

**AMFA-27
AMFA-29**

**Operator's Manual
&
Installation Instructions**

Rev. 2.5

Date: 17 July, 2010

Permanently-connected, utility Interactive, single-phase, inverters

Model AMFA-27 WIND TURBINE INVERTER (240 VAC nominal output)

The phase angle between L1 and L2 is 180°. Line to Neutral is 120 VAC nominal.

Model AMFA-29 WIND TURBINE INVERTER (208 VAC nominal output)

The phase angle between L1 and L2 is 120°. Line to Neutral is 120 VAC nominal.

USL - Evaluated to the requirements of the Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources, UL 1741, 2nd Edition, dated January 28, 2010.

CNL - Additionally evaluated to CAN/CSA C22.2 No. 107.1-1, "General Use Power Supplies." 3rd Edition, Dated September 1st, 2001 with revision through 2006.

The Diversified Technology Inc. Model AMFA-27 and AMFA-29 inverters are intended for variable frequency un-rectified 3-phase AC input from Wind Powered Turbines.

Table of Contents

1. Ratings
2. Important Safety Instructions
3. Installation
 - a. Mounting
 - b. Electrical Connections
4. Markings
5. Operation
6. Touch Screen Display
 - a. Stop / Reset
 - b. Status
 - c. Faults
 - d. Parameters
7. Equipment Maintenance

Ratings**Turbine Input**

Input Voltage Maximum (3 Phase Input)	400 VAC
Input Start Voltage Minimum	30 VAC
Input Operating Voltage Range	200 to 400 VAC
Input Frequency Maximum	400 Hz
Input Current Maximum	40 Amps
Input Short Circuit Current Maximum	462 Amps
AC Backfeed Current to Input Source	N/A

Utility Interactive Output

	AMFA-27	AMFA-29
Continuous Output Power Maximum	12000 KW	10400 KW
Continuous Output Power Tolerance	+/-10%	
Continuous Output Current Maximum	50 Amps	
Continuous Output Current Tolerance	+/- 10%	
Output Voltage Nominal (Single Phase) Line-Line	240 VAC	208 VAC
Operating Voltage Range Line-Line	212-264	184-228
Output Voltage Nominal (Single Phase) Line-Neutral	120 VAC	
Operating Voltage Range Line-Neutral	106-132 VAC	
Voltage Measurement Tolerance	+/- 10 VAC	
Operating Frequency Nominal	60 Hz	
Operating Frequency Range	59.3 to 60.5 Hz	
Operating Frequency Measurement Tolerance	+/- 0.5 Hz	
Output Power Factor	0.95 +/- 0.05	
Temperature Range Normal Operation	-20°C to 45°C	
Output Over-Current Protection Maximum	80 Amps	
Output Fault Current Maximum	1030 Amps	
Synchronization In-Rush Current Maximum	6.3 Amps	
Utility Interconnection Trip Time	100 msec	
Time Measurement Tolerance	+/- 85 msec	

Important Safety Instructions

SAVE THESE INSTRUCTIONS

This manual contains important instructions for Model
AMFA-27 and AMFA-29
that shall be followed during installation and maintenance of the inverter.

The output field wiring terminal can be used for connection of a maximum of:
One 1/0 AWG wire per terminal (1 wire for each line)

The input field wiring terminal can be used for connection of a maximum of:
One 2 AWG wire per terminal (1 wire per phase per terminal provided).

The field-wiring terminals shall be connected using the following wire types:

Copper Conductors Only (Input connection)
Use No. 6 - 2 AWG, 90 °C copper wire only

Copper, Aluminum or Copper-Clad Aluminum Conductors Only (Output connection)
Use No. 6 – 1/0 AWG, 90 °C Copper Conductors
Use No. 4 – 1/0 AWG, 90 °C Copper Clad Aluminum, or Aluminum Conductors.

The following symbols are used as markings on this product with the following meanings:

Equipment grounding conductor –



This inverter is intended for operation in an indoor NEMA 1 compatible environment having
a maximum ambient temperature of 45 degrees C.

This unit or system is provided with fixed trip limits and shall
not be aggregated above 30 kW on a single Point of Common Connection

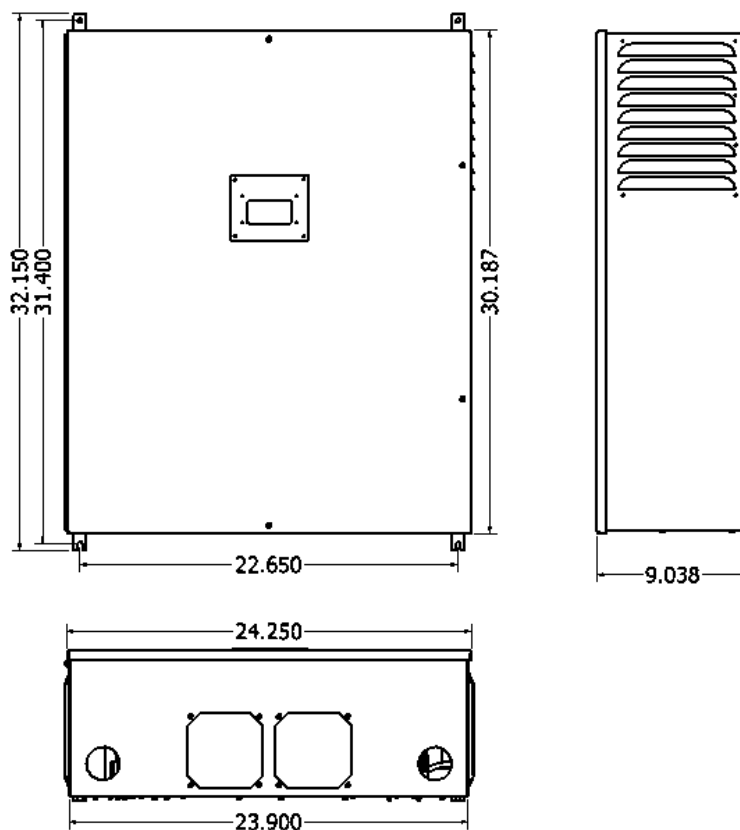
CAUTION

To reduce the risk of fire, connect only to a circuit provided with 80 amperes maximum
branch-circuit over-current protection in accordance with the National Electrical Code,
ANSI/NFPA 70.

Note that the input and output circuits are isolated from the enclosure. In accordance with
Clause 15.2.1.1 of CAN/CSA-C22.2 No. 107.1, system grounding, when required by the
Canadian Electrical Code, Part I, is the responsibility of the installer.

2. Installation

- a. Mounting
- i. The enclosure, having a NEMA 1 rating, is designed for indoor installation.
 - ii. The enclosure is provided with four mounting feet with 0.281" dia. mounting holes.
 - iii. For mounting to a 0.10" thick metal surface, use M6, ¼-20 or ¼-28 bolts grade 3 or higher with nuts and flat washers.
 - iv. For mounting to concrete, use M6 or ¼" bolts using concrete anchors with an 800 pound or greater tension rating.
 - v. The required bolt length is such that the internal threads need to be 100% engaged.
 - vi. The enclosure is to be oriented with the conduit openings facing toward the floor.
 - vii. Enclosure ventilation is to be provided such that the following guidelines are satisfied.
 1. Provide a minimum of 12 inches clearance to the air inlet filters.
 2. Provide a minimum of 6 inches clearance to the outlet side vents.
 3. Use in a well ventilated area within the maximum ambient temperature rating.



- b. Electrical Connections are made to the unit via the holes in the bottom of the enclosure. Holes are sized for 1.5" rated conduit. Wiring methods in accordance with the National Electrical Code, ANSI/NFPA 70 are to be used.
- c. The input and output circuits are isolated from the enclosure. System grounding when required by the *Canadian Electrical Code, Part I*, is the responsibility of the installer.
- d. AC Output Connection (Utility)
- i. The AC output is single phase and not bonded to ground.
 - ii. Connect the two single phase 240VAC wires to the dual fuse block located on the lower left side of the enclosure.
 - iii. Tightening torque, allowable wire size, and type, for the Field-Wiring Terminals:
 1. 100 lbf-in tightening torque maximum
 2. 6 AWG to a maximum of 1/0 AWG for Copper Conductors Only

3. 4 AWG to a maximum of 1/0 AWG for Aluminum Or Copper-Clad Aluminum Conductors Only
 4. Wire type – rated 90C minimum
 - iv. The inverter's earth ground connection must be bonded directly to the service entrance's earth ground which in turn is bonded to neutral.
- e. AC Input Connection (Turbine)
- i. Connect the three phase turbine wires to the DIN rail terminal block located on the lower right side of the enclosure.
 - ii. The inverter's wind turbine input must be connected to a 3-phase "delta" or "wye" connection with the neutral not connected to earth ground (left floating).
 - iii. The inverter must be provided with 3, UL listed fuses rated, 400 VAC minimum, 50 Amp maximum for proper protection from the wind turbine input to the unit as well as an appropriate UL listed fuse holder to accommodate the fuses.
 - iv. Tightening torque, allowable wire size, and type, for the Field-Wiring Terminals:
 1. 22 lbf-in tightening torque
 2. 6 AWG - to a maximum of 2 AWG for Copper Conductors Only
 3. Wire type – rated 90C minimum
 - v. An input ground connection must be made between the inverter and the ground terminal of the tower disconnect, wire size minimum of 8 AWG."
- f. Earth Ground Connection
- i. Earth ground is to be connected to the two terminals provided inside the enclosure as indicated by the earth ground equipment marking.
 - ii. Allowable wire size range is 8 AWG – 4 AWG.
 - iii. 50 lbf-in tightening torque

3. Markings

- a. Enclosure: **Type 1 – for INDOOR USE ONLY**
- b. Earth ground is indicated by the following marking:



4. Operation

This equipment is a UL 1741 certified Utility Interactive Inverter and complies with the requirements of IEEE1547 which is the standard for interconnecting distributed resources with electric power systems.

The Normal Operation of the inverter is as follows: When single phase 240VAC is applied to the inverter, the display will power up and a message stating that the unit is initializing is shown. A countdown timer set for 5 minutes (300 seconds) starts before the inverter is ready to transfer power to the utility grid. The inverter will automatically transfer power to the utility when AC voltages in the range of 30VAC to 400VAC are present at the Turbine input.

5. Touch Screen Display

- a. The touch screen display located on the front panel of the enclosure provides manual over-ride and status of the inverter’s operation. The touch screen display also provides a Stop and a Reset button. The Stop button is used when it is desired to disconnect the inverter from the power grid and the wind turbine. After Stop is pressed the inverter will remain in a powered-up stand-by mode until Reset is pressed or Grid voltage is removed. When Reset is pressed the inverter will resume normal operation.
- b. Status
 - i. Status of the inverters operation is shown on the lines one and two of the display. The following table lists the status messages that may appear.

Status Message	Description
Waiting Initializing	The inverter has been reset or that the 5 minute countdown delay is in progress
Waiting For Wind	The voltage from the turbine is lower than the factory set auto-start voltage threshold
AC Running	The active rectifier is regulating the internal DC Boost voltage
Running	The inverter is transferring power to the utility grid
Fault	A fault has occurred. See fault messages
Manual Stop Press Reset	The manual stop button has been pressed
Fault Limit Press Reset	Three faults have occurred in an hours time
Disconnected	Indicates that a communication problem exists between the display and the inverter. Check for bad cable connection.
Soft Grid	The inverter has detected that the output voltage is approaching the over voltage limit and is reducing its output to compensate for the less than ideal current carrying ability of grid connection.



c. Fault Messages

- i. Fault messages are displayed when a fault occurs and when the last fault parameter is selected. The following table is a list of possible faults that may be displayed.

Fault Message	Fault Code	Description
INTERNAL ERROR	10	IGBT Desat or control logic fault. An occurrence of this fault requires that the unit be completely powered down to reset it.
DC OVER VOLT 1	1000	The DC Bus voltage has exceeded its maximum threshold
DC OVER VOLT 2	1500	The DC Input voltage has exceeded its maximum threshold
DC UNDER VOLT	1250	The internal DC Boost voltage has dropped below its minimum threshold
AC OVER VOLT	2030	The AC line voltage has exceeded its maximum threshold
AC UNDER VOLT	2280	The AC line voltage has dropped below its minimum threshold
TURBINE PHASE	2500	Indicates that there is a problem with one or more of the turbine input phases. Bad connection, missing phase.
OVER CURRENT	3000	Phase A line current sensed by the converter module has exceeded its maximum current threshold
OVER CURRENT	3020	Phase C line current sensed by the converter module has exceeded its maximum current threshold
OVER CURRENT	3050	The DC Boost phase of the converter module has exceeded its maximum current threshold
OVER TEMP	4000	The internal high temperature threshold has been exceeded
UNDER TEMP	4250	The internal low temperature threshold has been exceeded
GROUND FAULT	7000	An input phase appears to be shorted to chassis ground
AC UNDER FREQ	8000	The frequency of the utility grid voltage went out of range. The upper range threshold was crossed
AC OVER FREQ	8100	The frequency of the utility grid voltage went out of range. The lower range threshold was crossed

d. Parameters

- i. The Up and Down arrow that is visible on the left side of the touch screen display* is used to scroll through a list of parameters. The list of viewable parameters is as follows:

Parameter	Description
Grid Voltage	Magnitude of the connected single phase grid voltage
Grid Frequency	Frequency of the connected single phase grid voltage
Bus Voltage	Magnitude of the actively rectified DC bus voltage
DC Current	Averaged value of the DC current
Turbine Volts	Averaged value of the rectified AC voltage from the Input
Output Power	Output power displayed in watts
Accum. Energy	Output Power accumulated over time of operation. Accuracy within 10%.
VRef	Used for factory setup**
IRef	Used for factory setup**
Last Fault	Displays the last fault that occurred since the inverter was powered up along with a fault code that may be useful when troubleshooting.

*A hidden feature of the display is the contrast adjustment. The right side of the display has invisible up and down arrows that can be used to increase and decrease the contrast of the display.

**Vref is used as an index look-up into a virtual table used for a customizable power curve, the graph of which is configured by parameters 81 through 93, called Iref request values. The virtual size of the table is 768 points. The table parameters configure every 64th value of the look-up curve for Iref. Iref is the current request in counts for a given DC input voltage tracked by Vref. Using this configuration the inverter can be adjusted to provide any power curve required.

6. Equipment Maintenance

- a. Periodically check the ventilation screen for the cooling fans. When necessary, use a vacuum to clean the screen from the outside of the enclosure. Do not force air or spray water into the enclosure.
- b. The touch screen display may become dirty over time. To clean the display use clean water applied to a soft non-abrasive cloth. Water sprayed directly onto the display could possibly leak inside and cause damage. Dirt and fingerprints do not affect the operation of the touch screen display.