

Title	<i>Preliminary Reference Design Report for a 150 W Three-Phase Inverter Using BridgeSwitch™-2 BRD2463C and LinkSwitch™-TN2 LNK3204D in FOC Operation</i>
Specification	340 VDC Input, 150 W Continuous Three-Phase Inverter Output Power, 750 mA _{RMS} Continuous Motor Phase Current
Application	High-Voltage Brushless DC (BLDC) Motor Drive
Author	Applications Engineering Department
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Revision	1.0

Summary and Features

- Integrated 600 V FREDFETs with ultra-soft, fast recovery diodes
- Fully self-biased operation (wired to support external bias supply if required)
 - +5 V auxiliary supply
- 97% full-load efficiency (external supply)
 - PCB-level cooling (no heatsink required)
- < 10 mW (total for inverter) no-load power consumption using sleep-mode
- High-side and low-side cycle-by-cycle current limit
- Optional latching low-side current limit
- Two-level device over-temperature protection (latching or hysteretic)
- System-level temperature monitoring
- High-voltage bus monitor with four undervoltage thresholds and one overvoltage threshold
- Simplified error notification via Error Flag (EF) pin
- Supports any microcontroller suitable for sensorless field-oriented control (FOC)
- Instantaneous phase-current telemetry reporting for each BridgeSwitch-2 IC

PATENT INFORMATION

The products and applications illustrated herein (including transformer construction and circuits external to the products) may be covered by one or more U.S. and foreign patents, or potentially by pending U.S. and foreign patent applications assigned to Power Integrations. A complete list of Power Integrations' patents may be found at www.power.com. Power Integrations grants its customers a license under certain patent rights as set forth at <https://www.power.com/company/intellectual-property-licensing/>.

PRELIMINARY



1. Introduction

This document describes a 150 W, high efficiency, three-phase inverter using three BridgeSwitch-2 BRD2463C devices to drive a high-voltage brushless DC (BLDC) motor. The design showcases the BridgeSwitch-2 device performance – high efficiency, phase current reporting, self-supplied operation, extremely low no-load operation, internal and system-level monitoring plus fault protection. A high-voltage, low part-count buck converter utilizing the LinkSwitch-TN2 (LNK3204D) IC provides an optional external supply to increase full-load efficiency. A current sense amplifier is also included for each phase to provide an alternative current reporting mechanism.

This report is a preliminary summary. To receive additional information including bill of materials, printed circuit board (PCB) layout, computer performance data and test setup, contact your local PI representative.

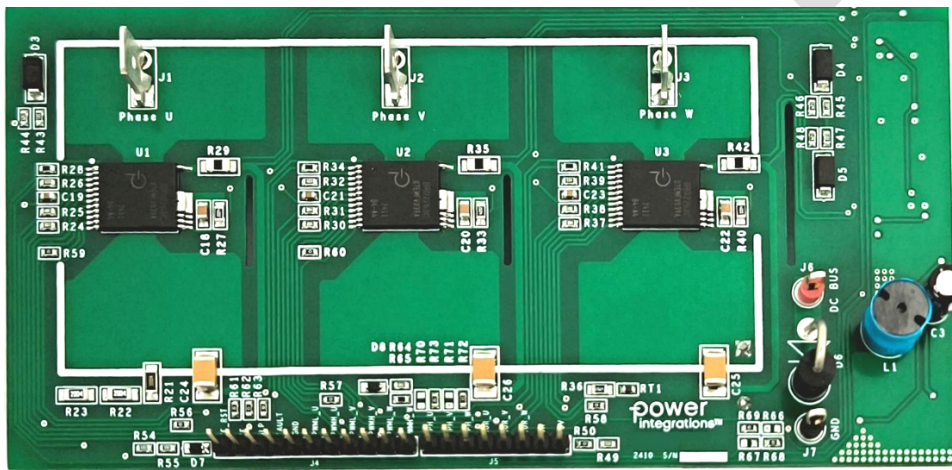


Figure 1 – Populated Circuit Board Top View.

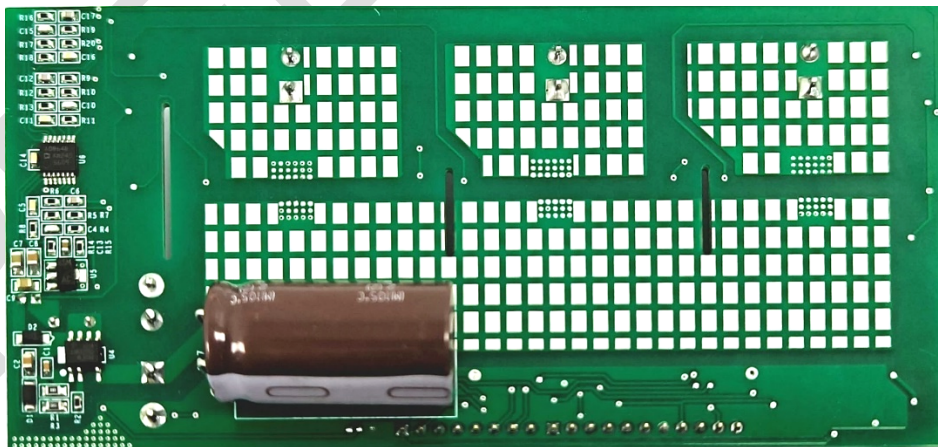


Figure 2 – Populated Circuit Board Bottom View.

2. Inverter Specification

The table below provides the electrical specification of the three-phase inverter design. Operation is based on sensorless field-oriented control (FOC) employing a Space Vector Modulation (SVM) control technique.

Description	Symbol	Min.	Typ.	Max.	Units	Comments
Input						
Voltage	V_{IN}	270	340	365	V	2-wire DC Input.
Current	I_{IN}		0.46		A_{RMS}	RMS Current
Power	P_{IN}		153		W	At Efficiency = 96%.
Output						
Power	P_{OUT}		147		W	Inverter Output Power
Motor Phase Current	$I_{MOT(RMS)}$		0.75		A_{RMS}	Continuous RMS per Phase
Inverter Peak Output Current	$I_{INT(PK)}$		2.50		A	Inverter Peak Current
PWM Carrier Frequency ¹	f_{PWM}		10		kHz	Three-Phase FOC Modulation
Inverter Efficiency	η		96		%	Self-Supplied Operation
Output Speed	ω		3000		RPM	Motor Speed at 150 W Inverter Output
Environmental						
Ambient Temperature	T_{AMB}	-20	29	65	°C	Average Ambient Temperature. Closed case. Free Convection
Device Case Temperature	$T_{PACKAGE}$		75	111	°C	0.75 A_{RMS} Phase Current in Self-Supplied Operation
System Level Monitoring						
DC Bus Sensing						
OV Threshold	V_{OV}		362		V	Reported through Status Communication Bus (FAULT Pin)
1 st UV Threshold	V_{UV100}		212		V	
2 nd UV Threshold	V_{UV85}		182		V	
3 rd UV Threshold	V_{UV60}		152		V	
4 th UV Threshold	V_{UV55}		122		V	
Over Current Protection ²	I_{OCP}		2.50		A_{PK}	At XL/XH = 42.2 k Ω
System Warning Temperature ³	T_{SYS}		90		°C	
Notes: 1. 20 kHz is the maximum recommended PWM frequency when using self-supply 2. This can be manually configured by adjusting the value of the XL/XH resistors. For BRD2463C, the maximum current protection level is 2.50 A at an XL/XH resistance of 42.2 k Ω . 3. Sensed through an external thermistor, the temperature threshold depends on the chosen NTC thermistor.						
Table 1 – Inverter Specification.						

3. Simplified Schematic

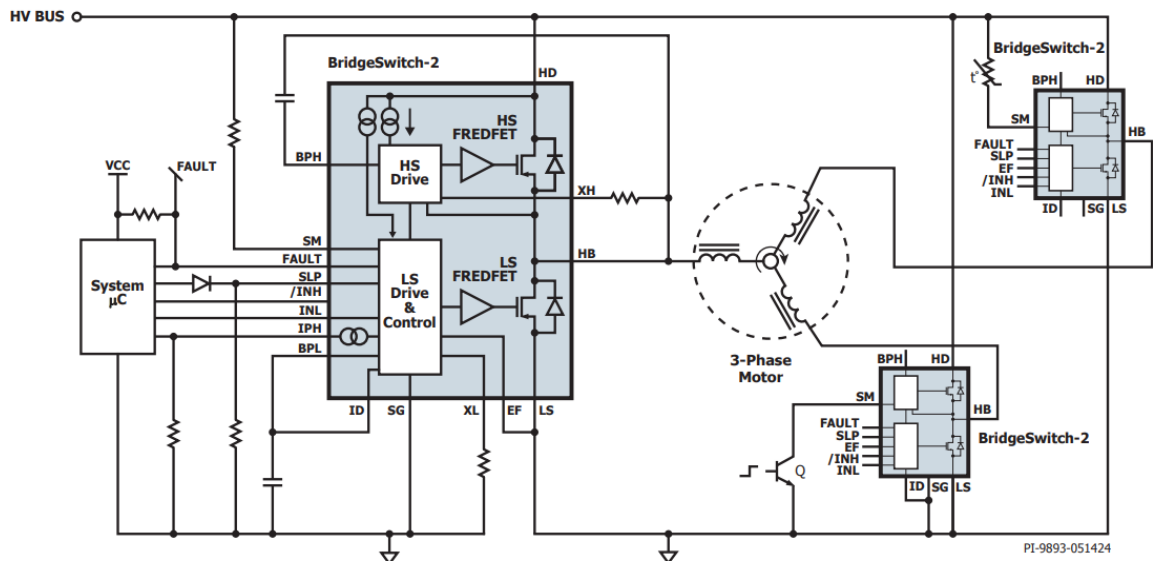


Figure 3 – BridgeSwitch Three-Phase Inverter Schematic

4. Preliminary Performance Information

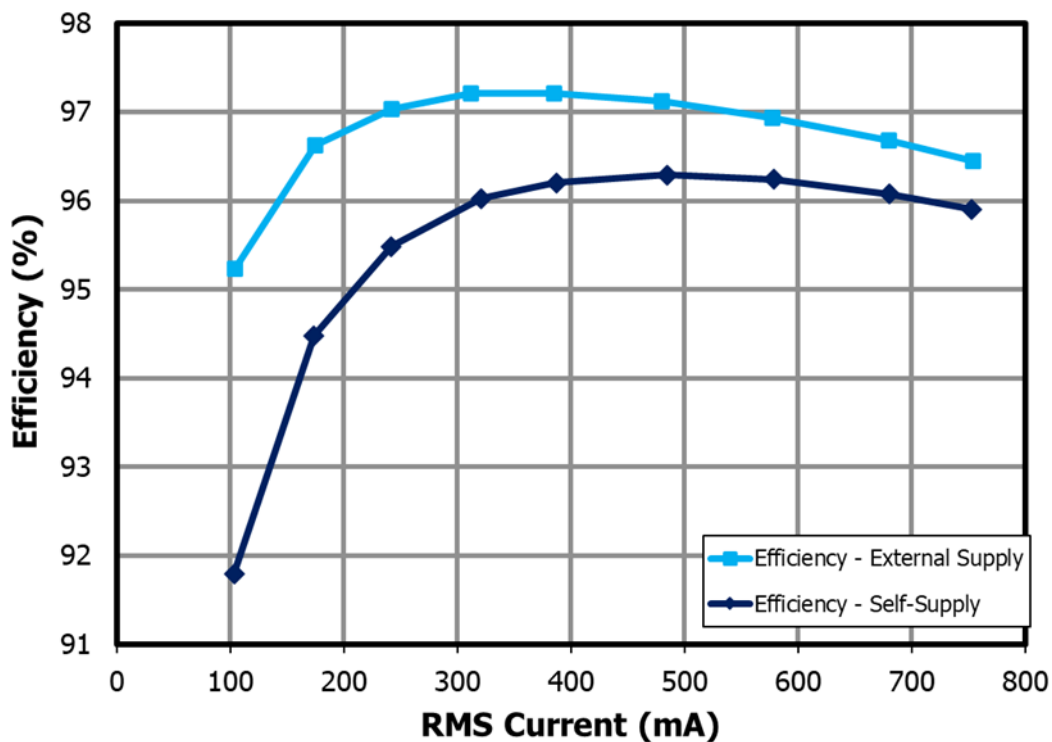


Figure 4 – 3-Phase Inverter Efficiency Across Load



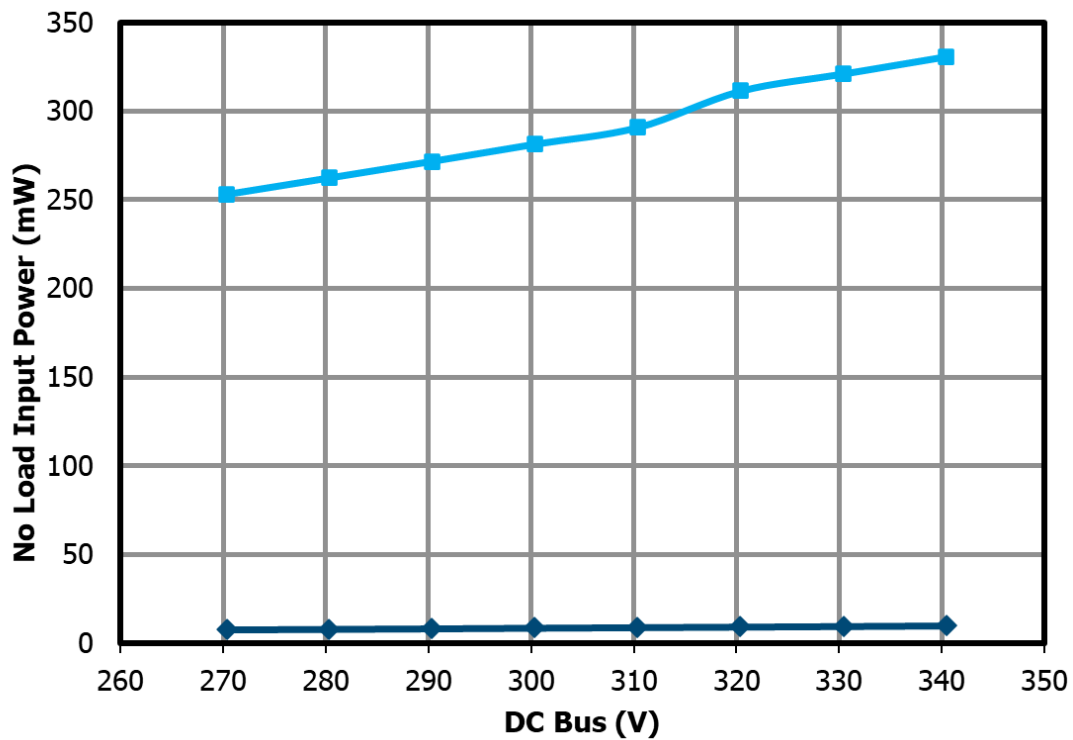


Figure 5 – No-Load Input Power Comparison (Sleep Mode ON vs. OFF)

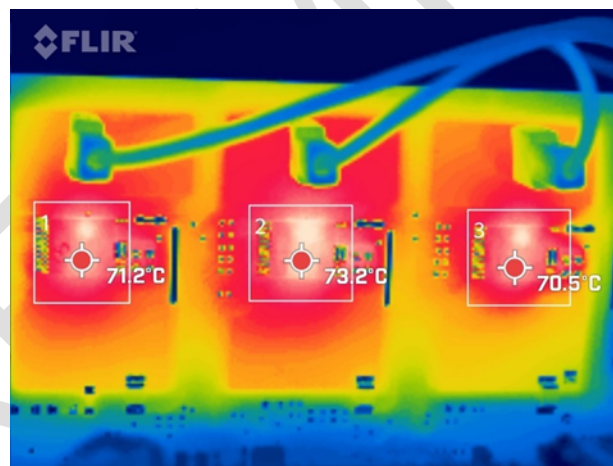


Figure 6 – BridgeSwitch-2 Case Temperature at 750 mA Phase Current (External Supply Mode) 29 °C Ambient

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