HBR Series of Railway Half-Brick

Up to 300 Watts DC-DC Converter

FEATURES

- Industry standard Half Brick Package
- 300 Watts of output power
- Up to 91 % Efficiency
- Fully Isolated to 3000 DCV
- Over Current, Voltage and Temperature Protection
- Ultra-Wide (Input range (43 - 160 Volts)
- Input Under-Voltage Lockout Protection (UVLO)
- Extended temperature range of -40°C to +100°C
- Remote On/Off logic control (Positive or Negative)
- Continuous Short Circuit Protection
- Ideal Solution for energy critical systems with only 10 mA of no load power consumption
- 5000 meters operating altitude
- Shock & Vibration Meet EN 50155 (EN 61373)
- Fire & Smoke meet EN45545-2
- Designed to meet CE 2004/108/EC, UL60950-1 2nd (Basic Insulation) and IEC60950-1

PRODUCT OVERVIEW

This HBR Railway series offers 300 watts of output power in standard half brick package. This series features high efficiency up to 91%, high power density and 3000 Volts of DC isolation. These converters are reliable and compact, with a single DC output voltage of 5, 12, 24, 28 and 48 volts. This HBR series can deliver up to 60A of output current and provide precise regulated output voltage over a wide input range of 43 to 160 volts. These modules operate over a wide case temperature range of –40°C to +100°C. These converters offer Input Under-Voltage Lockout Protection (UVLO). The main features of these converters include remote On/Off, remote sense, output voltage adjustment, over voltage, over current and over temperature protection.

APPLICATIONS:

- Railway Systems' 72, 92 and 110V nominal
- Distributed Power Architectures
- Telecommunication and Servers
- Mobile Equipment
- Military and industrial applications

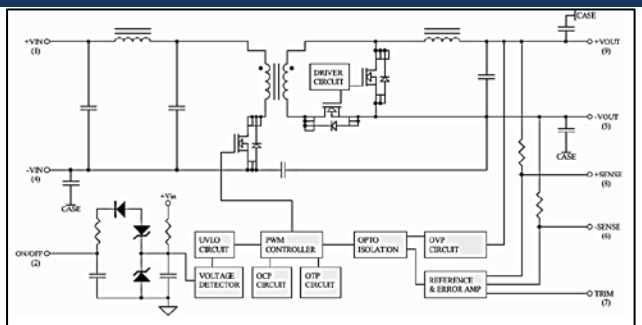
AVAILABLE OPTIONS

- Customizable Input/ Output voltages
- Heatsink, customizable packaging
- UL60950-1, EN50155

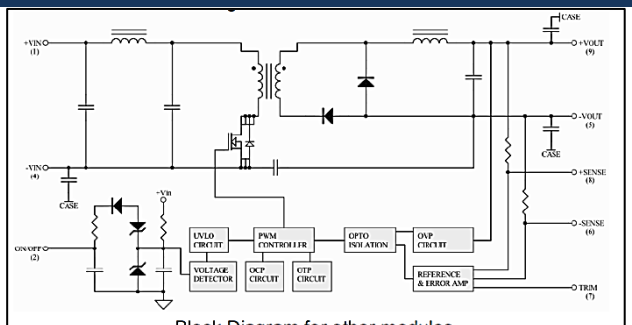
Contact DATEL for other series of Half-Brick footprint, Cost Saving, Lower Power, different input or output voltage, etc.

MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT MAX	EFFICIENCY %	LOAD REGULATION	OPTIONS
HBR106S5-60	43-160 VDC	5VDC	60 A	88	± 0.2 %	N, H, M
HBR106S12-25	43-160 VDC	12 VDC	25 A	90	± 0.2 %	N, H, M
HBR106S24-12.5	43-160 VDC	24 VDC	12.5 A	89	± 0.2 %	N, H, M
HBR106S28-10.7	43-160 VDC	24 VDC	10.7 A	89	± 0.2 %	N, H, M
HBR106S48-6.25	43-160 VDC	28 VDC	6.25 A	91	± 0.2 %	N, H, M

BLOCK DIAGRAM



Block Diagram for 5Vout and 12Vout



Block Diagram for other modules

OUTPUT CHARACTERISTICS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Output Voltage Ripple and Noise (5Hz to 20MHz bandwidth)						
Peak-to-Peak	Full load, 5V:47uF T521 KO CAP <55mR and 1uF ceramic capacitor Other: 10uF aluminum solid and 1uF Ceramic capacitor	Vo=5V Vo=12V Vo=24V Vo=28V Vo=48V			120 150 240 280 480	mV
RMS	Full load, 10µF solid tantalum and 1.0µF ceramic capacitors.	Vo=5V Vo=12V Vo=24V Vo=28V Vo=48V			60 80 120 140 220	mV
Operating Output Current Range		Vo=5V Vo=12V Vo=24V Vo=28V Vo=48V	0 0 0 0 0		60 25 12.5 10.7 6.25	A
Output DC Current Limit Inception	Vo = 90% Nominal Output Voltage	All	110	125	160	%
Maximum Output Capacitance	Full load (resistive)	Vo=5V Vo=12V Vo=24V Vo=28V Vo=48V	0 0 0 0 0		60000 25000 12500 10700 4700	µF

DYNAMIC CHARACTERISTICS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Output Voltage Current Transient						
Step Change in Output Current	75% to 100% of I_{o_max} d_i/d_t=0.1A/us	All			±5	%
Setting Time (within 1% Vout nominal)		All			250	µs
Turn-On Delay and Rise Time						
Turn-On Delay Time, From On/Off control	$V_{on/off}$ to 10%V_{o_set}	All		20		ms
Turn-On Delay Time, From Input	$V_{in\ min}$ to 10%V_{o_set}	All		20		ms
Output Voltage Rise Time	10%V_{o_set} to 90%V_{o_set}	All		15		ms

EFFICIENCY

PARAMETER	CONDITIONS	Device	Min.	Typical	Max.	Units
Full Load	Vin=110V	Vo=5V Vo=12V Vo=24V Vo=28V Vo=48V		88 90 89 89 91		%

ISOLATION CHARACTERISTICS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Isolation Voltage	1minute; input/output, DC	All			3000	Volts
	1 minute; input/case, DC	All			3000	
	1 minute; output/case, AC	All			500	

Isolation Resistance		All	100			MΩ
Isolation Capacitance	input/output	All		3000		pF
	input/case	All		3000		
	output/case	All		20000		

FEATURE CHARACTERISTICS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Switching Frequency		All	270	300	330	KHz
On/Off Control, Positive Remote On/Off logic						
Logic Low (Module Off)	$V_{on/off}$ at $I_{on/off}$=1.0mA	All			1.2	V
Logic High (Module On)	$V_{on/off}$ at $I_{on/off}$=0.0uA	All	3.5 or Open Circuit		160	V
On/Off Control, Negative Remote On/Off logic, refer to –Vin Pin						
Logic Low (Module On)	Von/off at Ion/off=1.0mA	All			1.2	V
Logic High (Module Off)	Von/off at Ion/off=0.0uA	All	3.5 or Open Circuit		160	V
On/Off Current for both remote on/off logic	$I_{on/off}$ at $V_{on/off}$=0.0V	All		0.3	1	mA
Leakage Current for both remote on/off logic	Logic High, $V_{on/off}$=15V	All			30	μA
Off Converter Input Current	Shutdown input idle current	All		3	5	mA
Over Temperature recovery		All		110		°C
Over-Temperature Shutdown		All		100		°C

GENERAL SPECIFICATIONS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
MTBF	I_o=100% of $I_{o\ max}$; T_a=25°C per MIL-HDBK-217F	Vo=48V All		900 600		K hours
Weight		All		114		grams
Case Material	Plastic, DAP					
Baseplate Material	Aluminum					
Pin Material	Base: Copper, Plating: Nickel with Matte Tin					
Potting Material	UL 94V-0					
Shock/Vibration	MIL-STD-810 / EN61373					
Humidity	95% RH max. Non-condensing					
Thermal Shock	MIL-STD-810F					
Fire & Smaoke	Meets EN45545-2					
EMI	Meets EN50155(EN50121-3-2) with external input filter					
ESD	Meet EN61000-4-2 Air ±8000V Perf. Criteria A					
	Meet EN61000-4-2 Contact ±6KV Perf. Criteria A					
Radiated Immunity	Meet EN61000-4-3 20V/m Perf. Criteria A					
Fast Transient	Meet EN61000-4-4 ±2KV Perf. Criteria A					
Surge	Meet EN61000-4-5 ±1KV Perf. Criteria B					
Conducted Immunity	Meet EN61000-4-6 10Vr.m.s Perf. Criteria A					
Interruptions of voltage Supply	EN50155 Class S2：10ms Interruptions					
Supply Change Over	EN50155 Class C2：During a supply break of 30 ms					

Operating Temperature Range

This HBR series of converters is rated to operate over a wide case temperature range of -40°C to +100°C. Consideration must be given to the de-rating curves when ascertaining maximum power that can be drawn from the converter. The maximum power drawn from half brick models is influenced by usual factors, such as:

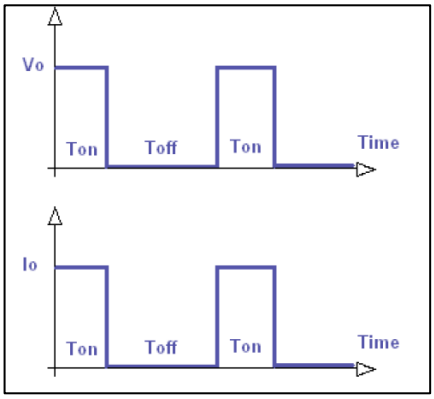
- Input voltage range
- Output load current
- Forced air or natural convection

Output Voltage Adjustment

The output voltage for the on HBR series is adjustable within the range of +10% to –10%.

Over Current Protection

All models have internal over current and continuous short circuit protection. The unit operates normally once the fault condition is removed. At the point of current limit inception, the converter will go into hiccup mode protection.



Output over Voltage Protection

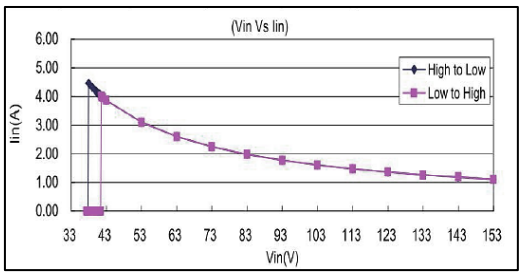
The output over voltage protection consists of circuitry that internally limits the output voltage. If more accurate output over voltage protection is required then an external circuit can be used via the remote on/off pin. Note: Please note that device inside the power supply might fail when voltage more than rate output voltage is applied to output pin. This could happen when the customer tests the over voltage protection of unit.

Remote On/Off

The On/Off input pin permits the user to turn the power module on or off via a system signal. Two remote on/off options are available. Positive logic turns the module on during a logic high voltage on the On/Off pin, and off during a logic low. The On/Off pin is internally pulled up through a resistor. A properly de-bounced mechanical switch, open collector transistor, or FET can be used to drive the input of the On/Off pin. If not using the remote on/off feature, leave the On/Off pin open. Models with part number suffix "N" are the "negative logic" remote on/off version. The unit turns off if the remote on/off pin is high (>3.5Vdc or open circuit). The converter turns on if the on/off pin input is low (<1.8Vdc). Note that the converter is off by default.

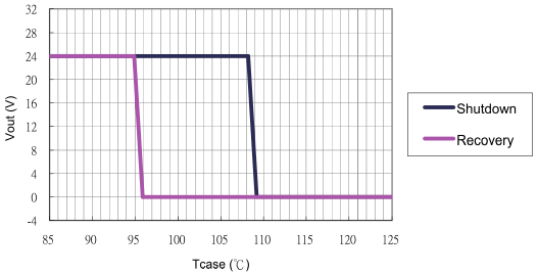
UVLO (Under Voltage Lock Out)

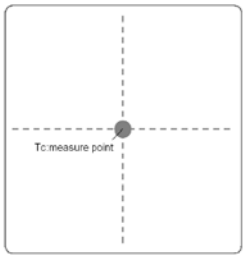
Input under voltage lockout is standard with this converter. The unit will shut down when the input voltage drops below a threshold, and the unit will operate when the input voltage goes above the upper threshold.



Over Temperature Protection

These modules have an over temperature protection circuit to safeguard against thermal damage. Shutdown occurs with the maximum case reference temperature is exceeded. The module will restart when the case temperature falls below over temperature recovery threshold. Please measure case temperature of the center part of aluminum baseplate.



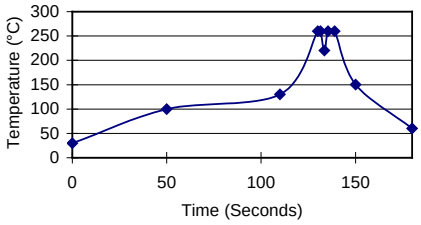


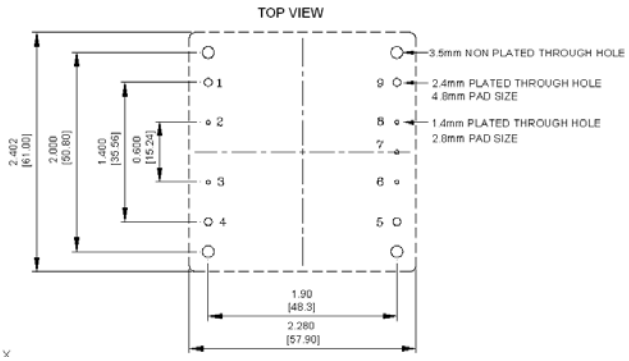
Recommended Layout, PCB Footprint and Soldering Information

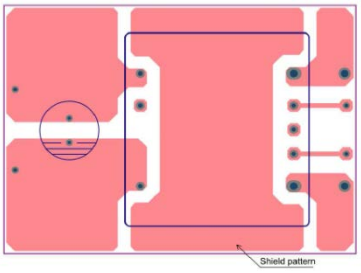
The user must ensure that other components and metal in the vicinity of the converter meet the spacing requirements to which the system is approved. Low resistance and low inductance PCB layout should be used where possible. Proper attention must also be given to low impedance tracks between power module, input and output grounds. The recommended footprints and soldering profiles are shown in the next two figures.

Clean the soldered side of the module with a brush, prevent liquid from getting into the module. Do not clean by soaking the module into liquid. Do not allow solvent to come in contact with product labels or resin case as this may change the color of the resin case or cause deletion of the letters printed on the product label. After cleaning, dry the modules well. The suggested soldering iron is 450℃ for up to 5seconds(less than 50W). Furthermore, the recommended soldering profile and PCB layout are shown below.

Lead Free Wave Soldering Profile





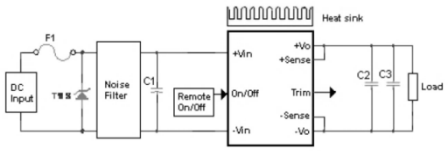


Convection Requirements for Cooling

To predict the approximate cooling needed for the half brick module, refer to the power de-rating curves in the next section These de-rating curves are approximations of the ambient temperatures and airflows required to keep the power module temperature below its maximum rating. Once the module is assembled in the actual system, the module's temperature should be monitored to ensure it does not exceed 100°C as being measured at the center of the top of the case (thus verifying proper cooling).

Connection for standard use

The connection for standard use is shown below. An external input capacitor (C1) 220uF for all models is recommended to reduce input ripple voltage. External output capacitors (C2, C3) are recommended to reduce output ripple and noise, 5Vout with 47uF T521 KO CAP. <55mR and 1uF ceramic capacitor, other modes with 10uF aluminum solid and 1uF ceramic capacitor.

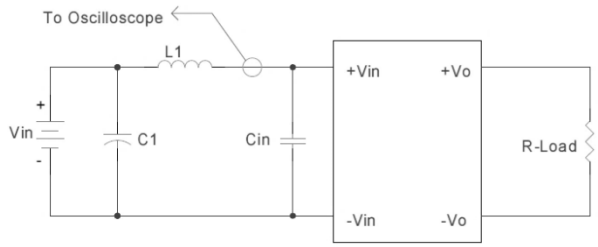


Symbol	Component
F1,TVS	Input fuse,TVS
C1	External capacitor on input side
C2,C3	External capacitor on the output side
Noise Filter	External input noise filter
Remote On/Off	External Remote On/Off control
Trim	External output voltage adjustment
Heat sink	External heat sink
+Sense/-Sense	--

Note: If the impedance of input line is high, C1 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20 ℃.

Input Capacitance at the Power Module

The converters must be connected to low AC source impedance. To avoid problems with loop stability source inductance should be low. Also, the input capacitors (Cin) should be placed close to the converter input pins to decouple distribution inductance. However, the external input capacitors are chosen for suitable ripple handling capability. Low ESR capacitors are good choice. Circuit as shown as below represents typical measurement methods for reflected ripple current. C1 and L1 simulate a typical DC source impedance. The input reflected-ripple current is measured by current probe to oscilloscope with a simulated source Inductance (L1).



L1: 12uH
C1: 220uF ESR<0.14ohm @100KHz
Cin: 220uF ESR<0.14ohm @100KHz

Thermal Considerations

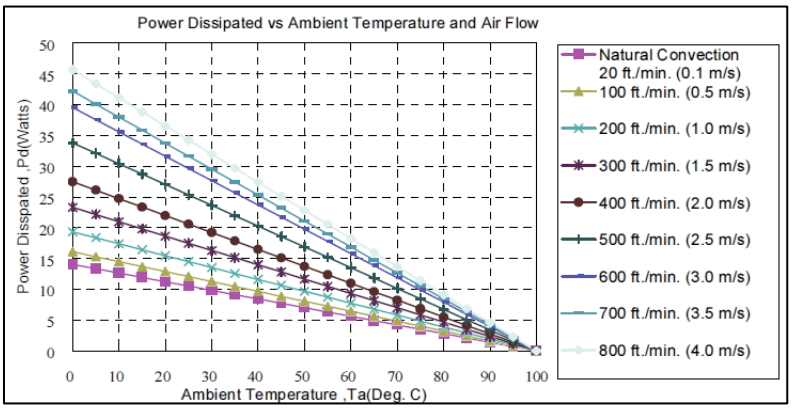
The power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. The test data is presented in the next section. The power output of the module should not be allowed to exceed rated power (Vo_set x Io_max).

Power De-rating

The operating case temperature range of HBR series is -40°C to +100°C. When operating the HBR series, proper de-rating or cooling is needed. The maximum case temperature under any operating condition should not exceed + 100°C.

AIR FLOW RATE	TYPICAL Rca

The following curve is the de-rating curve of HBR series without heat sink.



Natural Convection 20ft./min. (0.1m/s)	7.12 °C/W
100 ft./min. (0.5m/s)	6.21 °C/W
200 ft./min. (1.0m/s)	5.17 °C/W
300 ft./min. (1.5m/s)	4.29 °C/W
400 ft./min. (2.0m/s)	3.64 °C/W
500 ft./min. (2.5m/s)	2.96 °C/W
600 ft./min. (2.5m/s)	2.53 °C/W
700 ft./min. (2.5m/s)	2.37 °C/W
800 ft./min. (2.5m/s)	2.19 °C/W

Example (without heat sink):

What is the minimum airflow necessary for a HBR106S24-12.5 operating at nominal line voltage, an output current of 12.5A, and a maximum ambient temperature of 15°C?

Solution:

Given: Vin=110Vdc, Vo=24Vdc, Io=12.5A

Determine Power dissipation (Pd):
Pd =Pi-Po=Po(1- η)/ η
Pd =24V×12.5A×(1-0.89)/0.89=37.08Watts

Determine airflow:
Given: Pd =37.08W and Ta=15°C

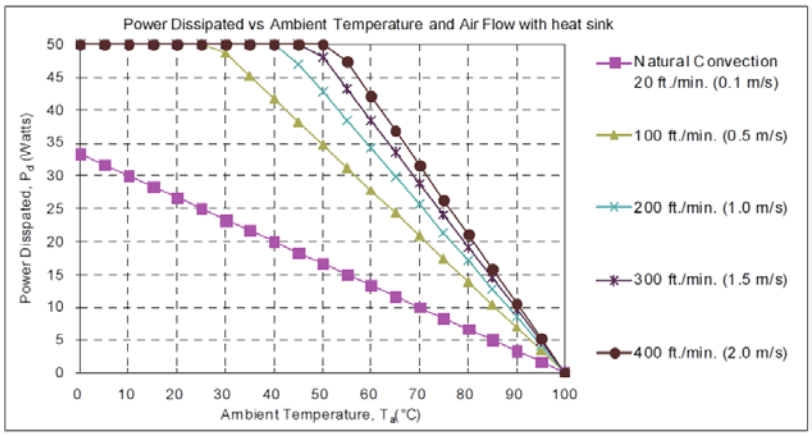
Check Power Derating curve:
Minimum airflow= 800 ft./min.
Verify:

Maximum temperature rise is
$\triangle$T = Pd × Rca=37.08W×2.19=81.2°C.

Maximum case temperature is
Tc=Ta+$\triangle$T=96.2°C <100°C.

Where:
The Rca is thermal resistance from case to ambient environment.
Ta is ambient temperature and Tc is case temperature.

The following curve is the de-rating curve of HBR series with heat sink



AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	3 ℃/W
100 ft./min. (0.5m/s)	1.44 ℃/W
200 ft./min. (1.0m/s)	1.17 ℃/W
300 ft./min. (1.5m/s)	1.04 ℃/W
400 ft./min. (2.0m/s)	0.95 ℃/W

Example (with heat sink M-C092):

What is the minimum airflow necessary for a HBR106S24-12.5 operating at nominal line voltage, an output current of 12.5A, and a maximum ambient temperature of 45℃?

Solution:

Given:
Vin=110Vdc, Vo=24Vdc, Io=12.5A

Determine Power dissipation (Pd):
Pd=Pi-Po=Po(1- η)/ η
Pd=24×12.5×(1-0.89)/0.89=37.08Watts

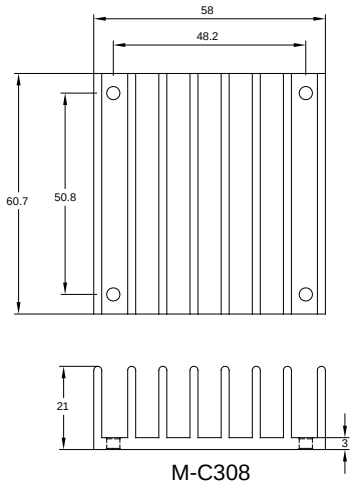
Determine airflow:
Given: Pd=37.08W and Ta=45℃

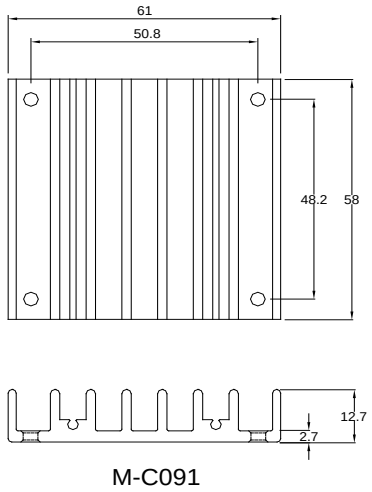
Check above Power de-rating curve:
Minimum Airflow = 100 ft/min

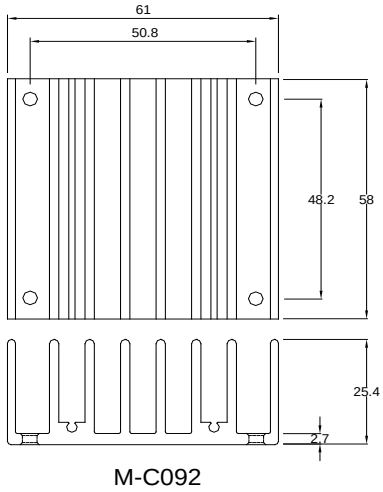
Verify:
Maximum temperature rise is
△T = Pd × Rca=37.08×1.44= 53.40℃
Maximum case temperature is
Tc=Ta+△T=98.40℃ <100℃

Where:
The Rca is thermal resistance from case to ambient environment.
Ta is ambient temperature and Tc is case temperature.

Half Brick Heat Sinks:







M-C308 (G6620400201)
Longitudinal Heat Sink

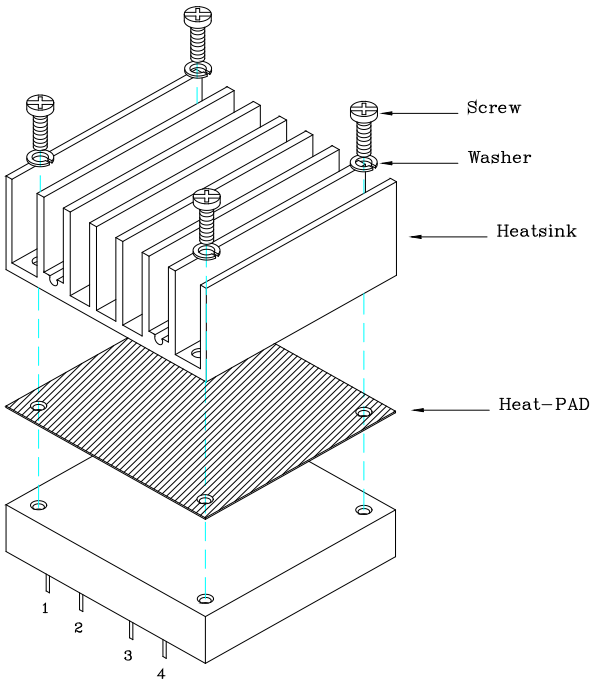
Rca:
3.90°C/W (typ.), natural convection
1.74°C/W (typ.), at 100LFM
1.33°C/W (typ.), at 200LFM
1.12°C/W (typ.), at 300LFM
0.97°C/W (typ.), at 400LFM

M-C091 (G6610120402)
Transverse Heat Sink

Rca:
4.70°C/W (typ.), natural convection
2.89°C/W (typ.), at 100LFM
2.30°C/W (typ.), at 200LFM
1.88°C/W (typ.), at 300LFM
1.59°C/W (typ.), at 400LFM

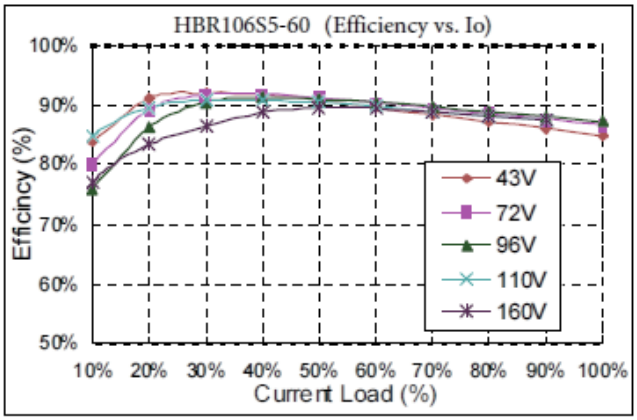
M-C092 (G6610130402)
Transverse Heat Sink

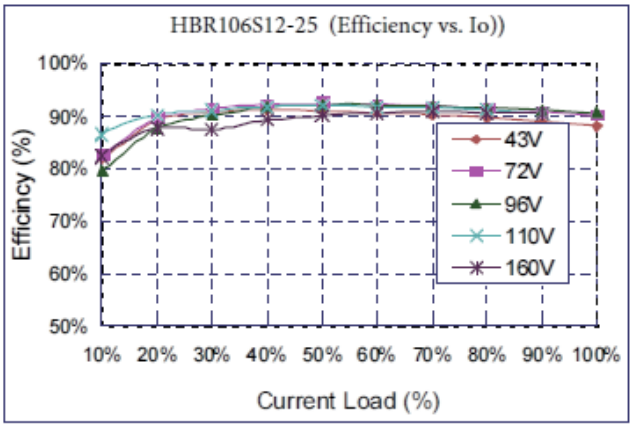
Rca:
3.00°C/W (typ.), natural convection
1.44°C/W (typ.), at 100LFM
1.17°C/W (typ.), at 200LFM
1.04°C/W (typ.), at 300LFM
0.95°C/W (typ.), at 400LFM

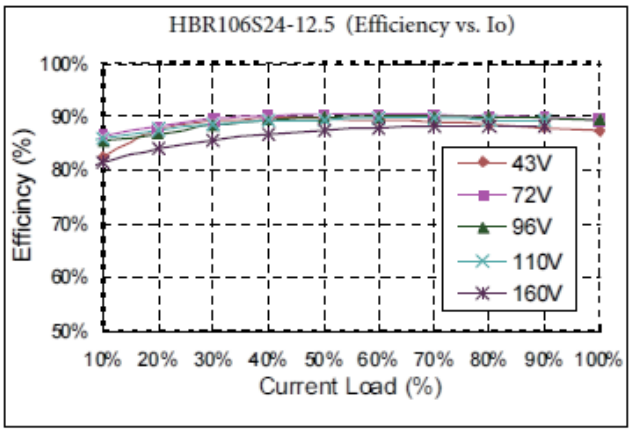


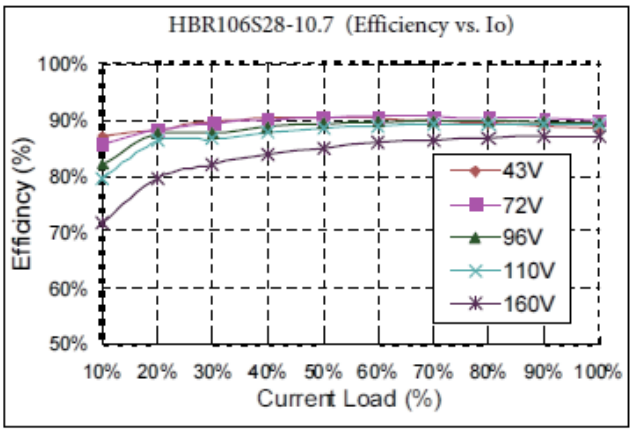
THERMAL PAD: SZ 56.9*60*0.25 mm (G6135041091)
SCREW: SMP+SW M3*8L
(G75A1300322)

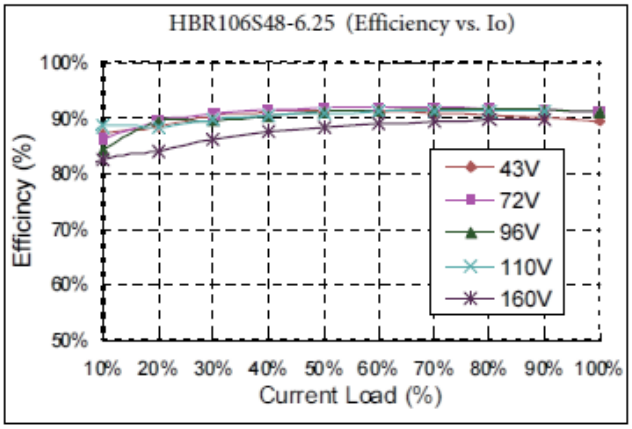
EFFICIENCY vs. LOAD











Test Set-Up

The basic test set-up to measure efficiency, load regulation, line regulation and other parameters is shown in the next figure. When testing the converter under any transient conditions, the user should ensure that the transient response of the source is sufficient to power the equipment under test. Below is the calculation of:

1- Efficiency
2- Load regulation
3- Line regulation

The value of efficiency is defined as:

$$\eta = \frac{Vo \times Io}{Vin \times Iin} \times 100\%$$

Where:

V_o is output voltage,
I_o is output current,
V_{in} is input voltage,
I_{in} is input current.

The value of load regulation is defined as:

$$Load.reg = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

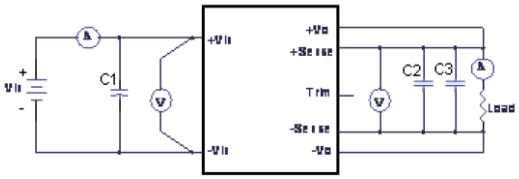
Where:

V_{FL} is the output voltage at full load
V_{NL} is the output voltage at no load

The value of line regulation is defined as:

$$Line.reg = \frac{V_{HL} - V_{LL}}{V_{LL}} \times 100\%$$

Where: V_{HL} is the output voltage of maximum input voltage at full load. V_{LL} is the output voltage of minimum input voltage at full load.

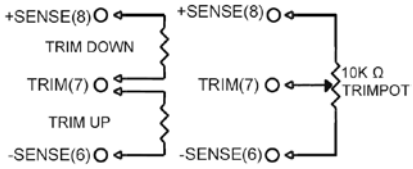


HBR Series Test Setup

C1: 220uF/200V ESR<0.14Ω
C2: 1uF/ 1210 ceramic capacitor
C3: 10uF aluminum solid capacitor for other models.
47uF T521 KO CAP. <55mR for 5Vout

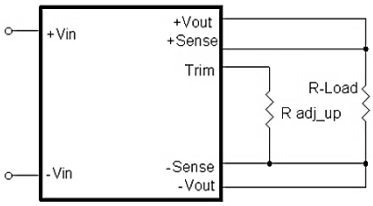
Output Voltage Adjustment

Output may be externally trimmed (±10%) with a fixed resistor or an external trim-pot as shown (optional). Model specific formulas for calculating trim resistors are available upon request as a separate document

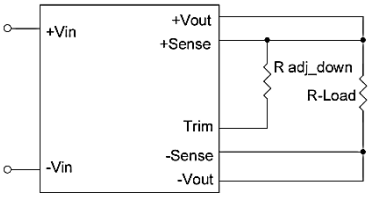


Output voltage trim circuit configuration

In order to trim the voltage up or down, one needs to connect the trim resistor either between the trim pin and -Vo for trim-up or between trim pin and +Vo for trim-down. The output voltage trim range is ±10%. This is shown in the figure below



Output voltage trim up circuit



Output voltage trim down circuit

The recommend Resistor Values:

V_{out} (V)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	VR (KΩ)	Vf (KΩ)
5	2.32	3.3	0	2.5	0
12	9.1	51	5.1	2.5	0.46
24	20	130	6.2	2.5	0.46
28	23.7	150	6.2	2.5	0.46
48	36	270	5.1	2.5	0.46

For HBR series, R trim_up is defined as:

$$R_{trim_up} = \left(\frac{R_1\left(V_r - V_f\left(\frac{R_2}{R_2+R_3}\right)\right)}{V_O - V_{o_nom}}\right) - \frac{R_2 R_3}{R_2+R_3} \ (\mathrm{K\Omega})$$

Where:

1- R trim_up is the external resistor in KΩ.
2- Vo_nom is the nominal output voltage.
3- Vo is the desired output voltage.
4- R1, R2, R3 and Vr are internal components.

For example: to trim-up the output voltage of the HBR106S12-25 module by 5% to 12.6V, R trim_up is calculated as follows:
Vo – V o_nom = 12.6 – 12 = 0.6V
R1 = 9.1 KΩ, R2 = 51 KΩ, R3 = 5.1KΩ, Vr= 2.5 V , Vf=0.46 V

$$R_{trim_up} = \frac{18.944}{0.6} - 4.636 = 26.94\ (\mathrm{K\Omega})$$

On the other hand, R trim_down is defined as:

$$R_{trim_down} = \frac{R_1 \times (V_o - V_r)}{V_{o_nom} - V_o} - R_2 \ (\mathrm{K\Omega})$$

Where:

1- R trim_down is the external resistor in KΩ.
2- V o_nom is the nominal output voltage
3- Vo is the desired output voltage.
4- R1, R2, R3 and Vr are internal components.

For example: to trim-down the output voltage of the HBR113S12-12.5 module by 5% to 11.4V, R trim_down is calculated as follows:
Vo_nom – V o = 12 – 11.4 = 0.6 V

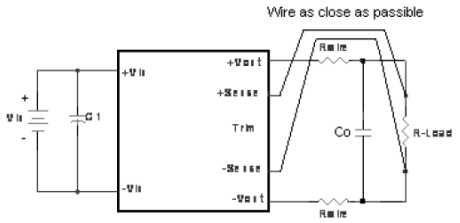
R1 = 9.1 KΩ, R2 = 51 KΩ, Vr = 2.5 V

$$R_{trim_down} = \frac{9.1 \times (11.4 - 2.5)}{0.6} - 51 = 83.98\ (\mathrm{K\Omega})$$

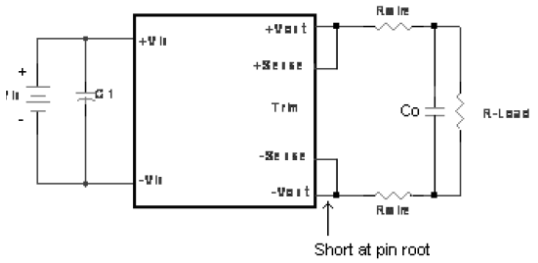
Output Remote Sensing

The HBR SERIES converter has the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the HBR series in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load. The remote-sense voltage range is:

$[(+V_{out}) - (-V_{out})] - [(+\text{Sense}) - (-\text{Sense})] \leqq 10\%$ of $V_{o_nominal}$
If the remote sense feature is not to be used, the sense pins should be connected locally. The +Sense pin should be connected to the +Vout pin at the module and the -Sense pin should be connected to the -Vout pin at the module. This is shown in the schematic below:

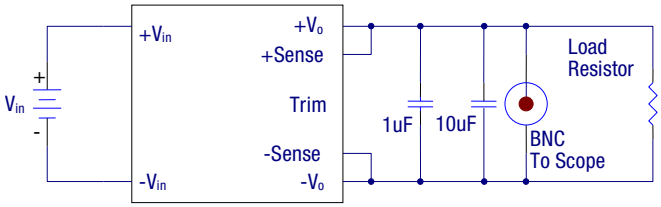


If the remote sense feature is not to be used, the sense pins should be connected locally. The +Sense pin should be connected to the +Vout pin at the module and the -Sense pin should be connected to the -Vout pin at the module. Wire between +Sense and +Vout and between -Sense and –Vout as short as possible. Loop wiring should be avoided. The converter might become unstable by noise coming from poor wiring. This is shown in the schematic below.



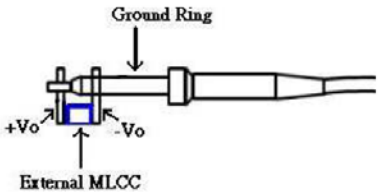
Note: Although the output voltage can be increased by both the remote sense and by the trim, the maximum increase for the output voltage is not the sum of both. The maximum increase is the larger of either the remote sense or the trim. The amount of power delivered by the module is defined as the voltage at the output terminals multiplied by the output current. When using remote sense and trim, the output voltage of the module can be increased and consequently increase the power output of the module if output current remains unchanged. Care should be taken to ensure that the maximum output power of the module remains at or below the maximum rated power (Maximum rated power = $V_{o,set}$ x $I_{o,max}$)

Output Ripple and Noise



Output ripple and noise measured with 47uF T521 KO CAP. <55mR capacitor and 1uF ceramic capacitor across output for 5Vout and 10uF aluminum solid and 1uF ceramic capacitor for other models. A 20 MHz bandwidth oscilloscope is normally used for the measurement. The conventional ground clip on an oscilloscope probe should never be used in this kind of measurement. This clip, when placed in a field of radiated high frequency energy, acts as an antenna or inductive pickup loop, creating an extraneous voltage that is not part of the output noise of the converter.

Another method is shown in below, in case of coaxialcable/BNC is not available. The noise pickup is eliminated by pressing scope probe ground ring directly against the -Vout terminal while the tip contacts the +Vout terminal. This makes the shortest possible connection across the output terminals.

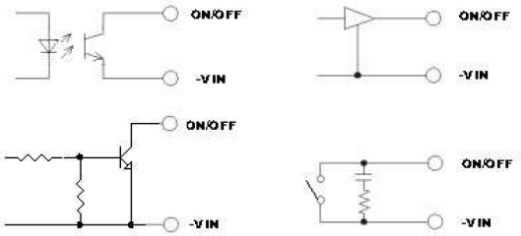


Output Capacitance

For good transient response, low ESR output capacitors should be located close to the point of load. PCB design emphasizes low resistance and inductance tracks in consideration of high current applications. Output capacitors with their associated ESR values have an impact on loop stability and bandwidth. For absolute maximum value of HBR series' output capacitance, please refer to page 3 Maximum Output Capacitance. For values larger than this, please contact your local DATEL's representative.

Remote On/Off circuit

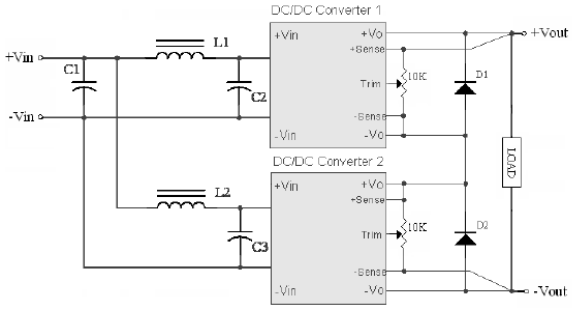
The converter remote On/Off circuit built-in on input side. The ground pin of input side Remote On/Off circuit is –Vin pin. Refer to 5.6 for more details. Connection examples see below.



Remote On/Off Connection Example

Series operation

Series operation is possible by connecting the outputs two or more units. Connection is shown in below. The output current in series connection should be lower than the lowest rate current in each power module.

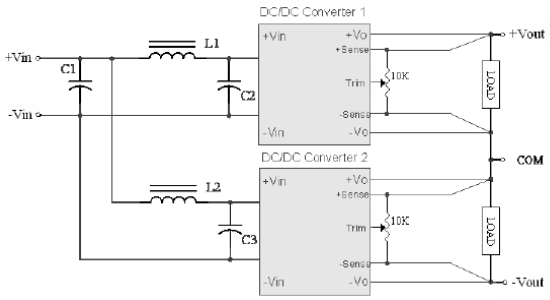


Simple Series Operation Connect Circuit

L1, L2: 1.0uH
C1, C2, C3: 220uF/200V ESR<0.140Ω

Note:
1. If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20 ℃.
2. Recommend Schottky diode (D1, D2) be connected across the output of each series connected converter, so that if one converter shuts down for any reason, then the output stage won't be thermally overstressed. Without this external diode, the output stage of the shut-down converter could carry the load current provided by the other series converters, with its MOSFETs conducting through the body diodes. The MOSFETs could then be overstressed and fail. The external diode should be capable of handling the full load current for as long as the application is expected to run with any unit shut down.

Series for ±output operation is possible by connecting the outputs two units, as shown in the schematic below.



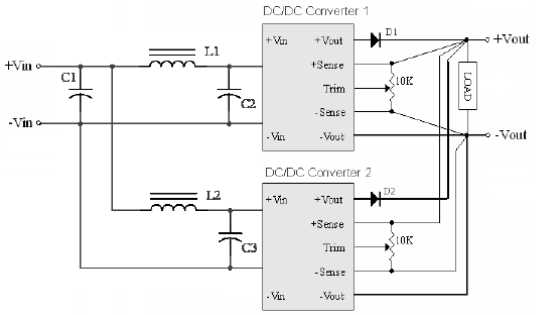
Simple ±Output Operation Connect Circuit

L1, L2:1.0uH
C1, C2, C3:220uF/200V ESR<0.140Ω

Note: If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20 ℃

Parallel / Redundant operation

The CHB300W-110S series parallel operation is not possible. Parallel for redundancy operation is possible by connecting the units as shown in the schematic below. The current of each converter become unbalance by a slight difference of the output voltage. Make sure that the output voltage of units of equal value and the output current from each power supply does not exceed the rate current. Suggest use an external potentiometer to adjust output voltage from each power supply.

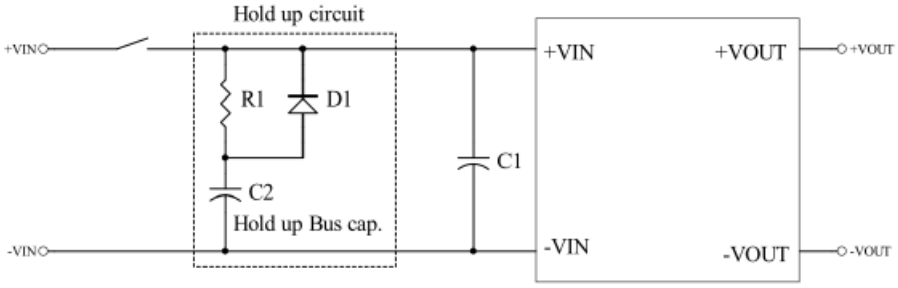


Simple Redundant Operation Connect Circuit

L1, L2: 1.0uH
C1, C2, C3: 220uF/200V ESR<0.140Ω
Note: If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20 ℃

Hold up Time

Hold up time is defined as the duration of time that DC/DC converter output will remain active following a loss of input power. To meet power supply interruptions, an external circuit is required, shown below.



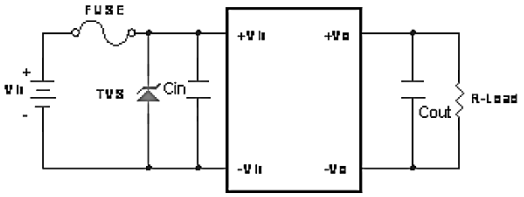
D1:200V/10A
R1:100Ω/10W
C1:220uF/200V ESR<0.140Ω

C2	72Vin	96Vin	110Vin
Hold up time for 10ms	2700uF	1000uF	700uF
Hold up time for 30ms	8000uF	3400uF	2400uF

SAFETY and EMC

Input Fusing and Safety Considerations

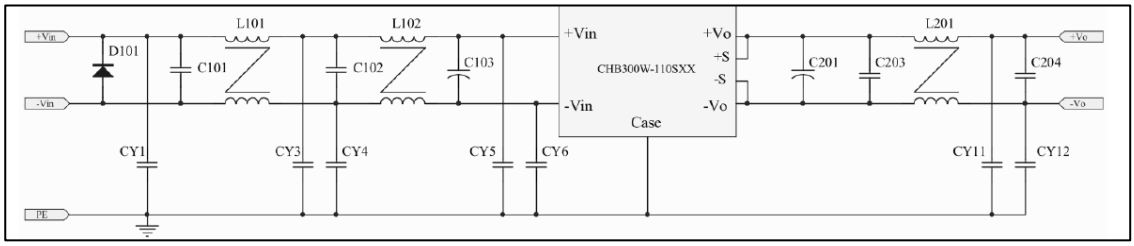
This HBR series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 10A time delay fuse. It is recommended that the circuit have a transient voltage suppressor diode (TVS) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage as shown below:



EMC Considerations

EMI Test standard: EN50121-3-2:2015 Conducted & Radiated Emission. Test Condition: Input Voltage: 110Vdc, Output Load: Full Load

(1) EMI meet EN50121-3-2:2015:



Connection circuit for EMI testing

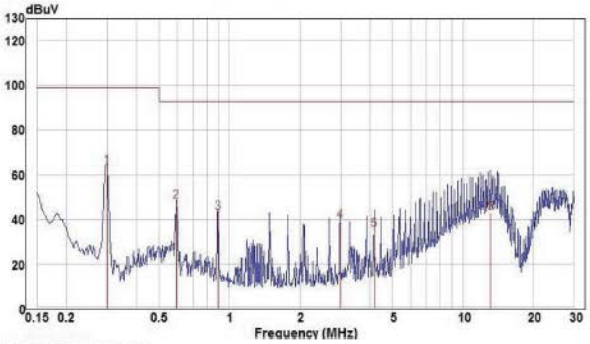
Model Number	HBR106S5-60	HBR106S12-25	HBR106S24-12.5	HBR106S28-10.7	HBR106S48-6.25
C101/C102	1uF/250V X7R 1812	1uF/250V X7R 812	1uF/250V X7R 1812	1uF/250V X7R 1812	1uF/250V X7R 1812
C103	220uF/200V Aluminum cap. YXF series	220uF/200V Aluminum cap. YXF series	220uF/200V Aluminum cap. YXF series	220uF/200V Aluminum cap. YXF series	220uF/200V Aluminum cap. YXF series
C201	47uF/20V Polymer tantalum cap	10uF/50V X5R 1210	10uF/50V X5R 1210	10uF/50V X5R 1210	47uF/20V Polymer tantalum cap
C203/C204	1uF/100V X7R 1206	1uF/100V X7R 1206	1uF/100V X7R 1206	1uF/100V X7R 1206	1uF/100V X7R 1206
CY1	NC	NC	1000pF/Y2	NC	NC
CY3	220pF/Y2	220pF/Y2	220pF/Y2	220pF/Y2	220pF/Y2
CY4	4700pF/Y2	4700pF/Y2	4700pF/Y2	4700pF/Y2	4700pF/Y2
CY5	2200pF/Y2	2200pF/Y2	2200pF/Y2	2200pF/Y2	2200pF/Y2
CY6/CY11/CY12	1000pF/Y2	1000pF/Y2	1000pF/Y2	1000pF/Y2	1000pF/Y2
D101	1.5KE180A Littelfuse	1.5KE180A Littelfuse	1.5KE180A Littelfuse	1.5KE180A Littelfuse	1.5KE180A Littelfuse
L101/L102	ACME A10 T25*15*15C 3.5mH, ϕ 1.0mm*1/16T	ACME A10 T25*15*15C 3.5mH, ϕ 1.0mm*1/16T	ACME A10 T25*15*15C 3.5mH, ϕ 1.0mm*1/16T	ACME A10 T25*15*15C 3.5mH, ϕ 1.0mm*1/16T	ACME A10 T25*15*15C 3.5mH, ϕ 1.0mm*1/16T
L201	FERROXCUBE T29/19/15-3E6 0.17mH, ϕ 1.0mm*4/4T	FERROXCUBE T29/19/15-3E6 0.17mH, ϕ 1.0mm*4/4T	FERROXCUBE T29/19/15-3E6 0.17mH, ϕ 1.0mm*4/4T	FERROXCUBE T29/19/15-3E6 0.17mH, ϕ 1.0mm*4/4T	FERROXCUBE T29/19/15-3E6 0.17mH, ϕ 1.0mm*4/4T

C103 is RUBYCON YXF series aluminum capacitors or equivalent, CYxx is MURATA Y2 capacitor or equivalentr

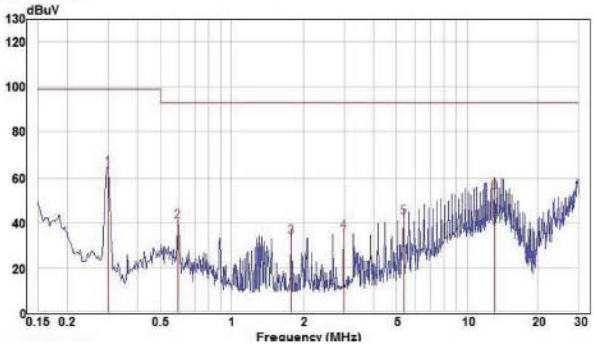
CONCUCTED EMISSION (Input)

HBR106S5-60

Line

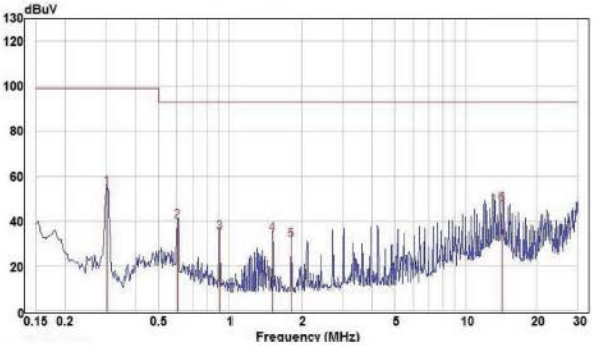


Neutral

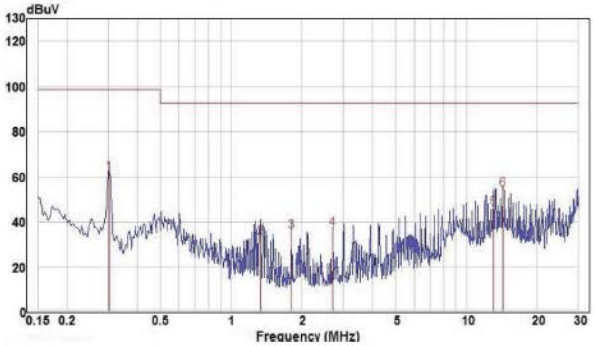


HBR106S12-25

Line

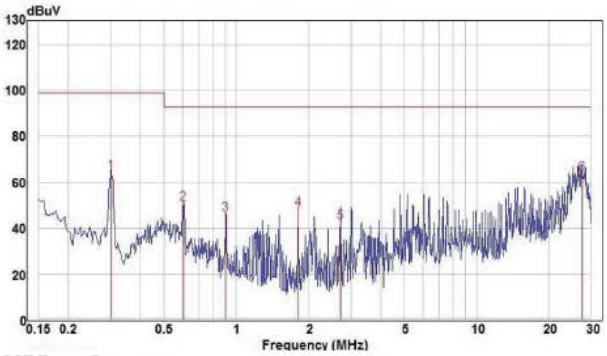


Neutral

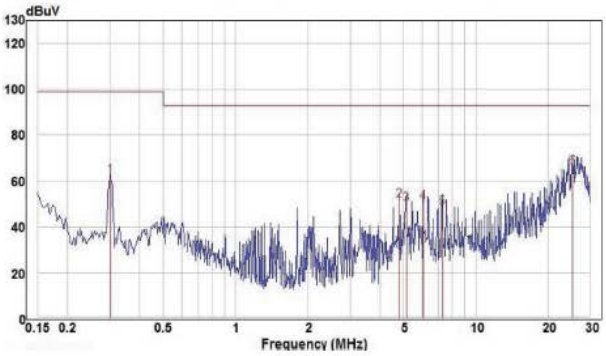


HBR106S24-12.5

Line

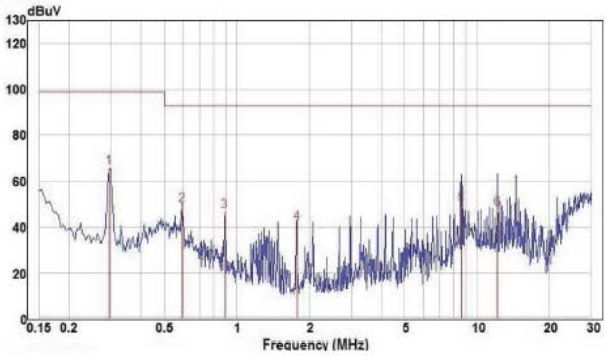


Neutral

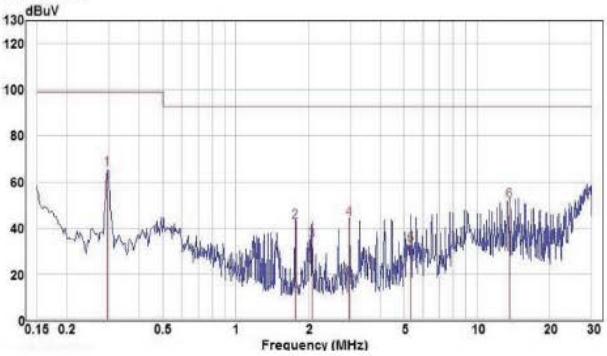


HBR106S28-10.7

Line

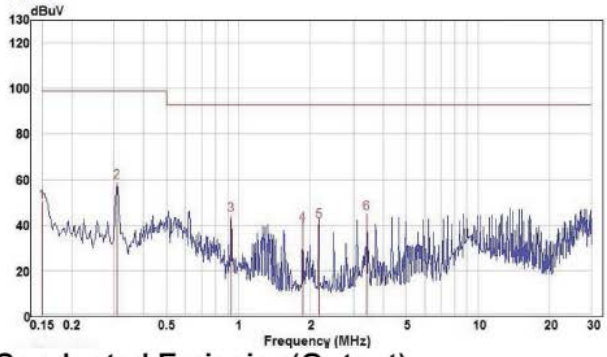


Neutral

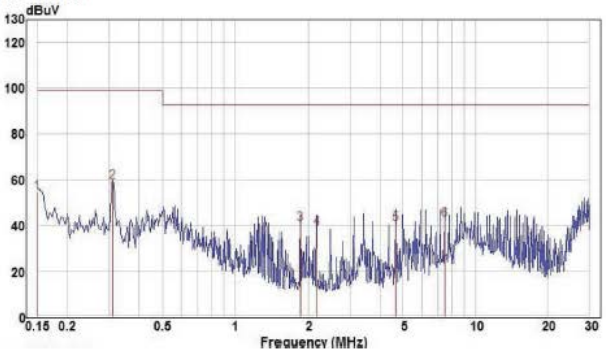


HBR106S48-6.25

Line



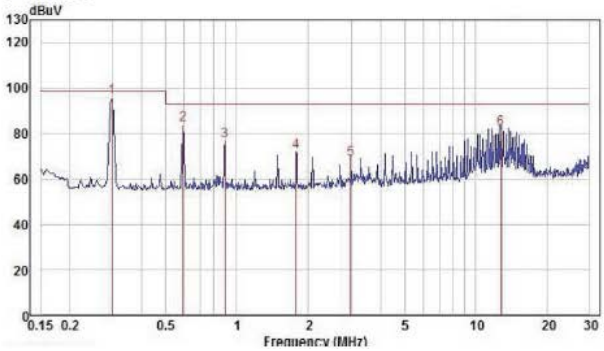
Neutral



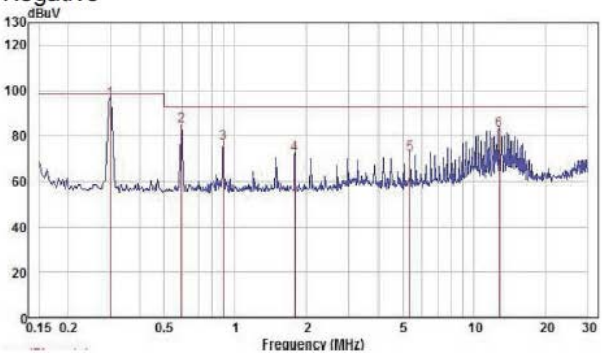
Conducted Emission(Output):

HBR106S5-60

Positive



Negative



HBR106S12-25

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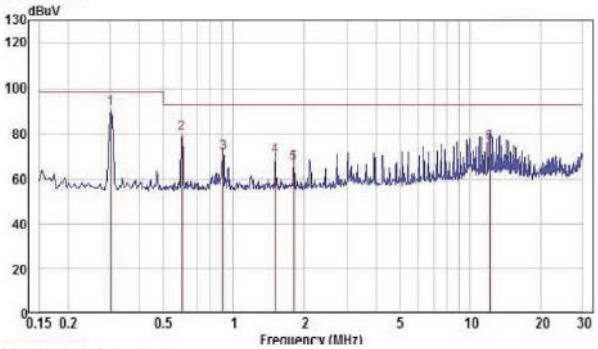

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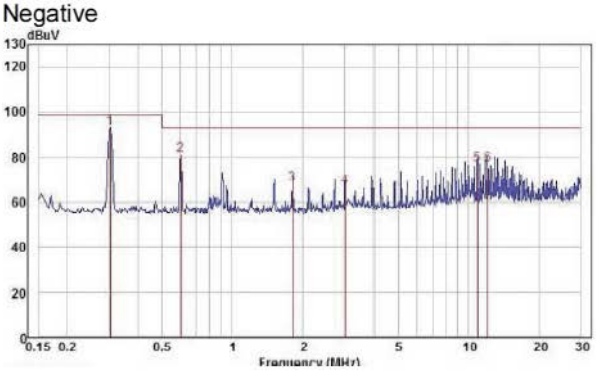

HBR106S24-12.5

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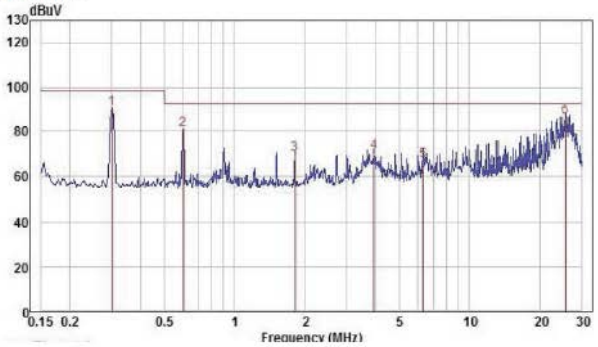

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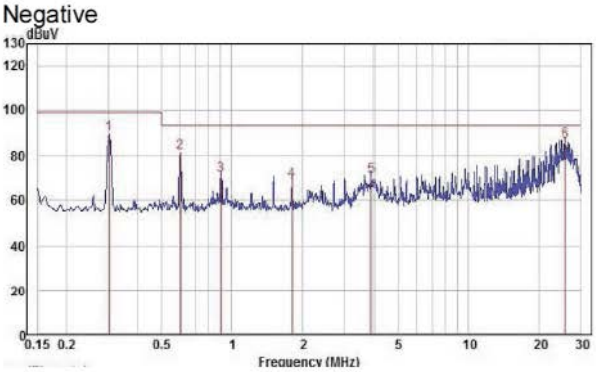

HBR106S28-10.7

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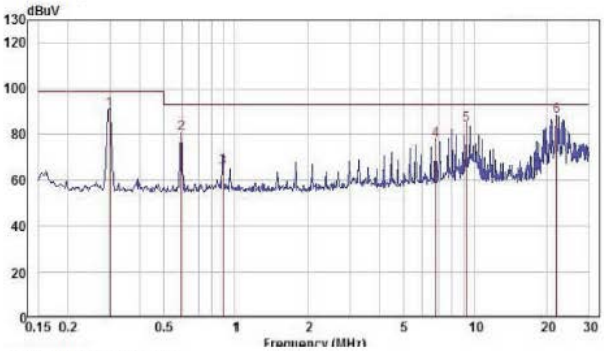

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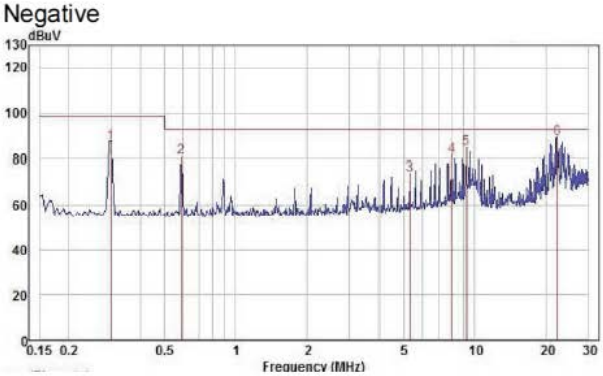
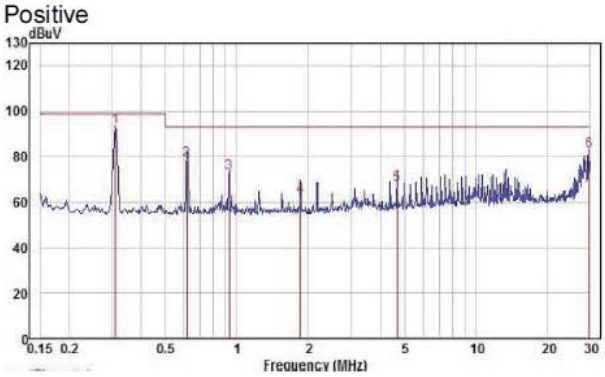


HBR106S48-6.25

Positive



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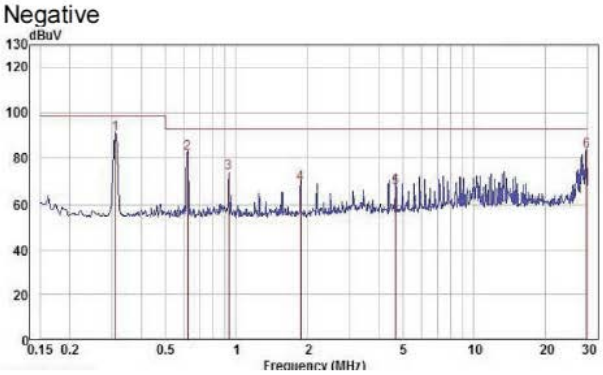
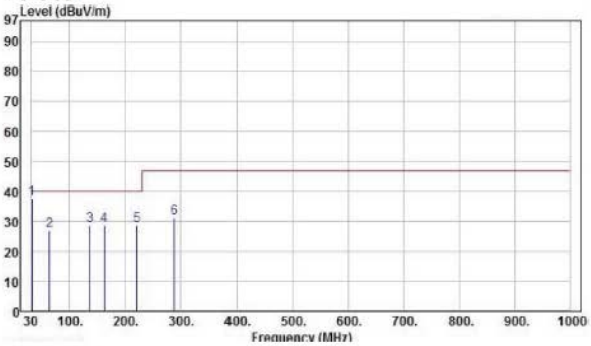


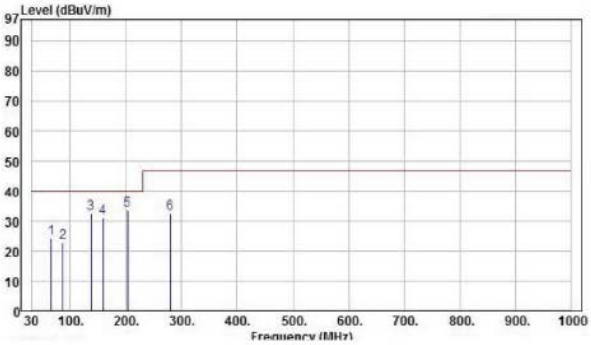
Radiated Emission:

HBR106S5-60

Vertical

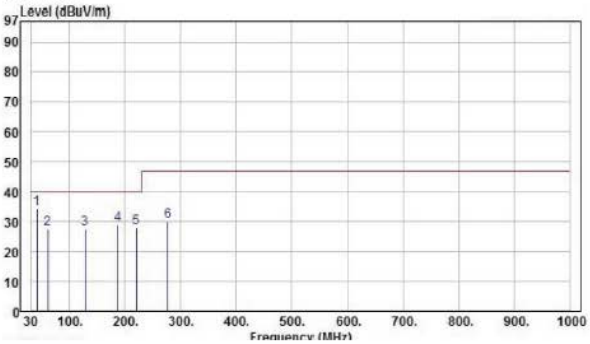


Horizontal

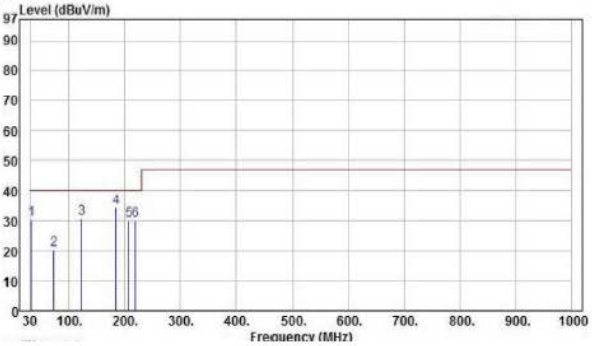


HBR106S12-25

Vertical

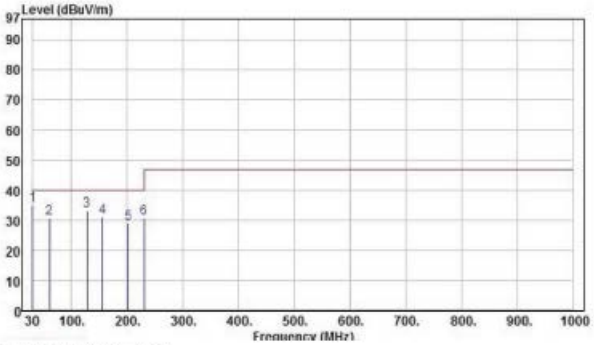


Horizontal



HBR106S24-12.5

Vertical



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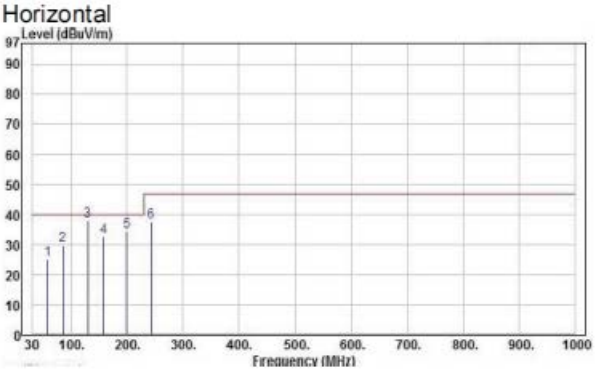
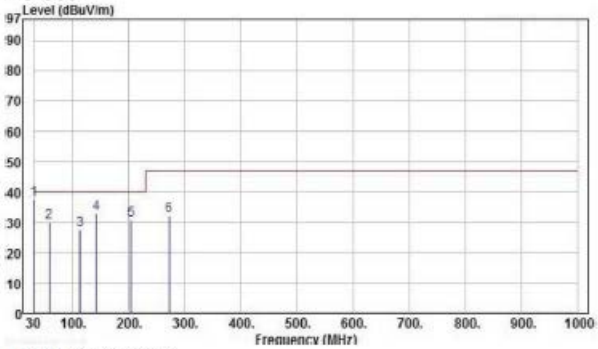


HBR106S28-10.7

Vertical



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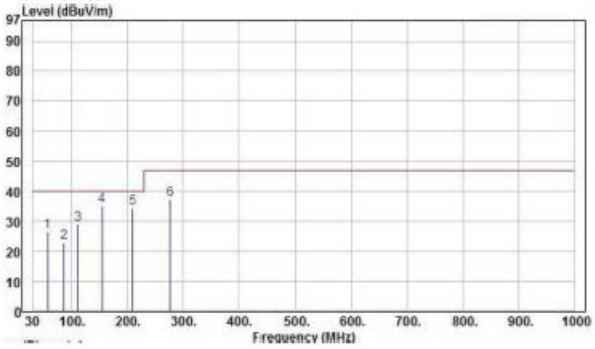
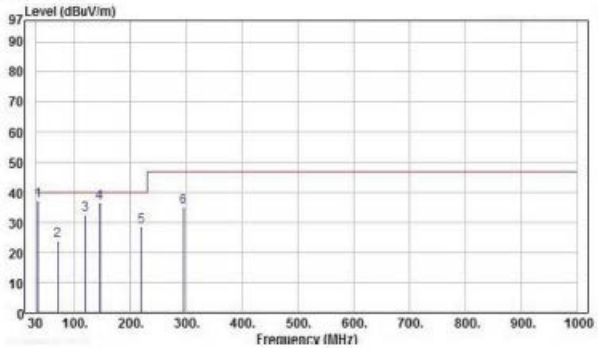
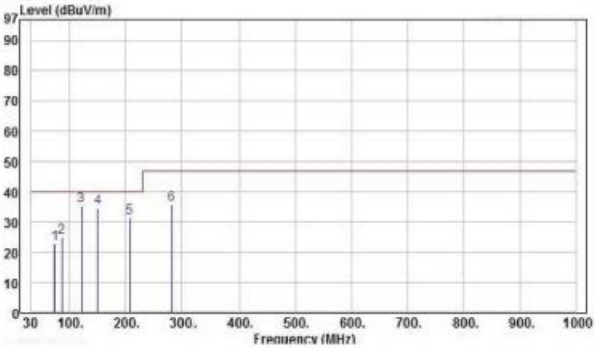


HBR106S48-6.25

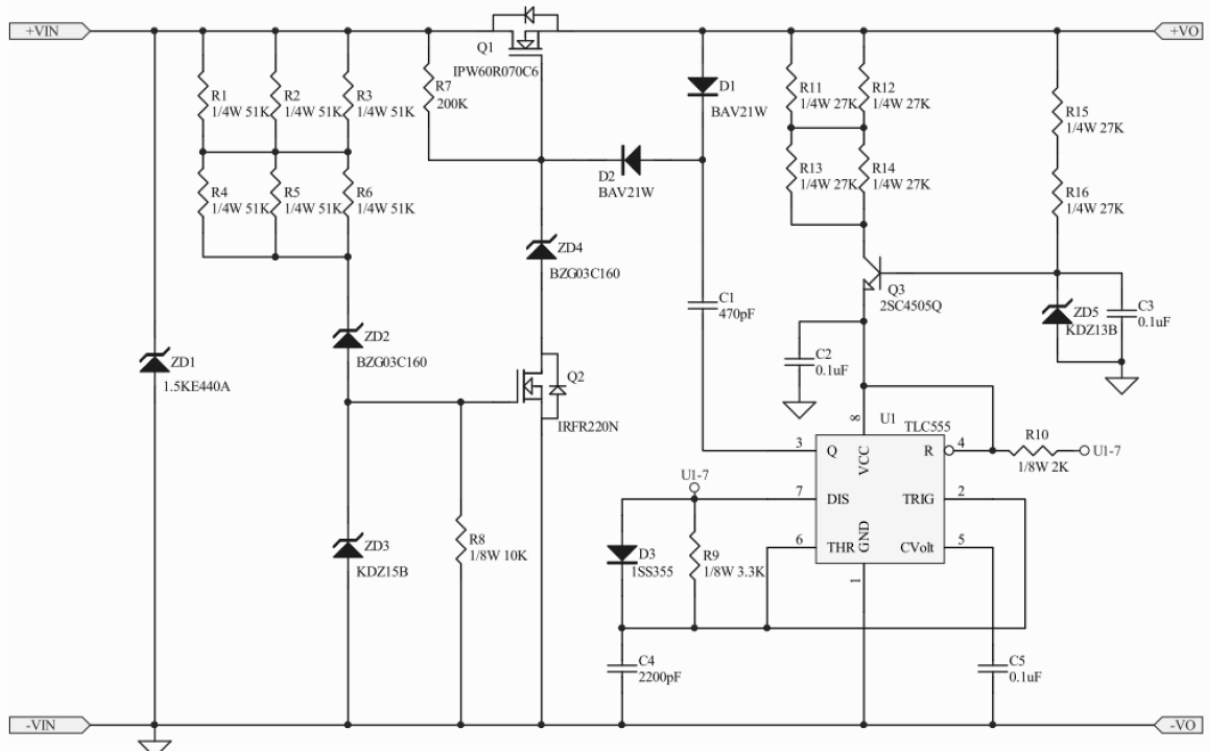
Vertical



Horizontal

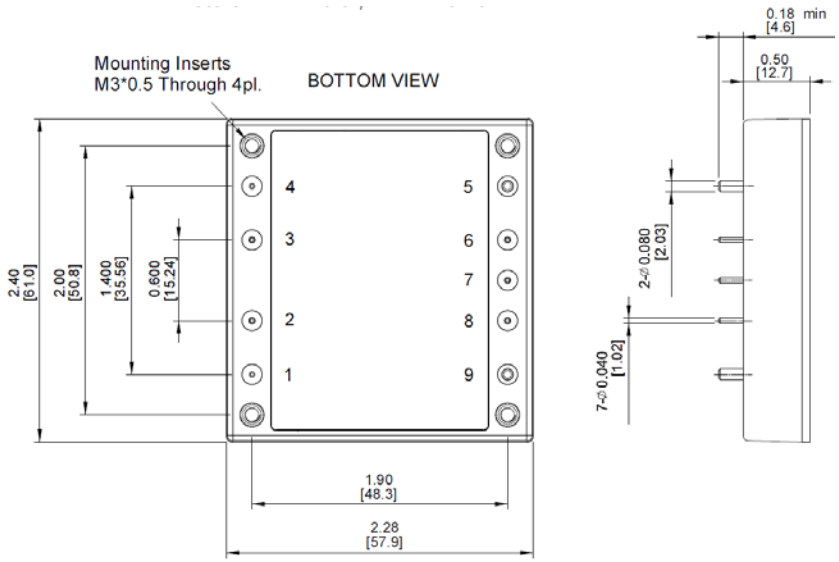


Suggested Configuration for RIA12 Surge Test



Note: Q1 suggest use Infineon IPW60R070C6 or equivalent, and provide good heat dissipation conditions.

MECHANICAL SPECIFICATIONS



Note: All dimensions are in inches (millimeters). Tolerance: x.xx ±0.02 in. (0.5mm), x.xxx ±0.010 in. (0.25 mm) unless otherwise noted

PIN CONNECTIONS

PIN CONNECTION	
PIN	**SINGLE**
1	+ V Input
2	On/Off
3	Case
4	-V Input
5	- V Output
6	-Sense
7	Trim
8	+ Sense
9	+ V Output

PART NUMBER ORDERING INFORMATION

Family, Form Factor, Package	Nominal Vin	Number of Outputs	Output Voltage		Output Current (A)	Options
HBR	106	S	12	—	25	H1, H2, H3, M, N

- **Nominal Vin:** (43-160) - 106V nominal
- **Output Voltage:** 5 Volts, 12 Volts, 24 Volts, 28 Volts, 48 Volts
- **Output Current (A):** 5 Volts – 60; 12 Volts – 25; 24 Volts – 12.5; 28 Volts – 10.7; 48 Volts – 6.25
- **Options:**
  - None – Positive On/Off Remote
  - H1 – Longitudinal Heatsink
  - H2 – Short Transverse Heatsink
  - H3 – Tall Transverse Heatsink
  - M – Clear Mounting Inserts
  - N – Negative On/Off Remote

Note: For proper part ordering, enter option suffixes in order listed in table above

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