



DC/AC-AC Inverter

Installation, Operation, Maintenance & Specification



FOR:

ESI48T102AB A (120V) 100/110/115/120VAC, 50/60HZ

ESI48I102AB E (220V) 208/220/230/240 VAC, 50/60HZ



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1 DOCUMENT INFORMATION

1.1 Version control

Document number	Document description	
DC/AC-AC Inverter IOM-00	DC/AC-AC Inverter IOM	
Previous version	Description of changes	
	Controlled by	Date
	Charles Chang	Aug.26.2005

	Approved by	Date
	Eddy Lee	Aug.26.2005



2 PRODUCT INTRODUCTION

2.1 General Description

The ESI (Energy Saving Inverter) series inverter is a High reliability 1KVA DC/AC-AC Power Inverter system that accepts DC (-48V nominal) and AC (Low line model; ESI48T102ABA, 120VAC or high line model; ESI48I102ABE, 220 VAC) Input sources and provides a Selectable (100/110/115/120VAC, 50/60HZ-ESI48T102AB A or 208/220/230/240 VAC, 50/60HZ-ESI48I102AB E) uninterruptible AC output. The input Source is automatically selected when the existing input voltage source is lost. The AC input mode is always used by default. The DC input mode can only be used when the AC input is missing.

2.2 Benefit

Advanced power electronics and microprocessor technology are used to achieve the following features:

Self-Diagnosis and High Reliability

Identification of any failure by message(s) on the LED/LCD display with visual alarm once a failure is encountered. Each unit also provides contact closure for remote alarms.

High Frequency Architecture

With the high frequency architecture design, the ESI series inverter has outstanding characteristics such as high efficiency, light weight and compact outlook. The high efficiency feature means less energy waste during power conversion from DC to AC. The light weight and compact outlook benefits easy installation.

Modular Design

All ESI inverters use a modular design structure. The outstanding feature allows the inverter to be easily maintained and have high MTBF time.

High Efficiency

The ESI series inverter uses advanced soft-switching techniques to increase operating efficiency and reduce switching noise.

Protection

Including following protection:

- DC input reverse polarity protection.
- Internal over temperature protection.
- Output over load protection.
- Output over/under voltage protection.
- Output electronic protection for short circuit.
- DC input short circuit protection: fuse and breaker both.

- AC input short circuit protection: breaker.
- Input over/under voltage protection.
- Fan failure detection.

2.3 Features

- Standard 18", 19" and 23" rack or cabinet
- 1KVA/800W
- Efficiency >83% (Full linear load at 48V Input/120V Output, ESI48T102AB A) or 85% (Full linear load at 48V Input/220V Output, ESI48I102AB E).
- Pure sine wave output
- Uninterruptible AC output during input source changes.
- User friendly LCD/LED Interface
- Intelligent software for power management
- Light weight and small size
- Load power factor 0.5~1.0
- Fan aging, failure, disconnection and blocking alarm and protection
- User-selectable output voltage (software)
- User-selectable output frequencies (software)
- Local remote management and control
- DC Input reverse-polarity protection (No breaker trip or fuse blow)
- Auto restart (Powers on to an operating state without any manual intervention)
- AC Bypass / Inverter operational mode selectable (by front panel)
- Low input DC or AC ripple current
- Low DC input inrush current limit (< 100A)



3 IMPORTANT SAFETY NOTES

- SAVE THESE INSTRUCTIONS - This manual contains important instructions for our inverter that should be followed during installation and maintenance of the inverter.
- To reduce the risk of electric shock, install this inverter in a temperature and humidity controlled indoor area free of conductive contaminants. Ambient temperature must not exceed 55°C (131°F).
- The over-load protection for the output AC has two protection modes:
 1. When work in On-line mode; the Inverter AC output is electronically AC short circuit protected. (For information on the on-line and off line modes, refer to section 4.8.)
 2. When work in Off-line mode; the Inverter output is protected with the AC input circuit breaker.
- The following precautions should be observed when working on inverter:
 1. Remove watches, rings, or other metal objects.
 2. Use tools with insulated handles.
- Examine the packing container for damage. Notify the carrier immediately if damage is present.
- Do not disassemble the inverter.
- Do not operate near water or excessive humidity.
- Keep liquid and foreign objects from getting inside the inverter.
- Install inverter in a well-ventilated area. Do not block air vents in front of inverter or air exhausts in the back.
- Do not operate close to gas or fire.
- Do not operate if the unit is leaking liquid or if any residue is present.
- Elevated operating ambient temperature: If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the manufacturer's maximum rated ambient temperature.
- Reduced air flow: Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised.
- Mechanical loading: Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.
- Circuit overloading: Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of circuits might have on over-current protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

- Grounding of rack-mounted equipment should be maintained. Particular attention should be given to supply connection other than direct connections to the branch circuit.
- **Safety Warning Label Notes**



- Do not remove the “Warning Label”
- If the label is missing contact Delta for a replacement.
- For North America please contact **888-533-3582**, for outside North America, please visit the website http://www.delta.com.tw/contact_us.asp "Telecom Power" Product Series under "Power Management" Product Category.

3.1 Symbol



PROTECTIVE GROUNDING TERMINAL: A terminal, which must be connected to earth ground prior to making any other connection to the equipment.



This symbol indicates the word "phase".



FRAME GROUNDING TERMINAL: A terminal, which must be connected to frame ground prior to making any other connection to the equipment.



4 INSTALLATION SECTION

4.1 Receiving

Although this equipment was thoroughly tested and inspected by manufacturer and carefully packed for shipment, damage in transit may have occurred. Follow the procedures below to receive the equipment from the freight carrier:

Inspect the shipping container for damage. If damage is noticed, request that the carrier inspect the equipment during unpacking. We suggest photographing any damage. A full report of the damage should be obtained by the claim agent and forwarded to your dealer.

4.2 Unpacking

Check the condition of the package. If the package or unit is damaged contact your local dealer at once. Carefully open the box. Do not use sharp objects.

Accessories include:

1. Mounting bracket : Total 5 pairs; 3 pairs for 18", one pair for 19" and the other pair for 23" installation.
2. Screw Bag : Total 20 PCS of Hex head M4 screws in bag; 2 for the ground wire, the others for mounting brackets installation.
3. Green ground wire 1 PC
4. User's manual 1 PC

If Items are missing, contact:

For North America please contact **888-533-3582**, for outside North America, please visit the website http://www.delta.com.tw/contact_us.asp "Telecom Power" Product Series under "Power Management" Product Category.

4.2.1 Contents

Please refer to (**Fig. 1**) below for the detail contents inside the shipping carton:

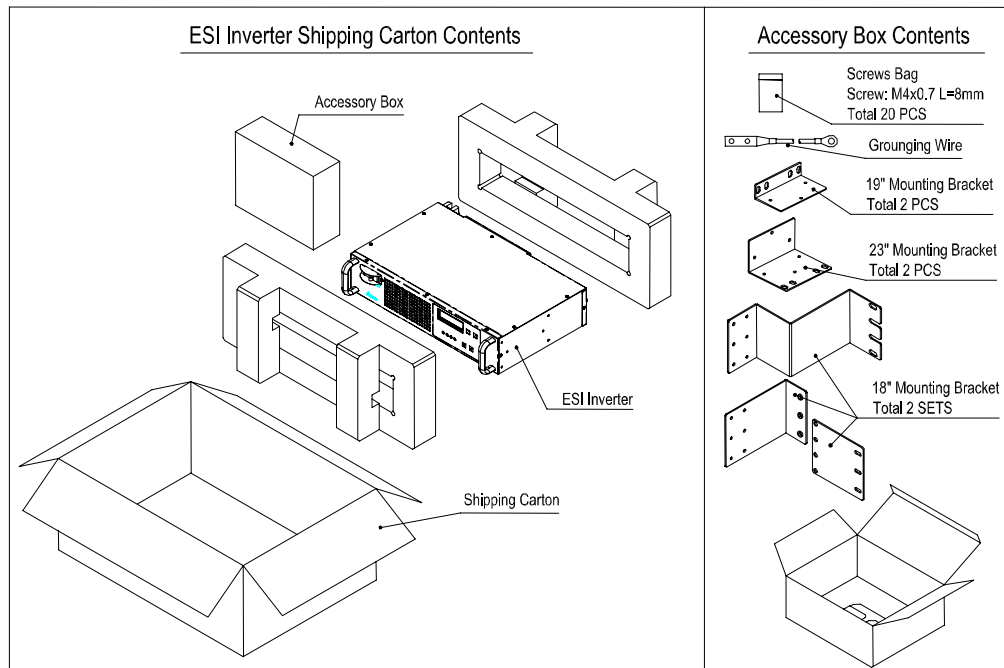


Figure 1. ESI Inverter Shipping Carton Contents

4.2.2 Prior to Installation

Successful installation depends on careful planning and site preparation. Installation of the ESI inverter must be performed by skilled technicians and electricians which familiar with high-energy electrical equipment. Do not allow unqualified personnel to handle, install, or operate the equipment. The installation must comply with both the requirements of the National Electrical Code (ANSI/NFPA 70, latest issue), and local codes.

4.3 System Ventilation Notes

The ESI Inverter is designed for installation in a controlled environment. Factors to be considered in selecting a location include ventilation, temperature, humidity, and accessibility. Install the ESI Inverter in a clean, dry location where the airflow is not restricted.

The Inverter is cooled by forced air. Airflow is from front to back. The front of the system should be clear of all obstruction and not restrict fan air intake.

For stand-alone installation, allow at least 6 inches of air space to the sides of equipment, and no less than 4 inches from the rear of the shelf to the wall. When installed next to other heat generating equipment allow a minimum of 12" (30.48 cm) to the sides;

4.4 Mechanical Installation

4.4.1 CABINET / RACK INSTALLATION

4.4.1.1 Bracket Mounting Selection Notes

The ESI Inverter can be installed on 3 different sizes of Cabinets or Open Racks: 18", 19", and 23" by using the mounting brackets supplied with the unit in accessory box.

For Cabinet mounting to a "19 or 23 " Cabinet, the mounting brackets should be installed to ESI Inverter's "Front Position" (**Fig. 2**)

For Open Rack mounting the "Rear Position" is used (**Fig. 3**).

- For 18 inch rack installation, 6 PCS of the "18" Mounting Bracket "should be used (**Fig. 4**)
- For 19" installation, 2 PCS "Mounting Bracket A" should be installed to ESI Inverter (**Fig. 5**) .
- For 23" installation, 2 PCS of "Mounting Bracket B" are used (**Fig. 6**).

Accessory Bag Contents Note :

The screws bag in accessory box contains 20 PCS screws of M4x0.7 L=8mm. Use 6 PCS (19" or 23") or 18 PCS (18") screws to fix mounting brackets to the ESI Inverter. The remaining 2 screws are for the grounding wire attachment to the grounding point on the rear side of ESI Inverter as mention in section 4.7.4.1.

STEP 1 : Attaching the Brackets

After selecting the proper bracket configuration, attach the brackets and tighten the screws.

STEP 2 : Mount the Inverter in the Rack or Cabinet

Following below (**Fig. 2**) to (**Fig. 6**) process instruction to mount the ESI inverter into the rack or cabinet.

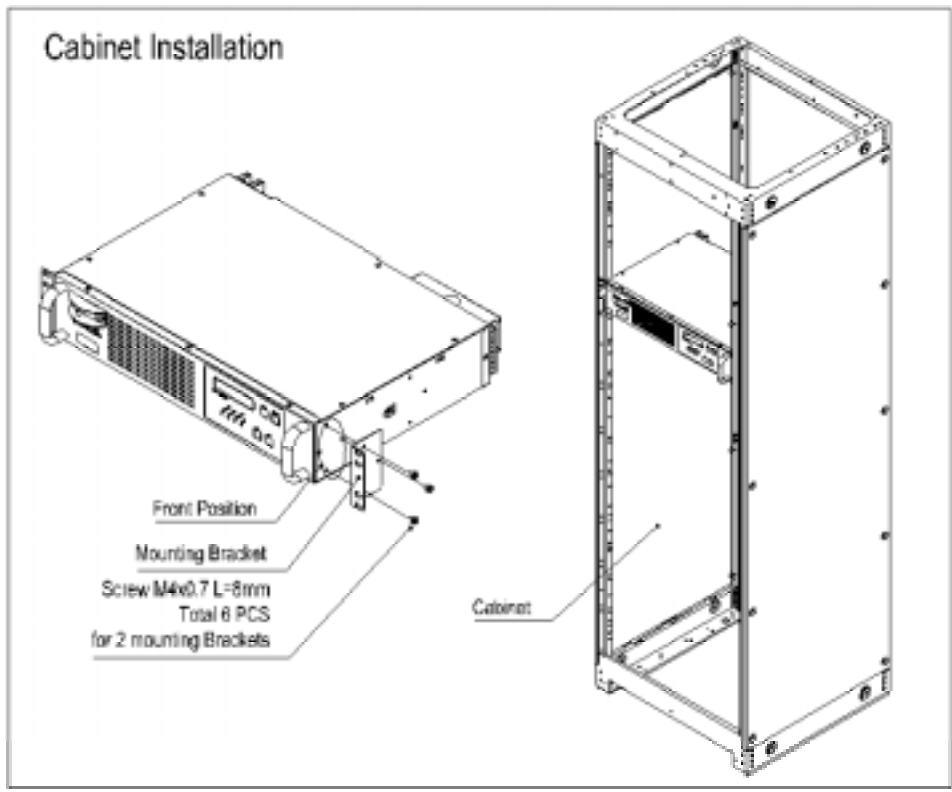


Figure 2. Cabinet Installation

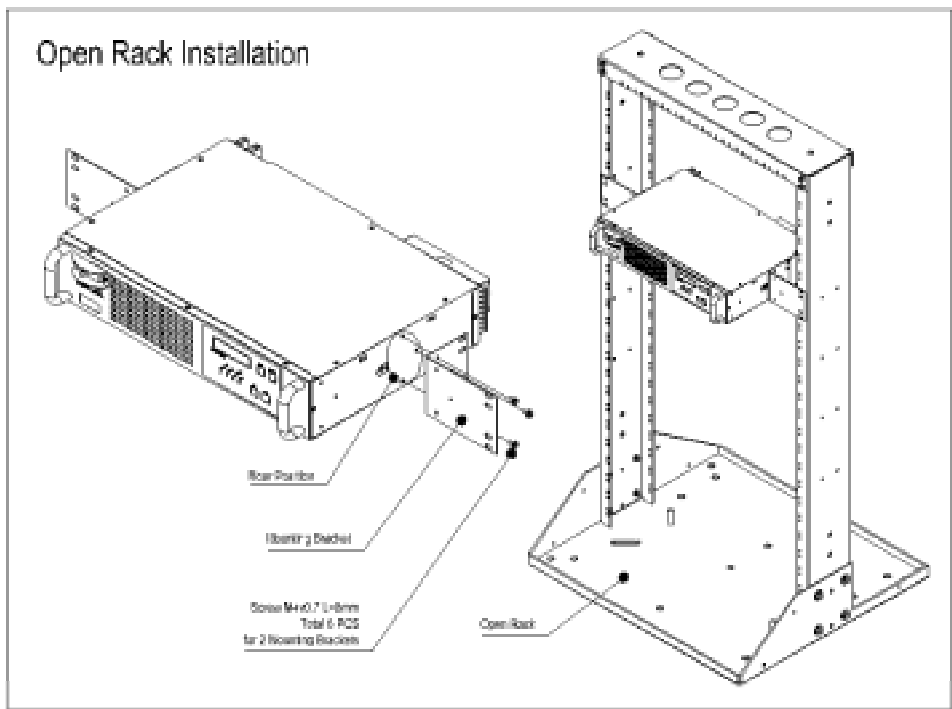


Figure 3. Open Rack Installation

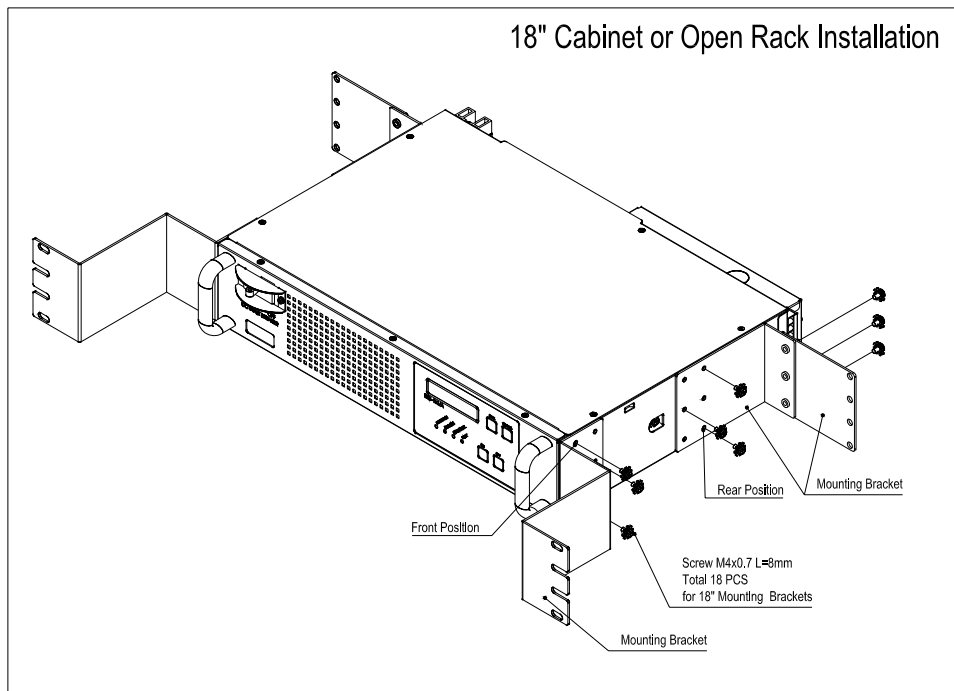


Figure 4. 18" Cabinet or Open Rack Installation

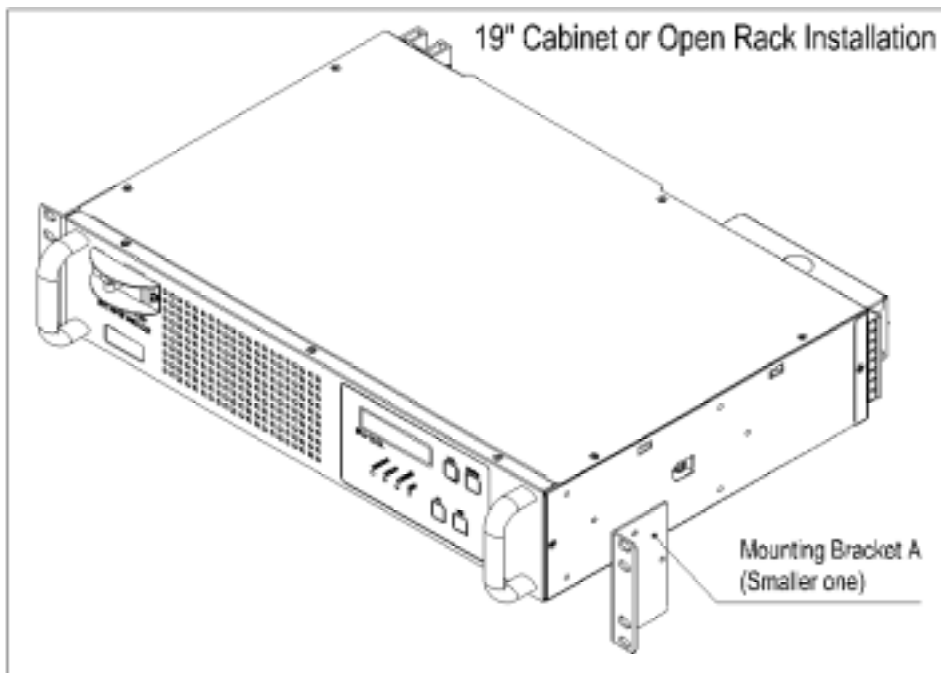


Figure 5. 19" Cabinet or Open Rack Installation

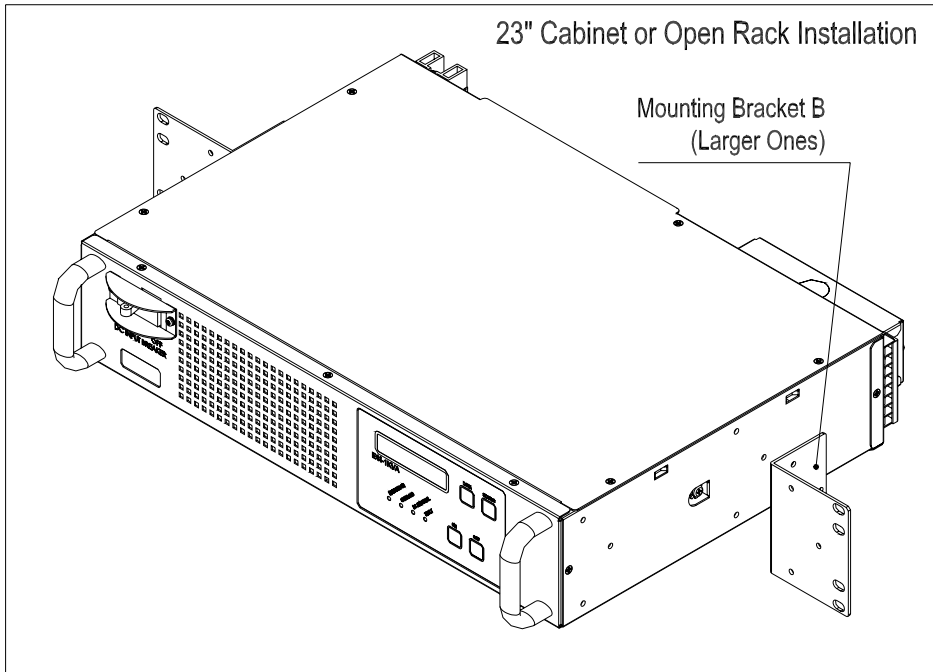


Figure 6. 23" Cabinet or Open Rack Installation

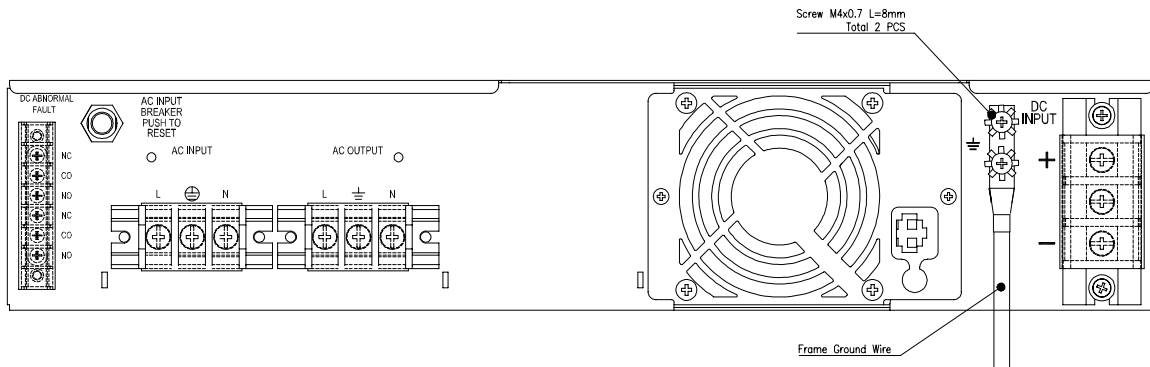
4.5 Safety Grounding

4.5.1 Safety Grounding Notes

For safety and proper operation of the unit, including maximum attenuation of electrical noise, suitable safety grounding is required. Be sure to connect from the ground (GND) terminal on real side of ESI Inverter to a nearby grounding electrode by the grounding wire attached in accessory box.

The grounding wire should be grounded to structural metal, a metal water pipe, or a suitable ground rod (National Electrical Code 250-26). The safety grounding electrode should be as near as possible to the unit.

STEP 3 : Connect the Safety ground using the green ground wire, and 2 screws provided in the accessory box. Connect the other end of the wire to the cabinet or rack.





4.6 Power Wiring Notes

Before connecting any DC or AC power source to ESI inverter, below items must be checked :

1. Turn off the input circuit breaker power source, both for DC and AC.
2. Turn off the DC input circuit breaker on the front panel of ESI inverter.
3. Don't turn on any AC or DC input circuit breaker on your power source or ESI inverter until the installation process is finished.
4. Use the following cables sizes when connecting power source to the inverter.

Type	Model	DC Input	AC Input	AC Output
1KVA/120V	ESI48T102AB A	#8AWG Ring terminal	#12AWG Ring terminal	#12AWG Ring terminal
1KVA/230V	ESI48I102AB E	#8AWG Ring terminal	#12AWG Ring terminal	#12AWG Ring terminal

4.7 DC Input Connection

4.7.1 DC Input connecting Notes

Check the input DC voltage meets the specification of the inverter and note the polarity of the DC voltage connections. The normal input voltage for ESI inverter is -48VDC.

This system is designed for battery systems with the positive terminal Earth Ground. All DC breakers are in the -48 Power lines. The -48V in return conductor is isolated from earth or chassis ground

All DC input cables are connected to the DC input terminal block, located on the rear side of ESI Inverter.

Make sure that the upstream source DC circuit breaker and AC circuit breaker (if applicable) supplying the ESI Inverter are in the off (or open) position.

DC input power cables should be sized such that the maximum voltage drop between ESI Inverter and battery terminals is less than 1.0 volt at the breaker current rating.

The unit can accommodate a positive wire and a negative wire up to AWG #10. Two suitable screw type terminals are attached on the DC input terminal block. Connect the DC input cables to the terminal block using the following steps below:

4.7.2 DC Input Circuit Breaker Note

Due to tremendous amounts of short circuit current available (in excess of 1000A for as long as several minutes!) from bank(s) of batteries, that supply electrical power to ESI Inverter, it is extremely important to connect a properly sized 30 to 50 amp fuse or circuit breaker DC circuit breaker at the DC input cable that feeds the ESI inverter.

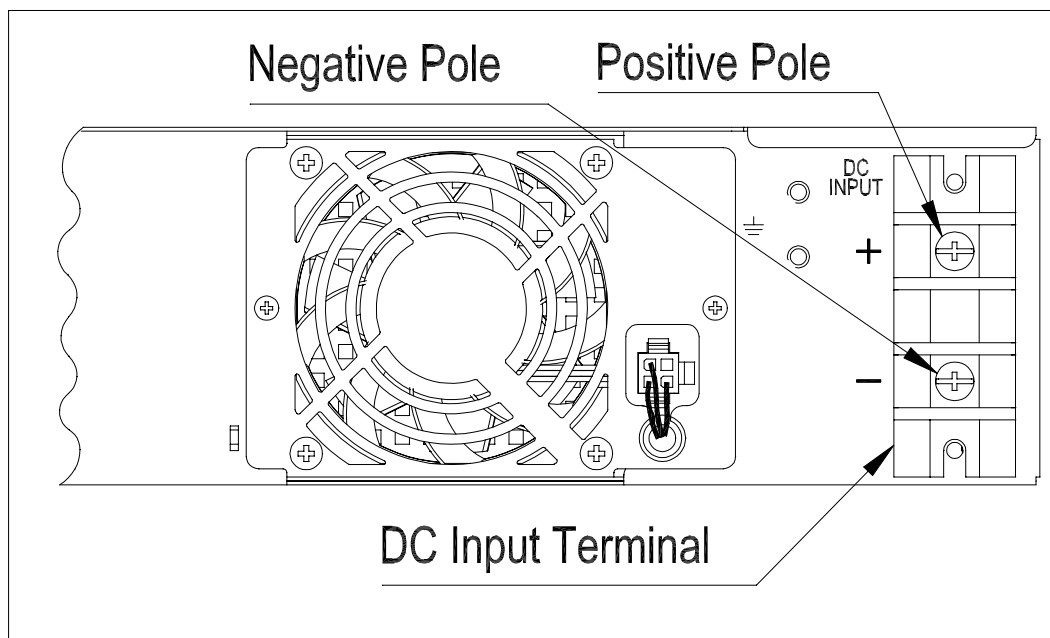
Make sure the DC Input breaker located on the front panel is in the “Off” position before connecting the DC voltage to the input terminal.

Note! DO NOT CONNECT THE DC INPUT with the circuit breaker on.

4.7.3 DC CONNECTIONS

STEP 4 : Connect the DC positive (+) to the positive (+) point on input terminal block.

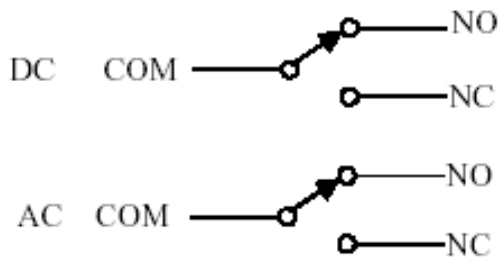
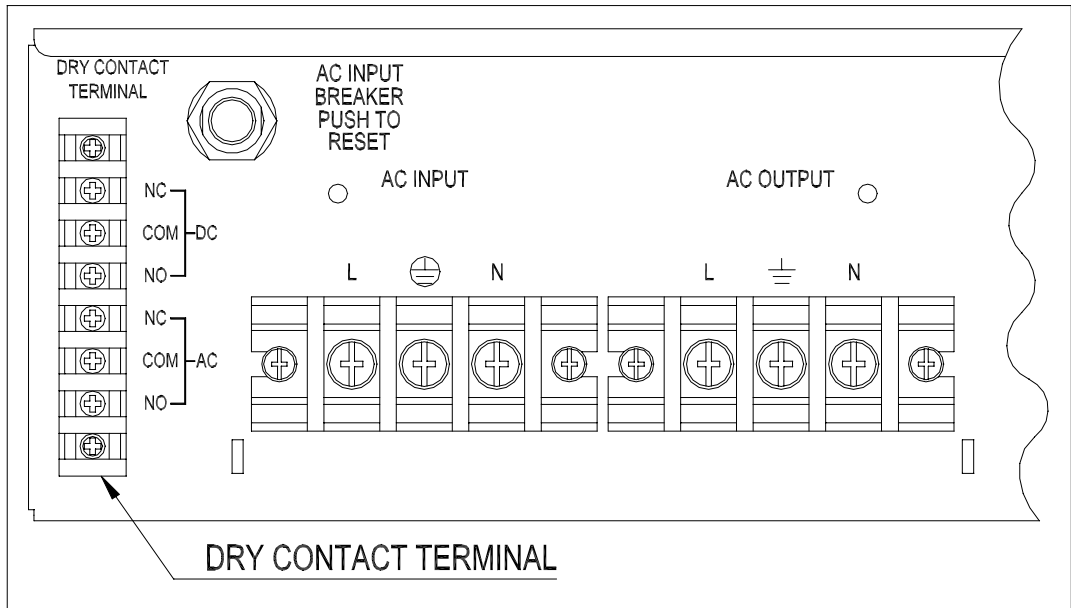
STEP 5 : Connect the DC negative (-) to the negative (-) point on input terminal block. Connect DC wiring at source.



4.8 Alarm Dry Contact Connection

4.8.1 Dry Contact Terminal Function :

The ESI inverter provides two sets of alarm contacts (DC and AC alarms, total six-terminals. These alarms allow monitoring DC input or AC input power abnormal conditions.



4.8.2 Dry Contact Terminal Actions

Alarm relay COM. Port Actions		
TYPE	Condition	Connection
AC Normal	AC input voltage within inverter range	AC set contact Switch to NC
AC Fail	AC input voltage > rating voltage +20V AC input voltage < rating voltage - 20V AC input frequency > 50/60 + 5 Hz AC input frequency < 50/60 - 5 Hz	AC set contact Switch to NO
DC Normal	DC input voltage within inverter range	DC set contact Switch to NC
DC Fail	DC input voltage < 40V DC input voltage > 59V	DC set contact Switch to NO

4.9 AC Wiring Connection

4.9.1 AC Input Connection Note

CAUTION: If utility line voltage is connected to the system, an appropriately rated AC circuit breaker **MUST** be installed between the supplying AC source and the ESI inverter. Installation must comply with local/national electrical code requirements.

4.9.2 AC Output Connection Notes

Note! Calculate the total power consumption (VA) of the output load. Make sure that the total power consumption does not exceed the Maximum load rating of the Inverter or ampacity of the output conductors

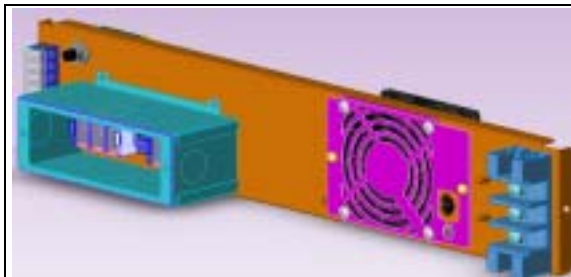
Warning! The AC input and the external battery bank must have a circuit breaker or fused disconnect switch, which must be open (or off) when making connections. When making connections, be sure to observe correct polarity.

4.9.3 AC Connection

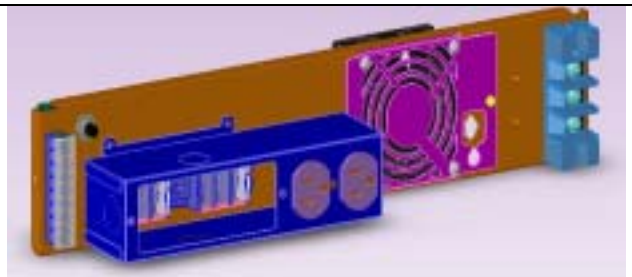
Step 6: Make sure the breaker for your AC source is "OFF".

Step 7: Turn off all the equipment powered by ESI inverter off.

Step 8: Remove Panel cover from AC box as below figures.



ESI48I102AB E (220V model) Rear Panel



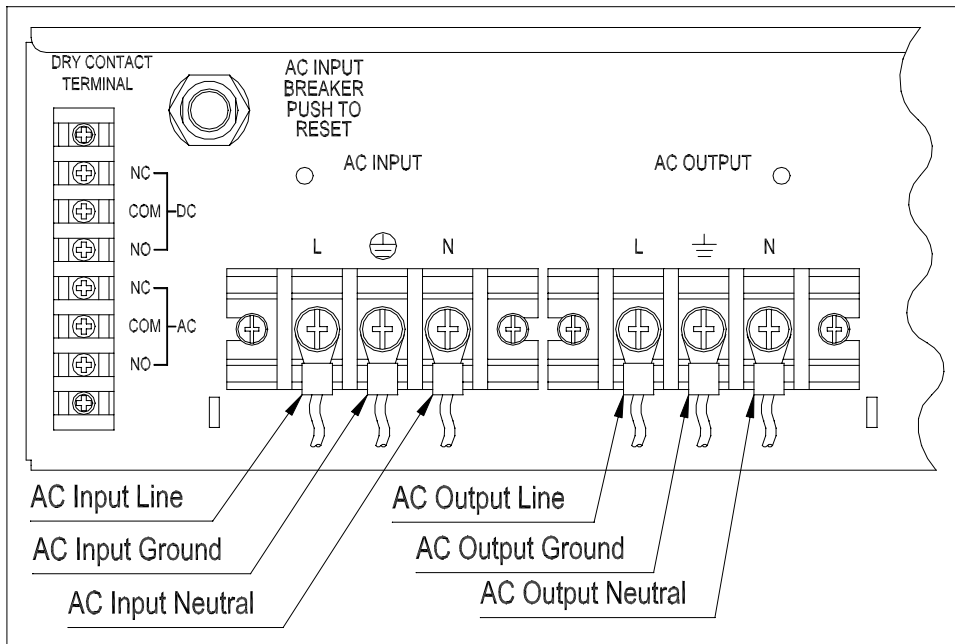
ESI48T102AB A (120V model) Rear Panel

Step 9: Determine which knockout will be used to route wiring.

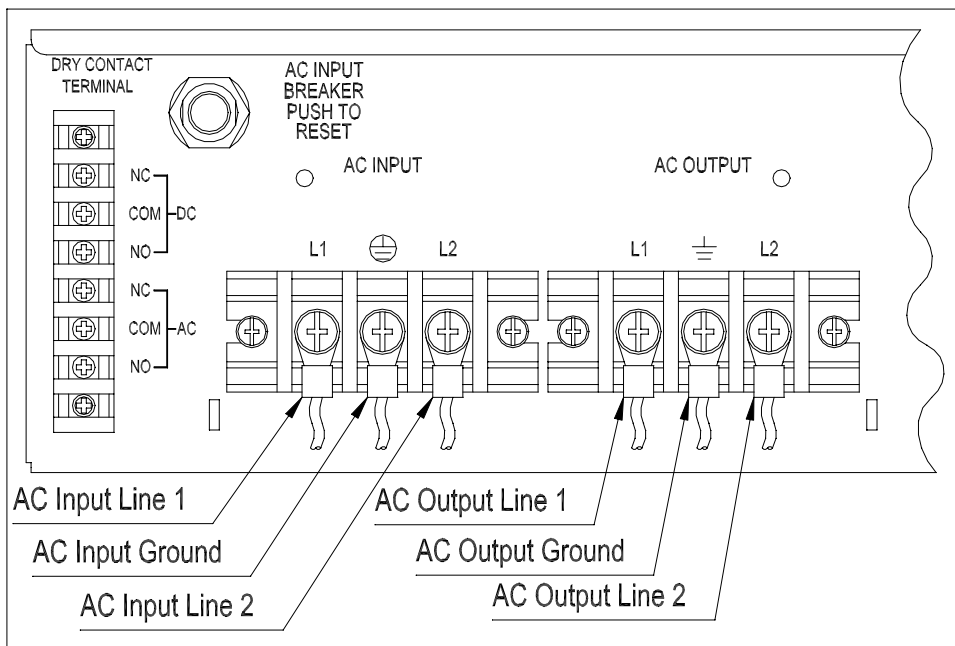
Step 10: Remove the knockout and install the conduit.

Step 11: Pull AC Input and Output wiring thru conduit.

Step 12: Attach AC wires using ring terminals as below figures. Attach AC wiring at Source.



ESI48T102AB A (120V model) AC wiring connection



ESI48I102AB E (220V model) AC wiring connection

Step 13: Tighten screws and reattach cover.

- **Installation is now completed.**

5 OPERATION SECTION

5.1 Initial Startup Notes

At Initial startup the Inverter setup must be checked to make sure the Inverter Output Voltage is the same as the AC Input Voltage. If not set correctly, a fault will occur.

Step 1. Turn on the DC voltage from the source.

Step 2. Turn on AC voltage from the source.

Step 3. At Initial start-up, or if the Inverter has been removed from power source, the front LCD will display the Default values.

For model ESI 48T 102AB A (120V) the default values are:

120V/60Hz

ESI 48I 102AB E (220V)/ the default values are:

220V/50Hz

To change to a value other than the default, press the On Key. The Inverter will now allow you to select a range of frequency and then voltage.

Note!	<i>When inverter is already on, ON button is used to select Off-line/On-line mode. Once operational mode has been chosen, the mode will be saved in EEPROM. System will work on the chosen mode when next time inverter is turned on.</i>
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5.2 Front Panel

Fig.8 shows the function buttons and indicators on the front panel of the inverter.

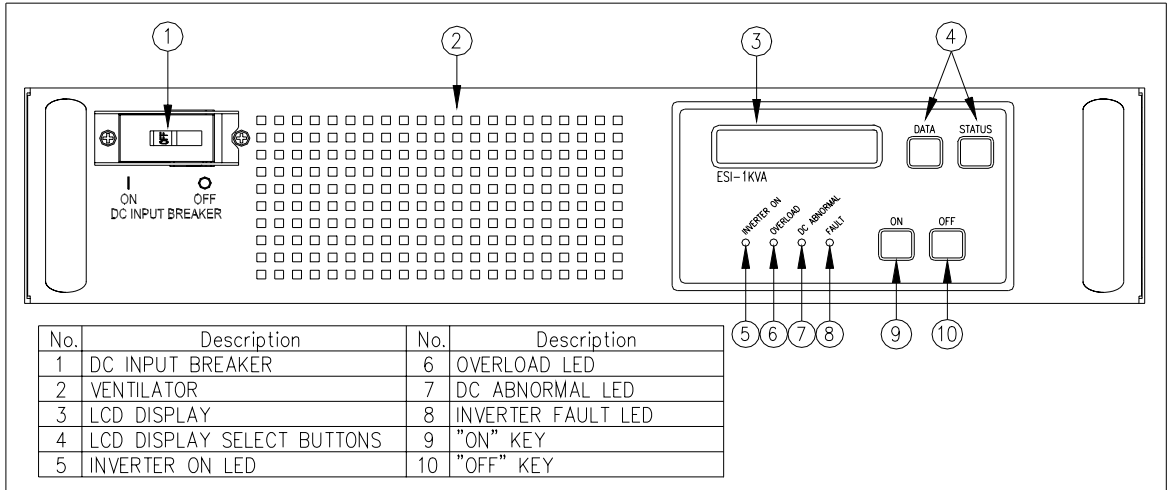


Figure 8 Front Panel

1. DC input breaker

The breaker will trip if a short circuit occurs inside the inverter. Input reverse polarity protection and overload protection are implemented by electronic circuitry, the DC breaker will not trip under these conditions.

2. Cooling

The inverter is air cooled by a DC powered fan. The airflow direction is from the front to the rear.

3. LCD display

4. LCD display selection buttons

Various information (output voltage, output frequency, load, input dc voltage, bypass ac voltage, bypass ac frequency, etc.) and system status can be sequentially displayed on LCD by pressing these two selection buttons. Please refer to chapter 3 for more information.

5. INVERTER ON LED

Indicates the inverter has been turned on and works normally (output is available).

6. OVERLOAD LED

Means that the inverter is overloaded or output is short-circuited.

7. DC ABNORMAL LED

Means that the input DC voltage is abnormal.

8. FAULT LED

Indicates that there are faults present in the inverter.

9. ON button

Once inverter has been turned on, the “ON” button works as an On-Line \Leftrightarrow Off-Line mode switching button.

10. OFF button:

Power switch is for turning on the inverter. The button switch turns off the power for the inverter.

5.3 Rear Panel

Fig.9 shows the terminals and other parts on the rear panel of the inverter.

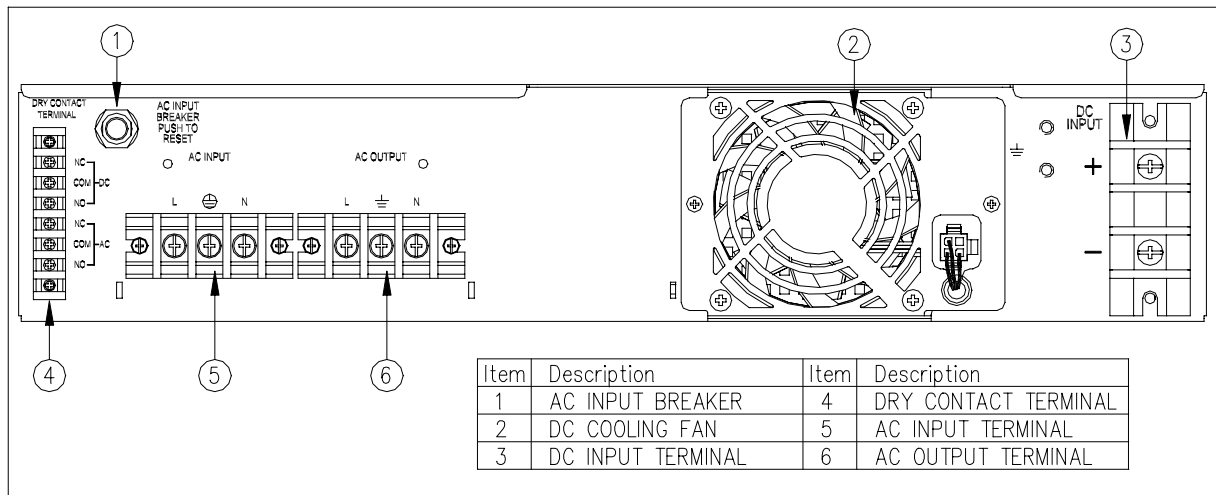


Figure 9 Rear Panel

1. AC input circuit breaker

Circuit Breaker for AC input

2. DC fan

DC fan used for cooling the inverter.

3. DC input terminal

Terminal for 48V DC input voltage

4. Alarm terminal

When input DC voltage or the AC voltage are abnormal, an internal relay will trip.

(DC voltage abnormal indicate inverter DC voltage <40V or DC voltage >59V)

(Inverter fault condition include Over-temperature, Output Under Voltage, Output Over Voltage, Fan Failure, Output short circuit, D/D over voltage, and AC Line Fail)

The terminal can carry 5A / 250VAC (maximum).

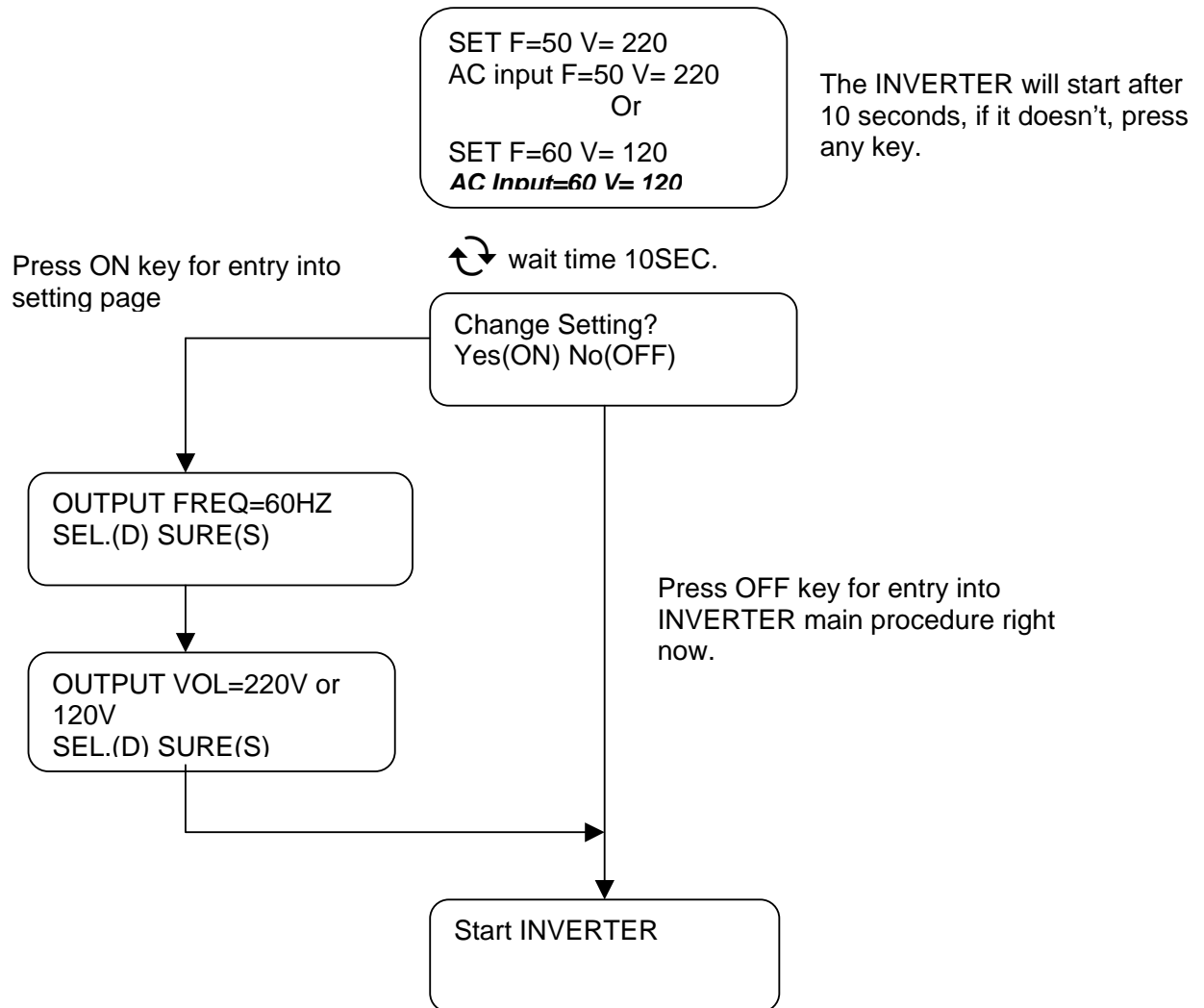
5. AC input terminal

Terminal for AC input voltage.

6. AC output receptacles

Terminal for AC output voltage

5.4 Initial setting



5.5 Front panel Initial selection

1. Press the "ON" button the Front panel to for entry setting page.
2. Press the "DATA" button for output frequency (50/60 Hz) . LCD shows

OUTPUT FREQ = 60Hz.
SEL.(D) SURE(S)

3. Press the "STATUS" button for output frequency (50/60 Hz) .

4. Press the "DATA" button for output voltage (208V/220V/230V/240V or 100V/110V/115V/120V) . LCD shows

OUTPUT VOLT = 120V.
SEL.(D) SURE(S)

5. Press the "STATUS" button for output voltage (208V/220V/230V/240V or 100V/110V/115V/120V) . LCD shows

```
SET F=60 = 120V.
SEL.(D) SURE(S)
```

5.6 Front panel operation

1. Make sure that installation has been carried out correctly. When the breaker is turned on or the utility input is available, the LCD of the inverter displays the following message

```
SYSTEM IS AT
ON-LINE MODE
```

```
SYSTEM IS AT
OFF-LINE MODE
```

2. Press the "Off" button (and release in **1~10** seconds) to start the system power. (if you press the off key less than **1** seconds or more than 10 seconds , CPU will not enable to prevent miss-pressing). The inverter is in normal condition when the following message appears on the LCD screen:

```
INVERTER : ON
BYPASS : STD BY
```

```
INVERTER : STD BY
BYPASS : ON
```

5.7 "DATA" button

The "DATA" button selects the information to be displayed. Use left function key displays the following information:

1. **Output voltage:** Shows present output voltage

```
OUTPUT VOLT.
*** . V ***
```

2. **Inverter voltage:** Shows present "inverter" voltage

```
INVERTER VOLT.
*** . V ***
```

3. **Output frequency:** Shows present output frequency.



OUTPUT FREQ.
*** . Hz ***

4. **Bypass AC voltage:** Shows present input bypass AC voltage

BYPASS AC VOLT
*** . V ***

Note! AC bypass voltage and frequency range list:

120V Inverter: ESI48T102AB A

OUTPUT VOLTAGE	100 VAC	110 VAC	115 VAC	120 VAC
AC BYPASS VOLTAGE RANGE	80Vac ~ 120Vac	90Vac ~130Vac	95Vac ~ 135Vac	100Vac ~140Vac
AC BYPASS FREQUENCY RANGE F=50Hz	45.5Hz ~ 54.5Hz			
AC BYPASS FREQUENCY RANGE F=60Hz	55.5Hz ~ 64.5Hz			

220V Inverter: ESI48I102AB E

	O/P = 208Vac	O/P = 220Vac	O/P = 230Vac	O/P = 240Vac
AC BYPASS VOLTAGE RANGE	188Vac ~228Vac	200Vac ~240Vac	210Vac ~250Vac	220Vac ~260Vac
AC BYPASS FREQUENCY RANGE F=50Hz	45.5Hz ~ 54.5Hz			
AC BYPASS FREQUENCY RANGE F=60Hz	55.5Hz ~ 64.5Hz			

5. **Bypass AC frequency:** Shows present input bypass AC frequency

BYPASS AC FREQ
*** . Hz ***

6. **Input DC voltage:** Shows the input DC voltage

INPUT DC VOLTAGE
*** . V ***

7. **Output current:** Shows present output current

OUTPUT CURRENT
*** . A ***

8. **Output VA:** Shows present output Volt-Amp

OUTPUT VA
*** VA ***

9. **Output power:** Shows present output power (Watt)

```

OUTPUT POWER
***      W ***
    
```

10. **Temperature:** Shows the temperature inside the INVERTER

```

TEMPERATURE
***      °C ***
    
```

11. **Firmware Version:** Shows the CPU firmware version

```

FIRMWARE VERSION
*** V . ***
    
```

5.8 "STATUS" key

The "**select**" button selects system status display. The following can be selected for display:

5.8.1 Output status:

1. When the input bypass voltage is normal and INVERTER output voltage (100V/110V/115V/120V or 208V/220V/230V/240V) is from DC to AC inverter, LCD shows

```

INVERTER : ON
BYPASS   : STD BY
    
```

2. When output is from input bypass AC, LCD shows

```

INVERTER : STD BY
BYPASS   : ON
    
```

3. When INVERTER is turned off by firmware, LCD shows

```

** OUTPUT **
OUTPUT OFF
    
```

4. When INVERTER is turned off by software, LCD shows

```

** OUTPUT **
SCHEDULE OFF
    
```

5.8.2 DC to AC inverter status

1. When INVERTER is normal, LCD shows

```

** INVERTER **
NORMAL
    
```

2. When inverter is over temperature (may be caused by overload, high ambient temperature or fan failure), LCD shows

** INVERTER **
OVER TEMPERATURE

3. When the temperature inside the INVERTER is too high, LCD shows

** AMBIENT **
OVER TEMPERATURE

4. When the INVERTER output is short circuited, LCD shows

** INVERTER **
SHORT CIRCUIT

5. When the INVERTER output is overloaded, LCD shows

** INVERTER **
OVERLOAD

6. When the fan is blocked or worn out, LCD shows

** INVERTER **
FAN FAILURE

7. When INVERTER voltage is too high, LCD shows input, output, or both

** INVERTER **
OVER VOLTAGE

8. When INVERTER voltage is low, LCD shows input, output, or both

** INVERTER **
UNDER VOLTAGE

5.8.3 Bypass AC status

1. When the input bypass voltage is normal, LCD shows

** BYPASS AC **
NORMAL

2. When the input bypass voltage is normal and INVERTER output is from bypass voltage, LCD shows

INVERTER : STD BY
BYPASS : ON

3. When the input bypass voltage is too low, LCD shows

** BYPASS AC **
UNDER VOLTAGE

4. When the input bypass voltage is too high, LCD shows

** BYPASS AC **
OVER VOLTAGE

5. When the input bypass is over normal frequency range, LCD shows

** BYPASS AC **
OUT OF FREQ.

6. When the output is overloaded, LCD shows

** BYPASS AC **
OVER LOAD

5.8.4 Input DC status

1. When the input DC voltage is normal 40V ~59V, LCD shows

** INPUT DC **
NORMAL

2. When the input DC voltage is under 40V, LCD shows

** INPUT DC **
LOW VOLTAGE

3. When the input DC voltage is over 59V, LCD shows

** INPUT DC **
HIGH VOLTAGE

4. When the input DC voltage is under 39V, INVERTER will switch to bypass mode (if bypass AC available) and LCD shows

DC UNDER VOLT
INVERTER OFF

5. When the input DC voltage is over 60V, INVERTER will switch to bypass mode (if bypass AC available) and LCD shows

DC OVER VOLT
INVERTER OFF

5.9 Error messages

If the following messages are displayed on LCD, contact your local dealer at once.

** INVERTER ** SOFTSTART FAIL
EEPROM NOT AVAILABLE
EEPROM checksum error



6 MAINTENANCE & STORAGE SECTION

6.1 Maintenance

- Make sure that the vent openings on the inverter are not blocked.
- Use a vacuum cleaner to remove any dust that may have accumulated on the vent openings
- When cleaning the case or front panel, only use a soft, dry cloth. If the front panel is very dirty, use a neutral, non-abrasive detergent sparingly on a soft, dry cloth. Do not use alcohol or ammonia based solutions.
- Ask qualified service engineer to check the entire system periodically.
- If moving your inverter handle it with care.
- Avoid spilling liquids on the Inverter.

FASTENER CHART

LOCATION	TYPE	SIZE	TORQUE
DC In	Standard Terminal	M6	36-44 In-Lb /42-51kgf-cm
AC In	Standard Terminal	M5	26-33 In-Lb /30-38kgf-cm
AC Out	Standard Terminal	M5	26-33 In-Lb /30-38kgf-cm
Frame Ground	2 Hole-lug (Pitch: 1")	M4	10-14 In-Lb /12-17kgf-cm

6.2 Storage

If the equipment is to be stored prior to installation, it should be stored in a cool, dry, well-ventilated area that is protected against rain, splashing water, chemical agents, etc. The equipment should be covered with a tarpaulin or plastic wrap to protect it against dust, dirt, paint, or other foreign materials.

7 TROUBLESHOOTING SECTION

Table of troubleshooting list

Problem	Possible cause	Action to take
LEDs do not light up	The circuit breaker is off	Turn on or reset the circuit breaker.
	Internal fuse was blown.	Call for service personnel to replace the fuse.
	DC input is over or under voltage.	Apply correct DC voltage.
"FAULT" LED lights up	Bypass AC fail	AC voltage , frequency may be out of range.
	Inverter failure.	Call for service.
	Output was short.	Load may be abnormal
"OVERLOAD" LED is ON	The power drawn from the inverter exceeded the load rating of the inverter.	Remove unnecessary load.
"FAULT"LED lights, LCD OVERTEMPERATURE	Temperature inside the inverter is too high.	Check the ventilator and fan.

8 SPECIFICATION SECTION

8.1 Block Diagram

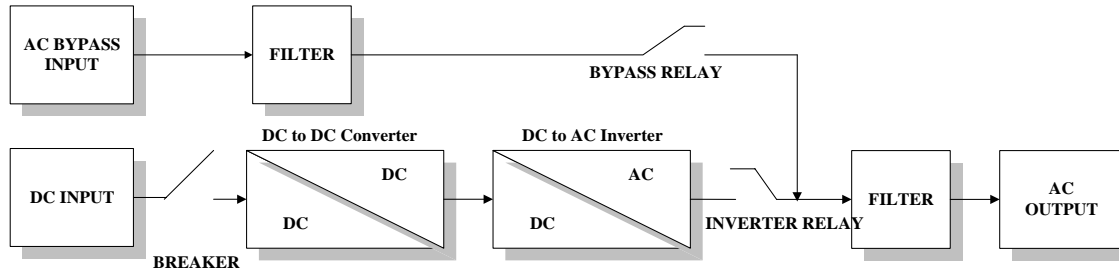


Figure 7. ESI Inverter block diagram

Different to the traditional design concept of using low frequency transformer and bipolar transistor, ESI inverter adopts IGBT. The new design concept does not only minimize the weight and dimensions, but also enhances output short circuit reliability and overload capacity.

There are two paths that can supply output voltage. One is from the AC input, another is from DC to AC inverter. So there are two operational modes can be chosen (by the front panel). The operational mode decides the default output path.

The first one is **Off-line Mode (default)**; the output will come from AC bypass path during the normal condition and after initial start-up. The System will transfer the output to DC/AC inverter path if AC input is out of specification. When the AC input returns to specification, system will come back to bypass path automatically. During operating under this mode, the efficiency is very high, but the output waveform is totally decided by AC input.

The other one is **On-line Mode**; the output will come from DC/AC inverter path during the normal condition. The System will transfer output to bypass path if DC/AC inverter fails or the DC input out of specification. When DC inverter input comes back to normal, the system will come back to DC/AC inverter path automatically.

Fig.7 shows the block diagram of the inverter.



8.2 Table of Technical Specifications

MODEL		ESI48I102AB E	ESI48T102AB A
AC OUTPUT	Capacity	1000VA / 800W	
	Voltage	208V/220V/230V/240 V	100V/110V/115V/120 V
	Frequency	50 /60 Hz	
	Waveform	Pure Sine Wave	
	THD:	< 3% (Linear Load), < 6% (Rectified Load) for 230V output	< 3% (Linear Load), < 5% (Rectified Load) for 120V output
	Crest Factor	3: 1	
	Receptacle	3-poles type terminal block; x1	3-poles type terminal block; x1 NEMA 5-15R outlet; x2
	Short	Electrical Protection	
PROTECTION	Overload	105% ~125% 3 minutes; 126% ~150 % 30 seconds; >151 % 1 second; Shutdown (Switch to bypass)	
	Temperature	Electrical Protection for Over Temperature	
	Output Voltage	Over and Under Voltage Protection	
AC INPUT	Voltage	208V/220V/230V/240V ± 20V	100V/110V/115V/120V ± 20V
	Rated Current	5 A MAX	10A MAX
	Protection	Breaker	
	Connection	Terminal block (2 P)	
DC INPUT	Voltage	39V ~ 60V (Bypass voltage is normal) < 39V, jump to off line mode < 40V, displays show input dc low 59V, displays show input dc high > 60V, jump to off line mode	
	Rated Current	25A max	
	Protection	Breaker and fuse	
INTERFACE	Efficiency (liner load)	> 85 % (DC input 48V / AC output 230V)	> 83 % (DC input 48V / AC output 120V)
	Connection	Terminal block (3 P)	
	LED Display	INVERTER ON, OVERLOAD, DC ABNORMAL, FAULT	
	LCD Display (data)	Output voltage, Output frequency, Bypass AC voltage, Bypass AC frequency, VA, W, Input DC voltage, Temperature, Firmware Version	
	LCD Display (status)	OUTPUT STATUS, DC TO AC INVERTER STATUS BYPASS AC STATUS, DC INPUT STATUS	
ENVIRONMENT	Temperature	0 ~ 131°F	
	Storage Temperate	-4 °F~+158 °F	
	Storage Humidity	20~90 % Relative Humidity (Non-Condensing)	
	Humidity	20% ~ 90%(NO-Condensing)	
	Noise	<45 dB, 1m front	<46 dB, 1m front
MTBF	Inverter	A. 210K hours (With the DC fan @ 25) B. 420K hours. (Without the DC fan @ 25)	
	Fan	70K hours. (Fan only, @ 40)	



MECHANICAL	Dimension	442 × 354 × 88 (For 19" Rack) (W × D × H / mm) H=2U	
	Marking language	English, Safety Label - English, French	
	Color	Front Panel: Pantone Cool Gray 3C painting	
	Weight	18.7 lb	17.2 lb

8.3 Input/Output Specifications

100V, 110V, 120V Applications							
Inverter size	Nominal Output @ 120V (Amps)	Maximum Load @ 120V (Amps)	AC input circuit breaker rating	AC input/output wire size	Maximum dc input Amps @ 40.0 Vdc	DC input fuse or circuit breaker size	Minimum dc input wire size AWG
1 KVA	6.67A	10A	15A	#12 AWG	30A	25A * 2/40A	#8 AWG
2 KVA	-	-	-	-	-	-	-

208V, 220V, 230V or 240V Applications							
Inverter size	Nominal Output @ selected 220V, 230V or 240 V (Amps)	Maximum Load @ 220V, 230V or 240V (Amps)	AC input circuit breaker rating	AC input/output wire size	Maximum dc input Amps @ 40.0 Vdc	DC input fuse or circuit breaker size	Minimum dc input wire size AWG
1 KVA	3.636/3.478/3.333A	5.45/5.217/5A	8A	#12 AWG	30A	25A * 2/40A	#8 AWG
2 KVA	-	-	-	-	-	-	-



8.4 Electrical Specifications

8.4.1 DC Input Parameters

Item	Specification/Function	Standard/Comments
1A-1 DC Input voltage range (DC/AC Inverter O/P is available)	39V ~ 60V±3% If DC voltage is out of this range but AC input voltage is normal, Inverter still can supply output voltage from bypass path.	
1A-2 DC Input high voltage	<p>>59V±3% LED & LCD Warning</p> <p>>60V±3% AC normal : switch to Bypass output AC fail : output will be off but LED and LCD keep on displaying</p> <p>>68V±5% AC normal : Bypass output AC fail : Whole system shut down</p> <p><59V±3% DC abnormal situation removed Inverter will auto restart if output was auto turned off by system because of DC over voltage situation.</p>	<p>LED : DC Abnormal LCD : Input DC high voltage</p> <p>LED : DC Abnormal LCD : DC over volt Inverter off</p>

<p>1A-3 DC Input low voltage</p>	<p><40V±3% LED & LCD Warning</p> <p><39V±3% AC normal : switch to Bypass output AC fail : output will be off but LED and LCD keep on displaying</p> <p><36V±5% If AC input is available , LCD will keep on showing data and output is switched to bypass path. If there is no AC input, system will shut down and LED, LCD go off (to prevent battery over discharging if input DC voltage comes from battery).</p> <p>>42V±3% DC abnormal situation removed Inverter will auto restart if output was auto turned off by system because of DC over voltage situation.</p>	<p>LED : DC Abnormal LCD : Input DC Low voltage</p> <p>LED : DC Abnormal LCD : DC under volt Inverter off</p>
<p>1A-4 Input current Maximum r.m.s. current</p>	<p>25A</p>	<p>Min. input voltage</p>
<p>1A-5 DC Input Inlet/Receptacle Type Component spec./rating Standard</p>	<p>Terminal block (2 poles, + , -) 75A/600V UL Listed (ESI48T102ABA) VDE Listed (ESI48I102ABE)</p>	<p>M6 Screw</p>
<p>1A-6 Input protection Type Rating Standard Allocation</p>	<p>Fuse *2 25A/125V * 2 UL Approved PCB</p>	<p>Connected at negative pole</p>



1A-7 Input protection		
Type	DC Breaker	Connecting at negative pole
Rating	40A/80V	
Standard	UL/VDE Approved	
Allocation	Front Panel	
1A-8 GND wiring character	Resistance value <math>< 0.1\Omega</math> at current 25A	
1A-9 Input Current Ripple	<math>< 10\%</math> ($I_{ripple\ rms} / I_{DC}$)	Linear load

8.4.2 AC Input Parameters

Item	Specification/Function	Standard/Comments
1B-1a Bypass AC Input Voltage Range (ESI48T102ABA)	100V/110V/115V/120V ± 20 V, window 5V	voltage tolerance $\pm 3\%$
1B-1b Bypass AC Input Voltage Range (ESI48I102ABE)	208V/220V/230V/240V ± 20 V, window 5V	voltage tolerance $\pm 3\%$
1B-2 Bypass AC Input Over Voltage	> rating voltage + 20V Switch to Inverter Output < rating voltage + 15V Recovery from over voltage	LED : Fault LCD : Bypass AC over voltage
1B-3 Bypass AC Input Under Voltage	< rating voltage – 20V Switch to Inverter Output > rating voltage – 15V Recovery from under voltage	LED : Fault LCD : Bypass AC Under voltage
1B-4 Bypass AC Input Frequency Range	50/60 ± 5 Hz , window 0.5Hz	
1B-5 Bypass AC Input Over Frequency	> 50/60 + 5 Hz Switch to Inverter Output < 50/60 + 4.5 Hz Recovery from over frequency	LED : Fault LCD : Bypass AC Under voltage
1B-6 Bypass AC Input Under Frequency	< 50/60 – 5 Hz Switch to Inverter Output > 50/60 – 4.5 Hz Recovery from under frequency	LED : Fault LCD : Bypass AC Out of freq.



1B-7 Bypass AC Input Inlet -Type -Rating -Standard	Terminal block (3 poles – L, N and FG) 40A/600V UL Approved (ESI48T102ABA) VDE Approved (ESI48I102ABE)	M5 Screw
1B-8a Bypass AC Input protection (ESI48T102ABA) -Type -Rating -Standard	AC circuit Breaker 250V/15A UL/VDE Approved	
1B-8b Bypass AC Input protection (ESI48I102ABE) -Type -Rating -Standard	AC circuit Breaker 250V/8A UL/VDE Approved	
1B-9a Max Current (ESI48T102ABA)	10A	
1B-9b Max Current (ESI48I102ABE)	5A	

8.4.3 Inverter Output Parameters

Item	Specification/Function	Standard/Comments
1C-1 Rated output capacity	1000VA/800W	
1C-2 Output power factor	0.8	
1C-3a O/P voltage (ESI48T102ABA) Nominal output voltage Voltage waveform Voltage waveform total harmonic distortion	100V/110V/115V/120V Single phase sine-wave 3 % 5 %	120V/100% linear load 120V/100% rectified load
1C-3b O/P voltage (ESI48I102ABE) Nominal output voltage	208V/220V/230V/240V Single phase sine-wave	



Voltage waveform	3 %	100% linear load
Voltage waveform total harmonic distortion	6 %	100% SPS load
1C-4 Output frequency		
Nominal output frequency	50/60Hz	
Frequency regulation	±0.2Hz	
1C-5 Number of phase/number of wire	Single phase/two wire with grounding wire	
1C-6 Output Crest Factor	3:1	
1C-7a Transient recovery time (ESI48T102AB A)	<p><100ms (rise to 75% $V_{rated, peak}$)</p> <p><300ms (down to 110% $V_{rated, peak}$)</p> <p><300ms (down to normal $V_{rated, peak}$)</p> <p>Voltage rise(peak)<25V</p> <p><200ms (rise to normal $V_{rated, peak}$)</p> <p>Voltage down(peak)<25V</p>	<p>0%→100% SPS load</p> <p>100%→0% SPS load</p> <p>100%→0% R load</p> <p>0%→100% R load</p>
1C-7b Transient recovery time (ESI48I102AB E)	<p><100 ms (rise to 75% $V_{rated, peak}$)</p> <p><300 ms (down to 110% $V_{rated, peak}$)</p> <p><250ms (down to normal $V_{rated, peak}$)</p> <p>Voltage rise(peak) <45V</p> <p><150ms(rise to normal $V_{rated, peak}$)</p> <p>Voltage down(peak)<45V</p>	<p>0%→100% SPS load</p> <p>switch power supply</p> <p>100% → 0% SPS load</p> <p>100% → 0% R load</p> <p>0%→100% Rload</p>
1C-8a Efficiency (ESI48T102AB A)	>83% (Full linear load)	Measured at rated linear load , 48V input, 120Vac Output
1C-8b Efficiency (ESI48I102AB E)	>85% (Full linear load)	Measured at rated linear load , 48V input, 230Vac Output
1C-9 Output Voltage regulation	± 3%	Input : 39 Vdc ~60Vdc Load :1000VA / 800W
1C-10 Overload capacity (Inverter Path) (Note 1)	<p>105~125% for 3 minutes</p> <p>126~150% for 30 seconds</p> <p>>150% for 1 second</p> <p>Switch to bypass</p>	<p>Load</p> <p>Tolerance :±50VA/50W</p> <p>LED : OVER LOAD</p> <p>LCD : INVERTER</p> <p>OVER LOAD</p>



1C-11 short circuit	lasting 3 mins then output shutdown (Note 2)	Before output off: LED : OVER LOAD LCD : INVERTER SHORT CIRCUIT After output off : LED : OVER LOAD & FAULT LCD : INVERTER SHORT CIRCUIT
1C-12a Outlet (ESI48T102AB A) type component spec/rating standard Optional	Terminal block (3 poles – L, N and FG) 40A/600V UL Approved NEMA 5-15R (receptacle) x 2	M5 Screw
1C-12b Outlet (ESI48I102AB E) type component spec/rating standard	Terminal block (3 poles – L, N and FG) 40A/600V VDE Approved	M5 Screw
1C-13 Protection Detection	Output overload Output short detection and alarm	
1C-14 Transfer Time Automatic bypass	Typical 4 msec. Maximum 10 msec.	Note 3

Note! 1-a. If output over-current occurs when output comes from bypass path, the bypass path will supply the power until the input AC breaker trips. Output will turn off once input AC breaker trips.

Note! 1-b. When the output is overload, the inverter will switch to bypass path, user can manually switch it back to inverter path by press ON key.

Note! 2. When short circuit occurs under bypass output, two situations may happen:

a. AC input breaker trips.

b. Transfer to Inverter output and acting as inverter short circuit.

Note! 3. AC input voltage should be checked more than 3 seconds before switching to bypass output.



8.4.4 Protection

Item	Condition	Protection
2-1 Input DC over voltage DC under voltage Input reverse-polarity protection AC over voltage AC under voltage AC over frequency AC under frequency	refer to 1A-2 refer to 1A-3 <80V refer to 1B-2 refer to 1B-3 refer to 1B-5 refer to 1B-6	No fuse blown or breaker trip Bypass output available
2-2 Output Overload Output Short Circuit	refer to 1C-10 refer to 1C-11	
2-3 Other Protection Over-temperature Note1 FAN Failure Note2	105±5 (DD MOSFET heat sink) 105±5 (Inverter IGBT heat sink) Transfer to bypass output 55±5 (inside the case) Transfer to bypass output Fan blocking or aging Won't transfer to bypass until over-temperature occurs.	LED : Fault LCD : Inverter over temp. LED : Fault LCD : Ambient over temp. LED : Fault LCD : Fan failure

Note! 1. If output transfers to bypass because of Over-temperature, the fault alarm won't be clear even temperature recovery to normal range unless pressing OFF button.

Note! 2. If fan failure situation has been eliminated, the "FAULT" LED will be off and system recovery to normal condition automatically.



8.4.5 Indicators & Display

8.4.5.1 LED

Item	Specification/Function	Standard/Comments
3.1 Inverter ON component type color function on condition off condition	LED Green Output ON Output Off	
3.2 Overload component type color function on condition off condition	LED Red Inverter overload or short circuit occurs Inverter normal	
3.3 DC Abnormal component type color function on condition off condition	LED Red Inverter DC voltage < 40V or DC voltage > 59V Inverter DC voltage normal	
3.4 Fault component type color function on condition off condition	LED Red Inverter failure Inverter Normal	Over-temperature Output Under Voltage Output Over Voltage Fan Failure Output short circuit D/D over voltage Line Fail

8.4.5.2 LCD

Item	Specification/Function	Regulation
3-5 LCD Display	16 x 2 character LCD Panel 2.2" x 0.45" / 56.21 mm x 11.5mm (W x H)	
3-6 Information	<ul style="list-style-type: none"> -Output Normal -Output voltage -Inverter volt. -Inverter Freq. -Bypass AC Volt -Bypass AC Freq. -DC Input Voltage -Output current -Output VA -Output power -Temperature (inside case) -Firmware Version -Operating at On-line Mode -Operating at Off-line Mode -Inverter normal -Inverter output fail -Inverter over voltage -Inverter under voltage -Output OFF -Output schedule off -Overload inverter off -Inverter over temperature -Ambient over temperature -Inverter over load -Inverter short Circuit -Inverter overload -Inverter softstart fail -Inverter : on bypass: std by -Inverter : on bypass: fault -Inverter : off bypass: on -Inverter :std bypass : on -Inverter : fault bypass: on -Inverter : fault bypass: fault -Fan Failure -Bypass AC Normal -Bypass AC Fail -Bypass AC Under Voltage -Bypass AC Over Voltage -Bypass AC Out Of Freq. -Bypass AC Over Load -Input DC Normal -Input DC Low voltage -Input DC High voltage -DC under volt Inverter off -DC over volt Inverter off 	<ul style="list-style-type: none"> ± 4V (ESI48I102ABE) ± 2V (ESI48T102ABA) ± 4V (ESI48I102ABE) ± 2V (ESI48T102ABA) ± 0.3 Hz ± 4V (ESI48I102ABE) ± 2V (ESI48T102ABA) ± 0.3 Hz ± 3% ± 5% ± 50VA (load>150VA),note 1 ± 50W (load>150W), note 1 ± 5
DATA		
STATUS		



8.4.5.3 Button

3-7 ON switch		
Type	Momentary switch	
Allocation	Front panel	
Function	Turn ON Inverter in standby mode, Bypass/On-line mode Selection	Note2
Time	1 ~ 10 sec	
3-8 OFF switch		
Type	Momentary switch	
Allocation	Front panel	
Function	Turn Inverter OFF	
Time	> 0.5 sec	
3-9 DATA		
Type	Momentary switch	
Allocation	Front panel	
Function	To select LCD display function	
3-10 STATUS		
Type	Momentary switch	
Allocation	Front panel	
Function	To select LCD display function	

Note! 1. Not including inductive nor half wave load.

Note! 2. When output is off, the ON button is used to turn inverter on.

Note! When inverter is already on, ON button is used to select Off-line/On-line mode. Once operational mode has been chosen, the mode will be saved in EEPROM. System will work on the chosen mode when next time inverter is turned on.

8.5 Standard

Item	Specification/Function	Standard/Comment
4-1 Vibration		
Sine wave	10Hz→500Hz→10Hz, 1.0G, 0.25 Oct/ min, 1 Sweep, 3 axes	One-Operating, without packing
Random	10→500Hz , 2.0G , 30 min/axis, 3 axes	IEC68-2-6(1992)

4-2 Shock Test	Half Sin50G, 12ms duration, 3 axes	Non-operating, without packing IEC68-2-27(1992)
4-3a Drop Test (ESI48T102ABA)	75 cm height 4 corner, 3 edges, 6 faces 10 cm height 2 corner, 2 edges, 1 face	Non-operating, with packing IEC68-2-32(1992.10) Unpackaging
4-3b Drop Test (ESI48I102ABE)	60 cm height 1 corner, 3 edges, 6 faces	Non-operating, with packing IEC68-2-32(1992.10)
4-4 Earthquake	Seismic Zone 4 requirement	
4-5 Acoustics	45 dBA at 1 meter in front of inverter	80mm FAN * 1
4-6a Safety Mark (ESI48T102ABA)	cULus	UL 60950-1 CAN/CSA-C22.2 No.60950-1-03
4-6b Safety Mark (ESI48I102ABE)	TUV/cULus	IEC 60950-1: 2001 MOD
4-7 EMI/RFI	CISPR Class A/FCC Class A	
4-8 Susceptibility	IEC 1000-4-2 (ESD) IEC 1000-4-3 (Radiated field) IEC 1000-4-4 (EFT) IEC 1000-4-5 (surge) IEC 1000-2-2 (conductive disturbance)	CONTACT : ±15KVAIR DISCHARGE : ±8KV CRITERIA A 10V/m 80-1000 MHz CRITERIA A ±2KV CRITERIA B L ↔ N 6 KV L,N ↔ PE 6 KV 10V / 140~360 Hz

4-9 Low Frequency electrical noise	32 dB mc	
4-10a Withstand Voltage (ESI48T102ABA)	AC to DC(FG) 2000Vac 60Hz < 15 mA 60 secs	Remove Hi-Pot screw before proceeding the Hi-Pot test
4-10b Withstand Voltage (ESI48I102ABE)	AC to DC(FG) 3000Vac 60Hz < 20 mA 60 secs	Remove Hi-Pot screw before proceeding the Hi-Pot test
4-11 AC O/P transform waveform	Meet ITI, formerly CBEMA	
4-12 AC O/P Isolation	Meet NEC	Refer to Fig. 10 for AC 120V system

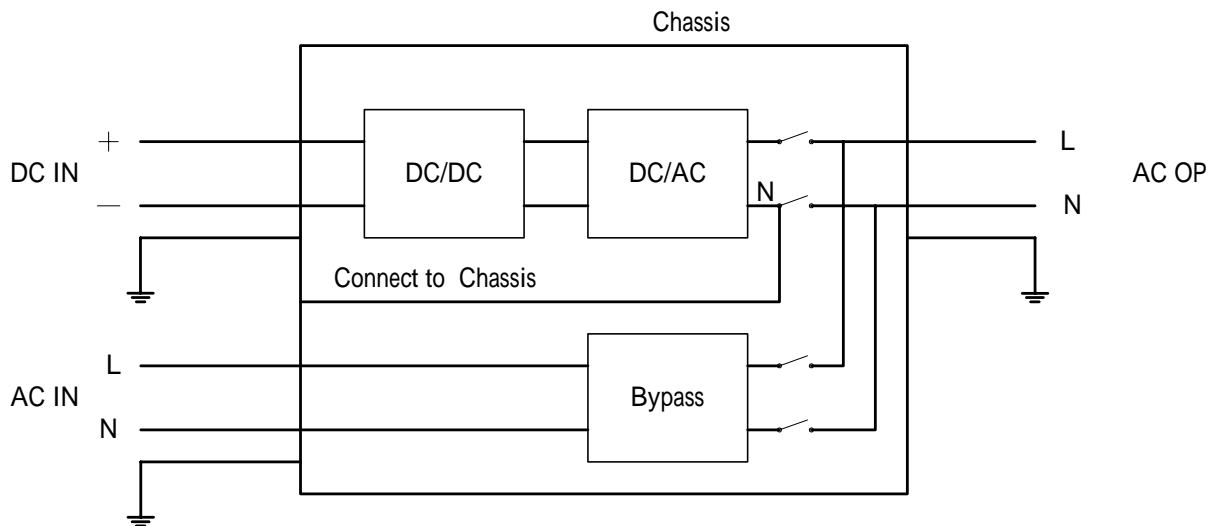


Figure 8. System Block Diagram



8.6 Communication

Item	Specification/Function	Standard/Comments
6-1 Dry contact Device Type Component spec./rating Standard	Terminal block 6 poles (DC COM ,NO,NC and AC COM , NO, NC) - 250V/10A UL approved (ES148T102ABA) VDE approved (ES148i102ABE)	M3 Screw
6-2 Dry contact terminal	Fault DC input abnormal	Without software supported 250Vac / 5A

