

# Quick Start Guide

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TDTP3300-RD

For evaluation purposes only

Design files and more at  
[transphormusa.com/tp33kit](http://transphormusa.com/tp33kit)

## TDTP3300-RD

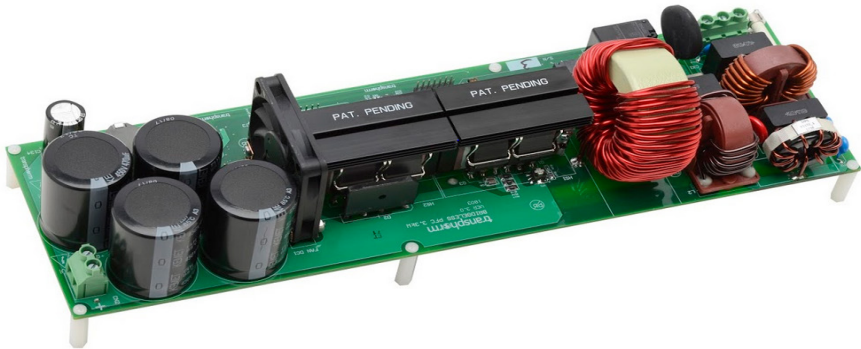
## Reference Design

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Highest Performance, Highest Reliability GaN

# Equipment Needed

- ➔ The TDTP3300-RD board
- ➔ High-voltage AC power supply for input
- ➔ Electronic/resistive load
  - Power range:
    - 350W to 3300W @230V
    - 150W TO 1650W @115V



## Cautions and Warnings



This reference design is intended as an educational tool for end customers developing their own bridgeless totem-pole PFC products. The tool kick starts end product development by providing a digital control design framework. No guarantees are made for standards compliance.

There are areas of this reference board that have exposed access to hazardous high voltage levels. Exercise caution to avoid contact with those voltages. Also note that the reference board may retain high voltage temporarily after input power has been removed. Exercise caution when handling.

When testing converters on a reference board, ensure adequate cooling. Apply cooling air with a fan blowing across the converter or across a heatsink attached to the converter. Monitor the converter temperature to ensure it does not exceed the maximum rated per the datasheet specification.

See page 5 for operating guidelines.

# Typical Performance Curves

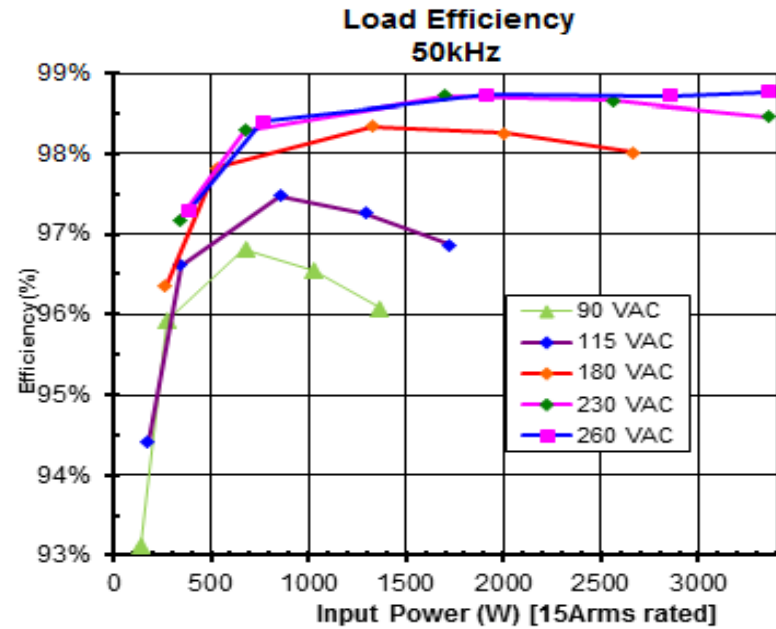
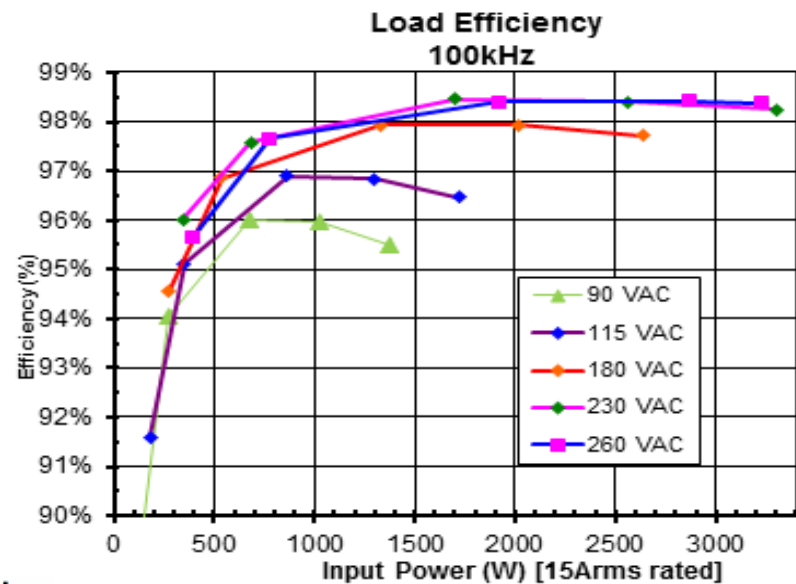


Figure 16 – Efficiency vs. Output Power, 50kHz



## Step 2: Power-up the Board

- ➔ Connect an electronic/resistive load to the corresponding marking (CN2). The requirements for the resistive load are:
  - At 115V<sub>AC</sub> input: 150W to ≤1250W
  - At 230V<sub>AC</sub> input: 350W to ≤3300W
- ➔ With the high-voltage power off, connect the high-voltage AC power input to the corresponding marking (CN1) on the PCB; N and L (PE: potential ground)
- ➔ Turn on the AC power input (85V<sub>AC</sub> to 265V<sub>AC</sub>, 50Hz to 60Hz); minimum power load for turn-on sequence is 150W
- ➔ Monitor CN2 output voltage with V<sub>DC</sub> meter to verify that 385V ±5V is generated
- ➔ Load can be increased when AC supply is on and board is functional

## Step 3: Power-down the Board

- ➔ Switch off the high-voltage AC power input

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**Note:**

See page 5 for important operating guidelines

## Transphorm GaN FET



Key Specifications	
V <sub>DSS</sub> (V)	650
V <sub>(TR)DSS</sub> (V)	800
R <sub>DS(on)eff</sub> (mΩ) max*	60
Q <sub>RR</sub> (nC) typ	125
Q <sub>G</sub> (nC) typ	16

### Description

The TP65H050WS 650V, 50mΩ Gallium Nitride (GaN) FET is a normally-off device. It combines state-of-the-art high voltage GaN HEMT and low voltage silicon MOSFET technologies—offering superior reliability and performance.

Transphorm GaN offers improved efficiency over silicon, through lower gate charge, lower crossover loss, and smaller reverse recovery charge.

### Features

- JEDEC qualified GaN technology
- Dynamic R<sub>DS(on)eff</sub> production tested
- Robust design, defined by
  - Intrinsic lifetime tests
  - Wide gate safety margin
  - Transient over-voltage capability
- Very low Q<sub>RR</sub>
- Reduced crossover loss
- RoHS compliant and Halogen-free packaging

TP65H050WS Datasheet available at [Transphormusa.com](https://www.transphormusa.com)

# Important Operating Guidelines

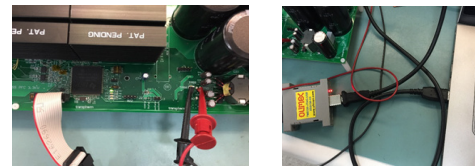
The TDTP3300-RD is intended as an educational tool for end customers developing their own bridgeless totem-pole PFC products. The reference board kick starts end product development by providing a digital control design framework. The reference board is not intended to be a finished product in terms of all required design testing and/or manufacturing-related protective considerations, including but not limited to product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. Additionally, the reference board does not include all protection features found in commercial power supplies. Additional warnings to keep in mind:

- ➔ An isolated AC source should be used as input.
  - Float the oscilloscope by using an isolated oscilloscope or by disabling the PE (Protective Earth) pin in the power plug. Float the current probe power supply (if any) by disabling the PE pin in the power plug.
- ➔ Use a resistive load only. The totem-pole PFC kit can work at zero load with burst mode and the output voltage will be swinging between 375V and 385V during burst mode.
- ➔ The reference board is not fully-tested at large load steps. **DO NOT** apply a very large step in the load (>1000W) when it is running.
- ➔ **DO NOT** manually probe the waveforms when the board is running. Set up probing before powering up the demo board.
- ➔ **DO NOT** touch any part of the evaluation board when it is running.
- ➔ If the evaluation circuit goes into protection mode it will work as a diode bridge by shutting down all PWM functions. Recycle the bias power supply to reset the DSP and exit protection mode.
- ➔ To get clean  $V_{GS}$  of the low side GaN FET, it is not recommended to measure the  $V_{DS}$  at the same time.
- ➔ It is not recommended to use a passive voltage probe for  $V_{DS}$  and  $V_{GS}$  measurements while simultaneously using a differential voltage probe for  $V_{IN}$  measurements, unless the differential probe has very good dV/dt immunity.

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# Step 0: Before Power Up

- ➔ Connect XDS100-V2 emulator to the PFC board (JTAG) and to computer USB port
- ➔ Apply 5V auxiliary power(GND-TP58, 5V-TP61)

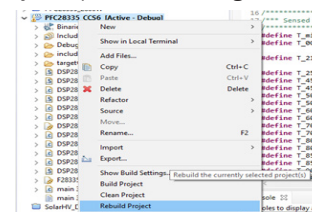


- ➔ Open CCS 6 or CCS 7 - import the 3.3 kW PFC project. Open the main file: main 390Vdc 400uH L 3.3kW\_V1.0\_dcp\_RevVm\_clc
- ➔ At Line 240-243, set the desired switching frequency, (uncomment) desired value between 45E3 and 150E3 (45kHz - 150kHz)

```

239 #define MASTER_FREQ 150E6
240 // #define ISR1_SAMPLE_FREQ 100E3
241 // #define ISR1_SAMPLE_FREQ 75E3
242 #define ISR1_SAMPLE_FREQ 50E3
243 // #define ISR1_SAMPLE_FREQ 45E3
244 // #define ISR1_SAMPLE_FREQ 48E3
    
```

- ➔ Select the project in Project explorer window. Right click the project name to rebuild Project, an .out file will be generated:

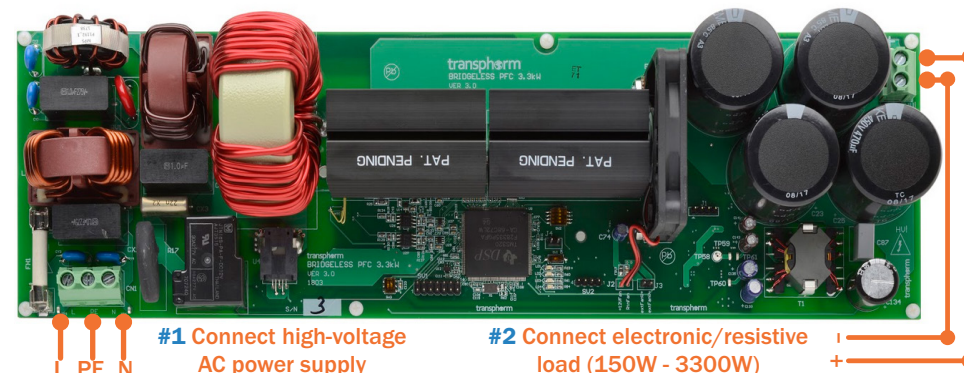


- ➔ Press F11 or button to download the file to the DSP.
- ➔ After finishing download, press button to run the code, and the LD2 red light will be shrinking. The code is downloaded to the DSP successfully.



- ➔ Disconnect the auxiliary power connection and Emulator connector for AC power up.

# Step 1: Connect the Board



**#1** Connect high-voltage AC power supply  
**#2** Connect electronic/resistive load (150W - 3300W)