Murata Power Solutions

# NCS12 Series

## Isolated 12W 4:1 Input Single & Dual Output DC-DC Converters


## FEATURES

- UL60950 recognised[2]
- 4:1 wide range voltage input
- Operating temperature range -40°C to 85°C
- Typical load regulation from 0.05%
- 1.5kVDC isolation 'Hi Pot Test'
- 3.3V, 5V, 12V & 15V outputs
- UL 94V-0 package materials
- No electrolytic capacitors
- Thermal shutdown
- Under voltage lock out
- Current fold back

## PRODUCT OVERVIEW

The NCS12 series of DC-DC converters offers single & dual output voltages from input voltage ranges of 9-36V and 18-75V. The NCS12 is housed in an industry standard package with a standard pinout. The NCS12 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.

## SELECTION GUIDE

| Order Code | Input Voltage | Output Voltage | Output Current | Load Regulation | | | | Efficiency | | MTTF[1] | Recommended Alternative |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Positive Output | Negative Output | Positive Output | Negative Output | | | | |
| | Nom. | | | Typical | | Max | | Min. | Typ. | | |
| | V | V | A | % | % | % | | % | % | Hrs | |
| **In Production** | | | | | | | | | | | |
| **NCS12S1203C** | 12 | 3.3 | 3.64 | 1 | | 1.5 | | 78 | 83.5 | 269,492 | Contact Murata |
| **NCS12S1205C** | 12 | 5 | 2.40 | 0.5 | | 1 | | 84 | 88 | 313,578 | Contact Murata |
| **NCS12S1212C** | 12 | 12 | 1.00 | 0.1 | | 0.3 | | 83 | 84.5 | 230,569 | Contact Murata |
| **NCS12S1215C** | 12 | 15 | 0.80 | 0.1 | | 0.3 | | 83 | 85.5 | 195,596 | Contact Murata |
| **NCS12S4803C** | 48 | 3.3 | 3.64 | 1.2 | | 2 | | 81 | 85.5 | 341,943 | Contact Murata |
| **NCS12S4805C** | 48 | 5 | 2.40 | 0.5 | | 1 | | 84 | 87.5 | 418,117 | Contact Murata |
| **NCS12S4812C** | 48 | 12 | 1.00 | 0.1 | | 0.3 | | 82 | 84.5 | 296,593 | Contact Murata |
| **NCS12S4815C** | 48 | 15 | 0.80 | 0.1 | | 0.3 | | 84 | 85 | 259,485 | Contact Murata |
| **Discontinued** | | | | | | | | | | | |
| NCS12D1205C | 12 | ±5 | ±1.2 | 0.15 | 0.3 | 0.3 | 2 | 80 | 81.5 | 182,655 | Contact Murata |
| NCS12D1212C | 12 | ±12 | ±0.5 | 0.05 | 0.2 | 0.3 | 1.5 | 83 | 85 | 158,750 | Contact Murata |
| NCS12D1215C | 12 | ±15 | ±0.4 | 0.05 | 0.1 | 0.3 | 1.5 | 84 | 86 | 140,435 | Contact Murata |
| NCS12D4805C | 48 | ±5 | ±1.2 | 0.15 | 0.5 | 0.3 | 2 | 78 | 80 | 165,931 | Contact Murata |
| NCS12D4812C | 48 | ±12 | ±0.5 | 0.05 | 0.4 | 0.3 | 1.5 | 83 | 85 | 215,533 | Contact Murata |
| NCS12D4815C | 48 | ±15 | ±0.4 | 0.05 | 0.4 | 0.3 | 1.5 | 83 | 85 | 146,257 | Contact Murata |

## SELECTION GUIDE (Continued)

| Order Code | Input Current | | | Ripple and Noise | | Recommended Alternative |
|---|---|---|---|---|---|---|
| | 10% Load | 10% Load | 100% Load | | | |
| | Typ. 12/48V | Typ. 24V | Typ. 12/48V | Typ. | Max | |
| | A | A | A | mVp/p | mVp/p | |
| **In Production** | | | | | | |
| **NCS12S1203C** | 0.15 | 0.1 | 1.2 | 60 | 125 | Contact Murata |
| **NCS12S1205C** | 0.1 | 0.16 | 1.1 | 50 | 125 | Contact Murata |
| **NCS12S1212C** | 0.1 | 0.06 | 1.2 | 80 | 125 | Contact Murata |
| **NCS12S1215C** | 0.06 | 0.1 | 1.2 | 100 | 125 | Contact Murata |
| **NCS12S4803C** | 0.05 | 0.08 | 0.3 | 100 | 125 | Contact Murata |
| **NCS12S4805C** | 0.05 | 0.08 | 0.3 | 90 | 125 | Contact Murata |
| **NCS12S4812C** | 0.03 | 0.06 | 0.3 | 75 | 125 | Contact Murata |
| **NCS12S4815C** | 0.03 | 0.06 | 0.3 | 90 | 125 | Contact Murata |
| **Discontinued** | | | | | | |
| NCS12D1205C | 0.04 | 0.07 | 1.25 | 35 | 100 | Contact Murata |
| NCS12D1212C | 0.04 | 0.07 | 1.2 | 40 | 100 | Contact Murata |
| NCS12D1215C | 0.05 | 0.07 | 1.5 | 55 | 100 | Contact Murata |
| NCS12D4805C | 0.03 | 0.07 | 0.3 | 70 | 100 | Contact Murata |
| NCS12D4812C | 0.03 | 0.07 | 0.3 | 84 | 100 | Contact Murata |
| NCS12D4815C | 0.03 | 0.07 | 0.4 | 55 | 100 | Contact Murata |

1. Calculated using MIL-HDBK-217 FN2, parts stress method with nominal input voltage at full load
2. The NCS12DxxxxC variants are not recognised to UL60950

All specifications typical at TA=25°C, nominal input voltage and rated output current unless otherwise specified.

For full details go to
https://www.murata.com/en-global/products/power/rohs

## INPUT CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Voltage range | 12V input types | 9 | 24 | 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 | | |
| Power consumption at shutdown | NCS12X12 | | 10 | | mW |
| | NCS12X48 | | 100 | | |
| Reflected ripple current | 48V dual output types | | 15 | | mA p-p |
| | All other types | | 10 | | |

## OUTPUT CHARACTERISTICS

| Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Rated power | All output types | | | | 12 | W |
| Minimal load to meet datasheet specification | | | 10 | | | % |
| Voltage set point accuracy | Positive outputs | | | | ±2 | |
| | Negative outputs | | | | ±3 | % |
| Line regulation | Low line to high line | Positive outputs | | 0.04 | 0.1 | % |
| | | Negative outputs | | 0.3 | 1 | |
| Cross Regulation | D1205 & D4805 | | | ±4 | ±6.5 | % |
| | D1212, D1215 ,D4812, D4815 | | | ±2 | ±5 | |
| Transient response | Peak deviation (12.5-37.5% & 37.5-12.5% swing) | | | | 5 | $\%V_{out}$ |
| | Settling time (within 1% $V_{out}$ Nom.) | Single output types | | 500 | | µs |
| | | Dual output types | | 250 | | |

## ISOLATION CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Isolation test voltage | Flash tested for 1 seconds | 1500 | | | VDC |
| Resistance | Viso = 1kVDC | 1 | | | GΩ |
| Capacitance | S1203, S1205, S4803, S4805 | | 600 | | pF |
| | All other types | | 230 | | |

## GENERAL CHARACTERISTICS[1]

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Switching frequency | S1203, S1205, S4803 & S4805 | | 340 | | kHz |
| | All other types | | 220 | | |
| Control pin input | Module on, pin unconnected or open collector floating | | | | |
| | Module off | | | 0.8 | V |

## TEMPERATURE CHARACTERISTICS

| Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Operation | With derating - see derating graph | | -40 | | 85 | °C |
| Storage | | | -50 | | 125 | |
| Case temperature above ambient | 100% Load, Nom $V_{IN}$, Still Air | NCS12S1203C | | 65 | | |
| | | NCS12S1215C, NCS12D1205C, NCS12D4805C | | 60 | | |
| | | All other types | | 44 | | |
| Thermal shutdown | Case Temperature | Single 3.3V & 5V outputs | | 135 | | |
| | | All other types | | 120 | | |

| ABSOLUTE MAXIMUM RATINGS | |
|---|---|
| Short-circuit protection (for SELV input voltages) | 30 minutes |
| Control pin input voltage | 18V Max |
| Lead temperature 1.0mm from case for 10 seconds (to JEDEC JESD22-B106 ISS C) | 260°C |
| Wave Solder | Wave Solder profile not to exceed the profile recommended in IEC 61760-1 Section 6.1.3. Please refer to application notes for further information. |
| Input voltage, NCS12 12V input types | 40V |
| Input voltage, NCS12 48V input types | 80V |

## 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 NCS12 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?"

For a part holding no specific agency approvals, such as the NCS12 series, 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 NCS12 series has an ER ferrite core, with no additional insulation between primary and secondary windings of enamelled 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 recognised 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

### UL60950

The NCS12 series is recognised by Underwriters Laboratory (UL) to UL60950 for functional insulation to a working voltage of 43Vrms. The NCS12DxxxxC variants are not recognised to UL60950.

File number E151252 applies.

### CE AND UKCA MARKING

The CE and UKCA markings are only applicable to NCS12S48XXSC variants.

### FUSING

The NCS12 Series of converters are not internally fused so to meet the requirements of UL an anti-surge input line fuse should always be used with ratings as defined below.
NCS12S12xxC: 4A
NCS12S48xxC: 2A
All fuses should be UL recognised and rated to 125V.

## RoHS COMPLIANCE INFORMATION

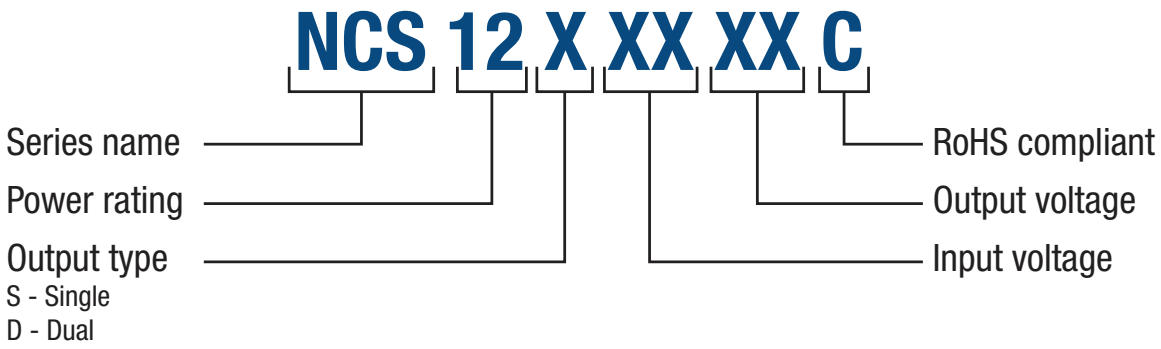
This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260ºC for 10 seconds. Please refer to application notes for further information. The pin termination finish on this product series is a Gold flash (0.05-0.10 micron) over Nickel Preplate. The series is backward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

## ENVIRONMENTAL VALIDATION TESTING

The following tests have been conducted on this product series, as part of our design verification process. The datasheet characteristics specify user operating conditions for this series, please contact Murata if further information about the tests is required.

| Test | Standard | Condition |
|---|---|---|
| Temperature cycling | MIL-STD-883 Method 1010, Condition B | 10 cycles between two chambers set to achieve -55°C and +125°C. The dwell time shall not be less than 10min and the load shall reach the specified temperature in 15min. |
| Storage life | JEDEC JESD22-A103, Condition A | 125°C +10/-0°C for ≥1000 hours. |
| Vibration | MIL-STD-883 Method 2007, Condition A | 1.5mm pk-pk/20g pk min, 20-2000Hz, 4 sweeps in each of 3 mutually perpendicular axes at 3 oct/min. |
| Shock | MIL-STD-883 Method 2002, Condition A | 500g 1ms half sine, 5 shocks in each direction of 3 mutually perpendicular axes. |
| Bump | IEC Class 4M5 of ETS 300 019-2-4 | Shock Spectrum Type II, 6mS duration, 250m/s$^2$ 500 bumps in 6 directions. |
| Solder heat | JEDEC JESD22-B106 | The test sample is subjected to a molten solder bath at 260 ±5°C for 10 seconds (96SC tin/ silver/copper). The leads are dipped in the solder bath to within 1mm of the device body. |
| Solderability | IPC/ECA J-STD-002, Test A and A1 | SnPb (Test A) For leaded solderability the parts are conditioned in a steam ager for 8 hours ±15 min. at a temperature of 93±3°C. Dipped in solder at 245°C ±5°C for 5 +0/-0.5 seconds. Pb-free (Test A1) For lead free solderability the parts are conditioned in a steam ager for 8 hours ± 15 min. at a temperature of 93±3°C. Dipped in solder at 255°C ±5°C for 5 +0/-0.5 seconds. |
| Solvent cleaning | Resistance to cleaning agents | Solvent – Novec 71IPA & Topklean EL-20A. Pulsed ultrasonic immersion 45°C-65°C. |
| Solvent resistance | MIL-STD-883 Method 2015 | The parts and the bristle portion of the brush are immersed in Isopropanol for a minimum of 1 minute. The parts are brushed 3 times, after the third time the parts are blown dry and inspected. |
| Lead Integrity (Adhesion) | MIL-STD-883 Method 2025 | Leads are bent through 90º until a fracture occurs. |
| Lead Integrity (Fatigue) | MIL-STD-883 Method 2004, Condition $B_2$ | The leads are bent to an angle of 15º. Each lead is subjected to 3 cycles. |
| Lead Integrity (Tension/Pull) | MIL-STD-883 Method 2004, Condition $A_1$ | Pull of 0.227kg applied for 30 seconds. The force is then increased until the pins snap. |

## PART NUMBER STRUCTURE



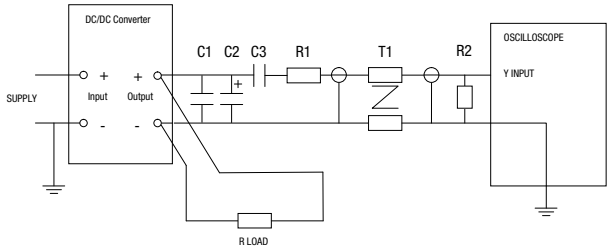
## CHARACTERISATION TEST METHODS

### 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




## APPLICATION NOTES

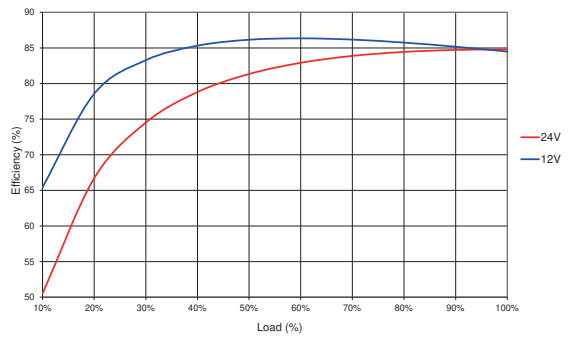
### Output Capacitance and start-up times

The NCS12 series does not require output capacitors to meet datasheet specification. To meet datasheet specification, total output capacitance should not exceed:

| Part No. | Maximum Load Capacitance (per output) | Start-up times |
|---|---|---|
| | µF | ms |
| NCS12S1203C | 470 | 16 |
| NCS12S1205C | 470 | 22 |
| NCS12S1212C | 220 | 7 |
| NCS12S1215C | 220 | 8.5 |
| NCS12S4803C | 470 | 14 |
| NCS12S4805C | 470 | 22 |
| NCS12S4812C | 220 | 8 |
| NCS12S4815C | 220 | 8.5 |
| NCS12D1205C | 220 | 5 |
| NCS12D1212C | 100 | 8 |
| NCS12D1215C | 100 | 9 |
| NCS12D4805C | 220 | 5 |
| NCS12D4812C | 100 | 7.5 |
| NCS12D4815C | 100 | 7 |

## EFFICIENCY VS LOAD

### NCS12S1203C

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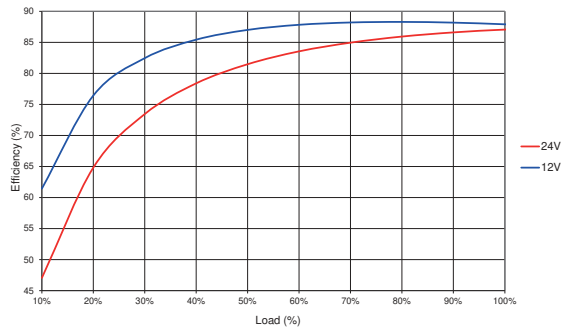


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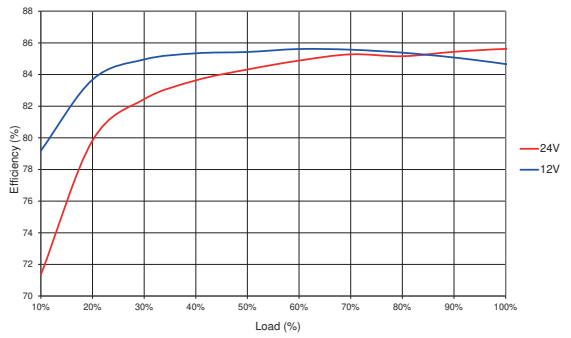
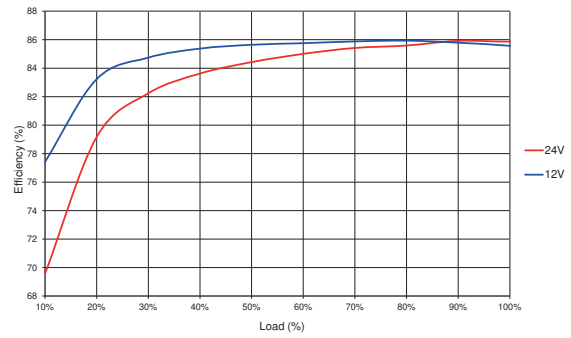
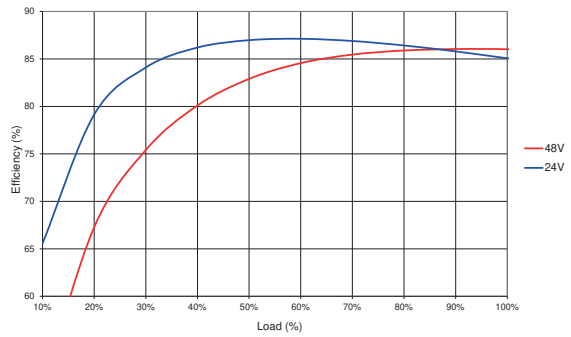


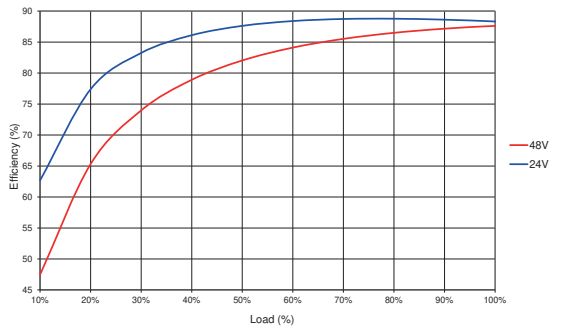

### NCS12S1215C



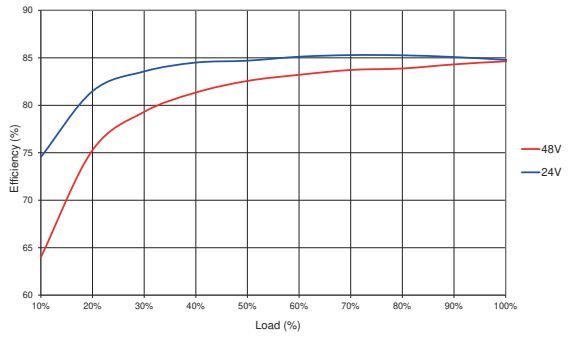

### NCS12S4803C



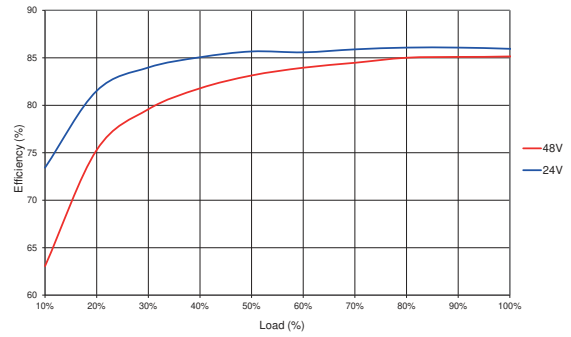

### NCS12S4805C




### NCS12S4812C

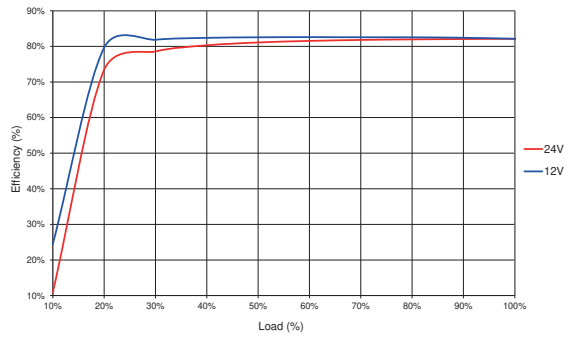



### NCS12S4815C

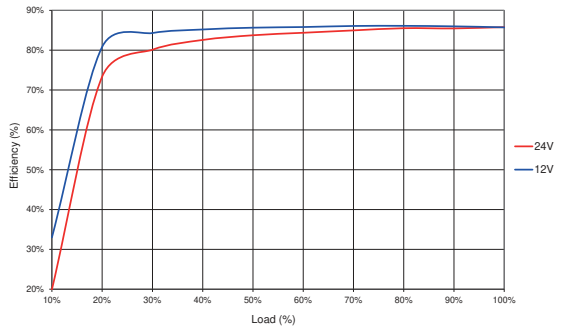


## EFFICIENCY VS LOAD (Continued)

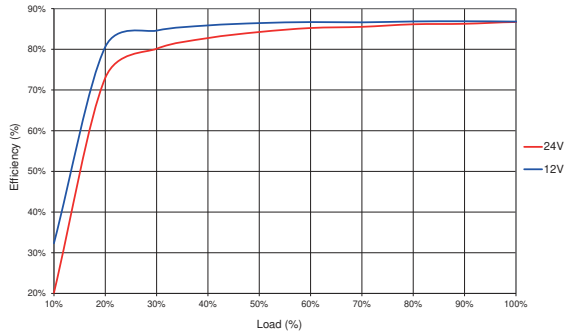
### NCS12D1205C



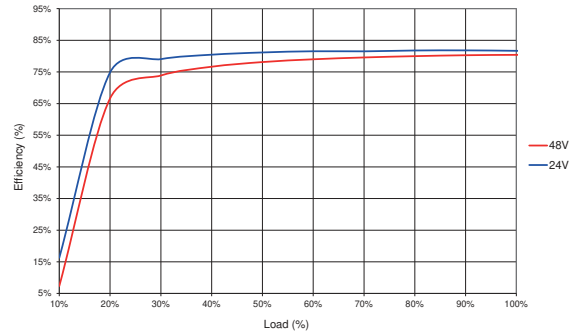

### NCS12D1212C



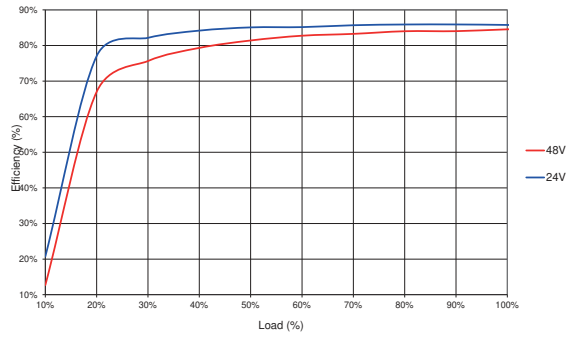

### NCS12D1215C




### NCS12D4805C




### NCS12D4812C

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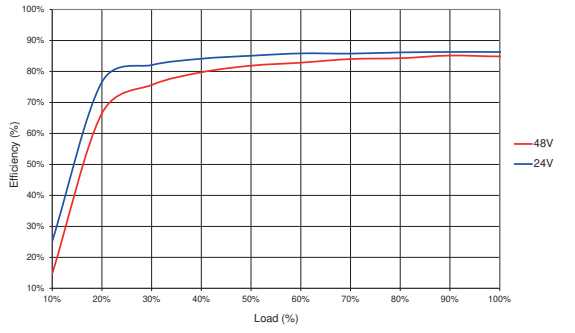
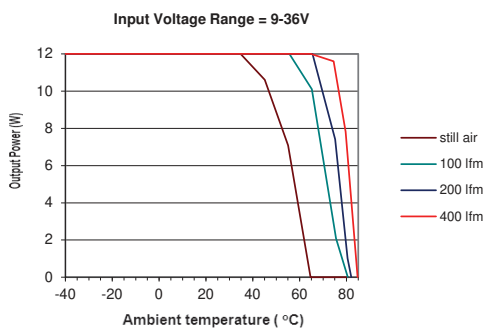
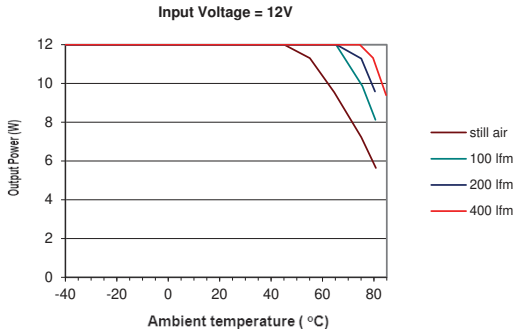


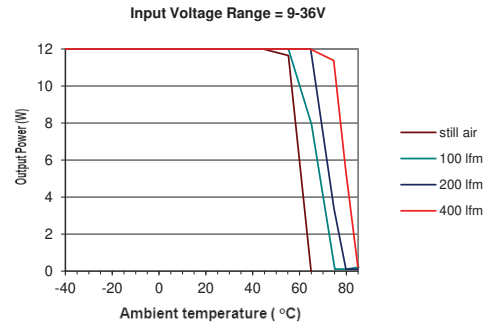
## TEMPERATURE DERATING

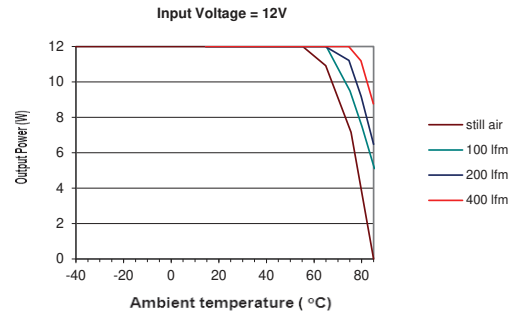
### NCS12S1203C



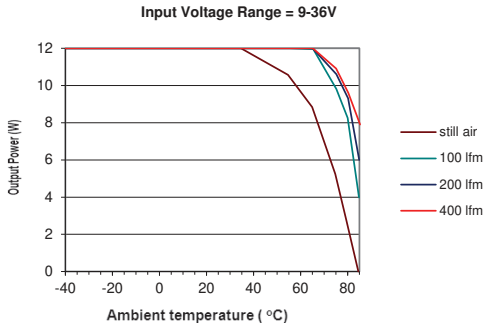



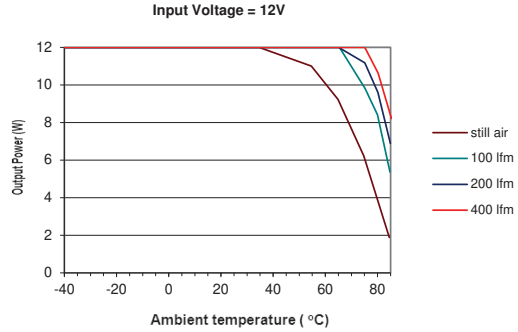

### NCS12S1205C



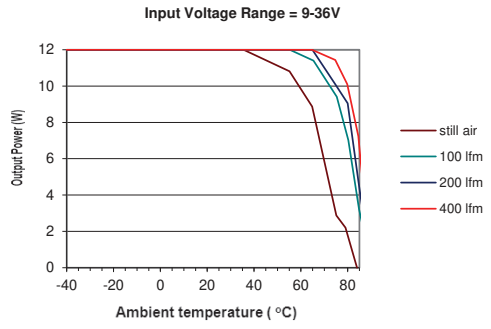



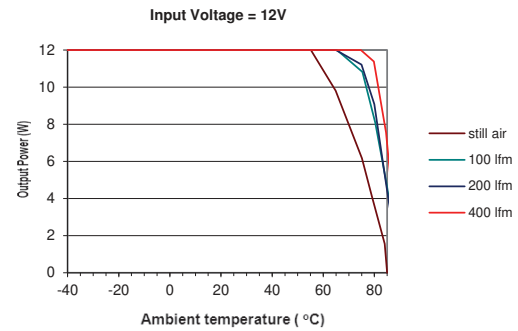

### NCS12S1212C



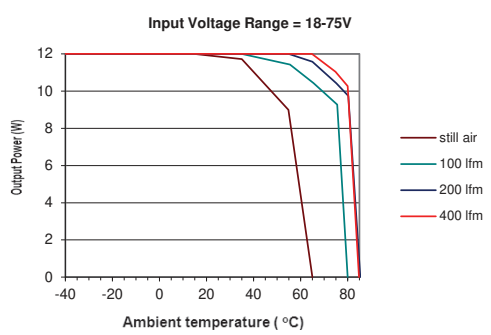

### NCS12S1215C

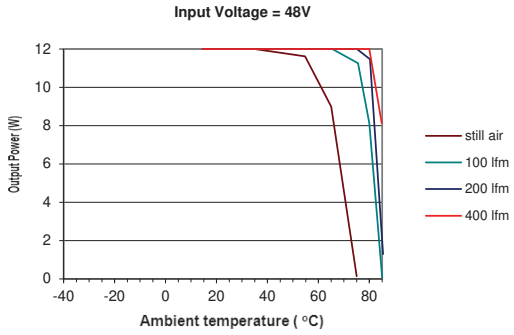


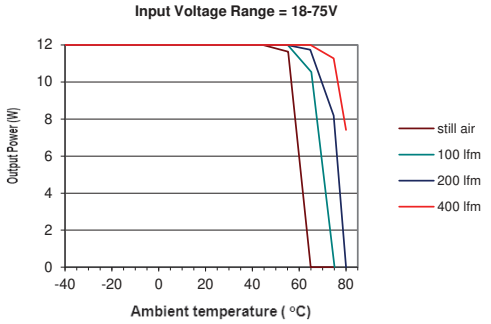
## TEMPERATURE DERATING (Continued)

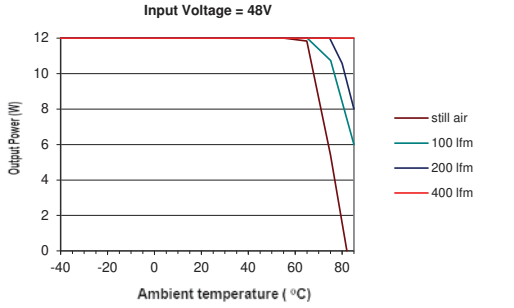
### NCS12S4803C




### NCS12S4805C

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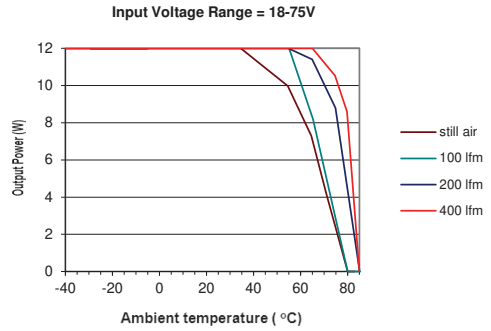


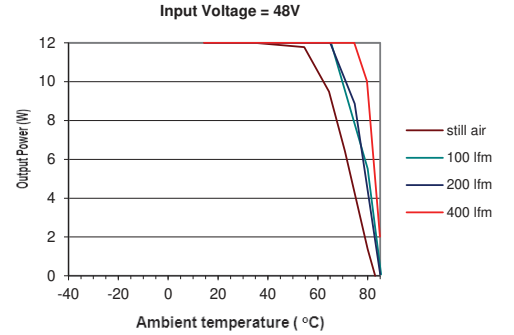


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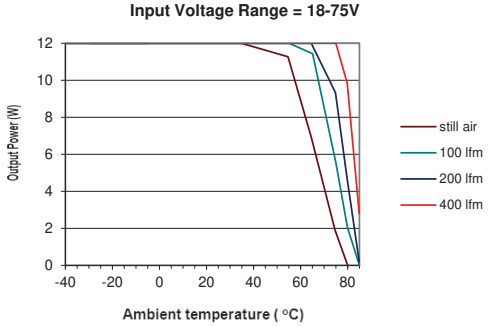
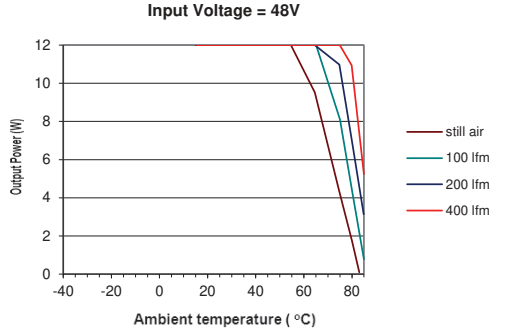
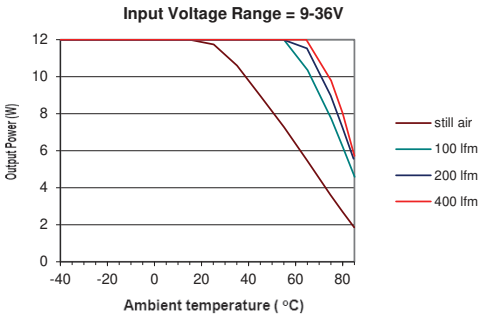
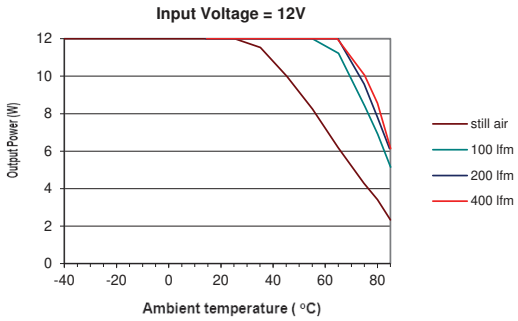


## TEMPERATURE DERATING (Continued)

### NCS12D1205C

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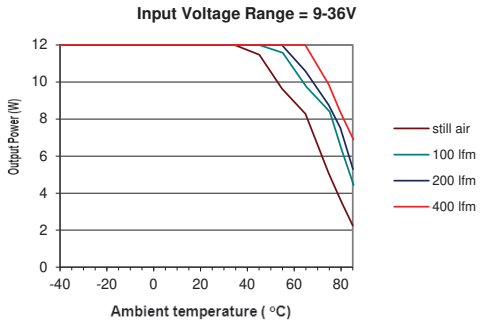


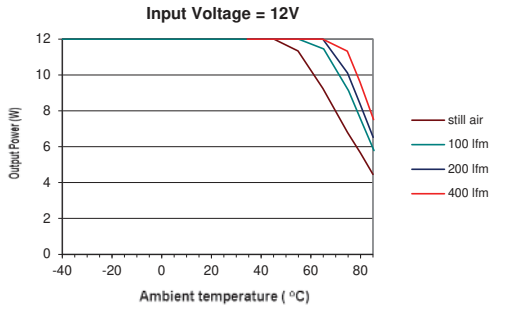


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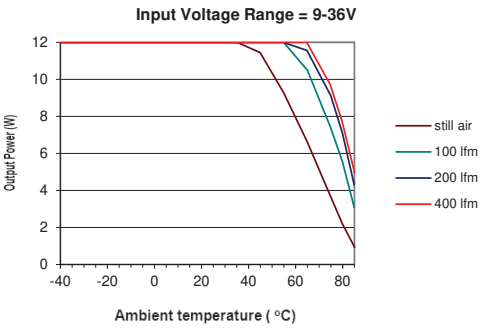


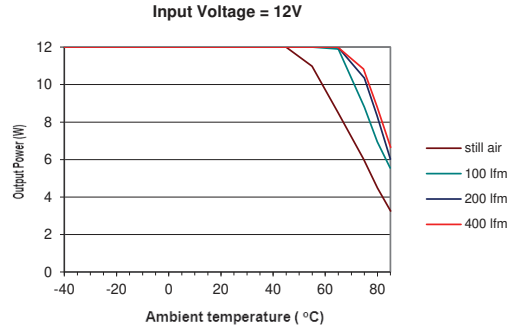


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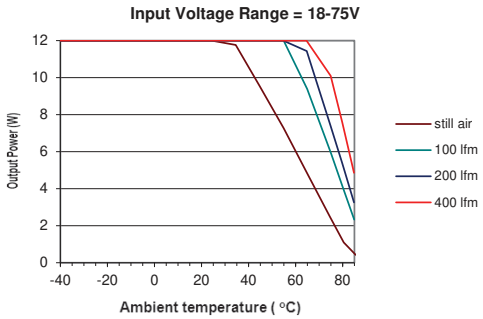


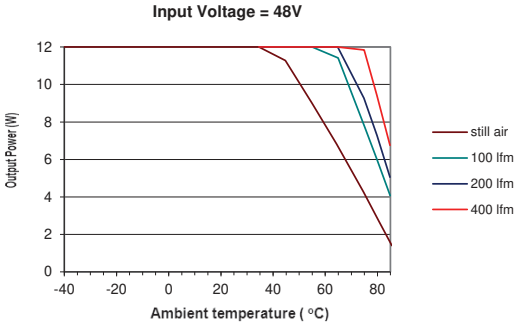

## TEMPERATURE DERATING (Continued)

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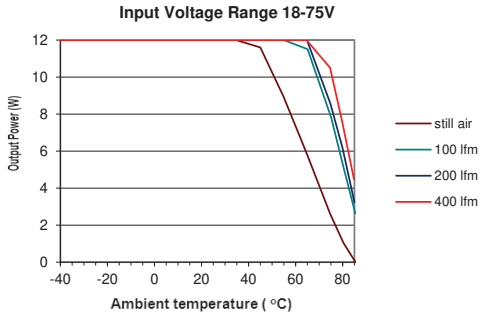


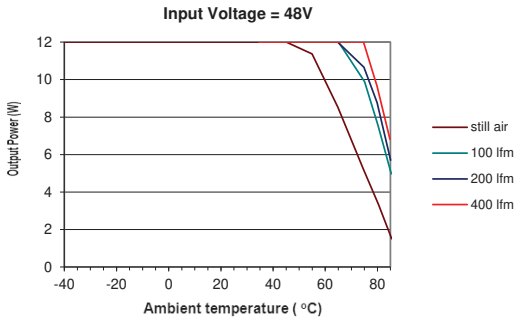


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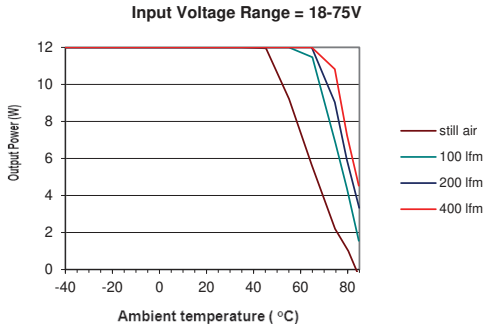
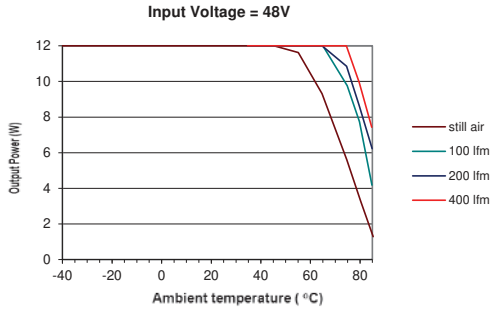


## EMC FILTERING AND SPECTRA

### FILTERING

The module includes a basic level of filtering, sufficient for many applications. Where lower noise levels are desired, filters can easily be added to achieve any required noise performance.

A DC-DC converter generates noise in two principle forms: that which is radiated from its body and that conducted on its external connections. There are three separate modes of conducted noise: input differential, output differential and input-output.

This last appears as common mode at the input and the output, and cannot therefore be removed by filtering at the input or output alone. The first level of filtering is to connect capacitors between input and output returns, to reduce this form of noise. It typically contains high harmonics of the switching frequency, which tend to appear as spikes on surrounding circuits. The voltage rating of this capacitor must match the required isolation voltage. (Due to the great variety in isolation voltage and required noise performance, this capacitor has not been included within the converter.)

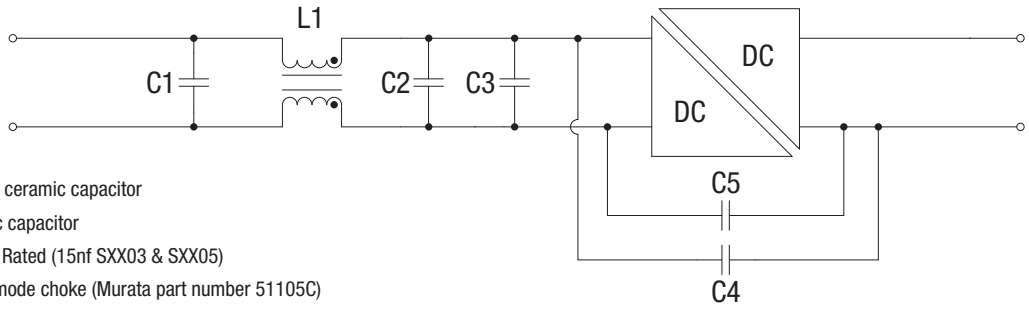
Input ripple is a voltage developed across the internal Input decoupling capacitor. It is therefore measured with a defined supply source impedance. Although simple series inductance will provide filtering, on its own it can degrade the stability. A shunt capacitor is therefore recommended across the converter input terminals, so that it is fed from a low impedance.

If no filtering is required, the inductance of long supply wiring could also cause a problem, requiring an input decoupling capacitor for stability. An electrolytic will perform well in these situations. The input-output filtering is performed by the common-mode choke on the primary. This could be placed on the output, but would then degrade the regulation and produce less benefit for a given size, cost, and power loss.

Radiated noise is present in magnetic and electrostatic forms. The latter is suppressed by the metal case, which is connected to the output return, typically a zero-volt point. Thanks to the small size of these units, neither form of noise will be radiated “efficiently”, so will not normally cause a problem. Any question of this kind usually better repays attention to conducted signals.

### EMC FILTER AND VALUES TO OBTAIN SPECTRA AS SHOWN

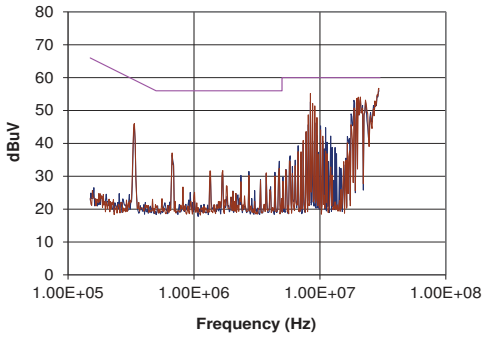
The following filter circuit shows the input filter typically required to meet CISPR22 Quasi-PeakCurve B.




| | |
|---|---|
| **C1, C2** | 1µF Polyester or ceramic capacitor |
| **C3** | 47µF Electrolytic capacitor |
| **C4 & C5** | 10nF 250 VAC Y Rated (15nf SXX03 & SXX05) |
| **L1** | 1mH Common-mode choke (Murata part number 51105C) |

## EMC FILTERING AND SPECTRA (Continued)

### NCS12S1203C

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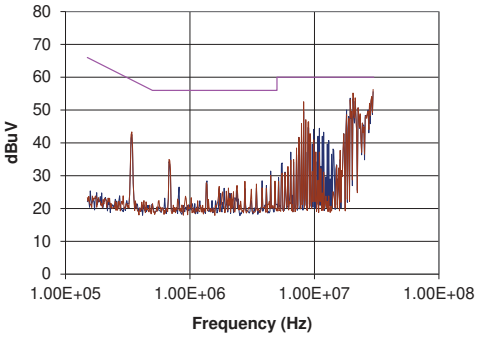
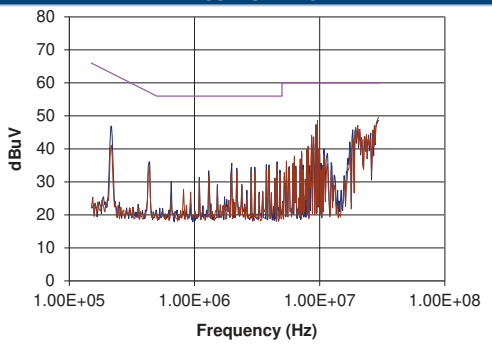



### NCS12S1212C

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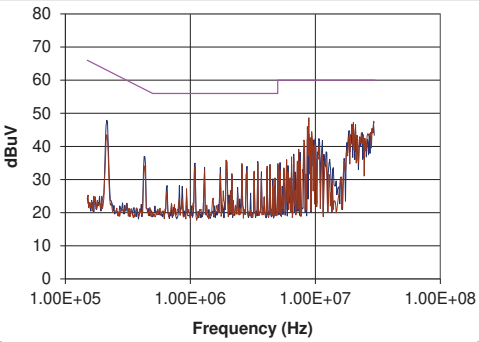


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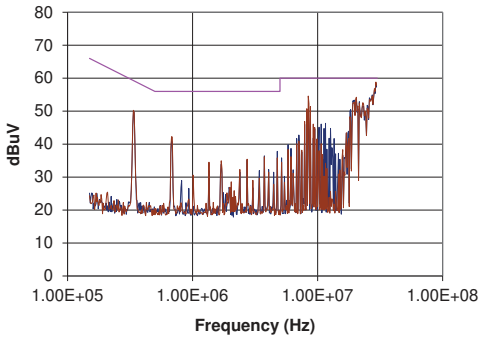


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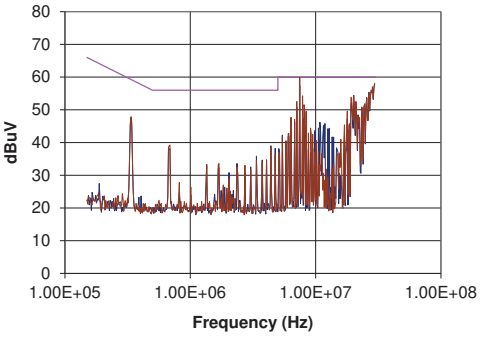


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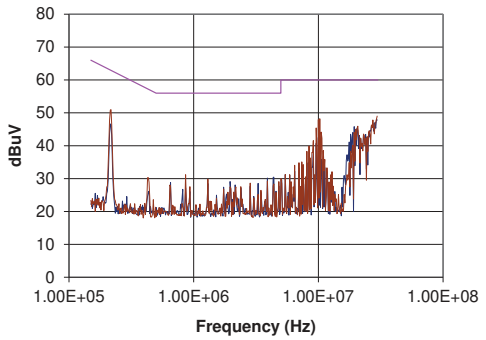


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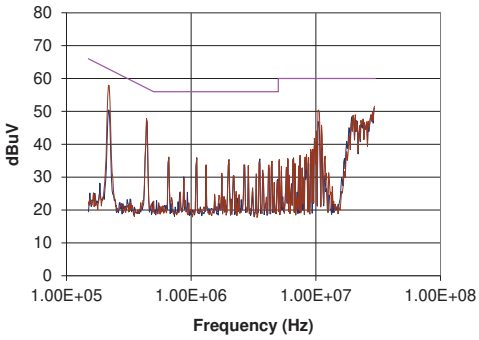
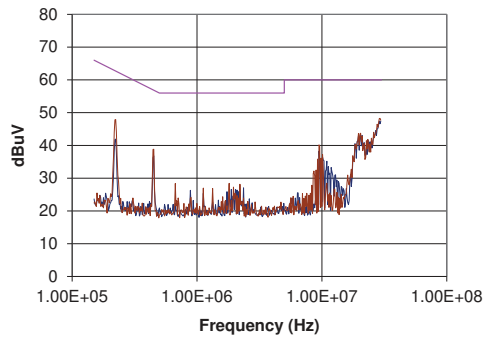


## EMC FILTERING AND SPECTRA (Continued)

### NCS12D1205C

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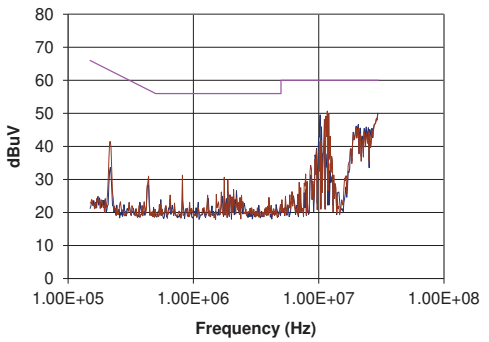


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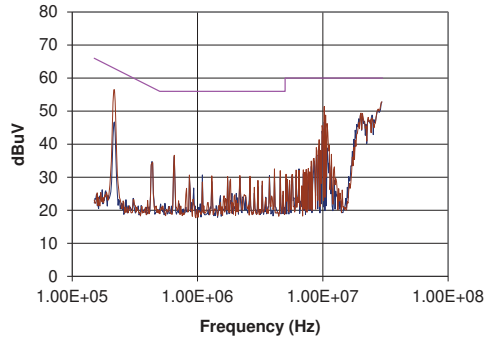


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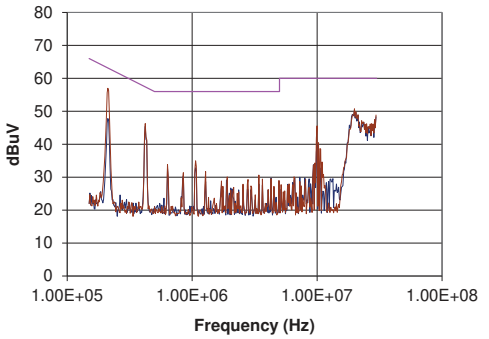


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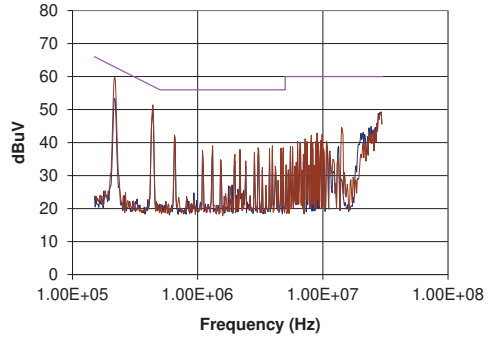
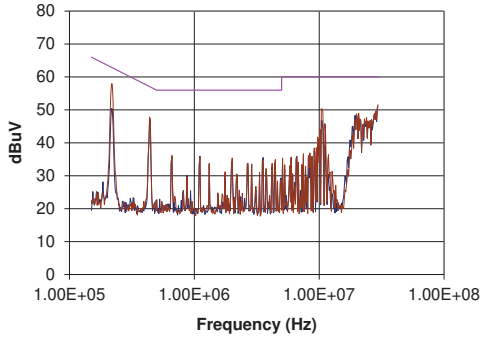
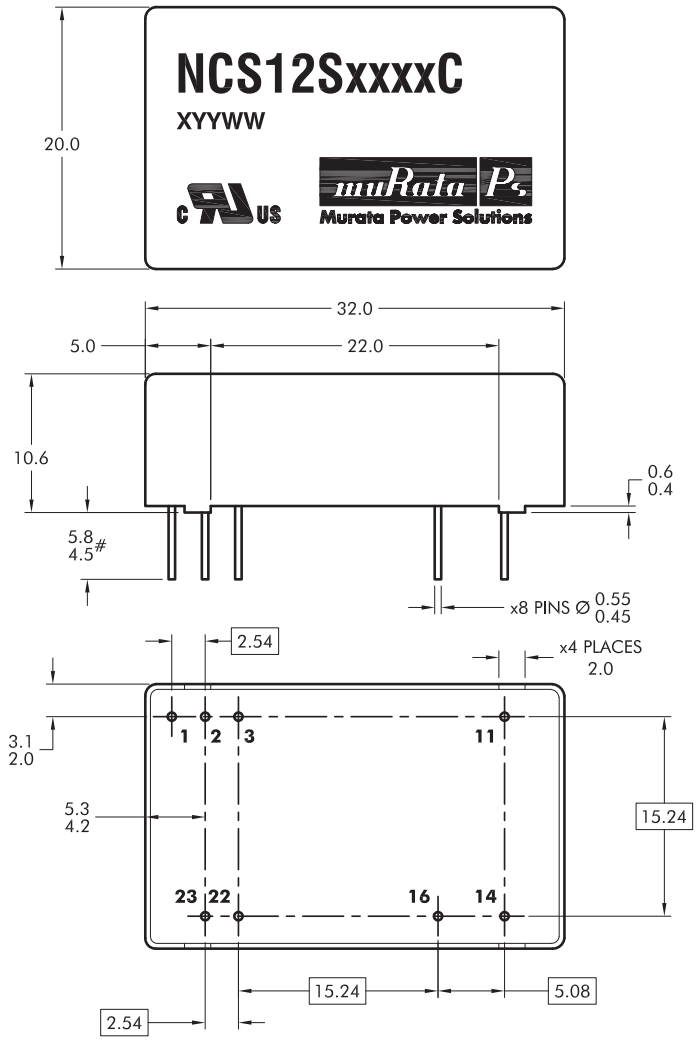



### NCS12D4815C



## PACKAGE SPECIFICATIONS

### MECHANICAL DIMENSIONS - SINGLE




# The pin length of the following variants is 4.2-5.3; NCS12Sxx03C & NCS12Sxx05SC

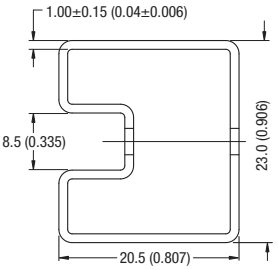
All dimensions in mm.
Tolerances (unless otherwise stated) ±0.4 .
All pins on a 2.54 pitch and within ±0.25 of true position

Weight: 17g

### PIN CONNECTIONS

| Pin | Function |
|---|---|
| | Single |
| 1 | Control |
| 2 | $-V_{IN}$ |
| 3 | $-V_{IN}$ |
| 11 | N/C |
| 14 | $+V_{OUT}$ |
| 16 | 0V |
| 22 | $+V_{IN}$ |
| 23 | $+V_{IN}$ |

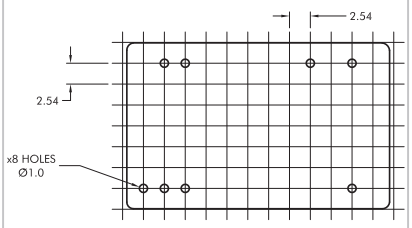
### TUBE OUTLINE DIMENSIONS




Tube length 520 (20.47)
All dimensions in mm (inches) ±0.25 (0.010).

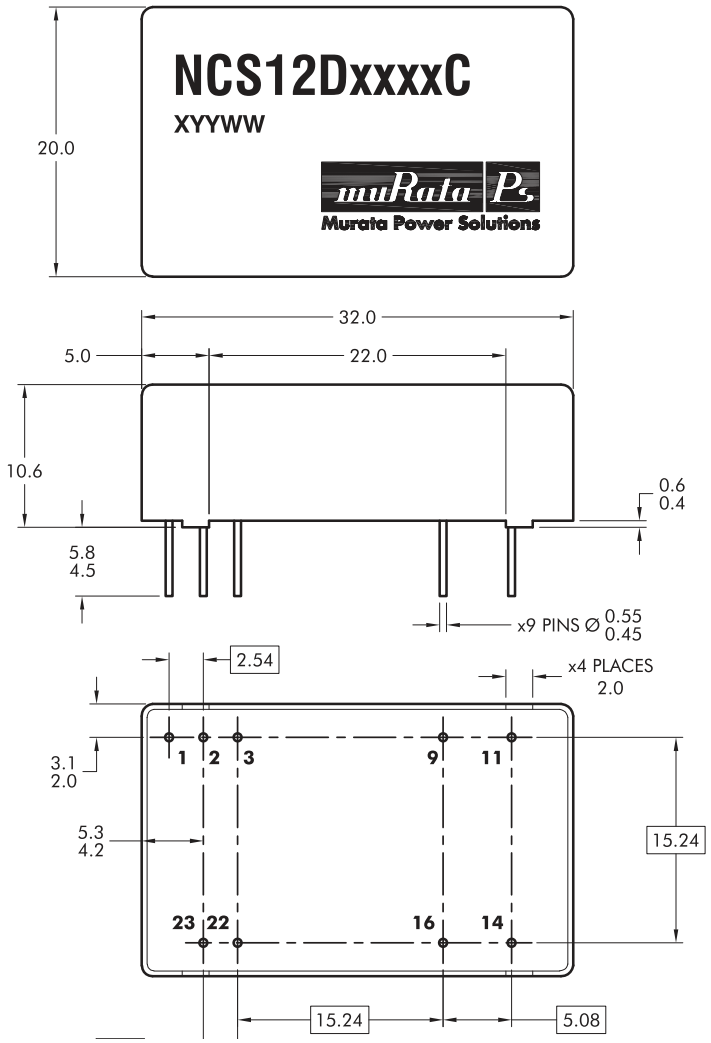
Quantity: 15

### RECOMMENDED FOOTPRINT DETAILS



## PACKAGE SPECIFICATIONS (Continued)

### MECHANICAL DIMENSIONS - DUAL



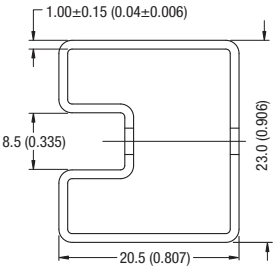

All dimensions in mm.
Tolerances (unless otherwise stated).
All pins on a 2.54 pitch and within ±0.25 of true position.

Weight: 17g

### PIN CONNECTIONS

| Pin | Function |
|---|---|
| | Single |
| 1 | Control |
| 2 | $-V_{IN}$ |
| 3 | $-V_{IN}$ |
| 9 | 0V |
| 11 | -Vout |
| 14 | $+V_{OUT}$ |
| 16 | 0V |
| 22 | $+V_{IN}$ |
| 23 | $+V_{IN}$ |

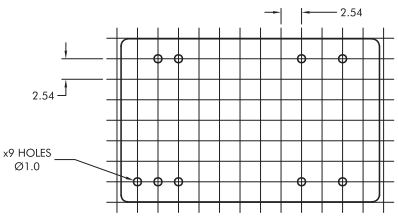
### TUBE OUTLINE DIMENSIONS




Tube length 520 (20.47)
All dimensions in mm (inches) ±0.25 (0.010).

Quantity: 15

### RECOMMENDED FOOTPRINT DETAILS



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- Aerospace equipment
- Undersea equipment
- Power plant control equipment
- Medical equipment
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- Traffic signal equipment
- Disaster prevention / crime prevention equipment
- Data Processing equipment

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