QB SERIES Quarter-Brick

Wide Input Range 180 to 425 Volts
Up to 150 Watts DC-DC Converter

PRODUCT OVERVIEW

This QB series offers up to 150 watts of output power and is housed in an industry standard quarter-brick package with high power density. This QB series features wide input voltage range from 180 to 425 VDC (300 Volts nominal), high efficiency, isolation of 3000 VAC and provide a precise regulated voltage output.

All QB models operate over the temperature range of – 40°C to +105°C. The modules offer Input under voltage lock out (UVLO), and are fully protected against output overvoltage and over temperature conditions. All models have internal over current and continuous short circuit protection. The output voltage can be trimmed to the required voltage and the product includes Remote On/Off function.

This QB series provides efficiency up to 89%, meet industrial standard and is the best choice for military, industrial, distributed power architectures, telecommunications, and mobile applications.

Please contact DATEL if your application requires different output voltage or any other special feature.

FEATURES

- Isolated Output up to 150 Watts
- Quarter Brick Dimension
- Wide input range (180 – 425 VDC)
- Regulated Outputs
- Efficiency up to 89%
- Remote On/Off
- Continuous Short Circuit Protection
- -40 ^{0}C to +100 ^{0}C
- Voltage/Current/Over-temperature Protection
- Meet Industrial Standard
- Designed to meet UL60950-1 and EN60950
- Designed to meet CE Mark 2014/30/EU

APPLICATIONS:

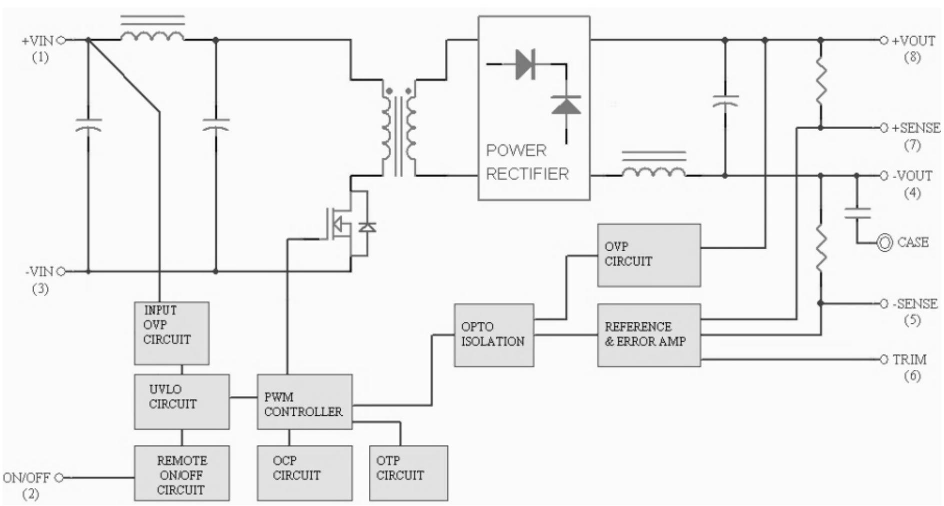
- Defense
- Naval
- Distributed Power Systems
- mobile equipment
- Telecommunications

AVAILABLE OPTIONS

- Customizable Input/ Output voltages
- Heatsink, customizable packaging
- UL/CSA60950-1 and EN60950
- CE Mark 2004/108/EC

MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT MAX	EFFICIENCY %	LOAD REGULATION	OPTIONS
QB300S5-30	180-425 VDC	5 VDC	30 A	86	± 0.2 %	N, M
QB300S12-12.5	180-425 VDC	12 VDC	12.5 A	89	± 0.2 %	N, M
QB300S15-8.4	180-425 VDC	15 VDC	8.4 A	89	± 0.2 %	N, M
QB300S24-6.3	180-425 VDC	24 VDC	6.3 A	88	± 0.2 %	N, M
QB300S28-5.4	180-425 VDC	28 VDC	5.4 A	88	± 0.2 %	N, M
QB300S48-3.2	180-425 VDC	48 VDC	3.2 A	89	± 0.2 %	N, M

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Input Voltage						
Continuous	DC	All	-0.3		425	Volts
Transient	100 ms, DC	All			500	Volts
Operating Case Temperature		All	-40		+105	°C
Storage Temperature		All	-55		+125	°C
Isolation Voltage	1 minute; input/output, AC	All			3000	VAC
	1 minute; input/case, AC				2500	VAC
	1 minute; output/case, AC	All			500	VAC

Stresses above the absolute maximum ratings can cause permanent damage to the device.

FUNCTIONAL SPECIFICATIONS

The following specifications apply over the operating temperature range, under the following conditions TA = +25°C unless otherwise specified

INPUT CHARACTERISTICS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Operating Input Voltage	**DC**	All	180	300	425	Volts
Input Under-voltage Lockout						
Turn-On Voltage Threshold	DC	All	165	170	175	Volts
Turn-Off Voltage Threshold	DC	All	155	160	165	Volts
Lockout Hysteresis Voltage	DC	All		10		Volts
Maximum Input Current	100% Load, V_{in}= 180V	All		1000		mA
No-Load Input Current	V_{in}=Nominal	Vo=5V		10		mA
		Vo=12V		10		mA
		Vo=15V		10		mA
		Vo=24V		10		mA
		Vo=28V		10		mA
		Vo=48V		10		mA
Inrush Current (I^2t)	As Per ETS300 132-2	All			0.1	A^2s
Input Filter	Pi Filter	All				
Input Reflected Ripple Current	P-P thru 12μH inductor, 5Hz to 20MHz	All		30		mA

OUTPUT CHARACTERISTICS

PARAMETER	CONDITIONS	Device	Min.	Typical	Max.	Units
Output Voltage Set Point	V_{in}=Nominal V_{in}, I_o = I_{o_max}, Tc=25°C DC	Vo=5 V Vo=12 V Vo=15 V Vo=24 V V0= 28V Vo= 48V	4.95 11.88 14.85 23.76 27.72 47.52	5 12 15 24 28 48	5.05 12.12 15.15 24.24 28.28 48.48	Volts
Output Voltage Regulation						
Load Regulation	I_o= I_{o_min} to I_{o_max}	All			±0.2	%
Line Regulation	V_{in}= low line to high line	All			±0.2	%
Temperature Coefficient	TC=-40°C to 105°C	All			±0.02	%/°C
Output Voltage Ripple and Noise (5Hz to 20MHz bandwidth)						
Peak-to-Peak	Full load, 10µF tantalum and 1.0uF ceramic capacitors (For Vo = 48V: Full Load 10 µF Aluminum and 1.0uF ceramic capacitors	Vo=5V Vo=12V Vo=15V Vo=24V Vo=28V Vo=48V			100 150 150 280 280 480	mV
RMS		Vo=5V Vo=12V Vo=15V Vo=24V Vo=28V Vo=48V			60 60 60 100 100 200	mV
Operating Output Current Range		Vo=5V Vo=12V Vo=15V Vo=24V Vo=28V Vo=48V	0 0 0 0 0 0		30 12.5 10 6.3 5.4 3.2	A
Output DC Current Limit inception	Hiccup Mode, auto recovery	All	110	125	180	%
Output Voltage Trim	Maximum Load	All	-20		+10	%
Output Over Voltage Protection		All	115	125	140	%
Maximum Output Capacitance	Full resistive load	Vo=5V Vo=12V Vo=15V Vo=24V Vo=28V Vo=48V	0 0 0 0 0 0		10000 8800 8800 3300 3300 1000	µF

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Output Voltage Current Transient						
Step Change in Output Current	75% to 100% of I_{o_max}	All			±5	%
Setting Time (within 1% Vout nominal)	d_i/d_t=0.1A/µs	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		250		ms
Turn-On Delay Time from Input	$V_{in\ min}$ to 10%V_{o_set}	All		250		ms
Output Voltage Rise Time	10%V_{o_set} to 90%V_{o_set}	All		30		ms

EFFICIENCY

PARAMETER	CONDITIONS	Device	Min.	Typical	Max.	Units
Full Load	V_{in}=Nominal V_{in}, Tc=25°C	Vo=5V Vo=12V Vo=15V Vo=24V Vo=28V Vo=48V		86 89 89 88.5 88.5 89		%

ISOLATION CHARACTERISTICS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Isolation Voltage	1minute; input/output	All			3000	Volts
	1 minute; input/case, output/case	All			2500/500	
Isolation Resistance		All	100			MΩ
Isolation Capacitance	Output/case	All		10		nF

FEATURE CHARACTERISTICS

PARAMETER	CONDITIONS	Model	Min.	Typical	Max.	Units
Switching Frequency		All	330	360	390	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		75	V
On/Off Control, Negative Remote On/Off logic						
Logic High (Module Off)	$V_{on/off}$ at $I_{on/off}$=0.0uA	All	3.5 or Open Circuit		75	V
Logic Low (Module On)	$V_{on/off}$ at $I_{on/off}$=1.0mA	All			1.2	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		5	10	mA
Output Voltage Trim Range	P_{out}=max rated power	All	-20		+10	%
Output Over Voltage Protection		All	115	125	140	%
Over-Temperature Shutdown		All		110		°C
Over-Temperature Recovery		All		100		°C

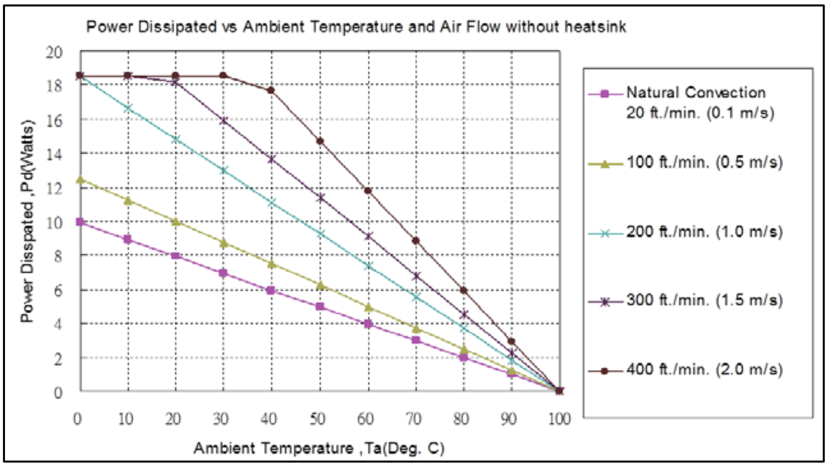
GENERAL SPECIFICATIONS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
MTBF	I_o=100% of $I_{o\ max}$; T_a=25°C per MIL-HDBK-217F	Vo=48V Others		1000 800		K hours
Weight		All		65		grams
Case Material	Plastic, DAP					
Baseplate Material	Aluminum					
Potting Materials	UL94V-0					
Pin Material	Base: Copper. Plating: Nickel with Mate Tin					
Altitude	2000m Operating Altitude, 12000M Transport Altitude					
EMC (see Item 7.2)	Meet EN50155(EN50121-3-2) With External Filter					
EMI ESD	Meets EN55011, EN55022 & EN50155 with external input filter EN55032 EN61000-4-2 Level 3: Air ±8kV, Contact ±6kV					
Radiated Immunity	EN61000-4-3 Level 3: 80~1000MHz, 20V/m					
Fast Transient	EN61000-4-4 Level 3: On power input port, ±2kV, external input capacitor required					
Surge	Meet EN61000-4-5 Level 4: Line to earth, ±4kV, Line to line, ±2kV					
Conducted Immunity	EN61000-4-6 Level 3: 0.15~80MHz, 10V					

POWER DERATING

The operating case temperature range of this QB series is -40°C to +105°C. When operating this QB series, proper derating or cooling is needed. The maximum case temperature under any operating condition should not exceed + 105°C.

Forced Convection Power De-rating without Heat Sink
Example (without heatsink):



AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	10.1 °C /W
100 ft./min. (0.5m/s)	8.0 °C /W
200 ft./min. (1.0m/s)	5.4 °C /W
300 ft./min. (1.5m/s)	4.4 °C /W
400 ft./min. (2.0m/s)	3.4 °C /W

What is the minimum airflow necessary for a QB300S12-12.5 operating at nominal line voltage, an output current of 12.5A, and a maximum ambient temperature of 40°C?

Solution:
Given:
Vin =330Vdc, Vo=12Vdc, Io=12.5A

Determine Power dissipation (Pd):
Pd =Pi-Po=Po(1-η)/η
Pd =12V×12.5A×(1-0.89)/0.89=18.54 Watts

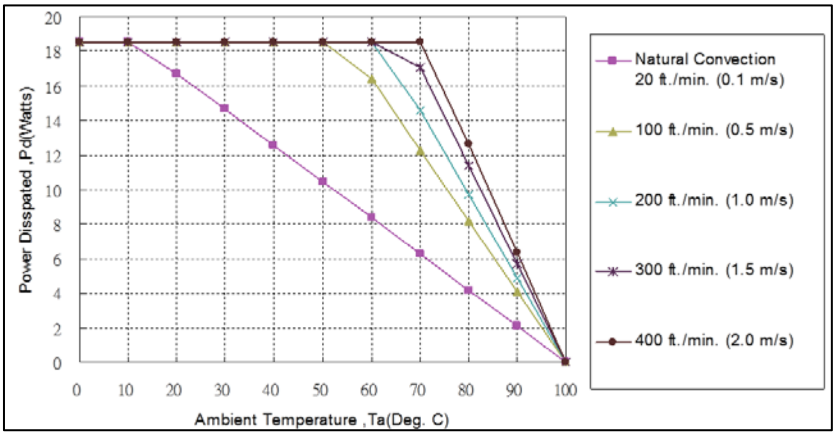
Determine airflow:
Given: Pd =18.547W and Ta=40°C

Check Power Derating curve:
Minimum airflow= 400 ft./min.

Verify:
Maximum temperature rise is
ΔT = Pd × Rca=18.54 W × 3.4 = 63.04°C.
The maximum case temperature is
Tc=Ta+ΔT=103.04°C <105°C.

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

Example (with heatsink M-C421)



AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	4.78 °C/W
100 ft./min. (0.5m/s)	2.44 °C/W
200 ft./min. (1.0m/s)	2.06 °C/W
300 ft./min. (1.5m/s)	1.76 °C/W
400 ft./min. (2.0m/s)	1.58 °C/W

What is the minimum airflow necessary for a QB300S12-12.5 operating at nominal line voltage, an output current of 12.5A, and a maximum ambient temperature of 40°C?

Solution:

Given:

Vin=300V_{dc}, Vo=12V_{dc}, Io=12.5 A

Determine Power dissipation (P_d):

Pd=Pi-Po=Po(1-η)/η

Pd=12×12.5×(1-0.89)/0.89=18.54 Watts

Determine airflow:

Given: Pd=18.54W and Ta=40°C

Check above Power de-rating curve:

Minimum airflow= 100 ft./min

Verify:

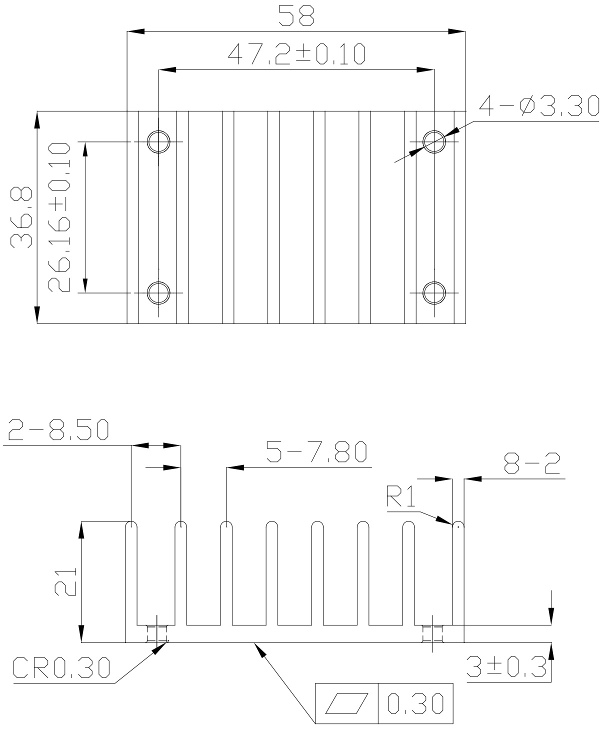
Maximum temperature rise is ΔT = Pd × Rca = 18.54×2.44 = 45.24°C

Maximum case temperature is Tc = Ta + ΔT=85.24°C <105°C

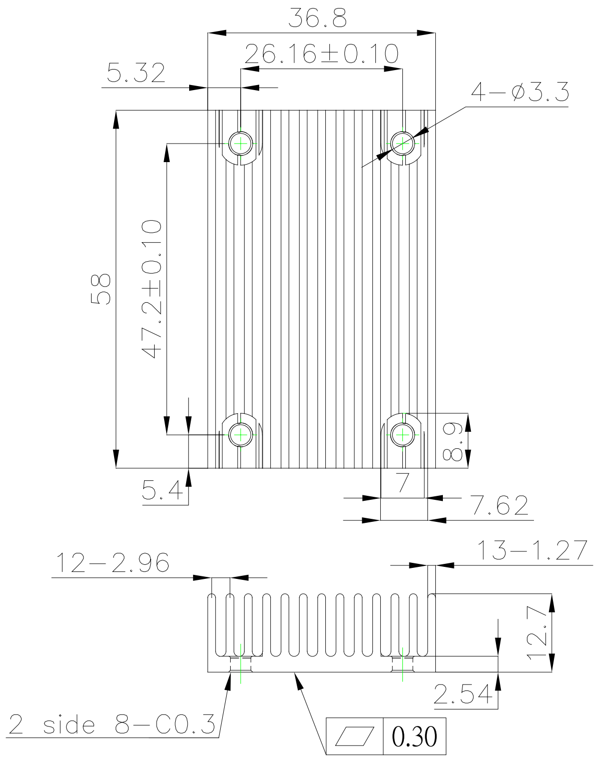
Where:

Rca is the thermal resistance from case to ambient environment, Ta is the ambient temperature, and Tc is the case temperature.

QUARTER BRICK HEAT SINKS:



M-C421 (G6620510201)
Transverse Heat Sink



M-C488 (G6620570202)
Longitudinal Heat Sink

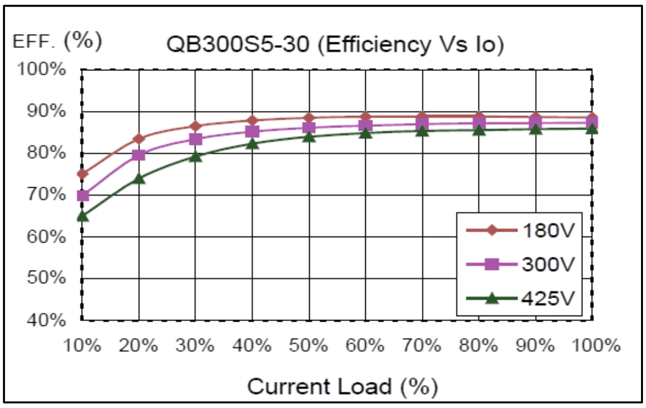
All Dimensions in mm

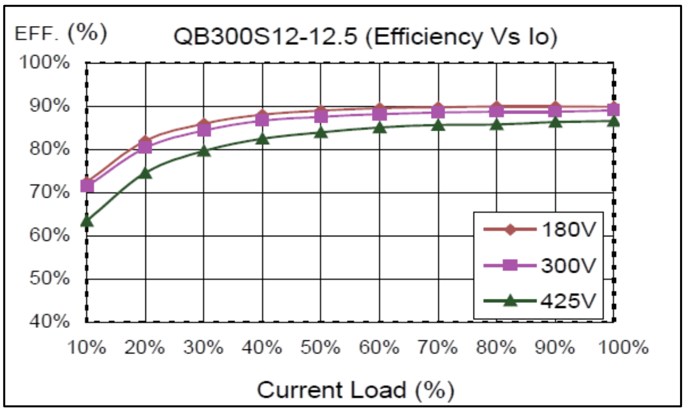
Rca: 4.78°C/W (typ.), At natural convection
2.44°C/W (typ.), At 100LFM
2.06°C/W (typ.), At 200LFM
1.76°C/W (typ.), At 300LFM
1.58°C/W (typ.), At 400LFM

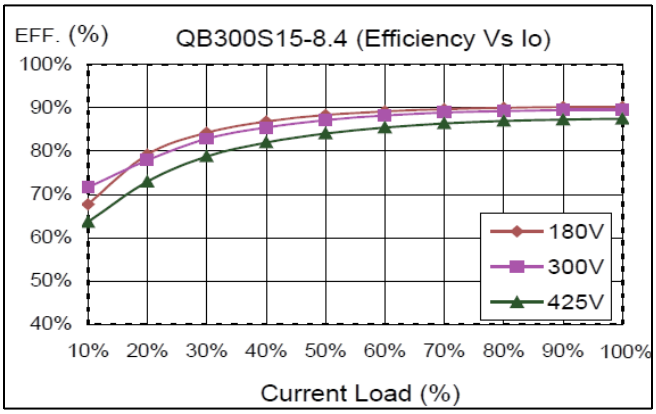
Rca: 5.61°C/W (typ.), At natural convection
4.01°C/W (typ.), At 100LFM
3.39°C/W (typ.), At 200LFM
2.86°C/W (typ.), At 300LFM
2.49°C/W (typ.), At 400LFM

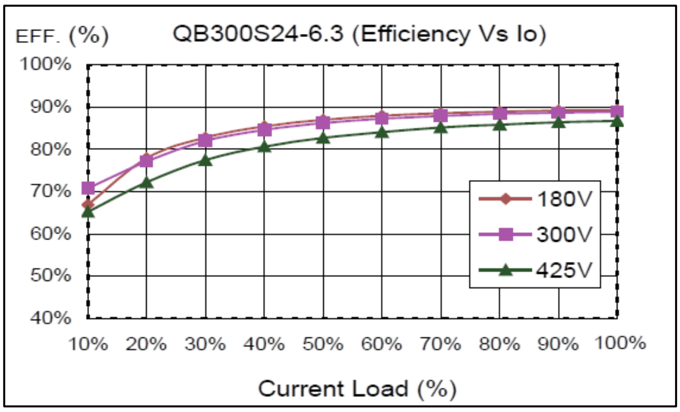
THERMAL PAD: SZ 35.8*56.9*0.25 mm (G6135041041)
SCREW: SMP+SW M3*8L (G75A1300322)

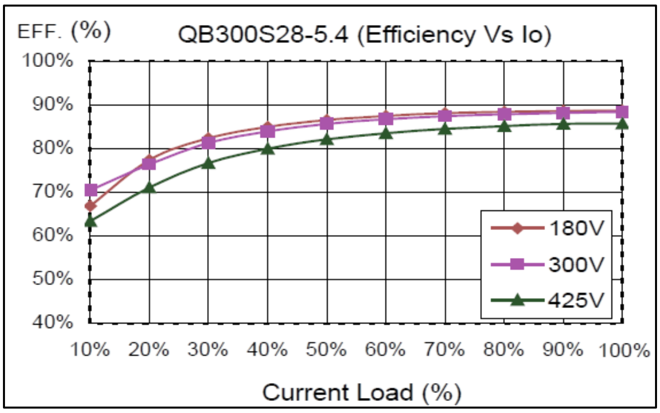
Efficiency versus Load

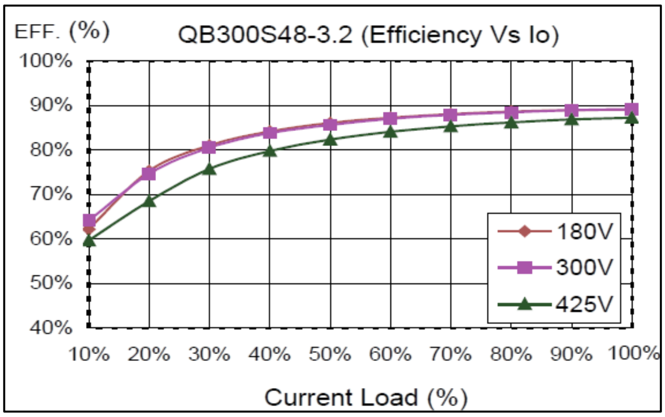












Operating Temperature Range

The QB series converters can be operated over a wide case temperature range of -40°C to + 105°C. Consideration must be given to the derating curves when maximum power is drawn from the converter. The maximum power drawn from open half brick models is influenced by multiple factors, such as:

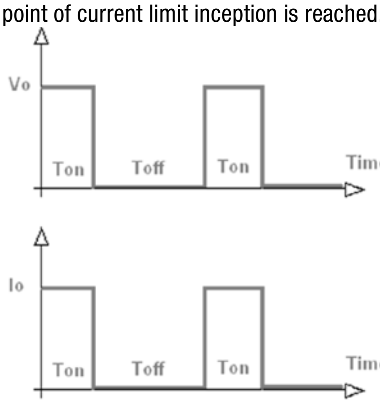
- Input voltage range
- Output load current
- Forced air or natural convection
- Heat Sink

Output Voltage Adjustment

The next page describes in detail how to trim the output voltage with respect to its set point. The output voltage on all models is adjustable within the range of +10% to –20%.

Over Current Protection

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



Output Overvoltage 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.

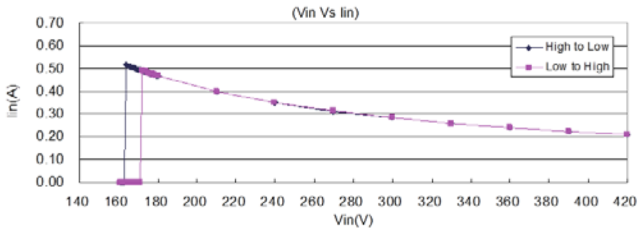
Remote On/Off

The QB series allows the user to switch the module on and off electronically with the remote on/off feature. All models are available in "positive logic" and "negative logic" (optional) versions. The converter turns on if the remote On/Off pin is high (>3.5Vdc or open circuit). Setting the pin low (<1.2Vdc) will turn the converter off. The signal level of the remote on/off input is defined with respect to ground. If not using the remote on/off pin, leave the pin open (converter will be on). 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 (<1.2Vdc). Note that the converter is off by default.

Logic State (Pin 2)	Negative Logic	Positive Logic
Logic Low – Switch Closed	Module on	Module off
Logic High – Switch Open	Module off	Module on

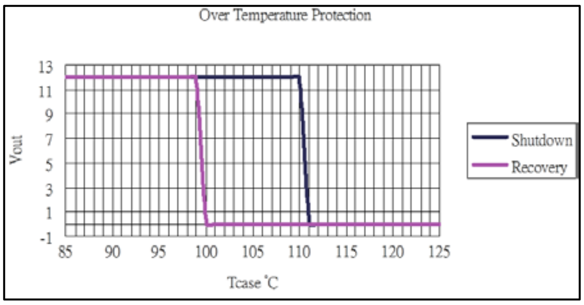
UVLO (Under voltage Lock Out)

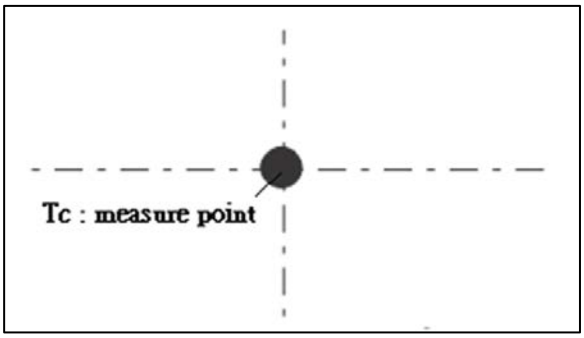
Input under voltage lockout is standard on the QB unit. The unit will shut down when the input voltage drops below a threshold, and the unit will operate when the input voltage goes above the upper threshold.



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.

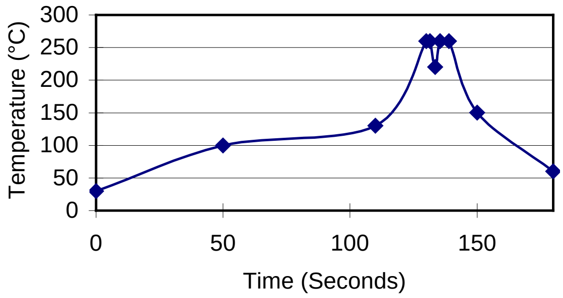




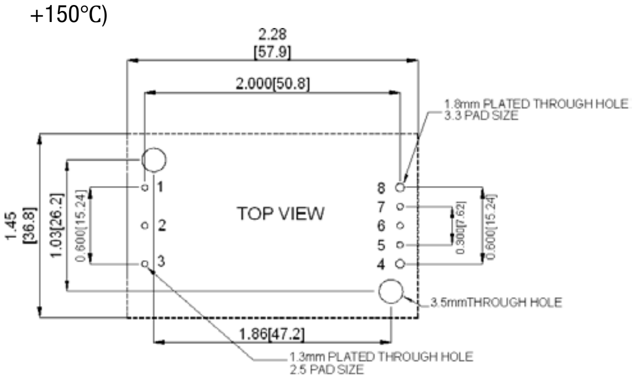
PCB Foot print, Recommended Layout, and Soldering Information

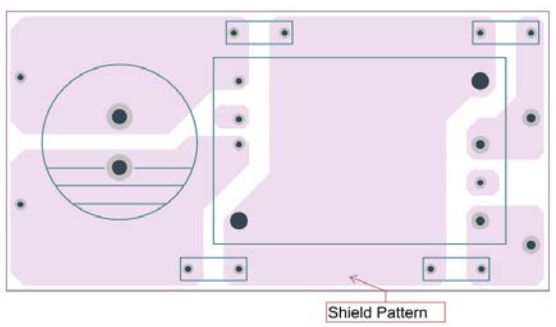
The end user of the converter must ensure that other components and metal in the vicinity of the converter meet the spacing requirements to which the system is approved. Low resistance and low inductance PCB layout traces should be used where possible. Careful consideration must also be given to proper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

Lead Free Wave Soldering Profile



Note：
1. Soldering Materials: Sn/Cu/Ni
2. Ramp up rate during preheat: 1.4 °C/Sec (From+ 50°C to +100°C)
3. Soaking temperature: 0.5 °C/Sec (From +100°C to+ 130°C), 60 ± 20 seconds
4. Peak temperature: +260°C, above+ 250°C 3~6 Seconds
5. Ramp up rate during cooling: -10.0 °C/Sec (From+ 260°C to +150°C)





Convection Requirements for Cooling

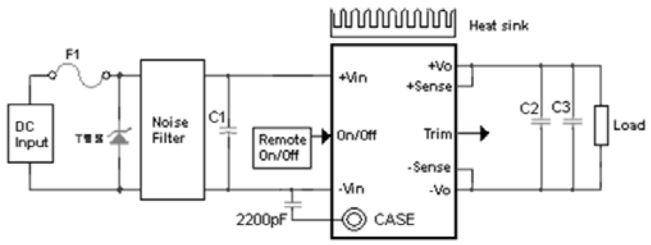
To predict the approximate cooling needed for the Quarter brick module, refer to the power derating curves. These derating curves are approximations of the ambient temperatures and airflows required to keep the power module temperature below its maximum rating. Once the module is assembled in the actual system, the module's temperature should be monitored to ensure it does not exceed +105°C as measured at the center of the top of the case, thus verifying proper cooling.

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 power output of the module should not be allowed to exceed rated power (V_{o_set} x I_{o_max}).

Connection Diagram

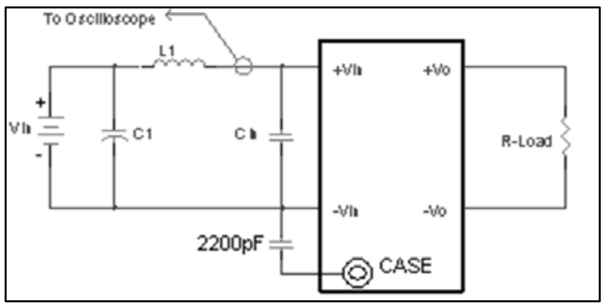
The connection for standard use is shown below. An external input capacitor (C1) 180uF for all models is recommended to reduce input ripple voltage. External output capacitors (C2, C3) are recommended to reduce output ripple and noise, 10uF aluminum and 1uF ceramic capacitor for 48Vout, and 10uF tantalum and 1uF ceramic capacitor for other models.



Note:
It is to note that 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 the temperature of -20 ℃.

External Input Capacitance

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 de-couple 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).



Note:
L1: 12uH
C1: 330uF ESR<0.7ohm @100KHz
Cin: 180uF ESR<0.7ohm @100KHz

TEST SET-UP

The basic test set-up to measure parameters such as efficiency and load regulation is shown below. When testing the modules under any

transient conditions please ensure that the transient response of the source is sufficient to power the equipment under test.
We can calculate:

- Efficiency
- Load regulation
- Line regulation.

The value of efficiency is defined as:

$$\eta = \frac{V_o \times I_o}{V_{in} \times I_{in}} \times 100\%$$

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:

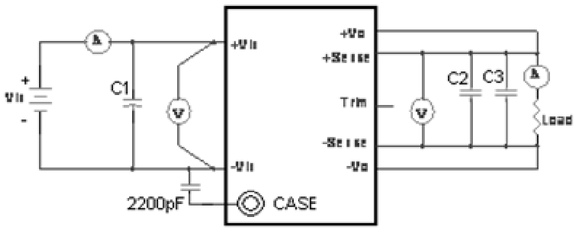
V_{FL} is the output voltage at full load
V_{NL} is the output voltage at no load

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.

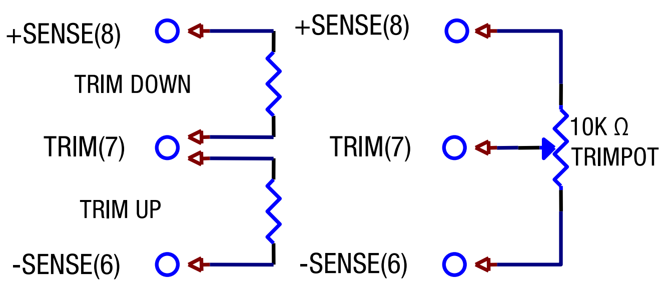


QB Series Test Setup

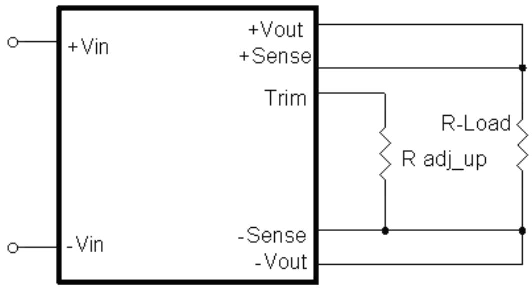
Where:
C1: 180uF/100V ESR<0.7Ω
C2: 1uF/ 1210 ceramic capacitor
C3: 10uF aluminum capacitor for 48Vout and 10uF tantalum capacitor for others

Output Voltage Adjustment

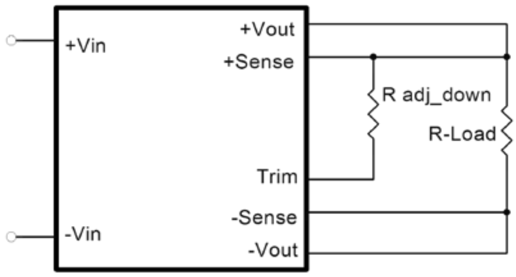
Output may be externally trimmed (+10%, -20%) with a fixed resistor or an external trim pot as shown (optional). Model specific formulas for calculating trim resistors are available upon request as a separate document.



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%, -20%. This is shown:



Trim-up Voltage Setup



Trim-down Voltage Setup

V_{out} (V)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	V_r (V)	V_f (V)
5V	2.32	1.8	0	2.5	0
12V	9.1	24	5.1	2.5	0.5
15V	12	36	8.25	2.5	0.5
24V	20	68	7.5	2.5	0.5
28V	23.7	68	6.2	2.6	0.5
48V	36	82	5.1	2.5	0.5

Trim Resistor Values

The value of Rtrim_up is defined as:

For Vo = 5V Rtrim_up decision:

$$R_{trim\_up} = \frac{R_1 V_r}{Vo - V_{o\_nom}} - R_2 \quad (K\Omega)$$

Where:

For others Rtrim_up decision:

$$R_{trim\_up} = \left(\frac{R_1(V_r - V_f(\frac{R_2}{R_2 + R_3}))}{Vo - V_{o\_nom}}\right) - \frac{R_2 R_3}{R_2 + R_3} \quad (K\Omega)$$

Where:

R_{trim_up} is the external resistor in KΩ.

V_{o_nom} is the nominal output voltage.
V_o is the desired output voltage.
R1, R2, R3 and V_r are internal components.

For example, to trim-up the output voltage of QB113S12-12.5, 12V output module by 5% to 12.6V, R_{trim_up} is calculated as follows:

$V_o - V_{o\_nom} = 12.6 - 12 = 0.6V$
R1 = 9.1 KΩ, R2 = 24 KΩ, R3 = 5.1KΩ

V_r= 2.5 V, V_f=0.5 V

$$R_{trim\_up} = \frac{18.997}{0.6} - 4.206 = 27.45\,(K\Omega)$$

The value of R_{trim_down} defined as:

$$R_{trim\_down} = \frac{R_1 \times (V_o - V_r)}{V_{o\_nom} - V_o} - R_2 \ \ (K\Omega)$$

Where:

R_{trim_down} is the external resistor in KΩ.
V_{o_nom} is the nominal output voltage.
V_o is the desired output voltage.
R1, R2, R3 and V_r are internal components.

For example: to trim-down the output voltage of QB113S12-12.5, 12V module by 5% to 11.4V, R_{trim_down} is calculated as follows:

$V_{o\_nom} - V_o = 12 - 11.4 = 0.6$ V
R1 = 9.1 KΩ, R2 = 24 KΩ, V_r = 2.5 V

$$R_{trim\_down} = \frac{9.1 \times (11.4 - 2.5)}{0.6} - 24 = 110.98\ \ (K\Omega)$$

The typical value of R_{trim_up}

Vout	5V	12V	15V	24V	28V	48V
Trim up %	R_{trim_up} (KΩ)					
1%	114.2	154.1	160.7	164.0	167.1	147.3
2%	56.20	74.95	77.01	78.64	80.72	71.29
3%	36.86	48.56	49.10	50.18	51.92	45.93
4%	27.20	35.37	35.15	35.94	37.52	33.24
5%	21.40	27.45	26.78	27.40	28.88	25.63
6%	17.53	22.17	21.19	21.71	23.12	20.56
7%	14.77	18.41	17.21	17.64	19.00	16.94
8%	12.70	15.58	14.22	14.59	15.92	14.22
9%	11.08	13.38	11.89	12.22	13.52	12.10
10%	9.800	11.62	10.03	10.32	11.60	10.41

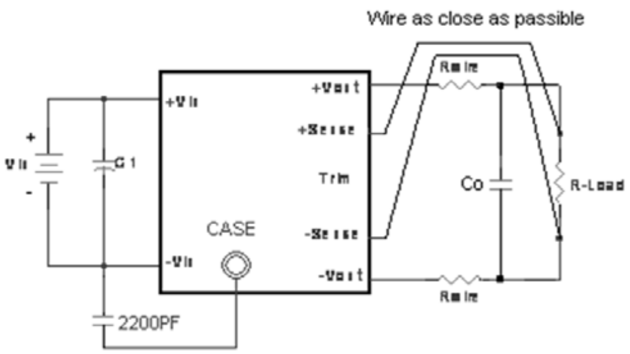
The typical value of R_{trim_down}

Vout	5V	12V	15V	24V	28V	48V
Trim down %	R_{trim_down} (KΩ)					
1%	111.8	687.3	952.0	1703	2066	3294
2%	53.88	327.1	452.0	807.8	987.4	1588
3%	34.55	207.0	285.3	509.2	627.7	1019
4%	24.88	147.0	202.0	359.9	447.8	735.1
5%	19.08	110.9	152.0	270.3	339.9	564.5
6%	15.21	86.96	118.6	210.6	268.0	450.7
7%	12.45	69.81	94.85	167.9	216.6	369.5
8%	10.38	56.95	77.00	135.9	178.0	308.5
9%	8.769	46.94	63.11	111.0	148.1	261.1
10%	7.480	38.94	52.00	91.16	124.1	223.2
11%	6.425	32.39	42.90	74.87	104.5	192.2
12%	5.547	26.93	35.33	61.30	88.16	166.3
13%	4.803	22.31	28.92	49.82	74.33	144.5
14%	4.166	18.35	23.42	39.97	62.47	125.7
15%	3.613	14.92	18.66	31.44	52.19	109.5
16%	3.130	11.92	14.50	23.97	43.20	95.28
17%	2.704	9.277	10.82	17.39	35.26	82.73
18%	2.324	6.923	7.556	11.53	28.21	71.58
19%	1.985	4.817	4.632	6.298	21.90	61.60
20%	1.680	2.921	2.000	1.583	16.22	52.62

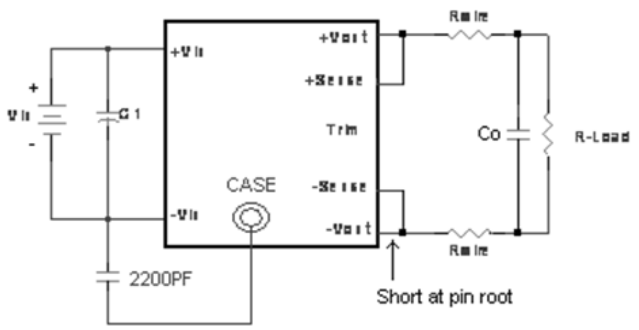
Output Remote Sensing

This QB 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 QB 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})] – [(+Sense) – (-Sense)] ≦ 10% of $V_{o\_nominal}$

When remote sense is in use, the sense should be connected by twisted-pair wire or shield wire. If the sensing patterns short, heave current flows and the pattern may be damaged. Output voltage might become unstable because of impedance of wiring and load condition when length of wire is exceeding 400mm. 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.



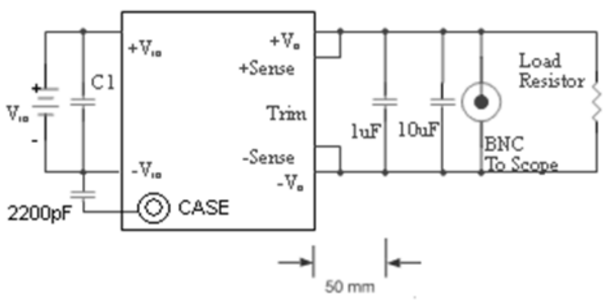
Note:

Although the output voltage can be varied (increased or decreased) by both remote sense and trim, the maximum variation for the output voltage is the larger of the two values not the sum of the values. The output power delivered by the module is defined as the voltage at the output terminals multiplied by the output current. Using remote sense and trim can cause the output voltage to increase and consequently increase the power output of the module if output current remains unchanged. Always ensure that the output power of the module remains at or below the maximum rated power. Also be aware that if $V_{o.set}$ is below nominal value, $P_{out.max}$ will also decrease accordingly because $I_{o.max}$ is an absolute limit. Thus, $P_{out.max} = V_{o.set} \times I_{o.max}$ is also an absolute limit.

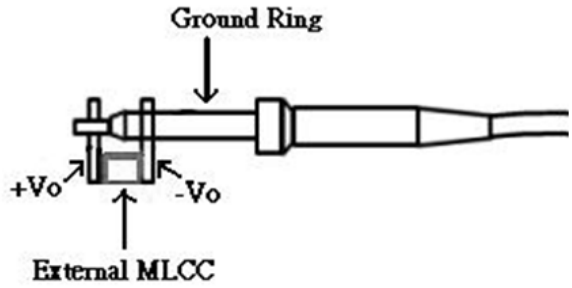
Output Ripple and Noise

Output ripple and noise measured with 10uF aluminum and 1uF ceramic capacitor across output for 48Vout and with 10uF tantalum and 1uF ceramic capacitor for others. 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 coaxial-cable/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 ripple and noise is measured with 10μF tantalum and 1μF ceramic capacitors across the output.

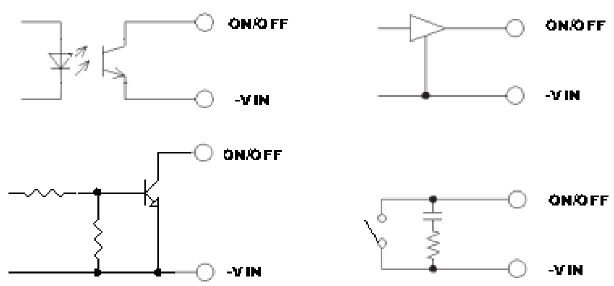


Output Capacitance

This QB series of converters provide unconditional stability with or without external capacitors. 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. DATEL converters are designed to work with load capacitance to meet the technical specification.

Remote On/Off circuit

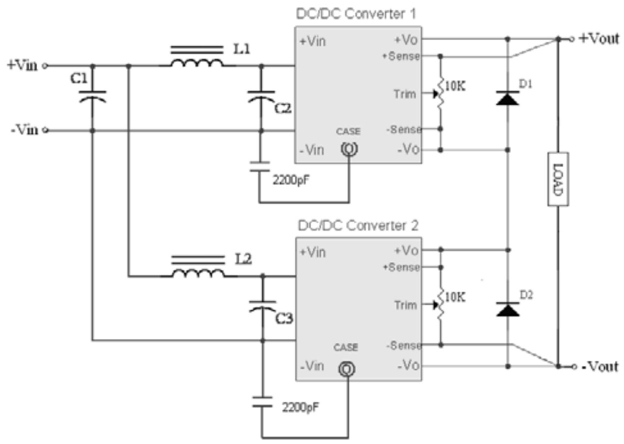
The converter remote On/Off circuit built-in on input side. The ground pin of input side Remote On/Off circuit is –Vin pin. Refer to the below figure for more details. Connection examples see below.



Remote On/Off Connection

Series operation

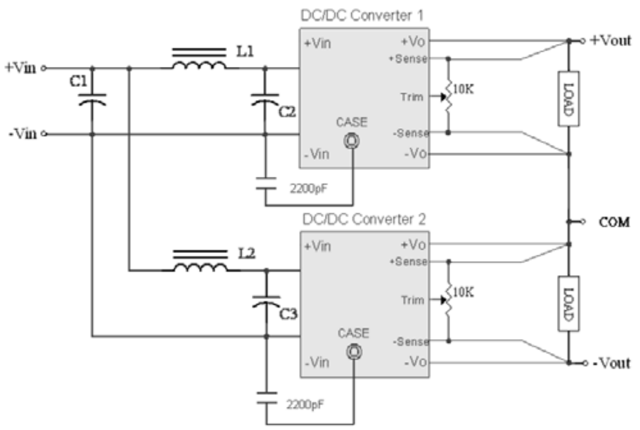
Series operation is possible by connecting the outputs two or more units. Connection is shown in below. The output current in series connection should be lower than the lowest rate current in each power module.



Simple Series Connect Circuit

Where:
L1, L2: 1.0uH
C1, C2, C3: 180uF/450V ESR<0.7Ω

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

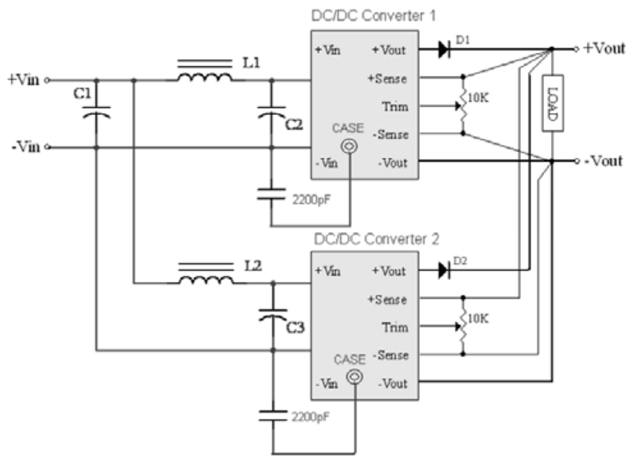


Simple ±Output Connect Circuit

Where:
L1, L2: 1.0uH
C1, C2, C3: 180uF/450V ESR<0.7Ω
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 CQB150-300SXX 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.



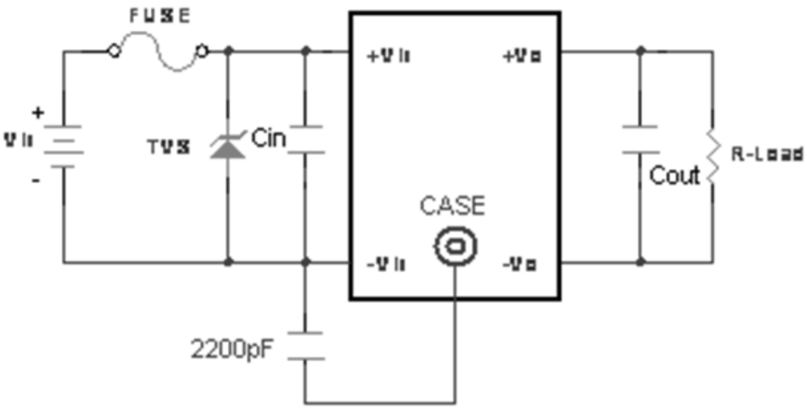
Simple Redundant Operation Connect Circuit

L1, L2: 1.0uH
C1, C2, C3: 180uF/450V ESR<0.7Ω
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 ℃

SAFETY and EMC

Input Fusing and Safety Considerations

The QB series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a time delay fuse 2A. 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).



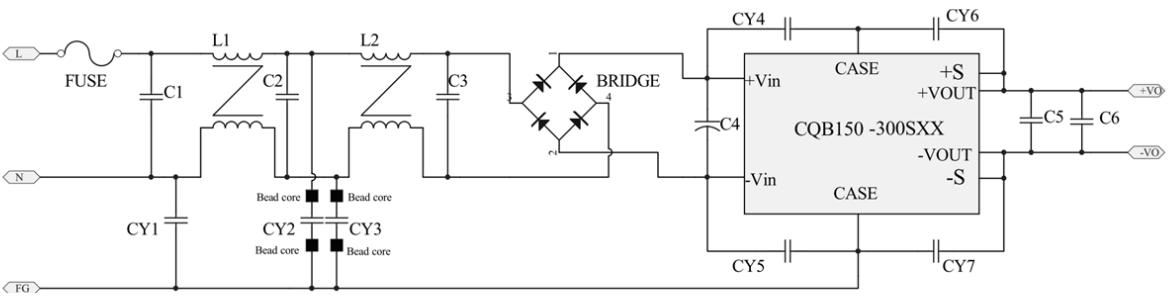
The external input capacitor (Cin) is required for this QB series has to meet EN61000-4-4, EN61000-4-5.

It is recommended to use an aluminum capacitor (Nippon chemi-con KMQ series, 180uF/450V) to connect parallel.

EMC Considerations

EMI Test standard: EN55022 / EN55032 Class A Conducted Emission
Test Condition: Input Voltage: 220VAC, Output Load: Full Load

(1) EMI and conducted noise meet EN55022 Class A:



Connection circuit for conducted EMI Class A testing

Model No.	C1	C2	C3	C4	C5	C6	CY1
	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	270uF/450V Aluminum cap KMR	10uF/50V X7R 2220	1uF/50V X7R 1210	NC
	CY2	**CY3**	**CY4**	**CY5**	**CY6**	**CY7**	**FUSE**
QB300S5-30	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	3300pF Y1 cap MURATA	3300pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	6A/250VAC
	L1	**L2**	**BEAD CORE**	**BRIDGE**			
	URT24-050055H 5mH/5A	URT24-050055H 5mH//5A	BRH 4*1.5*2 CHILISIN	S10GBU80-C 800V 10A			

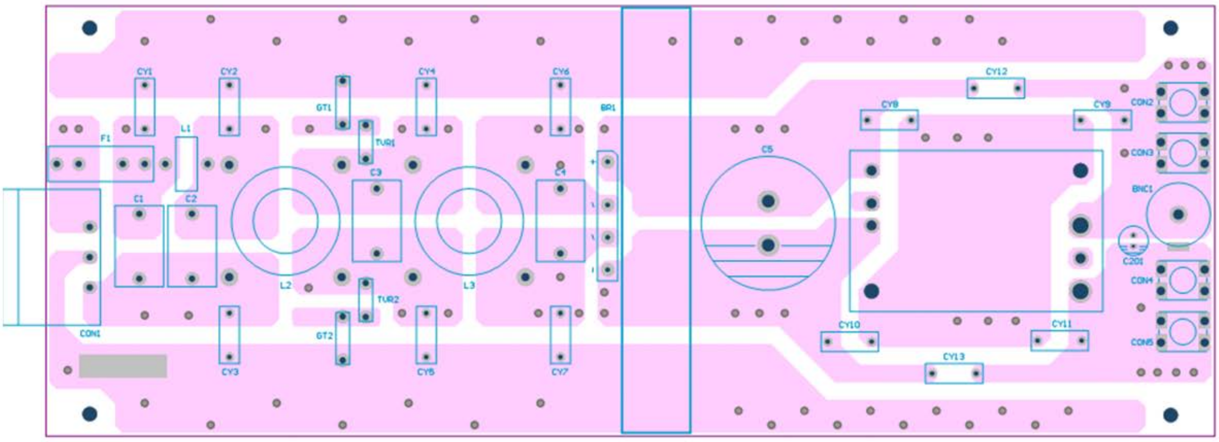
Model No.	C1	C2	C3	C4	C5	C6	CY1
QB300S12-12.5	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	270uF/450V Aluminum cap KMR	10uF/50V X7R 2220	1uF/50V X7R 1210	NC
	CY2	**CY3**	**CY4**	**CY5**	**CY6**	**CY7**	**FUSE**
	3300pF Y1 cap MURATA	3300pF Y1 cap MURATA	2200pF Y1 cap MURATA	1500pF Y1 cap MURATA	2200pF Y1 cap MURATA	4700pF Y1 cap MURATA	6A/250VAC
	L1	**L2**	**BEAD CORE**	**BRIDGE**			
	URT24-050055H 5mH/5A	URT24-050055H 5mH//5A	BRH 4*1.5*2 CHILISIN	S10GBU80-C 800V 10A			

Model No.	C1	C2	C3	C4	C5	C6	CY1
QB300S15-8.4	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	270uF/450V Aluminum cap KMR	10uF/50V X7R 2220	1uF/50V X7R 1210	NC
	CY2	**CY3**	**CY4**	**CY5**	**CY6**	**CY7**	**FUSE**
	3300pF Y1 cap MURATA	3300pF Y1 cap MURATA	2200pF Y1 cap MURATA	1500pF Y1 cap MURATA	2200pF Y1 cap MURATA	4700pF Y1 cap MURATA	6A/250VAC
	L1	**L2**	**BEAD CORE**	**BRIDGE**			
	URT24-050055H 5mH/5A	URT24-050055H 5mH//5A	NC	S10GBU80-C 800V 10A			

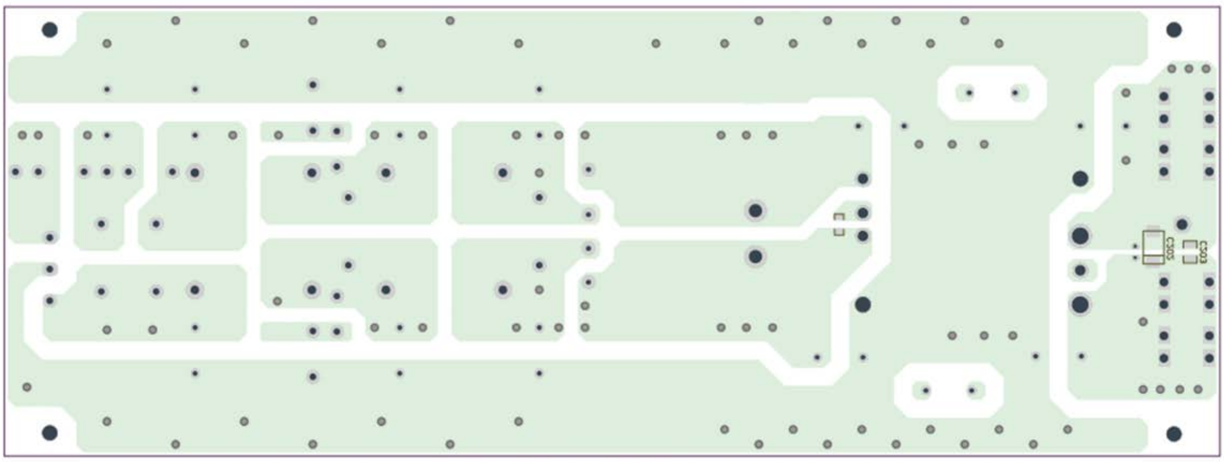
Model No.	C1	C2	C3	C4	C5	C6	CY1
QB300S24-6.3	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	270uF/450V Aluminum cap KMR	10uF/50V X7R 2220	1uF/50V X7R 1210	2200pF Y1 cap MURATA
	CY2	**CY3**	**CY4**	**CY5**	**CY6**	**CY7**	**FUSE**
	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	6A/250VAC
	L1	**L2**	**BEAD CORE**	**BRIDGE**			
	URT24-050055H 5mH/5A	URT24-050055H 5mH//5A	NC	S10GBU80-C 800V 10A			

Model No.	C1	C2	C3	C4	C5	C6	CY1
QB300S28-5.4	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	270uF/450V Aluminum cap KMR	10uF/50V X7R 2220	1uF/50V X7R 1210	NC
	CY2	CY3	CY4	CY5	CY6	CY7	FUSE
	2200pF Y1 cap MURATA	1000pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	6A/250VAC
	L1	**L2**	**BEAD CORE**	**BRIDGE**			
	URT24-050055H 5mH/5A	URT24-050055H 5mH//5A	NC	S10GBU80-C 800V 10A			

Model No.	C1	C2	C3	C4	C5	C6	CY1
QB300S48-3.2	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	0.68uF/305V X2 cap MKP62(C42)	270uF/450V Aluminum cap KMR	4.7uF/100V X7R 2220	1uF/100V X7R 1210	2200pF Y1 cap MURATA
	CY2	**CY3**	**CY4**	**CY5**	**CY6**	**CY7**	**FUSE**
	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	2200pF Y1 cap MURATA	6A/250VAC
	L1	**L2**	**BEAD CORE**	**BRIDGE**			
	URT24-050055H 5mH/5A	URT24-050055H 5mH//5A	NC	S10GBU80-C 800V 10A			



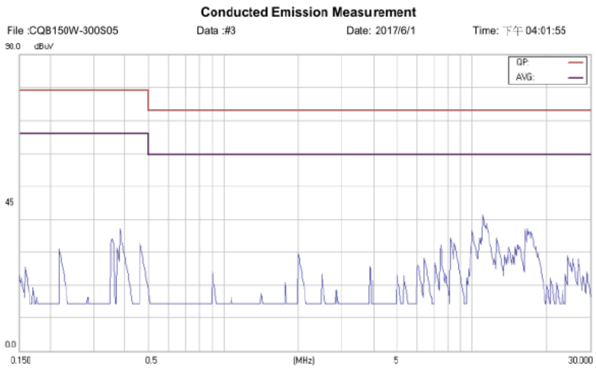
EMI test board top side



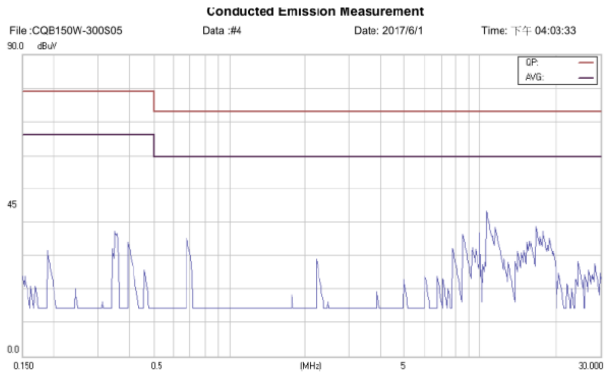
EMI test board bottom side

Note: C1, C2 Aluminum Capacitors and C3, C4 Ceramic Capacitors

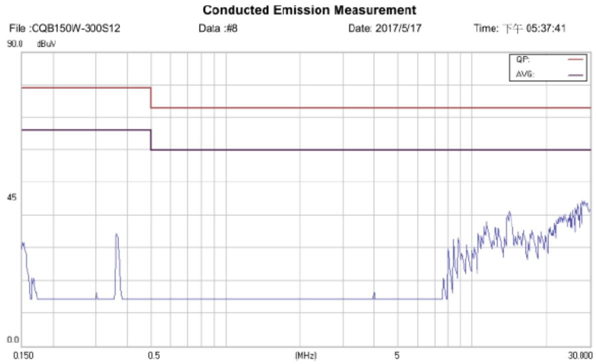
EMI and conducted noise meet EN55022 Class B



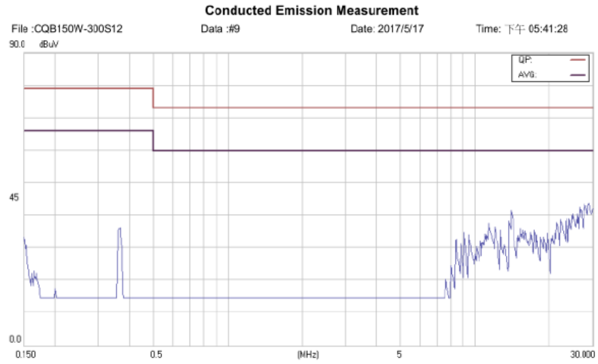
Conducted Class A Test for QB300S5-30 Line



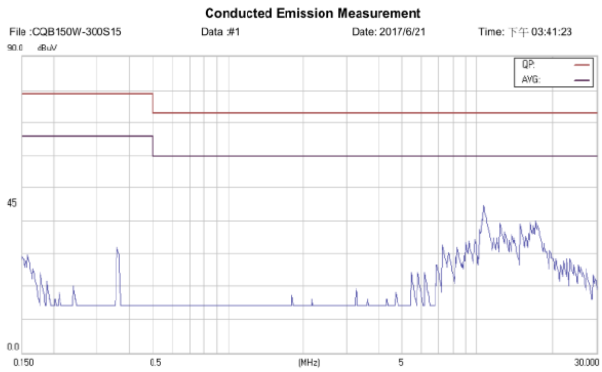
Conducted Class A Test for QB300S5-30 Nature



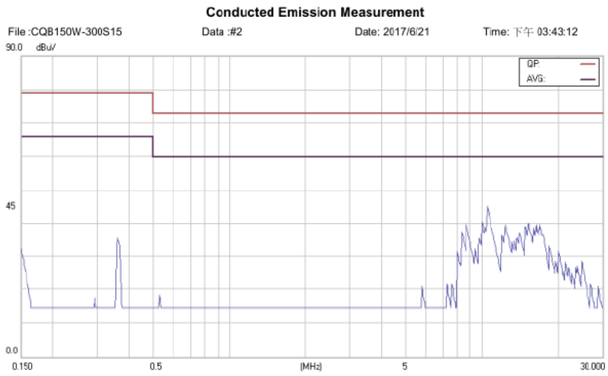
Conducted Class A Test for QB300S12-12.5 Line



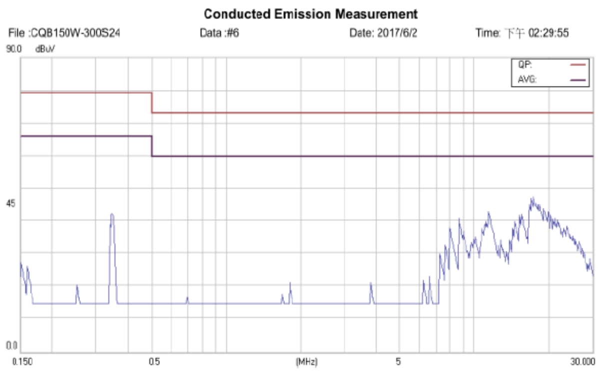
Conducted Class A Test for QB300S12-12.5 Nature



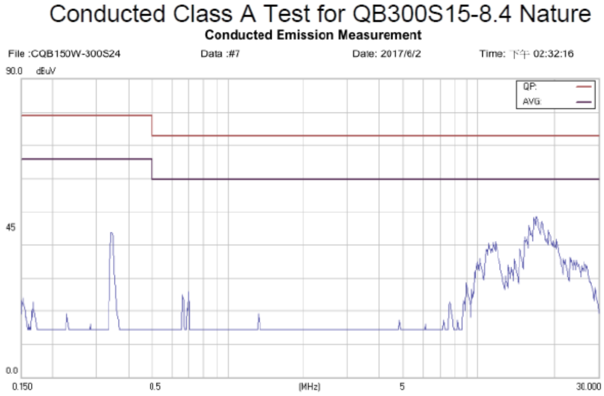
Conducted Class A Test for QB300S15-8.4 Line



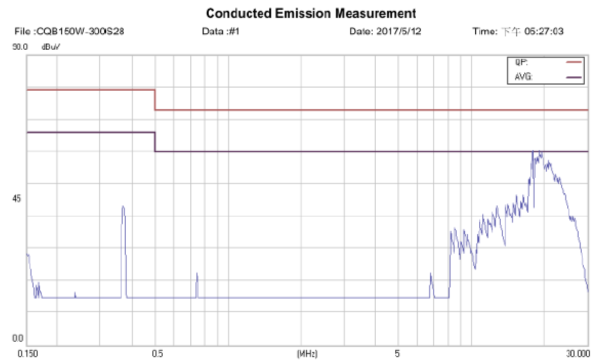
Conducted Class A Test for QB300S15-8.4 Nature



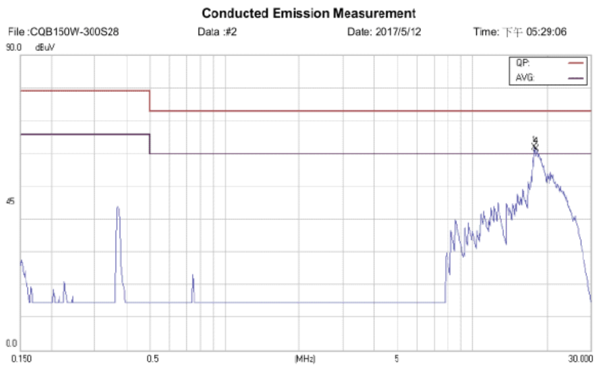
Conducted Class A Test for QB300S24-6.3 Line



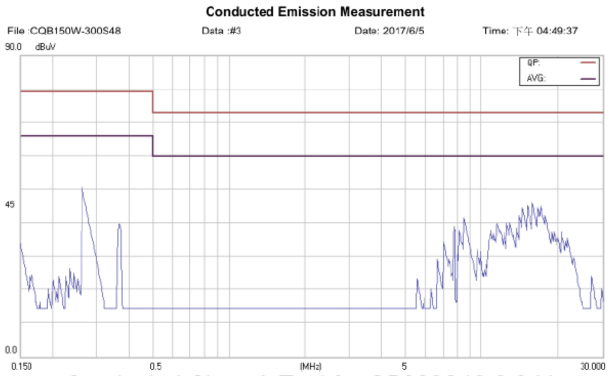
Conducted Class A Test for QB300S24-6.3 Nature



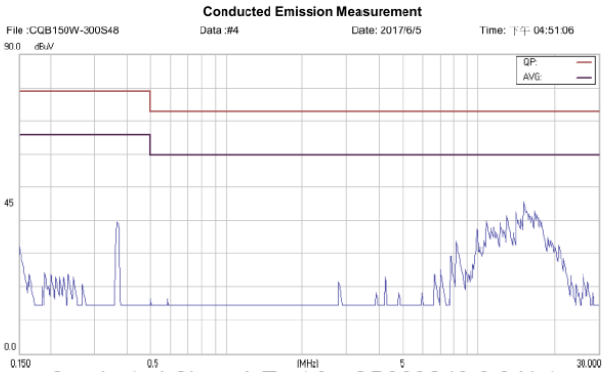
Conducted Class A Test for QB300S28-5.4 Line



Conducted Class A Test for QB300S28-5.4 Nature

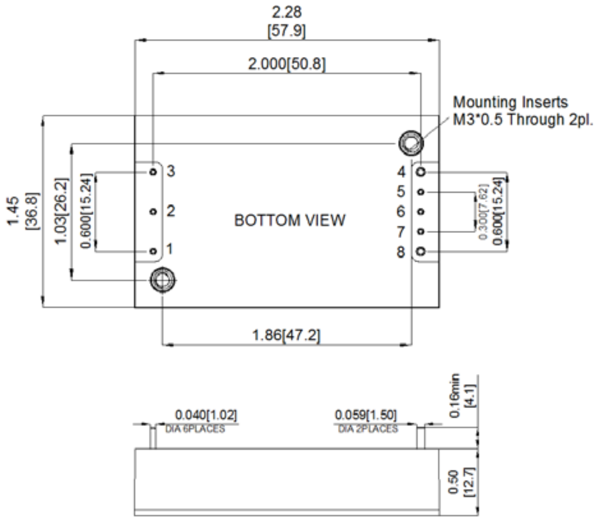


Conducted Class A Test for QB300S48-3.2 Line



Conducted Class A Test for QB300S48-3.2 Nature

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	SINGLE OUTPUT
1	+ V Input
2	On/Off
3	- V Input
4	-V output
5	-Sense
6	Trim
7	+ Sense
8	+ V Output

PART NUMBER ORDERING INFORMATION

Family, Form, Factor Package	Nominal Input voltage	Number of Outputs	Voltage Output Volts	Current Output (A)	Options
QB	300	S	5	12	N, M
	(180-425) 300 Volts	S - Single	5 Volts 12 Volts 15 Volts 24 Volts 28 Volts 48 Volts	5 Volts - 30A 12 Volts – 12.5A 15 Volts – 8.4A 24 Volts – 6.3A 28Volts – 5.4A 48Volts – 3.2A	None – Positive ON/OFF Control N - Negative On/Off control M – Clear Mounting Insert

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