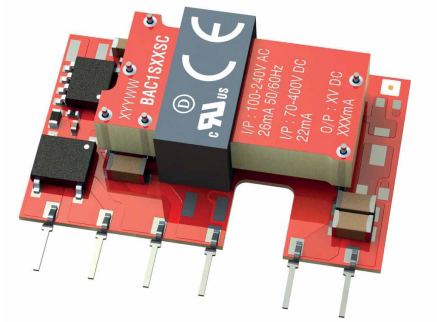
Murata Power Solutions

# BAC1 Series

Isolated 1W Regulated Single Output AC/DC Converters




## FEATURES

- UL60950-1 recognised
- EN60950-1 certified
- UL60335-1 recognition pending
- ANSI/AAMI ES60601-1, 1 MOPP/2 MOOP's recognition pending
- Wide input voltage range 85-264VAC/ 70-400VDC
- Operating temperature range –40°C to 85°C
- 4kVAC isolation 'Hi Pot Test'
- 5V, 12V & 24V single regulated outputs
- Short circuit protection
- No optocoupler
- Low standby power

## PRODUCT OVERVIEW

The BAC1 series is the first series release from the BAC family of board mount AC/DC converters. The BAC1 series operates over the wide industrial temperature range of -40°C to +85°C, supporting operation in still air for the most demanding environments. All models deliver full power to 85°C, and operate from -40°C. The BAC1 has ultra low standby power consumption for demanding energy and cost saving applications.

ErP COMPLIANT

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

## SELECTION GUIDE

| Order Code | Output Power | Output Voltage | Output Current | Ripple & Noise | | Efficiency | | | | Isolation Capacitance | MTTF[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 115V | | 230V | | | | |
| | | | | Min. | Typ. | Min. | Typ. | Min. | Typ. | | MIL 217 | Telecordia |
| | W | V | A | mVp-p | | % | | | | pF | kHrs | |
| **BAC1S05SC** | 1 | 5 | 0.2 | 50 | 120 | 70 | 74 | 69 | 73 | 11 | 1613 | 36180 |
| **BAC1S12SC** | 1 | 12 | 0.083 | 60 | 120 | 70 | 74 | 69 | 73 | 11 | 2038 | 44328 |
| **BAC1S24SC** | 1 | 24 | 0.042 | 85 | 120 | 68 | 73 | 67 | 71 | 11 | 1815 | 40463 |

## INPUT CHARACTERISTICS

| Parameter | Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Voltage range | All input types | | 85 | 115/230 | 264 | VAC |
| | All input types | | 70 | | 400 | VDC |
| Input frequency | | | 47 | 50/60 | 63 | Hz |
| Switching frequency | Nominal Vin = 115VAC | | | 50 | | kHz |
| | Nominal Vin = 230VAC | | | 40 | | |
| Input current | Nominal Vin = 115VAC | | | 25 | | mA |
| | Nominal Vin = 230VAC | | | 17 | | |
| Inrush current | Nominal Vin = 115VAC | | | 6 | | A |
| | Nominal Vin = 230VAC | | | 9 | | |
| Input leakage current | 230VAC | | | 1 | | µA |
| Stand by power | BAC1S05SC | 115V | | 19.5 | | mW |
| | | 230V | | 60.8 | | |
| | BAC1S12SC | 115V | | 58.1 | | |
| | | 230V | | 67.8 | | |
| | BAC1S24SC | 115V | | 25.7 | | |
| | | 230V | | 80.8 | | |

## ISOLATION CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Isolation test voltage | Production tested for 1 second | 4000 | | | VAC |
| | Qualififcation tested for 1 minute | 4000 | | | |
| Resistance | Viso = 1000VDC | 100 | | | MΩ |

## OUTPUT CHARACTERISTICS

| Parameter | Conditions | | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Minimum load | | | | 5 | | | % |
| Initial voltage accuracy | 5V output types | | | | | ±5 | % |
| | All other output types | | | | | ±4 | |
| Line regulation | Low line to high line | 5V output types | | | ±0.3 | ±1 | % |
| | | All other output types | | | ±0.1 | ±1 | |
| Load Regulation | 10% total load to 100% total load | 12V output type | 230VAC | | ±0.2 | ±1.5 | % |
| | | All other output types | 115VAC & 230VAC | | ±0.1 | ±1.5 | |
| Total regulation | Includes line, load, temperature and drift | | | | | ±5 | % |
| Temperature coefficient | | | | | | 0.05 | %/°C |
| Transient Response | Peak deviation - Single Output (50-75% & 75-50% swing) | BAC1S05SC | | | | ±4 | %Vout |
| | | BAC1S12SC | | | | ±3 | |
| | | BAC1S24SC | | | | ±2 | |
| | Settling time (within 1% Vout Nom.) | 24V output type | | | 8 | | ms |
| | | All other output types | | | 6 | | |
| Current limit inception | Auto-recovery | | | 150 | | 280 | % |

1. Calculated using MIL-HDBK-217F FN2 and Telecordia SR-332 calculation model at $T_A$=25°C with nominal input voltage at full load.
All specifications typical at $T_A$=25°C, nominal input voltage, rated output current and recommended components unless otherwise specified.

| OUTPUT CHARACTERISTICS (continued) | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Conditions | | Min. | Typ. | Max. | Units |
| Hold up time | from power fail | 115VAC | | 50 | | ms |
| | | 230VAC | | 240 | | |

| TEMPERATURE CHARACTERISTICS | | | | | |
|---|---|---|---|---|---|
| Parameter | Conditions | Min. | Typ. | Max. | Units |
| Operation | Sealed box with no air flow | -40 | | 85 | °C |
| Storage | | -40 | | 125 | |
| Product temperature rise above ambient | | | | 16 | |

| ABSOLUTE MAXIMUM RATINGS | |
|---|---|
| Short-circuit protection | Continuous |
| Lead temperature 1.0mm from case for 7 seconds (to JEDEC JESD22-B106 ISS E) | 270°C |

## EMC STANDARDS

| | |
|---|---|
| Conducted input noise | EN55032, Class B with external X cap |
| Radiated noise | EN55032, Class B |
| ESD immunity | IEC/EN61000-4-2 level 3 perf criteria A |
| Conducted transient immunity | EN61000-4-6, 10 Vrms, perf criteria A |
| Conducted surge immunity | EN61000-4-5, Installation class 3, perf criteria A |
| EFT/Burst | EN61000-4-4, level 3, perf criteria A |
| Radiated field immunity | EN61000-4-3, 10 V/m, perf criteria A |
| Dips and interruptions | EN61000-4-11, 100% reduction for 20ms (A), 60% reduction for 200ms (A), 30% reduction for 500ms (A), 100% reduction for 5s (B) |
| Magnetic fields | EN61000-4-8 30A/m, perf criteria A |

## 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 BAC1 series of AC-DC converters are all 100% production tested at their stated isolation voltage. This is 4kVAC for 1 seconds.

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

The BAC1 series has been recognised by Underwriters Laboratory to 264VAC for Reinforced Insulation.

The BAC1 series has been certified by Demko to 264VAC for Reinforced Insulation.

### 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. 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.

## SAFETY APPROVAL

### ANSI/AAMI ES60601-1

The BAC1 series is pending recognition by Underwriters Laboratory (UL) to ANSI/AAMI ES60601-1 and provides 2 MOOP (Means Of Operator Protection) and 1 MOPP (means of patient protection) based upon a working voltage of 264VAC max., between Primary and Secondary. File number E202895 applies.

### EN60950-1

The BAC1 series has been certified by Demko (D) to EN60950 for reinforced insulation to a working voltage of 264VAC. File number E151252 applies.

### UL60950-1

The BAC1 series has been recognised by Underwriters Laboratory (UL) to UL60950 for reinforced insulation to a working voltage of 264VAC. File number E151252 applies.

Creepage and clearance 8mm
Working altitude OVC II 5000m
Working altitude OVC III 2000M

### UL60335-1

The BAC1 series is pending recognition by Underwriters Laboratory (UL) to UL60335-1.

### FUSING

As stated in the appliaction notes, to meet datasheet specifications it is required that a 1W 10Ω fusible resistor is fitted.

## RoHS COMPLIANCE INFORMATION

This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260ºC for 10 seconds based on JEDEC JESD22-A111-A. The pin termination finish on this product series is Hot Dipped over Matte Tin with Nickel Preplate. The series is backward compatible with Sn/Pb soldering systems. For further information, please visit www.murata-ps.com/rohs

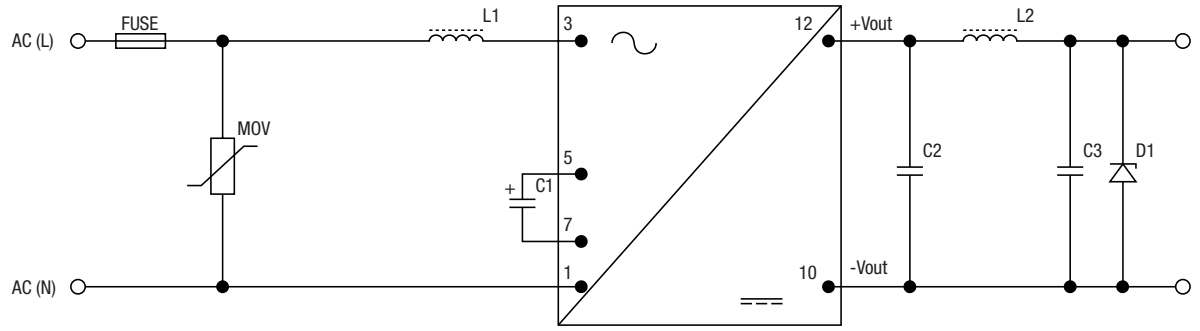
## PART NUMBER STRUCTURE

**BAC 1 S XX S C**

- Series name
- Power rating
- Output type
  - S - Single
  - D - Dual
- Output voltage
- Package type
  - S - SIP
  - D - DIP
  - M - Surface mount
  - Z - ZIP
- RoHS compliant

## APPLICATION NOTES

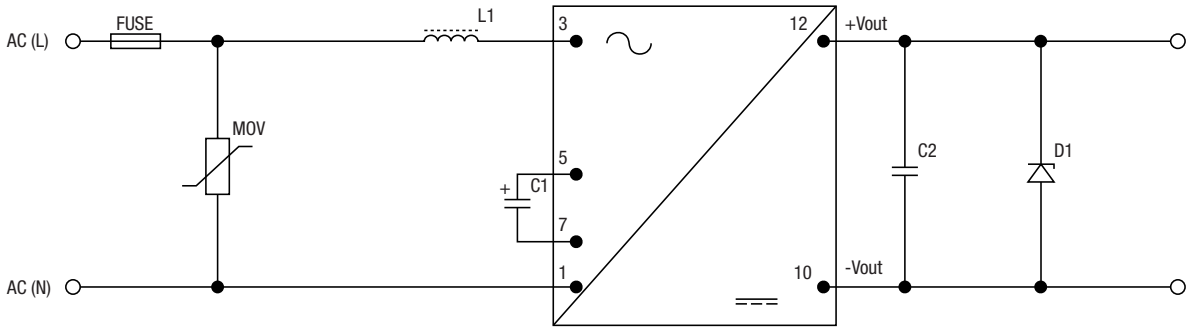
Components required to meet datasheet specifications - 5V output types




| | |
|---|---|
| FUSE | 1W 10Ω fusible resistor |
| MOV | Component fitted for compliance with EN61000-4-5, Installation class 3, perf criteria A |
| L1 | 330µH |
| C1 | 6.8µF 400V |
| C2 | 68µF 20mΩ low ESR polymer |
| L2 | 6.8µH 84682C |
| C3 | 22µF |
| D1 | SMBJ7.0A transient voltage suppressor - component fitted for overshoot protection |

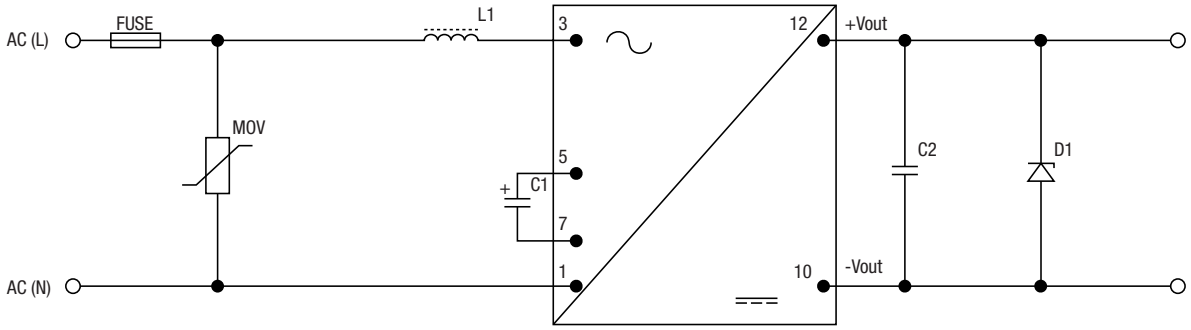
## APPLICATION NOTES (continued)

### Components required to meet datasheet specifications - 12V output types




| | |
|---|---|
| FUSE | 1W 10Ω fusible resistor |
| MOV | Component fitted for compliance with EN61000-4-5, Installation class 3, perf criteria A |
| L1 | 330µH |
| C1 | 6.8µF 400V |
| C2 | 68µF 20mΩ low ESR polymer |
| D1 | SMBJ7.0A transient voltage suppressor - component fitted for overshoot protection |

### Components required to meet datasheet specifications - 24V output types




| | |
|---|---|
| FUSE | 1W 10Ω fusible resistor |
| MOV | Component fitted for compliance with EN61000-4-5, Installation class 3, perf criteria A |
| L1 | 330µH |
| C1 | 6.8µF 400V |
| C2 | 47µF 25mΩ low ESR polymer |
| D1 | SMBJ30A transient voltage suppressor - component fitted for overshoot protection |

### Advisory Notes

The BAC1 series is not hermetically sealed, customers should ensure that parts are fully dried before input power application.

## APPLICATION NOTES (continued)

### Output Capacitance and start-up times

The recommended specified caps on page 4 and 5 can already meet datasheet specification, there is no need to add extra caps. However, if customers connects to load capacitance, the below load capacitance are max (additional to recommended specified caps) to ensure start up at minimum AC input.

| Part No. | Maximum Load Capacitance (per output) | Start-up times (AC input) | Start-up times (DC input) |
|---|---|---|---|
| | µF | s | s |
| **BAC1S05SC** | 220 | 0.5 | 5 |
| **BAC1S12SC** | 100 | 1 | 5 |
| **BAC1S24SC** | 100 | 1 | 5 |

### Minimum Load

The minimum load to meet full datasheet specification is 5% of the full rated load across the specified input voltage range.

### 24V output type - minimum input voltage requirements

At -40C the part is guaranteed to start into 100% load with a minimum input voltage of 115Vac; once the product is operating, the product will continue to operate at lower input voltages with higher output loading.

The product will start at -40C with 80% or lower load with an input voltage of 100VAC; once the product is operating, the product will continue to operate at lower input voltages with higher output loading.

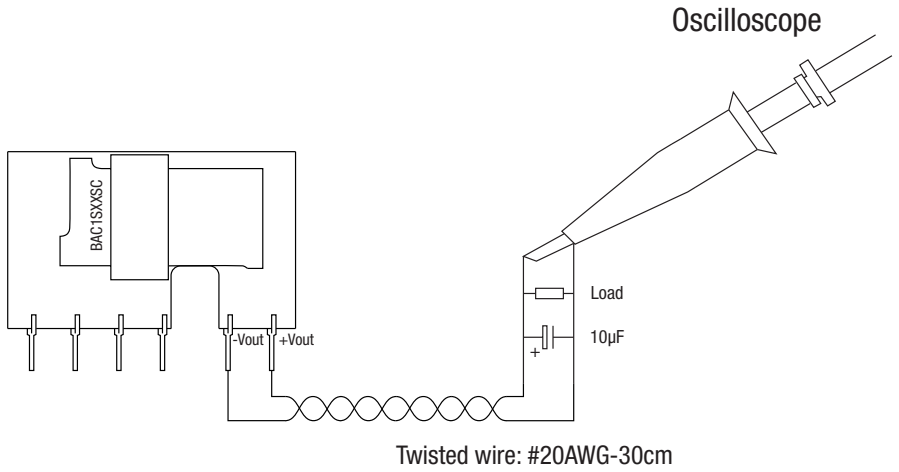
## CHARACTERISATION TEST METHODS

### Ripple & Noise Characterisation Method

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

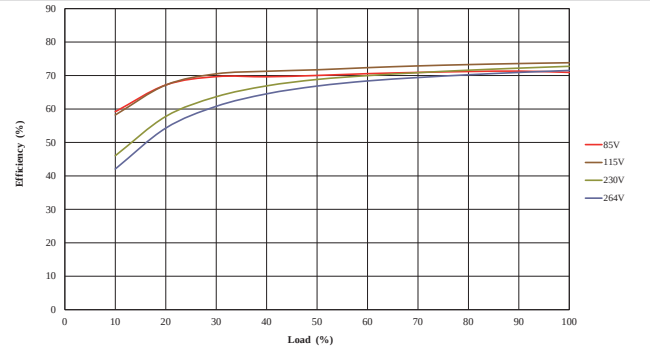
| | |
|---|---|
| C1 | 10µF electrolytic capacitor |

Differential Mode Noise Test Schematic

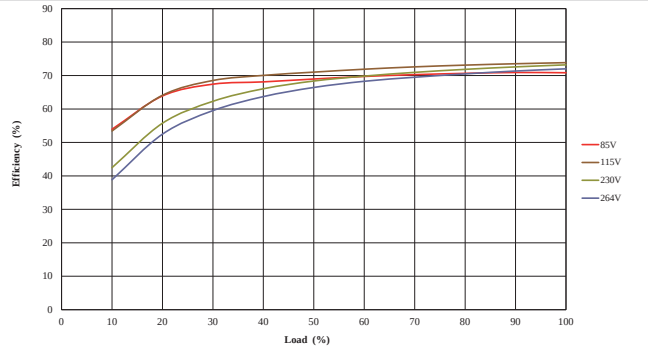


## EFFIECIENCY VS LOAD

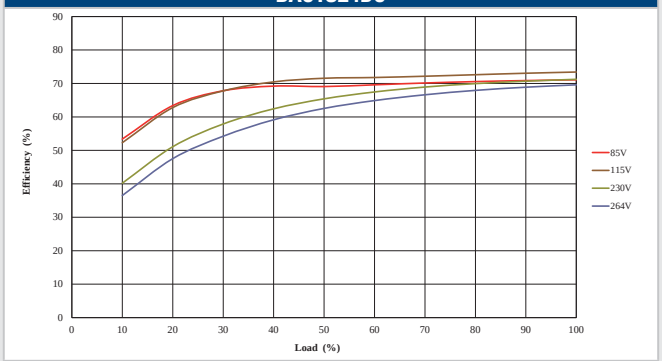
### BAC1S05DC




### BAC1S12DC



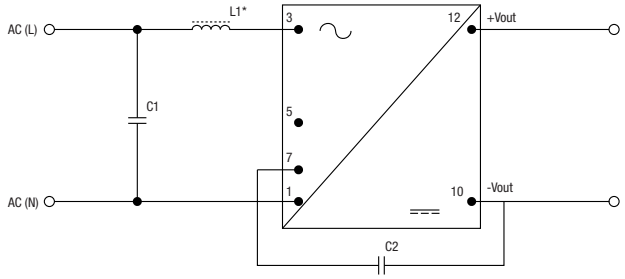

### BAC1S24DC



## EMC FILTERING AND SPECTRA

### FILTERING

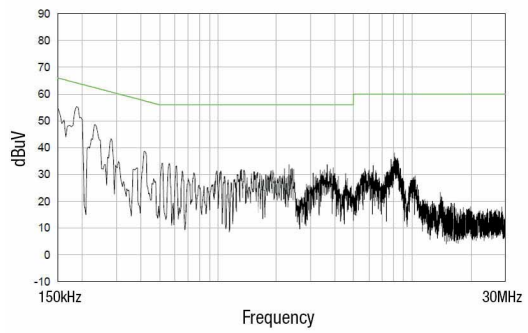
The following filter circuit and filter table shows the input filters typically required to meet EN55032 Quasi-Peak (green line) Curve B limit vs peak conducted emisions.



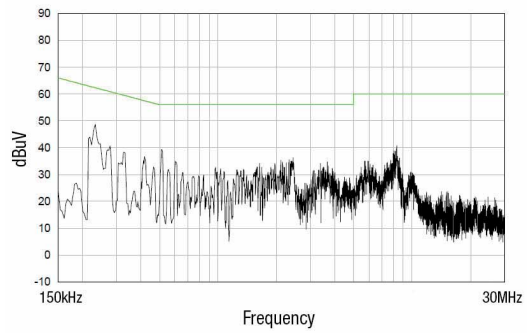

| 5V and 12V output types | |
|---|---|
| Component | Description |
| **C1** | 68nF 275VAC |
| **L1** | refer to "components required to match datasheet specifications" |
| **C2** | 100pF Y-cap |

Components marked with an asterisk are already fitted and should not be duplicated

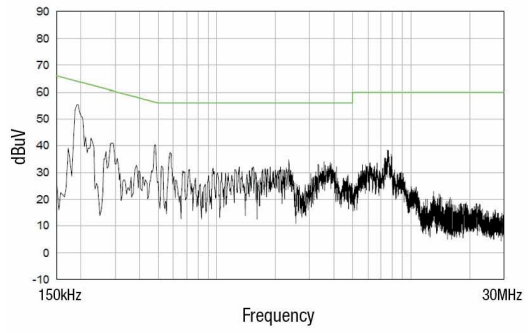
**BAC1S05SC (110V) - Live**



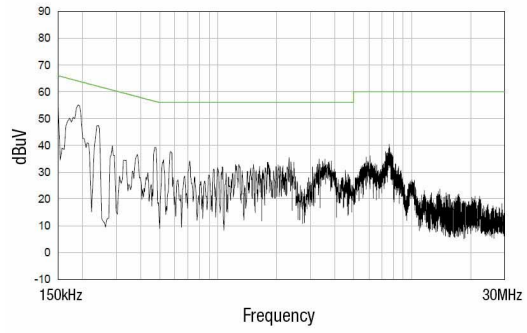

**BAC1S05SC (110V) - Neutral**




**BAC1S12SC (110V) - Live**

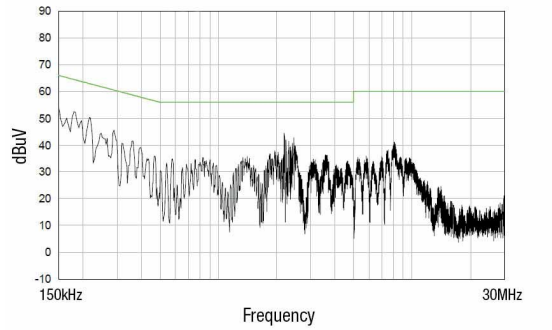



**BAC1S12SC (110V) - Neutral**

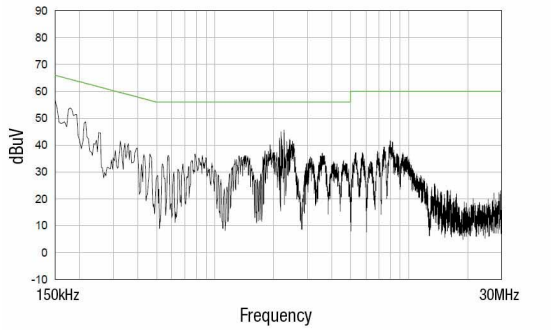


## EMC FILTERING AND SPECTRA (continued)

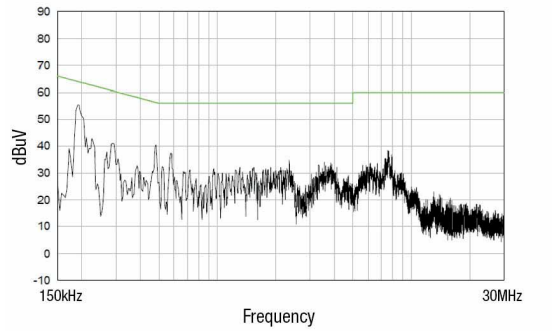
### BAC1S05SC (230V) - Live



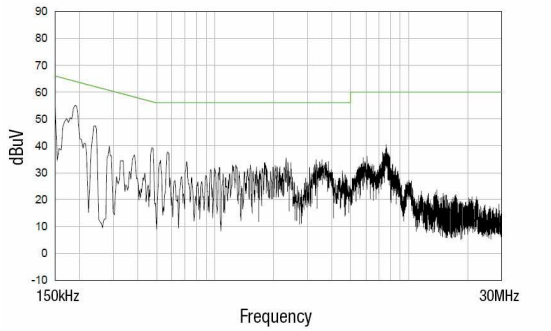

### BAC1S05SC (230V) - Neutral




### BAC1S12SC (230V) - Live



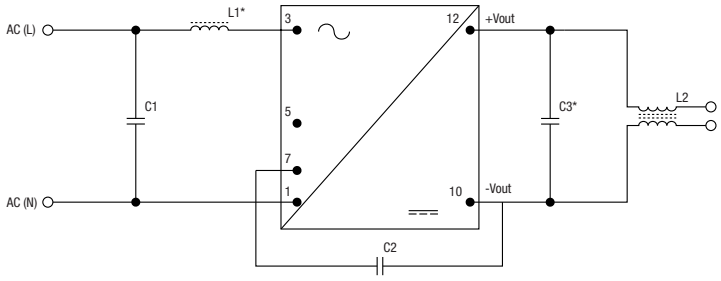

### BAC1S12SC (230V) - Neutral



## EMC FILTERING AND SPECTRA (continued)

### FILTERING

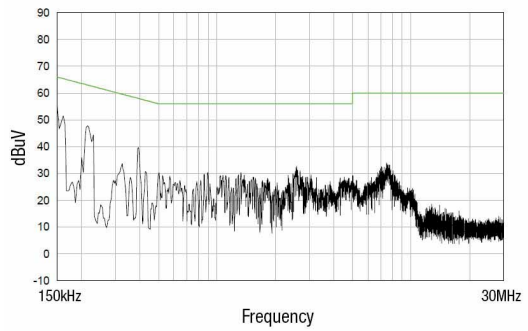
The following filter circuit and filter table shows the input filters typically required to meet EN55032 Quasi-Peak (green line) Curve B peak conducted emisions.



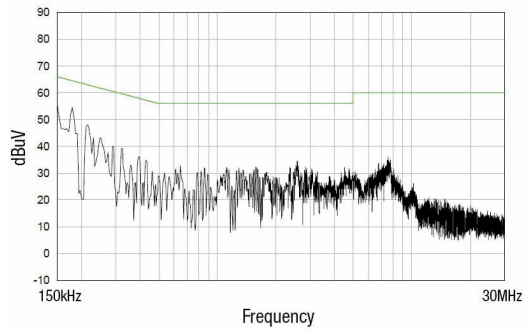

| BAC1S24SC | |
|---|---|
| Component | Description |
| **C1** | 68nF 275VAC |
| **L1** | refer to “components required to match datasheet specifications” |
| **C2** | 100pF Y-cap |
| **C3** | refer to “components required to match datasheet specifications” |
| **L2** | DLW21SN261SQ2L |

Components marked with an asterisk are already fitted and should not be duplicated

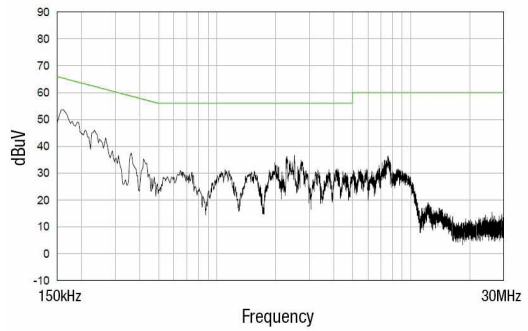
**BAC1S24SC (110V) - Live**



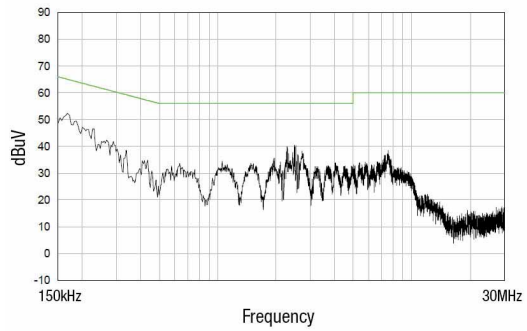

**BAC1S24SC (110V) - Neutral**




**BAC1S24SC (230V) - Live**

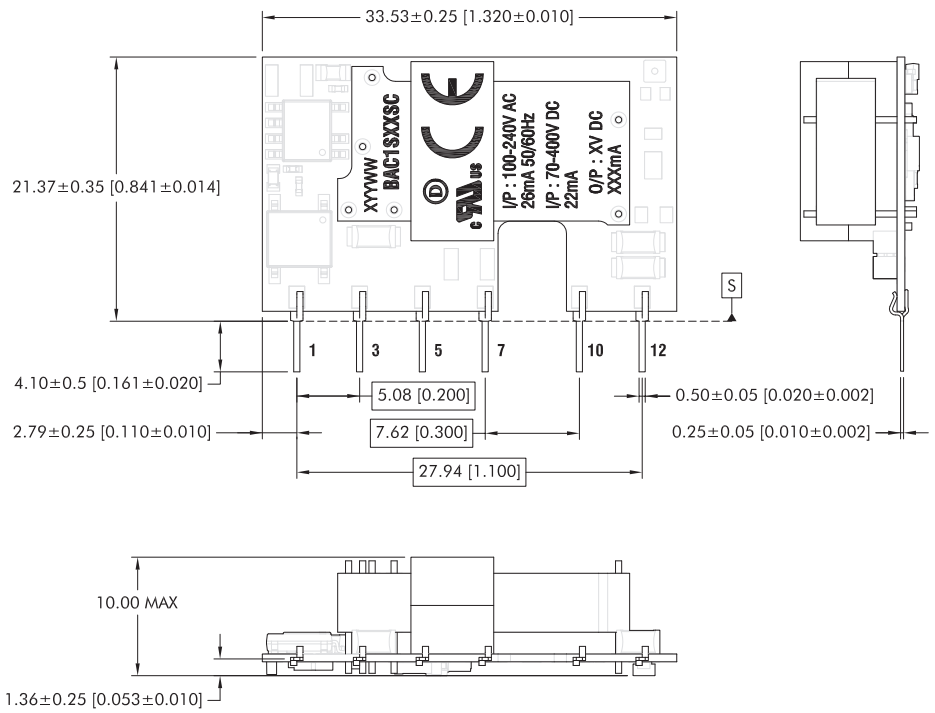



**BAC1S24SC (230V) - Neutral**



## PACKAGE SPECIFICATIONS

### MECHANICAL DIMENSIONS




All dimensions in mm (inches) Controlling dimension is mm.
All pins on a 2.54 (0. I 00) pitch and within ±0. I (0.004) of true position from pin I at seating plane 'S'

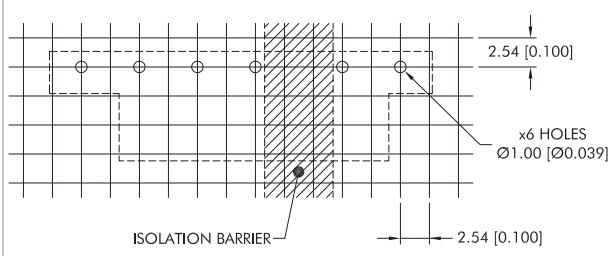
Weight:6.2g

### PIN CONNECTIONS

Pin Output

| Pin | Function |
|---|---|
| 1 | AC( N) |
| 3 | AC (L) |
| 5 | +Vin |
| 7 | -Vin |
| 10 | -Vout |
| 12 | +Vout |

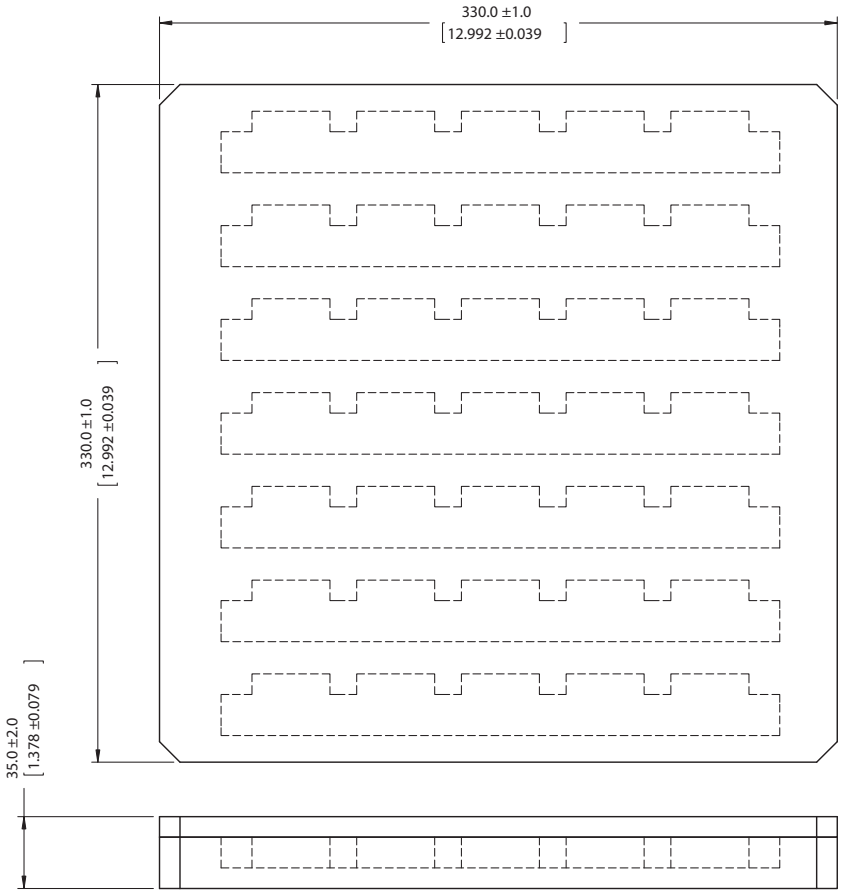
### RECOMMENDED FOOTPRINT DETAILS




All dimensions in mm ±0.25mm (inches ±0.01).

## PACKAGING SPECIFICATIONS (continued)

### TRAY OUTLINE DIMENSIONS




EPE Tray/Lid
Quantity: 35
All dimensions in mm (inches) Controlling dimension is mm.

**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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