CBAM™ PQ-28

Features

- The Power Quality Module (PQ-28) is a single input power conditioning module
- 1/2 brick package (2.28” x 2.4” x 0.50”)
- Designed for 200 Watts
- Designed to interface with MIL-STD-1275B, 28VDC Power Bus
- 100VDC input capability
- Automatic recovery for output short circuit
- Aluminum substrate technology
- All applicable materials used are a minimum of UL94V-0 rated. Designed to meet UL60950
- All ceramic solution
- Excellent MTBF
- Five year warranty
- Available with RoHS compliant construction part number: PQ-28 (RoHS)

Description

The Power Quality Module PQ-28 is a single input power conditioning module. Built in a 1/2 brick size package that operates over a 11 - 100VDC input, the PQ-28 is designed for 200 Watts and features automatic recovery for output short circuit.

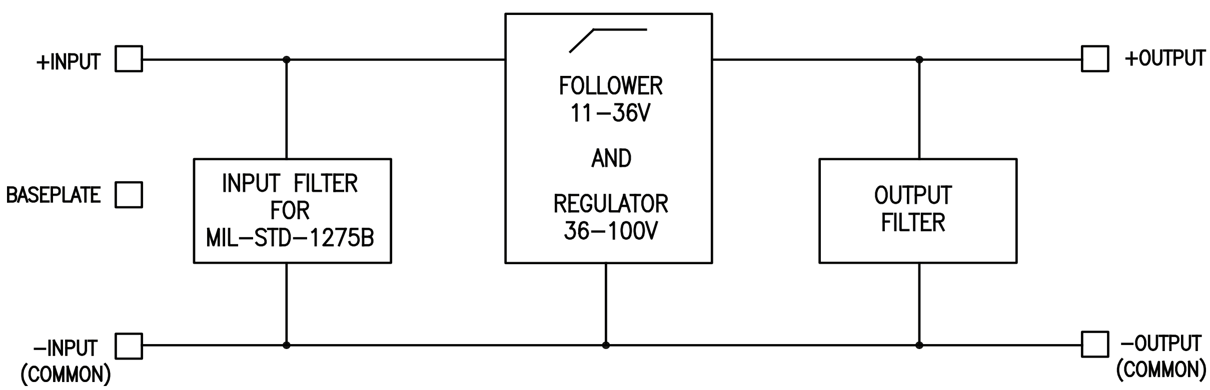


Figure 1. Block Diagram

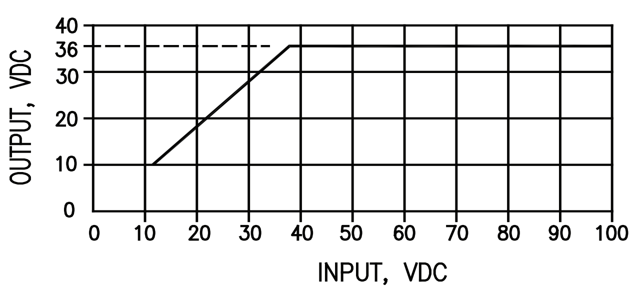


Figure 2. Input - Output DC Voltage

2401 Stanwell Drive, Concord Ca. 94520 Ph: 925-687-4411 Fax: 925-687-3333 www.calex.com Email: sales@calex.com

Input Parameters (Note 1)			
Model		PQ-28	Units
Input Voltage Range	MIN TYP MAX	11 28 100	VDC
Input Current, No Load	TYP	90	mA
Input Current, 28VDC, 200W Load	TYP	7.4	A
Efficiency 28VDC. 200W Load	TYP	95	%
Under Voltage Lock Out Turn-on Turn-off	 TYP TYP	 10 9.5	 VDC VDC
Turn-on time Delay before rise Rise time Overshoot	 TYP TYP TYP	 180 - 420 25 3	 ms ms %
Switching Frequency	TYP	200	kHz
Input Fuse		(2)	
Input Reverse Polarity Protection		(2)	

Performance Features (Note 1)			
Model		PQ-28	Units
Output Power	MAX MIN	See Derating 0	W
Input to Output Voltage Drop, 11VDC, 100W	TYP	2.8	VDC
Load Regulation (45-100VDC)	TYP MAX	0.1 1	%
Temperature Coefficient (45 -100VDC)	TYP	150	ppm/ºC
Short Circuit Protection +Output to -Output		Auto Restart	

Notes:

(1) All parameters measured at T_{AMB}=25ºC, Vin=28VDC, Full Power Out, 100µF Bus Capacitor unless otherwise noted. Refer to the Calex Application Notes for the definition of terms, measurement circuits, and other information.

(2) Refer to Calex Application notes for information on fusing. Fuse is only required for system protection, and input reverse polarity protection.

(3) Load regulation is defined as the output voltage change when changing load power from maximum to minimum.

(4) Isolation is measured by applying a DC voltage between the baseplate and pins.

(5) Thermal shutdown occurs at about +112ºC on the baseplate. The unit will autostart at about +110ºC.

(6) The thermal impedance is defined as the temperature rise above ambient per package watt dissipated. Baseplate not connected to an external heatsink.

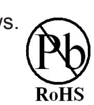
(7) MTBF is calculated based on MIL-HDBK-217F under the following conditions:

Reliability prediction method	=	Part Stress Analysis
Baseplate temperature	=	40ºC
Environment	=	Ground, Benign

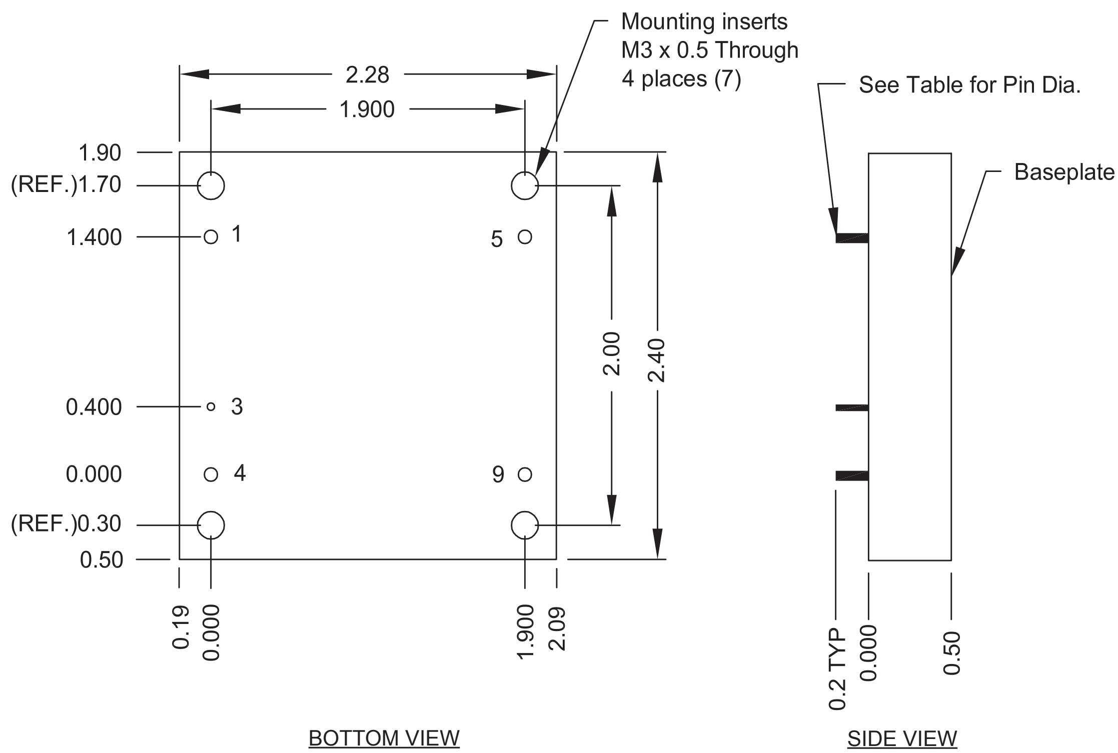
(8) Torque fasteners into threaded mounting inserts at 12 in.oz. or less. Greater torque may result in damage to the unit and void the warranty.

(9) Calex CBAM™ modules are designed to withstand most solder/wash processes. Careful attention should be used when assessing the applicability in your specific manufacturing process. The CBAM™ modules are not hermetically sealed.

(10) Available with RoHS and Non-RoHS construction, contact factory for details.
RoHS Compliance means conformity to EU Directive 2002/95/EC of 27 January 2003, on the restriction of the use of certain hazardous substances in electrical and electronic equipment, lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers are not present in quantities exceeding the following maximum concentrations in any homogeneous material, except for applicable exemptions.
0.1% (by weight of homogeneous material) lead, mercury, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers, or 0.01% (by weight of homogeneous material) cadmium.
The RoHS marking is as follows.



General Specifications			
Model		**PQ-28**	Units
Isolation			
Baseplate to pins (4)	MIN	700	VDC
Environmental			
Baseplate Operating Temperature Range (5)	MIN MAX	-40 +100	ºC
Storage Temperature Range	MIN MAX	-40 +120	ºC
Thermal Impedance (6)	TYP	7	ºC/Watt
MTBF MIL-HDBK-217F (7)	MIN	170,750	h
General			
Unit Weight	TYP	100	g
Case Dimension		2.28” x 2.4” x 0.50”	
Torque on Mounting Inserts (8)	MAX	12 in. oz.	



Pin	Function	Pin Dia.
1	-INPUT (COMMON)	0.080”
3	BASEPLATE	0.040”
4	+INPUT	0.080”
5	-OUTPUT (COMMON)	0.080”
9	+OUTPUT	0.080”

Mechanical tolerances unless otherwise noted:
X.XX dimensions ±0.020 inches
X.XXX dimensions ±0.005 inches

PQ-28 Application Section

Circuit Description

The PQ-28 consists of an Input filter to interface with MIL-STD-1275B. See Fig. 1. The next section of the circuit is a DC/DC converter with an integral output filter. For input voltages of 11V up to about 40V, the DC/DC follows the input voltage in a semi-regulated mode, where the output voltage will reduce as the output power is increased. At about 40V input and higher the output will be regulated to 36V nominal.

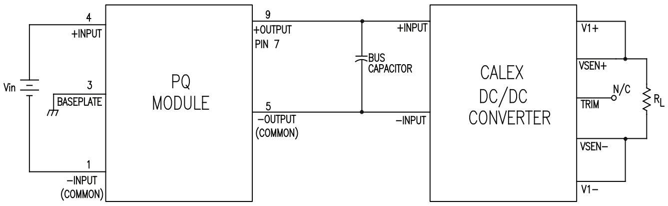


Figure 3. TYPICAL APPLICATION

A typical application, Figure 3. shows a PQ-28 driving a HEW DC/DC converter. A Bus Capacitor is required at the output of the PQ-28. Suggested types or equivalent as shown in the table.

Nippon Chemi-Con	100µF, 100V, ESR=0.15□, Aluminum Radial Thru Hole, EXLV101__101MK20S
NIC Components	100µF 100V, ESR=0.17□, Aluminum Surface Mount NACK101M100V16x17TR13F

Input Reverse Polarity Protection

Input Reverse Polarity Protection is achieved by the internal TVS diode which is part of the Input Filter (see Fig. 1, Block Diagram). If the Input is connected in the reverse polarity then the TVS diode provides a low impedance path to blow the external input fuse.

The fuse rating should be about 130% of the nominal running current. If the application has too wide an input current range, then the designer should consider using an external series diode to provide the Input Reverse Polarity Protection.

Derating

The output power derating graph is shown in Fig. 4. The full 200W ouput is available over the range of 20 to 75V input. The output in the dashed area is limited to a 10 second ON time at a 1% duty cycle. At the lower input voltages the power loss is due to copper loss, while at the higher input voltages the power loss is due to the switching losses. At 11V input the output is semi-regulated and reduces as the load is increased, see fig. 5 & 6. To have 200W output at 11V input requires a load of about 25A, and the output voltage will be drifting lower during the test as the internal components heat up.

Sufficient heatsinking is required to keep the baseplate below the 100ºC specification.

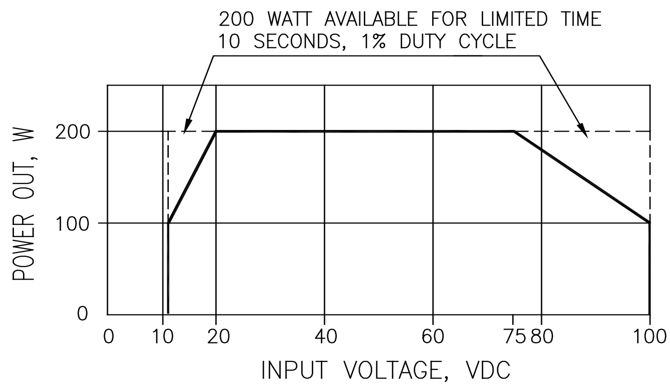


Figure 4. Derating Curve

Performance Data

Figs. 5, 6 & 7 show the output voltage for various input voltages and loads. Fig. 8 shows Efficiency vs. Input Voltage. Note that with 11V input to the PQ-28, it can handle an HEW with up to about a 75W output load. For higher power loads on the HEW, the PQ must have higher input voltages so that the input to the HEW does not drop below it's UVLO dropout of 9V.

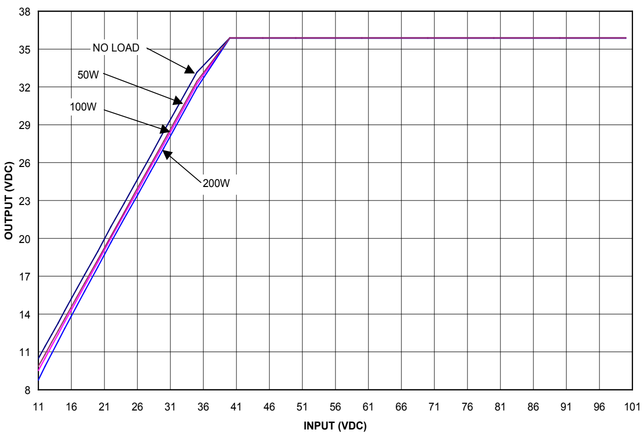


Figure 5. Output (V) vs Input Voltage (V)
11V to 100V Input for various power out levels

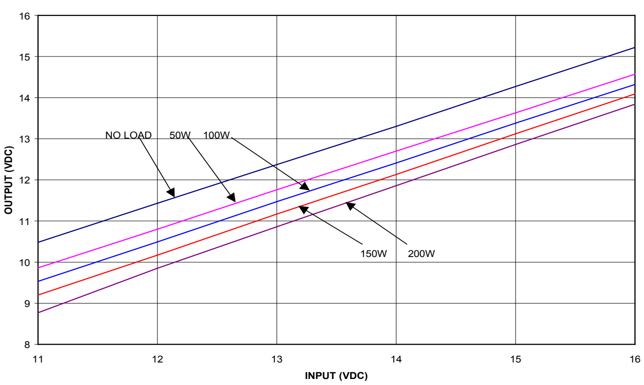


Figure 6. Output (V) vs Input Voltage (V)
11V to 16V Input for various power out levels

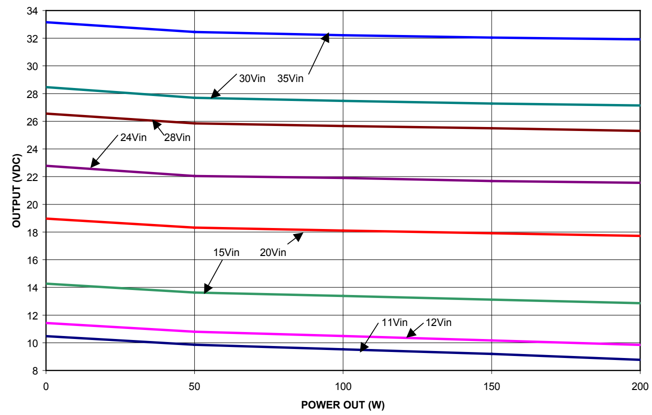


Figure 7. Output (V) vs Power (W)
over 11-35V input range

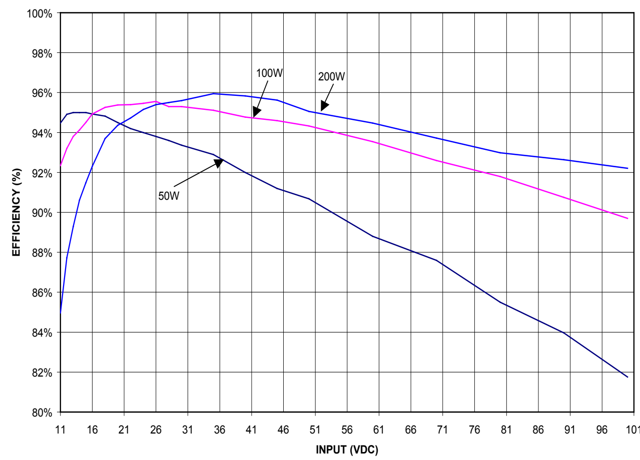


Figure 8. Efficiency (%) vs. Input (V) for various loads.

MIL-STD-1275B Testing

Testing to MIL-STD-1275B was done using non-certified Calex in-house designed and built testers. The test circuits provide stresses to the PQ-28 that are comparable to those indicated in the MIL-STD-1275B.

Spikes Imported Into EDUT

The PS MAIN power supply provides the steady state DC voltage to the PQ-28 input. The PS SPIKE power supply charges a 0.47μF capacitor to a selectable +250V or -250V, which stores the 15mJ energy required for the test. ±250V pulses are the Single Fault values. The capacitor is then switched onto the PQ-28 Input. The input circuit of the PQ-28 contains about 3.5μF of ceramic capacitors, which reduces the transferred voltage to about a 25V change at the PQ-28 Input. Figure 9 shows the Spike Test Setup.

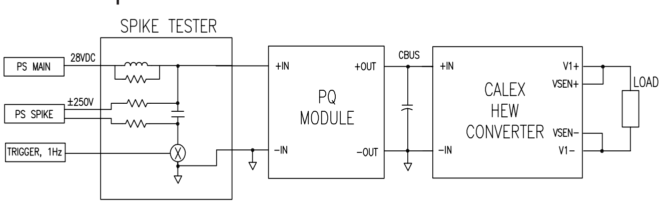


Figure 9. Spike Test Setup

28VDC Input, CBus=100μF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input   CH2: PQ Output
CH3: HEW Output

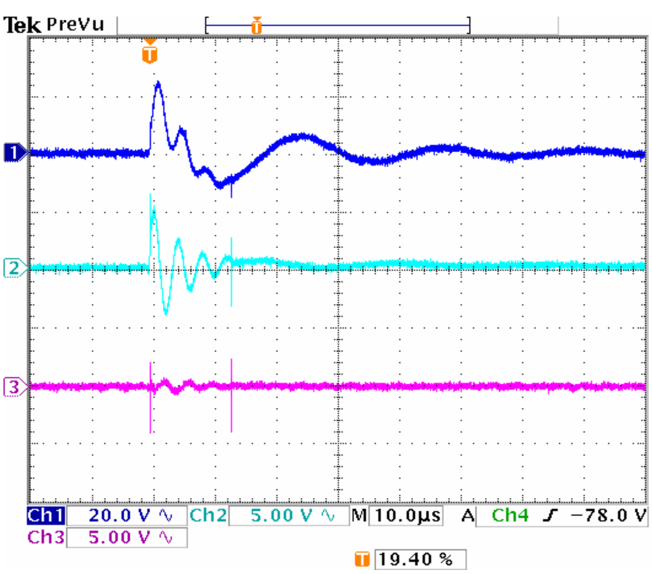


Figure 10. Positive 250V Spike

28VDC Input, CBus=100μF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input   CH2: PQ Output
CH3: HEW Output

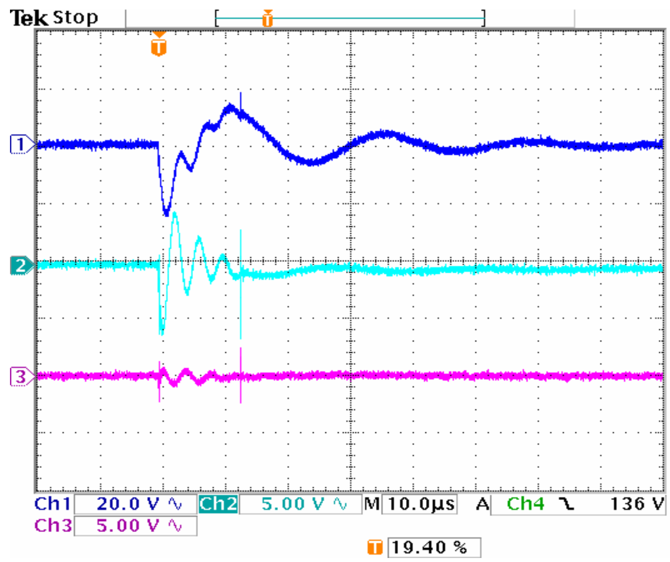


Figure 11. Negative 250V Spike

Voltage Surges Imported into EDUT

The MIL-STD-1275B calls for the input to surge up to +100V which is the Single Fault value. This will not harm the PQ-28 as it is rated for 100V input. Figure 12 shows the Surge Test Setup. The PS MAIN power supply supplies the normal 28VDC to the PQ-28 input. The PS Surge power supply is set to 100V and when the FET SWITCH is closed, the +IN of the PQ-28 will go to +100V. The diodes isolate the 2 power supplies.
Note that MIL-STD-1275B calls out for a 1ms rise or fall time. Significantly faster rises (shorter rise time) will cause the output of the PQ-28 to overshoot more than shown. The fall time of the Calex tester could no be reduced to less than the 3 1/2 ms shown.

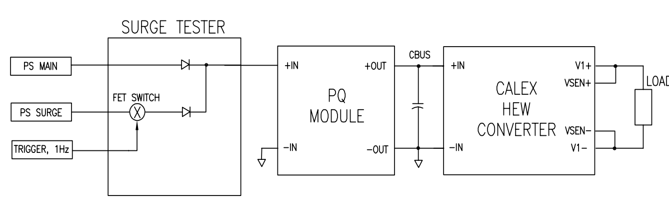


Figure 12. Surge Test Setup

28VDC Input, CBus=100µF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input CH2: PQ Output
CH3: HEW Output

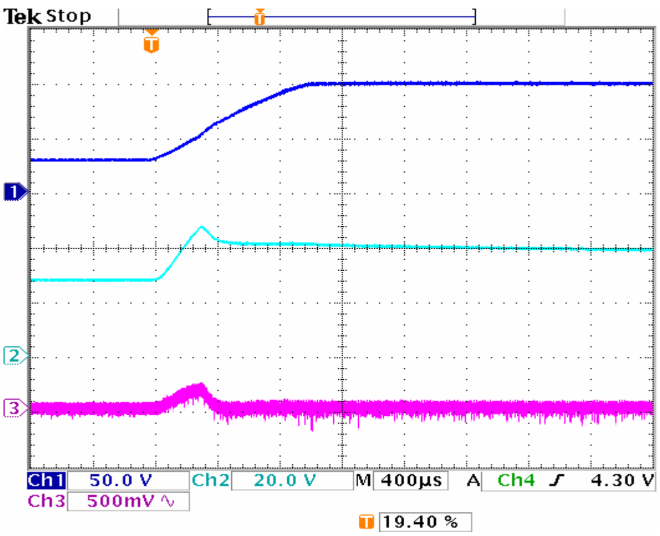


Figure 13. Positive slope input

28VDC Input, CBus=100µF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input CH2: PQ Output
CH3: HEW Output

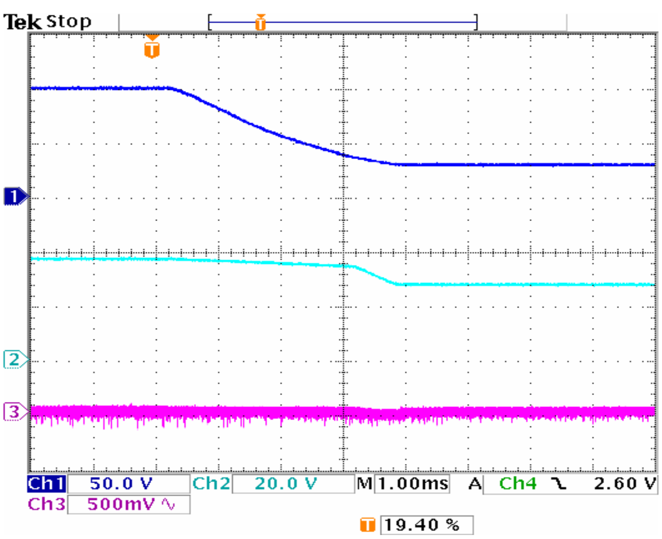


Figure 14. Negative slope input

Ripple Voltage Imported into EDUT

The MIL-STD-1275B single fault condition calls out for a ±7V signal over the frequency range of 50Hz to 200kHz to be superimposed onto the DC Input voltage. Several testing problems arise. At about 8-10kHz the input is a low impedance due to the series resonance of the internal inductor and output capacitors. At 200kHz the input is a low impedance due to the internal input capacitor array. The problem is to find a generator that can supply the current at the required voltage and frequency. The Calex tester could only produce a ±1.3V signal at the series resonance of 8-10kHz which resulted in a ±7A into the PQ-28 input. If a generator with a ±7V is available, it would have to be capable of supplying ±37A. Not a simple task.
At 200kHz the input of the PQ-28 is the internal capacitor array of 4.3µF which equates to 0.18□. This would require a generator with a ±38A capability at ±7V. The Calex tester could only produce a ±0.8V at the PQ-28 input.

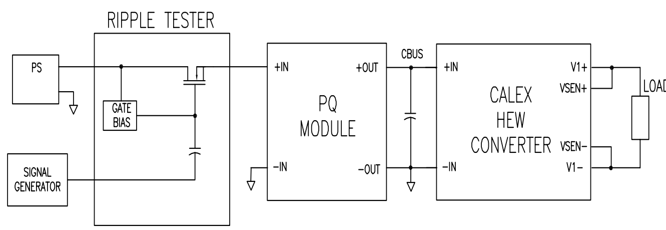


Figure 15. Ripple Tester Block Diagram

28VDC Input, CBus=100µF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input CH2: PQ Output
CH3: HEW Output

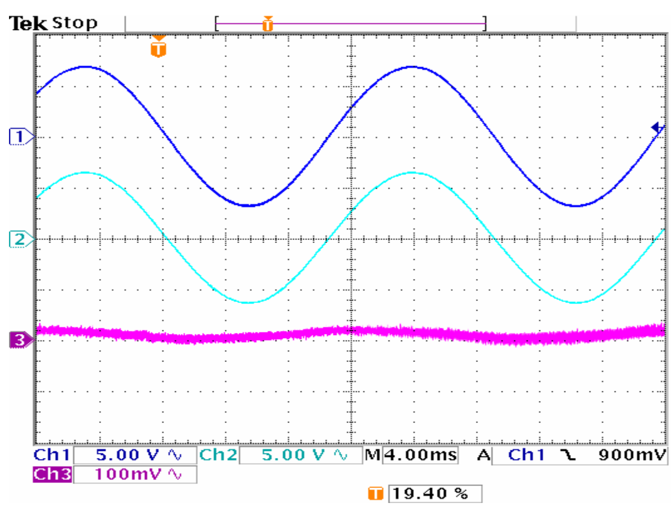


Figure 16. 50Hz Ripple Signal

28VDC Input, CBus=100µF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input CH2: PQ Output
CH3: HEW Output

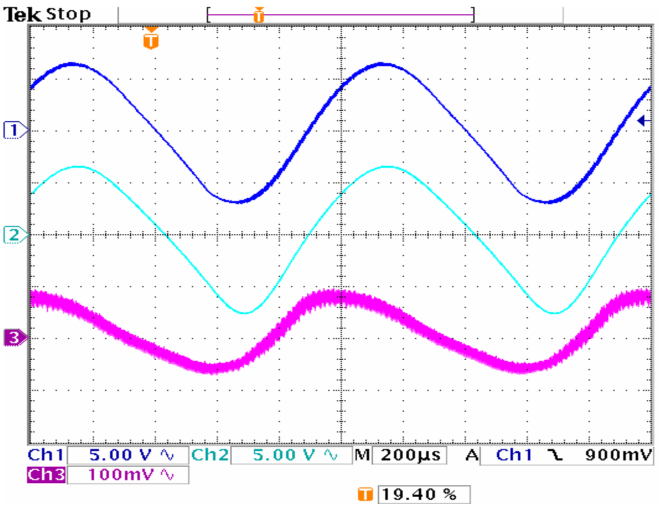


Figure 17. 1kHz Ripple Signal

28VDC Input, CBus=100µF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input CH2: PQ Output
CH3: HEW Output

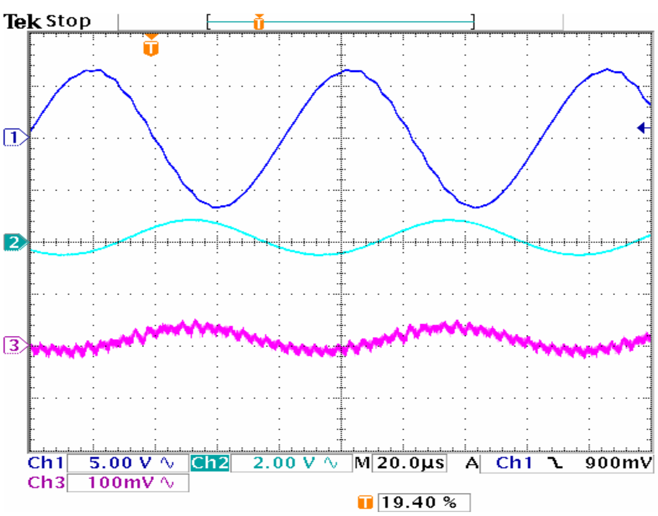


Figure 18. 12kHz Ripple Signal

28VDC Input, CBus=100µF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input CH2: PQ Output
CH3: HEW Output

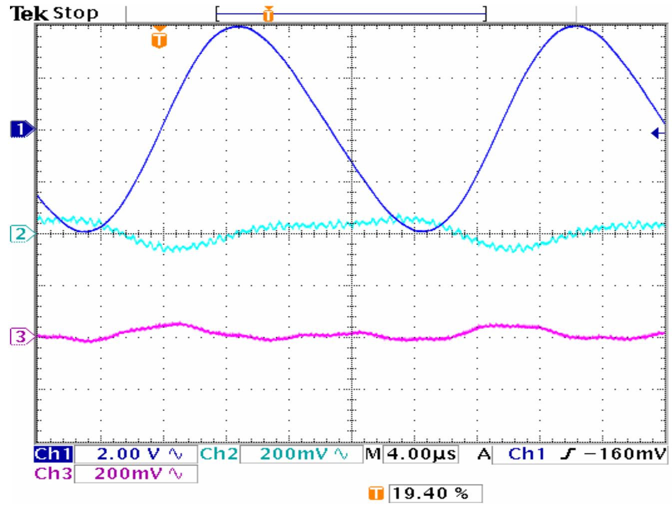


Figure 19. 48kHz Ripple Signal

28VDC Input, CBus=100µF, 24S12.12HEW
Output load = 8A.
CH1: PQ Input CH2: PQ Output
CH3: HEW Output

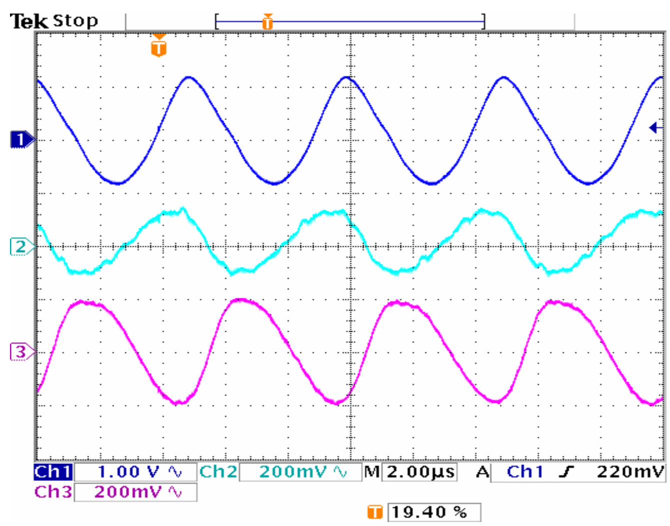


Figure 20. 200kHz Ripple Signal

Adding an EMI filter in to the PQ-28 Input.

The EFIL-28 is not designed to meet the requirements of MIL-STD-1275B. Consult the factory for information on adding an EMI Filter.