

### FEATURES

- UL 60950 recognized
- RoHS compliant
- 4:1 Wide range voltage input
- Operating temperature range -40°C to 85°C
- Typical load regulation from 0.06%
- 1.5kVDC Isolation
- Typical efficiency to 87%
- 12V & 48V Nominal input
- Power density 0.94W/cm<sup>3</sup>
- UL 94V-0 Package materials
- No electrolytic capacitors
- Low noise
- Under voltage lock out
- Current fold back

### PRODUCT OVERVIEW

The NCS6 series of DC/DC converters offers single & dual output voltages from input voltage ranges of 9-36V and 18-75V. The NCS6 is housed in an industry standard package with a standard pinout. The NCS6 is packaged in a metal case for improved EMI shielding and is also encapsulated for superior thermal performance.

Applications include telecommunications, battery powered systems, process control and distributed power systems.



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

### SELECTION GUIDE

| Order Code | Input Voltage | Output Voltage | Output Current 100% Load | Input Current |           | Ripple & Noise (Typ.) | Efficiency |      | MTTF <sup>1</sup> |
|------------|---------------|----------------|--------------------------|---------------|-----------|-----------------------|------------|------|-------------------|
|            | Nom.          |                |                          | 0% Load       | 100% Load |                       | Min.       | Typ. |                   |
|            | V             |                |                          | mA            | mA        |                       | %          | %    |                   |
| NCS6D1205C | 12            | ±5             | ±0.6                     | 7             | 610       | 15                    | 80         | 82   | 384,470           |
| NCS6D1212C | 12            | ±12            | ±0.25                    | 10            | 580       | 10                    | 82         | 86   | 406,121           |
| NCS6D1215C | 12            | ±15            | ±0.2                     | 12            | 580       | 20                    | 84         | 87   | 344,957           |
| NCS6S1203C | 12            | 3.3            | 1.52                     | 10            | 550       | 30                    | 75         | 78   | 662,073           |
| NCS6S1205C | 12            | 5              | 1.2                      | 7             | 610       | 30                    | 79         | 82   | 521,975           |
| NCS6S1212C | 12            | 12             | 0.5                      | 10            | 580       | 30                    | 84         | 86   | 435,567           |
| NCS6S1215C | 12            | 15             | 0.4                      | 12            | 580       | 30                    | 85         | 87   | 437,582           |
| NCS6D4805C | 48            | ±5             | ±0.6                     | 6             | 160       | 50                    | 79         | 80   | 373,195           |
| NCS6D4812C | 48            | ±12            | ±0.25                    | 7             | 150       | 30                    | 82         | 84   | 391,563           |
| NCS6D4815C | 48            | ±15            | ±0.2                     | 7             | 150       | 30                    | 82         | 84   | 330,752           |
| NCS6S4803C | 48            | 3.3            | 1.52                     | 10            | 150       | 40                    | 73         | 76   | 483,460           |
| NCS6S4805C | 48            | 5              | 1.2                      | 6             | 160       | 30                    | 78         | 80   | 441,850           |
| NCS6S4812C | 48            | 12             | 0.5                      | 7             | 150       | 30                    | 82         | 84   | 408,555           |
| NCS6S4815C | 48            | 15             | 0.4                      | 7             | 150       | 30                    | 83         | 84   | 416,319           |

### INPUT CHARACTERISTICS

| Parameter                | Conditions                         | Min.                | Typ. | Max. | Units  |
|--------------------------|------------------------------------|---------------------|------|------|--------|
| Voltage range            | 12V input types                    | 9                   | 12   | 36   | V      |
|                          | 48V input types                    | 18                  | 48   | 75   |        |
| Under voltage lock out   | Turn on threshold 12V input types  |                     | 8.5  |      | V      |
|                          | Turn off threshold 12V input types |                     | 7.5  |      |        |
|                          | Turn on threshold 48V input types  |                     | 16.7 |      |        |
|                          | Turn off threshold 48V input types |                     | 15.8 |      |        |
| Reflected ripple current | 12V input types                    | Single output types | 12   |      | mA p-p |
|                          |                                    | Dual output types   | 4    |      |        |
|                          | 48V input types                    | Single output types | 9    |      |        |
|                          |                                    | Dual output types   | 6    |      |        |

### OUTPUT CHARACTERISTICS

| Parameter                  | Conditions  | Min.                       | Typ.  | Max. | Units |
|----------------------------|---|----------------------------|-------|------|-------|
| Rated power                | 5V, 12V & 15V output types  |                            |       | 6    | W     |
|                            | 3.3V output types   |                            |       | 5    |       |
| Voltage set point accuracy | Positive outputs  |                            |       | ±2   | %     |
|                            | Negative outputs  |                            |       | ±3   |       |
| Line regulation            | Low line to high line   | Positive outputs           | 0.002 | 0.2  | %     |
|                            |   | Negative outputs           | 0.09  | 0.7  |       |
| Load Regulation            | 10% total load to 100% total load   | 3V outputs                 | 0.5   | 0.6  | %     |
|                            |   | 5V positive outputs        | 0.3   | 0.5  |       |
|                            |   | 12V & 15V positive outputs | 0.06  | 0.2  |       |
|                            |   | All negative outputs       | 0.2   | 1.0  |       |
| Cross Regulation           | % voltage change on negative output when positive load varies from 12.5% to 37.5% with negative load fixed at 50% | 5V                         |       | 5    | %     |
|                            | 12V & 15V   |                            |       | 2.5  |       |
| Start-up Time              | 3.3V & 5V output types  | Single output types        | 2.5   |      | mS    |
|                            |   | Dual output types          | 25    |      |       |
|                            | 12V output types  | Single output types        | 4.6   |      |       |
|                            |   | Dual output types          | 11    |      |       |
|                            | 15V output types  | Single output types        | 5.5   |      |       |
|                            |   | Dual output types          | 14    |      |       |

<sup>1</sup> Calculated using MIL-HDBK-217F FN2, parts stress method with nominal input voltage at full load.  
All specifications typical at TA=25°C, nominal input voltage and rated output current unless otherwise specified.

### ISOLATION CHARACTERISTICS

| Parameter              | Conditions                 | Min. | Typ. | Max. | Units |
|------------------------|----------------------------|------|------|------|-------|
| Isolation test voltage | Flash tested for 1 seconds | 1500 |      |      | VDC   |
| Resistance             | Viso = 1kVDC               | 1    |      |      | GΩ    |
| Capacitance            |                            |      | 225  |      | pF    |

### ABSOLUTE MAXIMUM RATINGS

|  |                   |
|--|-------------------|
| Short-circuit protection (for SELV input voltages)                           | Continuous        |
| Internal power dissipation   | 2.1W              |
| Lead temperature 1.0mm from case for 10 seconds (to JEDEC JESD22-B106 ISS C) | 260°C             |
| Minimum output load for specification (see application notes)                | 10% of rated load |
| Input voltage, NCS6 12V input types  | 40V               |
| Input voltage, NCS6 48V input types  | 80V               |

### GENERAL CHARACTERISTICS<sup>1</sup>

| Parameter           | Conditions | Min. | Typ. | Max. | Units |
|---------------------|------------|------|------|------|-------|
| Switching frequency |            |      | 180  |      | kHz   |

### TEMPERATURE CHARACTERISTICS

| Parameter                           | Conditions                       | Min.                   | Typ.             | Max. | Units |     |    |
|-------------------------------------|----------------------------------|------------------------|------------------|------|-------|-----|----|
| Operation                           |                                  | -40                    |                  | 85   | °C    |     |    |
| Storage                             |                                  | -50                    |                  | 125  |       |     |    |
| Case temperature rise above ambient | 100% Load, Nom VIN,<br>Still Air | 48VIN Dual outputs     | 5V               | 36   |       |     |    |
|                                     |                                  |                        | 12V              | 32   |       |     |    |
|                                     |                                  |                        | 15V              | 31   |       |     |    |
|                                     |                                  | All other output types | 3.3V             | 32   |       |     |    |
|                                     |                                  |                        | 5V               | 32   |       |     |    |
|                                     |                                  |                        | 12V              | 28   |       |     |    |
|                                     |                                  |                        |                  |      |       | 15V | 26 |
|                                     |                                  | Thermal shutdown       | Case Temperature |      |       | 105 |    |

### APPLICATION NOTES

#### Output Capacitors

The NCS6 series does not require output capacitors to meet datasheet specification. To meet datasheet specification, total output capacitance should not exceed:

| Output Voltage (V) | Output Capacitance (μF) |
|--------------------|-------------------------|
| 3.3                | 470                     |
| 5                  | 470                     |
| 12                 | 220                     |
| 15                 | 220                     |

#### Minimum Load

The minimum load to meet full datasheet specification is 10% of the full rated load across the specified input voltage range.

Between 0% and 10% output loading, the positive output voltage will remain within data sheet specification however, output ripple and noise will increase as well as a decrease in accuracy on negative outputs.

**TECHNICAL NOTES**

**ISOLATION VOLTAGE**

'Hi Pot Test', 'Flash Tested', 'Withstand Voltage', 'Proof Voltage', 'Dielectric Withstand Voltage' & 'Isolation Test Voltage' are all terms that relate to the same thing, a test voltage, applied for a specified time, across a component designed to provide electrical isolation, to verify the integrity of that isolation.

Murata Power Solutions NCS6 series of DC/DC converters are all 100% production tested at their stated isolation voltage. This is 1.5kVDC for 1 second.

A question commonly asked is, "What is the continuous voltage that can be applied across the part in normal operation?"

The NCS6 has been recognized by Underwriters Laboratory for functional isolation. Both input and output should normally be maintained within SELV limits i.e. less than 42.4V peak, or 60VDC. The isolation test voltage represents a measure of immunity to transient voltages and the part should never be used as an element of a safety isolation system. The part could be expected to function correctly with several hundred volts offset applied continuously across the isolation barrier; but then the circuitry on both sides of the barrier must be regarded as operating at an unsafe voltage and further isolation/insulation systems must form a barrier between these circuits and any user-accessible circuitry according to safety standard requirements.

**REPEATED HIGH-VOLTAGE ISOLATION TESTING**

It is well known that repeated high-voltage isolation testing of a barrier component can actually degrade isolation capability, to a lesser or greater degree depending on materials, construction and environment. The NCS6 series has an ER ferrite core, with no additional insulation between primary and secondary windings of enameled wire. While parts can be expected to withstand several times the stated test voltage, the isolation capability does depend on the wire insulation. Any material, including this enamel (typically polyurethane) is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage.

This consideration equally applies to agency recognized parts rated for better than functional isolation where the wire enamel insulation is always supplemented by a further insulation system of physical spacing or barriers.

**SAFETY APPROVAL**

The NCS6 series has been recognised by Underwriters Laboratory (UL) to UL 60950 for functional insulation in a maximum ambient temperature of 85°C and/or case temperature limit of 120°C (case temperature measured on the face opposite the pins). File number E151252 applies.

Note: This series gained UL 60950 recognition for products manufactured on or after datecode G1114, any NCS6 parts manufactured before this date code should not be considered UL 60950 recognized. Any NCS6 that is UL recognized will be printed with the UL logo. 

**RoHS COMPLIANCE INFORMATION**



This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260°C for 10 seconds. The pin termination finish on this product series is a Gold flash (0.05-0.10 micron) over Nickel Preplate. The series is backward compatible with Sn/Pb soldering systems. For further information, please visit [www.murata-ps.com/rohs](http://www.murata-ps.com/rohs)

**CHARACTERISATION TEST METHODS**

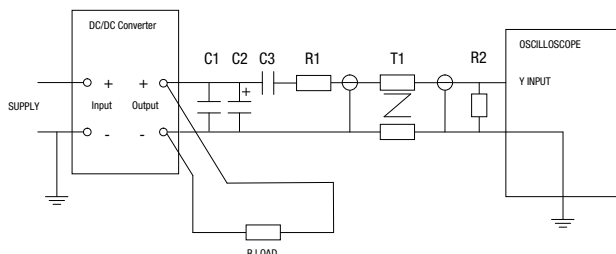
**Ripple & Noise Characterisation Method**

Ripple and noise measurements are performed with the following test configuration.

|       |  |
|-------|--|
| C1    | 1µF X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC/DC converter                                |
| C2    | 10µF tantalum capacitor, voltage rating to be a minimum of 1.5 times the output voltage of the DC/DC converter with an ESR of less than 100mΩ at 100 kHz |
| C3    | 100nF multilayer ceramic capacitor, general purpose  |
| R1    | 450Ω resistor, carbon film, ±1% tolerance  |
| R2    | 50Ω BNC termination  |
| T1    | 3T of the coax cable through a ferrite toroid  |
| RLOAD | Resistive load to the maximum power rating of the DC/DC converter. Connections should be made via twisted wires  |

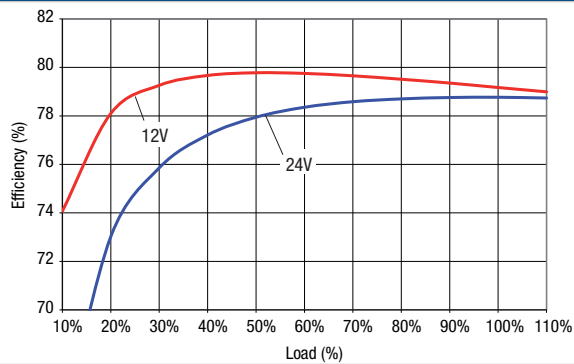
Measured values are multiplied by 10 to obtain the specified values.

**Differential Mode Noise Test Schematic**

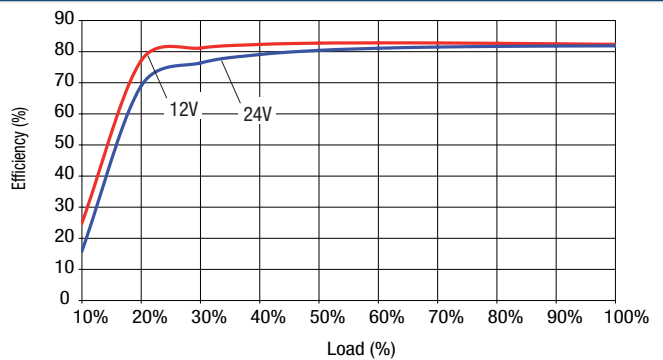


**EFFICIENCY VS LOAD**

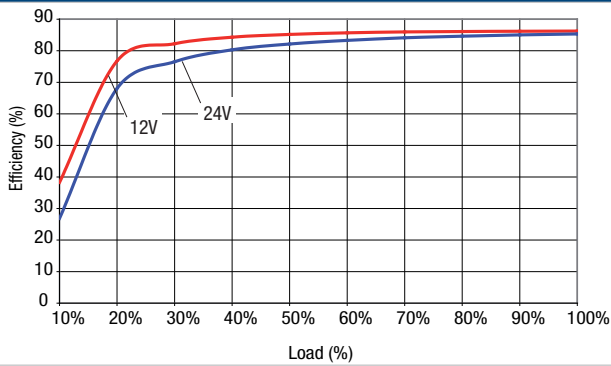
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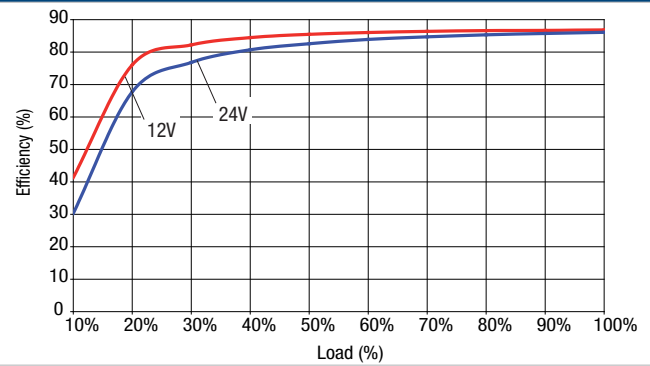
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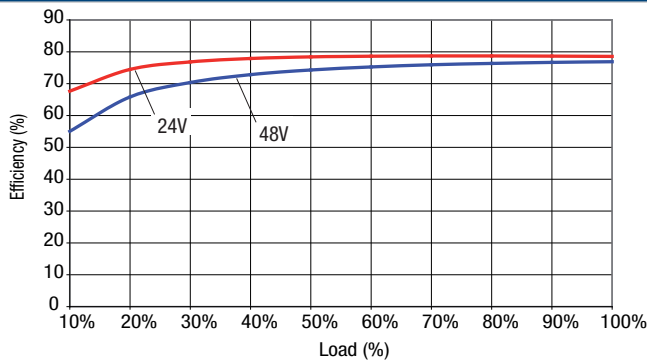
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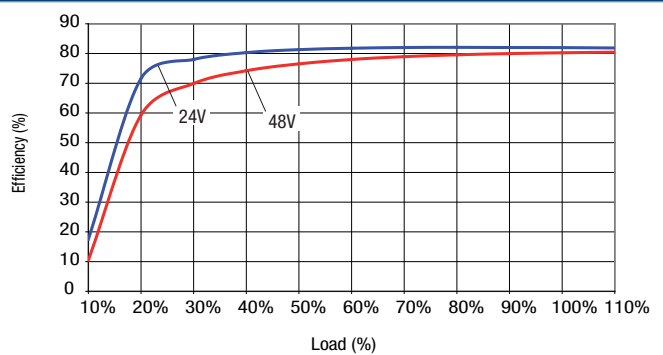
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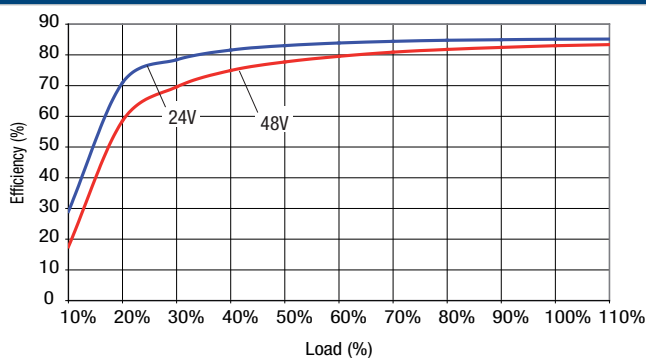
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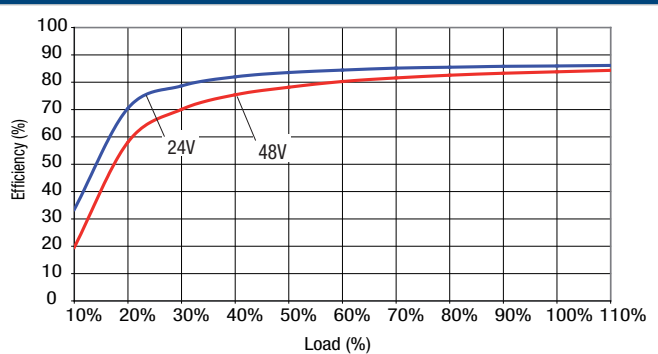
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**NCS6S4812C**

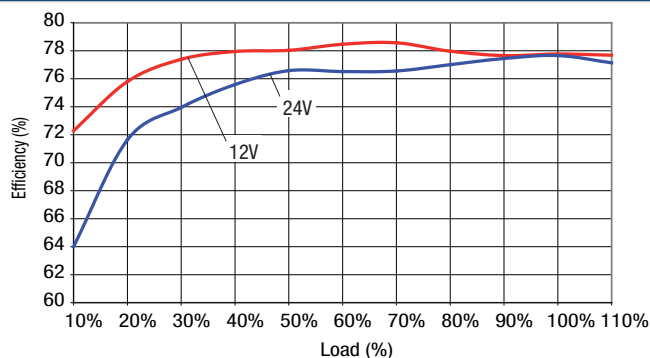


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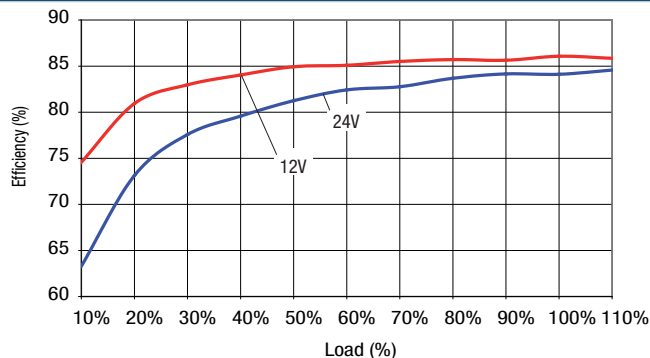


**EFFICIENCY VS LOAD**

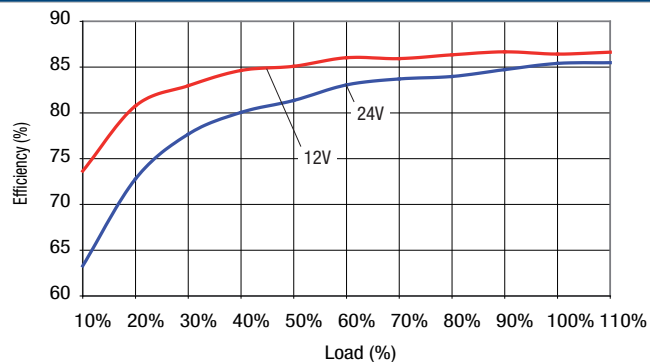
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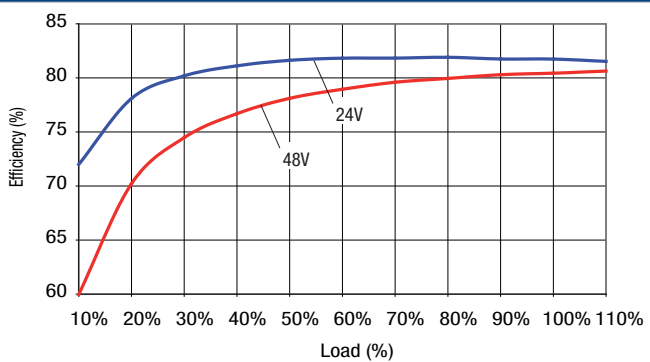
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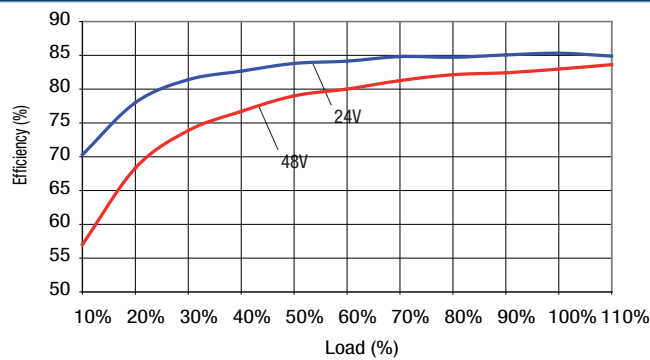
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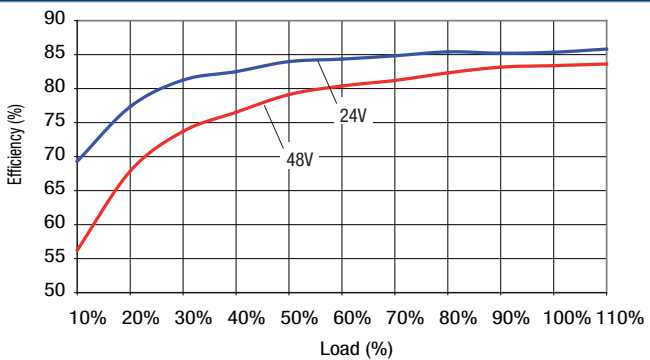
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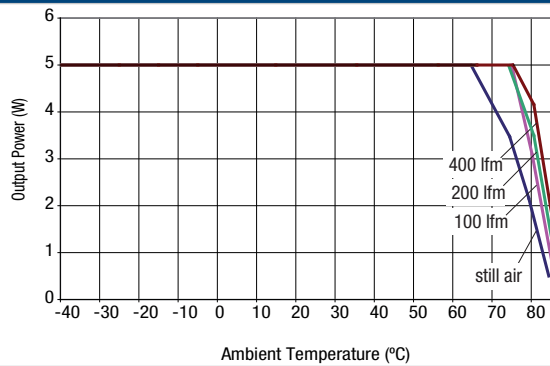


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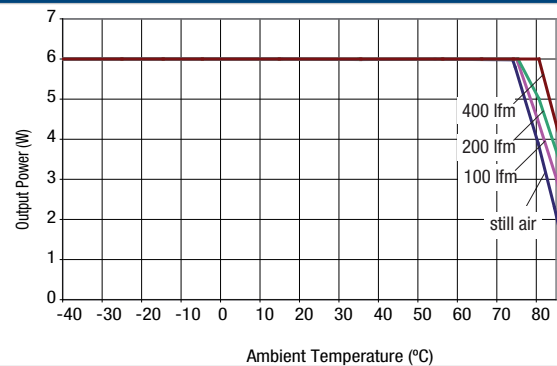


**TEMPERATURE DERATING**

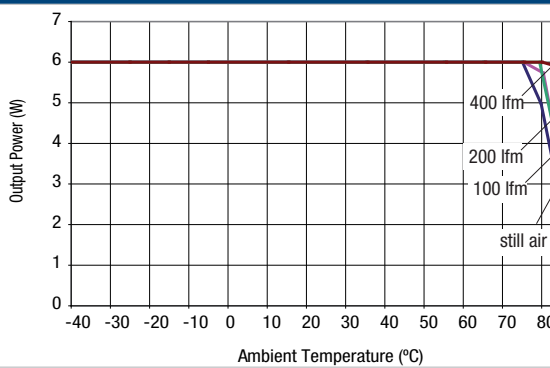
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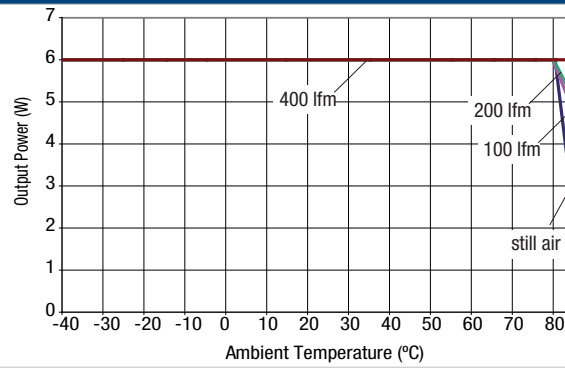
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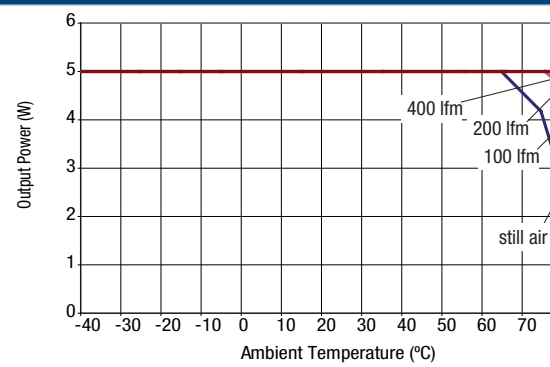
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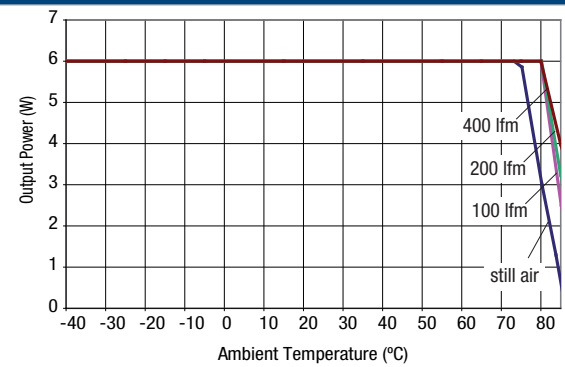
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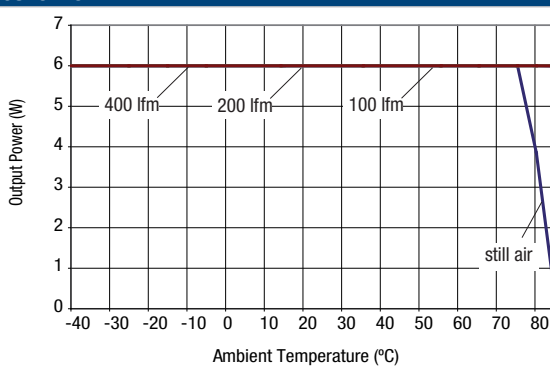
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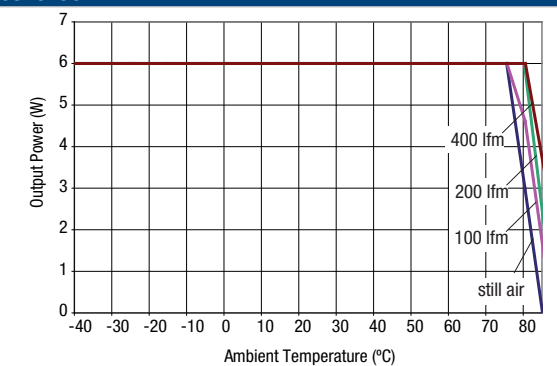
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**NCS6S4812C**

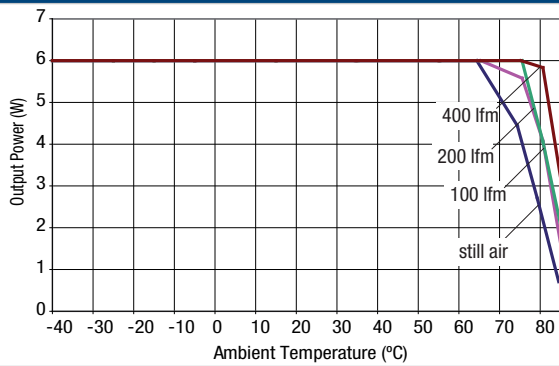


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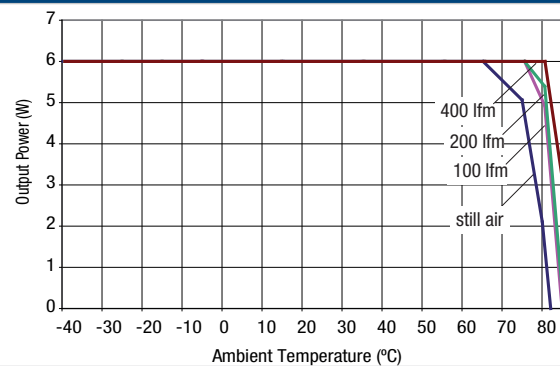


**TEMPERATURE DERATING**

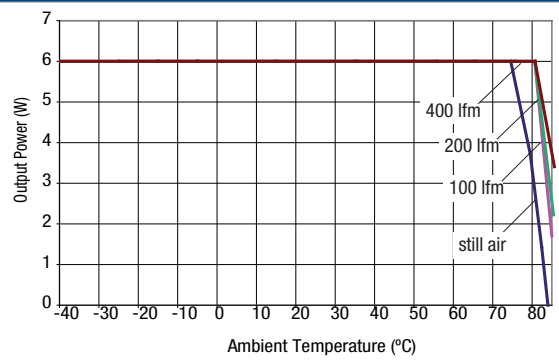
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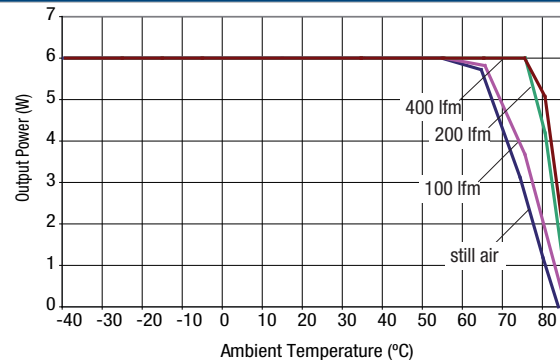
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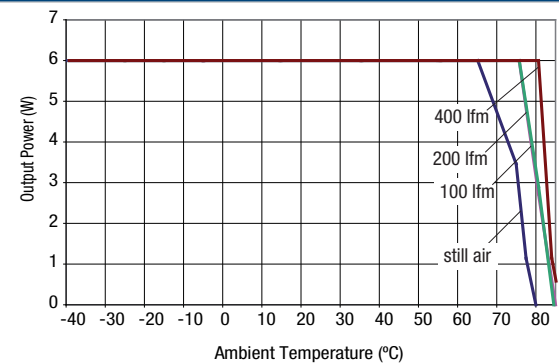
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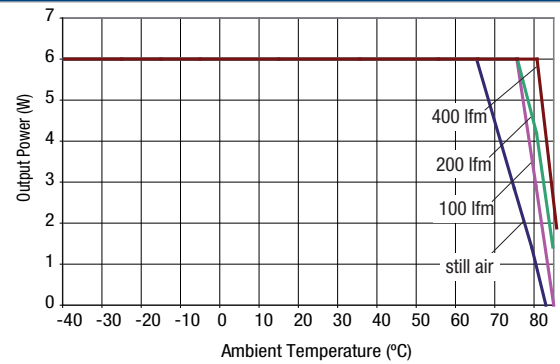
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**NCS6D4812C**



**NCS6D4815C**



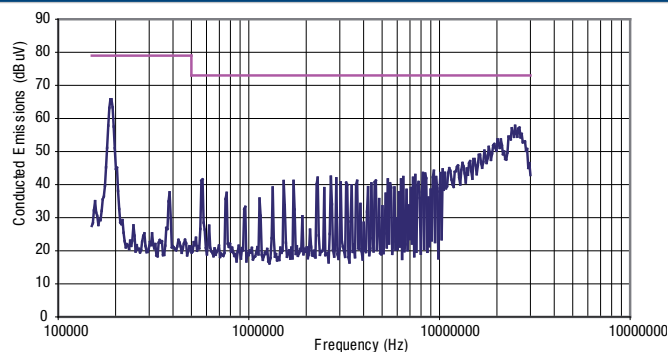
**EMC FILTERING AND SPECTRA**

**FILTERING**

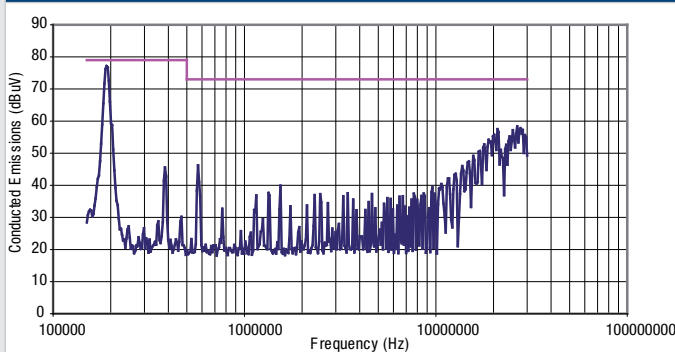
The module includes a basic level of filtering, the following table shows the additional input capacitor typically required to meet EN 55022 Curve A Quasi-Peak EMC limit, as shown in the below plots.

|            |             |            |             |
|------------|-------------|------------|-------------|
| NCS6D1205C | 2.2 $\mu$ F | NCS6S1203C | 4.7 $\mu$ F |
| NCS6D1212C | none        | NCS6S1205C | 4.7 $\mu$ F |
| NCS6D1215C | none        | NCS6S1212C | 10 $\mu$ F  |
| NCS6D4805C | 10 $\mu$ F  | NCS6S1215C | 10 $\mu$ F  |
| NCS6D4812C | 10 $\mu$ F  | NCS6S4803C | 4.7 $\mu$ F |
| NCS6D4815C | 10 $\mu$ F  | NCS6S4805C | 10 $\mu$ F  |
|            |             | NCS6S4812C | 10 $\mu$ F  |
|            |             | NCS6S4815C | 10 $\mu$ F  |

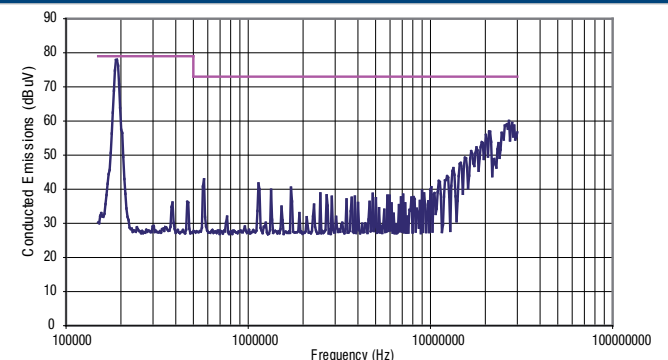
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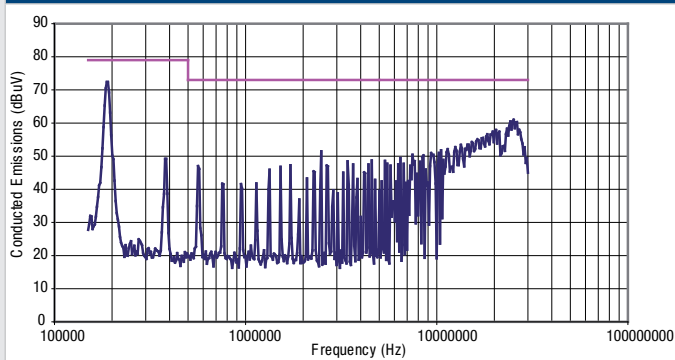
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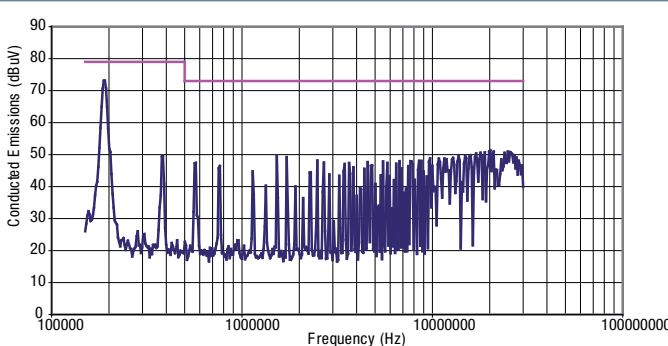
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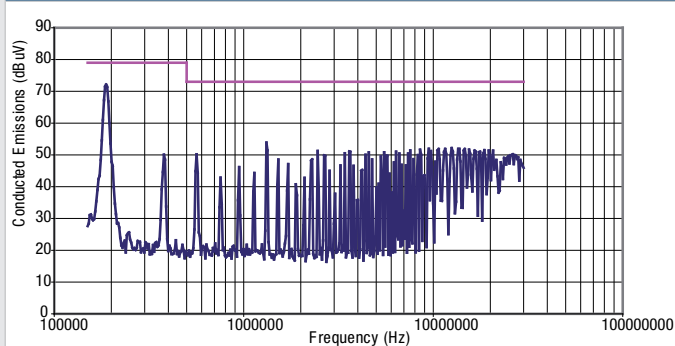
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**NCS6D4812C**



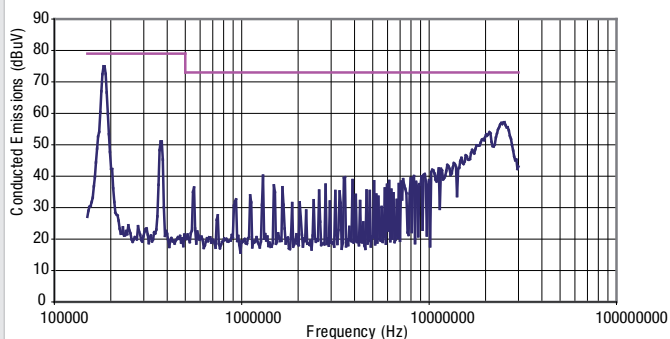
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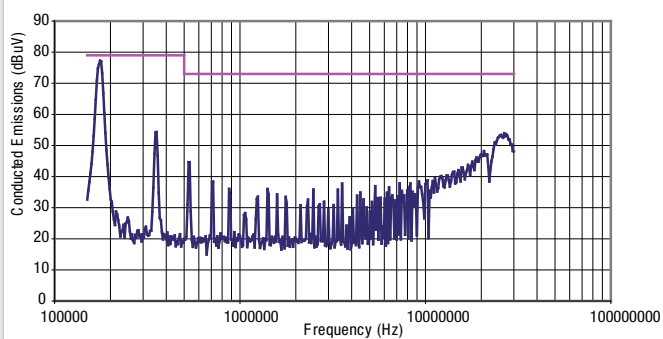


**EMC FILTERING AND SPECTRA (continued)**

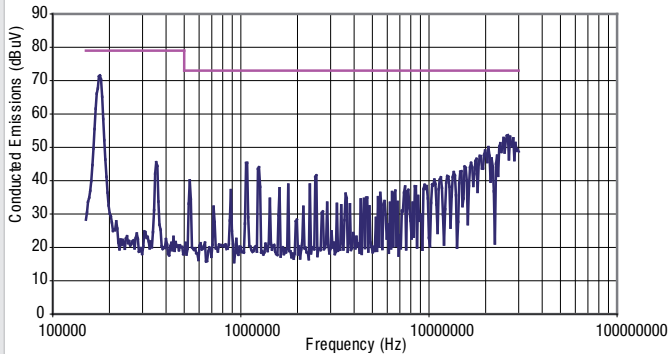
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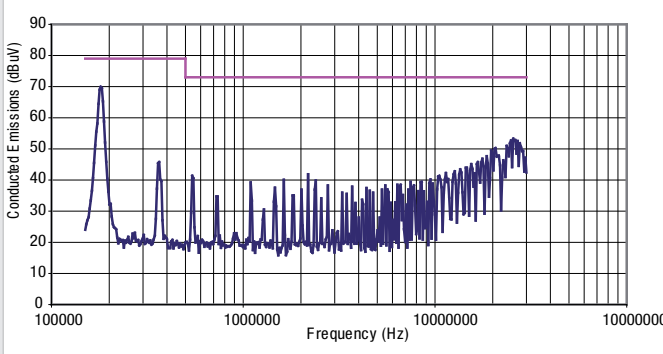
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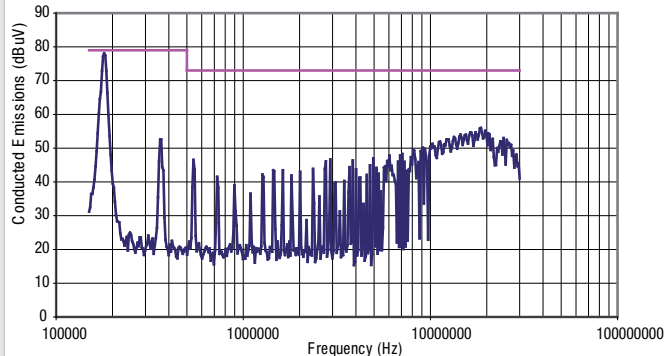
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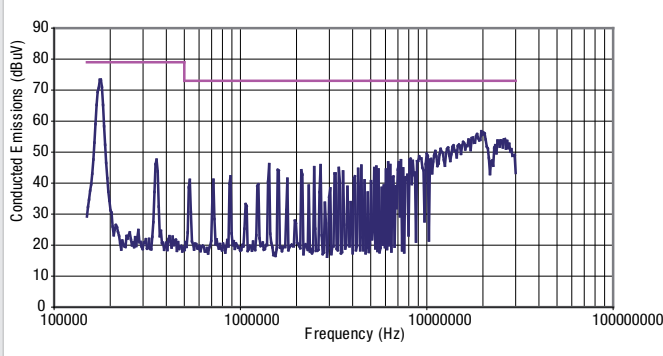
**NCS6S1215C**



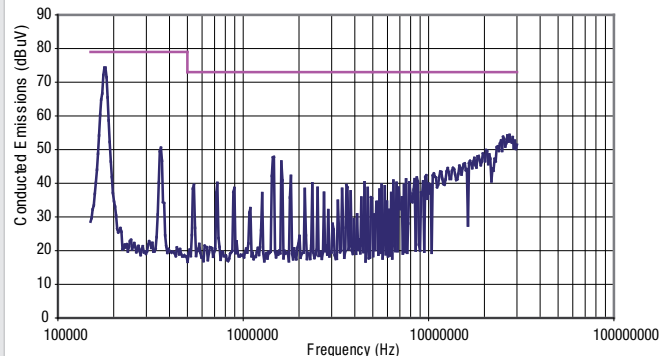
**NCS6S4803C**



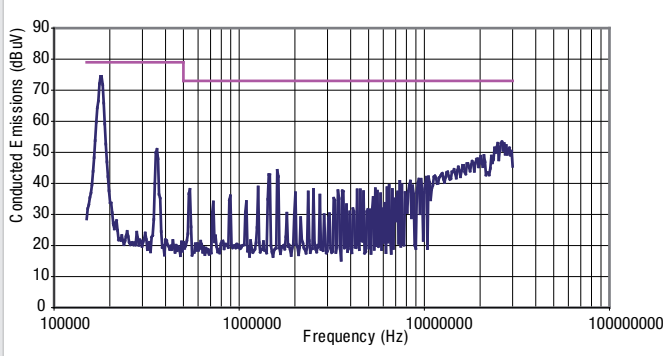
**NCS6S4805C**



**NCS6S4812C**

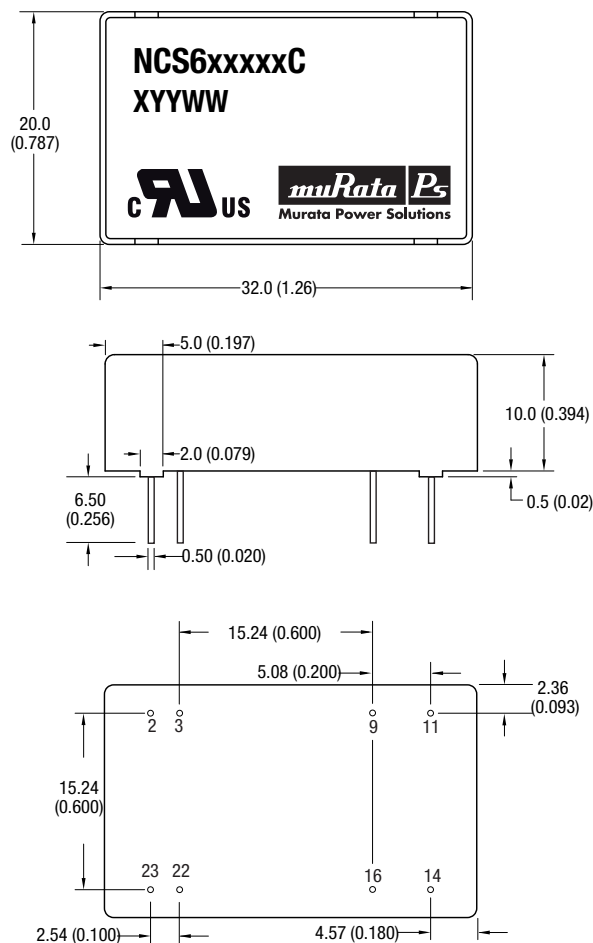


**NCS6S4815C**



**PACKAGE SPECIFICATIONS**

**MECHANICAL DIMENSIONS**



All dimensions in mm (inches)  $\pm 0.5$  (0.020) except pin to pin tolerance  $\pm 0.25$  (0.010). All pins on a 2.54 (0.100) pitch and within 0.25 (0.010) of true position.

Weight: 17g

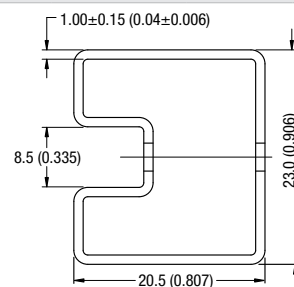
The copper case is connected to the output (-V<sub>OUT</sub>) pin. Care is needed in the design of this circuit board on which the converter is mounted. Top side tracks must not contact the edge of the case on the underside of the unit.

Please note that from 2010 onwards, you may receive either a blue or a black case.

**PIN CONNECTIONS**

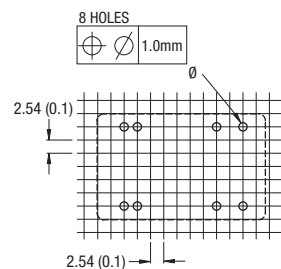
| Pin | Function          |                   |
|-----|-------------------|-------------------|
|     | Single            | Dual              |
| 2   | -V <sub>IN</sub>  | -V <sub>IN</sub>  |
| 3   | -V <sub>IN</sub>  | -V <sub>IN</sub>  |
| 9   | No pin            | 0V                |
| 11  | N/C               | -V <sub>OUT</sub> |
| 14  | +V <sub>OUT</sub> | +V <sub>OUT</sub> |
| 16  | -V <sub>OUT</sub> | 0V                |
| 22  | +V <sub>IN</sub>  | +V <sub>IN</sub>  |
| 23  | +V <sub>IN</sub>  | +V <sub>IN</sub>  |

**TUBE OUTLINE DIMENSIONS**



Tube length 520 (20.47)  
All dimensions in mm (inches)  $\pm 0.25$  (0.010). Quantity: 15

**RECOMMENDED FOOTPRINT DETAILS**



All dimensions in mm (inches)  $\pm 0.25$  ( $\pm 0.010$ ).

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11 Cabot Boulevard, Mansfield, MA 02048-1151 U.S.A.  
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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