the AC input current under the APM setpoint. The APM circuit will not limit power to the passthrough AC loads. If the passthrough AC loads exceed 30 Amp, the battery charger output will be reduced to zero and the breaker may trip.

Charger and APM Programming

The chart below shows the control switch settings for programming the ITC Charger and APM settings.

NOTE: *It should be noted that the power switch on the front of the unit must be cycled to read in the new Control Switch settings into memory. The new values will not be recognized until this takes place.*

The first 4 (1-4) switches program in the Maximum Charger Current and the next 4 (5-8) program in the APM Current Limit.

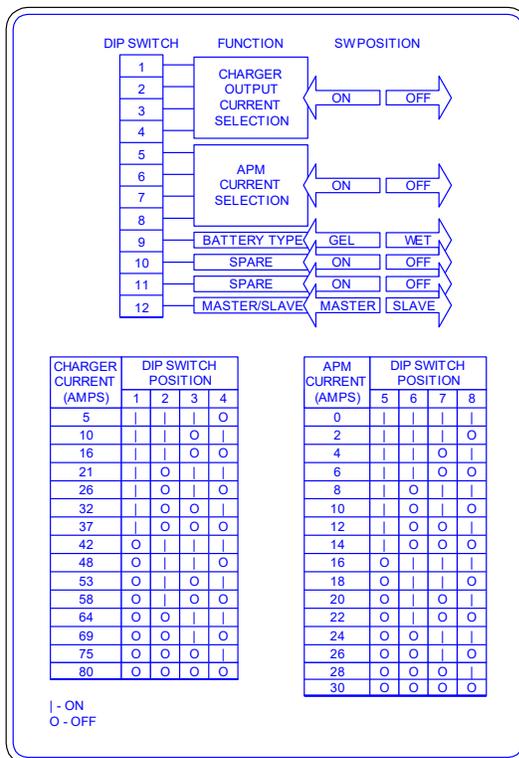
The next switch (switch 9) is for selecting either Gel or Wet (Flooded) type batteries.

The next switch (switch 10) is reserved for future expansion.

The next switch (switch 11) is reserved for future expansion.

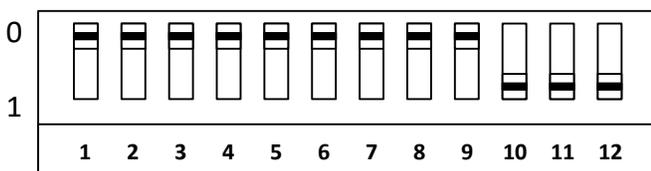
The next switch (switch 12) is reserved for selecting a Master/Slave remote with multiple Control/Display Units.

Note: The figure below is also available on the Rear of the Control/Display Unit.



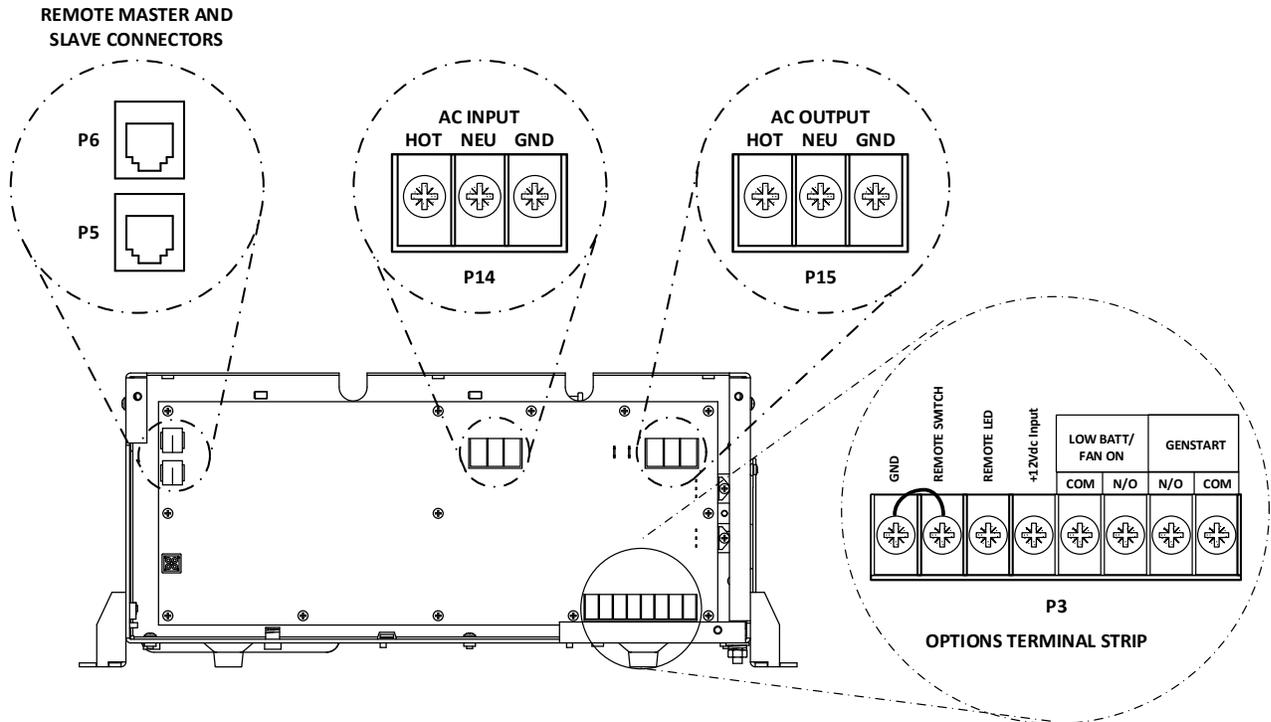
Note: After a new switch setting is set, the power switch must be cycled on the main unit for the new setting to take effect.

F 12 Figure 2.4-1 APM/Charger/Config DIP Switch Settings



The graphic to the left indicates the factory defaults. Switches 1 through 4 show a maximum charger current setting. Switches 5 through 8 indicate 30-amp automatic power management. Switch 9 has selected Wet (Flooded) Cell battery configuration. Switch number 12 indicates "Master" display/control unit.

F 13 Figure 3-1 Customer Terminations



All field wiring enters the ITC housing through the side panels.

Customer Wiring Identification

AC Input & Output Wiring

The AC wiring compartment is located on the front right side of the unit. A removable access cover covers this compartment. Two cable clamps are installed for the AC input and AC output wiring. The removable access cover can be removed by simply removing the screws on the front panel of the unit (ONLY!). There is no need to remove screws from the top or sides of the unit to gain access to the AC wiring compartment. Inside the compartment are terminal strips for making AC input and AC output connections (**P14** and **P15**). Torque to 20lb-in, going above this will fracture the stud and is not covered under the Havis warranty.

NOTE

The AC output voltage and the *required* AC input voltage of the ITC is 120 VAC, 60Hz.

DC (Battery) Wiring

A DC wiring compartment is located behind the wiring panel on the right side of the unit. The compartment contains a removable access cover on the top of the inverter and two cable clamps for the battery positive and battery negative cables. The inverter's battery cable terminal studs are 5/16-18 and can accommodate Cable sizes up to 250 MCM. This connection should be torqued to 130lb-in, going above this will fracture the stud and is not covered under the Havis warranty.

Front Panel Control/Display Outlet

This is a RJ-11 (6-Wire) jack (P5) for communications with the Control/Display Unit. A secondary Control/Display unit can be plugged into the P6 jack who would be configured as a *slave*.

System ON/OFF Switch

Use this rocker switch to turn the system ON and OFF and to reset the system. This switch is located on the front panel of the system. If placed in the "OFF" position, this switch will override the operation of a remote ON/OFF switch connected to terminals 7 and 8, it will not override the +12Vdc input terminal 5 of the Options connector shown in Figure 3-1 – Customer Terminations.

WARNING: The System ON/OFF Switch does not interrupt the DC input power to the system, so it must be noted that dangerous DC voltages still exist inside the unit, even if the power switch is turned off.

Remote Signal Contacts

Terminal Contacts provide capabilities for Remote Inverter Power ON/OFF and Power indication, Remote Low Battery Warning or Fan On indication. Contacts are rated 2 amps at 12 volts, Class 2 circuits. Wiring connections are made through an 8 position Options terminal block. Screw pressure-clamp terminals accept up to 14-gauge wire. Torque to 7lb-in, going above this will fracture the stud and is not covered under the Havis warranty.

A remote power switch will control the system by tying terminals 7 and 8 of the options connector (shown in Figure 3-1) together. This will actuate an internal relay that turns the control power on. The Power On/Off switch on the front panel defeats this remote switch.

In addition, a terminal for a remote LED indicator is provided (terminal 6) with a current limiting resistor integral to the circuit.

INSTALLATION

Unpacking the Inverter

Inspect the shipping container and equipment for loose or damaged parts. If any damage is found, immediately notify the freight carrier.

Basic Guidelines

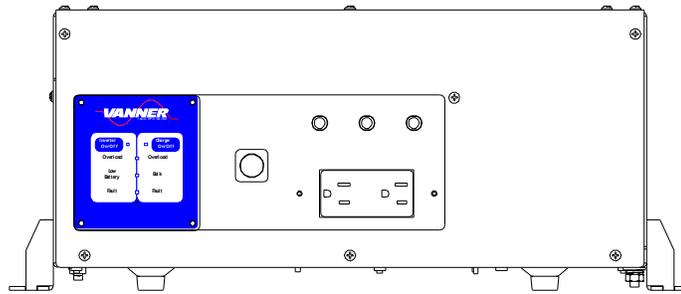
The wiring of your inverter installation should conform to the National Electric Code (NEC) and any other state or local codes in effect at the time of installation. These codes have been written for your protection and their requirements should be followed.

Mounting

Locate a secure, dry, flat horizontal surface large enough to mount the inverter. The location should be as close to the battery as possible without being in the same compartment and should provide adequate ventilation to maintain room temperature (75°F, 24°C) while the inverter is operating. The location must allow unobstructed cooling airflow at sides, rear, and bottom of the unit, and the location must be free from road spray, dripping water or other moisture contamination. A recommended minimum clearance of 4 inches (102 mm) should be maintained on all sides of the unit.

WARNING: Risk of fire or explosion. The inverter must not be mounted in fuel storage areas, battery compartments, or other hazardous areas where potentially explosive gases may be present.

WARNING: It is important to utilize the included mounting brackets mounting. Mount the inverter in the under cabinet method or bolted to a shelf. There **must be a minimum of 5/8 inches below the unit**, which provides adequate airflow to cool the Inverter/Charger. If the unit is to be set on its base (in a shelf mount configuration) and not bolted down, make certain that the mounting feet are bolted to the unit to provide the adequate clearance as shown below.



F 14 Figure 4.1-1 Shelf Mount Configuration

NOTE

The wiring of your inverter installation should conform to the National Electric Code (NEC) and any other state or local codes in effect at the time of installation. Article 551-10 of the NEC requires any DC cable from a battery, which measures longer than 18 inches along its length, be protected by a fuse. Other codes may require each ungrounded output conductor from a storage battery, other than to the engine cranking motor, to have a manually reset trip-free circuit breaker or fuse within 18 inches of the battery as measured along the conductor.

DC Wiring

Preliminary Considerations

1. **BE AWARE** that, as a large number of capacitors become charged upon completion of the DC circuit, **THERE WILL BE A LARGE SPARK** when the last battery connection is made. The spark is normal and will occur every time the batteries are connected.
2. Do not use the vehicle chassis as the DC negative conductor. Use a cable the same size as the DC positive to go directly from the inverter to the battery negative.
3. A DC fuse is required to properly protect the inverter.
4. Route the DC positive and negative cables as close together as possible, and use cable ties to keep them together. This reduces some electromagnetic radiation that could interfere with some sensitive electronics.
5. The DC cables should be as short as possible. It is electrically more efficient to run the lower current AC wiring longer distances than the DC cables. (See DC Cable Sizing Chart for proper size.)
6. Route the AC and DC power wiring separately, and with as much physical separation as possible, from low voltage wiring such as audio and video signal wires.
7. DC power input cables that pass through steel or other ferrous metal walls need to pass through the same hole. If two holes are required, cut a slot connecting the two holes to prevent a transformer effect.
8. Do not allow wire fragments or metal shavings to fall into the DC wiring compartment or to enter the inverter in any way. Severe inverter damage will result which is not covered by the warranty.
9. Do not connect the inverter to the battery at this time. Final battery connections will be made after the installation has been inspected.
10. **WARNING:** A poorly made (loose hardware or crimp) high current connection may result in the risk of fire and personal injury.
11. **WARNING:** Be sure of the polarity of the DC input wiring. Reverse polarity may severely damage your inverter and is not covered under warranty. Risk of fire or explosion of batteries may occur due to very high currents.
12. The table below shows the recommended minimum cable size which should be used. Wire sizing charts published in the NEC may allow a greater amp capacity than we recommend. We have sized the cable for a minimum voltage drop on the cable to maintain better performance of your inverter installation. The inverter's DC cable terminal lugs can accommodate cable sizes up to 250 MCM.

T 2 Table 4-1 DC Cable and Fuse Sizing Chart

DC Cable Size	Max. Distance from Inverter to Battery in Feet	Terminal Lug - Amp Part Number	Terminal Crimping Tool – Amp Part Number
	ITC12-2100W/ ITC12-3200W		
250MCM Copper Conductor	31/20	325703	AMP DYNA-CRIMP Head - Part #69099 AMP DYNA-CRIMP Die - Part #46751-2 AMP DYNA-CRIMP Hydraulic Power Units - Part #69120-1 or 314979-1
4/0 Copper Conductor	26/17	321271	AMP Rota-Crimp Part# 600850 (2/0-4/0)
Fuse Information	Bussmann Part Number	Havis Part Number	
ITC12-2100	Bussmann ANL300	03645	
ITC12-3200	Bussmann ANL500	03646	
Fuse Holder	Bussmann 4164	03637	

DC Wiring Installation

The DC input terminals are located in the rear right side of the unit and accessed from the top. The connections are 5/16-18 brass studs that require a lugged connection and are to be tightened by a torque wrench. The positive and negative cables enter the compartment through separate strain reliefs located at the right front of the unit. This connection should be torqued to 130lb-in, going above this will fracture the stud and is not covered under the Havis warranty.

WARNING

Make certain the ON/OFF control switch on front of inverter is in the OFF position before connecting to the battery. Never make electrical connections "live". Make the connections to the inverter first, and the battery, last.

NOTE

Severe damage to the inverter will result if wire fragments or other metal particles enter the inverter through the DC wiring compartment. This is not covered under warranty.

Procedure

- Step 1: Verify that the inverter is turned OFF (the Inverter ON-OFF switch is in the OFF position).
- Step 2: Select a location for the unit.
An ideal installation location has the following characteristics:
 - Close to the battery without being in the battery compartment (usually within six feet).
 - Protected from the weather.
 - Well ventilated.
- Step 3: Connect the DC cables to the inverter:
 - A) Put lugs (For the appropriate wire size called out in Table 4-1) on the ends of the Positive and Negative DC Cable ends with the appropriate terminals. Be sure that all cable strands are completely in the lug to avoid shorting to another conductor. Remove the cover plate on the DC cable compartment exposing the positive and negative threaded studs.
 - B) Remove the two flat washers, split ring washers, and nuts from the threaded studs.
 - C) Insert the black, negative (-) cable end through the strain relief and onto the negative terminal

- threaded stud, and tighten to **130 inch-pounds**.
- D) Insert the red, positive (+) cable end through the strain relief and onto the positive threaded stud, and tighten to **130 inch-pounds**.
 - E) Tighten the two cable clamps.
 - F) Inspect the DC cable compartment to ensure that no foreign particles are present.
 - G) Replace the cover plate over the DC cable compartment.
 - H) Repeat steps A, D, E, and H as general maintenance for the unit.
- Step 4: Route the negative and positive DC input cables from the inverter to the battery. If required, protect cables where they contact hard, sharp edges.
- Step 5: Install the in-line fuse in the red, positive DC input cable between the battery and inverter, within 18 in. of the battery or DC wiring bus system. Make sure all connections are torqued to manufactures specification and protective covers are installed where necessary.
- Step 6: Once all cables are double checked for proper connection and polarity, connect the battery to the appropriate cable. **There will be a spark!**
- Step 7: Verify Installation. Verify all connections are tight and the cables are secure.

AC Wiring

Preliminary Considerations

1. Output and Input Voltages

The ITC is designed to operate with an AC Output Voltage and AC Input Voltage of 120 VAC, 60Hz.

Note: AC input source branch rated overcurrent protection is to be provided by others to comply with the National Electric Code, NFPA 70.

2. AC Wire Size

To properly size the AC input and output wiring the installer must consider the inverter output capability, the inverter passthrough capability, and the battery charger input requirement. The AC input/output terminal strip is a compression lug style that will accept up to 10 AWG copper wire.

Model ITC12-3200 – The 26.7 amp at 120-volt (3200-watt) inverter output capability requires #10 AWG wire minimum is used for the AC output. The AC transfer switch is rated 30 amps at 120 volts.

Use input copper wire up to 10 AWG to suit the AC input source. The AC output wire should be the same size as the AC input wire but not less than #10 AWG.

3. The AC Input and output wiring compartment is accessed by removing the front panel and is on the right side of the unit. Field wires are brought in through two cable clamps to the terminal strips identifying the “AC Input” and “AC Output” terminals.

4. **If AC Input is wired into the AC Output, damage will occur to the inverter!** The power distribution circuits must be designed to prevent AC power from an external source (shore power or a generator) from feeding back into the inverter's AC output.

5. The inverter AC output must be wired to a Ground Fault Circuit Interrupter (GFCI) to ensure a safe installation. Always maintain an isolated neutral downstream from the GFCI to prevent nuisance tripping.

6. The Circuit Breakers on the front panel are NOT BRANCH RATED! In all installations please follow all national and regional electric codes and use the mandated branch rated breakers for power distribution.

7. The CHASSIS BONDING LUG located on the right of the unit has been provided for safety to prevent possible shock hazards. Connect a #8 AWG minimum wire to this terminal and then to chassis of the vehicle, the installation's grounding system, or to earth ground.

Failure to connect the chassis bonding lug to the chassis of the vehicle, the installation's grounding system, or to earth ground may result in a lethal shock hazard.

AC Wiring Procedure (refer to Figure 3-1)

Warning: Make certain that the AC field wiring (upper right of the wiring compartment) and the Signal wiring (at the lower right of the wiring compartment) are kept separate to avoid any problems or conflicts with code. Make certain to route the Signal wires out of the provided port (lower most on the right

side of the unit). This is to insure that there are no problems that may arise from the poor insulation properties of most signal level wire. Make certain that the auxiliary contact and option wiring are routed below the barrier, and the AC Power Wires above the barrier.

Step 1: Connect the AC output. Remove the front cover to expose the AC input and output terminal strips. Identify the right terminals labeled “AC Output”. Insert the output field wires through the nearest (to the board) strain relief into the AC wiring compartment. Tighten the strain relief. Connect the copper field wires to the proper AC output terminals and tighten to 9 lb-in max.

Warning: Do not attempt to use a stranded wire. Stranded wire has a tendency to break off some of the strands and will drop into the unit causing possible failures. If a stranded wire is used, the appropriate “ring terminal” must be used.

Step 2: Connect AC Input. Identify the terminal strip’s terminals labeled “AC Input”. Insert the field wires through the (closest to the front panel) strain relief into the AC wiring compartment. Tighten the strain relief. Connect the copper field wires to the proper AC input terminals and tighten to 9 lb-in max. Replace the front cover.

Warning: Do not attempt to use a stranded wire. Stranded wire has a tendency to break off some of the strands and will drop into the inverter causing possible failures. If a stranded wire is used, the appropriate “ring terminal” must be used.

Step 3: Verify Installation. Verify all connections are tight and secure for maximum performance.

System Start-up and Testing

Step 1: Completely install the ITC-Series Inverter/Charger following the system design considerations and instructions provided previously in this manual.

Step 2: Place the System Power On/Off switch located on the front of the inverter in the OFF position.

Step 3: Verify that the internal GFCI outlet is reset and connect an AC load, such as a 100-Watt light. Note: GFCI’s require power to be applied before they reset.

Step 4: Turn ON the battery DC power to the inverter.

Step 5: Turn ON the AC shore power (or generator) to supply the AC input power to the system.

Step 6: Place the System On/Off Power switch located on the front of the inverter to the ON position.

Step 7: The Lights on the Control/Display Unit on the front of the inverter should come ON, by doing a lamp test.

Step 8: Disable the Charger Operation of the unit by pressing the Charger ON/OFF button once if the Charger LIGHT is On or blinking. This turns the charger function OFF.

Step 9 If the Inverter LIGHT is not On or blinking, enable the Inverter Operation of the unit by pressing the Inverter ON/OFF button once. This turns the Inverter function ON.

Step 10 The AC output test light should come ON, indicating the presence of shore power and correct operation of the AC transfer switch.

Step 11: Turn off the AC shore power input. The AC output test light should immediately quickly blink once, indicating the transfer switch transferred the test light from shore power to inverter power.

Step 12: At this point, apply AC loads up to rated output watts to verify full-power operation.

Step 13: Apply shore power. After a delay the AC output test light should blink and the ITC Inverter LIGHT should blink indicating the transfer of the load from inverter power to shore power.

Step 14: Test the battery charger operation

A) With shore power applied, press the Charger ON/OFF button to enable the Charger (if not enabled). The Charge LIGHT should come on and the batteries should begin charging.

Remember to reduce the loads on the unit since the APM will limit the available power to the charger based on its settings.

- B) Connect an ammeter to the DC cables between the inverter and the battery to monitor the current (DC amps), and a voltmeter to the battery to monitor the battery voltage. The battery charger will step through its sequence and stop in the float mode.
- C) Disconnect the shore power – the unit should transfer back to Inverter mode.
- D) Discharge the battery by leaving the AC load on the system and operating the inverter.
- E) As the battery discharges the low battery lamp will illuminate on the remote. Leaving the load on the fault light will eventually illuminate. When the battery charge level is low, the inverter output will turn off and stay in fault mode.
- D) Remove all loads, reattach shore power and allow the system to fully recharge the batteries to Float charge.

Step 15: The system is now ready for operation.

MAINTENANCE & TROUBLESHOOTING

Preventative Maintenance

There are no user serviceable components inside the ITC-Series Inverter/charger. For service refer to Havis Incorporated or other qualified service personnel.

Maintenance Items:

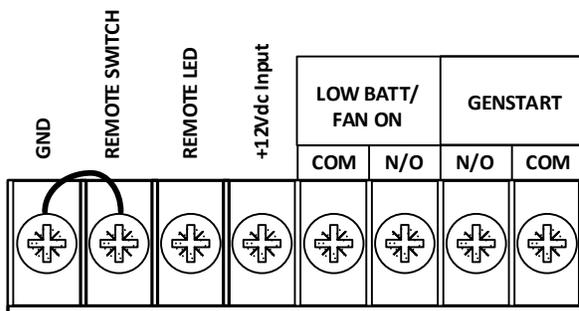
For continued reliability and safety, a monthly maintenance program should be implemented to include the following:

1. Check to insure that all AC and DC wiring is secure and connections are tight and corrosion free.
2. Check air ventilation openings for dust and other obstructions.
3. Examine receptacle, indicators and switches for cracks and breaks in insulation material.

Trouble Shooting:

The Unit does not come on when Shore Power or DC is applied and the front Power Switch is on.

Suggestion:



P3

Make certain that the remote switch connected to Options Terminal Strip P3 - terminals (Remote Power Switch P3-7– To Ground P3-8) is functioning properly. If the switch is not installed, make certain that a jumper is present between the two left most terminals (GND and Remote Switch) as shown below.

F 15 Figure 6.1-1 Options Terminal Strip

Owner's Manual Addendum New GFCI Receptacle

Hubbell GFRST15W GFCI Receptacle (w/Automatic Self-Test)

Due to a UL943 change that requires all GFCI receptacles manufactured after June 29, 2015 to automatically self-test, we had to change the GFCI receptacle on our inverters.

The new Hubbell GFRST15W GFCI receptacle (Havis P/N 07115) requires 120Vac to be present when manually testing or resetting the device. On Havis quasiwave inverters with load demand active, you will need to turn off the inverter and then turn the inverter back on to reset the GFCI receptacle within 5 seconds before the inverter goes back into load demand mode. You can also disable the load demand mode via dipswitch, if applicable.

LED Function – The Green LED will be on when A/C power (120 volts) is present to the GFCI.

The Red LED will be on solid in addition to the Green LED when the GFCI protection has been activated. If the Red LED is flashing the receptacle has lost its GFCI protection and shall be replaced immediately. Contact Sales or Service 1-800-AC-POWER (1-800-227-6937).

Note: The Bybon BYB-E15 GFCI will also be used on our inverters.



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