# SQE48T20120

## Eighth-Brick DC-DC Converter



The new high performance 20 A **SQE48T20120** DC-DC converter provides a high efficiency single output, in a 1/8th brick package that is only 62% the size of the industry-standard quarter-brick. Specifically designed for operation in systems that have limited airflow and increased ambient temperatures, the SQE48T20120 converter utilizes the same pinout and Input/Output functionality of the industry-standard quarter-bricks. In addition, a heat-spreader (baseplate) feature is available (-xDxBx suffix) that provides an effective thermal interface for coldplate and heat sinking options.

The SQE48T20120 converter thermal performance is accomplished through the use advanced circuits, packaging, and processing techniques to achieve ultra-high efficiency, excellent thermal management, and a low-body profile.

Operating from a wide-range 36-75 V input, the SQE48T20120 converter provides a fully regulated 12V output voltage. Employing a standard power pinout, the SQE48T20120 converter is an ideal drop-in replacement for existing high current quarter-brick designs. Inclusion of this converter in a new design can result in significant board space and cost savings. The designer can expect reliability improvement over other available converters because of the SQE48T20120's optimized thermal efficiency.

RoHS Compliant

## Key Features & Benefits

- 36-75 VDC Input; 12.0 VDC @ 20 A Output
- Industry-standard quarter-brick pinout
- Delivers 240W at 94.2% efficiency
- Withstands 100V input transient for 100ms
- Fixed-frequency operation
- On-board input differential LC-filter
- Start-up into pre-biased load
- No minimum load required
- Meets Basic Insulation requirements
- Fully protected (OTP, OCP, OVP, UVLO)
- Positive or negative logic ON/OFF option
- Low height of 0.44" (11.18 mm)
- Weight: 32 g w/o baseplate, 40 g with baseplate
- High reliability: MTBF = 14.3 million hours, calculated per Telcordia SR-332, Method I Case 1
- Approved to the latest edition of the following standards:
- UL/CSA60950-1, IEC60950-1 and EN60950-1.
- Designed to meet Class B conducted emissions per FCC and EN55022 when used with external filter
- All materials meet UL94, V-0 flammability rating

## Applications

- Intermediate Bus Architectures
- Data communications/processing
- LAN/WAN
- Servers, Workstations



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## 1. ELECTRICAL SPECIFICATIONS

Conditions: $T_A$ = 25 °C, Airflow = 300 LFM (1.5 m/s), Vin = 48 VDC, Cin=100 µF, unless otherwise specified.

| PARAMETER | NOTES | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| ***Absolute Maximum Ratings*** | | | | | |
| Input Voltage | Continuous | -0.3 | | 80 | VDC |
| | Transient (100ms) | | | 100 | VDC |
| Operating Temperature | Ambient ($T_A$) | -40 | | 85 | °C |
| | Component ($T_C$)[1] | -40 | | 125 | °C |
| (See Derating Curves) | Baseplate ($T_B$) | -40 | | 105 | °C |
| Storage Temperature | | -55 | | 125 | °C |
| ***Isolation Characteristics*** | | | | | |
| I/O Isolation | Dielectric strength | 2,250 | | | VDC |
| Isolation Capacitance | UL/CSA60950-1, EN60950-1, and | | 1200 | | pF |
| Isolation Resistance | IEC60950-1. Basic Insulation | 10 | | | MΩ |
| Input to Baseplate | | 1,500 | | | VDC |
| Output to Baseplate | | 1,500 | | | VDC |
| ***Feature Characteristics*** | | | | | |
| Switching Frequency | | 428 | 450 | 502 | kHz |
| Output Voltage Trim Range[2] | | | n/a | | % |
| Remote Sense Compensation[2] | | | n/a | | % |
| Output Overvoltage Protection | Non-latching | 110 | 120 | 130 | % |
| Over Temperature Shutdown | Non-latching, Component ($T_C$)[2] | | 130 | | °C |
| Auto-Restart Period | Applies to all protection features | | 250 | | ms |
| Turn-On Time from Vin | Time from UVLO to Vo = 90% $V_{OUT(NOM)}$<br>Resistive load | | 22 | 25 | ms |
| Turn-On Time from ON/OFF Control | Time from ON to Vo = 90%$V_{OUT(NOM)}$<br>Resistive load | | 12 | 15 | ms |
| Turn-On Time from Vin<br>(w/ Co max.) | Time from UVLO to Vo = 90% $V_{OUT(NOM)}$<br>Resistive load, $C_{EXT}$ = 10,000 µF load | | 22 | 25 | ms |
| Turn-On Time from ON/OFF Control<br>(w/ Co max.) | Time from ON to Vo = 90% $V_{OUT(NOM)}$<br>Resistive load, $C_{EXT}$ = 10,000 µF load | | 12 | 15 | ms |
| ON/OFF Control (Positive Logic) | Converter Off (logic low) | -20 | | 0.8 | VDC |
| | Converter On (logic high) | 2.4 | | 20 | VDC |
| ON/OFF Control (Negative Logic) | Converter Off (logic low) | 2.4 | | 20 | VDC |
| | Converter On (logic high) | -20 | | 0.8 | VDC |
| ***Input Characteristics*** | | | | | |
| Operating Input Voltage Range | | 36 | 48 | 75 | VDC |
| Input Undervoltage Lockout | Turn-on Threshold | 31.5 | 34.5 | 35.5 | VDC |
| | Turn-off Threshold | 30 | 32 | 34.0 | VDC |
| Lockout Hysteresis Voltage | | 1.5 | 2.0 | 2.5 | VDC |
| Maximum Input Current | Po = 240W @ 36 VDC In | | | 7.3 | ADC |
| Input Standby Current | Vin = 48V, converter disabled | | 3 | 5 | mA |
| Input No Load Current<br>(No load on the output) | Vin = 48V, converter enabled | 50 | 70 | 130 | mA |

[1] Reference Figure E for component ($T_C$ and $T_B$) locations.
[2] This functionality not provided, however the unit is fully regulated.



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| | | | | | |
|---|---|---|---|---|---|
| Input Reflected-Ripple Current, ic | Vin = 48V, 25 MHz bandwidth, Po = 240 W (Figs. 19, 20, 21) | | 760 | 900 | $mA_{PK-PK}$ |
| | | | 265 | 325 | $mA_{RMS}$ |
| Input Reflected-Ripple Current, is | | | 8 | 14 | $mA_{PK-PK}$ |
| | | | 2 | 5 | $mA_{RMS}$ |
| Input Voltage Ripple Rejection | 120 Hz | | 45 | | dB |
| ***Output Characteristics*** | | | | | |
| Output Voltage Setpoint | $V_{IN}$ = 48 V, $I_{OUT}$ = 0 Amps, $T_A$ = 25°C | 11.76 | 12.00 | 12.24 | VDC |
| Output Regulation | | | | | |
| Over Line | $I_{OUT}$ = 20 Amps, $T_A$ = 25°C | | ±12 | ±24 | mV |
| Over Load | $V_{IN}$ = 48 V, , $T_A$ = 25°C | | ±6 | ±12 | mV |
| Output Voltage Range | Over line, load and temperature | 11.64 | | 12.36 | VDC |
| Output Ripple and Noise – 25 MHz bandwidth | $I_{OUT}$ = 20 Amps, $C_{EXT}$ =10 µF tantalum + 1 µF ceramic | | 50 | 100 | $mV_{PK-PK}$ |
| | | | 25 | 50 | $V_{RMS}$ |
| Admissible External Load Capacitance | $I_{OUT}$ = 20 Amps (resistive) $C_{EXT}$ | 0[3] | | 10,000 | µF |
| | ESR | 1 | | | mOhm |
| Output Current Range | | 0 | | 20 | ADC |
| Current Limit Inception | Non-latching | 22 | 25 | 29 | ADC |
| RMS Short-Circuit Current | Non-latching Short = 10 mΩ | | 2.4 | 5 | $A_{RMS}$ |
| ***Dynamic Response*** | | | | | |
| Load Change 50%-75%-50% of $I_{OUT}$ Max (di/dt = 0.1 A/µs) | $C_{EXT}$ = 10µF tantalum + 1 µF ceramic | | 75 | 140 | mV |
| Settling Time to 1% of $V_{OUT}$ | | | 30 | 50 | µs |
| ***Efficiency*** | | | | | |
| @ 100% Load | 48$V_{IN}$, $T_A$ = 25°C, 300LFM | | 94.2 | | % |
| @ 60% Load | | | 94 | | % |
| ***Environmental*** | | | | | |
| Operating Humidity | Non-condensing | | | 95 | % |
| Storage Humidity | Non-condensing | | | 95 | % |
| ***Mechanical*** | | | | | |
| Weight | Without baseplate | | 32 | | g |
| | With baseplate | | 40 | | g |
| Vibration | GR-63-CORE, Sect. 5.4.2 | 1 | | | g |
| Shocks | Half Sinewave, 3-axis | 50 | | | g |
| ***Reliability*** | | | | | |
| MTBF | Telcordia SR-332, Method I Case 1 50% electrical stress, 40°C components | | 14.3 | | MHrs |
| ***EMI and Regulatory Compliance*** | | | | | |
| Conducted Emissions | CISPR 22 B with external EMI filter network | | | | |

[3] See *"Input Output Impedance"*, Page 4



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# 2. OPERATIONS

## 2.1 INPUT AND OUTPUT IMPEDANCE

These power converters have been designed to be stable with no external capacitors when used in low inductance input and output circuits.

However, in some applications, the inductance associated with the distribution from the power source to the input of the converter can affect the stability of the converter. A 100 µF electrolytic capacitor with adequate ESR based on input impedance is recommended to ensure stability of the converter.

In many end applications, a high capacitance value is applied to the converter's output via distributed capacitors. The power converter will exhibit stable operation with external load capacitance up to 10,000 µF.

## 2.2 ON/OFF (Pin 2)

The ON/OFF pin is used to turn the power converter on or off remotely via a system signal. There are two remote control options available, positive and negative logic, with both referenced to Vin(-). A typical connection is shown in Figure A.
The positive logic version turns on when the ON/OFF pin is at a logic high or left open and turns off when it is at a logic low. See the Electrical Specifications for logic high/low definitions.

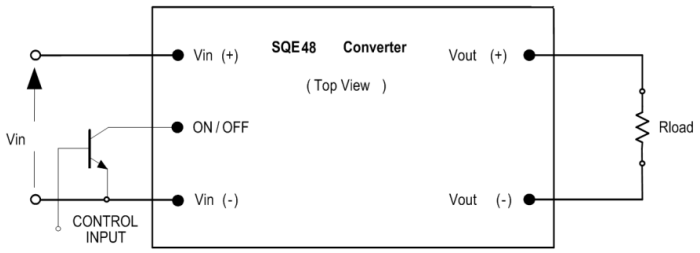



*Figure A. Circuit configuration for ON/OFF function.*

The negative logic version turns on when the ON/OFF pin is at a logic low and turns off when the pin is at logic high. To enable automatic power up of the converter without the need of an external control signal the ON/OFF pin can be hard wired directly to Vin(-) for N and left open for P version.

The ON/OFF pin is internally pulled up to 5V 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. The device must be capable of sinking up to 0.2 mA at a low level voltage of ≤ 0.8 V. An external voltage source (±20 V maximum) may be connected directly to the ON/OFF input, in which case it must be capable of sourcing or sinking up to 1 mA depending on the signal polarity. See the Startup Information section for system timing waveforms associated with use of the ON/OFF pin.

# 3. PROTECTION FEATURES

## 3.1 INPUT UNDERVOLTAGE LOCKOUT

Input undervoltage lockout is standard with this converter. The converter will shut down when the input voltage drops below a pre-determined voltage.

The input voltage must be typically 35V for the converter to turn on. Once the converter has been turned on, it will shut off when the input voltage drops typically below 33V. This feature is beneficial in preventing deep discharging of batteries used in telecom applications.

## 3.2 OUTPUT OVERCURRENT PROTECTION (OCP)

The converter is protected against overcurrent or short circuit conditions. Upon sensing an overcurrent condition, the converter will shut down after entering the constant current mode of operation, regardless of the value of the output voltage.



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Once the converter has shut down, it will enter hiccup mode with attempt to restart every 260ms until the overload or short circuit conditions are removed.

## 3.3 OUTPUT OVERVOLTAGE PROTECTION (OVP)

The converter will shut down if the output voltage across Vout(+) and Vout(-) exceeds the threshold of the OVP circuitry. The OVP circuitry contains its own reference, independent of the output voltage regulation loop. Once the converter has shut down, it will attempt to restart every 260 ms until the OVP condition is removed.

## 3.4 OVERTEMPERATURE PROTECTION (OTP)

The converter will shut down under an overtemperature condition to protect itself from overheating caused by operation outside the thermal derating curves, or operation in abnormal conditions. The converter will automatically restart after it has cooled to a safe operating temperature.

## 3.5 SAFETY REQUIREMENTS

The converters are safety approved to UL/CSA60950-1, EN60950-1, and IEC60950-1. Basic Insulation is provided between input and output.

The converters have no internal fuse. To comply with safety agencies requirements, an input line fuse must be used external to the converter. A 10 A fuse is recommended for use with this product. The fuse must not be placed in the grounded input line. The SQE48 converter is UL approved for a maximum fuse rating of 15Amps**.**

## 3.6 ELECTROMAGNETIC COMPATIBILITY (EMC)

EMC requirements must be met at the end-product system level, as no specific standards dedicated to EMC characteristics of board mounted component dc-dc converters exist. However, Bel Power Solutions tests its converters to several system level standards, primary of which is the more stringent EN55022, Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.

An effective internal LC differential filter significantly reduces input reflected ripple current, and improves EMC.

With the addition of an external filter, the SQE48T20120 converter will pass the requirements of Class B conducted emissions per EN55022 and FCC requirements. Refer to Figures 18 – 19 for typical performance with external filter.

## 3.7 STARTUP INFORMATION (USING NEGATIVE ON/OFF)

**Scenario #1: Initial Startup From Bulk Supply**
ON/OFF function enabled, converter started via application of $V_{IN}$. See Figure. B.

| Time | Comments |
|---|---|
| $t_0$ | ON/OFF pin is ON; system front end power is toggled on, $V_{IN}$ to converter begins to rise. |
| $t_1$ | $V_{IN}$ crosses Undervoltage Lockout protection circuit threshold; converter enabled. |
| $t_2$ | Converter begins to respond to turn-on command (converter turn-on delay). |
| $t_3$ | Converter $V_{OUT}$ reaches 100% of nominal value. |

For this example, the total converter startup time **($t_3$ - $t_1$)** is typically 22 ms.

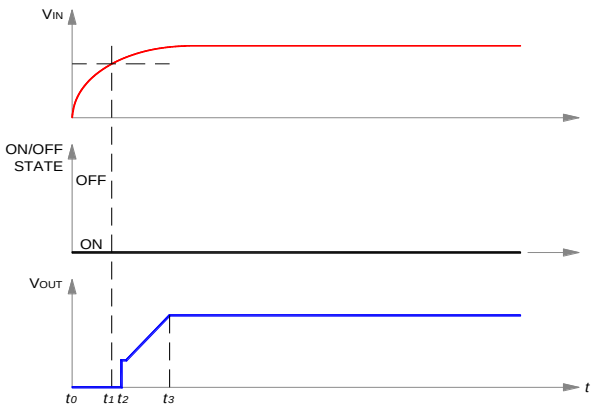



*Figure B. Startup scenario #1.*



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**Scenario #2: Initial Startup Using ON/OFF Pin**
With $V_{IN}$ previously powered, converter started via ON/OFF pin. See Figure C.

| Time | Comments |
|---|---|
| $t_0$ | $V_{INPUT}$ at nominal value. |
| $t_1$ | Arbitrary time when ON/OFF pin is enabled (converter enabled). |
| $t_2$ | End of converter turn-on delay. |
| $t_3$ | Converter $V_{OUT}$ reaches 100% of nominal value. |

For this example, the total converter startup time **($t_3$- $t_1$)** is typically 12 ms.

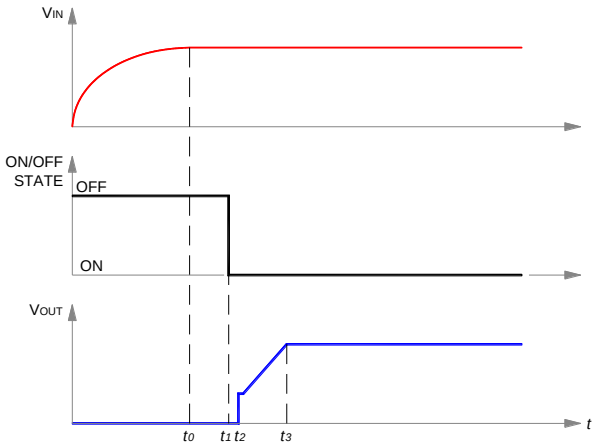



*Figure C. Startup scenario #2.*

**Scenario #3: Turn-off and Restart Using ON/OFF Pin**
With $V_{IN}$ previously powered, converter is disabled and then enabled via ON/OFF pin. See Figure D.

| Time | Comments |
|---|---|
| $t_0$ | $V_{IN}$ and $V_{OUT}$ are at nominal values; ON/OFF pin ON. |
| $t_1$ | ON/OFF pin arbitrarily disabled; converter output falls to zero; turn-on inhibit delay period (300 ms typical) is initiated, and ON/OFF pin action is internally inhibited. |
| $t_2$ | ON/OFF pin is externally re-enabled.<br>**If ($t_2$ - $t_1$) ≤ 250 ms**, external action of ON/OFF pin is locked out by startup inhibit timer.<br>**If ($t_2$ - $t_1$) > 250 ms**, ON/OFF pin action is internally enabled. |
| $t_3$ | Turn-on inhibit delay period ends. If ON/OFF pin is ON, converter begins turn-on; if off, converter awaits ON/OFF pin ON signal; see Figure F. |
| $t_4$ | End of converter turn-on delay. |
| $t_5$ | Converter $V_{OUT}$ reaches 100% of nominal value. |

For the condition **($t_2$-$t_1$) ≤ 250 ms**, the total converter startup time **($t_5$-$t_2$)** is typically 272 ms. For **($t_2$-$t_1$) > 250 ms**, startup will be typically 22 ms after release of ON/OFF pin.

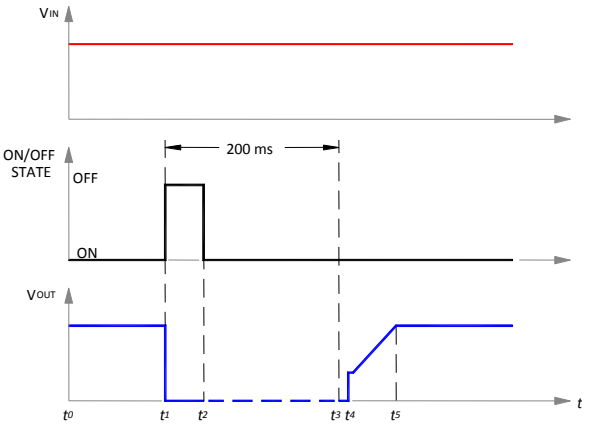



*Figure D. Startup scenario #3.*

# 4. CHARACTERIZATION

## 4.1 GENERAL INFORMATION

The converter has been characterized for many operational aspects, to include thermal derating (maximum load current as a function of ambient temperature and airflow), efficiency, startup and shutdown parameters, output ripple and noise, transient response to load step-change, overcurrent, and short circuit.

The following pages contain specific plots or waveforms associated with the converter. Additional comments for specific data are provided below.

## 4.2 TEST CONDITIONS

All data presented were taken with the converter soldered to a test board, specifically a 0.060” thick printed wiring board (PWB) with four layers. The top and bottom layers were not metalized. The two inner layers, comprised of two-ounce copper, were used to provide traces for connectivity to the converter.

The lack of metallization on the outer layers as well as the limited thermal connection ensured that heat transfer from the converter to the PWB was minimized. This provides a worst-case but consistent scenario for thermal derating purposes.



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All measurements requiring airflow were made in the vertical and horizontal wind tunnel using Infrared (IR) thermography and thermocouples for thermometry.

Ensuring components on the converter do not exceed their ratings is important to maintaining high reliability. If one anticipates operating the converter at or close to the maximum loads specified in the derating curves, it is prudent to check actual operating temperatures in the application. Thermographic imaging is preferable; if this capability is not available, then thermocouples may be used. The use of AWG #40 gauge thermocouples is recommended to ensure measurement accuracy. Careful routing of the thermocouple leads will further minimize measurement error. Refer to Figure E for the optimum measuring thermocouple location.

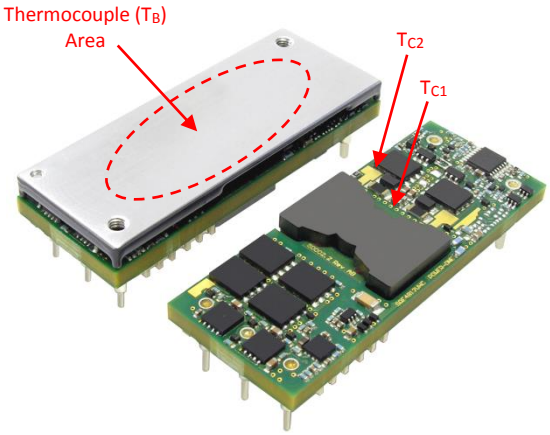



*Fig. E: Location of the thermocouple for thermal testing.*

## 4.3 THERMAL DERATING

### AIR COOLED

Load current vs. ambient temperature and airflow rates are given in Figures 1 for converter w/o base plate, and in Figure 7 and 8 for converter with Baseplate and 0.25" and 0.5" tall heatsink, respectively. Ambient temperature was varied between 25°C and 85°C, with airflow rates from 30 to 500LFM (0.15 to 2.5m/s).

For each set of conditions, the maximum load current was defined as the lowest of:

(i) The output current at which any FET junction temperature does not exceed a maximum temperature of 125°C as indicated by the thermal measurement.
(ii) The output current at which the temperature at the thermocouple locations $T_{C1}$ and $T_{C2}$ do not exceed 125°C (Figure E).
(iii) The nominal rating of the converter (20A/240W).

### BASEPLATE COLED (P/N: -XGXBX)

The maximum load current rating vs. baseplate temperature is provided in Figure 9. The ambient temperature of the converter was maintained ≤ 85°C, with an airflow rate of ≤ 30LFM (≤ 0.15m/s).
Thermocouple measurements were maximized, as above, to the following limits:
$T_{C1}$ ≤ 125°C, $T_{C2}$ ≤ 125°C & $T_B$ ≤ 105°C.
The user should design for $T_B$ ≤ 105°C.
Note that use of baseplate alone without heatsink or attachment to cold plate provides lower power rating then open frame unit due to the present baseplate temperature limitation of 105°C.

## 4.4 EFFICIENCY

Figure 10 shows the efficiency vs. load current plot for ambient temperature ($T_A$) of 25°C, airflow rate of 300LFM (1.5m/s) with vertical mounting and input voltages of 36V, 48V, and 75V.
Efficiency vs. load current and ambient temperature for converter w/o baseplate mounted vertically with Vin = 48 V and air flowing from pin 3 to pin 1 at a rate of 200 LFM (1.0 m/s) is shown in Figure 12.



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## 4.5 POWER DISSIPATION

Figure 11 shows the power dissipation vs. load current for $T_A$=25ºC, airflow rate of 300LFM (1.5m/s) with vertical mounting and input voltages of 36V, 48V, and 75V.

Figure 1 shows the power dissipation vs. load current and ambient temperature for converter w/o baseplate mounted vertically with Vin = 48 V and air flowing from pin 3 to pin 1 at a rate of 200 LFM (1.0 m/s).

## 4.6 STARTUP

Output voltage waveforms, during the turn-on transient using the ON/OFF pin for full rated load currents (resistive load) are shown with and without external load capacitance in Figure 14 and 15, respectively.

## 4.7 RIPPLE AND NOISE

Figure 18 shows the output voltage ripple waveform, measured at full rated load current with a 10µF tantalum and a 1µF ceramic capacitor across the output. Note that all output voltage waveforms are measured across the 1µF ceramic capacitor.

The input reflected-ripple current waveforms are obtained using the test setup shown in Figure 19.The corresponding waveforms are shown in Figure 20 and Figure 21.

## 4.8 THERMAL CONSIDERATIONS

In general, high density power converter modules built with integrated baseplates are selected when they are to interface with the users' cold plate, bulkhead or other physical heat sinking surface. Baseplates alone do not necessarily improve the power converter's power capability when compared to the same module without baseplate.

Output power de-rating charts are provided for modules both with and without an integrated baseplate.

All performance charts below (Fig. 3 thru 9) reflect modules with integrated baseplates.

Figures 3 - 6: Power derating with the baseplate temperature (TBP) maintained ≤ 115°C and TJ ≤ 120°C.

Figures 7 - 9: Power derating with TBP maintained ≤ 105°C and TJ ≤ 110°C.

(with approved Operational insulation (to 2.250 VDC)

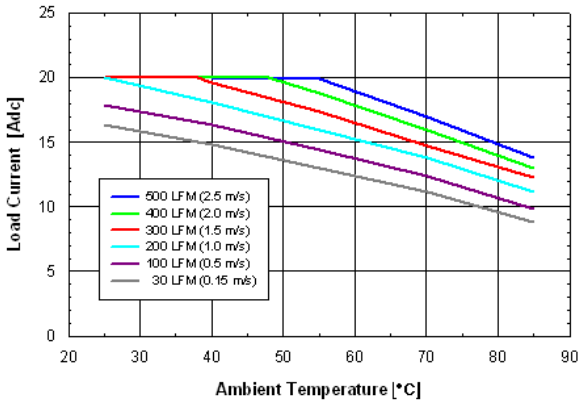



*Figure 1: Available load current vs. ambient air temperature and airflow rates for SQE48T20120 converter mounted vertically with air flowing from pin 3 to pin 1, MOSFET temperature ≤ 125°C, Vin = 48 V.[1]*

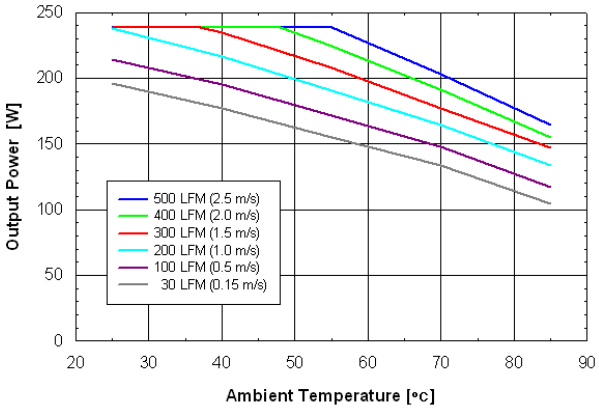



*Figure 2: Available output power vs. ambient air temperature and airflow rates for SQE48T20120 converter mounted vertically with air flowing from pin 3 to pin 1, MOSFET temperature ≤ 125°C, Vin = 48 V.[1]*



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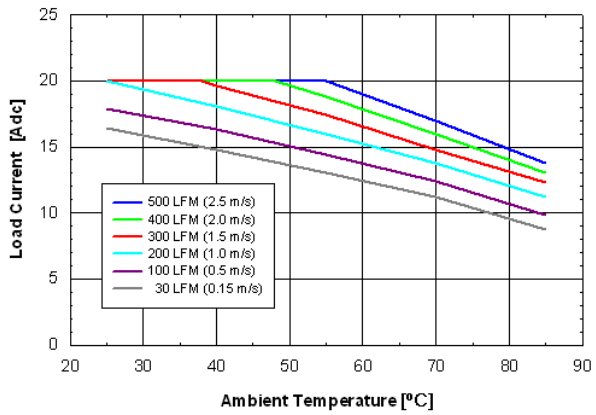



*Figure 3: Available load current vs. ambient air temperature and airflow rates for SQE48T20120 converter mounted vertically with air flowing from pin 3 to pin 1, MOSFET temperature ≤ 120°C, Vin = 48 V (nom.).[2]*

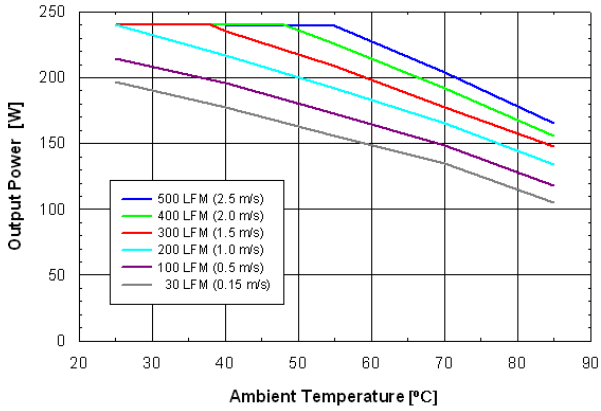



*Figure 4: Available output power vs. ambient air temperature and airflow rates for SQE48T20120 converter mounted vertically with air flowing from pin 3 to pin 1, MOSFET temperature ≤ 120 °C, Vin = 48 V (nom.).[2]*

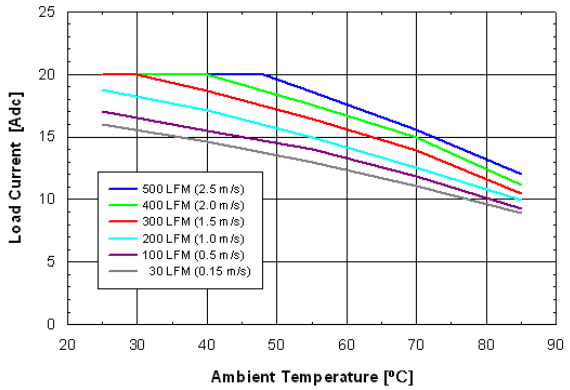



*Figure 5: Available load current vs. ambient air temperature and airflow rates for SQE48T20120 converter mounted vertically with air flowing from In/Out, MOSFET temperature ≤ 120 °C, Vin = 48 V (nom.).[3]*

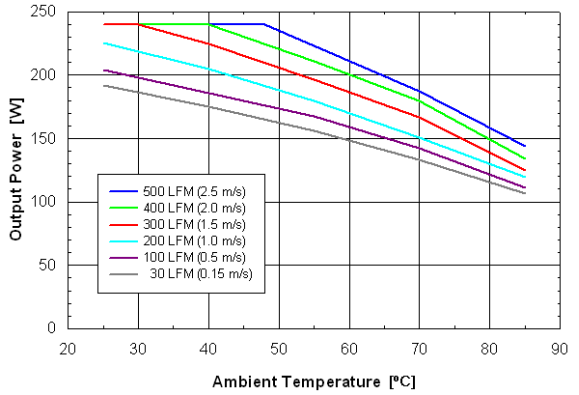



*Figure 6: Available output power vs. ambient air temperature and airflow rates for SQE48T20120 converter mounted vertically with air flowing from In/Out, MOSFET temperature ≤ 120 °C,Vin = 48 V (nom.).[3]*

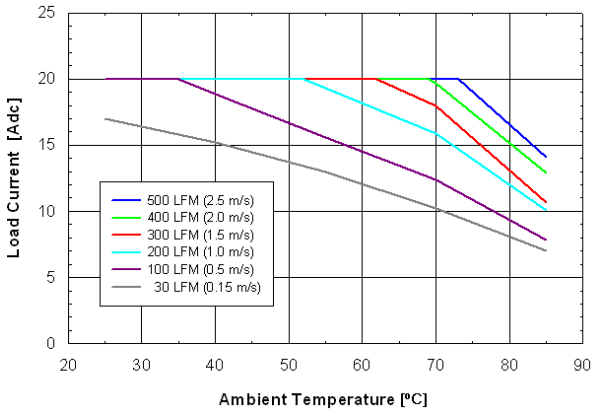



*Figure 7: Available load current vs. ambient air temperature and airflow rates for SQE48T20120 converter with baseplate option and 0.25" tall transverse-fin heatsink. Unit mounted vertically with air flowing from pin 3 to pin 1, Vin = 48 V (nom.).[4]*

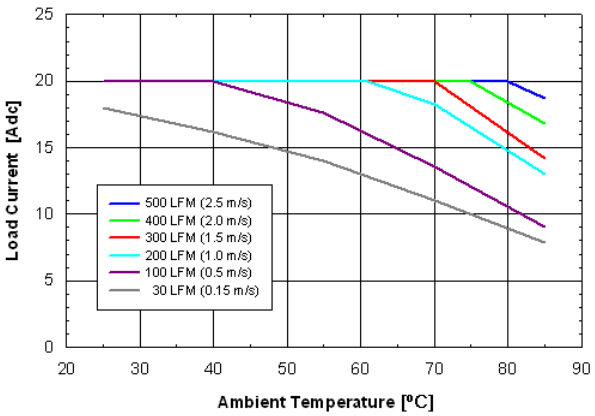



*Figure 8: Available load current vs. ambient air temperature and airflow rates for SQE48T20120 converter with baseplate option and 0.5" tall transverse-fin heatsink. Unit mounted vertically with air flowing from pin 3 to pin 1, Vin = 48 V (nom.).[4]*



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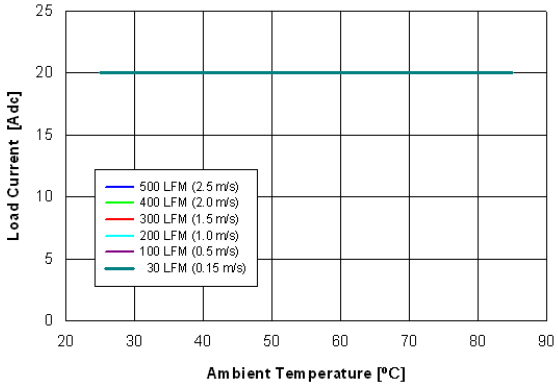



*Figure 9: Power derating of SQE48T20120 converter with baseplate option and cold plate cooling. (Conditions: $T_B \leq 105°C$, $T_A \leq 85°C$, Air velocity ≤ 30LFM (≤ 0.15m/s), Vin = 48V.[4]*

*[1]Figures 1 & 2 without Baseplate, Transverse airflow, $T_J \leq 125°C$*
*[2] Figures 3 & 4 with Baseplate, Transverse airflow, $T_J \leq 120$ °C*
*[3]Figures 5 & 6 with Baseplate, Longitudinal airflow, $T_J \leq 120°C$*
*[4]Figures 7 - 9 with baseplate, cold plate, heatsink combinations, $T_J \leq 110$ °C*

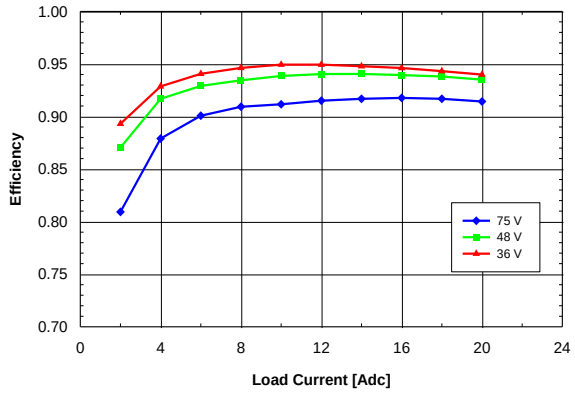



*Figure 10: Efficiency vs. load current and input voltage for converter w/o baseplate mounted vertically with air flowing from pin 3 to pin 1 at a rate of 300 LFM (1.5 m/s) and Ta = 25 °C.*

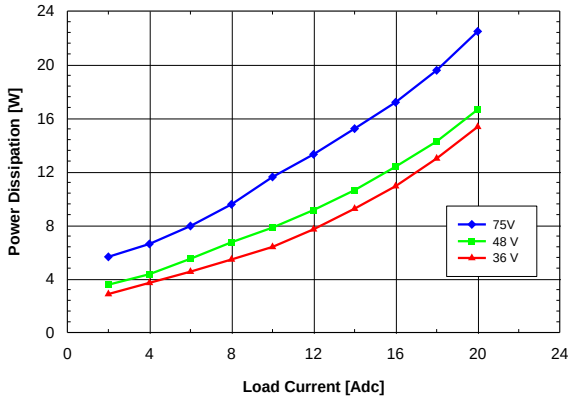



*Figure 11: Power dissipation vs. load current and input voltage for converter w/o baseplate mounted vertically with air flowing from pin 3 to pin 1 at a rate of 300 LFM (1.5 m/s) and Ta = 25 °C.*

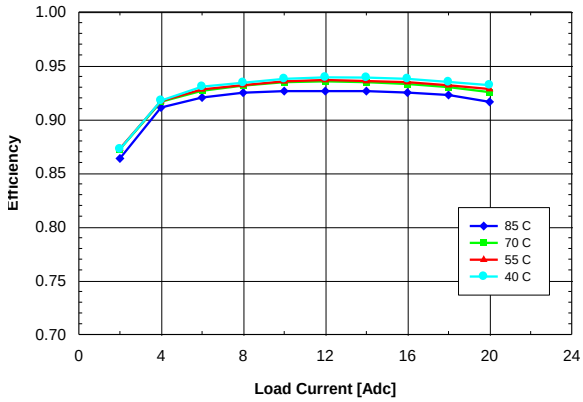



*Figure 12: Efficiency vs. load current and ambient temperature for converter w/o baseplate mounted vertically with Vin = 48 V and air flowing from pin 3 to pin 1 at a rate of 200 LFM (1.0 m/s).*

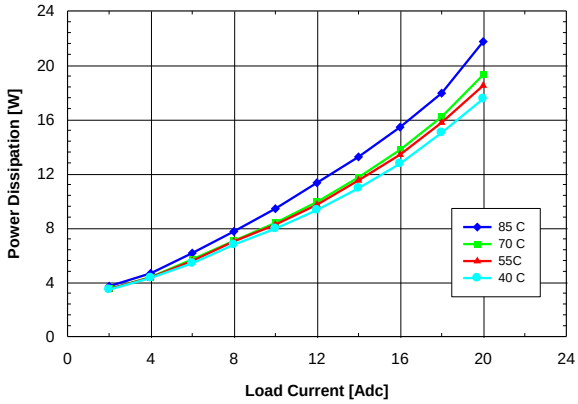



*Figure 13: Power dissipation vs. load current and ambient temperature for converter w/o baseplate mounted vertically with Vin = 48 V and air flowing from pin 3 to pin 1 at a rate of 200 LFM (1.0 m/s).*



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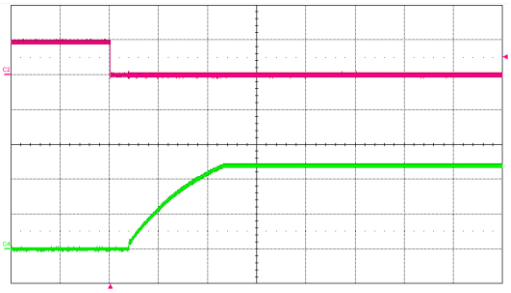


*Figure 14: Turn-on transient at full rated load current (resistive) with Cout 10 µF tantalum + 1 µF ceramic at Vin = 48 V, triggered via ON/OFF pin. Top trace: ON/OFF signal (5 V/div.). Bottom trace: output voltage (5 V/div.). Time scale: 5 ms/div.*

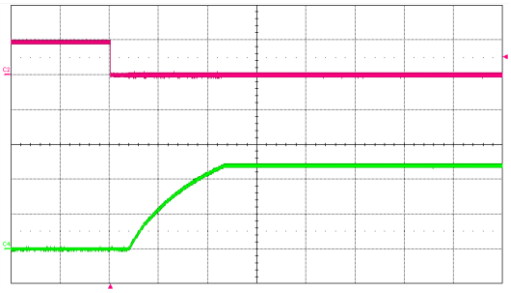


*Figure 15: Turn-on transient at full rated load current (resistive) plus 10,000 µF at Vin = 48 V, triggered via ON/OFF pin. Top trace: ON/OFF signal (5 V/div.). Bottom trace: output voltage (5 V/div.). Time scale: 5 ms/div*

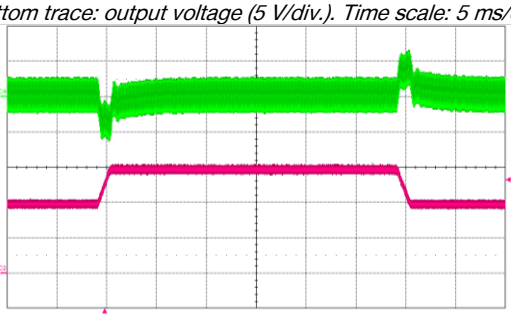


*Figure 16: Output voltage response to load current step-change (10 A – 15 A – 10 A) at Vin = 48 V. Top trace: output voltage (100mV/div.). Bottom trace: load current (5 A/div.). Current slew rate: 0.1 A/µs. Co = 1 µF ceramic + 10 µF tantalum. Time scale: 200 µs/div.*

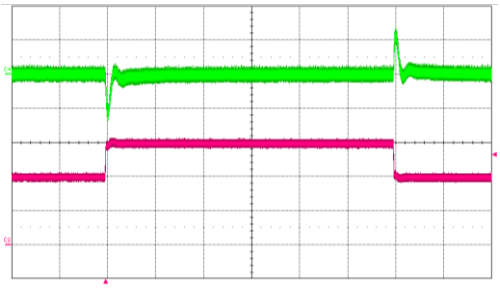


*Figure 17: Output voltage response to load current step-change (10 A – 15 A – 10 A) at Vin = 48 V. Top trace: output voltage (200mV/div.). Bottom trace: load current (5 A/div.). Current slew rate: 1 A/µs. Co = 1 µF ceramic + 100 µF POS.Time scale: 200µs/div.*

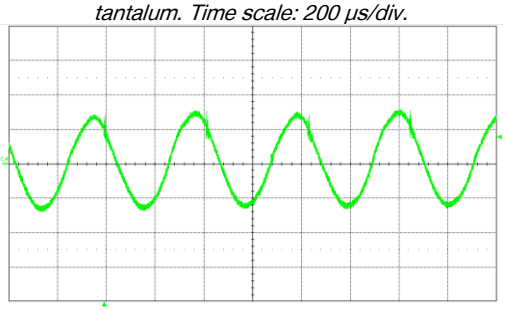


*Figure 18: Output voltage ripple (20mV/div.) at full rated load current into a resistive load with Co = 10µF tantalum + 1µF ceramic and Vin = 48V. Time scale: 1µs/div.*

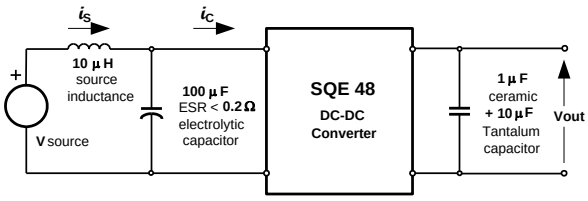



*Figure 19: Test setup for measuring input reflected ripple currents, $i_c$ and $i_s$.*

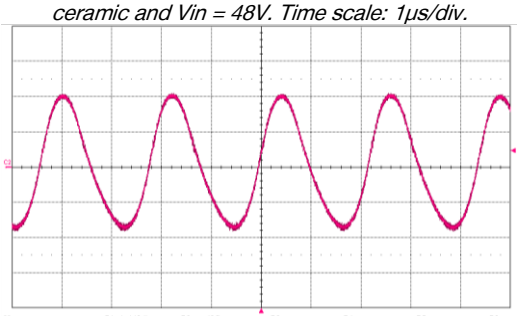


*Figure 20: Input reflected ripple current, $i_c$ (200 mA/div.), measured at input terminals at full rated load current and Vin = 48V. Refer to Figure 32 for test setup. Time scale:1µs/div.*

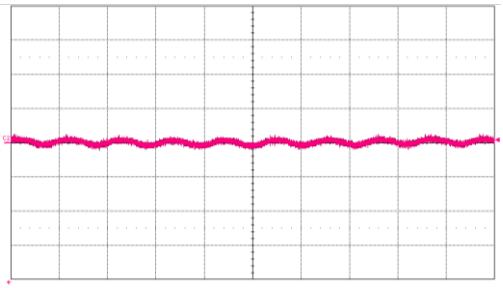


*Figure 21: Input reflected ripple current, $i_s$ (20 mA/div.), measured through 1µH at the source at full rated load current and Vin = 48V.Refer to Fig. 14 for test setup. Time scale: 2 µs/div*



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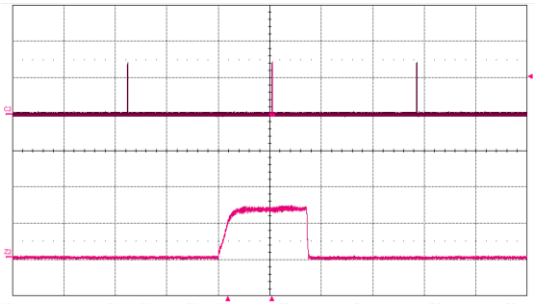


*Figure 22: Load current (top trace, 20 A/div., 100 ms/div.) into a 10 mΩ short circuit during restart, at Vin = 48 V. Bottom trace (20 A/div., 1 ms/div.) is an expansion of the on-time portion of the top trace*

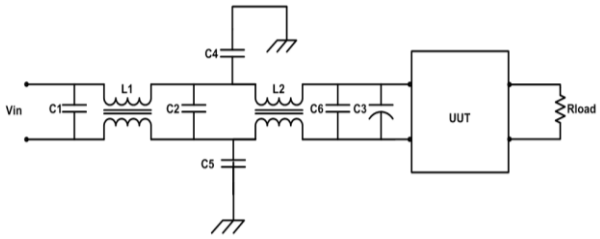



*Figure 23: Typical input EMI filter circuit to attenuate conducted emissions*

| COMP. DES. | DESCRIPTION |
|---|---|
| C1, C2, C6 | (2EA, 6 capacitors)<br>1 uF, 100 V ceramic cap |
| C3 | 33 uF, 100 V electrolytic cap |
| L1, L2 | 0.59mH, Pulse P0353NL |
| C4, C5 | 4,700 pF, ceramic cap |

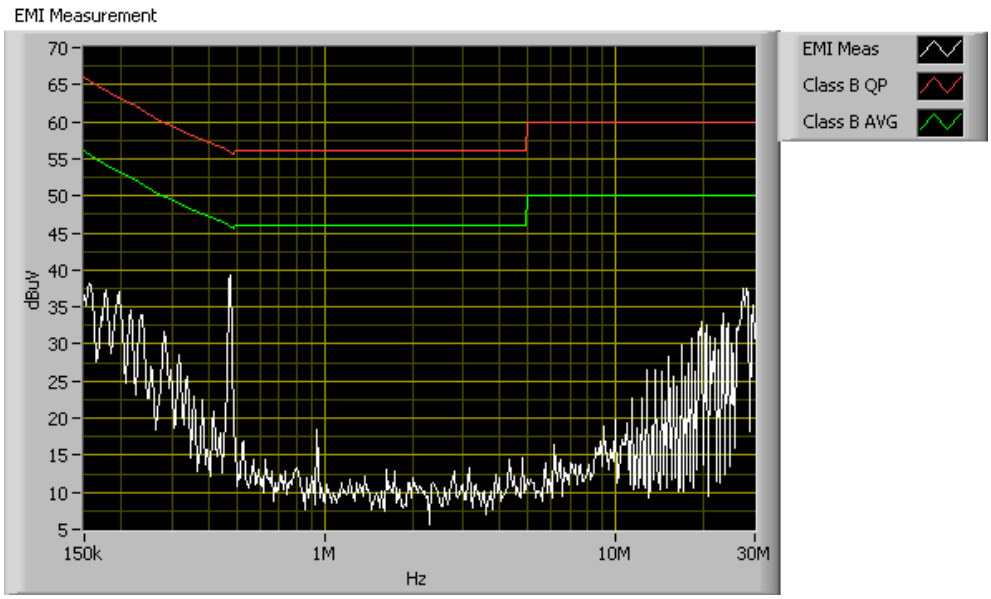


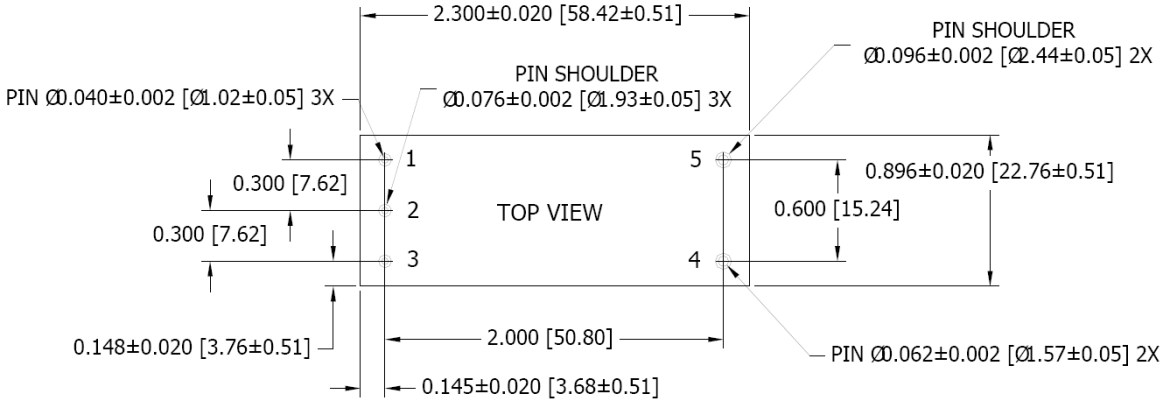

*Figure 24: Input conducted emissions measurement (Typ.) of SQE48T20120.*
*Conditions: $V_{IN}$ = 48 VDC, $I_{OUT}$ = 20 AMPS*

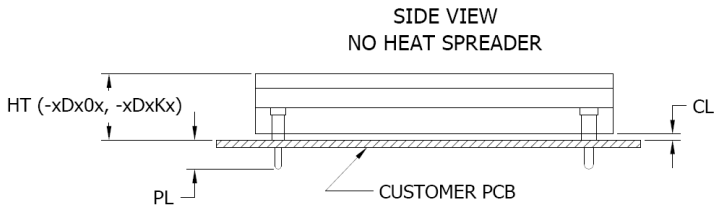


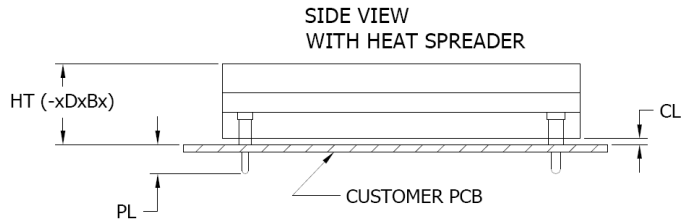
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# 5. MECHANICAL PARAMETERS

## 5.1 SQE48T PINOUT (THROUGH-HOLE)




| HEIGHT [HT] | | MIN CLEARANCE [CL] | SPECIAL FEATURES |
|---|---|---|---|
| D | 0.440" [11.18] Max | 0.028" [0.71] | 0 |
| | 0.500" +/- 0.020 [12.70 +/-0.51] | 0.028" [0.71] | B |

| Pin Option | PL Pin Length |
|---|---|
| | ±0.005 [±0.13] |
| A | 0.188 [4.78] |
| B | 0.145 [3.68] |

| PAD/PIN CONNECTIONS | |
|---|---|
| Pad/Pin # | Function |
| 1 | Vin (+) |
| 2 | ON/OFF |
| 3 | Vin (-) |
| 4 | Vout (-) |
| 6 | Vout (+) |

**SQE48T Platform Notes**

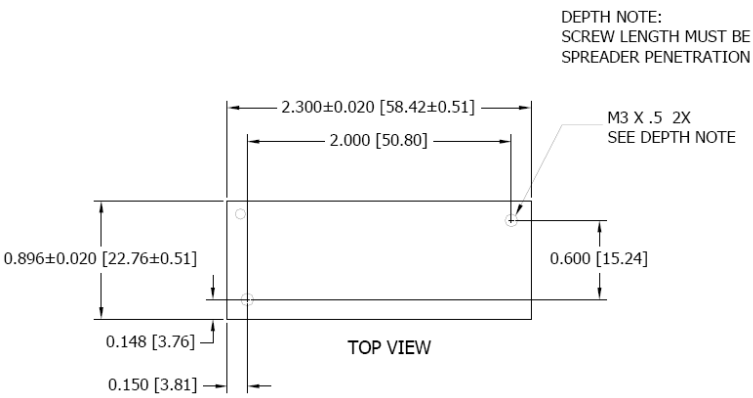
- All dimensions are in inches [mm]
- Pins 1-3 are Ø 0.040" [1.02] with Ø 0.076" [1.93] shoulder
- Pins 4 and 5 are Ø 0.062" [1.57] with are Ø 0.096" [2.44] shoulder
- Pin Material: Brass Alloy 360
- Pin Finish: Tin over Nickel

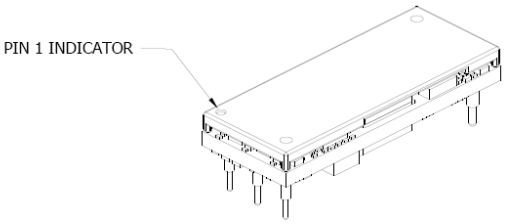


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## 5.2 HEAT SPREADER INTERFACE INFORMATION




**NOTE:** Maximum allowable torque on heat spreader screw hole is 8kgF.cm

## 5.3 ORDERING INFORMATION

| PRODUCT SERIES | INPUT VOLTAGE | MOUNTING SCHEME | RATED LOAD CURRENT | OUTPUT VOLTAGE | | ON/OFF LOGIC | MAX HEIGHT [HT] | PIN LENGTH [PL] | SPECIAL FEATURES | ROHS |
|---|---|---|---|---|---|---|---|---|---|---|
| **SQE** | **48** | **T** | **20** | **120** | **-** | **N** | **D** | **A** | **B** | **G** |
| 1/8th Brick Format | 36-75 V | T⇒ Through-hole | 20 ⇒ 20 ADC | 120 ⇒ 12.0 V | | N ⇒ Negative<br>P ⇒ Positive | D ⇒ 0.440" for –xDx0x<br>0.520" for –xDxBx | Through hole<br>A ⇒ 0.188"<br>B ⇒ 0.145" | 0 ⇒ Standard<br>B ⇒ Baseplate option<br>L ⇒ Enhanced input surge ride through | No Suffix ⇒ RoHS lead-solder-exemption compliant<br>G ⇒ RoHS compliant for all six substances |

The example above describes P/N SQE48T20120-NDABG: 36-75 V input, through-hole, 20 A @ 12 V output, negative enable (ON/OFF logic), pin length of 0.188", maximum height of 0.52", 2250 VDC isolation, no common mode capacitor, RoHS compliant for all 6 substances and integral heat spreader (Baseplate).

Consult factory for availability of other options.

## For more information on these products consult: tech.support@psbel.com

**NUCLEAR AND MEDICAL APPLICATIONS** - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.
**TECHNICAL REVISIONS** - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.



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