

### FEATURES

- UL60950 recognition pending
- Operation to zero load
- Single isolated output
- 1kVDC isolation
- Efficiency up to 87% typical
- Wide temperature performance at full 1 watt load, -40°C to 85°C
- Power density from 1.305W/cm<sup>3</sup>
- Industry standard pinout
- 3.3V, 5V, 12V, 15V & 24V input
- 3.3V, 5V, 9V, 12V and 15V output
- Custom solutions available
- Pin compatible with LME, NME, NKE & NML series
- PCB mounting

### DESCRIPTION

The MEE1 series is the new high performance version of our 1W NME series. The MEE1 series is more efficient and offers improved regulation performance for applications where a wide output voltage variation can not be tolerated. They are ideally suited for providing local supplies on control system boards with the added benefit of 1kVDC galvanic isolation to reduce switching noise.

### SELECTION GUIDE

| Order Code  | Nominal Input Voltage | Output Voltage | Output Current | Load Regulation (Typ) | Load Regulation (Max) | Ripple & Noise (Typ) | Ripple & Noise (Max) | Input Current at Rated Load | Efficiency (Min) | Efficiency (Typ) | Isolation Capacitance (Typ) | MTTF | Package Style |
|-------------|-----------------------|----------------|----------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------------|------------------|------------------|-----------------------------|------|---------------|
|             | V                     | V              | mA             | %                     | %                     | mVp-p                | mVp-p                | mA                          | %                | %                | pF                          | kHrs |               |
| MEE1S0303SC | 3.3                   | 3.3            | 303            | 10                    | 12                    | 26                   | 50                   | 377                         | 76               | 78.5             | 42                          | 3852 | SIP           |
| MEE1S0305SC | 3.3                   | 5              | 200            | 9.2                   | 11                    | 23                   | 50                   | 360                         | 79               | 81.5             | 44                          | 4008 |               |
| MEE1S0309SC | 3.3                   | 9              | 111            | 10                    | 12                    | 15                   | 40                   | 361                         | 79               | 81.5             | 47                          | 4930 |               |
| MEE1S0312SC | 3.3                   | 12             | 83             | 8.7                   | 11                    | 14                   | 40                   | 352                         | 81               | 84               | 48                          | 4040 |               |
| MEE1S0315SC | 3.3                   | 15             | 67             | 7.8                   | 10                    | 12                   | 35                   | 350                         | 82               | 84.5             | 50                          | 3792 |               |
| MEE1S0503SC | 5                     | 3.3            | 303            | 8                     | 10                    | 22                   | 45                   | 246                         | 76               | 80               | 39                          | 3213 |               |
| MEE1S0505SC | 5                     | 5              | 200            | 5.6                   | 7                     | 19                   | 40                   | 237                         | 80               | 83               | 46                          | 3990 |               |
| MEE1S0509SC | 5                     | 9              | 111            | 6.8                   | 9                     | 13                   | 35                   | 238                         | 80               | 83.5             | 53                          | 4526 |               |
| MEE1S0512SC | 5                     | 12             | 83             | 6.5                   | 8                     | 11                   | 35                   | 233                         | 81               | 85               | 49                          | 3756 |               |
| MEE1S0515SC | 5                     | 15             | 67             | 5.7                   | 8                     | 9                    | 30                   | 230                         | 83               | 85.5             | 46                          | 3240 |               |
| MEE1S1205SC | 12                    | 5              | 200            | 5                     | 7                     | 16                   | 40                   | 97                          | 79               | 83.5             | 47                          | 3857 |               |
| MEE1S1209SC | 12                    | 9              | 111            | 5.8                   | 8                     | 12                   | 35                   | 97                          | 79               | 84               | 77                          | 4370 |               |
| MEE1S1212SC | 12                    | 12             | 83             | 4.8                   | 6                     | 10                   | 35                   | 97                          | 82               | 85               | 79                          | 3774 |               |
| MEE1S1215SC | 12                    | 15             | 67             | 4.2                   | 7                     | 9                    | 35                   | 95                          | 81               | 86.5             | 81                          | 3779 |               |
| MEE1S1505SC | 15                    | 5              | 200            | 4.2                   | 6                     | 15                   | 40                   | 79                          | 77               | 83.5             | 41                          | 3312 |               |
| MEE1S1509SC | 15                    | 9              | 111            | 5.1                   | 7                     | 12                   | 35                   | 79                          | 77               | 83               | 65                          | 3451 |               |
| MEE1S1512SC | 15                    | 12             | 83             | 4.3                   | 5                     | 11                   | 35                   | 77                          | 78               | 85               | 77                          | 3940 |               |
| MEE1S1515SC | 15                    | 15             | 67             | 3.8                   | 5                     | 8                    | 30                   | 76                          | 83               | 86.5             | 100                         | 3420 |               |
| MEE1S2405SC | 24                    | 5              | 200            | 3.6                   | 5                     | 19                   | 50                   | 49                          | 75               | 83               | 51                          | 3983 |               |
| MEE1S2409SC | 24                    | 9              | 111            | 4                     | 6                     | 17                   | 40                   | 50                          | 74               | 83               | 70                          | 4255 |               |
| MEE1S2412SC | 24                    | 12             | 83             | 3.4                   | 5                     | 11                   | 35                   | 49                          | 79               | 85.5             | 89                          | 3991 |               |
| MEE1S2415SC | 24                    | 15             | 67             | 3                     | 5                     | 9                    | 35                   | 49                          | 78               | 86               | 101                         | 3532 |               |
| MEE1S0303DC | 3.3                   | 3.3            | 303            | 10                    | 12                    | 26                   | 50                   | 377                         | 76               | 78.5             | 42                          | 3852 | DIP           |
| MEE1S0305DC | 3.3                   | 5              | 200            | 9.2                   | 11                    | 23                   | 50                   | 360                         | 79               | 81.5             | 44                          | 4008 |               |
| MEE1S0309DC | 3.3                   | 9              | 111            | 10                    | 12                    | 15                   | 40                   | 361                         | 79               | 81.5             | 47                          | 4930 |               |
| MEE1S0312DC | 3.3                   | 12             | 83             | 8.7                   | 11                    | 14                   | 40                   | 352                         | 81               | 84               | 48                          | 4040 |               |
| MEE1S0315DC | 3.3                   | 15             | 67             | 7.8                   | 10                    | 12                   | 35                   | 350                         | 82               | 84.5             | 50                          | 3792 |               |
| MEE1S0503DC | 5                     | 3.3            | 303            | 8                     | 10                    | 22                   | 45                   | 246                         | 76               | 80               | 39                          | 3213 |               |
| MEE1S0505DC | 5                     | 5              | 200            | 5.6                   | 7                     | 19                   | 40                   | 237                         | 80               | 83               | 46                          | 3990 |               |
| MEE1S0509DC | 5                     | 9              | 111            | 6.8                   | 9                     | 13                   | 35                   | 238                         | 80               | 83.5             | 53                          | 4526 |               |
| MEE1S0512DC | 5                     | 12             | 83             | 6.5                   | 8                     | 11                   | 35                   | 233                         | 81               | 85               | 49                          | 3756 |               |
| MEE1S0515DC | 5                     | 15             | 67             | 5.7                   | 8                     | 9                    | 30                   | 230                         | 83               | 85.5             | 46                          | 3240 |               |
| MEE1S1205DC | 12                    | 5              | 200            | 5                     | 7                     | 16                   | 40                   | 97                          | 79               | 83.5             | 47                          | 3857 |               |
| MEE1S1209DC | 12                    | 9              | 111            | 5.8                   | 8                     | 12                   | 35                   | 97                          | 79               | 84               | 77                          | 4370 |               |
| MEE1S1212DC | 12                    | 12             | 83             | 4.8                   | 6                     | 10                   | 35                   | 97                          | 82               | 85               | 79                          | 3774 |               |
| MEE1S1215DC | 12                    | 15             | 67             | 4.2                   | 7                     | 9                    | 35                   | 95                          | 81               | 86.5             | 81                          | 3779 |               |
| MEE1S1505DC | 15                    | 5              | 200            | 4.2                   | 6                     | 15                   | 40                   | 79                          | 77               | 83.5             | 41                          | 3312 |               |
| MEE1S1509DC | 15                    | 9              | 111            | 5.1                   | 7                     | 12                   | 35                   | 79                          | 77               | 83               | 65                          | 3451 |               |
| MEE1S1512DC | 15                    | 12             | 83             | 4.3                   | 5                     | 11                   | 35                   | 77                          | 78               | 85               | 77                          | 3940 |               |
| MEE1S1515DC | 15                    | 15             | 67             | 3.8                   | 5                     | 8                    | 30                   | 76                          | 83               | 86.5             | 100                         | 3420 |               |
| MEE1S2405DC | 24                    | 5              | 200            | 3.6                   | 5                     | 19                   | 50                   | 49                          | 75               | 83               | 51                          | 3983 |               |
| MEE1S2409DC | 24                    | 9              | 111            | 4                     | 6                     | 17                   | 40                   | 50                          | 74               | 83               | 70                          | 4255 |               |
| MEE1S2412DC | 24                    | 12             | 83             | 3.4                   | 5                     | 11                   | 35                   | 49                          | 79               | 85.5             | 89                          | 3991 |               |
| MEE1S2415DC | 24                    | 15             | 67             | 3                     | 5                     | 9                    | 35                   | 49                          | 78               | 86               | 101                         | 3532 |               |

1. Calculated using MIL-HDBK-217F FN2 with nominal input voltage at full load.

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



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

| INPUT CHARACTERISTICS    |                                        |      |      |      |        |
|--------------------------|----------------------------------------|------|------|------|--------|
| Parameter                | Conditions                             | Min. | Typ. | Max. | Units  |
| Voltage range            | Continuous operation, 3.3V input types | 2.97 | 3.3  | 3.63 | V      |
|                          | Continuous operation, 5V input types   | 4.5  | 5.0  | 5.5  |        |
|                          | Continuous operation, 12V input types  | 10.8 | 12.0 | 13.2 |        |
|                          | Continuous operation, 15V input types  | 13.5 | 15   | 16.5 |        |
|                          | Continuous operation, 24V input types  | 21.6 | 24   | 26.4 |        |
| Reflected ripple current | 3.3V, 5V & 12V Input types             |      | 5    | 20   | mA p-p |
|                          | 15V Input types                        |      | 3    | 10   |        |
|                          | 24V Input types                        |      | 4    | 10   |        |

| OUTPUT CHARACTERISTICS     |                                             |                  |      |      |       |
|----------------------------|---------------------------------------------|------------------|------|------|-------|
| Parameter                  | Conditions                                  | Min.             | Typ. | Max. | Units |
| Rated Power <sup>2</sup>   | T <sub>A</sub> =-40°C to 85°C               |                  |      | 1.0  | W     |
| Voltage Set Point Accuracy | See tolerance envelope                      |                  |      |      |       |
| Line regulation            | High V <sub>IN</sub> to low V <sub>IN</sub> | 3.3V Input       | 1.0  | 1.15 | %/%   |
|                            |                                             | All other inputs | 1.0  | 1.1  |       |

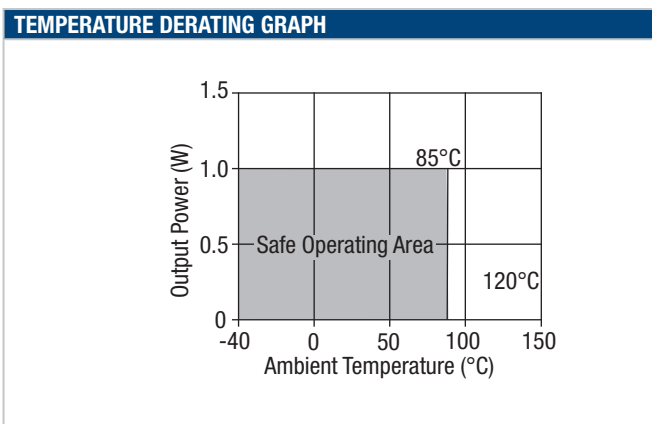
| ISOLATION CHARACTERISTICS |                           |      |      |      |       |
|---------------------------|---------------------------|------|------|------|-------|
| Parameter                 | Conditions                | Min. | Typ. | Max. | Units |
| Isolation test voltage    | Flash tested for 1 second | 1000 |      |      | VDC   |
| Resistance                | Viso= 1000VDC             | 10   |      |      | GΩ    |

| GENERAL CHARACTERISTICS |                  |      |      |      |       |
|-------------------------|------------------|------|------|------|-------|
| Parameter               | Conditions       | Min. | Typ. | Max. | Units |
| Switching frequency     | 3.3V input types |      | 47   |      | kHz   |
|                         | 5V input types   |      | 60   |      |       |
|                         | 12V input types  |      | 70   |      |       |
|                         | 15V input types  |      | 77   |      |       |
|                         | 24V input types  |      | 80   |      |       |

| TEMPERATURE CHARACTERISTICS    |                     |      |      |      |       |
|--------------------------------|---------------------|------|------|------|-------|
| Parameter                      | Conditions          | Min. | Typ. | Max. | Units |
| Specification                  | All output types    | -40  |      | 85   | °C    |
| Storage                        |                     | -50  |      | 125  |       |
| Case Temperature above ambient | MEE1S0303SC         |      |      | 30   |       |
|                                | All other types     |      |      | 25   |       |
| Cooling                        | Free air convection |      |      |      |       |

| ABSOLUTE MAXIMUM RATINGS                        |       |
|-------------------------------------------------|-------|
| Lead temperature 1.5mm from case for 10 seconds | 260°C |
| Internal power dissipation                      | 450mW |
| Input voltage V <sub>IN</sub> , MEE1S03 types   | 5.5V  |
| Input voltage V <sub>IN</sub> , MEE1S05 types   | 7V    |
| Input voltage V <sub>IN</sub> , MEE1S12 types   | 15V   |
| Input voltage V <sub>IN</sub> , MEE1S15 types   | 18V   |
| Input voltage V <sub>IN</sub> , MEE1S24 types   | 28V   |

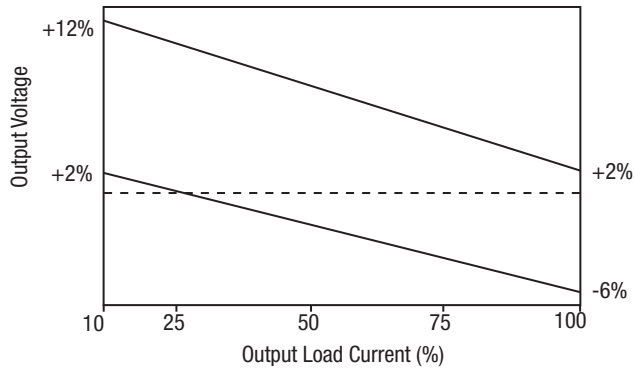
All specifications typical at T<sub>A</sub>=25°C, nominal input voltage and rated output current unless otherwise specified.



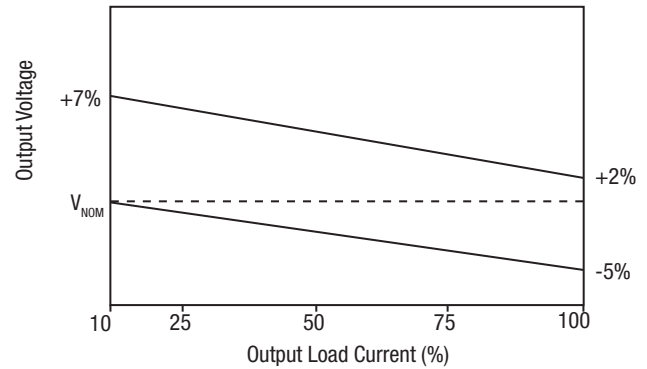
### TOLERANCE ENVELOPES

The voltage tolerance envelopes show typical load regulation characteristics for this product series. The tolerance envelope is the maximum output voltage variation due to changes in output loading and set point accuracy.

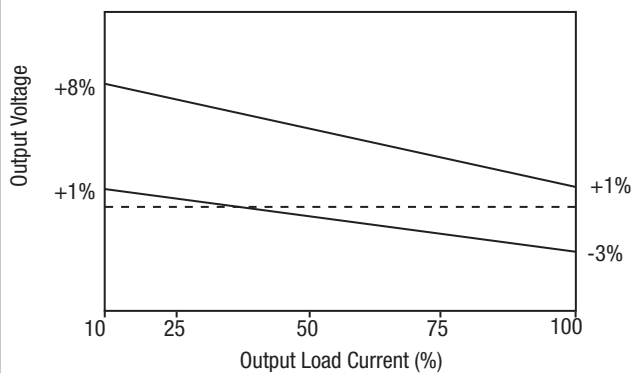
**3.3V Input & 0305**



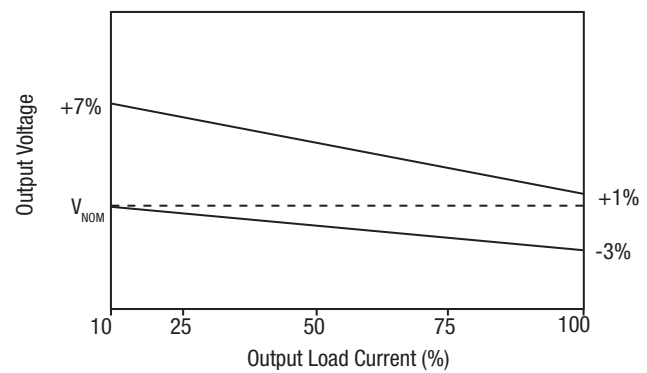
**5V Output**



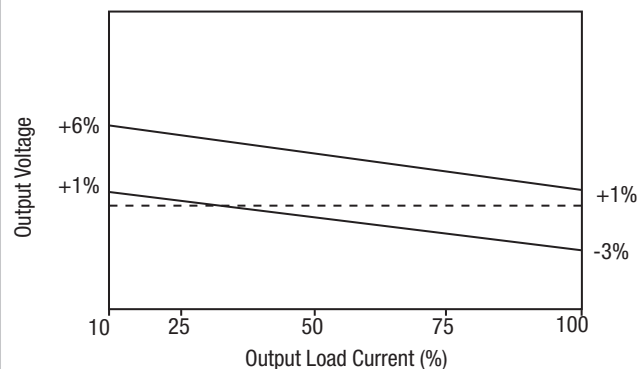
**9V Output**



**12V Output**



**15V Output**



### RoHS COMPLIANCE INFORMATION

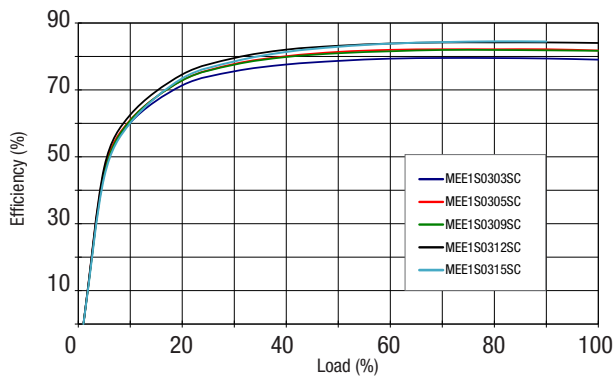


This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260°C for 10 seconds. The pin termination finish on the SIP package type is Tin Plate, Hot Dipped over Matte Tin with Nickel Preplate. The DIP types are Matte Tin over Nickel Preplate. Both types in this series are backward compatible with Sn/Pb soldering systems.

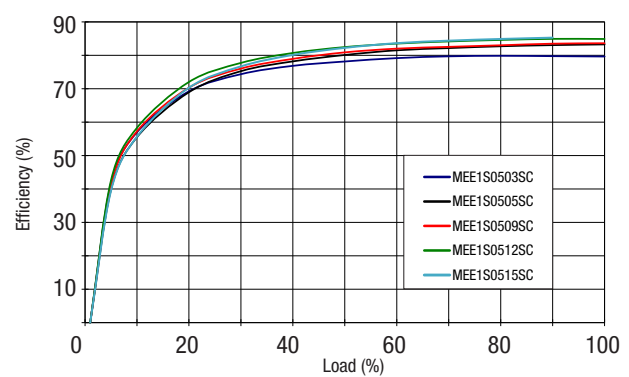
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### EFFICIENCY VS LOAD

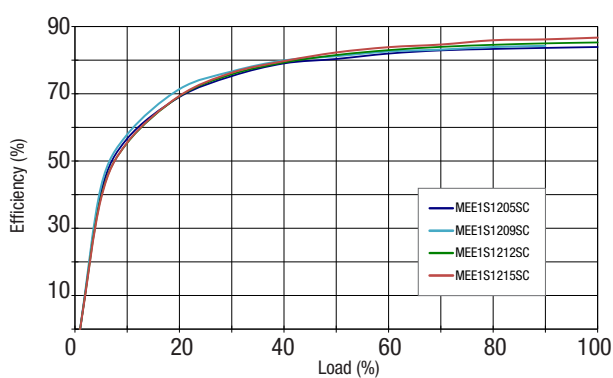
**3.3V Input**



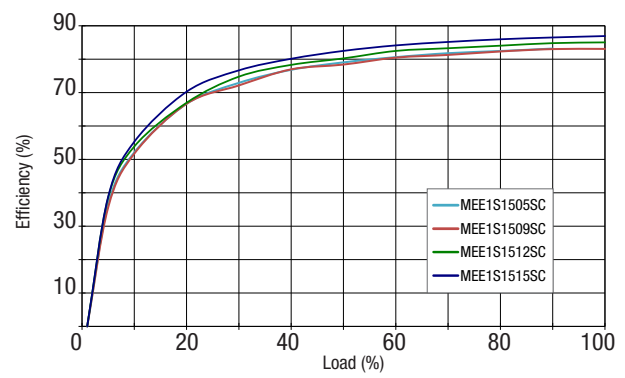
**5V Input**



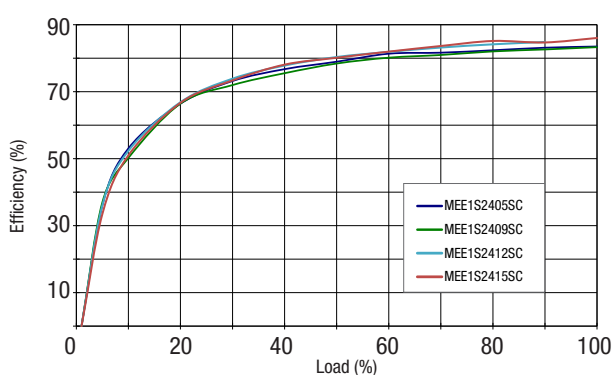
**12V Input**



**15V Input**



**24V Input**



### APPLICATION NOTES

#### Minimum and Operation to Zero Load

The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

#### Capacitive loading and start up

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

|             | Start-up time<br>$\mu$ s |             | Start-up time<br>$\mu$ s |
|-------------|--------------------------|-------------|--------------------------|
| MEE1S0303XC |                          | MEE1S1209XC |                          |
| MEE1S0305XC |                          | MEE1S1212XC |                          |
| MEE1S0309XC |                          | MEE1S1215XC |                          |
| MEE1S0312XC |                          | MEE1S1505XC |                          |
| MEE1S0315XC |                          | MEE1S1509XC |                          |
| MEE1S0503XC |                          | MEE1S1512XC |                          |
| MEE1S0505XC |                          | MEE1S1515XC |                          |
| MEE1S0509XC |                          | MEE1S2405XC |                          |
| MEE1S0512XC |                          | MEE1S2409XC |                          |
| MEE1S0515XC |                          | MEE1S2412XC |                          |
| MEE1S1205XC |                          | MEE1S2415XC |                          |

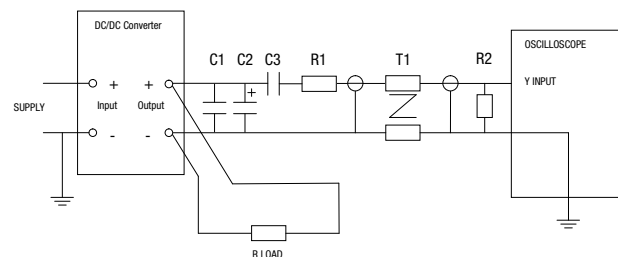
#### Ripple & Noise Characterisation Method

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

|       |                                                                                                                                                                        |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| C1    | 1 $\mu$ F X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC/DC converter                                        |
| C2    | 10 $\mu$ F 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 100m $\Omega$ at 100 kHz |
| C3    | 100nF multilayer ceramic capacitor, general purpose                                                                                                                    |
| R1    | 450 $\Omega$ resistor, carbon film, $\pm$ 1% tolerance                                                                                                                 |
| R2    | 50 $\Omega$ 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



### 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 MEE1 series of DC/DC converters are all 100% production tested at their stated isolation voltage. This is 1kVDC 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 MEE1 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

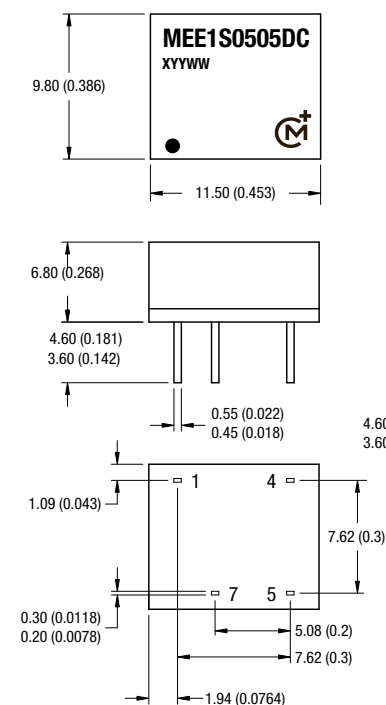
It is well known that repeated high-voltage isolation testing of a barrier component can actually degrade isolation capability, to a lesser or greater degree depending on materials, construction and environment. The MEE1 series has toroidal isolation transformers, with no additional insulation between 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.

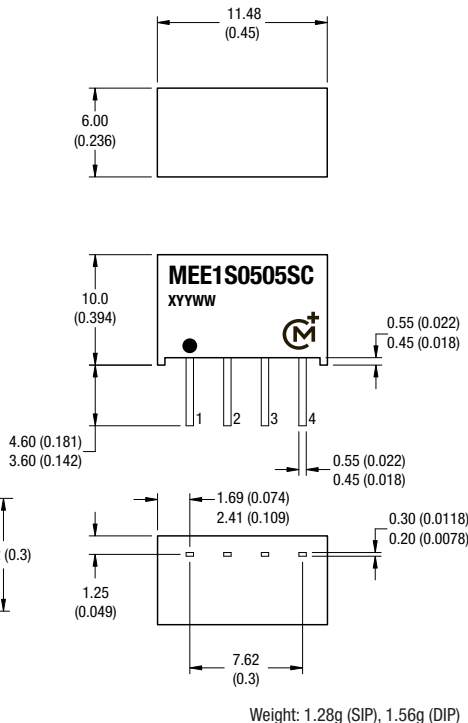
### PACKAGE SPECIFICATIONS

#### MECHANICAL DIMENSIONS

##### DIP Package



##### SIP Package



Weight: 1.28g (SIP), 1.56g (DIP)

All dimensions in mm  $\pm 0.25$ mm (inches  $\pm 0.01$ ). All pins on a 2.54 (0.1) pitch and within  $\pm 0.25$  (0.01) of true position.

#### PIN CONNECTIONS - 8 PIN DIP

| Pin | Function |
|-----|----------|
| 1   | -VIN     |
| 4   | +VIN     |
| 5   | +VOUT    |
| 7   | -VOUT    |

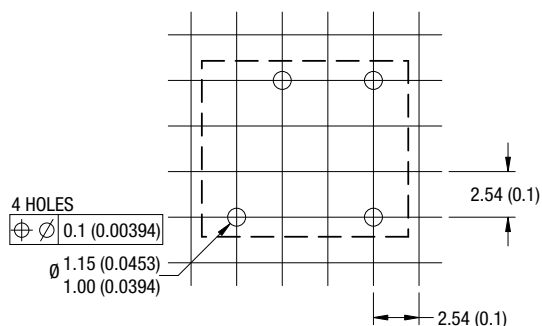
#### PIN CONNECTIONS - 4 PIN SIP

| Pin | Function |
|-----|----------|
| 1   | -VIN     |
| 2   | +VIN     |
| 3   | -VOUT    |
| 4   | +VOUT    |

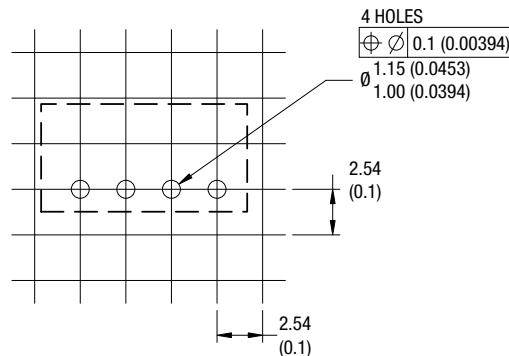
## PACKAGE SPECIFICATIONS (continued)

### RECOMMENDED FOOTPRINT DETAILS

8 Pin DIP Package

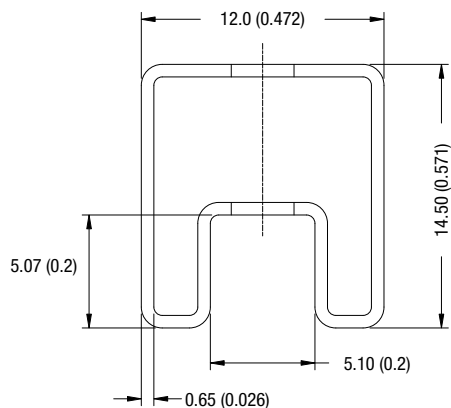


4 Pin SIP Package

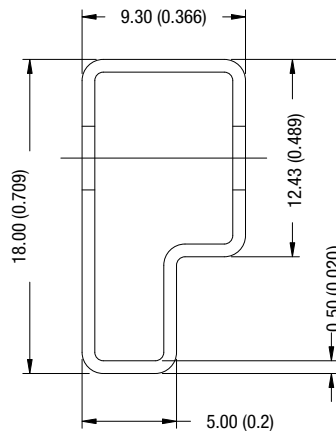


### TUBE OUTLINE DIMENSIONS

8 Pin DIP Tube



4 Pin SIP Tube



Unless otherwise stated all dimensions in mm (inches)  $\pm 0.5$ mm.  
 Tube length (8 Pin DIP) : 520mm  $\pm 2$ mm (20.47).  
 Tube length (4 Pin SIP) : 520mm  $\pm 2$ mm (20.47).

Tube Quantity : 35

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 ISO 9001 and 14001 REGISTERED



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| <a href="#"><u>MEE1S1212SC</u></a> | <a href="#"><u>MEE1S1215DC</u></a> | <a href="#"><u>MEE1S1212DC</u></a> | <a href="#"><u>MEE1S1209SC</u></a> | <a href="#"><u>MEE1S1209DC</u></a> | <a href="#"><u>MEE1S1505DC</u></a> | <a href="#"><u>MEE1S1505SC</u></a> |
| <a href="#"><u>MEE1S1509DC</u></a> | <a href="#"><u>MEE1S1509SC</u></a> | <a href="#"><u>MEE1S1512DC</u></a> | <a href="#"><u>MEE1S1205SC</u></a> | <a href="#"><u>MEE1S1512SC</u></a> | <a href="#"><u>MEE1S1215SC</u></a> | <a href="#"><u>MEE1S2412SC</u></a> |
| <a href="#"><u>MEE1S0305DC</u></a> | <a href="#"><u>MEE1S2415DC</u></a> | <a href="#"><u>MEE1S1205DC</u></a> | <a href="#"><u>MEE1S1515DC</u></a> | <a href="#"><u>MEE1S2412DC</u></a> | <a href="#"><u>MEE1S2409SC</u></a> |                                    |
| <a href="#"><u>MEE1S2409DC</u></a> | <a href="#"><u>MEE1S2405SC</u></a> | <a href="#"><u>MEE1S2405DC</u></a> | <a href="#"><u>MEE1S1515SC</u></a> | <a href="#"><u>MEE1S2415SC</u></a> | <a href="#"><u>MEE1S0305SC</u></a> | <a href="#"><u>MEE1S0309DC</u></a> |
| <a href="#"><u>MEE1S0515SC</u></a> | <a href="#"><u>MEE1S0303SC</u></a> | <a href="#"><u>MEE1S0309SC</u></a> | <a href="#"><u>MEE1S0505DC</u></a> | <a href="#"><u>MEE1S0515DC</u></a> | <a href="#"><u>MEE1S0512SC</u></a> | <a href="#"><u>MEE1S0512DC</u></a> |
| <a href="#"><u>MEE1S0509SC</u></a> | <a href="#"><u>MEE1S0303DC</u></a> | <a href="#"><u>MEE1S0505SC</u></a> | <a href="#"><u>MEE1S0312DC</u></a> | <a href="#"><u>MEE1S0503SC</u></a> | <a href="#"><u>MEE1S0503DC</u></a> | <a href="#"><u>MEE1S0315SC</u></a> |
| <a href="#"><u>MEE1S0315DC</u></a> | <a href="#"><u>MEE1S0312SC</u></a> | <a href="#"><u>MEE1S0509DC</u></a> |                                    |                                    |                                    |                                    |