

## 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 ±15	+5 & ±12 +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.

# MSR SERIES 4 WATT

# DC/DC CONVERTERS

ABSOLUTE MAXIMUM RATINGS	
<b>Input Voltage</b>	<ul style="list-style-type: none"> <li>16 to 32 VDC</li> </ul>
<b>Output Power</b>	<ul style="list-style-type: none"> <li>3.2 to 4 watts depending on model</li> </ul>
<b>Lead Soldering Temperature (10 sec per lead)</b>	<ul style="list-style-type: none"> <li>300°C</li> </ul>
<b>Storage Temperature Range (Case)</b>	<ul style="list-style-type: none"> <li>-65°C to +150°C</li> </ul>

INHIBIT	
<b>Inhibit TTL Open Collector</b>	<ul style="list-style-type: none"> <li>Logic low (output disabled) <math>\leq 0.8</math> V</li> <li>Referenced to input common</li> <li>Logic high (output enabled) <math>\geq 12</math> V</li> </ul>
	Open collector

TYPICAL CHARACTERISTICS	
<b>Output Voltage Temperature Coefficient</b>	<ul style="list-style-type: none"> <li>MSR2805S 100 ppm/°C typ, 200 max.</li> <li>MSR28XXD 50 ppm/°C typ</li> <li>MSR285XT 100 ppm/°C typ</li> </ul>
<b>Input to Output Capacitance</b>	<ul style="list-style-type: none"> <li>60 pF typical</li> </ul>
<b>Isolation</b>	<ul style="list-style-type: none"> <li>100 megohm minimum at 500 V</li> </ul>
<b>Conversion Frequency</b>	<ul style="list-style-type: none"> <li>Single and dual output models, 80 kHz at full load typical, variable frequency</li> <li>Triple output models, 200 kHz typical fixed frequency</li> </ul>
<b>Inhibit Pin Voltage (unit enabled)</b>	<ul style="list-style-type: none"> <li>12 to 28 V</li> </ul>

RECOMMENDED OPERATING CONDITIONS	
<b>Input Voltage Range</b>	<ul style="list-style-type: none"> <li>16 to 32 VDC continuous</li> <li>40 V for 50 msec transient</li> </ul>
<b>Case Operating Temperature (Tc)</b>	<ul style="list-style-type: none"> <li>-55°C to +85°C full power</li> <li>-55°C to +115°C absolute</li> </ul>
<b>Derating Output Power/Current</b>	<ul style="list-style-type: none"> <li>Linearly from 100% at 85°C to 0% at 115°C</li> </ul>

**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

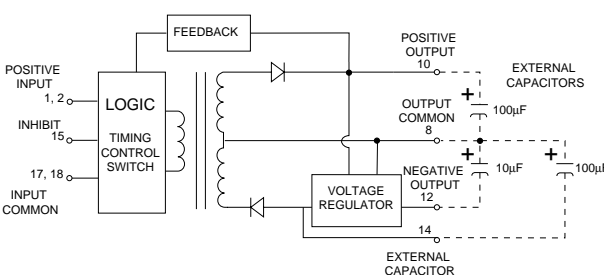
- External capacitors required to prevent damage to internal circuitry (see Table 1 for specifications).
- Dual output models deliver up to 4 watts total for balanced or unbalanced loads, however, the positive output should carry at least 25% of the total load.

### 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 µF, 10 V
Dual Outputs <sup>2</sup> MSR2812D and MSR2815D	Positive Output (10) to Output Common (8)	100 µF, 25 V
	External Capacitor (14) to Output Common (8) <sup>3</sup>	100 µF, 25 V
	Negative Output (12) to Output Common (8)	10 µF, 25 V



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

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.

# DC/DC CONVERTERS

# MSR SERIES 4 WATT

**WARNING: EXTERNAL CAPACITORS REQUIRED**

**Electrical Characteristics: 25°C Tc, 28 VDC Vin, 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>	Tc = -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	Tc = -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**

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

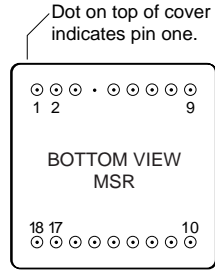
# DC/DC CONVERTERS

**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

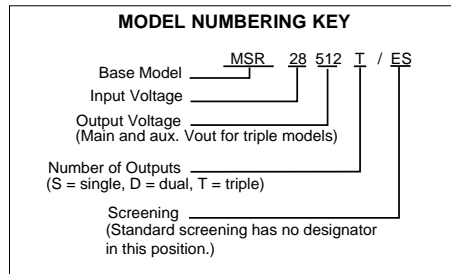
Pin Out Notes

- Make external connection to both pins on all models.  
Pins 1 and 2 positive input  
Pins 17 and 18 input common
- Pins 6 and 7 on triple output models are connected internally.
- 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).



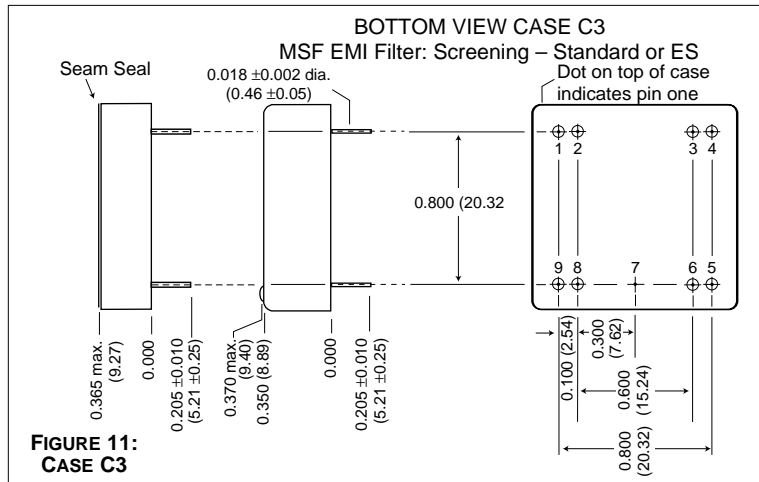
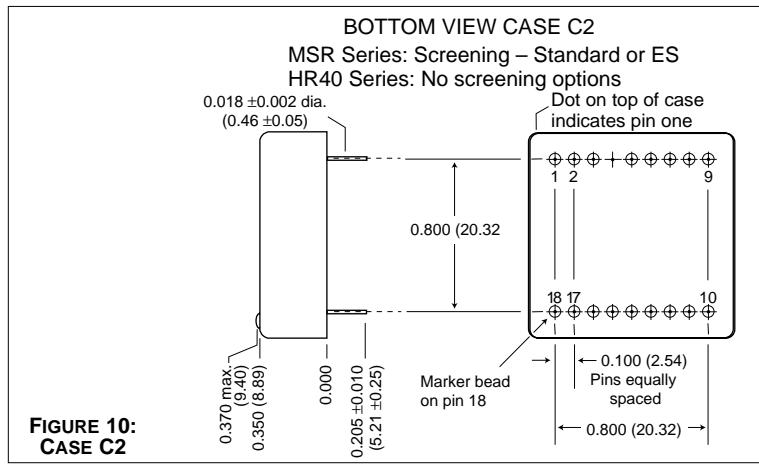
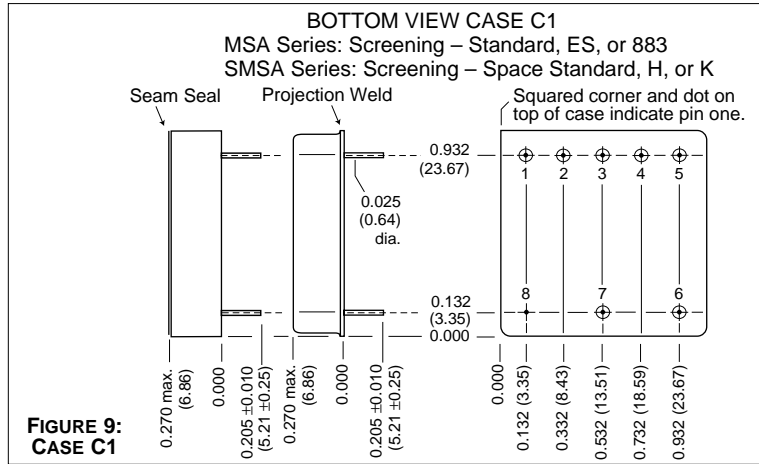
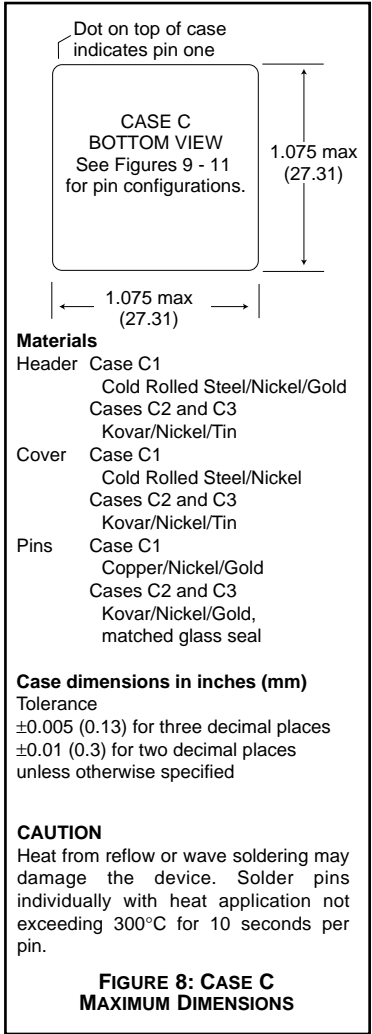
See section B8, case C2, for dimensions.

**FIGURE 3: PIN OUT**



# 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.

**QA SCREENING  
85°C PRODUCTS**

**85°C PRODUCTS**

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