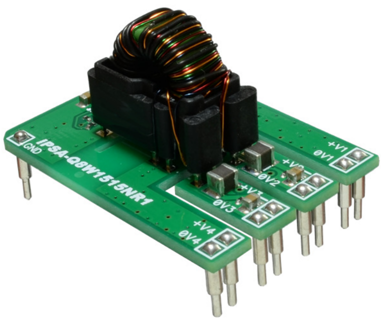
IPSA-Q8W1515NR1

Non-Regulated Isolated 4-Channel 8W DC/DC Converter for Gate Drive Applications



Applications

- Isolated IGBT/MOSFET Gate Drive Circuits
- Isolated Power Supplies
- R&D Inverters
- IPM DC/DC Supply
- Renewable Energy Long-Life Inverters

Compliance

- ROHS

Features

- 4 Channels Best Suited for IPM & Three Phase Gate Drives
- High Power Density
- 3000 V_{RMS} Input to Output Isolation
- 500 V_{RMS} Output to Output Isolation*
- Reverse Polarity Protection
- Input UVLO Protection
- High Efficiency up to 85.5%
- High MTBF for Long-Life Applications
- -40 To 85°C Operating Temperature Range (Without De-rating)

Description

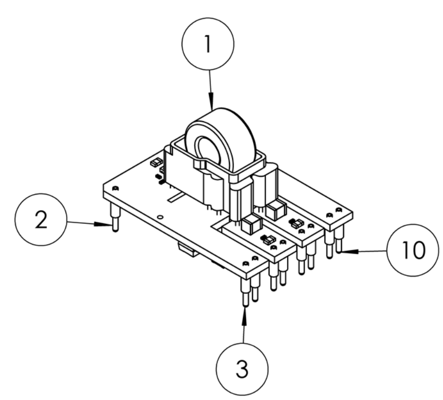
IPSA series of isolated DC/DC converters family offers efficient DC power supply for high voltage isolation demanding applications such as high performance IGBT/MOSFET gate drive circuits. These converters were specifically designed and optimized for such applications where safety, long-life, high temperature operation and lowest cost is desired.

The 4 channel version is perfectly suited for 3 phase gate drive circuits where 4 isolated supplies are required. Such configuration is very widely used in industrial and renewable energy Inverters and Converters. The small size and high power density makes it absolutely ideal for Intelligent Power Modules (IPMs) gate drive supply requirements.

Featuring a full 8 Watts of isolated 4 channels output supplies in small board area, the IPSA series enables you to develop Lowest Cost, High Performance and High Current IGBT/MOSFET Gate Drive Circuits.

Pin Description:

Name	Pin No.	Pin No.	Name
1	+15 Vs	7	0V2
2	GND	6	+V3
10	+V1	5	0V3
9	0V1	4	+V4
8	+V2	3	0V4



Revision History Table

Version	Release Date	Changes
1.0	16/08/2015	First Version Released

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SAFETY NOTICE !

ATTENTION PLEASE! THIS DEVICE IS ESD SENSITIVE AND NEEDS TO BE HANDLED WITH CARE. HIGH VOLTAGE CONDITION MAY OCCUR DURING OPERATION OF THE DEVICE, AND HENCE USER IS SOLELY RESPONSIBLE OF EQUIPMENT AND PERSONNEL SAFETY. TARAZ TECHNOLOGIES SHALL NOT BE HOLD LIABLE FOR ANY DAMAGE TO PERSONNEL AND/OR PROPERTIES AS A RESULT OF USING THIS DEVICE. USER MUST TAKE ADEQUATE STEPS TO ENSURE ELECTRICAL AND MECHANICAL SAFETLY OF THE DEVICE IN USE.

Ratings & Characteristics

*All ratings are given at Vs=15V and 25°C ambient temperature unless otherwise specified.

Absolute Maximum Ratings	Test Conditions/ Note	Minimum	Typical	Max	Unit
Input Voltage (V_S)	25°C	-	-	18	V
Input Current	25°C	-	-	0.8	A
Output Power (P_{OUT})	25°C	-	-	12	W
Output Current (I_{OUT})	One Channel at Time	-	-	300	mA
Input to Output Isolation	AC RMS, 25°C	-	-	3000	V_{RMS}
Output to Output Isolation	AC RMS, 25°C	-	-	1500	V_{RMS}
Output to Output Isolation (V2 & V3)	AC RMS, 25°C	-	-	500	V_{RMS}
Operating temperature	Without de-rating	-30	-	+90	°C
Storage temperature				TBD	
Recommended Operating Conditions	**Test Conditions/ Note**	**Minimum**	**Typical**	**Max**	**Unit**
Input Voltage (V_S)	25°C	13	15	17	V
Output Power (P_{OUT})	Over Temperature Range	-	-	8	W
No Load Input Current	V_S = 15V	-	30	-	mA
Operating temperature	Without De-rating	-25	-	+85	°C
Maximum Output Current	Single Channel	-	-	300	mA
Maximum Output Current	Per Channel	-	-	140	mA
Characteristics	**Test Conditions/ Note**	**Minimum**	**Typical**	**Max**	**Unit**
Output Voltage	No Load	-	14.7	-	V
UVLO Threshold	UVLO + UVLO -	10 8	11 9	12 10	V
Switching Frequency		95	100	105	kHz
Weight			11		g
Mean Time Before Failure (MTBF)			TBD		Hours
	1:1 Loading [1]				
Output Voltage	I_{OUT} = 140mA (Per Channel)	-	13.47	-	V
Efficiency	I_{OUT} = 140mA (Per Channel)	-	84.1	-	%
Output Voltage Ripple (pk-pk)	I_{OUT} = 140mA (Per Channel)	-	61.5	-	mV
	3:1 Loading [2]				
Output Voltage	I_{OUT} = 100mA (Channels)	-	13.55	-	V
Output Voltage	I_{OUT} = 300mA (Channel)	-	13.14	-	V
Efficiency	3x I_{OUT} = 100mA, 1x I_{OUT} = 300mA	-	84.64	-	%
Output Voltage Ripple (pk-pk)	I_{OUT} = 100mA (Channels)	-	77	-	mV
Output Voltage Ripple (pk-pk)	I_{OUT} = 300mA (Channel)	-	162	-	mV

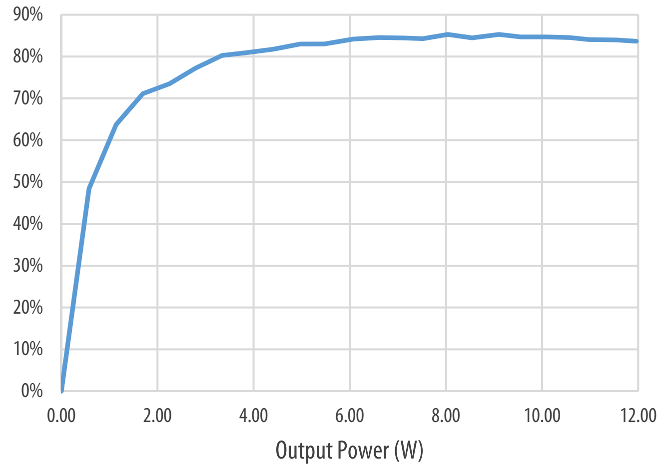
Notes:

1) 1:1 Loading means all channels are equally loaded.
2) 3:1 Loading means 3 of the channels are equally loaded while fourth channel is 3 times loaded. (Practical case of 3 phase gate drive circuits where single channel is used for lower side switches).

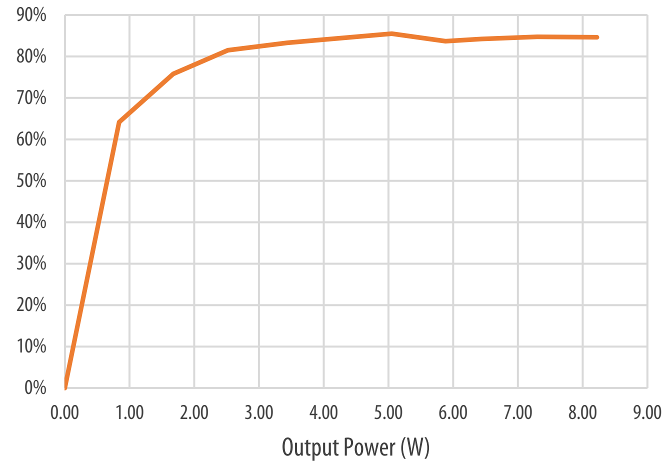
Performance Data

*All ratings are given at Vs=15V and 25°C ambient temperature unless otherwise specified.

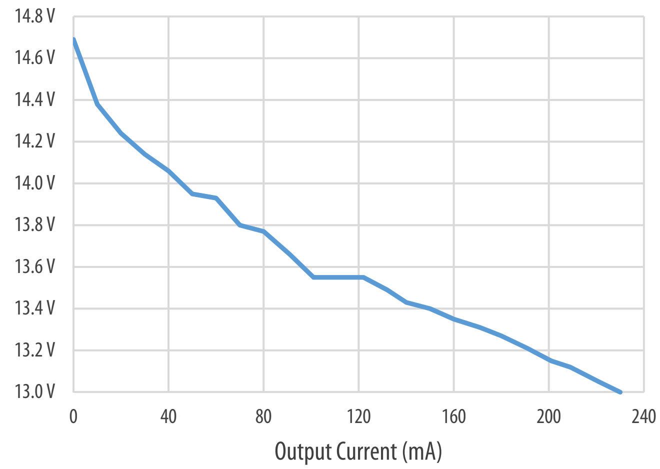
1A: Efficiency vs Output Power [1:1 Loading]



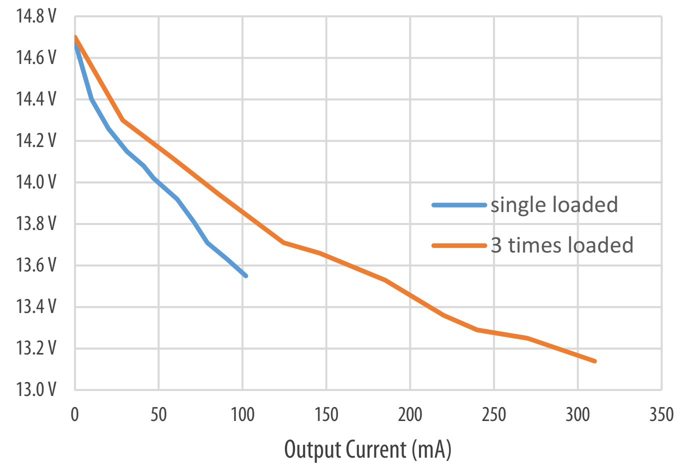
1B: Efficiency vs Output Power [3:1 Loading]



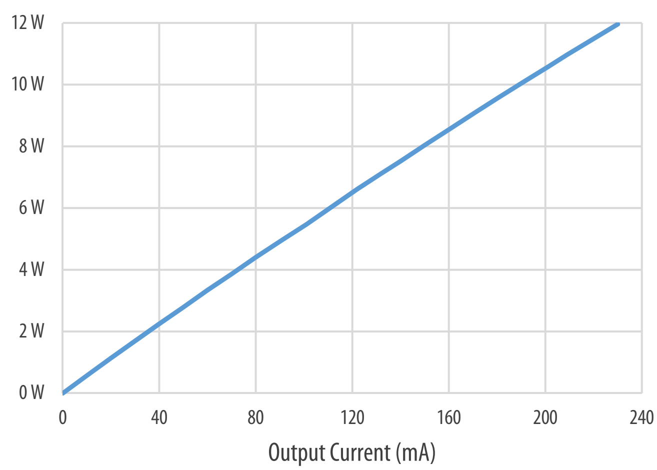
2A: Output Voltage vs Output Current [1:1 Loading]



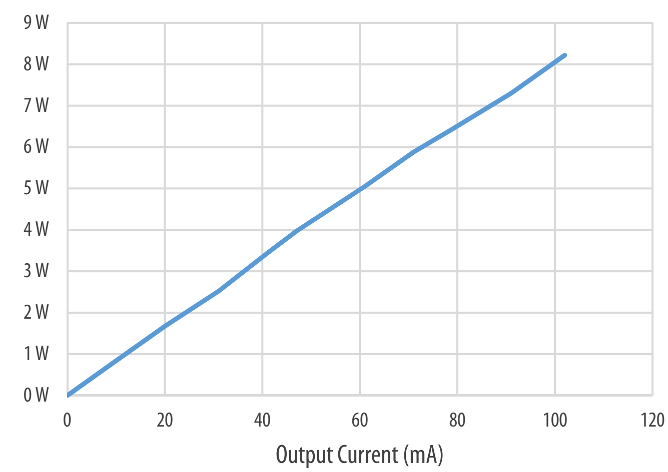
2B: Output Voltage vs Output Current [3:1 Loading]



3A: Output Power vs Output Current [1:1 Loading]



3B: Output Power vs Output Current [3:1 Loading]



Application Information

This note covers the design of IGBT/MOSFET gate drive circuits using the 4 channel IPSA-series DC-DC converter. Following these simplified steps will give you comparable performance characteristics to real life application. However, this guideline should not be taken as a guarantee of performance.

Designing for 3 Phase Inverter Applications

First, user need to consult the datasheets of gate driver chip as well as IGBT/MOSFET to know the things like output bias power ($P_{O(BIAS)}$) or output bias current (I_{CC2MAX}), total gate charge of IGBT/MOSFET (Q_G) and switching frequency (f_{SW}). In this guideline, we will consider using Avago ACPL-332J gate drive IC along with IPSA DC/DC converter.

1. Select the IGBT/MOSFET and the gate drive IC:
   For this example, we will use Avago ACPL-332J to drive GeneSIC GB100XCP12-227 IGBT (100A, 1200V). We need to find out IC power requirement by finding output bias current (I_{CC2MAX}), and IGBT gate drive power requirement by finding total gate charge (Q_G).

   For ACPL-332j, I_{CC2MAX}= 5mA, Q_G for high power IGBT is around 590nC (900nC at +15..-8), and V_{CC} = 15V at max.

2. Determine output power requirement of single switch gate drive circuit:
   a. ACPL332J IC Power (P_{IC})

   $$P_{IC} = I_{CC2MAX} \times V_{CC}$$

   Where, V_{CC} : Voltage supply of gate side (15V)

   I_{CC2MAX} : Output bias current (5mA)

   b. Switch Gate Drive Power (P_G)

   $$P_G = \Delta V_{GE} \times Q_G \times f_{SW}$$

   Where, ΔV_{GE} : Change of voltage across gate to emitter (15V in our case), Q_G : Total gate charge (590nC), f_{SW} : Switching frequency (40KHz for example).

   c. Total Output Power (P_{OUT}) will be

   $$P_{OUT} = P_{IC} + P_G$$

   Calculations with give us 75mW IC consumption and 354mW gate requirement. A total of **429mW** to be needed for each switch, which needs to be lower than ACPL-332J maximum output power of 600mW.

3. Calculate total power needed to drive 6 switches of 3 phase inverter:

   $$P_{TOTAL} = 6 \times 429mW = \mathbf{2.574W}$$

4. From Performance Data, determine DC/DC characteristics at this load:
   a. From 3B, at 2.574W, output current from 3 high side channels will be around 32mA, while low side single channel will give 96mA.
   b. From 2B, output voltage from high side channels will be 14.15V, while low side channel will have 13.87V output.
5. Determine efficiency and input power requirement at this load, from 1B, efficiency at 2.574W will be 82%, which will result in 210mA at 15V supply voltage.

Although this DC/DC converter is non-regulated at output, precise characteristic can still be determined, and input voltage can be increased accordingly to achieve desired output voltage level.

Input Under-Voltage Lockout

Under normal startup, converter will not begin to supply output voltage until the rising input voltage exceeds and remains at UVLO+ threshold. Once operating, converter will not turn off until the input voltage drops below the UVLO- threshold. This built-in hysteresis prevents any unstable on/off operation. Users should be aware however of input sources near the Under-Voltage Shutdown whose voltage decays as input current is consumed (such as poorly regulated capacitor inputs), the converter shuts off and then restarts as the external capacitor recharges. Such situations could oscillate. To prevent this, make sure the operating input voltage is well above the UV Shutdown voltage AT ALL TIMES.

Input Fusing

Certain applications and/or safety agencies may require fuses at the inputs of power conversion components. Fuses should also be used when there is the possibility of sustained over current. For greatest safety, it is recommended to use fast blow fuse at the input supply line.

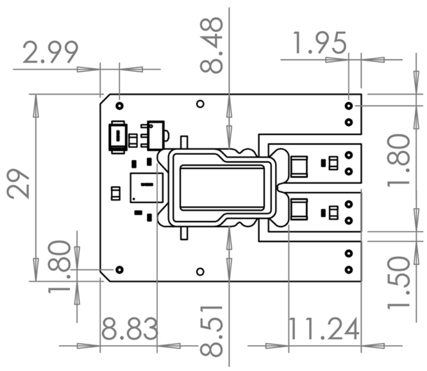
Recommended Input Filtering

The user must assure that the input source has low AC impedance and that the input supply has little or no inductive content such as long distributed wiring to a remote power supply. The converter will operate with no additional external capacitance if these conditions are met. For best performance, we recommend installing a low-ESR capacitor of 10uF immediately adjacent to the converter's input terminals.

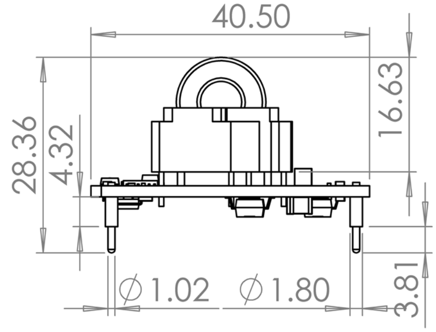
Recommended Output Filtering

The converter will achieve its rated output ripple with no additional external capacitor. However, the user may install more external output capacitance to reduce the ripple, minimize switching noise and/or to handle spike current load steps. Again, it is recommended to use low-ESR ceramic or film capacitors. Initial values of 10 to 47µF may be utilized either single or multiple capacitors in parallel.

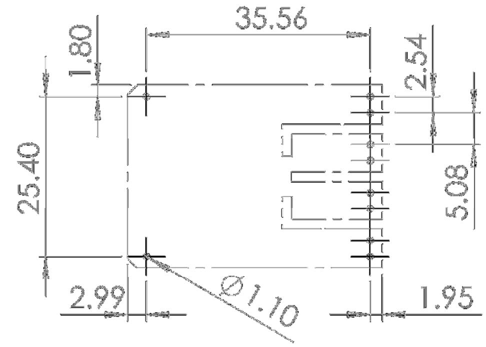
Mechanical Drawing



TOP VIEW



SIDE VIEW

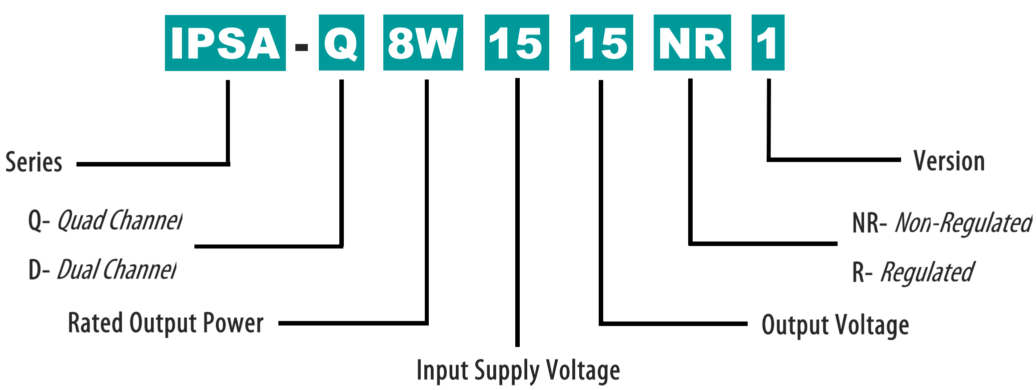


FOOTPRINT
Recommended hole size is 1.2mm

* All dimensions are in mm.

* 3D Model (.step) available online.

Ordering Information



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