

### Features:

- ✓ 12 Volt / 12 Amp output
- ✓ Greater than 92% Efficient
- ✓ Input 5V Standard Buck Regulator
- ✓ Full 144 Watt capability to more than 70 °C
- ✓ Output voltage trim capability
- ✓ Thermal and overload protection
- ✓ Microprocessor controlled supervisory functions
- ✓ Out-gassing feature ensures reliable pin soldering
- ✓ RoHS Compliant

**OBSOLETE PRODUCT**



Table 1

| Input Characteristics              | Notes & Conditions (1)                                                       | Min  | Typ.     | Max | Units            |
|------------------------------------|------------------------------------------------------------------------------|------|----------|-----|------------------|
| Input Voltage Operating Range      |                                                                              | 36   | 48       | 75  | Vdc              |
| Input Voltage Transient Protection |                                                                              |      |          | 100 | Vdc              |
| Input Undervoltage Lockout         | Turn-on Threshold                                                            | 32   |          | 35  | Vdc              |
|                                    | Turn-off Threshold                                                           | 31   |          | 34  | Vdc              |
|                                    | Hysteresis Voltage                                                           |      | 1        |     | Vdc              |
| Input Overvoltage Lockout          | Turn-on Threshold                                                            | 76   |          | 80  | Vdc              |
|                                    | Turn-off Threshold                                                           | 75   |          | 79  | Vdc              |
|                                    | Hysteresis Voltage                                                           |      | 1        |     | Vdc              |
| Input Current                      | Steady-State                                                                 |      | 3.3      |     | A                |
| No-Load Input Current              | Enabled state                                                                |      | 150      |     | mA               |
| Disabled Input Current             | Disabled state                                                               |      |          |     | mA               |
| Input Reflected Ripple Current (2) |                                                                              |      |          | 25  | mA p-p           |
| Inrush Current Transient           |                                                                              |      |          | 0.1 | A <sup>2</sup> s |
| Enable Characteristics             | Internal pull-up voltage, ref. to Vi(-)<br>Input Impedance, internal pull-up |      | 5<br>100 |     | Vdc<br>kOhms     |
| Enable – Negative Logic Version    | On State range                                                               | -0.1 |          | 0.8 | Vdc              |
| Enable – Positive Logic Version    | Off State range                                                              | -0.1 |          | 0.8 | Vdc              |



For full details go to  
[www.murata-ps.com/rohs](http://www.murata-ps.com/rohs)

Table 2

| Output Characteristics                   | Notes & Conditions (1)            | Min       | Typ.  | Max       | Units  |
|------------------------------------------|-----------------------------------|-----------|-------|-----------|--------|
| Output Voltage Set Point                 | Trim feature not used             | 11.88     | 12    | 12.12     | Vdc    |
| Output Line Regulation                   |                                   |           |       | 0.2       | %      |
| Output Load Regulation                   |                                   |           |       | 0.2       | %      |
| Output Voltage Total Regulation          |                                   | 11.8<br>1 |       | 12.1<br>9 | Vdc    |
| Output Ripple Voltage & Noise (3)        | 20 MHz Bandwidth                  |           | 50    | 100       | mV p-p |
| Output Current Operating Range           |                                   | 0         |       | 12        | A      |
| Efficiency                               | 100% Load                         |           | 93    |           | %      |
| Turn-On Time                             | Vin present: Enable to 90% Vout   |           | 13    |           | ms     |
| Start-up Inhibit Time                    | Enabled: Vin applied to 90% Vout  |           | 15    |           | ms     |
| Transient Response (4)                   | 25% step, 0.1A/μs, ΔVo            |           |       | 200       | mV     |
|                                          | Recovery Time                     |           |       | 300       | μs     |
| Remote Sense Compensation Range (5), (6) | Of Output Voltage Set Point, typ. |           |       | +10       | %      |
| Output Voltage Trim Range (6)            | Of Output Voltage Set Point, typ. | -20       |       | +10       | %      |
| Maximum Output Capacitance               |                                   |           | 3,900 |           | μF     |

Table 3

| Protection Characteristics    | Notes & Conditions (1) | Min | Typ. | Max  | Units |
|-------------------------------|------------------------|-----|------|------|-------|
| Output Over-Current Shutdown  | Non-Latching           |     | 14   |      | A     |
|                               | Re-start rate          |     | 3    |      | s     |
| Over Voltage Shutdown         | Latching               | 14  |      | 15.2 | Vdc   |
| Over Temperature Shutdown (7) | Non-Latching           |     | 125  |      | °C    |

Table 4

| General Specifications                             | Notes & Conditions (1)                                 | Min  | Typ. | Max | Units               |
|----------------------------------------------------|--------------------------------------------------------|------|------|-----|---------------------|
| Isolation Voltage                                  | Input to Output                                        | 1500 |      |     | Vdc                 |
| Isolation Resistance                               | Input to Output                                        | 10   |      |     | Mohm                |
| Isolation Capacitance                              |                                                        |      | 6800 |     | pF                  |
| Storage Temperature Range                          | Non-condensing                                         | -40  |      | 125 | °C                  |
| Thermal Measurement Location (TML) Temperature (9) | See mechanical drawing for location                    |      |      |     |                     |
| Operating Temperature Range                        | Measured at TML                                        | -40  |      | 120 | °C                  |
| Semiconductor Junction Temperature                 | Package Rating                                         |      |      | 150 | °C                  |
| Material Flammability                              | UL 94V-0                                               |      |      |     |                     |
| MTBF                                               | Calculated (Bellcore TR-332)                           | 1.2  |      |     | 10 <sup>6</sup> Hrs |
|                                                    | Demonstrated                                           | tbd  |      |     | 10 <sup>6</sup> Hrs |
| Switching Frequency                                |                                                        |      | 350  |     | kHz                 |
| Dimension (LxWxH)                                  | 2.28"L x 1.45" W x 0.47"H<br>(57.91 x 36.83 x 11.8 mm) |      |      |     |                     |
| Weight                                             |                                                        |      |      |     | grams               |

Table 5

| Standards Compliance | Notes & Conditions (8)                                  |
|----------------------|---------------------------------------------------------|
| UL/CSA 60950         | c-UL-us recognized (basic Insulation), UL File# E165113 |
| TUV                  | (Bauart) certified                                      |

### Notes:

- (1)  $V_{in} = 48V_{dc}$ ,  $T_a = 25\text{ }^{\circ}\text{C}$ , Airflow = 200 LFM unless otherwise noted.
- (2) Input Reflected Ripple Current is specified when measured with the filter shown in Figure 7.
- (3) Output Ripple Voltage and noise is specified when measured with a 10uF tantalum and a 1uF ceramic capacitor at the converter output pins.
- (4) Transient response is specified without a capacitor at the output of the converter.
- (5) If remote sense is not required or used, the Sense(+) and Sense(-) pins must be connected to  $V_o(+)$  and  $V_o(-)$  respectively.
- (6) See 'Remote Sense' and 'Trim Feature' details regarding output voltage range limitations.
- (7) Thermal shutdown is monitored at the 'Thermal Measurement Location' (TML). See 'Mechanical Information' on page 4 for the thermal measurement location.
- (8) See 'Safety Considerations'.
- (9) De-rating curves are conducted in a controlled environment. End application testing is required to ensure the Thermal Measurement Location temperature is below the maximum specified.



### Pin Assignment

Table 6

| Pin # | Pin Name | Function                | Notes & Conditions                                                                                                                |
|-------|----------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 1     | Vi(+)    | Positive Input Voltage  |                                                                                                                                   |
| 2     | En       | Input Enable / Disable  | Referenced to Vo(-).<br>No external source required.<br>Positive Logic: Floating = Enabled<br>Negative Logic: Floating = Disabled |
| 3     | Vi(-)    | Negative Input Voltage  |                                                                                                                                   |
| 4     | Vo(-)    | Negative Output Voltage |                                                                                                                                   |
| 5     | Sense(-) | Negative Remote Sense   | Must be connected to Vo(-)                                                                                                        |
| 6     | Trim     | Output Voltage Trim     | See 'Trim Feature' below                                                                                                          |
| 7     | Sense(+) | Positive Remote Sense   | Must be connected to Vo(+)                                                                                                        |
| 8     | Vo(+)    | Positive Output Voltage |                                                                                                                                   |

### Remote Sense

The remote sense regulates the output voltage across the sensing connections, and should be connected at the point on the board where regulation is desired. It is used to compensate for contact and distribution losses to the load. Efforts should be made to minimize these losses to help reduce noise and improve efficiency of the system.

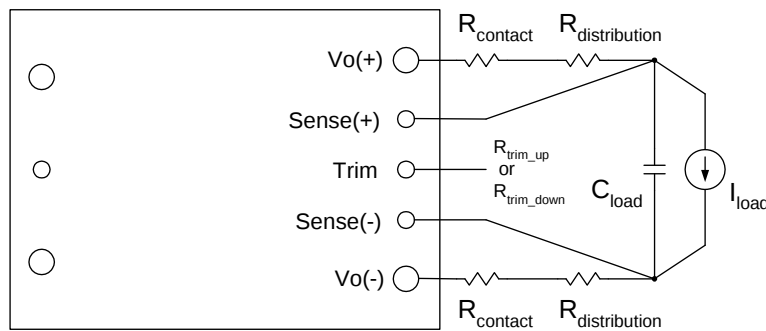


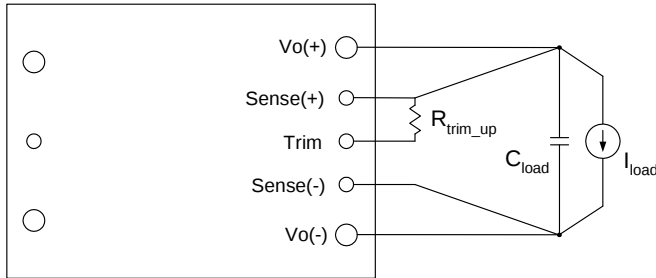
Figure 2

The voltage between remote sense pins and the output terminals must not exceed the output voltage sense range as specified in Table 2.

$$[Vo(+) - Vo(-)] - [Sense(+) - Sense(-)] \leq \text{Sense Range \%} \times \text{set point}$$

### Trim-up Feature

The Trim-up configuration is used to increase the level of the nominal output voltage. This is achieved by connecting a resistor between Trim and Sense(+) pins:



**Figure 3**

The value of the trim-up resistor is determined by the following equation:

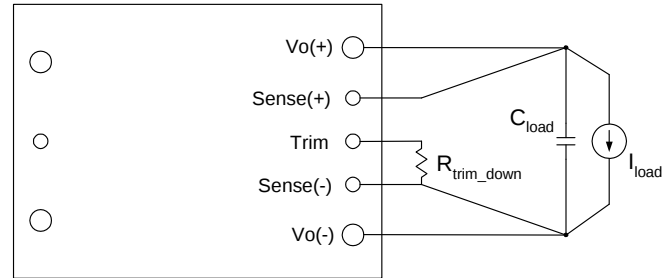
$$R_{up}(V_{nom}, \Delta\%) := \left[ 5.11 \cdot V_{nom} \cdot \frac{(100 + \Delta\%)}{1.225 \cdot \Delta\%} \right] - \left\{ \frac{511}{\Delta\%} \right\} - 10.22$$

$V_o$ : target output voltage

$V_{nom}$ : nominal output voltage

### Trim-down Feature

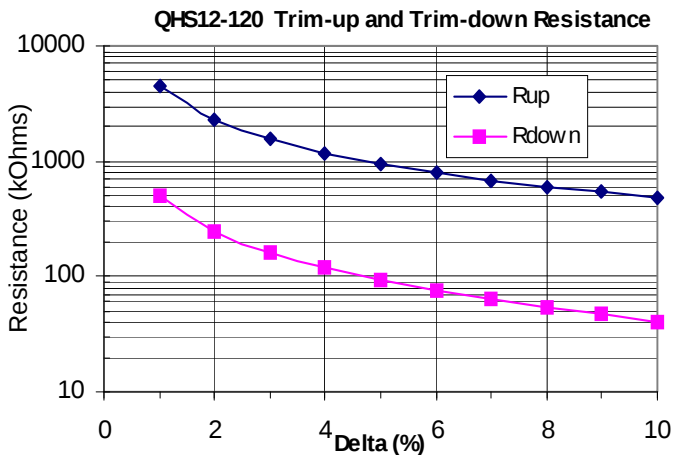
The Trim-down configuration is used to reduce the level of the nominal output voltage. Trim-down is achieved by connecting a resistor between Trim and Sense(-) pins:



**Figure 4**

The value of the trim-down resistor is determined by the following equation:

$$R_{dwn}(\Delta\%) := \frac{511}{\Delta\%} - 10.22$$



The voltage between the Vo(+) and Vo(-) terminals must not exceed the minimum output over voltage shut-down value indicated in

Table 3. This limit includes any increase in voltage due to remote-sense compensation and output voltage set-point adjustment (trim).

The amount of power delivered by the module is defined as the voltage at the output terminals multiplied by the output current. (Output Voltage Set Point, typ x Output Current, Max) When using remote sense and/or trim, the output voltage of the module can be increased, and may result in an increase of output power. Care should be taken to ensure that the maximum output power of the module remains at or below the maximum rated power.

## Efficiency Curves

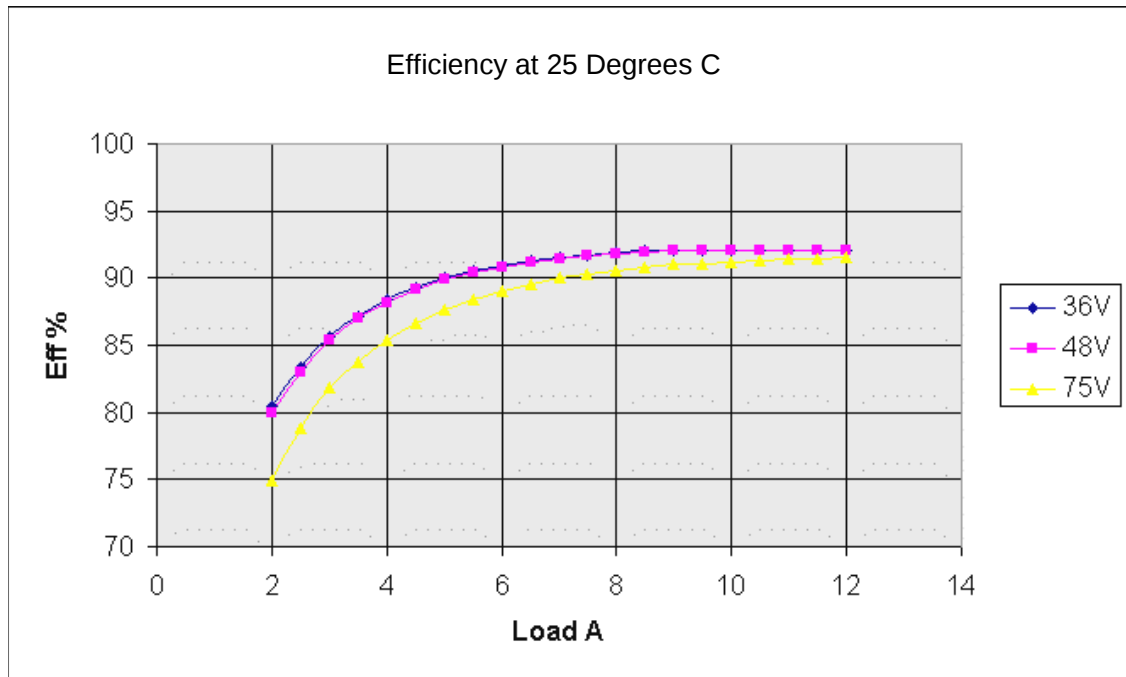


Figure 6 QHS12-120 Efficiency

## Test Setup

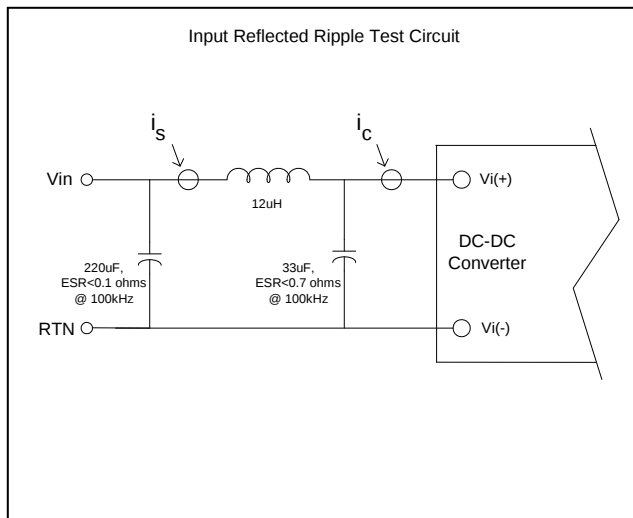


Figure 7 Test circuit used for input ripple current measurement

## Input Reflected Ripple

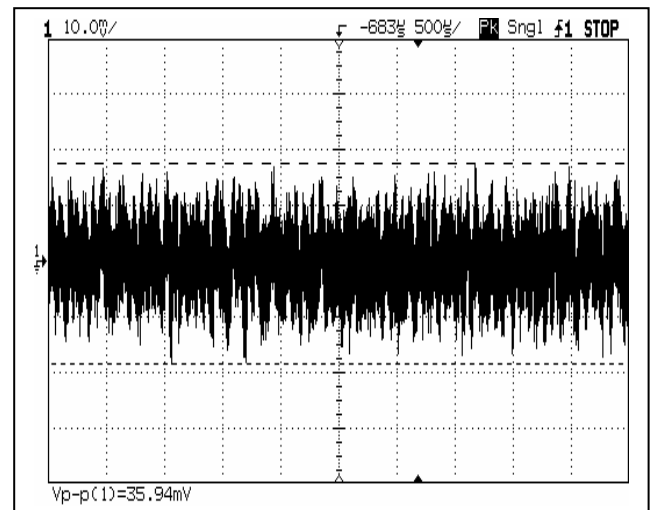


Figure 8 Input Current at full load, 48Vdc input. 5 mA/div, 500  $\mu$ S /div.

## Output Ripple/Noise

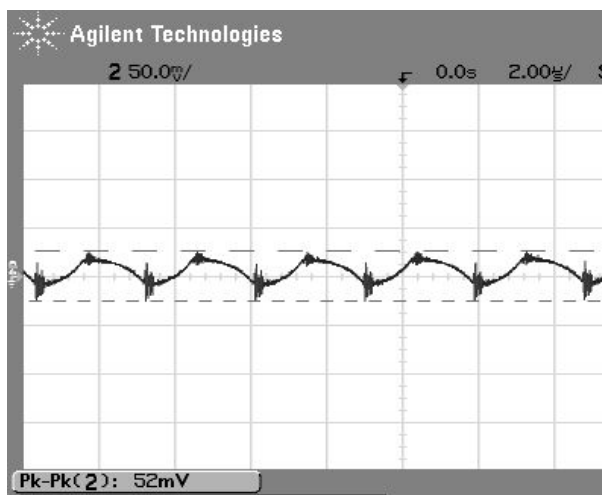


Figure 9 Output ripple:  $V_{in}=48$  Vdc,  $I_{out}=12$  Amps.  
Vert: 50 mV/div. Horiz: 2  $\mu$ S/div

## Load Transient +ve Step

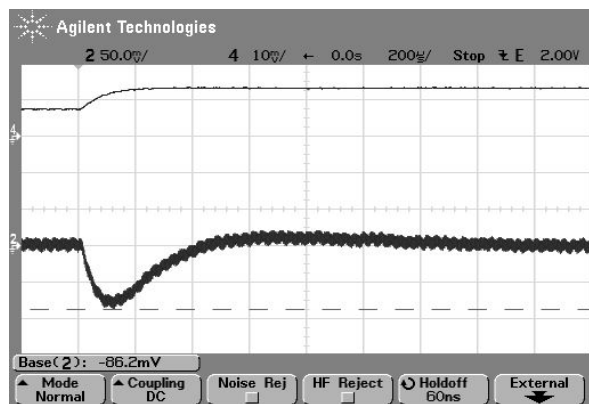


Figure 11 Top Trace: Load Current, 25% step,  
5 A/div. Bottom Trace:  $V_{out}$ , 50 mV/div.  
Horiz: 200  $\mu$ S/div.

## Load Transient -ve Step

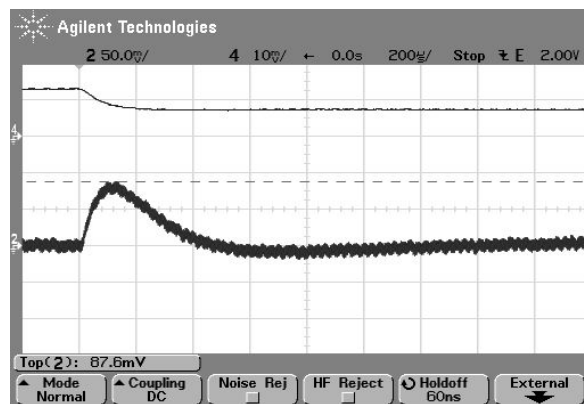
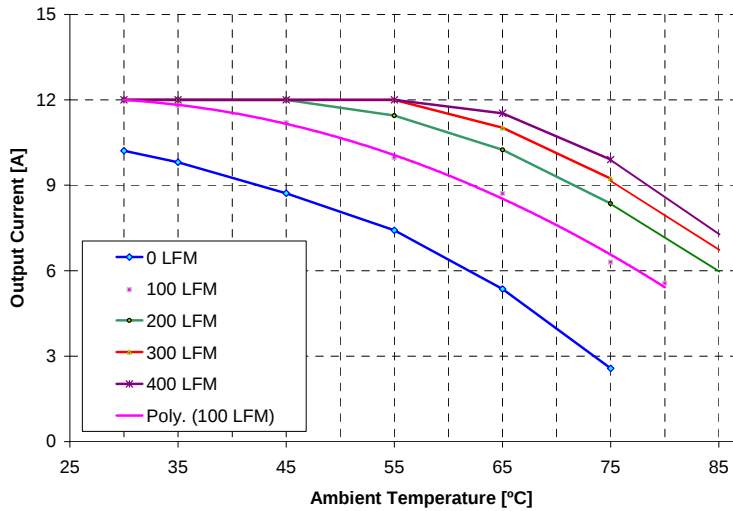


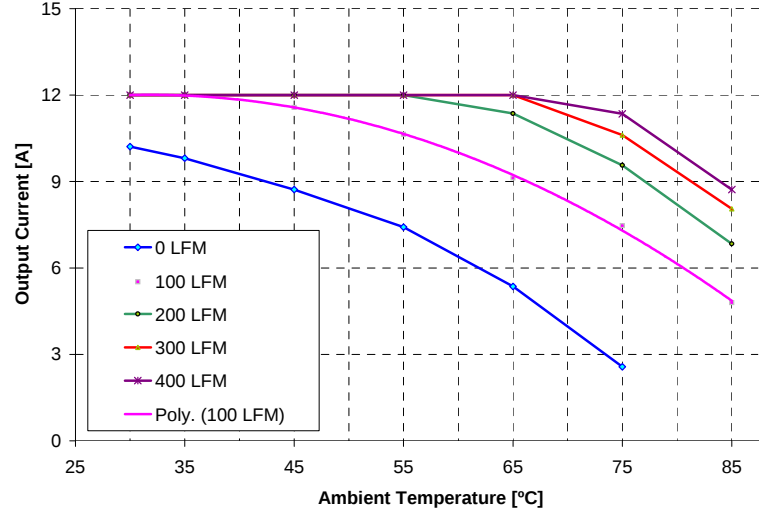
Figure 10 Top Trace: Load Current, 25% step,  
5 A/div. Bottom Trace:  $V_{out}$ , 50 mV/div.  
Horiz: 200  $\mu$ S/div.

**Thermal Derating (Parallel)  $T_{TML}=110^{\circ}\text{C}$**



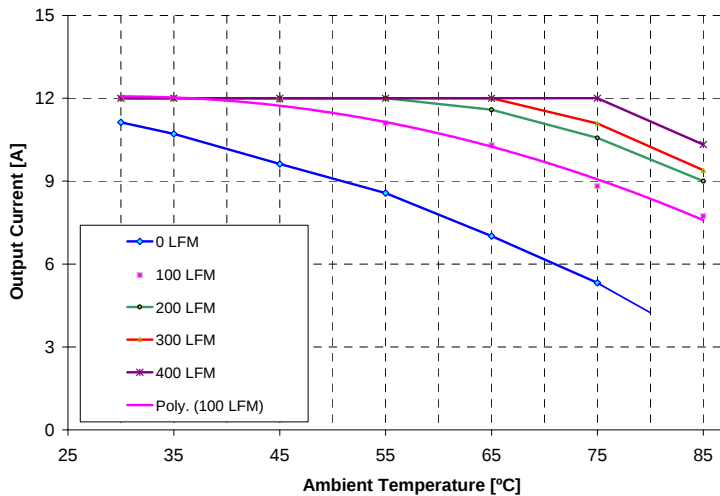
**Figure 12**

**Thermal Derating (Transverse)  $T_{TML}=110^{\circ}\text{C}$**



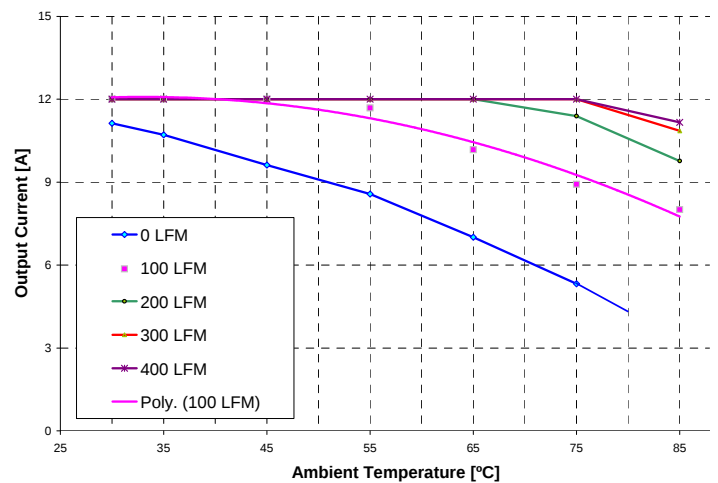
**Figure 13**

**Thermal Derating (Parallel)  $T_{TML}=120^{\circ}\text{C}$**



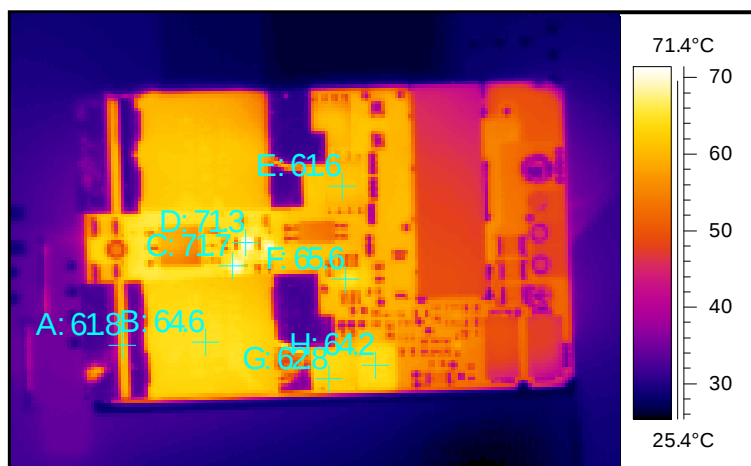
**Figure 14**

**Thermal Derating (Transverse)  $T_{TML}=120^{\circ}\text{C}$**



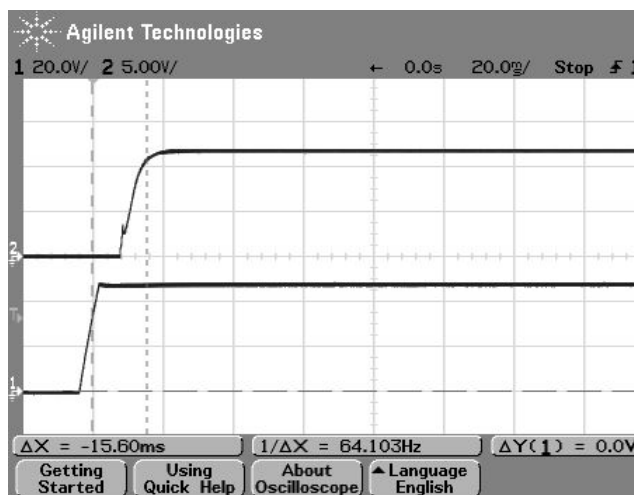
**Figure 15**

## Thermal Image, 300 LFM, Output to Input



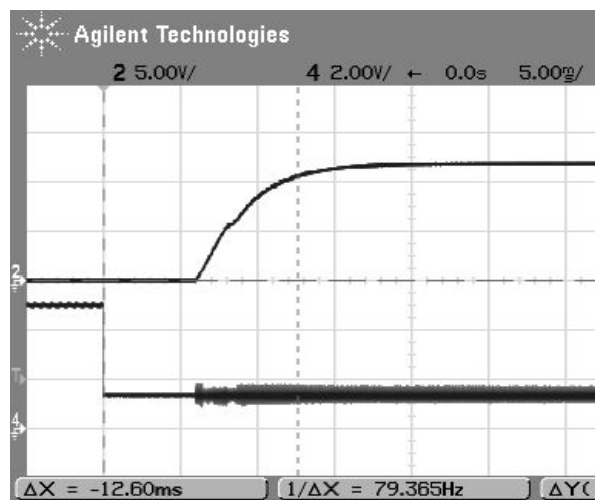
**Figure 20** Parallel Airflow at 300 LFM, from output to input (right to left). Ambient Temperature 25 °C.  $V_{in}$  = 48 V, and load current of 12 amps.

## Turn-on ( $V_{out}$ vs $V_{in}$ )



**Figure 16** Converter pre-enabled, load = 12 Adc plus 3,900 uf, top trace(2):  $V_{out}$ , bottom trace (1):  $V_{in}$  from 0 to 48 Vdc.

## Turn-on (Enable)



**Figure 17**  $V_{in}$ : 48 Vdc, load = 12 Adc plus 3,900 uf, top trace (2):  $V_{out}$ , bottom trace (1): Enable Signal, transition from disable to enable.

## EMI Signature

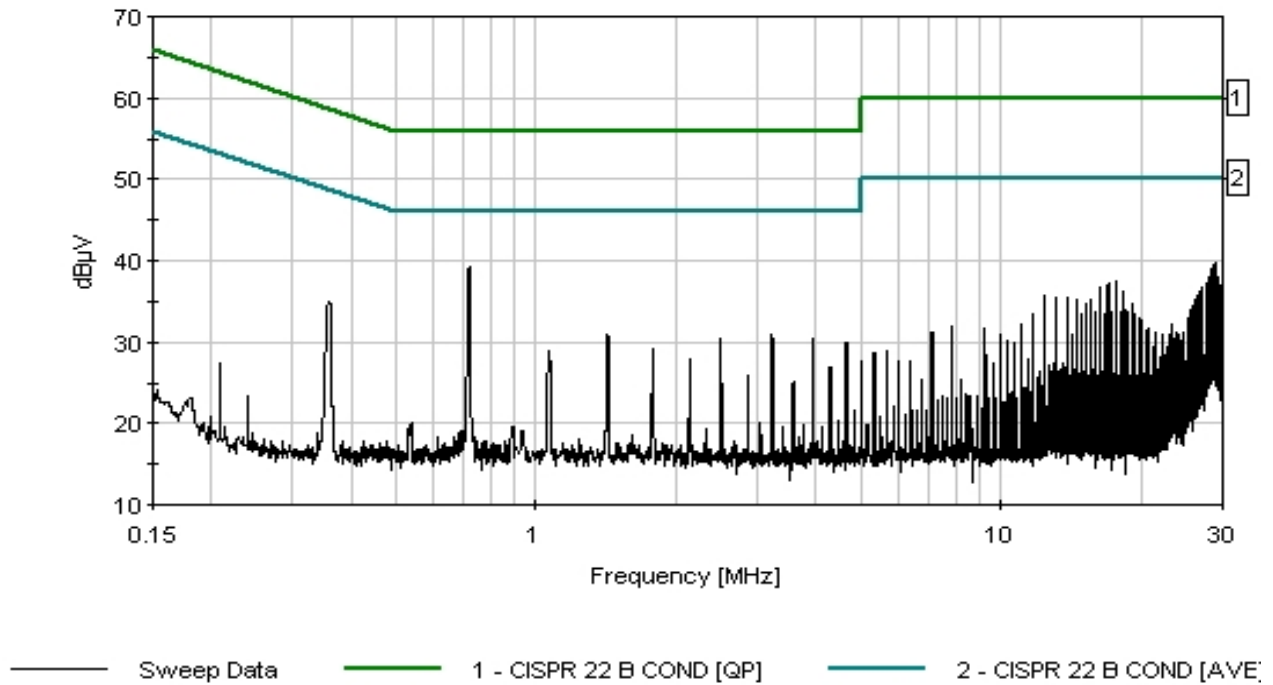


Figure 19 Quasi-Peak Measurement of positive input at 48Vdc and full load, with EMI filter as shown in Fig. 27.

## External EMI Test Filter

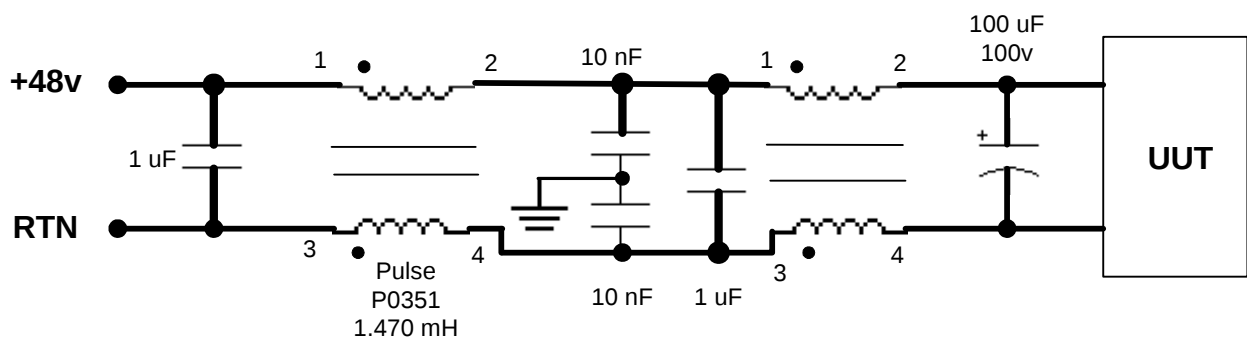


Figure 20 EMI Filter as used for EMI measurement of Fig. 26

### Safety Considerations

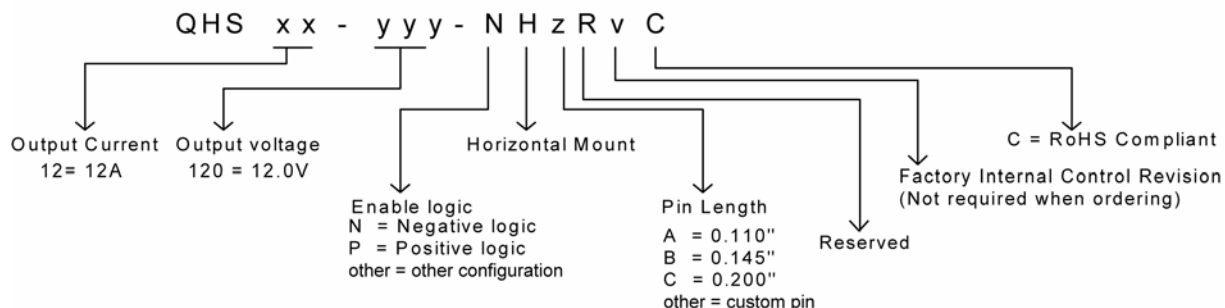
This Product is certified to the standards listed in the 'Standards Compliance' section in the table above. If this product is built into information technology equipment, the installation must comply with the above standard.

An external input fuse of 30 A maximum must be used to meet the above requirements.

The output of the converter [Vo(+)/Vo(-)] is considered to remain within SELV limits when the input to the converter meets SELV or TNV-2 requirements.

The converters and materials meet UL 94V-0 flammability ratings.

### Part Number Designations



### RoHS Compliant

The QHS12-120 series of converters is in compliance with the European Union Directive 2002/95/EC (RoHS) with respect to the following substances: lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

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ISO 9001 and 14001 REGISTERED



This product is subject to the following [operating requirements](#) and the [Life and Safety Critical Application Sales Policy](#):  
Refer to: <http://www.murata-ps.com/requirements/>

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