DATASHEET

QBVE094A0S10R7 Barracuda* Series; DC-DC Converter Power Modules

45-56V_{dc} Input; 10.7V_{dc}, 94A, 1000W Output

RoHS Compliant

Description

The QBVE094A0S10R7 Barracuda series of dc-dc converters are a new generation of fully regulated DC/DC power modules designed to support 10.7V_{dc} intermediate bus applications where multiple low voltages are subsequently generated using point of load (POL) converters, as well as other application requiring a tightly regulated output voltage. The QBVE094A0S10R7 series operate from an input voltage range of 45 to 56V_{dc} and provide up to 1000W output power at output voltages of 10.7V_{dc} in an industry standard, DOSA compliant quarter brick. The converter incorporates digital control, synchronous rectification technology, a fully regulated control topology, and innovative packaging techniques to achieve efficiency exceeding 97% peak at 10.7V_{dc} output. This leads to lower power dissipations such that for many applications a heat sink is not required. Standard features include on/off control, output overcurrent and over voltage protection, over temperature protection, input under and over voltage lockout.

The output is fully isolated from the input, allowing versatile polarity configurations and grounding connections. Built-in filtering for both input and output minimizes the need for external filtering.

Applications

- Distributed power architectures
- Intermediate bus voltage applications
- Servers and storage applications
- Fan assemblies and other systems requiring a tightly regulated output voltage

Options

- Negative Remote On/Off logic (1=option code, factory preferred)
- Auto-restart after fault shutdown (4=option code, factory preferred)
- Passive Droop Load Sharing and Power Good Feature/pin (-P option code)

See footnotes on page: 2

Features

- Compliant to RoHS Directive 2011/65/EU and amended Directive (EU) 2015/863.
- Compliant to REACH Directive (EC) No 1907/2006
- Can be processed with paste-through-hole Pb or Pb-free reflow process
- High and flat efficiency profile >97.0% at V_{in}=50$_{Vdc}$, 40% load to 100% output
- Input voltage range: 45-56V_{dc}
- Delivers up to 1000W output power
- Fully very tightly regulated output voltage
- Low output ripple and noise
- Industry standard, DOSA Compliant Quarter Brick: 58.4mm x 36.8mm x 14.5mm MAX (2.30in x 1.45in x 0.57in MAX)
- Base plate (-H=option code) (must be ordered)
- Constant switching frequency
- Positive Remote On/Off logic
- Power Good Monitor (-P=option code)
- Output over current/voltage protection
- Over temperature protection
- Wide operating temperature range -20°C to 85°C, continuous
- ANSI/UL* 62368-1 and CAN/CSA† C22.2 No. 62368-1 Recognized, DIN VDE‡ 0868-1/A11:2017 (EN62368-1:2014/A11:2017)
- 750V_{dc} Functional Isolation
- ISO** 9001 and ISO14001 certified manufacturing facilities

Footnotes

* Trademark of OmniOn Company

UL is a registered trademark of Underwriters Laboratories, Inc.

† CSA is a registered trademark of Canadian Standards Association.

‡ VDE is a trademark of Verband Deutscher Elektrotechniker e.V.

** ISO is a registered trademark of the International Organization of Standards.

Technical Specifications

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

Parameter	Device	Symbol	Min	Max	Unit
Input Voltage, Continuous[1]	All	V_{IN}	-0.3	64	V_{dc}
Power Good to V_{out}(-)	-P option	V_{PG}	-0.3	20	V_{dc}
Operating Ambient Temperature (See Thermal Considerations section)	All	T_A	-20	85	°C
Storage Temperature	All	T_{stg}	-40	100	°C
I/O Isolation Voltage (100% factory Hi-Pot tested)	All		—	750	V_{dc}
Operating Altitude[2]	All		-500	13,120	Ft.
Relative Humidity, Operating, Non-condensing	All		10	90	%

[1] Input over voltage protection will shutdown the output voltage when the input voltage exceeds threshold level.

[2] Maximum operating temperature shall be decreased 1°C per 1000 feet of altitude above sea-level.

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage		V_{IN}	45	50/54	56	V_{dc}
Maximum Input Current (V_{IN}=45V, I_O=$I_{O,\ max}$)		$I_{IN,max}$	-	-	25	A_{dc}
Input No Load Current (V_{IN} = $V_{IN,\ nom}$, I_O = 0, module enabled)	All	$I_{IN,No\ load}$		135		mA
Input Stand-by Current (V_{IN} = $V_{IN,\ nom}$, module disabled)	All	$I_{IN,stand\text{-}by}$			20	mA
External Input Capacitance	All		330	-	800	μF
Inrush Transient	All	I^2t	-	-	1	A^2s
Input Reflected Ripple Current, peak-to-peak (5Hz to 20MHz, 12μH source impedance; V_{IN}= 48V, I_O= I_{Omax} ; see Figure 9)	All		-	35	-	mAp-p
Input Terminal Ripple Current** 5Hz to 20MHz, V_{IN}= 45V to 56V, 50-100% of full load	All		-	-	1.0	mA_{RMS}/W
Input Terminal Ripple Current (Measured at module input pin with maximum specified input capacitance and < 500μH inductance between voltage source and input capacitance) 5Hz to 20MHz, V_{IN}= 45V to 56V, I_O= I_{Omax}	All		-	-	1000	mA_{rms}
Input Ripple Rejection (120Hz)	All		-	25	-	dB

**Measured at a wire loop of 3cm^2 minimum area connected between the external input capacitor (+) terminal and the Vin (+) pin of the module, with the maximum specified external input capacitance and < 500uH inductance between the voltage source and input capacitance.

CAUTION: This power module is not internally fused. An input line fuse must always be used.

This power module can be used in a wide variety of applications, ranging from simple standalone operation to an integrated part of sophisticated power architecture. To preserve maximum flexibility, internal fusing is not included, however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a fast-acting fuse with a maximum rating of 30A in the ungrounded input lead of the power supply (see Safety Considerations section). Based on the information provided in this Data Sheet on inrush energy and maximum dc input current, the same type of fuse with a lower rating can be used. Refer to the fuse manufacturer's Data Sheet for further information.

Technical Specifications (continued)

Electrical Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Voltage Set-point (V_{IN}=$V_{IN,nom,}$ I_O=47.0A, T_A =25°C)	All	$V_{O,\,set}$	10.68	10.70	10.72	V_{dc}
Output Voltage Over all operating input voltage (45V to 56V), resistive load, and temperature conditions until end of life	All w/o -P	V_O	10.4	—	11.0	V_{dc}
Output Voltage Over all operating input voltage (45V to 56V), resistive load, and temperature conditions until end of life Over all operating input voltage and temperature until end of life: At no load At full load Difference between units at the same input voltage, resistive load (20 to 100% of full load) and temperature (T_A = 25 to 85°C)	-P Option	V_O	10.0 10.3 10.0	10.7 10.84 10.56	11.4 11.4 11.1 0.03	V_{dc}
Output Regulation Line ($_{VIN}$= $V_{IN,\,min}$ to $V_{IN,\,max}$) Load (I_O=$I_{O,\,min}$ to $I_{O,\,max}$) Load Droop (20 to 100% of full load) Temperature (T_A = -5°C to +85°C)	All All w/o -P -P Option All		— — 2.75 —	0.2 0.2 2.95 —	— — 0.02	% $V_{O,\,set}$ % $V_{O,\,set}$ mV/A %/°C
Output Ripple and Noise on nominal output (V_{IN}=$V_{IN,\,nom}$ and I_O=$I_{O,\,min}$ to $_{IO,\,max}$) C_O=750µF RMS (5Hz to 20MHz bandwidth) Peak-to-Peak (5Hz to 20MHz bandwidth)	All All		— —	70 —	— 150	mV_{rms} mV_{pk-pk}
External Output Capacitance For C_O >4500µF, I_O must be < 50% $I_{O,max}$ during T_{rise}. Per module, when 2 or more modules are in parallel	All -P Option	$C_{O,\,max}$	0 0	—	4,500 4,500	µF µF
Output Current	All	I_O	0	—	94	A_{dc}
Output Current Limit Inception	All	$I_{O,lim}$	105	—	125	A_{dc}
Output Power	All	P_O	0	—	1000	W
Efficiency V_{IN}=$V_{IN,\,nom}$, T_A=25°C I_O=100% $I_{O,\,max,}$ V_O= $V_{O,set}$ I_O=30% $I_{O,\,max}$ to 100% $I_{O,\,max}$, V_O= $V_{O,set}$	All All	η η		97.0 97.0		% %
Switching Frequency (Primary FETs)		f_{sw}		160		kHz
Dynamic Load Response dI_O/dt=1A/1µs; V_{in}=50V_{dc}; T_A=25°C; (Tested with a 1.0µF ceramic, and 3200µF capacitor andacross the load.) Load Change from I_O = 50% to 75% of $IO_{,max}$: Peak Deviation Settling Time (V_O <10% peak deviation) Load Change from I_O = 75% to 50% of $I_{O,max}$: Peak Deviation Settling Time (V_O <10% peak deviation)	All All	V_{pk} t_s V_{pk} t_s	— —	350 700 350 700	— —	mV_{pk} µs mV_{pk} µs

Isolation Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Isolation Capacitance	C_{iso}	—	0.01	—	µF
Isolation Resistance	R_{iso}	10	—	—	MΩ

General Specifications

Parameter	Device	Symbol	Typ	Unit
Calculated Reliability Based upon Telcordia SR-332 Issue 3:	All	MTBF	9,803,082	Hours
Method I, Case 3, (I_O=80%$I_{O,\,max,}$ T_A=40°C, Airflow = 200 LFM), 90% confidence	All	FIT	102.0	10^9/Hours
Weight – with Base plate option		—	84.2 (2.97)	g (oz.)

Technical Specifications (continued)

Feature Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions. See Feature Descriptions for additional information.

Parameter	Device	Symbol	Min	Typ	Max	Unit
Remote On/Off Signal Interface						
(V_{IN}=$V_{IN, min}$ to $V_{IN, max}$, Signal referenced to V_{IN}- terminal)						
Negative Logic: device code suffix "1" Logic Low = module On, Logic High = module Off						
Positive Logic: No device code suffix required Logic Low = module Off, Logic High = module On						
Logic Low Specification						
On/Off Thresholds:						
Remote On/Off Current – Logic Low (V_{in} =56V)	All	$I_{on/off}$	—	—	200	µA
Logic Low Voltage	All	$V_{on/off}$	-0.3	—	0.8	V_{dc}
Logic High Voltage – (Typ = Open Collector)	All	$V_{on/off}$	2.4	—	14.5	V_{dc}
Logic High maximum allowable leakage current($V_{on/off}$ = 2.4V)	All	$I_{on/off}$	—	—	130	µA
Maximum voltage allowed on On/Off pin	All	$V_{on/off}$	—	—	14.5	V_{dc}
Turn-On Delay and Rise Times (I_O=$I_{O, max}$)						
T_{delay}=Time until V_O = 10% of $V_{O,set}$ from either application of V_{in} with Remote On/Off set to On (Enable with Vin); or operation of Remote On/Off from Off to On with Vin already applied for at least 30 milli-seconds (Enable with on/off).	All w/ "P" option	$T_{delay,Enable with Vin}$	20	—	30	ms
	All w/ "P" option	$T_{delay, Enable with on/off}$	—	—	5	ms
T_{rise}=Time for V_O to rise from 10% to 90% of $V_{O,set}$, For C_O >4500µF, I_O must be < 50% $I_{O, max}$ during T_{rise}.	All w/ "P' option	T_{rise}	—	—	15	ms
Output Overvoltage Protection	All	$V_{O,limit}$	12.0		16.0	V_{dc}
Overtemperature Protection (See Thermal Considerations, Fig. 16)	All	T_{ref}	—	140	—	°C
Input Undervoltage Lockout						
Turn-on Threshold			41	44	45	V_{dc}
Turn-off Threshold			39	41	43	V_{dc}
Hysteresis			2			V_{dc}
Input Overvoltage Lockout						
Turn-off Threshold			60	62	—	V_{dc}
Turn-on Threshold			—	60	—	V_{dc}
Power Good (available on –P option versions)	All w/ "P' option					
Output Voltage Low (trigger limits)[1]			8.2	8.3	8.6	V_{dc}
Output Voltage High (trigger limits)[1]			12.6	12.95	13.1	V_{dc}
Input Voltage Low (trigger limits) Falling[6]			42.5	—	45.0	V_{dc}
Input Voltage High (trigger limits) Rising[6]			58.0	—	61.0	V_{dc}
Hysteresis, Input Voltage Low or High			0.5	—	—	V_{dc}
High State Voltage (open collector; set externally)[1]			0	—	27	V_{dc}
High State Leakage Current (into Pin)[1]			0	—	10	µA
Low State Voltage[1]			0	—	0.8	V_{dc}
Low State Current (into Pin)[1]			0	—	5	mA
Power Good Signal De-assert Response Time[2,5]			0	—	3.0	ms
Power Good Signal Assert Response Time[3,5]			0	—	3.0	ms
Power Good Signal Duration[4]			200	—	600	ms

[1]Power Good signal is referenced to V_{out}(-)

[2]Power Good Signal De-assert Response Time is defined as the duration between the fault occurring and the Power-Good Signal de-asserting

[3]Power Good Signal Assert Response Time is defined as the duration between unit powering up with no faults and the Power Good Signal asserting

[4]Power Good Signal Duration is defined as the duration the Power-Good signal must stay de-asserted if a transient fault occurs

[5]Power Good assertion & de-assertion must be deglitched to avoid false triggering

[6]Power Good signal will indicate Good when Vin is within operating range and indicate bad before unit is shut-down due to UV or OV

Technical Specifications (continued)

Characteristic Curves, 10.7V$_{dc}$ Output

The following figures provide typical characteristics for the QBVE094A0S10R7 (10.7V, 1000W) at 25°C. The figures are identical for either positive or negative Remote On/Off logic.

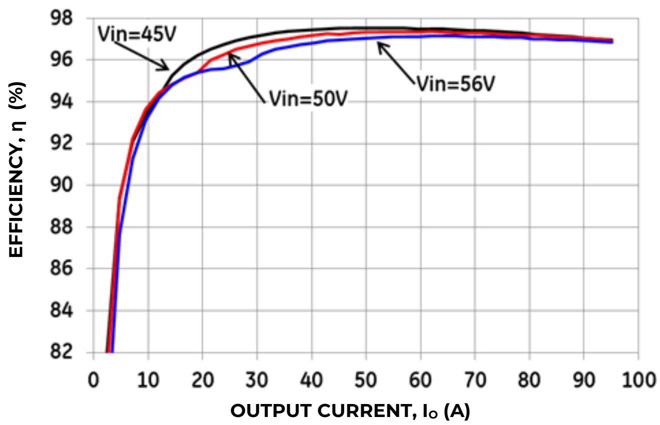


Figure 1. Typical Converter Efficiency versus Output Current.

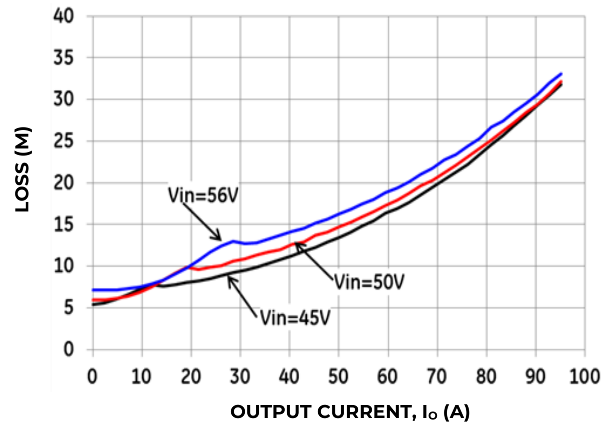


Figure 2. Typical Converter Loss vs. Output Current.

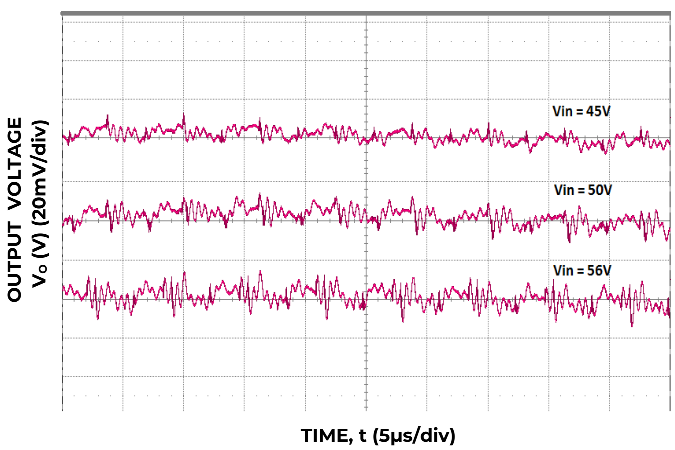


Figure 3. Typical output ripple and noise
$I_o = I_{o,max}$ C_O= 750μf.

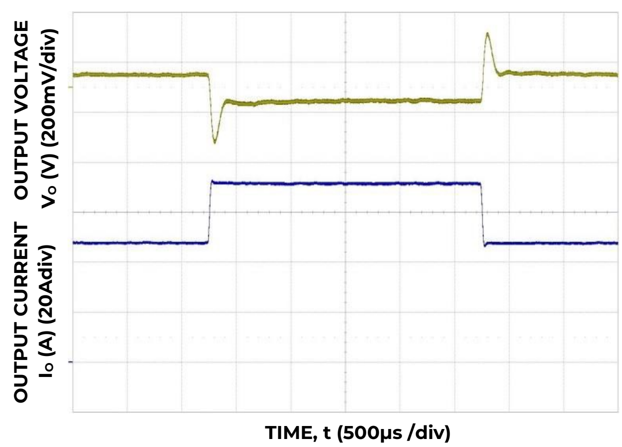


Figure 4. Typical Transient Response to 1A/μs Step Change in Load from 50% to 75% to 50% of Full Load, C_O=3200μF and 48 V$_{dc}$ Input.

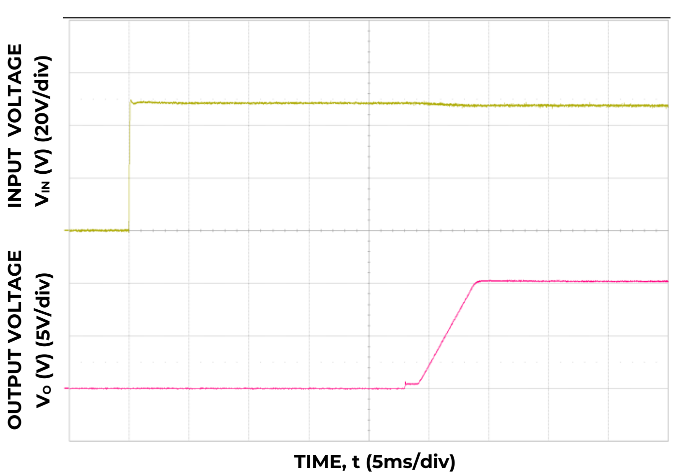


Figure 5. Typical Start-Up Using Vin with Remote On/Off enabled, negative logic version shown, $I_o = I_{o,max}$.

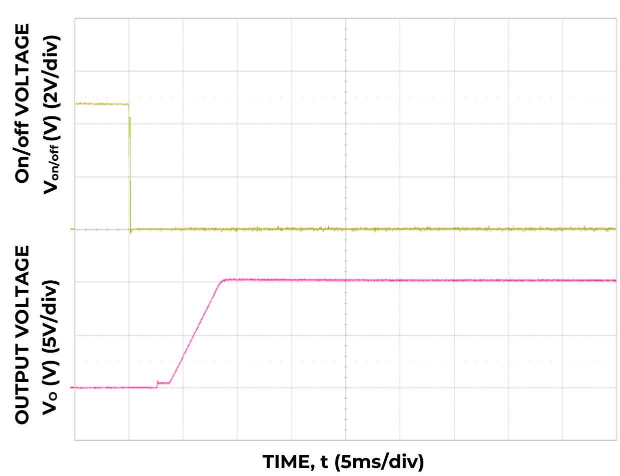


Figure 6. Typical Start-Up Using Remote On/Off with V$_{in}$ applied, negative logic version shown $I_o = I_{o,max}$.

Technical Specifications (continued)

Characteristic Curves, 10.7V$_{dc}$ Output (continued)

The following figures provide typical characteristics for the QBVE094A0S10R7 (10.7V, 1000W) at 25°C. The figures are identical for either positive or negative Remote On/Off logic.

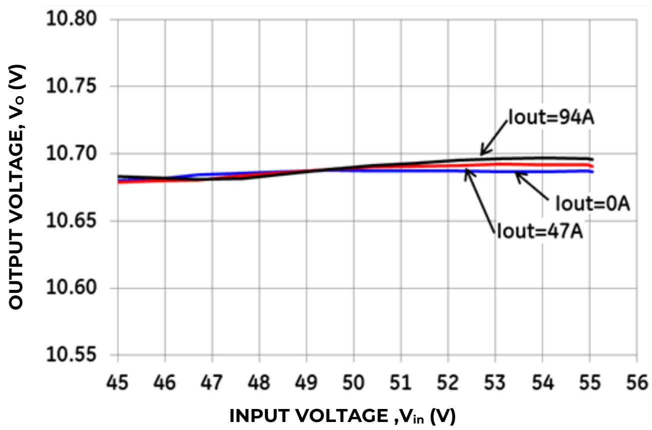


Figure 7. Typical Output Voltage Regulation vs. Input Voltage. [to be replaced; units now calibrated to 10.70V out]

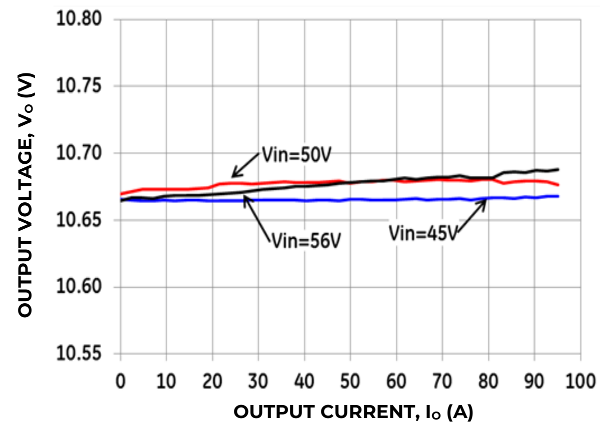


Figure 8. Typical Output Voltage Regulation vs. Output Current. [to be replaced; units now calibrated to 10.70V out]

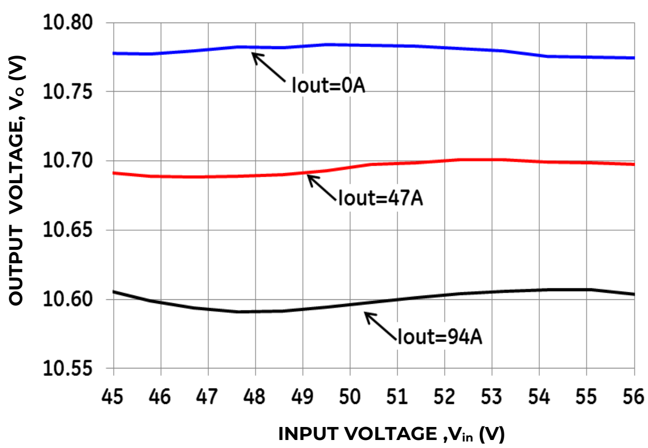


Figure 9. Typical Output Voltage Regulation vs. Input Voltage for the –P Version.

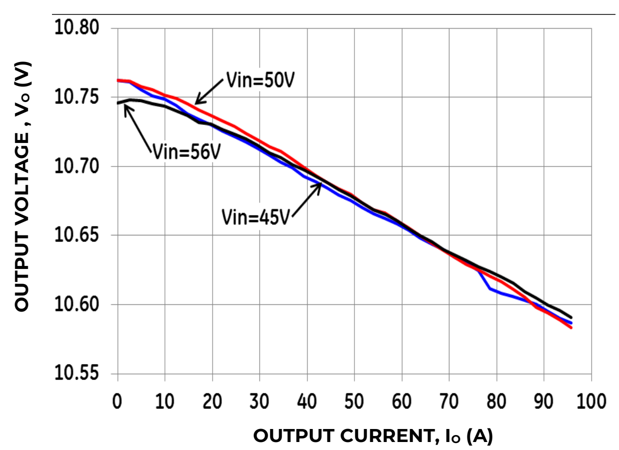
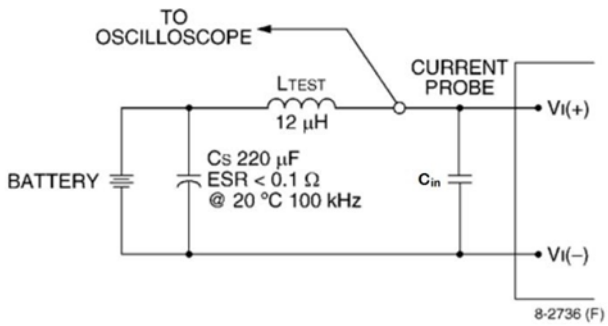


Figure 10. Typical Output Voltage Regulation vs. Output Current for the –P Version. [to be replaced]

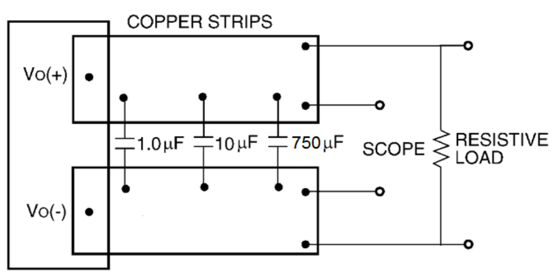
Technical Specifications (continued)

Test Configurations



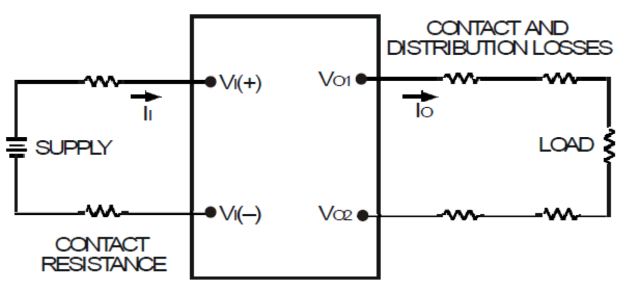
Note: Measure input reflected-ripple current with a simulated source inductance (LTEST) of 12 µH. Capacitor CS offsets possible battery impedance. Measure current as shown above.

Figure 11. Input Reflected Ripple Current Test Setup.



Note: Use a 1.0 µF ceramic capacitor, a 10 µF aluminum or tantalum capacitor and a 750µF polymer capacitor. Scope measurement should be made using a BNC socket. Position the load between 51 mm and 76 mm (2 in. and 3 in.) from the module.

Figure 12. Output Ripple and Noise Test Setup.



Note: All measurements are taken at the module terminals. When socketing, place Kelvin connections at module terminals to avoid measurement errors due to socket contact resistance.

$$\eta = \left(\frac{[V_O(+) - V_O(-)]I_O}{[V_I(+) - V_I(-)]I_I}\right) \times 100\ \%$$

Figure 13. Output Voltage and Efficiency Test Setup.

Design Considerations

Input Source Impedance

The power module should be connected to a low ac-impedance source. Highly inductive source impedance can affect the stability of the power module. For the test configuration in Figure 11, a 660µF electrolytic capacitor, C_{in}, (ESR<0.7Ω at 100kHz), mounted close to the power module helps ensure the stability of the unit.

Safety Considerations

For safety agency approval the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standards, i.e., UL ANSI/UL* 62368-1 and CAN/CSA+ C22.2 No. 62368-1 Recognized, DIN VDE 0868-1/ A11:2017 (EN62368-1:2014/A11:2017)

If the input source is non-SELV (ELV or a hazardous voltage greater than 60 Vdc and less than or equal to $75V_{dc}$), for the module's output to be considered as meeting the requirements for safety extra-low voltage (SELV), all of the following must be true:

- The input source is to be provided with reinforced insulation from any other hazardous voltages, including the ac mains.
- One V_{IN} pin and one V_{OUT} pin are to be grounded, or both the input and output pins are to be kept floating.
- The input pins of the module are not operator accessible.
- Another SELV reliability test is conducted on the whole system (combination of supply source and subject module), as required by the safety agencies, to verify that under a single fault, hazardous voltages do not appear at the module's output.

Note: Do not ground either of the input pins of the module without grounding one of the output pins. This may allow a non-SELV voltage to appear between the output pins and ground.

The power module has safety extra-low voltage (SELV) outputs when all inputs are SELV.

The input to these units is to be provided with a maximum 30A fast-acting (or time-delay) fuse in the ungrounded input lead.

Technical Specifications (continued)

Feature Descriptions

Overcurrent Protection

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry and can endure current limiting continuously. If the overcurrent condition causes the output voltage to fall greater than 3.0V from $V_{o,set,}$ the module will shut down and remain latched off. The overcurrent latch is reset by either cycling the input power or by toggling the on/off pin for one second. If the output overload condition still exists when the module restarts, it will shut down again. This operation will continue indefinitely until the overcurrent condition is corrected.

A factory configured auto-restart option (with overcurrent and overvoltage auto-restart managed as a group) is also available. An auto-restart feature continually attempts to restore the operation until fault condition is cleared.

Remote On/Off

The module contains a standard on/off control circuit reference to the V_{IN}(-) terminal. Two factory configured remote on/off logic options are available. Positive logic remote on/off turns the module on during a logic-high voltage on the ON/OFF pin, and off during a logic low. Negative logic remote on/off turns the module off during a logic high, and on during a logic low. Negative logic, device code suffix "1," is the factory-preferred configuration. The On/Off circuit is powered from an internal bias supply, derived from the input voltage terminals. To turn the power module on and off, the user must supply a switch to control the voltage between the On/Off terminal and the V_{IN}(-) terminal ($V_{on/off}$). The switch can be an open collector or equivalent (see Figure 12). A logic low is $V_{on/off}$ = -0.3V to 0.8V. The typical Ion/off during a logic low (V_{in}=48V, On/Off Terminal=0.3V) is 147µA. The switch should maintain a logic- low voltage while sinking 200µA. During a logic high, the maximum Von/off generated by the power module is 8.2V. The maximum allowable leakage current of the switch at $V_{on/off}$ = 2.4V is 130µA. If using an external voltage source, the maximum voltage Von/off on the pin is 14.5V with respect to the V_{IN}(-) terminal.

If not using the remote on/off feature, perform one of the following to turn the unit on:

For negative logic, short ON/OFF pin to V_{IN}(-).

For positive logic: leave ON/OFF pin open.

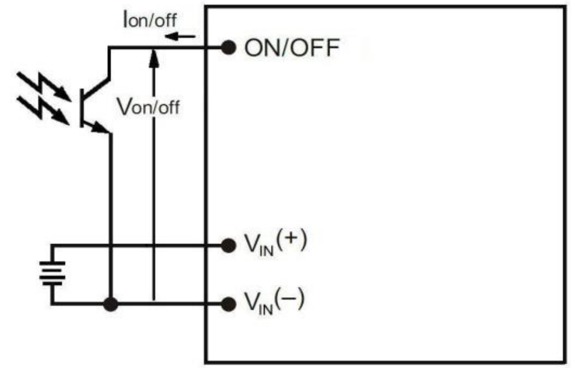


Figure 14. Remote On/Off Implementation.

Output Overvoltage Protection

The module contains circuitry to detect and respond to output overvoltage conditions. If the overvoltage condition causes the output voltage to rise above the limit in the Specifications Table, the module will shut down and remain latched off. The overvoltage latch is reset by either cycling the input power, or by toggling the on/off pin for one second. If the output overvoltage condition still exists when the module restarts, it will shut down again. This operation will continue indefinitely until the overvoltage condition is corrected.

A factory configured auto-restart option (with overcurrent and overvoltage auto-restart managed as a group) is also available. An auto-restart feature continually attempts to restore the operation until fault condition is cleared.

Overtemperature Protection

These modules feature an overtemperature protection circuit to safeguard against thermal damage. The circuit shuts down the module when the maximum device reference temperature is exceeded. The module will automatically restart once the reference temperature cools by ~25°C.

Input Under/Over voltage Lockout

At input voltages above or below the input under/over voltage lockout limits, module operation is disabled. The module will begin to operate when the input voltage level changes to within the under and overvoltage lockout limits.

Load Sharing

For higher power requirements, the QBVE094A0S10R7 power module offers an optional feature for parallel operation (-P Option code). This feature provides a precise forced output voltage load regulation droop characteristic. The output set point and droop slope are factory calibrated to insure optimum matching of multiple modules' load

Technical Specifications (continued)

Load Sharing (continued)

regulation characteristics. To implement load sharing, the following requirements should be followed:

- The V_{OUT}(+) and V_{OUT}(-) pins of all parallel modules must be connected together. Balance the trace resistance for each module's path to the output power planes, to insure best load sharing and operating temperature balance.
- V_{IN} must remain between 45V_{dc} and 56V_{dc} for droop sharing to be functional.
- It is permissible to use a common Remote On/Off signal to start all modules in parallel.
- These modules contain means to block reverse current flow upon start-up, when output voltage is present from other parallel modules, thus eliminating the requirement for external output ORing devices. Modules with the –P option may automatically increase the Turn On delay, T_{delay}, as specified in the Feature Specifications Table, if output voltage is present on the output bus at startup.
- When parallel modules startup into a pre-biased output, e.g. partially discharged output capacitance, the T_{rise} is automatically increased, as specified in the Feature Specifications Table, to insure graceful startup.
- Insure that the total load is <50% $I_{O,MAX}$ (for a single module) until all parallel modules have started (load full start > module T_{delay} time max + T_{rise} time).
- If fault tolerance is desired in parallel applications, output ORing devices should be used to prevent a single module failure from collapsing the load bus.

Power Good (included with –P option)

The Power Good signal is a non-latching open-collector output that is Low during normal operation and is pulled High when any of the following conditions occur:

- Over-Temperature Protection
- Over-Current
- V_{out} is outside of the DC Output Band while V_{in} is within the Vin Operating Range
- V_{in} is within the V_{in} Operating Range, but the unit is not operating (to determine if 1 Unit used in a parallel configuration is not operating)
- V_{in} is outside of the V_{in} Operating Range

Thermal Considerations

The power modules operate in a variety of thermal environments and sufficient cooling should be provided to help ensure reliable operation. Thermal considerations include ambient temperature, airflow, module power dissipation, and the need for increased reliability. A reduction in the operating temperature of the module will result in an increase in reliability. The thermal data presented here is based on physical measurements taken in a wind tunnel. Heat-dissipating components are mounted on the top side of the module. Heat is removed by conduction, convection and radiation to the surrounding environment. Proper cooling can be verified by measuring the thermal reference temperature (T_{ref}).

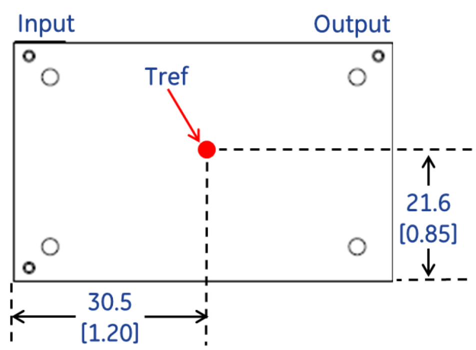


Figure 15. Location of the thermal reference temperature T_{ref} for base plate module.

Peak temperature occurs at the position indicated in Figure 15. For reliable operation this temperature should not exceed T_{ref}=115°C. For extremely high reliability you can limit this temperature to a lower value. The output power of the module should not exceed the rated power for the module as listed in the Ordering Information table, or the derated power for the actual operating conditions as indicated in Figs. 17 -20.

Heat Transfer via Convection

The thermal data presented here is based on physical measurements taken in a wind tunnel, using automated thermo-couple instrumentation to monitor key component temperatures: FETs, diodes, control ICs, magnetic cores, ceramic capacitors, opto-isolators, and module pwb conductors, while controlling the ambient airflow rate and temperature. For a given airflow and ambient temperature, the module output power is increased, until one (or more) of the components reaches its maximum derated operating temperature, as defined in IPC-9592B. This procedure is then repeated for a different airflow or ambient temperature until a family of module output derating curves is obtained.

Technical Specifications (continued)

Heat Transfer via Convection (continued)

Please refer to the Application Note "Thermal Characterization Process For Open-Frame Board-Mounted Power Modules" for a detailed discussion of thermal aspects including maximum device temperatures.

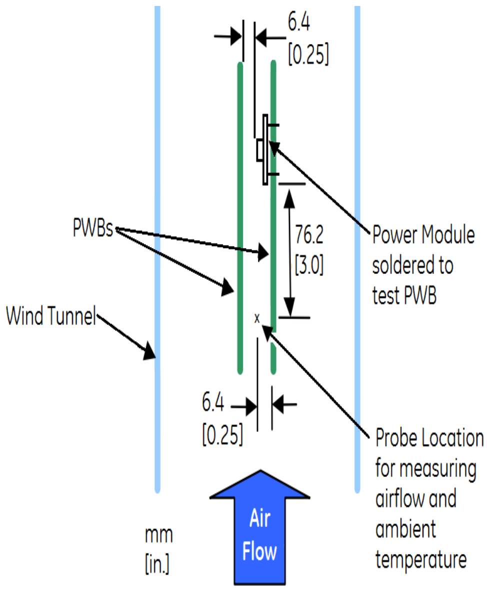


Figure 16. Thermal Test Setup .

Increased airflow over the module enhances the heat transfer via convection. The thermal derating of figure 17- 20 shows the maximum output current that can be delivered by each module in the indicated orientation without exceeding the maximum T_{ref} temperature versus local ambient temperature (T_A) for several air flow conditions.

Temperatures up to 85°C are long-term operating. Under these conditions, the following applies:

All components on the module meet IPC-9592 B derating guidelines

Technical Specifications (continued)

Heat Transfer via Convection (continued)

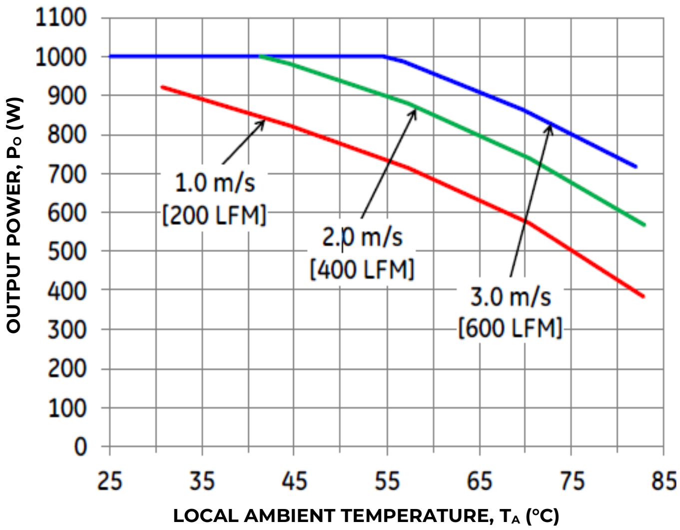


Figure 17. Output Power Derating for the Base plate QBVE094A0S10R7xx-H in the Transverse Orientation; Airflow Direction from V_{in}(-) to V_{in}(+); Vin = 51V.

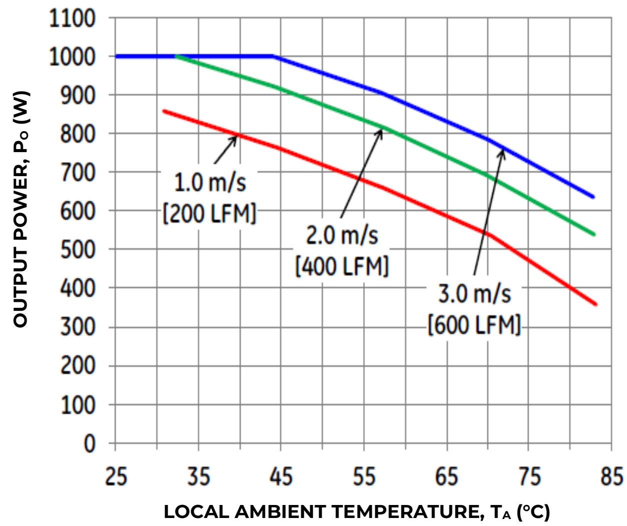


Figure 18. Output Power Derating for the Base Plate QBVE094A0S10R7xx-H in the Longitudinal Orientation; Airflow Direction from V_{out} to V_{in}; V_{in} = 51V.

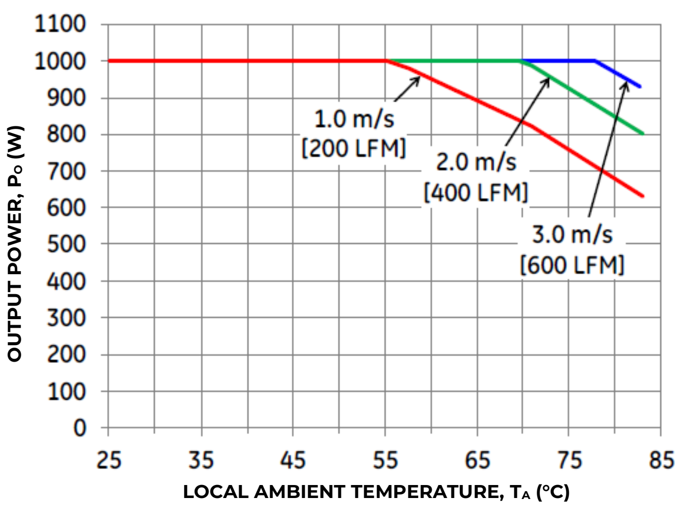


Figure 19. Output Power Derating with a 0.6" Heat Sink on QBVE094A0S10R7xx-H in the Transverse Orientation; Airflow Direction from V_{in}(-) to V_{in}(+); Vin = 51V.

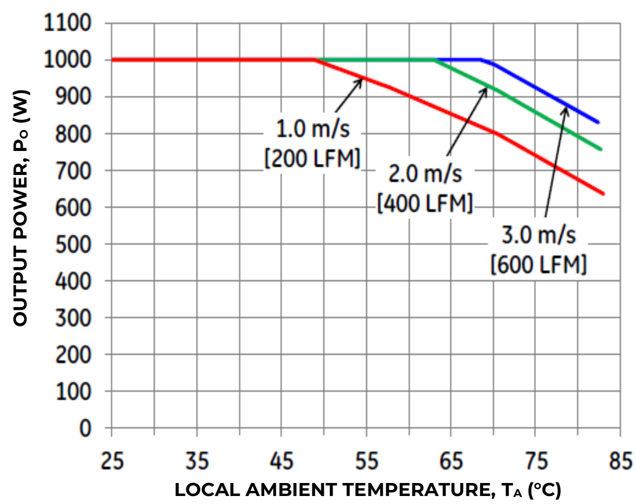


Figure 20. Output Power Derating with a 0.6" Heat Sink on QBVE094A0S10R7xx-H in the Longitudinal Orientation; Airflow Direction from V_{out} to V_{in}; V_{in} = 51V

Technical Specifications (continued)

Layout Considerations

The QBVE094A0S10R7 power module series are low profile in order to be used in fine pitch system card architectures. As such, component clearance between the bottom of the power module and the mounting board is limited. Avoid placing copper areas or via interconnects on the outer layer directly underneath the power module for the following reasons:

- Potential short-circuits due to direct contact and/or solder balls.
- Safety clearances. The safety isolation rating could be invalidated if copper on the mounting board reduces clearance at the isolation boundary.
- Noise coupling. Copper under the module creates stray capacitance that could couple switching noise into the mounting board.

For additional layout guide-lines, refer to FLT012A0Z Data Sheet.

Wave Soldering

The RoHS-compliant, Z version, through-hole products use the SAC (Sn/Ag/Cu) Pb-free solder and RoHS-compliant components. The module is designed to be processed through single or dual wave soldering machines. The pins have a RoHS-compliant, pure tin finish that is compatible with both Pb and Pb-free wave soldering processes. A maximum preheat rate of 3°C/s is suggested. The wave preheat process should be such that the temperature of the power module board is kept below 210°C. For Pb solder, the recommended pot temperature is 260°C, while the Pb-free solder pot is 270°C max.

Reflow Soldering

The RoHS-compliant through-hole products can be processed with the following pin-in-paste (paste-in-hole) Pb or Pb-free reflow process.

Max. sustain temperature :

245°C(J-STD-020C Table 4-2: Packaging Thickness>=2.5mm / Volume > 2000mm^3),

Peak temperature over 245°C is not suggested due to the potential reliability risk of components under continuous high-temperature.

Min. sustain duration above 217°C : 90 seconds Min. sustain duration above 180°C : 150 seconds

Max. heat up rate: 3°C/sec

Max. cool down rate: 4°C/sec

In compliance with JEDEC J-STD-020C spec for 2 times reflow requirement.

Pb-free Reflow Profile

BMP module will comply with JEDEC J-STD-020 Rev. D (Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices) for both Pb-free solder profiles and MSL classification procedures.

BMP will comply with J-STD-020C specification for reflow up to 3 times. When removing a module, using localized hot air counts as one reflow, but using a solder pot instead to heat the pins does not count as a reflow.

The suggested Pb-free solder paste is Sn/Ag/Cu (SAC). The recommended linear reflow profile using Sn/Ag/Cu solder is shown in Figure 21.

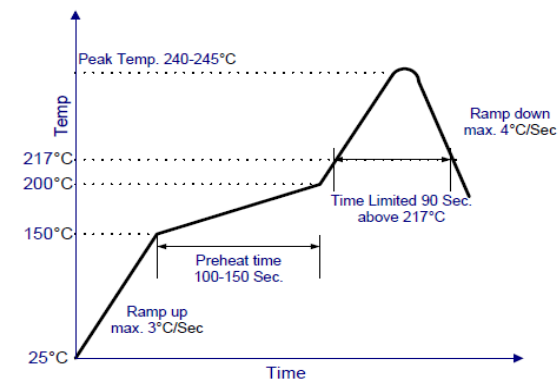


Figure 21. Recommended linear reflow profile using Sn/Ag/Cu solder

MSL Rating

The QBVE094A0S10R7 modules have a MSL rating of 2a.

Storage and Handling

The recommended storage environment and handling procedures for moisture-sensitive surface mount packages is detailed in J-STD-033 Rev. B (Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices). Moisture barrier bags (MBB) with desiccant are required for MSL ratings of 2 or greater. These sealed packages should not be broken until time of use. Once the original package is broken, the floor life of the product at conditions of ≤30°C and 60% relative humidity varies according to the MSL rating (see J-STD-060A). The shelf life for dry packed SMT packages will be a minimum of 12 months from the bag seal date, when stored at the following conditions: < 40° C, < 90% relative humidity.

Post Solder Cleaning and Drying Considerations

Post solder cleaning is usually the final circuit board assembly process prior to electrical board testing. The result of inadequate cleaning and drying can affect both the reliability of a power module and the testability of the finished circuit board assembly. For guidance on appropriate soldering, cleaning and drying procedures, refer to OmniOn Board Mounted Power Modules: Soldering and Cleaning Application Note (AN04-001).

If additional information is needed, please consult with your OmniOn Sales representative for more details.

Technical Specifications (continued)

EMC Considerations

The circuit and plots in Figure 22 shows a suggested configuration to meet the conducted emission limits of EN55032 Class A. For further information on designing for EMC compliance, please refer to the FLT012A0Z data sheet

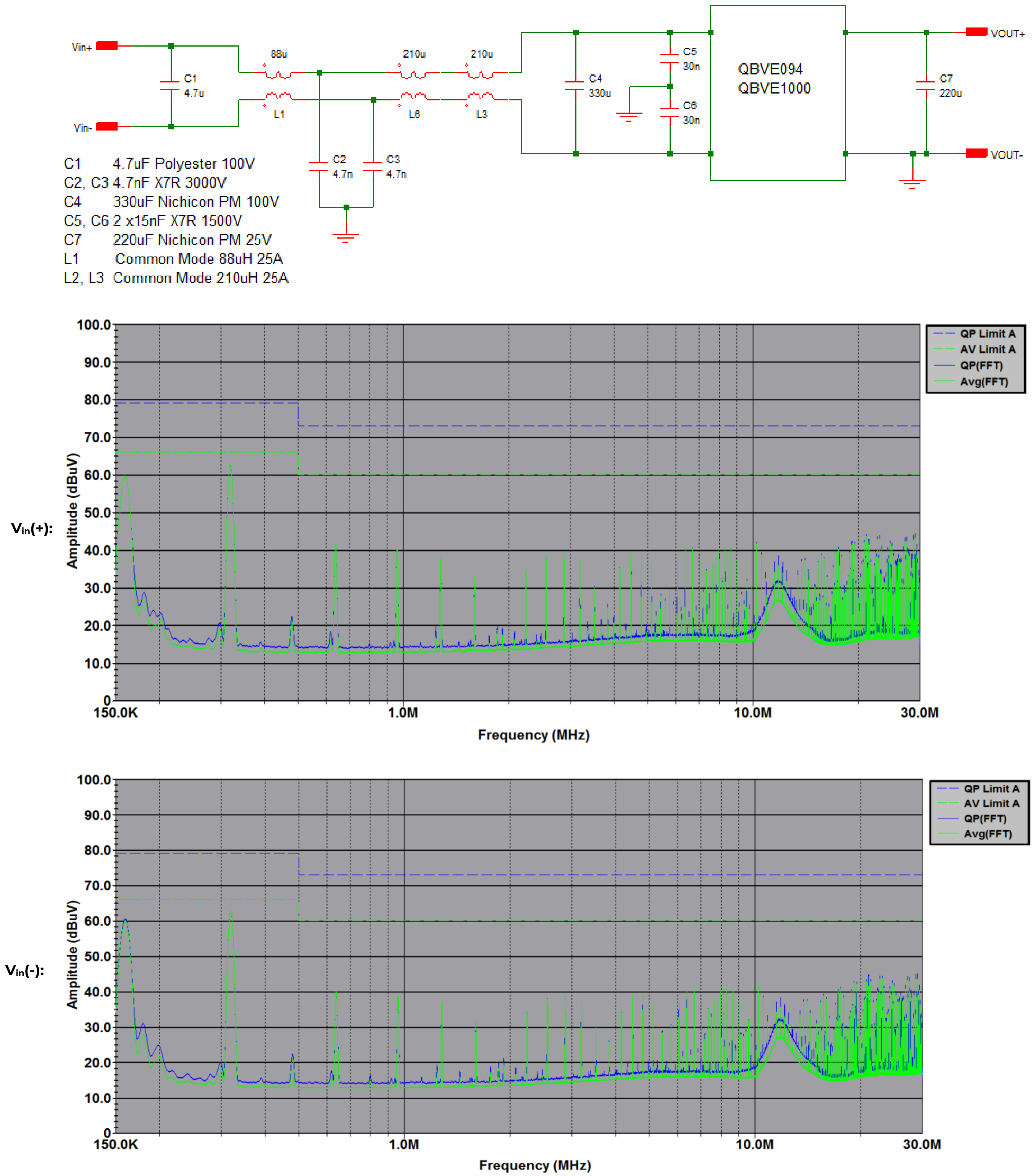


Figure 22. EMC Consideration

Technical Specifications (continued)

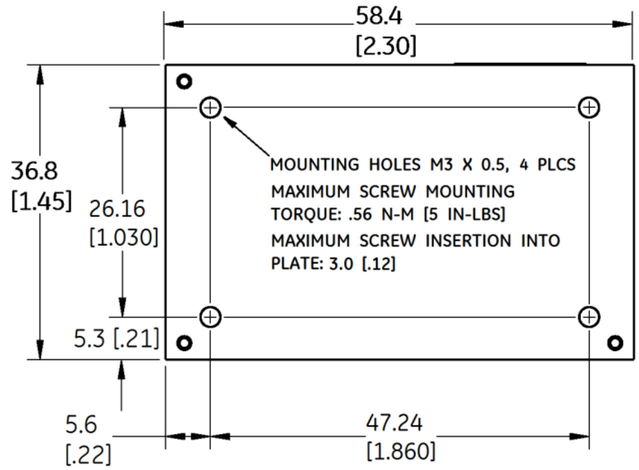
Mechanical Outline for QBVE094A0S10R7-xH (Base plate) Through-hole Module

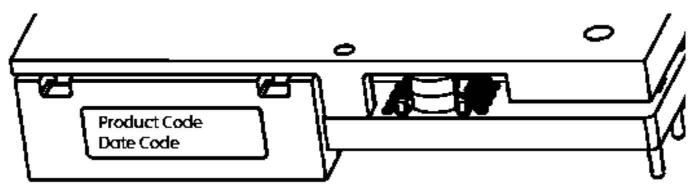
Dimensions are in millimeters and (inches).

Tolerances: x.x mm ± 0.5 mm (x.xx in. ± 0.02 in.) [unless otherwise indicated]

x.xx mm ±0.25 mm (x.xxx in ± 0.010 in.)

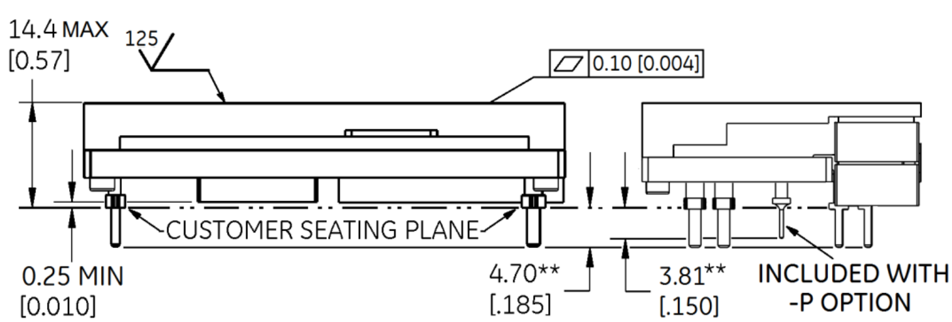
TOP VIEW





*Side label includes product designation, and data code

SIDE/END VIEWS*



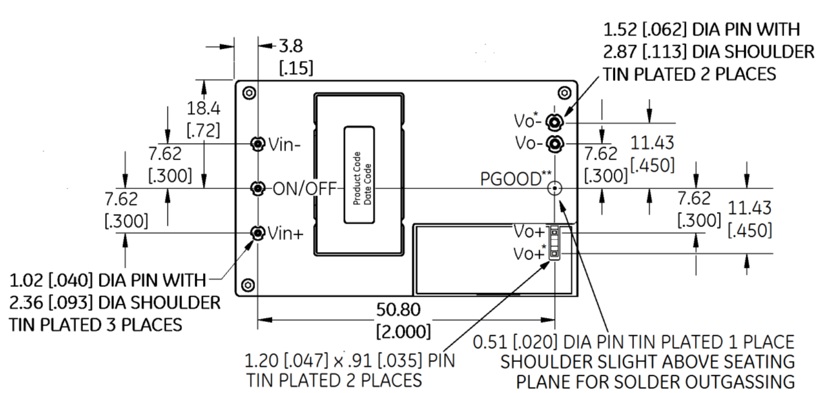
** Standard pin tail length. Optional pin tail lengths shown in Table 2, Device Options.

BOTTOM VIEW***

Pin Number	Pin Name
1	$V_{IN}(+)$
2	ON/OFF
3	$V_{IN}(-)$
4*	$V_{OUT}(-)$
5	$V_{OUT}(-)$
6**	PGOOD
7	$V_{OUT}(+)$
8*	$V_{OUT}(+)$

* Y Option

**P option



***Bottom side label includes OmniOn name, product designation, and data code

Recommended Pad Layout

Dimensions are in millimeters and (inches).

Tolerances: x.x mm ± 0.5 mm (x.xx in. ± 0.02 in.) [unless otherwise indicated]

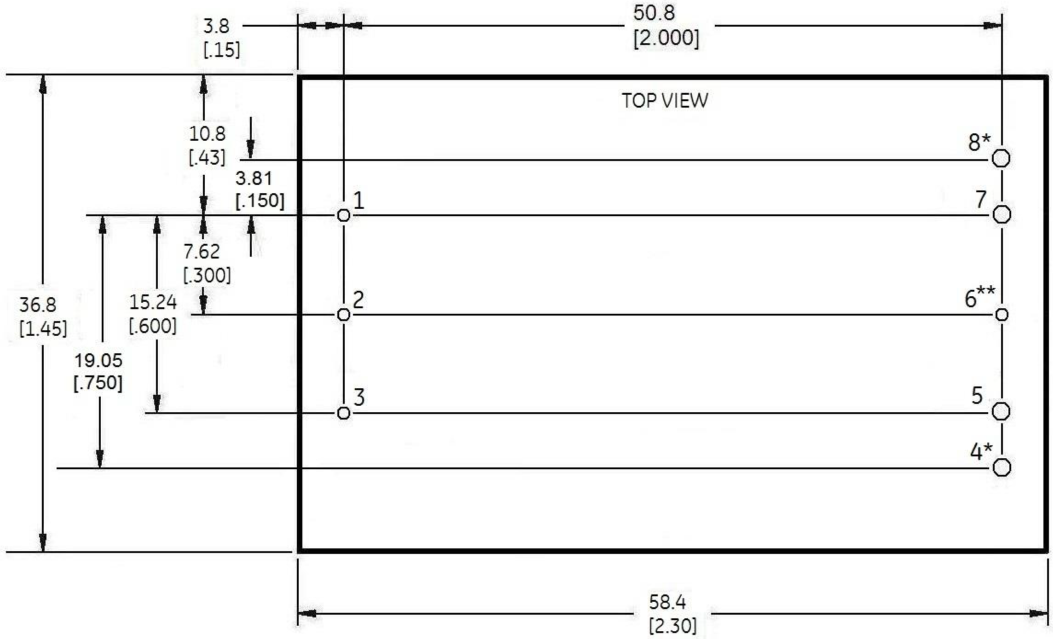
x.xx mm ±0.25 mm (x.xxx in ± 0.010 in.)

Through-Hole Modules

Pin Number	Pin Name
1	$V_{IN}(+)$
2	ON/OFF
3	$V_{IN}(-)$
4*	$V_{OUT}(-)$
5	$V_{OUT}(-)$
6**	PGOOD
7	$V_{OUT}(+)$
8*	$V_{OUT}(+)$

* Y Option

**P option



Hole and Pad diameter recommendations:

Pin Number	Hole Dia mm [in]	Pad Dia mm [in]
1, 2, 3	1.6 [.063]	2.1 [.083]
4*, 5, 7, 8*	2.2 [.087]	3.2 [.126]
6**	1.0 [.039]	1.5 [.059]

* Y Option

**P option

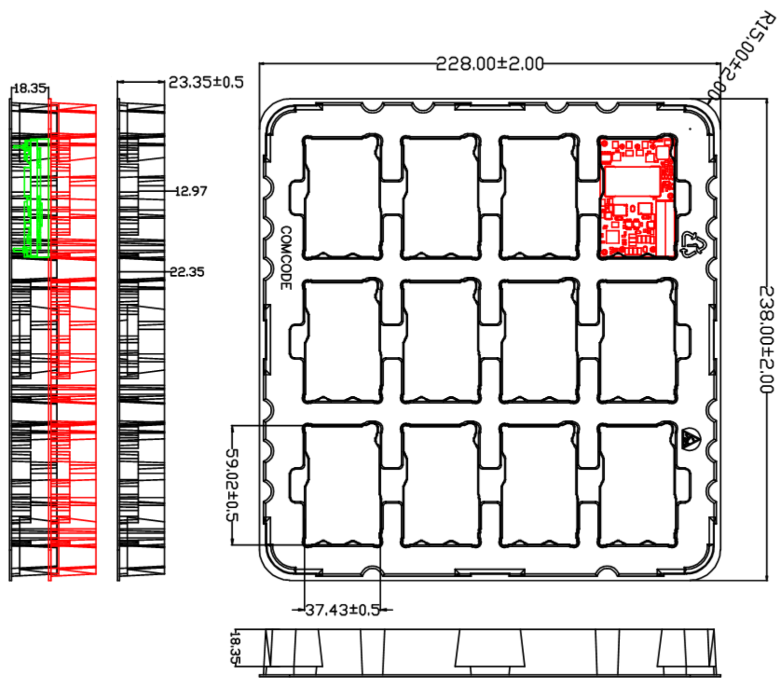
Technical Specifications (continued)

Packaging Details

All versions of the QBVE094A0S10R7 are supplied as standard in the plastic trays shown in Figure 23. Each tray contains a total of 12 power modules. The trays are self-stacking and each shipping box for the QBVE094A0S10R7 module contains 2 full trays plus one empty hold-down tray giving a total number of 24 power modules.

Tray Specification

Material	PET (1mm)
Max surface resistivity	10^9 -10^{11}Ω/PET
Color	Clear
Capacity	12 power modules
Min order quantity	24 pcs (1 box of 2 full trays + 1 empty top tray)



Base Plate Module Tray

Figure 23. QBVE094A0S10R7 Packaging Tray

Technical Specifications (continued)

Ordering Information

Please contact your OmniOn Sales Representative for pricing, availability and optional features.

Product codes	Input Voltage	Output	Output	Efficiency	Output	MSL	Power	Ordering Codes
QBVE094A0S10R741-YPHZ	50/54V (45-56V_{dc})	10.7V	1000W	97.0%	Dual	2a	Yes	150037393
QBVE094A0S10R741-YHZ	50/54V (45-56V_{dc})	10.7V	1000W	97.0%	Dual	2a	No	150049487

Table 1. Device Codes

	Characteristic	Character and Position												Definition
Ratings	Form Factor	**Q**												**Q** = Quarter Brick
	Family Designator		**BV**											**BV**= BARRACUDA Series
	Input Voltage			**E**										**E**=45V-56V
	Output Power				**094A0**									**094A0**= 94.0A Rated Output Current
	Output Voltage				**S10R7**									**S10R7**= 10.7V nominal
Options	Pin Length						**8** **6**							Omit = Default Pin Length shown in Mechanical Outline Figures **8** = Pin Length: 2.79 mm ± 0.25mm , (0.110 in. ± 0.010 in.) **6** = Pin Length: 3.68 mm ± 0.25mm , (0.145 in. ± 0.010 in.)
	Action following Protective Shutdown							**4**						Omit = Latching Mode **4** = Auto-restart following shutdown (Overcurrent/ Overvoltage)
	On/Off Logic								**1**					Omit = Positive Logic **1** = Negative Logic
										-				
	Customer Specific										**NM**			Omit = Standard Module **NM**,= Customer Specific Modified Code, Omit for Standard code
	Single or Dual V_{out} Pin											**Y**		Omit = Standard Single V_{out} Pin Y= Dual V_{out} Pins
	Load Share												**P**	Omit = Tight Load Regulation Module Does not include Power Good Pin and Feature **P**= Forced Droop Output for use in parallel applications Includes Power Good Pin and Feature
	Heat Plate												**H**	Omit = Standard Open Frame Module **H**= Heat plate, for use with heat sinks or cold-walls
	RoHS												**Z**	**Z** = RoHS Compliant

Table 2. Device Options

Contact Us

For more information, call us at

+1-877-546-3243 (US)

+1-972-244-9288 (Int'l)

Change History (excludes grammar & clarifications)

Revision	Date	Description of the change
2.2	04/14/2022	Updated as per template and upgraded RoHS standards
2.3	12/07/2023	Updated as per OmniOn template

OmniOn Power Inc.
601 Shiloh Rd.
Plano, TX USA

omnionpower.com