Murata Power Solutions

# NCS1 Series

Isolated 1W 4:1 Input Single Output DC/DC Converters


## FEATURES

- UL 60950 recognition pending
- 4:1 Wide range voltage input
- Operating temperature range -40°C to 105°C with derating
- 1 kVDC Isolation
- 3.3V, 5V & 12V outputs
- No electrolytic capacitors
- Continuous short circuit protection

## PRODUCT OVERVIEW

The NCS1 series of DC/DC converters offers a single output voltage from input voltage ranges of 4.5-18V and 9-36V. The NCS1 is housed in an industry standard package with a standard pinout.

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

## SELECTION GUIDE

| Order Code | Input Voltage | Output Voltage | Output Current | Efficiency 5V or 24V Input. | | Efficiency 12V Input. | | Ripple and Noise | | Isolation Capacitance | MTTF[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nom. | | | Min. | Typ. | Min. | Typ. | Typ. | Max. | | |
| | V | V | mA | % | % | % | % | mVp/p | mVp/p | pF | Hrs |
| **NCS1S1203SC** | 12 | 3.3 | 303 | 73 | 77 | 71 | 75 | 24 | 70 | 24 | |
| **NCS1S1205SC** | 12 | 5 | 200 | 76 | 79 | 74 | 77 | 25 | 50 | 30 | |
| **NCS1S1212SC** | 12 | 12 | 83 | 75 | 78 | 75 | 79 | 40 | 120 | 35 | |
| **NCS1S2403SC** | 24 | 3.3 | 303 | 76 | 78.5 | 73 | 76 | 35 | 70 | 28 | |
| **NCS1S2405SC** | 24 | 5 | 200 | 79 | 82 | 77 | 80 | 27 | 50 | 42 | |
| **NCS1S2412SC** | 24 | 12 | 83 | 80 | 83 | 77 | 80 | 28 | 120 | 42 | |

## INPUT CHARACTERISTICS

| Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Voltage range | 12V input types | | 4.5 | 12 | 18 | V |
| | 24V input types | | 9 | 24 | 36 | |
| Input current | NCS1S12XX | 5V input voltage | | 0.26 | | A |
| | | 12V input voltage | | 0.1 | | |
| | NCS1S24XX | 12V input voltage | | 0.1 | | |
| | | 24V input voltage | | 0.05 | | |
| Input ripple current | NCS1S12XX | | | 5 | 30 | mA p-p |
| | NCS1S24XX | | | 5 | 15 | |

## OUTPUT CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Rated power | All output types | | | 1 | W |
| Minimal load to meet datasheet specification | | 10 | | | % |
| Voltage set point accuracy | All output types | | ±1 | ±2 | % |
| Line regulation | Low line to high line | | | ±0.5 | % |
| Load regulation | All output types | | | 0.5 | % |
| Transient response | Peak deviation (12.5-37.5% & 37.5-12.5% swing) | | | 5 | $\%V_{out}$ |
| | Settling time (within 1% $V_{out}$ Nom.) | | 1000 | | µs |

## ISOLATION CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Isolation test voltage | Flash tested for 1 minute | 1000 | | | VDC |
| Resistance | Viso = 1kVDC | 1 | | | GΩ |

## GENERAL CHARACTERISTICS[1]

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Switching frequency | | 100 | | 400 | kHz |
| Control pin input | Module on, pin unconnected or open collector floating | | | | |
| | Module off | | | 0.8 | V |

1 Calculated using MIL-HDBK-217 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.

RoHS COMPLIANT

For full details go to
www.murata-ps.com/rohs

## TEMPERATURE CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Operation | | -40 | | 105 | °C |
| Storage | | -50 | | 125 | |
| Case temperature above ambient | 100% Load, Nom $V_{IN}$, Still Air | | 15 | 22 | |

## ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| Short-circuit protection (for SELV input voltages) | Continuous |
| Control pin input voltage | 18V Max |
| Lead temperature 1.0mm from case for 10 seconds (to JEDEC JESD22-B106 ISS C) | 260°C |
| Input voltage, NCS1 12V input types | 25V |
| Input voltage, NCS1 24V input types | 40V |

## APPLICATION NOTES

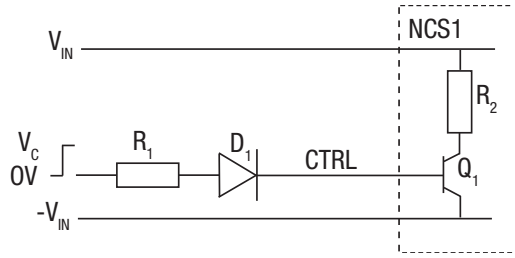
### Start-up times

Typical start up times for this series, with a typical input voltage rise time of 2.2µs and output capacitance of 10µF, are shown in the table below. The product series will start into a capacitance of 47µF with an increased start time, however the maximum recommended output capacitance is 10µF.

| Part No. | Start-up times ms |
|---|---|
| **NCS1S1203SC** | 6 |
| **NCS1S1205SC** | 9 |
| **NCS1S1212SC** | 20 |
| **NCS1S2403SC** | 12 |
| **NCS1S2405SC** | 7 |
| **NCS1S2412SC** | 12 |

### Control Pin

The NCS1 converters have a shutdown feature which enables the user to put the converter into a low power state. The control pin connects directly to the base of an internal transistor, and the switch off mechanism for the NCS1 works by forward biasing this NPN transistor. If the pin is left open (high impedance), the converter will be ON (there is no allowed low state for this pin), but once a control voltage is applied with sufficient drive current, the converter will be switched OFF. A suitable application circuit is shown below.




$D_1$ (e.g. 1N4003) is required to provide high impedence when the signal is low. From the NCS1 specification, the drive current to operate this function is recommended to be 3mA, and hence the value of $R_1$ can be derived as follows:

$$R_1 = \frac{V_C - V_D - V_Q}{I_C}$$

Assuming $V_C$=5V, $V_D$=0.7V and $V_Q$=1V:

$$R_1 = \frac{5 - 0.7 - 1.0}{3 \times 10^{-3}} = 1100\Omega$$

## 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 specifi ed time, across a component designed to provide electrical isolation, to verify the integrity of that isolation.

Murata Power Solutions NCS1 series of DC/DC converters are all 100% production tested at their stated isolation voltage. This is 1.0kVDC 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 NCS1 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 NCS1 series has a toroid 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.

## RoHS COMPLIANCE INFORMATION

RoHS COMPLIANT

This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260ºC for 10 seconds. The pin termination finish on this product series is Tin Plate, Hot Dipped over Matte Tin with Nickel Preplate. The series is backward compatible with Sn/Pb soldering systems.

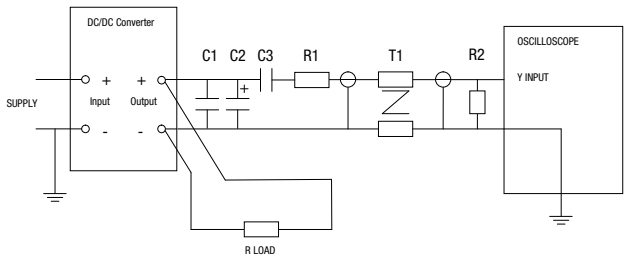
## CHARACTERISATION TEST METHODS

### Ripple & Noise Characterisation Method

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

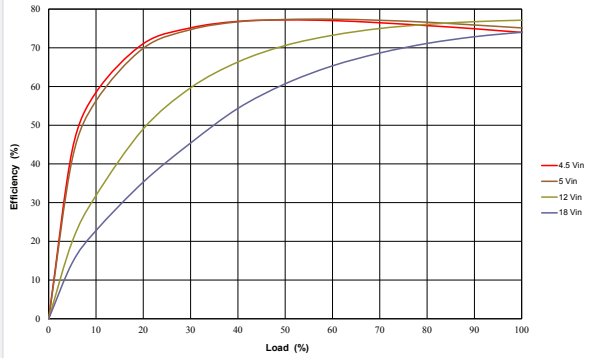
| | |
|---|---|
| C1 | 1µF X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC/DC converter |
| C2 | 10µF tantalum capacitor, voltage rating to be a minimum of 1.5 times the output voltage of the DC/DC converter with an ESR of less than 100mΩ at 100 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

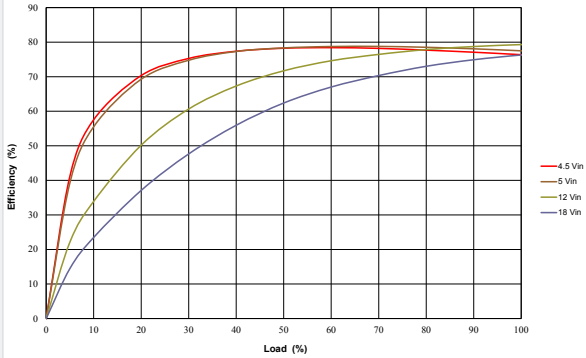


## EFFICIENCY VS LOAD

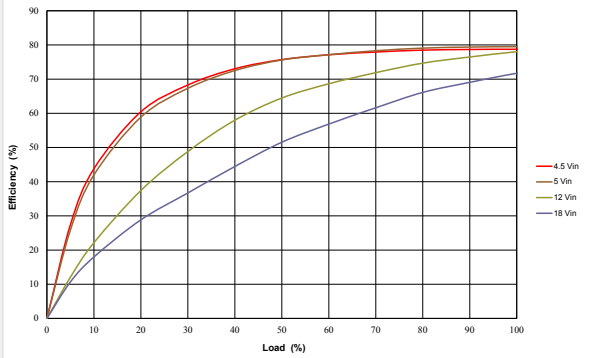
### NCS1S1203SC



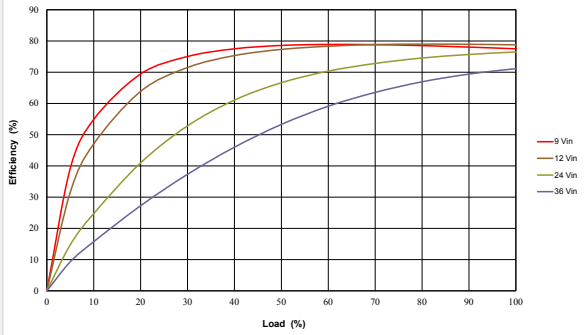

### NCS1S1205SC



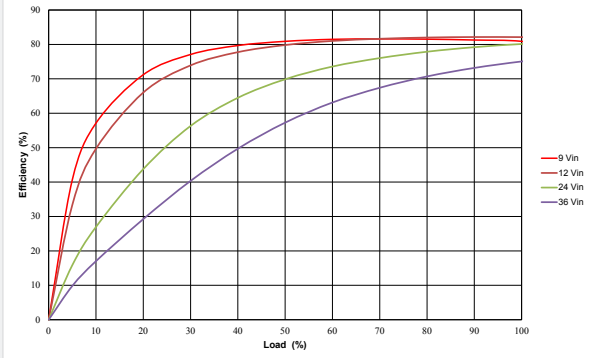

### NCS1S1212SC



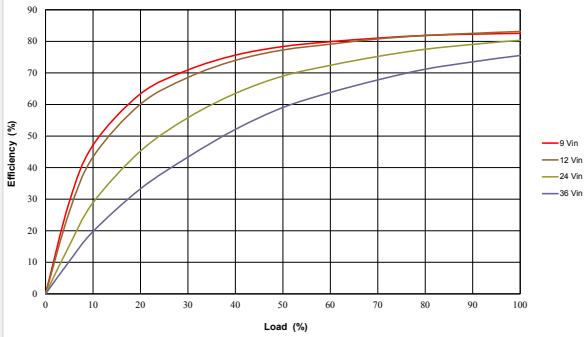

### NCS1S2403SC




### NCS1S2405SC

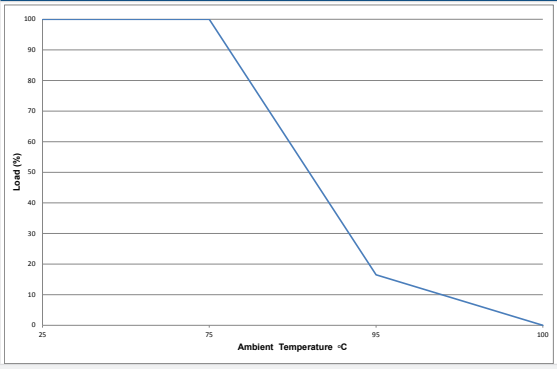



### NCS1S2412SC

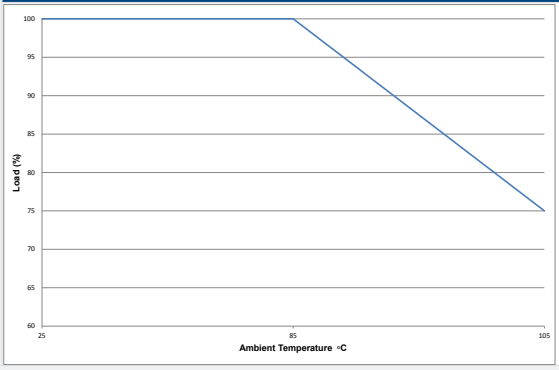


## TEMPERATURE DERATING

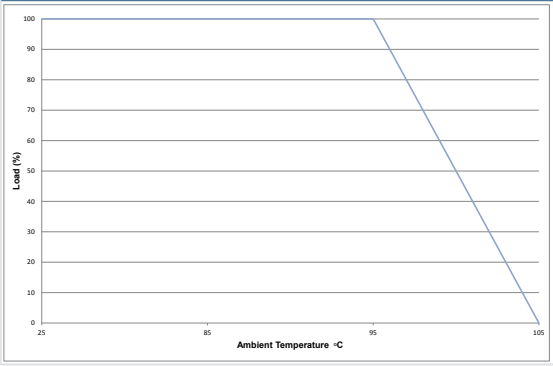
### NCS1S1203SC




### NCS1S1205SC




### NCS1S1212SC

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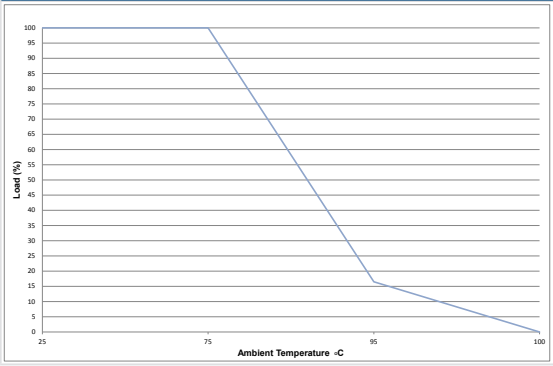
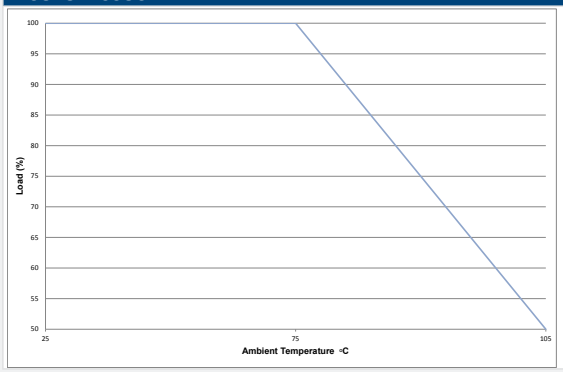
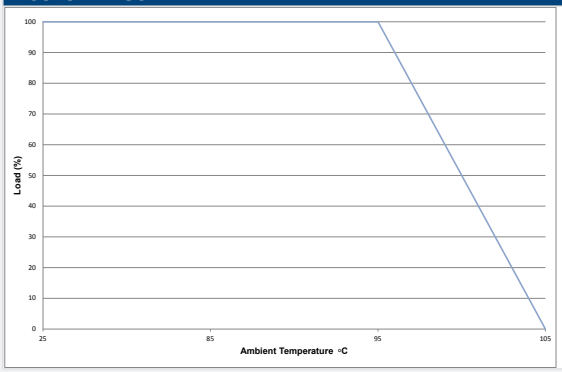



### NCS1S2405SC




### NCS1S2412SC



## EMC FILTERING AND SPECTRA

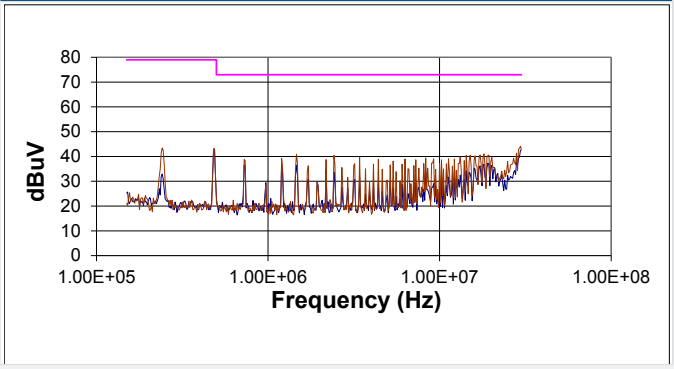
### FILTERING

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

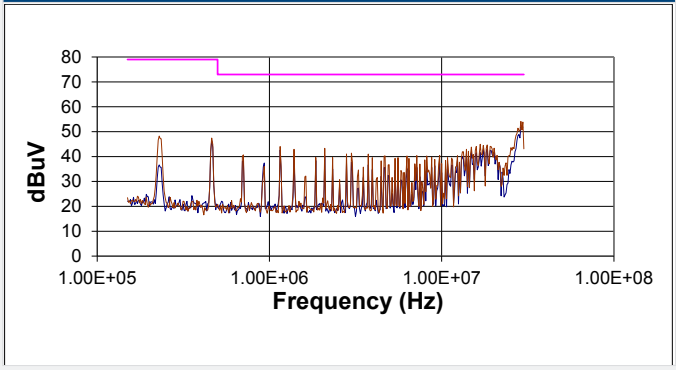
| Part Number | Capacitor | Inductor | Common Mode Choke |
|---|---|---|---|
| **NCS1S1203SC** | 330nF | 500µH | |
| **NCS1S1205SC** | 330nF | 500µH | |
| **NCS1S1212SC** | 2.2µF | 2.2mH | |
| **NCS1S2403SC** | 330nF | 500µH | 700µH |
| **NCS1S2405SC** | 330nF | 500µH | |
| **NCS1S2412SC** | 330nF | 500µH | |

## EMC FILTERING AND SPECTRA

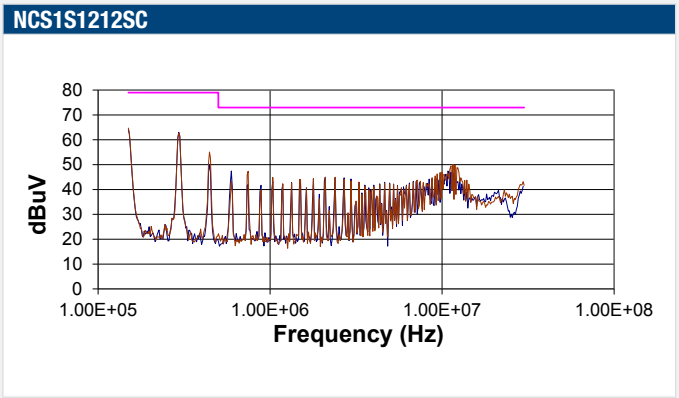
### NCS1S1203SC



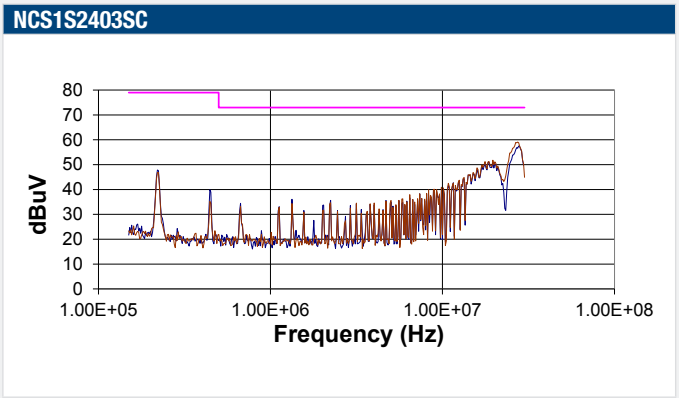

### NCS1S1205SC



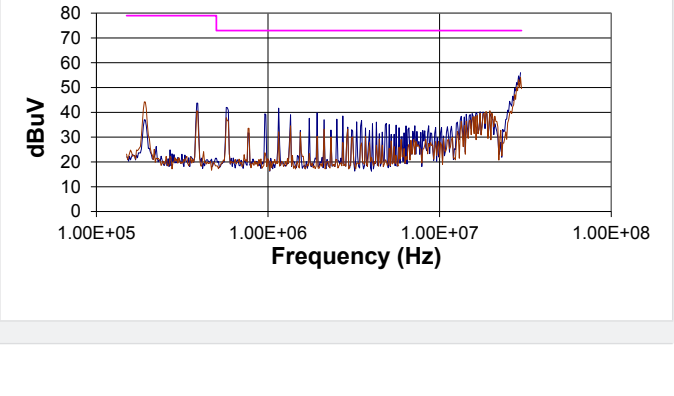

### NCS1S1212SC



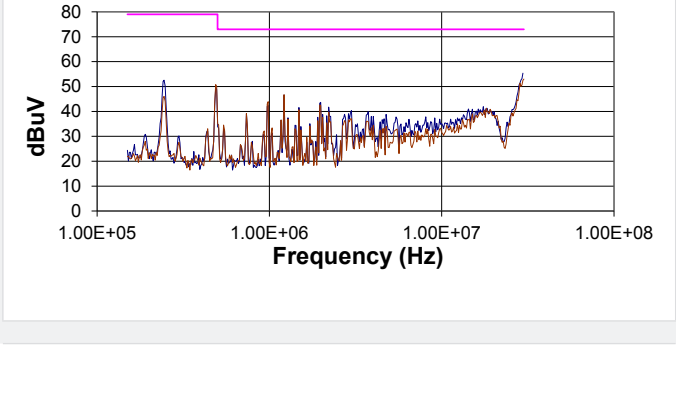

### NCS1S2403SC




### NCS1S2405SC

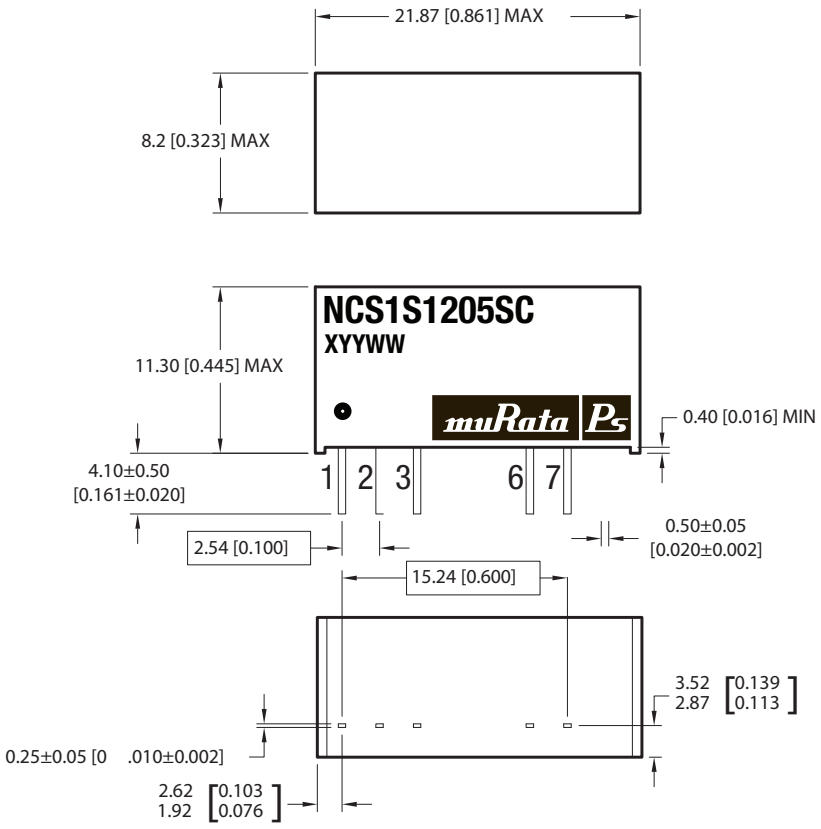



### NCS1S2412SC



## PACKAGE SPECIFICATIONS

### MECHANICAL DIMENSIONS



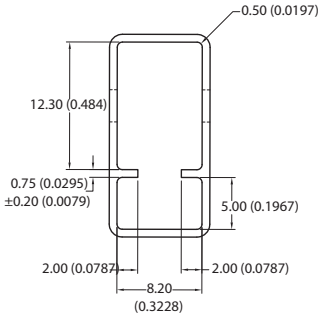

All dimensions in millimetres (inches) ± 0.5 (0.020) except pin to pin tolerance ±0.25 (0.010).
All pins on a 2.54 (0.100) pitch and within 0.25 (0.010) of true position.

Weight: 3.3g

### PIN CONNECTIONS

| Pin | Function |
|---|---|
| | Single |
| 1 | -$V_{IN}$ |
| 2 | +$V_{IN}$ |
| 3 | Control |
| 6 | +$V_{OUT}$ |
| 7 | -$V_{OUT}$ |

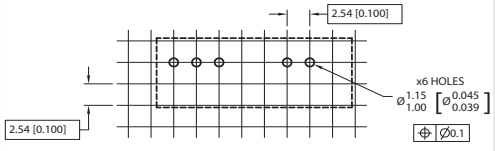
### TUBE OUTLINE DIMENSIONS




All dimensions in millimetres ±0.5 (inches ±0.01).
Tube length: 520±2 (20.47 inches ±0.079).

Quantity: 23

### RECOMMENDED FOOTPRINT DETAILS




All dimensions in mm (inches) ±0.25 (± 0.010).

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ISO 9001 and 14001 REGISTERED