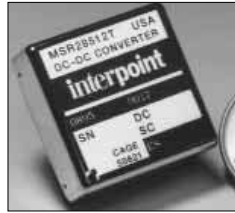


## FEATURES

- -55°C to +85°C operation
- 16 to 32 VDC input
- Fully isolated
- Opto-coupler feedback
- Switching frequency  
Single and dual outputs  
typical 80 kHz, variable freq.  
Triple output - 200 kHz, fixed
- Topology – Flyback
- 40 V for 50 ms transient protection
- Inhibit function
- Indefinite short circuit protection
- Up to 70% efficiency
- **External capacitors required**

# DC/DC CONVERTERS 28 VOLT INPUT



## MSR SERIES 4 WATT

| MODELS     |            |                      |
|------------|------------|----------------------|
| VDC OUTPUT |            |                      |
| SINGLE     | DUAL       | TRIPLE               |
| 5          | ±12<br>±15 | +5 & ±12<br>+5 & ±15 |

Size (max.): 1.075 x 1.075 x 0.370 inches (27.31 x 27.31 x 9.40 mm).

See Section B8, case C2, for dimensions.

Weight: 20 grams maximum.

Screening: Standard or ES. See Section C2 for screening options, see Section A5 for ordering information.

## DESCRIPTION

The MSR Series™ DC/DC converters provide the high efficiencies associated with switching regulators, yet have full isolation between input and output. Interpoint builds the MSR converters using thick-film hybrid technology and seals them in metal packages for military, aerospace, and other high-reliability applications. The solder sealed packages of the standard models pass a dip gross leak hermeticity test. Environmentally screened models pass a fine leak hermeticity test. See Section C2 for a complete list of screening options.

### CONVERTER DESIGN

A footprint of just over one square inch makes the MSR Series DC/DC converters one of Interpoint's smallest converters. These converters incorporate a flyback topology which requires a minimum of components resulting in small package size. Single and dual models self-oscillate at an operating frequency which is an approximate inverse function of the load. At full load, the frequency is typically 80 kHz for single and dual output models. Triple output models operate at a fixed frequency of approximately 200 kHz. A transformer in the forward power circuit and an opto-coupler in the feedback/control loop maintain input to output isolation.

### CONVERTER OPERATION

MSR Series DC/DC converters feature an input voltage range of 16 to 32 VDC and can withstand a transient of up to 40 V for up to 50 msec. They offer a choice of five different output voltage (VDC) configurations: +5, ±12, ±15, +5 main with ±12 auxiliaries, and +5 main with ±15 auxiliaries. Dual output models deliver up to 4 watts for either balanced or unbalanced loads, however, at least 25% of the total load should be on the positive output. The single output model supplies up to 3.5 watts of output power while the triple output models supply up to 3.2 watts. The high efficiency remains almost constant over the entire input voltage range and from approximately 25% of full load to full load. This makes the MSR Series converters ideal for either battery or aircraft power applications.

### INHIBIT FUNCTION

The open collector TTL compatible inhibit terminal is referenced to input common. Inhibiting the converter by pulling the inhibit terminal (pin 15) low results in an input current as low as 2 mA for the MSR2805S. The inhibit terminal has an open circuit voltage of 12 to 28 V.

### SHORT CIRCUIT PROTECTION

Each output has current limiting circuitry for indefinite short circuit protection providing that the case temperature does not exceed the specified limits. Under short circuit conditions the input current is reduced to less than full load input current and the output short circuit current remains higher than full load output current.

### MINIMAL HEAT SINKING

The MSR Series converters' high efficiency minimizes heat sinking requirements, but care should be taken to remove self-generated heat to prevent exceeding the maximum case temperature. Heat conducting material (PCB, copper sheet, heat sink, etc.) in contact with the converter's baseplate can help to increase heat dissipation. The converter can be operated at full load at a case temperature of 85°C, with the output power derated linearly to zero at 115°C.

### WARNING: EXTERNAL CAPACITORS REQUIRED

External capacitors are required on the outputs. **Operating the unit without external capacitors will result in damage to the internal circuitry.** Minimum recommended capacitor values are given in Tables 1 and 2. For optimum performance, low ESR (Equivalent Series Resistance) solid tantalum capacitors are required. The specifications on the following pages are based on the use of high-quality solid tantalums. Operation with different types of capacitors will seriously affect performance.

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B4-27

# MSR SERIES 4 WATT

# DC/DC CONVERTERS

| ABSOLUTE MAXIMUM RATINGS                            |                                     |
|-----------------------------------------------------|-------------------------------------|
| <b>Input Voltage</b>                                | • 16 to 32 VDC                      |
| <b>Output Power</b>                                 | • 3.2 to 4 watts depending on model |
| <b>Lead Soldering Temperature (10 sec per lead)</b> | • 300°C                             |
| <b>Storage Temperature Range (Case)</b>             | • -65°C to +150°C                   |

| INHIBIT                                |                                             |
|----------------------------------------|---------------------------------------------|
| <b>Inhibit TTL Open Collector</b>      | • Logic low (output disabled) $\leq 0.8$ V  |
|                                        | • Referenced to input common                |
|                                        | • Logic high (output enabled) $\geq 12$ V   |
|                                        | Open collector                              |
| RECOMMENDED OPERATING CONDITIONS       |                                             |
| <b>Input Voltage Range</b>             | • 16 to 32 VDC continuous                   |
|                                        | • 40 V for 50 msec transient                |
| <b>Case Operating Temperature (Tc)</b> | • -55°C to +85°C full power                 |
|                                        | • -55°C to +115°C absolute                  |
| <b>Derating Output Power/Current</b>   | • Linearly from 100% at 85°C to 0% at 115°C |

| TYPICAL CHARACTERISTICS                       |                                                                                  |
|-----------------------------------------------|----------------------------------------------------------------------------------|
| <b>Output Voltage Temperature Coefficient</b> | • MSR2805S 100 ppm/°C typ, 200 max.                                              |
|                                               | • MSR28XXD 50 ppm/°C typ                                                         |
|                                               | • MSR285XXT 100 ppm/°C typ                                                       |
| <b>Input to Output Capacitance</b>            | • 60 pF typical                                                                  |
| <b>Isolation</b>                              | • 100 megohm minimum at 500 V                                                    |
| <b>Conversion Frequency</b>                   | • Single and dual output models, 80 kHz at full load typical, variable frequency |
|                                               | • Triple output models, 200 kHz typical fixed frequency                          |
| <b>Inhibit Pin Voltage (unit enabled)</b>     | • 12 to 28 V                                                                     |

**WARNING: EXTERNAL CAPACITORS REQUIRED**

**Electrical Characteristics: 25°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.**

| SINGLE AND DUAL OUTPUT MODELS |                          | MSR2805S |     |      | MSR2812D |     |        | MSR2815D |     |        | UNITS  |
|-------------------------------|--------------------------|----------|-----|------|----------|-----|--------|----------|-----|--------|--------|
| PARAMETER <sup>1</sup>        | CONDITIONS               | MIN      | TYP | MAX  | MIN      | TYP | MAX    | MIN      | TYP | MAX    |        |
| OUTPUT VOLTAGE                |                          | 4.90     | 5.0 | 5.10 | ±11.88   | ±12 | ±12.12 | ±14.85   | ±15 | ±15.15 | VDC    |
| OUTPUT CURRENT                | 16 TO 32 V <sub>IN</sub> | —        | —   | 700  | —        | —   | ±167   | —        | —   | ±133   | mA     |
| OUTPUT POWER                  | Tc = -55°C TO +85°C      | —        | —   | 3.5  | —        | —   | 4.0    | —        | —   | 4.0    | W      |
| OUTPUT RIPPLE                 | BW = DC TO 1 MHz         | —        | 75  | 150  | —        | 75  | 150    | —        | 75  | 150    | mV p-p |
| LINE REGULATION               | 16 TO 32 V <sub>IN</sub> | —        | 5   | 10   | —        | 10  | 20     | —        | 10  | 20     | mV     |
| LOAD REGULATION               | NO LOAD TO FULL          | —        | 25  | 50   | —        | 12  | 24     | —        | 12  | 24     | mV     |
| INPUT VOLTAGE                 | Tc = -55°C TO +85°C      | 16       | 28  | 32   | 16       | 28  | 32     | 16       | 28  | 32     | VDC    |
|                               | TRANSIENT 50 ms          | —        | —   | 40   | —        | —   | 40     | —        | —   | 40     | V      |
| INPUT CURRENT                 | NO LOAD                  | —        | 7   | 10   | —        | 10  | 15     | —        | 10  | 15     | mA     |
|                               | FULL LOAD                | —        | —   | 192  | —        | —   | 213    | —        | —   | 213    |        |
|                               | INHIBITED                | —        | —   | 2    | —        | —   | 15     | —        | —   | 15     |        |
| EFFICIENCY                    |                          | 65       | 70  | —    | 67       | 70  | —      | 67       | 70  | —      | %      |

Notes

- External capacitors required to prevent damage to internal circuitry (see Table 1 for specifications).
- Dual output models deliver up to 4 watts total for balanced or unbalanced loads, however, the positive output should carry at least 25% of the total load.

### SINGLE AND DUAL OUTPUT EXTERNAL CAPACITORS

**OPERATION WITHOUT EXTERNAL CAPACITORS WILL RESULT IN DAMAGE TO THE INTERNAL CIRCUITRY.**

**TABLE 1: EXTERNAL CAPACITOR REQUIREMENTS**

| Model                                           | Required Connection                                       | Minimum Capacitor Value <sup>1</sup> |
|-------------------------------------------------|-----------------------------------------------------------|--------------------------------------|
| Single Output MSR2805S                          | Positive Output (12 & 13) to Output Common (8 & 9)        | 220 $\mu$ F, 10 V                    |
| Dual Outputs <sup>2</sup> MSR2812D and MSR2815D | Positive Output (10) to Output Common (8)                 | 100 $\mu$ F, 25 V                    |
|                                                 | External Capacitor (14) to Output Common (8) <sup>3</sup> | 100 $\mu$ F, 25 V                    |
|                                                 | Negative Output (12) to Output Common (8)                 | 10 $\mu$ F, 25 V                     |

Notes – Table 1

- Capacitors should be high quality, low ESR components — solid tantalum is recommended.
- See Figure 1 for connection diagram
- Place positive side of capacitor toward pin 8.

**FIGURE 1: DUAL OUTPUT EXTERNAL CAPACITOR CONNECTIONS**

# DC/DC CONVERTERS

## MSR SERIES 4 WATT

**WARNING: EXTERNAL CAPACITORS REQUIRED**

**Electrical Characteristics: 25°C T<sub>c</sub>, 28 VDC V<sub>in</sub>, 100% load, unless otherwise specified.**

| TRIPLE OUTPUT MODELS       |                                 |       | MSR28512T         |       |       | MSR28515T         |       |       | UNITS  |
|----------------------------|---------------------------------|-------|-------------------|-------|-------|-------------------|-------|-------|--------|
| PARAMETER                  | CONDITIONS                      |       | MIN               | TYP   | MAX   | MIN               | TYP   | MAX   |        |
| OUTPUT VOLTAGE             | 16 TO 32 V <sub>IN</sub>        | MAIN  | 4.9               | 5.0   | 5.1   | 4.9               | 5.0   | 5.1   | VDC    |
|                            | BALANCED LOAD                   | AUX   | ±11.5             | ±12.0 | ±12.5 | ±14.5             | ±15.0 | ±15.5 |        |
| OUTPUT CURRENT             |                                 | MAIN  | 10.0 <sup>1</sup> | —     | 400   | 10.0 <sup>1</sup> | —     | 400   | mA     |
|                            |                                 | AUX   | —                 | —     | ±50.0 | —                 | —     | ±40.0 |        |
| OUTPUT POWER <sup>2</sup>  | T <sub>c</sub> = -55°C TO +85°C |       | —                 | —     | 3.2   | —                 | —     | 3.2   | W      |
| OUTPUT RIPPLE <sup>3</sup> | BW DC TO 1 MHz                  | MAIN  | —                 | 50    | 100   | —                 | 50    | 100   | mV p-p |
|                            |                                 | ± AUX | —                 | 50    | 100   | —                 | 50    | 100   |        |
| LINE REGULATION            | 16 TO 32 V <sub>IN</sub>        | MAIN  | —                 | 5     | 10    | —                 | 5     | 10    | mV     |
|                            |                                 | ± AUX | —                 | 3     | 6     | —                 | 3     | 7.5   |        |
| LOAD REGULATION            | NO LOAD TO FULL                 | MAIN  | —                 | 15    | 30    | —                 | 15    | 30    | mV     |
|                            |                                 | ± AUX | —                 | 15    | 30    | —                 | 15    | 30    |        |
| INPUT VOLTAGE              | T <sub>c</sub> = -55°C TO +85°C |       | 16                | 28    | 32    | 16                | 28    | 32    | VDC    |
|                            | TRANSIENT 50 ms                 |       | —                 | —     | 40    | —                 | —     | 40    | V      |
| INPUT CURRENT              | NO LOAD                         |       | —                 | 10    | 20    | —                 | 10    | 20    | mA     |
|                            | FULL LOAD                       |       | —                 | —     | 176   | —                 | —     | 176   |        |
|                            | INHIBITED                       |       | —                 | —     | 5     | —                 | —     | 5     |        |
| EFFICIENCY                 |                                 |       | 65                | 70    | —     | 65                | 70    | —     | %      |

Notes

1. External capacitors required (see Table 2 for specifications).

2. Minimum load required on main output for full power auxiliary operation.

### TRIPLE OUTPUT EXTERNAL CAPACITOR

**OPERATION WITHOUT EXTERNAL CAPACITORS WILL RESULT IN DAMAGE TO THE INTERNAL CIRCUITRY.**

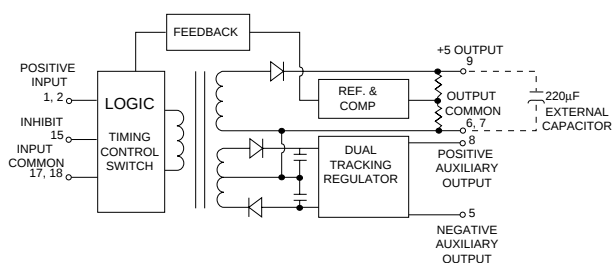
**TABLE 2: EXTERNAL CAPACITOR REQUIREMENTS**

| Model                   | Required Connection <sup>1</sup>                    | Minimum Capacitor Value <sup>2</sup> |
|-------------------------|-----------------------------------------------------|--------------------------------------|
| MSR28512T and MSR28515T | Positive 5 VDC Output (9) to Output Common (6 or 7) | 220 µF, 10 V                         |

Notes – Table 2

1. See Figure 2 for connection diagram.

2. Capacitors should be high quality, low ESR components — solid tantalum is recommended.



**FIGURE 2:  
TRIPLE OUTPUT EXTERNAL CAPACITOR CONNECTIONS**

# MSR SERIES 4 WATT

# DC/DC CONVERTERS

**WARNING: EXTERNAL CAPACITORS REQUIRED**  
OPERATION WITHOUT EXTERNAL CAPACITORS WILL RESULT IN DAMAGE TO THE INTERNAL CIRCUITRY.

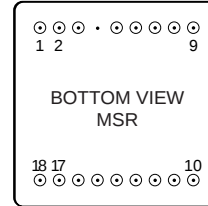
## PIN OUT

| Pin                 | Single Output                | Dual Output     | Triple Output                   |
|---------------------|------------------------------|-----------------|---------------------------------|
| 1, 2 <sup>1</sup>   | Positive Input               | Positive Input  | Positive Input                  |
| 3                   | No connection                | No connection   | No connection                   |
| 4                   | Case                         | Case            | Case                            |
| 5                   | No connection                | No connection   | Negative Aux. Output            |
| 6                   | No connection                | No Connection   | Output Common Main <sup>2</sup> |
| 7                   | No connection                | No connection   | Output Common Aux. <sup>2</sup> |
| 8                   | Output Common <sup>3</sup>   | Output Common   | Positive Aux. Output            |
| 9                   | Output Common <sup>3</sup>   | No connection   | +5 VDC Output                   |
| 10                  | No connection                | Positive Output | No connection                   |
| 11                  | No connection                | No connection   | No connection                   |
| 12                  | Positive Output <sup>3</sup> | Negative Output | No connection                   |
| 13                  | Positive Output <sup>3</sup> | No connection   | No connection                   |
| 14                  | No connection                | Ext. Capacitor  | No connection                   |
| 15                  | Inhibit                      | Inhibit         | Inhibit                         |
| 16                  | No connection                | No connection   | No connection                   |
| 17, 18 <sup>1</sup> | Input Common                 | Input Common    | Input Common                    |

### Pin Out Notes

1. Make external connection to both pins on all models.  
Pins 1 and 2 positive input  
Pins 17 and 18 input common
2. Pins 6 and 7 on triple output models are connected internally.
3. On the HR41-2805:  
Make external connections to both output common pins (8 and 9).  
Make external connections to both positive output pins (12 and 13).

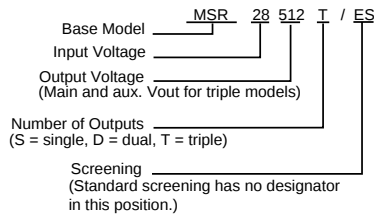
Dot on top of cover  
indicates pin one.



See section B8, case C2, for dimensions.

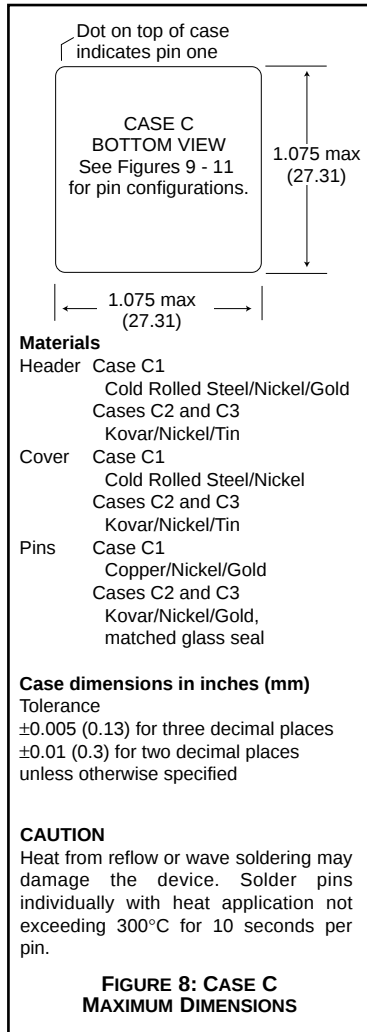
**FIGURE 3: PIN OUT**

## MODEL NUMBERING KEY

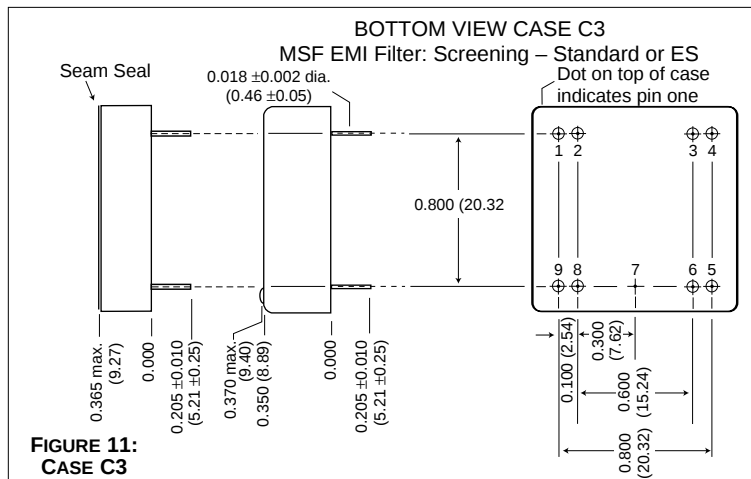
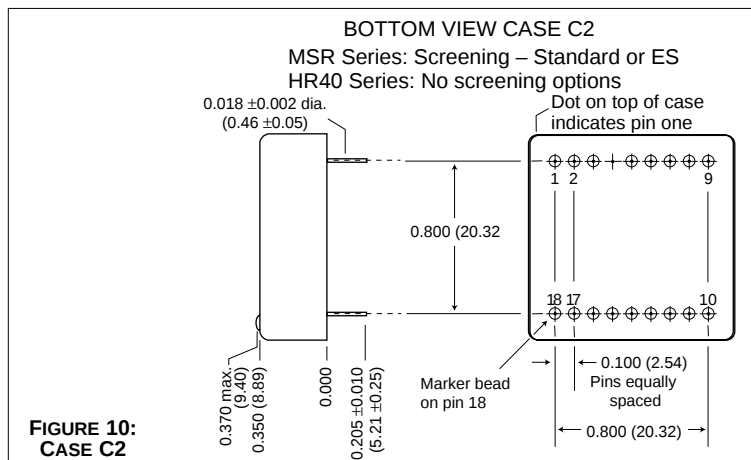
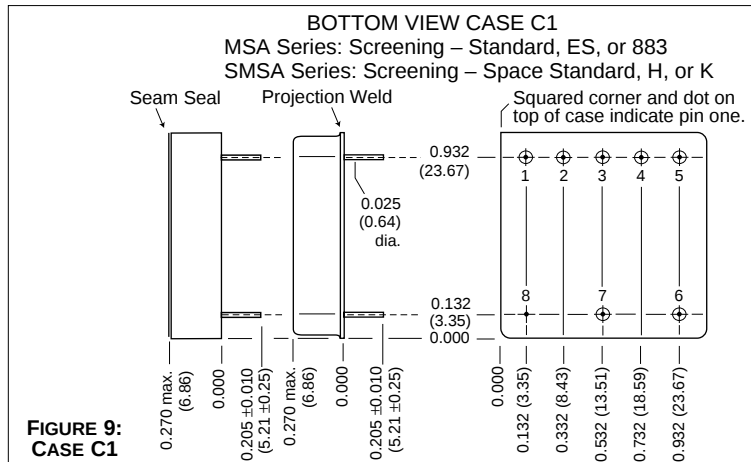


## CASE C

## CASES



Note: Although every effort has been made to render the case drawings at actual size, variations in the printing process may cause some distortion. Please refer to the numerical dimensions for accuracy.



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## QA SCREENING 85°C PRODUCTS

### 85°C PRODUCTS

| TEST (85°C Products excluding HR products)                                    | STANDARD | /ES |
|-------------------------------------------------------------------------------|----------|-----|
| PRE-CAP INSPECTION<br>Method 2017                                             | yes      | yes |
| TEMPERATURE CYCLE (10 times)<br>Method 1010, Cond. B, -55°C to 125°C          | no       | yes |
| CONSTANT ACCELERATION<br>Method 2001, 500 g                                   | no       | yes |
| BURN-IN<br>96 hours at 70°C ambient (typical)                                 | no       | yes |
| FINAL ELECTRICAL TEST MIL-PRF-38534, Group A<br>Subgroups 1 and 4: +25°C case | yes      | yes |
| HERMETICITY TESTING<br>Fine Leak, Method 1014, Cond. A                        | no       | yes |
| Gross Leak, Method 1014, Cond. C                                              | no       | yes |
| Gross Leak, Dip (1 x 10 <sup>-3</sup> )                                       | yes      | no  |
| FINAL VISUAL INSPECTION<br>Method 2009                                        | yes      | yes |

Test methods are referenced to MIL-STD-883 as determined by MIL-PRF-38534.

Applies to the following products:

MFW Series  
 MTW Series  
 MHE/MLP Series  
 MHL Series  
 MRH Series  
 MTO Series  
 MSR Series  
 DCH Series  
 FM/FMA/FMB EMI Filters  
 MSF EMI Filter