# **Operations Manual**



for the ASEA Power Systems Models DBT12, DBT15 and DBT24 Dock Boost Transformer Gen. 2

> P/N: 628051 Revision: C Revised 05/02/23

# **CERTIFICATION**

ASEA Power Systems certifies that this product has been thoroughly tested and inspected and found to meet or exceed its published specifications when shipped from the factory.

#### WARRANTY

ASEA Power Systems warrants each unit to be free from defects in material and workmanship. For a period of one year after purchase, ASEA Power Systems will repair or replace any unit returned to our plant, by the original buyer, with shipping both ways prepaid by the buyer.

ASEA Power Systems is not responsible for consequential damage arising from the use of its equipment. It does not apply to extensively modified or non-standard systems. Debit memos for returned units are not accepted, and will cause return of the unit without repair.

### LIFE SUPPORT POLICY

ASEA Power Systems does not authorize the use of any of its products or systems for use as an AC voltage supply (source) for life support systems. Life support systems are devices which support or sustain life, and whose failure to perform, when properly used in accordance with this Operations Manual, can be reasonably expected to result in significant injury to the user.



# 1. USING THIS MANUAL

This manual has been written as an Operations Manual. Installation, operations, and preventative maintenance are covered in detail. This manual covers the following models:

DBT12	12 kVA Dock Boost Transformer	P/N 628009
DBT15	15 kVA Dock Boost Transformer	P/N 628002
DBT24	24 kVA Dock Boost Transformer	P/N 628004

For higher power applications Trident Systems combine two DBT12/15/24 units and one Paralleling Master DBT12P/15P/24P unit to produce the following models:

Trident 24	24 kVA Trident System (2x DBT12 + 1x DBT12P)	P/N 628008
Trident 30	30 kVA Trident System (2x DBT15 + 1x DBT15P)	P/N 628013
Trident 48	48 kVA Trident System (2x DBT24 + 1x DBT24P)	P/N 628018

It is important that the operator reads this manual prior to installing and operating the unit. A thorough understanding of the information covered in this manual is required for proper installation and operation.

If any questions arise while reading this manual, the user is encouraged to contact ASEA Power Systems. ASEA Power Systems is located at:

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# 2. SAFETY NOTICES

The DBT12/15/24 can transfer large amounts of electrical energy very quickly. International symbols are used throughout this manual to stress important information. Read the text below each symbol carefully and use professional skills and prudent care when performing the actions described by the text.



THE CAUTION SYMBOL (TRIANGLE ENCLOSING AN EXCLAMATION POINT) INDICATES A CONDITION THAT COULD SERIOUSLY DAMAGE EQUIPMENT AND POSSIBLY INJURE PERSONNEL. CAUTIONS WILL BE PRESENTED IN THIS FORM. ALL CAUTIONS SHOULD BE RIGOROUSLY OBSERVED.



THE WARNING SYMBOL (TRIANGLE WITH A LIGHTNING BOLT) IS USED TO SIGNAL THE PRESENCE OF A POSSIBLE SERIOUS, LIFE THREATENING CONDITION. A CONDITION THAT IS HAZARDOUS TO BOTH PERSONNEL AND EQUIPMENT WILL BE ISSUED AS A WARNING. ALL WARNINGS WILL BE PRESENTED IN THIS FORM.





- THIS EQUIPMENT CONTAINS HIGH ENERGY, LOW IMPEDANCE CIRCUITS! LETHAL POTENTIALS ARE CONTAINED WITHIN THE UNIT EVEN WHEN IT IS APPARENTLY NOT OPERATING.
- CARE MUST BE EXERCISED WHEN SERVICING THIS EQUIPMENT IN ORDER TO PREVENT SERIOUS OPERATOR INJURY OR EQUIPMENT DAMAGE.
- DO NOT WORK ON OR OPERATE THIS EQUIPMENT UNLESS YOU ARE FULLY QUALIFIED TO DO SO. NEVER WORK ALONE.
- THE EQUIPMENT IS NOT IGNITION RATED, IT MUST NOT BE OPERATED IN AREAS WHERE COMBUSTIBLE GASES MAY ACCUMULATE.
- DO NOT REMOVE THE SHORE CORD FROM THE DOCK PEDESTAL WITHOUT FIRST OPENING THE DOCK OR YACHT BREAKER. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE DBT12/15/24 AND PEDESTAL.
- OBSERVE THE FOLLOWING WHEN SERVICE AND MAINTENANCE ARE REQUIRED:
- REMOVE ALL JEWELRY FROM ARMS AND NECK WHEN SERVICING THIS EQUIPMENT. THIS PREVENTS THE POSSIBILITY OF SHORTING THROUGH THE JEWELRY TO OR ELECTROCUTION OF THE OPERATOR.
- WEAR SAFETY GLASSES WHEN SERVICING THIS EQUIPMENT TO PREVENT EYE INJURY DUE TO FLYING PARTICLES CAUSED BY ACCIDENTAL SHORT CIRCUIT CONDITIONS.
- DO NOT REMOVE ANY PANELS OR COVERS WITHOUT FIRST OPENING ALL CIRCUIT BREAKERS AND THEN REMOVING THE INPUT SERVICE.
- SERVICE OTHER THAN CLEANING AIR FILTER ELEMENTS SHOULD BE REFERRED TO PERSONNEL AUTHORIZED BY THE FACTORY TO SERVICE THIS EQUIPMENT.



# 3. INTRODUCTION TO THE DBT12/15/24

The DBT12/15/24 is a high performance Isolation Transformer designed to isolate and normalize the shore power for reliable shipboard use.

Isolation is obtained through the use of a conservatively rated transformer compliant to the requirements of ABYC E-11, and as such includes a full fault current shield. The transformer also provides basic range normalization and a first level of electrical noise filtering as shown below.

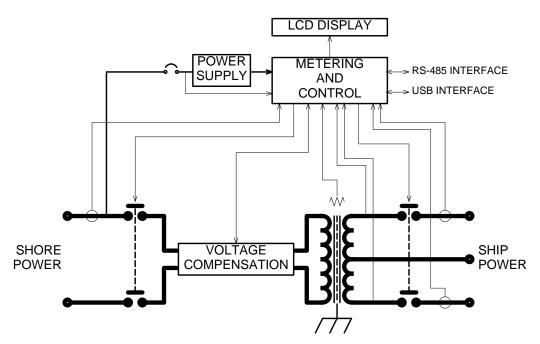


Figure 1: DBT12/15/24 Block Diagram

Being a unit designed from the ground up specifically for the yachting industry, all efforts have been made to produce a product capable of sustaining the marine environment. All unit components are packaged in a single drip-proof, dust-resistant aluminum enclosure. Complete maintenance and service can be provided with front, top and side access to the unit. Unit operation is managed through one circuit breaker and the LCD display.



# 4. SPECIFICATIONS

### 4.1. ELECTRICAL SPECIFICATIONS

<u>Parameter</u>	<u>DBT12</u>	<u>DB</u>	<u>T15</u>	<u>DBT24</u>	<u>DBT24-60Hz</u>
4.1.1. Input Service		50 Hz	60 Hz		
Input Power Form				Single Phase	
Input Voltage Range (V <sub>RMS</sub> )	167 – 270		167 – 270, 285 – 530	167 – 270, 325 – 530	
Input Frequency Range (Hz)	57 – 70		47 – 70	57 – 70	
Input Current, Continuous (A <sub>RMS</sub> )	50	50 63 50 100		00	
Input Current, Overload (A <sub>RMS</sub> )	125	156 125 250		50	

# 4.1.2. Output Service

Output Power Rating (kVA) *Note 1	12 15 24		4		
Output Power Form & Nominal Voltage (V <sub>RMS</sub> ) *Note 1	120 / 240 (center tapped)			15 / 230 ter tapped)	120 / 240 (center tapped)
Output Frequency	Same as Input Frequency				
Output Voltage Adjust Response Time	15 minutes				
Output Current, Continuous (A <sub>RMS</sub> )	50 63 50 100		00		
Output Current, Overload (A <sub>RMS</sub> )	125	156	156 125 250		
Efficiency at Rated Load				97%	

Note 1 - Power ratings are based on the nominal output voltage. As the DBT12/15/24 is current limited, the input voltage will affect the available output power.



# 4.1.3. Control and Status

On/Off Circuit Breaker, input power and output power contactors.

# 4.2. PHYSICAL SPECIFICATIONS

<u>Parameter</u>	<u>DBT12</u>	<u>DBT15</u>	<u>DBT24</u>	<u>DBT24-60Hz</u>
4.2.1. Mechanical				
Height	12.06" (30.6 cm)	13.06" (33.1 cm)	16.50" (41.9 cm)	
Width, Enclosure	13.16" (33.4 cm)	13.16" (33.4 cm)	19.56" (49.7 cm)	
Depth	18.66" (47.4 cm)	18.66" (47.4 cm)	24.67" (62	2.7cm)
Weight	128 lbs. (58.2 kg)	164 lbs. (74.5 kg)	427 lbs. (194 kg)	TBD

# 4.2.2. Environmental

Ambient Temperature Range	0 - 45°C non-condensing	
Air Exchange Rate	171 CFM (4.83 m <sup>3</sup> /min)	342 CFM (9.66 m <sup>3</sup> /min)



# 5. INSTALLATION

Read this manual thoroughly prior to attempting the installation. Improper installation is the most significant cause of system start-up problems and service issues over the products life. Upon receipt of the equipment, perform an external visual inspection. Verify that nameplate information is consistent with the ship's power requirements (required form, voltage, and frequency).

Proper planning will speed up installation, location, and connection of the equipment. Follow the suggested minimum clearances provided in Table 1.

Ensure the room / compartment has adequate ventilation and cooling. The thermal load presented is approximately 1,400 BTU/Hr. for the DBT12, 1,750 BTU/Hr. for the DBT15, and 2,800 BTU/Hr. for the DBT24 at rated load.



THE DBT12/15/24 UNITS ARE HEAVY. EXTREME CAUTION MUST BE EXERCISED IN HANDLING AND INSTALLATION TO AVOID EQUIPMENT DAMAGE OR INJURY TO PERSONNEL. AN ADEQUATE MATERIAL HANDLING DEVICE SHOULD BE USED FOR UNLOADING, MOVING, AND POSITIONING THE UNIT.



#### 5.1. MECHANICAL INSTALLATION

The DBT12/15/24 is designed for horizontal, deck-mount installation. The mounting feet on each side of the unit contain a number of slots, as shown in Figure 3 and Figure 6. The use of stainless steel hardware 3/8" (9 to 10 mm) or equivalent is required for mounting.

The mounting surface should be flat and dimensionally stable to within 1/16" (1.6 mm) to prevent torsional stresses being applied to the structure of the unit. Spacers (shim stock) may be added between the mounting surface and the mounting feet to adjust the mounting plane. Resilient mounts must not be used directly between the unit and the mounting surface. If the unit is to be mounted in a high vibration / shock environment, then the factory must be consulted concerning the application. Drawings for approved shock mounting panels will be supplied.

The following recommended clearances must be considered during installation:

**Table 1: Recommended Installation Clearances** 

Parameters	<b>Proper Operation</b>	Proper Service
Front	12" (30 cm) (User Access)	12" (30 cm)
Left Side	6" (15 cm) (Air Intake)	12" (30 cm)
Right Side	6" (15 cm) (Air Outlet)	12" (30 cm) (Side Cable Entry Installation)
Тор	None	14" (35 cm)
Rear	None	2" (5 cm)

The installation should prevent air circulation from the air outlet to the air intake.

The outline and mounting details are shown in Figure 2 – Figure 6.



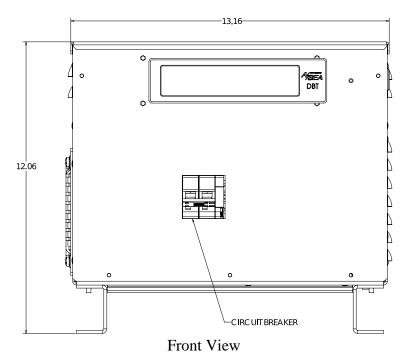
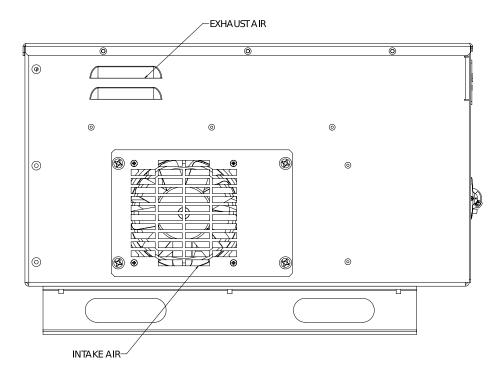
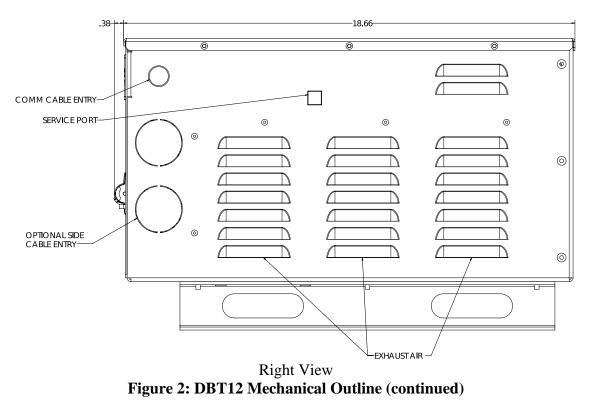


Figure 2: DBT12 Mechanical Outline



**Left View** 







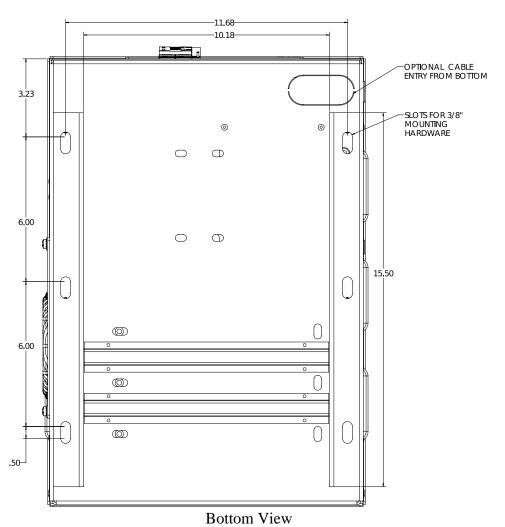


Figure 3: DBT12/15 Deck-Mounting Pattern



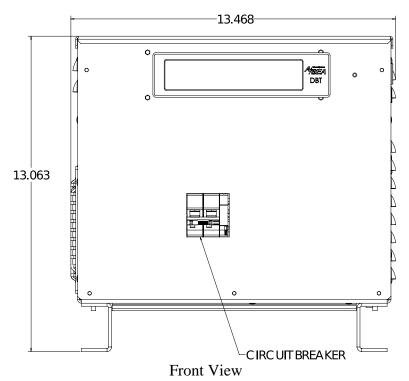
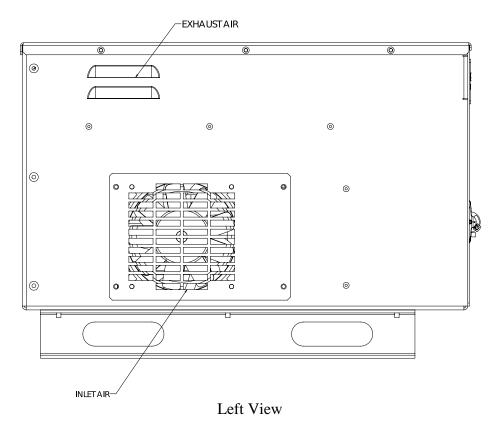
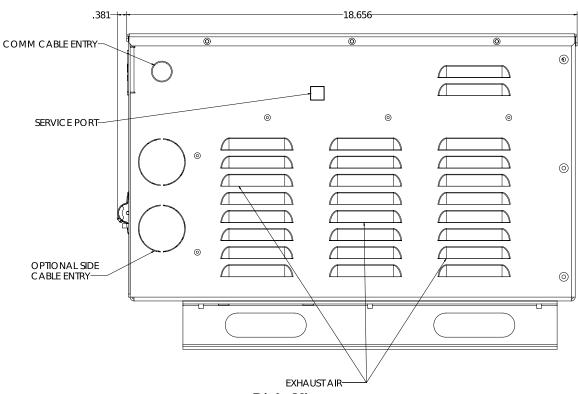


Figure 4: DBT15 Mechanical Outline

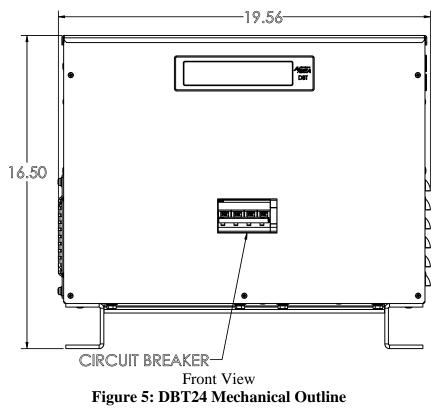




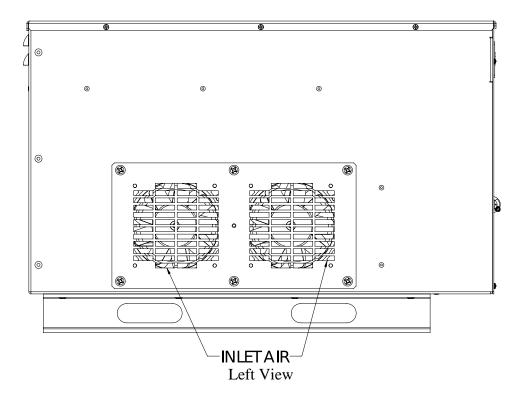


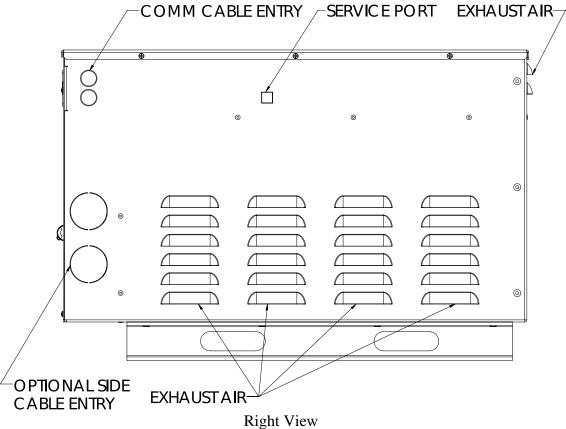
Right View
Figure 4: DBT15 Mechanical Outline (continued)











**Figure 5: DBT24 Mechanical Outline (continued)** 



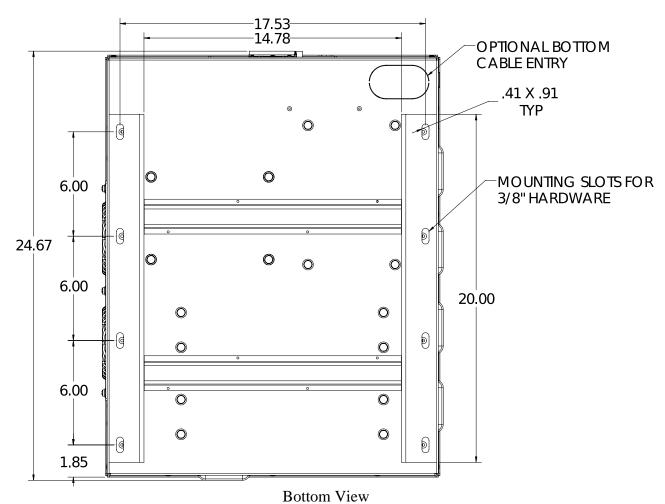


Figure 6: DBT24 Deck-Mounting Pattern



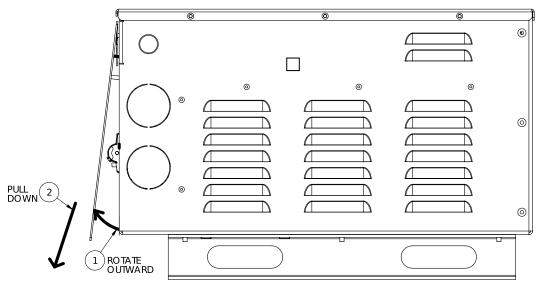
#### 5.2. ELECTRICAL INSTALLATION

This procedure assumes the physical installation of the unit has been completed. It is the user's responsibility to provide input service overcurrent protection and disconnect means.

It is recommended that connections be made to the distribution bus through a manually operated disconnect device such as a molded case switch or circuit breaker (rated for the total system amperage) to ease disconnection and provide a safe servicing environment in the event of unit failure.

Conductors should be sized for the maximum continuous currents listed in Section 4.1.1.

All power wiring requires the removal of the front cover. This cover is secured with 5 ea. 10-32  $\times$  1/4" stainless steel screws. Set the input circuit breaker to the OFF position. Remove the front cover by first tilting its bottom side outward so that it is no longer resting on the circuit breaker, then lowering it past the lip of the top cover. Take caution of the ribbon cable connected to the display.



**Figure 7: Front Cover Removal** 

Prepare the power cables by removing the outer cable jacket approximately 6" (15 cm). Strip back the insulation of all wires exposing ½" (1.25 cm) of bare conductor. Insert the prepared cable and strain relief assembly into the appropriate hole in the chassis. Insert the wire ends into the terminal blocks and tighten.



Reinstall the front cover using the removed hardware.

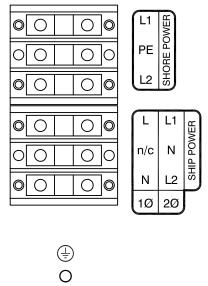


INPUT WIRING MUST BE PERFORMED BY A QUALIFIED ELECTRICIAN FAMILIAR WITH STANDARD SAFEGUARDS AND PROCEDURES REQUIRED BY THE INSTALLATION OF THIS TYPE OF **EQUIPMENT.** POWER MUST BE REMOVED FROM THE INPUT DISTRIBUTION SYSTEMS SUPPLYING POWER TO THE DBT12/15/24 PRIOR TO THE START OF THE FOLLOWING STEPS. INPUT POWER MUST BE SECURED (LOCKED) IN THE OFF (DE-ENERGIZED) STATE UNTIL INSTRUCTED OTHERWISE BY THIS DOCUMENT. SECURE IN THE OFF STATE ANY CIRCUIT BREAKER(S) IN THE SWITCHGEAR PANEL THAT MAY BE SUPPLYING SHIP'S BUS POWER TO THE DBT12/15/24 TERMINAL BLOCK. FAILURE TO FOLLOW THESE PROCEDURES CAN RESULT IN DAMAGE TO THE EQUIPMENT, AND CAN PRESENT THE RISK OF INJURY OR DEATH TO THE INSTALLER OR THE OPERATOR.

#### **5.2.1.** Shore / Ship Power Connections

The unit is equipped with 2 ea. compression type terminal blocks for power connections. Stud type terminal blocks are also available (Option P/N 628806). The terminal blocks accept wires in the range of 14 AWG (2.5 mm²) to 2 AWG (35 mm²) for the DBT12/15 and 14 AWG (2.5 mm²) to 2/0 AWG (70 mm²) for the DBT24. Refer to the applicable standard for selecting the required wire size and type. The shore / ship power cables should be connected according to Figure 8. The ground wire of the shore power cable should be connected to the middle shore power terminal labeled PE. The shore power connections are not phase sensitive for proper operation.





**Figure 8: Shore / Ship Power Terminals** 

Power cable entry can be from the right side or from the bottom of the unit. Depending on the selection made the corresponding knock out pieces must be punched out (two at the right side or one at the bottom).

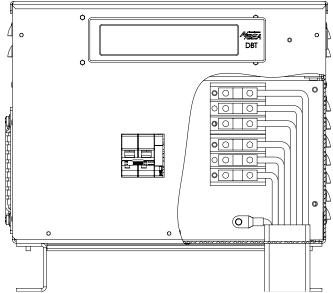


Figure 9: Power Cables Entering from the Bottom



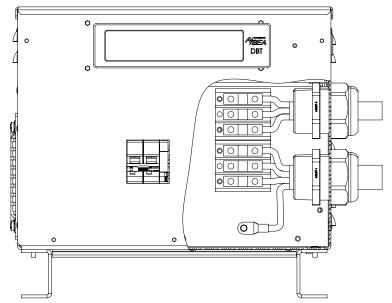


Figure 10: Power Cables Entering from the Right Side

Cord grip connectors with water sealing bushings and strain relief can be used to secure the cables coming in from the right side of the unit. Cord grip connectors are not supplied. The recommended cord grip connector for 0.87" (22 mm) to 1.26" (32 mm) diameter cables is Sealcon CD36NA-GY with locking nut NN-36-ST.

#### 5.2.2. Grounding

The unit chassis ground MUST be connected to the ship's hull or common ground point via the stud below the two terminal blocks, labeled with the ground symbol. Failure to do so may create conditions that may in turn cause injury or death to operators; failure to do so will also result in the voiding of the equipment warranty.



THE UNIT ISOLATES THE SHIP POWER FROM THE SHORE POWER AND EQUIPMENT (SAFETY) GROUNDS SIMILAR TO AN ISOLATION TRANSFORMER. THE INSTALLER MUST RE-ESTABLISH THE GROUND REFERENCE FOR THE EQUIPMENT AT TIME OF INSTALLATION. NEUTRAL AND EQUIPMENT (SAFETY) GROUND ARE TO BE CONNECTED PER THE APPROPRIATE CLASS STANDARD.



# **5.2.3.** Service Port

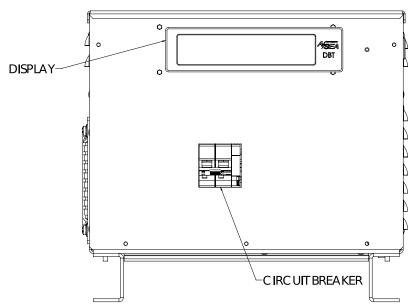
A service port can be found on the right hand side of the unit. It utilizes a standard female USB type-B connector. The service port is intended for diagnostics and firmware updates.



# 6. OPERATION

#### **6.1. POWER TURN-ON PROCEDURE**

Turn the circuit breaker to the ON position.



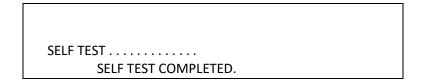
**Figure 11: Controls and Indicators** 

After a few seconds the fan will start spinning and the display will illuminate and show the product group and the software version:

DOCK BOOST TRANSFORMER-II

Version Vx.xx
(c)COPYRIGHT 2019 ASEA POWER SYSTEMS

The unit will perform a self-test which requires approximately 2 seconds to complete, select the proper gain for the shore voltage present, and close its internal shore and ship power contactors.



The display will sequence to the first summary screen indicating the unit model and the following shore and ship information: frequency, voltage, current, and apparent power. The screen also includes the unit status (OK, WARNING, or FAILURE) and voltage gain (1:1, BOOST1,



BOOST2 or BOOST3).

DBTxxxx SHORE SHIP-L1 SHIP-L2 xx.xHz
VOLTAGE: xxxV xxxV xxxV OK
CURRENT: xxA xxA xxA BOOST1
LOAD: xx.xkVA x.xkVA 1/2

Verify that the shore voltage and frequency displayed are the expected values. Also, ensure that the load is within the unit ratings. Monitor the shore voltage and current levels with load applied. Refer to published rating curves for maximum current, kVA and kW levels.

NOTE: It is normal under no load conditions to have up to 2 Amps of input current flowing. This current does not degrade the unit power rating.

After 5 seconds the display will sequence to the second summary screen indicating the unit model and the following shore and ship information: frequency, real power, power factor, and load level. The screen also includes the unit status and voltage gain.

DBTxxxx SHORE SHIP-L1 SHIP-L2 xx.xHz OK POWER: xx.xkW x.xkW x.xkW BOOST1 P.F.: X.X X.X LEVEL: xx % xx % xx % 2/2

The display will continue alternating between the two summary screens every 5 seconds.



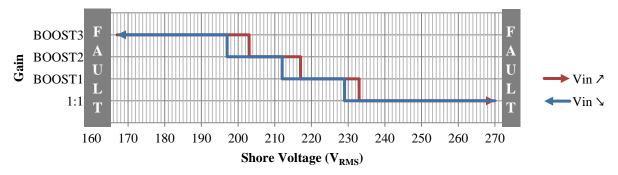
#### 6.2. OPERATION

The DBT24 and the DBT24-60Hz select once at power-up low- or high-range shore voltage operation. The DBT24 additionally selects 400  $V_{RMS}$  or 480  $V_{RMS}$  high-range shore voltage operation.

After power-up the DBT12/15/24 constantly monitors the shore voltage and selects an appropriate gain according to the following logic:

- a. When the shore voltage decreases, the unit will target a higher gain according to Figure 12.
- b. When the shore voltage increases, the unit will target a lower gain according to Figure 12.
- c. A gain change will take place after the target gain has been continuously higher or continuously lower than the current gain for a time period of 15 minutes, and only if no overload condition exists.

# DBT12 / DBT24-60Hz Low-Range



# **DBT15 / DBT24 Low-Range**

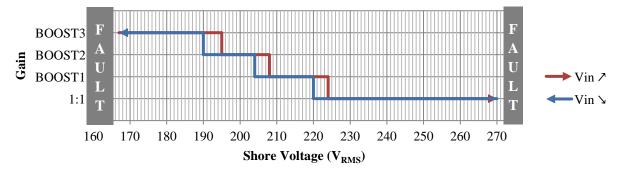
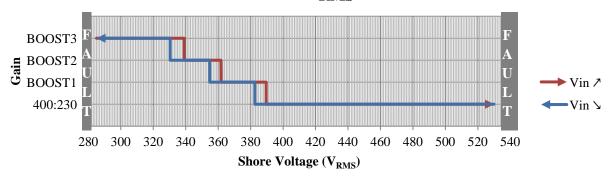


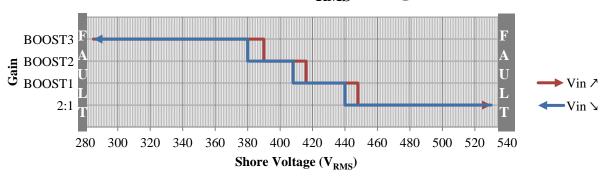
Figure 12: Voltage Chart Indicating the Gain Selection Hysteresis



# DBT24 400 $V_{RMS}$ Range



# DBT24 480 $V_{RMS}$ Range



# DBT24-60Hz High-Range

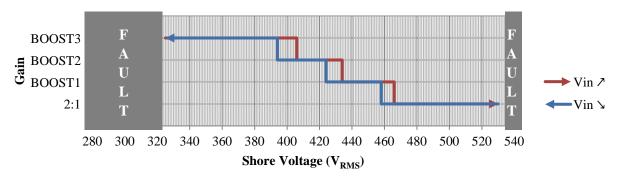


Figure 12: Voltage Chart Indicating the Gain Selection Hysteresis (continued)

#### 6.3. TURN-OFF PROCEDURE

Turn the circuit breaker to the OFF position. The unit will open its internal shore and ship power contactors, and then power off.



#### **6.4. AUTO RESTART FEATURE**

The Auto-Restart feature safely and automatically brings the unit back on-line following a shore power failure and recovery event. Highlights include:

- Automatically routes power from the dock to the ship's power bus.
- Fault tolerant to guarantee safe operation.
- Valid shore power verified prior to restart.
- Handles repeated power failures without operator intervention.



- LETHAL VOLTAGES ARE AUTOMATICALLY ROUTED WITHIN THE UNIT WHEN (1) SHORE POWER IS PRESENT, AND (2) THE CIRCUIT BREAKER IS IN THE "ON" POSITION.
- LETHAL VOLTAGES WILL BE AUTOMATICALLY ROUTED TO THE UNIT OUTPUT AND THE SHIP POWER CONTACTOR WILL AUTOMATICALLY CLOSE WHEN (1) SHORE POWER IS PRESENT, AND (2) THE CIRCUIT BREAKER IS IN THE "ON" POSITION.
- NEVER REMOVE ANY PANELS OR COVERS WITHOUT SECURING (REMOVING) SHORE POWER.
- NEVER PERFORM MAINTENANCE OR SERVICE WITHOUT SECURING (REMOVING) SHORE POWER.



### 7. TRIDENT SYSTEM

Two DBT12/15/24 units can be used to supply twice the power to the ship. The advantage of doing this is that power will be coming from two low power shore cords, which are more common at docks. The disadvantage is that the ship needs to be designed with a split bus electrical system, where electrical loads are distributed approximately equally between the two buses, and no load can exceed the rating of a single DBT unit. This is because the outputs of two independent DBT units cannot be connected in parallel to supply a single bus, since the voltages will most likely differ and / or the shore cords could be supplied from different phases of a 3-phase system.

A Trident System adds a Paralleling Master DBT12P/15P/24P unit to two Slave DBT12/15/24 units. Slave DBT units are DBT units that have a Paralleling Slave Option Board installed. The Paralleling Master monitors the 2 shore voltages and, if they come from the same phase, it connects the two Slave DBT outputs in parallel while also ensuring that the two shore cords have balanced currents. The advantage of using a Trident Systems vs. just two DBT units is that, if the two shore cords are powered from the same phase, loads on either ship bus up to the full system power (twice that of a single DBT) can be supplied. If the shore cords are supplied from different phases, then the two Slave DBT units run independently with a split bus.

All information contained in other sections of this operations manual applies to Trident Systems as well. This section contains additional details specific to Trident Systems.



#### 7.1. PARALLELING MASTER PHYSICAL SPECIFICATIONS

<u>Parameter</u>	DBT12P	DBT15P	DBT24P		
7.1.1. Mechanical	7.1.1. Mechanical				
Height	12.06" (	15.00" (38.1cm)			
Width	13.69" (	17.80" (45.2cm)			
Depth	16.88" (42.9 cm)		21.84" (55.4cm)		
Weight	39 lbs. (17.7 kg)	48 lbs. (21.8 kg)	145 lbs. (65.7kg)		

#### 7.1.2. Environmental

Ambient Temperature Range	0 - 45°C non-condensing
Air Exchange Rate	171 CFM (4.83 m <sup>3</sup> /min)

#### 7.2. PARALLELING MASTER MECHANICAL INSTALLATION

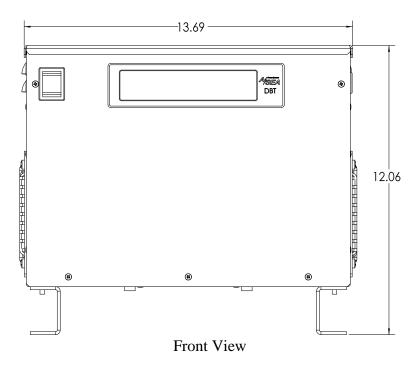
The following recommended clearances must be considered during installation:

**Table 2: Recommended Installation Clearances** 

Parameters	Proper Operation	Proper Service
Front	12" (30 cm) (User Access)	12" (30 cm)
Left Side	6" (15 cm) (Air Outlet or Intake)	12" (30 cm) (Air Intake – Option 628807)
Right Side	6" (15 cm) (Air Intake or Outlet)	12" (30 cm) (Air Intake – Default Configuration or Side Cable Entry Installation)
Тор	None	14" (35 cm)
Rear	None	2" (5 cm)

The outline and mounting details are shown in Figure 13 (DBT12/15P) and Figure 14 (DBT24P)





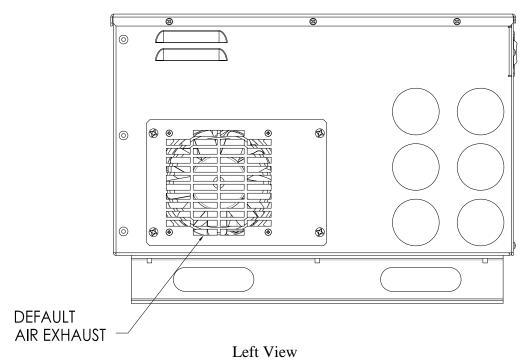
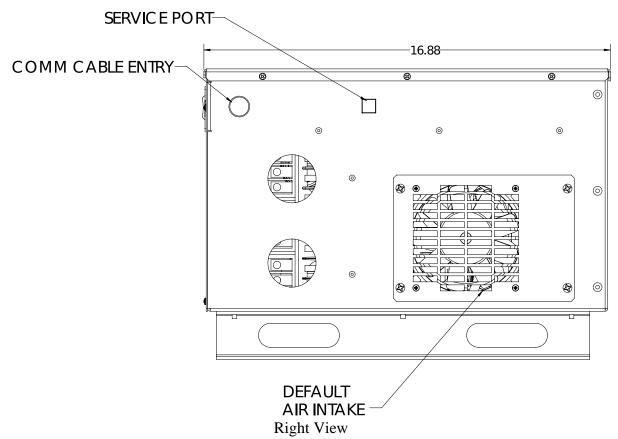


Figure 13: DBT12/15P Mechanical Outline





**Figure 13: DBT12/15P Mechanical Outline (continued)** 



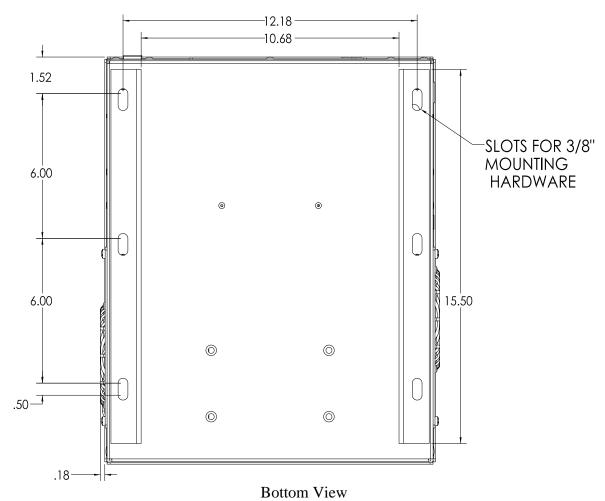


Figure 13: DBT12/15P Deck-Mounting Pattern

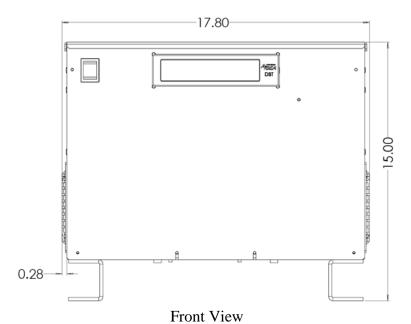
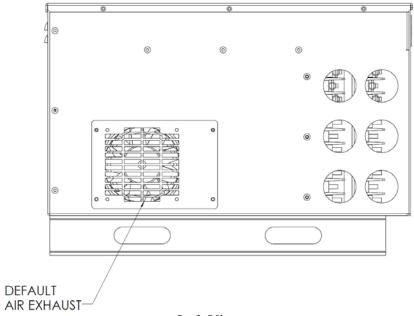
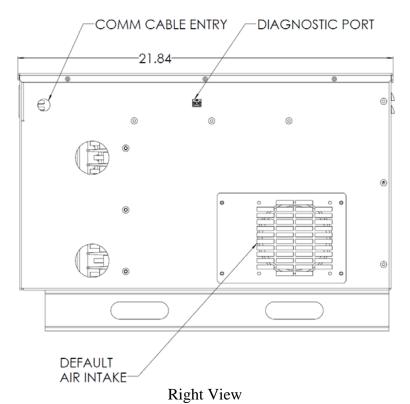


Figure 14: DBT24P Mechanical Outline



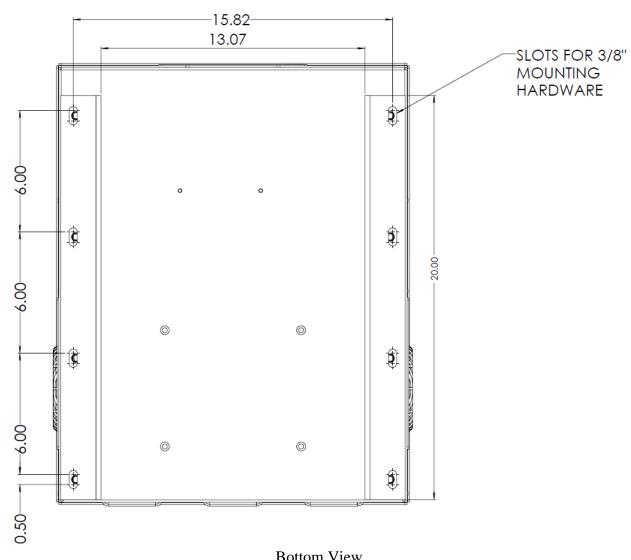






**Figure 14: DBT24P Mechanical Outline (continued)** 





Bottom View
Figure 14: DBT24P Deck-Mounting Pattern



The Paralleling Master is expected to be installed to the right of the first Slave DBT as shown in Figure 14. To prevent hot air from the DBT outlet from entering the Paralleling Master the Paralleling Master's air inlet is on the right side and outlet on the left. Option 628807 moves the Paralleling Master's air inlet to the left side and outlet to the right, for installations where the Paralleling Master is placed on top of the Slave DBT(s), like the one shown in Figure 15.

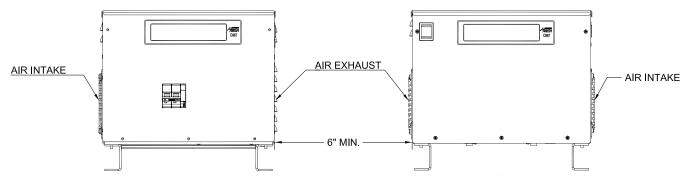


Figure 14: Paralleling Master Installed to the right of the first Slave DBT

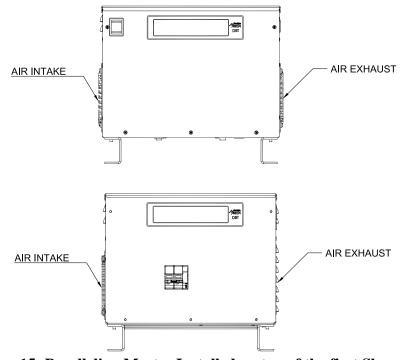


Figure 15: Paralleling Master Installed on top of the first Slave DBT



## 7.3. TRIDENT SYSTEM ELECTRICAL INSTALLATION

Power connections for Trident Systems should be according to Figure 16 for split-phase and Figure 17 for single-phase ship installations.

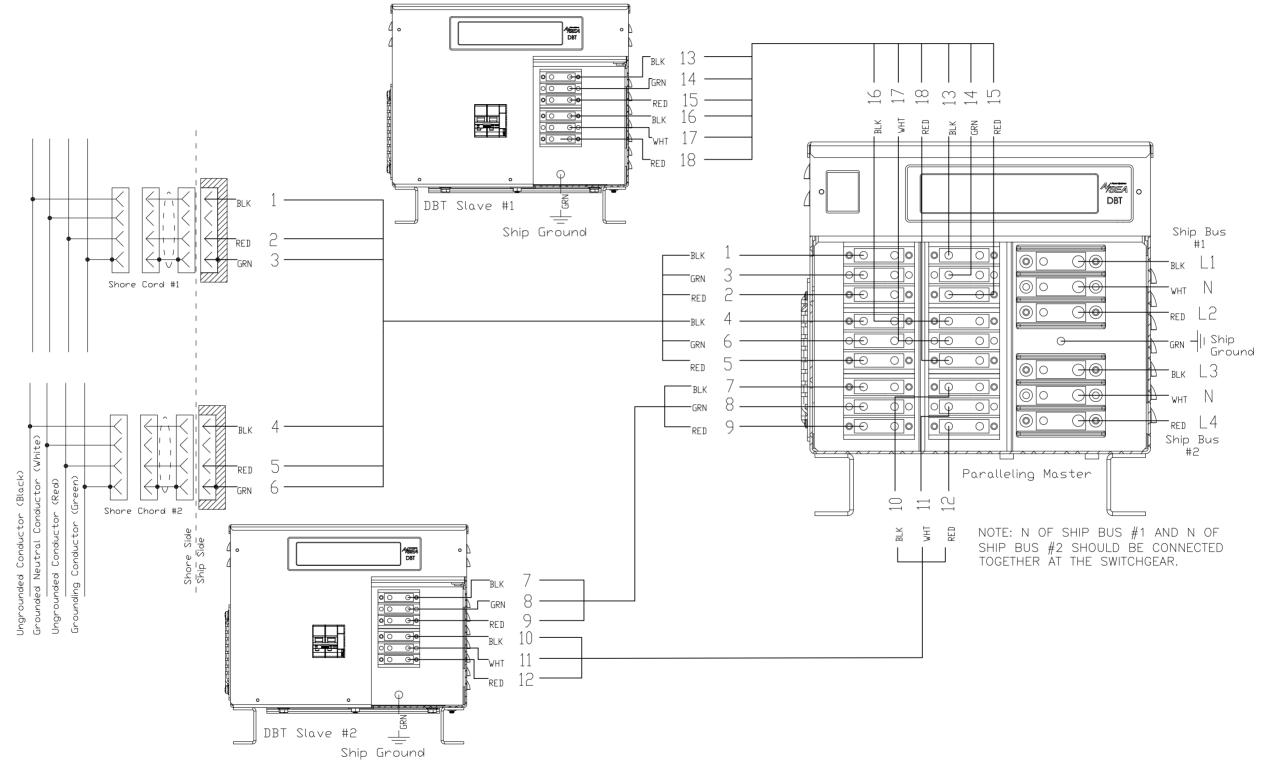


Figure 16: Trident System Power Connection Diagram for Split-Phase Installations



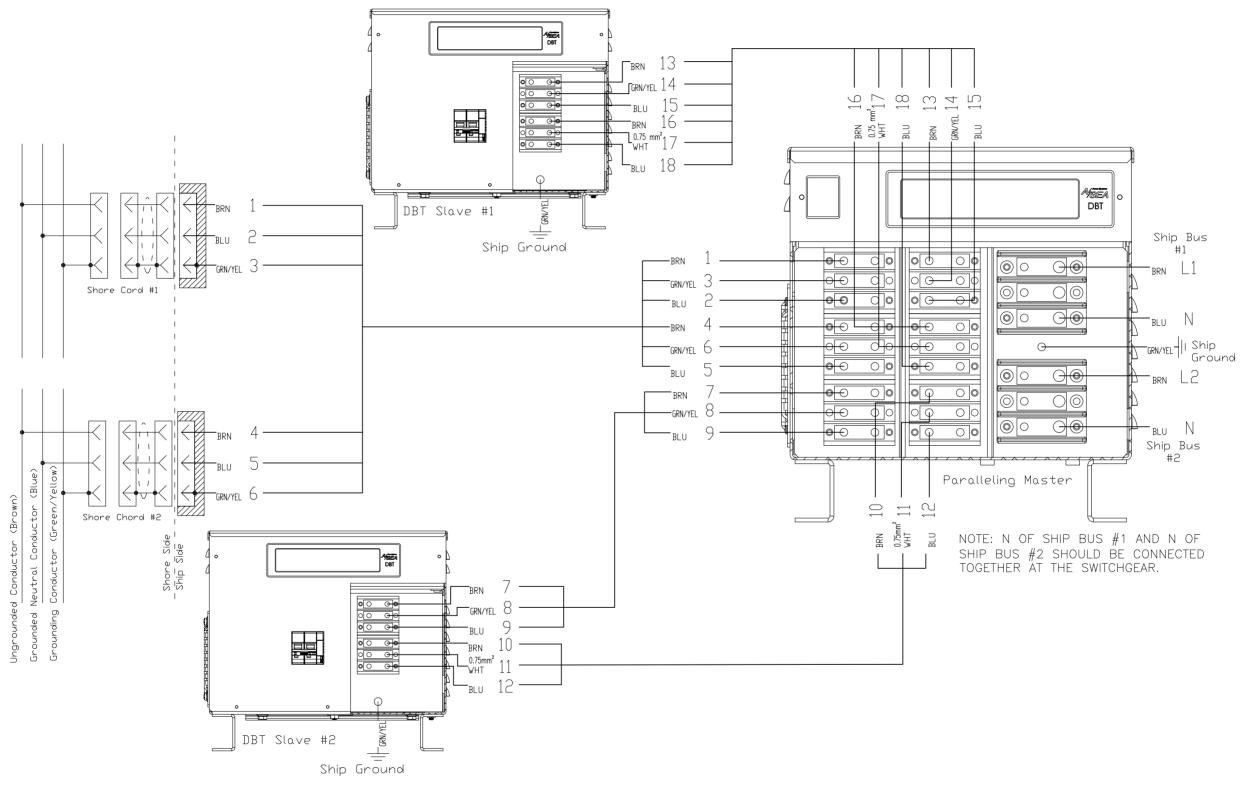


Figure 17: Trident System Power Connection Diagram for Single-Phase Installations



Paralleling cables carry control and status signals between the Paralleling Master and the two Slave DBT units and should be connected according to Figure 18. Trident systems are supplied with one 50' (15.2 m) and one 8' (2.4 m) paralleling cables standard. Custom lengths can also be specified at time of order. For reference, custom length paralleling cables have a part number of 628805-XX, where XX is the length in feet.

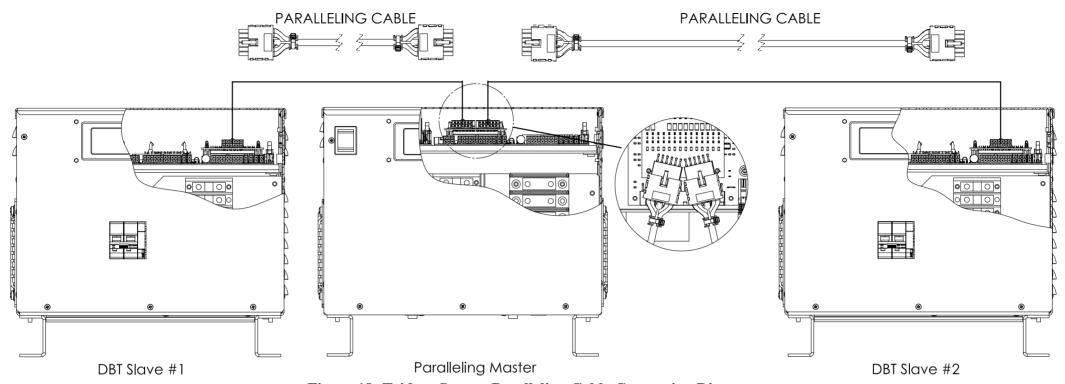


Figure 18: Trident System Paralleling Cable Connection Diagram



#### 7.4. TRIDENT SYSTEM OPERATION

#### 7.4.1. Power Turn-On Procedure

A 3-position rocker-style power switch is located on the front upper left side of the Paralleling Master. The switch positions are as follows:

Middle: OFF

Top: ON, using shore cord 1 to power the Paralleling Master

Bottom: ON, using shore cord 2 to power the Paralleling Master

It is expected that the Slave DBT circuit breakers and the Paralleling Master power switch will be left in the ON position, and power will be controlled via the dock circuit breakers. In case the Slave DBT circuit breakers and the Paralleling Master power switch are OFF and shore power is present, the Paralleling Master can be turned on after the Slave DBT units are turned on. If the Slave DBT units are powered on first, they will operate autonomously, each powering the bus that it is connected to.

A few seconds after powering up the Paralleling Master the fan will start spinning and the display will illuminate and show the model name and software version:

DOCK BOOST TRANSFORMER-II

Version Vx.xx
(c)COPYRIGHT 2019 ASEA POWER SYSTEMS

The display will sequence to the first summary screen indicating the following shore power information: phasing, voltage, current, load level, apparent and real power, and power factor. The screen also includes the Trident System operating mode (PARALLEL, 2SINGLES, SLAVE1, SLAVE2, OK, WARNING, or FAILURE) and, if in parallel mode, voltage gain (1:1, BOOST1, BOOST2 or BOOST3).

SHO	RE1	SHO	RE2	xxx	
xxx Vx	x.xkVA	xxx V xx.	xkVA	PARALLEL	
xxA	xx.xkW	xxA	xx.xkW	BOOST1	
xx %	x.xPF	xx %	x.xPF	1 of 3	



After 5 seconds the display will sequence to the second summary screen indicating the following ship power information: frequency, voltage, current and load level.

SLV1-1	SLV1-2	SLV2-1	SLV2-2	XX.X	
xxxV	xxxV	xxxV	xxxV	PARALLEL	
xxA	xxA	xxA	xxA	BOOST1	
xx %	xx %	xx %	xx %	2 of 3	

After another 5 seconds the display will sequence to the third summary screen indicating the following ship power information: frequency, apparent and real power, and power factor.

Verify that the shore power voltages and frequency displayed are the expected values. Also, ensure that the load is within the unit ratings. Monitor the shore power voltage and current levels with load applied. Refer to published rating curves for maximum current, kVA and kW levels.

NOTE: It is normal under no load conditions to have up to 2 Amps of input current flowing. This current does not degrade the unit power rating.

The display will continue alternating between the three summary screens every 5 seconds.

The Trident System operates in one of the following modes:

- Parallel
- Two Singles
- Slave 1 or Slave 2
- Standby

The operating modes will be explained in detail in the following sections.



#### 7.4.2. Parallel Mode

The Trident System operates in this mode if all of the following conditions are met:

- Both shore cords have power.
- Shore cords 1 and 2 are powered from the same phase.
- All units are turned ON and there are no faults.

In Parallel mode the Paralleling Master does the following:

- Displays the operating mode: PARALLEL.
- Connects the two ship buses together.
- If the shore cord 2 voltage has a 180° phase difference from that of shore cord 1, it reverses internally the polarity of shore cord 2, so that the Slave DBT shore power inputs are in phase.
- Enables current balancing between shore cords 1 and 2.
- Takes control of all relays and contactors of the Slave DBT units, also deciding the gain.

In Parallel mode the Slave DBT units display the status word SLAVE.

If one Slave DBT is turned OFF, loses power or detects a fault, and the Paralleling Master still has power, the Trident System will go to Slave 1 or Slave 2 mode. The Paralleling Master will safely release control of the Slave DBT relays and contactors. The Slave DBT units implement a 5 second delay to go from Slave to autonomous (Single) operation.

#### 7.4.3. Two Singles Mode

The Trident System operates in this mode if all of the following conditions are met:

- Both shore cords have power.
- Shore cords 1 and 2 are powered from different phases of a 3-phase system.
- All units are turned ON and there are no faults.

NOTE: The shore power phase difference is displayed on the Paralleling Master on the top right in the first summary screen. Any value between 6° and 174° or between 186° and 354° is interpreted as the shore cords being powered from different phases.



In Two Singles mode the Paralleling Master does the following:

- Displays the operating mode: 2SINGLES.
- Allows the Slave DBT units to run autonomously (Single operation), selecting the gain.
- Does NOT connect the two ship buses together. The available power on each ship bus is that
  of one Slave DBT.

If one Slave DBT is turned OFF, loses power or detects a fault, and the Paralleling Master still has power, the Trident System will go to Slave 1 or Slave 2 mode.

#### 7.4.4. Slave 1 or Slave 2 Modes

The Trident System operates in these modes if any of the following conditions are present:

- Only one shore cord has power and the Paralleling Master is powered from it.
- Only one Slave DBT is turned ON.
- One Slave DBT has detected a fault.

In Slave 1 or Slave 2 modes the Paralleling Master does the following:

- Displays an operating mode of SLAVE1 or SLAVE2.
- Allows the powered Slave DBT to run autonomously (Single operation), selecting the gain.
- Prevents the unpowered Slave DBT from coming on-line unexpectedly.
- Connects the two ship buses together so that they both have power. The available power is that of only one Slave DBT.

If the currently active Slave DBT is turned OFF, the Trident System will go to Standby mode.

If the currently active shore cord loses power, all units will turn off.

If the previously inactive Slave DBT is powered up or exits the fault state, the Trident System will go to either Parallel or Two Singles mode, according to the phasing of the two shore cords.

#### 7.4.5. Standby Mode

The Trident System operates in this mode if the Paralleling Master is powered up but both Slave DBT units are either not turned ON or are in a fault state. In this mode the Paralleling Master:

- Displays an operating mode of OK.
- Waits for a Slave DBT to be powered up or exit the fault state.



### 7.4.6. Turn-Off Procedure

It is expected that the Slave DBT circuit breakers and the Paralleling Master power switch will be left in the ON position, and power will be controlled via the dock circuit breakers. To turn off the Trident System, first turn OFF the dock circuit breaker that only powers a Slave DBT, then turn OFF the dock circuit breaker that powers the other Slave DBT and the Paralleling Master.

To turn off the Trident System from the unit front controls first turn OFF both Slave DBT circuit breakers. After the Slave DBT fans stop spinning and the displays go dark, turn OFF the Paralleling Master power switch.



NEVER TURN THE PARALLELING MASTER POWER SWITCH OFF WHEN THE TRIDENT SYSTEM IS RUNNING IN PARALLEL MODE AS THIS CAN CAUSE INTERNAL DAMAGE TO THE SLAVE DBT UNITS.



# 8. TROUBLESHOOTING AND DIAGNOSTICS

## 8.1. COMMON PROBLEMS

When encountering difficulty in achieving successful operation of the DBT12/15/24, there are some problems which can easily be identified and solved. The following list is not intended to be exhaustive.

SYMPTOM	POSSIBLE CAUSE / SUGGESTED ACTION	
Upon initial power-up, the unit does not behave in accordance with Section 6.1 (the display doesn't light up and the fan doesn't spin).	<ul> <li>Ensure dock power is available. Check pedestal and shore cord circuit breakers.</li> <li>Have input power to the unit checked by a qualified electrician.</li> </ul>	
The unit powers-up in accordance with Section 6.1 but does not close its contactors and output voltage and power.		
The unit trips to a POWER OFF state and reports the message "FAULT: Latched OFF, Recycle Power"	• Review Section 8.3.	
Upon initial power-up, DBT slave screen stays on "self-test mode".	• Paralleling master issued boost request before slave was powered up. Cycle power on slave DBT to reset.	

## 8.2. SOFT-START INHIBIT

If the DBT12/15/24 is turned off within approximately 5 seconds from the time it was turned on, at the next power up the following screen is displayed. The soft-start inhibit timer will count down from 60 seconds and the unit will then proceed with normal power up.

SOFT-START INHIBIT COUNTDOWN: xx seconds

If Turn-On Problem Persists,

Please Contact ASEA Factory Service Rep



#### 8.3. ABNORMAL OPERATION

Abnormal operating conditions are classified into warnings and faults.

## **8.3.1.** Warnings

Warnings are abnormal operating conditions that do not prevent the DBT12/15/24 from delivering power. Although the DBT12/15/24 continues operating, it may do so at a reduced performance level or with reduced functionality. The status word WARNING is displayed for as long as a warning condition is present.

#### 8.3.2. Faults and Restart

Faults are abnormal operating conditions that require the DBT12/15/24 to immediately stop delivering power. As soon as a fault is detected the shore power and ship power contactors are opened. The status word FAILURE is displayed for as long as the fault condition is present. After the fault condition clears the DBT12/15/24 waits for 15 seconds and attempts to restart operation. During this time the status word WAIT and the 15 second timer are displayed.

DBTxxxx SHORE SHIP-L1 SHIP-L2 xx.xHz

VOLTAGE: xxxV 0V 0V WAIT xx

CURRENT: 0A 0A 0A BOOST1

LOAD: 0.0kVA 0.0kVA 0.0kVA 1/3

NOTE: Since many fault conditions clear immediately upon opening the contactors, the status word FAILURE may only be displayed for a split second before it is replaced by WAIT and the 15 second timer.

To prevent wear on the contactors and relays the DBT12/15/24 limits the number of restarts to 3 per hour. After the third fault clears restart is delayed until 1 hour has passed since the first fault occurred. Only a single summary screen is displayed during this time with shore power information, the last 3 faults logged, the status words RESTART, WAIT, and the 1 hour timer.

DBTxxxx SHORE FAULTS LOGGED xx.xHz
VOLTAGE: xxx V xxxxxxxx, RESTART
CURRENT: 0 A xxxxxxxx, WAIT
LOAD: 0.0kVA xxxxxxxx, xx:xx



## **8.3.3.** Failure and Warning Messages

To aid in system diagnostics, when an abnormal operating condition is detected, a diagnostics screen is added to the two summary screens rotation. The diagnostics screen displays a list of present fault and warning messages.

FAULT: No Fault
WARNING: Ship\_L1\_I\_Hi, Ship\_L2\_I\_Hi,
Shore\_I-Hi,

## Common fault messages are:

Ship_L1_V	Ship L1 voltage is outside the acceptable range
Ship_L2_V	Ship L2 voltage is outside the acceptable range
Shore_Freq	Shore frequency is outside the acceptable range
Shore_V	Shore voltage is outside the acceptable range
Sys_Ovld	System overload
T1_OT	Isolation transformer has exceeded its maximum temperature
T2_OT	Correction transformer has exceeded its maximum temperature
T3_OT	400V boost transformer has exceeded its maximum temperature
	(DBT24 only)

## Common warning messages are:

FAN_Locked	Fan is not spinning
Ship_L1_I_Hi	Ship L1 current is exceeding rated capacity
Ship_L2_I_Hi	Ship L2 current is exceeding rated capacity
T1_Hot	Isolation transformer is hot
T2_Hot	Correction transformer is hot
T3_Hot	400V boost transformer is hot (DBT24 only)



#### 8.4. BYPASS AND 1:1 MODES

The Bypass mode allows the DBT12/15/24 to temporarily operate under very unstable shore power conditions or while troubleshooting installations with extremely high load spikes. In this mode most advanced functionality of the DBT12/15/24 including voltage boosting and overvoltage or overload protection is disabled. A push-in / push-out Bypass switch located near the center of the control PCBA, as shown in Figure 19, is used to select normal operation in the out position or Bypass mode in the in position. The switch lights solid green when the DBT12/15/24 is operating normally and solid yellow in Bypass mode.

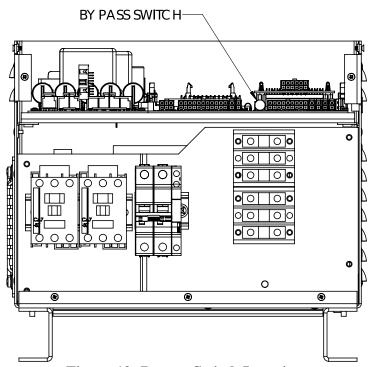


Figure 19: Bypass Switch Location.

If a Boost 1 or a Boost 2 fault is detected during self-test, voltage boosting is disabled and the DBT12/15/24 only runs in 1:1 mode. In this case the bypass switch flashes green.

### 8.5. GATHERING DATA

If a problem is being encountered by the unit, carefully record the fault and warning messages listed before removing power. When calling an authorized service center or the factory for assistance, please have the above mentioned information handy along with the unit model, serial number, and software version.



# 9. MAINTENANCE

Due to the design and construction of the DBT12/15/24, preventative maintenance is held to a low level. The following table lists minimum recommended tasks and frequency.

TASK	FREQUENCY	COMMENTS
Tighten electrical connections  WARNING	Every 6 months	Must be adjusted by the user based upon experience in the environment. Frequency will vary due to wire gauge, wire type, and applied vibration.
		Refer to licensed electrician or factory authorized technician.
CPU battery replacement	Every 3 years	May require greater frequency with elevated ambient temperature, or extended
<b>M</b> WARNING <b>A</b>		periods of non-operation.  Refer to factory authorized technician.
		•
Fan replacement	Every 2 years	May require greater frequency with elevated ambient temperature.
<b>M</b> WARNING <b>M</b>		Refer to factory authorized technician.



# 10. INTERNATIONAL POWER FORM REFERENCE

Country	Frequency	Nominal Voltage	Comments
American Samoa	60Hz	120/240 277/480	
Amer. Virgin Islands	60Hz	120/240 120/208	
Antigua and Barbuda	60Hz	230/400	
Argentina	50Hz	220/380	
Aruba	60Hz	127/220 115/230	
Australia	50Hz	240/415 250/435	
Azores	50Hz	110/190 220/380	
Bahamas	60Hz	120/240 120/208	
Bahrain	50Hz 60Hz	230/400 110/220	
Balearic Islands	50Hz	127/220 220/380	
Barbados	50Hz	115/230 115/200	
Belgium	50Hz	220/380	
Belize	60Hz	110/220 250/440	
Benin	50Hz	220/380	
Bermuda	60Hz	120/240 120/208	



Brazil	60Hz	115/230 127/220 220/380	
Brunei	50Hz	240/415	
Bulgaria	50Hz	220/380	
Canada	60Hz	120/240 120/208 277/480	
Canary Islands	50Hz	127/220 220/380	
Cape Verde	50Hz	220/380	
Cayman Islands	60Hz	120/240 120/208	
Chile	50Hz	220/380	
China (PRC)	50Hz	220/380	
Colombia	60Hz	110/220 120/208 150/260	
Costa Rica	60Hz	120/240 120/208	
Cyprus	50Hz	240/415	
Denmark	50Hz	230/400	
Dominica	50Hz	230/400	
Dominican Republic	60Hz	110/220 120/208	
Ecuador	60Hz	120/240 120/208	
Fiji	50Hz	240/415	
Finland	50Hz	230/400	



France	50Hz	230/400	
Gibraltar	50Hz	240/415	
Greece	50Hz	230/400	
Greenland	50Hz	220/380	
Grenada	50Hz	230/400	
Guadeloupe	50Hz	220/380	
Guam	60Hz	110/220 120/208	
Guatemala	60Hz	120/240 120/208	
Haiti	60Hz	110/220 120/208	
Honduras	60Hz	110/220 120/208	
Hong Kong	50Hz	220/380	
Ireland	50Hz	230/400	
Israel	50Hz	230/400	
Italy	50Hz	230/400	
Jamaica	50Hz	110/220	
Japan	50Hz 60Hz	100/200 100/200	
Kuwait	50Hz	240/415	
Madagascar	50Hz	127/220 220/380	
Malaysia	50Hz	230/400	
Maldives	50Hz	230/400	
Malta	50Hz	230/400	



Martinique	50Hz	220/380	
Mauritius	50Hz	230/400	
Mexico	60Hz	127/220	
Monaco	50Hz	230/400	
Montserrat	60Hz	120/240 230/400	
Morocco	50Hz	127/220 220/380	
Myanmar	50Hz	230/400	
Netherlands	50Hz	230/400	
Netherlands Antilles	50Hz	127/220 220/380	
	60Hz	120/240	
New Caledonia	50Hz	220/380	
New Zealand	50Hz	230/400	
Norway	50Hz	230/400	
Panama	60Hz	110/220 120/208	
Philippines	60Hz	115/230	
Portugal	50Hz	230/400	
Puerto Rico	60Hz	120/240 120/208	
St. Kitts and Nevis	60Hz	110/220 230/400	
St. Lucia	50Hz	240/415	
St. Vincent and the Grenadines	50Hz	230/400	
Saudi Arabia	60Hz	127/220	



Seychelles	50Hz	240/415	
Sierra Leone	50Hz	230/400	
Singapore	50Hz	230/400	
South Africa	50Hz	220/380	
South Korea	60Hz	110/220 220/380	
Spain	50Hz	230/400	
Sweden	50Hz	230/400	
Tahiti	60Hz	127/220	
Taiwan	60Hz	110/220 120/208	
Thailand	50Hz	220/380	
Togo	50Hz	127/220 220/380	
Trinidad & Tobago	60Hz	115/230 230/400	
Tunisia	50Hz	230/400	
United Arab Emirates	50Hz	220/400	
United Kingdom	50Hz	230/400	
Uruguay	50Hz	230/400	
Venezuela	60Hz	120/240 120/208	