

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

### FEATURES

#### Single, Dual and Triple models

- Operating temperature -55° to +125°C
- Qualified to MIL-PRF-38534 Class H and K
- Radiation hardness assurance (RHA) to level R 100 kRad(Si)
- Input voltage range 16 to 40 VDC
- Transient protection 50 V for 50 ms
- Fully Isolated, magnetic feedback
- Fixed high frequency switching, 600 kHz typical
- Trim function or remote sense on single output models
- Inhibit function
- Synchronization function
- Indefinite short circuit protection
- Up to 84% efficiency (up to 73% efficiency triple models)



MODELS		
VDC OUTPUT		
SINGLE	DUAL	TRIPLE
1.5	±5	+5 & ±12
2.5	±12	+5 & ±15
3.3	±15	
5		
12		
15		

### DESCRIPTION

The Intepoint™ SMTR Series™ of 28 volt DC/DC converters offers up to 30 watts of output power from single, dual or triple output configurations. They operate over the full military temperature range of -55°C to +125°C with up to 84% efficiency (up to 73% efficiency triple models). SMTR converters are packaged in hermetically sealed metal enclosures, making them ideal for use in military, aerospace and other high reliability applications.

### SCREENING

SMTR converters offer screening options to Space Prototype (O), Class H, or Class K. Radiation tolerant to Radiation Hardness Assurance (RHA) levels of “-” (O), “P,” or “R,” per MIL-STD-38534. Interpoint™ model numbers use an “O” in the RHA designator position to indicate the “-” (dash) Radiation Hardness Assurance level of MIL-PRF-38534, which is defined as “no RHA”. See Screening Tables 1 and 2 for more information.

### CONVERTER DESIGN

The SMTR converters are constant frequency, pulse-width modulated switching regulators which use a quasi-square wave, single ended, forward converter design. Tight load regulation is maintained by using a wide bandwidth magnetic feedback and, on single output models, through use of remote sense. On dual output models, the positive output is independently regulated and the negative output is cross regulated through the use of tightly-coupled magnetics. The SMTR Triple Series DC/DC converter's design includes individual regulators on the auxiliary outputs which provide for no cross regulation error when a minimum 300 mA load is maintained on the main (+5 V) output.

SMTR converters have an internal input filter that help reduce the need for external components in normal operation. Use our SFMC EMI input filter to meet the requirements of MIL-STD-461C's CE03. For the lowest noise performance, connection of the case to input common is recommended. The connection can be hard-wired or AC coupled with a small ceramic bypass capacitor. Indefinite short circuit protection and overload protection are provided by a constant current-limit feature. This protective system senses current in the converter's secondary stage and limits it to approximately 125% of the maximum rated output current.

### SYNCHRONIZATION

Synchronizing the converter with the system clock allows the designer to confine switching noise to clock transitions, minimizing interference and reducing the need for filtering. In sync mode, the converter will run at any frequency between 500 kHz and 675 kHz. The sync control operates with an active high at any duty cycle between 40% and 60%. The sync pin should be connected to input common pin when not in use.

### WIDE VOLTAGE RANGE

SMTR converters are designed to provide full power operation over a full 16 to 40 VDC voltage range. Operation below 16 volts, including MIL-STD-704D emergency power conditions is possible with derated power.

### IMPROVED DYNAMIC RESPONSE

The SMTR Series feed-forward compensation system provides excellent dynamic response and noise rejection. Audio rejection is typically 40 dB (50 dB for Triple output models). The min. to max. step line transient response is typically less than 4%.

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### INHIBIT FUNCTION

SMTR converters provide an inhibit terminal that can be used to disable internal switching, resulting in no output and very low quiescent input current. The converter is inhibited when the inhibit pin is pulled to  $\leq 0.8V$ . The unit is enabled when the pin, which is internally connected to a pull-up resistor, is left

unconnected or is connected to an open-collector gate. The open circuit output voltage associated with the inhibit pin is 9 to 11 VDC. In the inhibit mode, a maximum of 8 mA must be sunk from the inhibit pin.

### OPERATING CONDITIONS AND CHARACTERISTICS

#### Input Voltage Range

- 16 to 40 VDC continuous
- 50 V for 50 msec transient

#### Output Power

- Up to 30 watts depending on model

#### Lead Soldering Temperature (10 sec per pin)

- 300°C

#### Storage Temperature Range (Case)

- -65°C to +150°C

#### Case Operating Temperature (Tc)

- -55°C to +125°C full power
- -55°C to +135°C absolute

#### Derating Output Power/Current

- Linearly from 100% at 125°C to 0% at 135°C

#### Output Voltage Temperature Coefficient

- 100 ppm/°C typical single and dual outputs
- 200 ppm/°C main, 300 ppm/°C aux triple output

#### Input to Output Capacitance

- 50 pF typ (100 pF typ triple outputs)

#### Current Limit

- 125% of full load typical

#### Isolation

- 100 megohm minimum at 500 VDC
- Any pin to case, except case pin

#### Audio Rejection

- 40 dB typ (50 dB typ, triple output)

#### Conversion Frequency

- Free run 550 min, 600 typ, 650 max kHz
- External sync 500 to 675 kHz

### SYNC AND INHIBIT (INH1, INH2)

#### Sync

- Sync In
  - Input frequency 500 to 675 Hz.
  - Duty cycle 40% min, 60% max
  - Active low 0.8 V max
  - Active high 4.5 V min, 5 V max
  - Referenced to input common
- Sync Out
  - Referenced to input common

#### Inhibit (do not apply a voltage to the inhibit pin)

- Converter Disabled (active low)
  - Pull voltage to 0.8 V or below by connecting to ground or other method.
  - Inhibit pin source current, 8 mA max
  - Referenced to input common
- Converter Enabled (active high)
  - Inhibit pin open or through an open collector
  - If not used, leave unconnected
  - Open pin voltage 9 to 11 V

### MECHANICAL AND ENVIRONMENTAL

#### Size (maximum)

- Single and dual output
  - Non-flanged: 2.100 x 1.115 x 0.400 inches (53.34 x 28.32 x 10.16 mm) See case H2 for dimensions.
  - Flanged: 2.910 x 1.115 x 0.400 inches (73.91 x 28.32 x 10.16 mm) See case K3 for dimensions.
- Triple output
  - Non-flanged: 1.950 x 1.350 x 0.405 inches (49.53 x 34.29 x 10.29 mm) See case F1 for dimensions.
  - Flanged: 2.720 x 1.350 x 0.405 inches (69.09 x 34.29 x 10.29 mm) See case J1 for dimensions.

#### Weight (maximum)

- Single and dual non-flanged 50 grams, flanged 52 grams
- Triple non-flanged 58 grams, flanged 62 grams

#### Screening

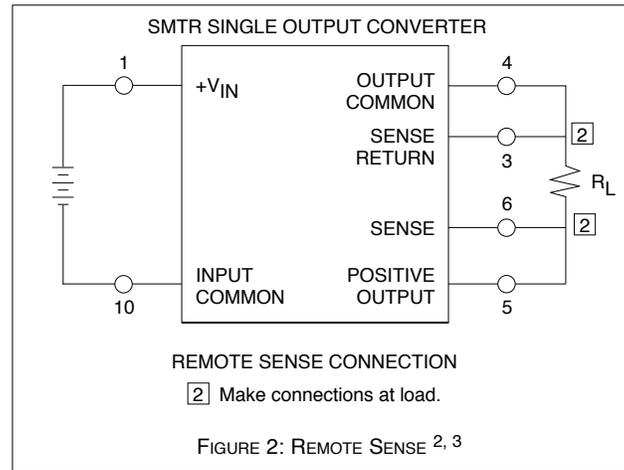
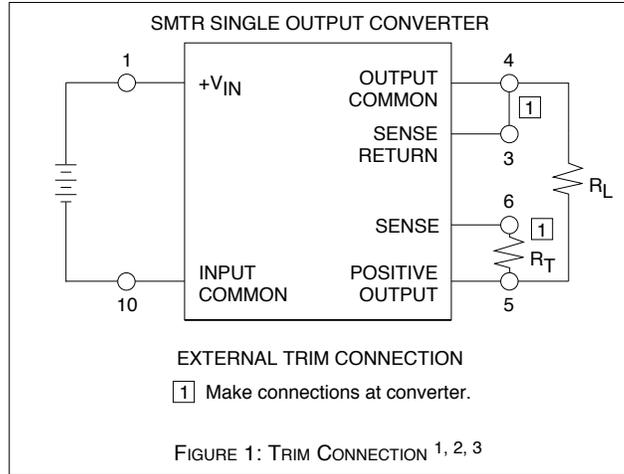
Space Prototype (O), Class H, or Class K are radiation tolerant to Radiation Hardness Assurance (RHA) levels of “-” (O), “P” or “R”, per MIL-STD-38534. Interpoint model numbers use an “O” in the RHA designator position to indicate the “-” (dash) Radiation hardness Assurance level of MIL-PRF- 38534, which is defined as “no RHA”.

See Screening Tables 1 and 2 for more information. Available configurations are: OO, HP, KP, HR, and KR

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### TRIM AND REMOTE SENSE (AVAILABLE ON SINGLE OUTPUT MODELS ONLY)



#### Trim Formulas

V<sub>out</sub> = desired output voltage; R<sub>T</sub> = trim resistor

$$3.3V: R_T = \frac{1300 * V_{out} - 4304}{1.2475}$$

$$5V: R_T = \frac{1300 * V_{out} - 6512}{1.2475}$$

$$12V: R_T = \frac{1300 * V_{out} - 15631}{1.2475}$$

$$15V: R_T = \frac{1300 * V_{out} - 19498}{1.2475}$$

#### Notes for Remote Sense and Trim

1. When trimming output voltage and/or remote sensing, the total output voltage increase must be less than 0.6 volts at the converters pins. Do not exceed maximum power.
2. If neither voltage trim nor remote sense will be used, connect pin 3 to pin 4 and pin 5 to pin 6 or the output voltage will increase by 1.2 volts.
3. CAUTION: The converter will be permanently damaged if the positive remote sense (pin 6) is shorted to ground. Damage may also result if the output common or positive output is disconnected from the load with the remote sense leads connected to the load.
4. When using remote sense for voltage compensation or when using remote sense for trim, the output will drift over temperature. Contact Applications Engineering for more information at [powerapps@crane-eg.com](mailto:powerapps@crane-eg.com)

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PIN OUT			
Pin	Single Output	Dual Output	Triple Output
1	Positive Input	Positive Input	Positive Input
2	Inhibit	Inhibit	Main (+5) Output
3	Sense Return	Positive Output	Output Common
4	Output Common	Output Common	Neg. Aux. Output
5	Positive Output	Negative Output	Pos. Aux. Output
6	Positive Sense	Case Ground	Case Ground
7	Case Ground	Case Ground	Case Ground
8	Case Ground	Case Ground	Inhibit
9	Sync	Sync	Sync
10	Input Common	Input Common	Input Common

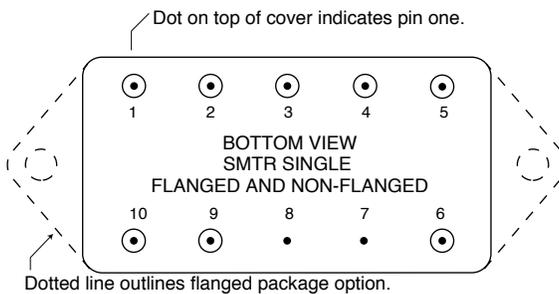


FIGURE 3: PIN OUT SMTR SINGLE OUTPUT MODELS  
See cases H2 and K3 for dimensions.

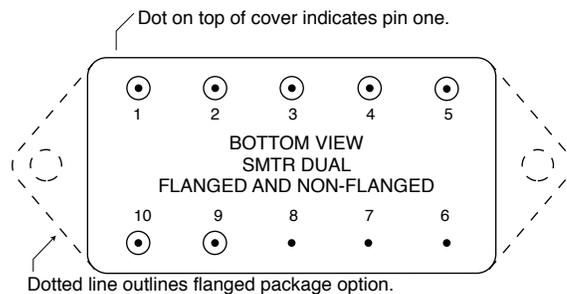


FIGURE 4: PIN OUT SMTR DUAL OUTPUT MODELS  
See cases H2 and K3 for dimensions.

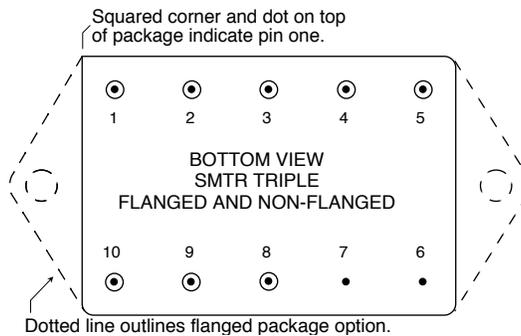


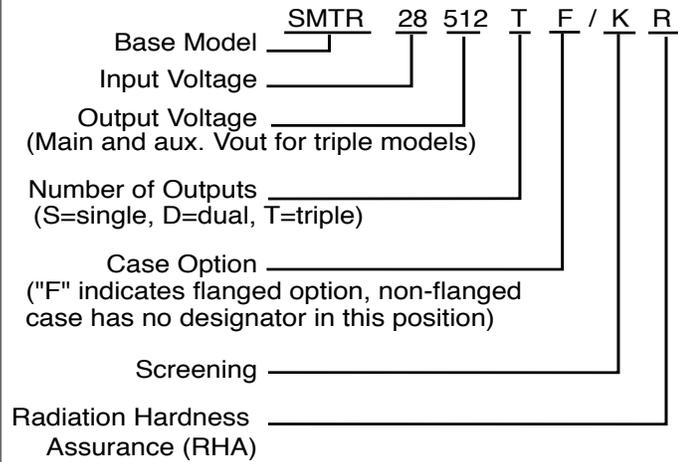
FIGURE 5: PIN OUT SMTR TRIPLE  
See cases F1 and J1 for dimensions.

PINS NOT IN USE	
<b>Inhibit</b>	Leave unconnected
<b>Sync In</b>	Connect to Input Common
<b>Sense Lines</b>	Must be connected to appropriate outputs

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### MODEL NUMBERING KEY



### SMD NUMBERS

STANDARD MICROCIRCUIT DRAWING (SMD)	SMTR SIMILAR PART
5962R0150102KXC	SMTR283R3S/KR
5962R9306802KXC	SMTR2805S/KR
5962R9306902KXC	SMTR2812S/KR
5962R9307002KXC	SMTR2815S/KR
5962R9320502KXC	SMTR2805D/KR
5962R9307102KXC	SMTR2812D/KR
5962R9307202KXC	SMTR2815D/KR
5962R9307402KXC	SMTR28515T/KR

To indicate the flanged case option change the "X" to "Z" in the SMD number. The SMD number shown is for Class K screening, non-flanged, and Radiation Hardness Assurance (RHA) level R. See the SMD for the numbers for other screening and radiation levels. For exact specifications for an SMD product, refer to the SMD drawing. SMDs can be downloaded from: <http://www.dscc.dla.mil/programs/smc>

### MODEL SELECTION

ON THE LINES BELOW, ENTER ONE SELECTION FROM EACH CATEGORY TO DETERMINE THE MODEL NUMBER.

CATEGORY	SMTR28	_____	_____	_____ / _____	_____	_____
	Base Model and Input Voltage	Output Voltage <sup>1</sup>	Number of Outputs <sup>2</sup>	Case Option <sup>3</sup>	Screening <sup>4</sup>	RHA <sup>5</sup>
SELECTION	SMTR28 is the only available selection	1R5, 2R5, 3R3, 05, 12, 15	S	(NON-FLANGED	O	O
		05, 12, 15	D	leave blank)	H	P
		512, 515	T	F (FLANGED)	K	R

Notes:

- Output Voltage: An R indicates a decimal point. 1R5 is 1.5 volts out. The value of 1R5, 2R5, and 3R3 are only available in single output models. The 512 and 515 triple output converters are +5 volt main and ±12 or ±15 volt auxiliaries.
- Number of Outputs: S is a single output, D is a dual output, and T is a triple output
- Case Options: For the standard case (cases F1 and H2 on pages 15 and 16) leave the case option blank. For the flanged case option (cases J1 and K3 on pages 17 and 18), insert the letter F in the Case Option position.
- Screening: A screening level of O is a Space Prototype and is only available with RHA O. See Screening Tables 1 and 2 for more information.
- RHA: Interpoint model numbers use an "O" in the RHA designator position to indicate the "-" (dash) Radiation Hardness Assurance level of MIL-PRF-38534, which is defined as "no RHA." RHA O is only available with Screening level O. See Screening Table 2 for more information.

# SMTR Single, Dual and Triple DC/DC Converters

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Electrical Characteristics: -55°C to +125°C T<sub>C</sub>, 28 VDC Vin, 100% load, no irradiation, unless otherwise specified.

SINGLE OUTPUT MODELS		SMTR281R5S			SMTR282R5S			SMTR283R3S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		1.455	—	1.545	2.425	—	2.575	3.201	—	3.399	VDC
OUTPUT CURRENT	V <sub>IN</sub> = 16 TO 40 VDC	0	—	8.0	0	—	8.0	0	—	6.06	A
OUTPUT POWER <sup>2</sup>	V <sub>IN</sub> = 16 TO 40 VDC	—	—	12	—	—	20	—	—	20	W
OUTPUT RIPPLE 10 kHz TO 2 MHz	T <sub>C</sub> = 25°C	—	20	50	—	25	65	—	20	40	mV p-p
	T <sub>C</sub> = -55°C TO +125°C	—	—	50	—	—	65	—	—	50	
LINE REGULATION	V <sub>IN</sub> = 16 TO 40 VDC	—	0	10	—	0	10	—	0	20	mV
LOAD REGULATION	NO LOAD TO FULL	—	2	10	—	2	10	—	2	20	mV
INPUT VOLTAGE	NO LOAD TO FULL CONTINUOUS	16	28	40	16	28	40	16	28	40	VDC
	TRANSIENT 50 ms <sup>1</sup>	—	—	50	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	45	90	—	60	100	—	30	75	mA
	INHIBITED	—	—	8	—	—	8	—	—	8	
INPUT RIPPLE CURRENT <sup>3</sup>	10 kHz - 10 MHz	—	20	50	—	25	50	—	25	50	mA p-p
EFFICIENCY	T <sub>C</sub> = 25°C	57	60	—	68	70	—	70	73	—	%
	T <sub>C</sub> = -55°C TO +125°C	55	—	—	66	—	—	66	—	—	
LOAD FAULT <sup>4</sup>	SHORT CIRCUIT POWER DISSIPATION	—	—	13	—	—	13	—	—	12	W
	RECOVERY <sup>1</sup>	—	—	6	—	—	6	—	—	6	ms
STEP LOAD RESPONSE	50% - 100% - 50% LOAD TRANSIENT	—	±75	±125	—	±90	±150	—	±130	±300	mV pk
	RECOVERY <sup>1, 5</sup>	—	—	200	—	—	200	—	—	200	μs
STEP LINE RESPONSE <sup>1</sup> 16 - 40 -16 VDC	TRANSIENT	—	—	±300	—	—	±300	—	—	±300	mV pk
	RECOVERY <sup>5</sup>	—	—	300	—	—	300	—	—	300	μs
START-UP <sup>6</sup>	DELAY	—	—	5	—	—	5	—	—	5	ms
	OVERSHOOT FULL LOAD <sup>1</sup>	—	0	30	—	0	30	—	0	50	mV pk
	OVERSHOOT NO LOAD <sup>1</sup>	—	—	75	—	—	125	—	—	150	
CAPACITIVE LOAD <sup>1</sup> T <sub>C</sub> = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	1000	—	—	1000	—	—	300	μF

### Notes

1. Guaranteed by design, not tested.

2. Operation is limited below 16 V (see Figure 22).

3. Tested with 6800 pF ceramic bypass capacitor connected externally from input common to case.

4. Short circuit protection not guaranteed above 125°C case temperature.

5. Recovery time is measured from application of the transient to the point at which V<sub>out</sub> is within 1% of final value.

6. Tested on release from inhibit.

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

Electrical Characteristics: -55°C to +125°C T<sub>C</sub>, 28 VDC Vin, 100% load, no irradiation, unless otherwise specified.

SINGLE OUTPUT MODELS		SMTR2805S			SMTR2812S			SMTR2815S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		4.85	—	5.15	11.64	—	12.36	14.70	—	15.30	VDC
OUTPUT CURRENT	V <sub>IN</sub> = 16 TO 40 VDC	0	—	5.0	0	—	2.5	0	—	2.0	A
OUTPUT POWER <sup>2</sup>	V <sub>IN</sub> = 16 TO 40 VDC	—	—	25	—	—	30	—	—	30	W
OUTPUT RIPPLE 10 kHz TO 2 MHz	T <sub>C</sub> = 25°C	—	20	50	—	15	40	—	15	40	mV p-p
	T <sub>C</sub> = -55°C TO +125°C	—	—	90	—	—	90	—	—	90	
LINE REGULATION	V <sub>IN</sub> = 16 TO 40 VDC	—	10	50	—	10	50	—	10	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	10	50	—	10	50	—	20	50	mV
INPUT VOLTAGE	NO LOAD TO FULL CONTINUOUS	16	28	40	16	28	40	16	28	40	VDC
	TRANSIENT 50 ms <sup>1</sup>	—	—	50	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	35	75	—	35	75	—	35	75	mA
	INHIBITED	—	—	8	—	—	8	—	—	8	
INPUT RIPPLE CURRENT <sup>3</sup>	10 kHz - 10 MHz	—	25	50	—	35	50	—	30	50	mA p-p
EFFICIENCY	T <sub>C</sub> = 25°C	74	78	—	78	83	—	79	84	—	%
	T <sub>C</sub> = -55°C TO +125°C	71	—	—	75	—	—	76	—	—	
LOAD FAULT <sup>4</sup>	SHORT CIRCUIT POWER DISSIPATION	—	—	12	—	—	12	—	—	12	W
	RECOVERY <sup>1</sup>	—	—	5	—	—	5	—	—	5	ms
STEP LOAD RESPONSE	50% - 100% - 50% LOAD TRANSIENT	—	±180	±300	—	±270	±400	—	±310	±500	mV pk
	RECOVERY <sup>1, 5</sup>	—	—	300	—	—	300	—	—	300	μs
STEP LINE RESPONSE <sup>1</sup> 16 - 40 - 16 VDC	TRANSIENT	—	—	±300	—	—	±500	—	—	±600	mV pk
	RECOVERY <sup>5</sup>	—	—	300	—	—	300	—	—	300	μs
START-UP <sup>6</sup>	DELAY	—	—	5	—	—	5	—	—	5	ms
	OVERSHOOT FULL LOAD <sup>1</sup>	—	0	50	—	0	120	—	0	150	mV pk
	OVERSHOOT NO LOAD <sup>1</sup>	—	—	250	—	—	600	—	—	750	
CAPACITIVE LOAD <sup>1</sup> T <sub>C</sub> = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	300	—	—	300	—	—	300	μF

### Notes

1. Guaranteed by design, not tested.

2. Operation is limited below 16 V (see Figure 22).

3. Tested with 6800 pF ceramic bypass capacitor connected externally from input common to case.

4. Short circuit protection not guaranteed above 125°C case temperature.

5. Recovery time is measured from application of the transient to the point at which V<sub>out</sub> is within 1% of final value.

6. Tested on release from inhibit.

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Electrical Characteristics: -55°C to +125°C T<sub>C</sub>, 28 VDC Vin, 100% load, no irradiation, unless otherwise specified.

DUAL OUTPUT MODELS		SMTR2805D			SMTR2812D			SMTR2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+V <sub>OUT</sub>	4.85	—	5.15	11.64	—	12.36	14.55	—	15.45	VDC
	-V <sub>OUT</sub>	4.83	—	5.18	11.58	—	12.42	14.47	—	15.53	
OUTPUT CURRENT <sup>2, 3</sup> V <sub>IN</sub> = 16 TO 40 VDC	EACH OUTPUT	0	±2.50	4.50 <sup>1</sup>	0	±1.25	2.25 <sup>1</sup>	0	±1.00	1.80 <sup>1</sup>	A
	TOTAL	—	—	5	—	—	2.5	—	—	2	
OUTPUT POWER <sup>3, 4</sup> V <sub>IN</sub> = 16 TO 40 VDC	EACH OUTPUT	—	±12.5	22.5 <sup>1</sup>	—	±15	27 <sup>1</sup>	—	±15	27 <sup>1</sup>	W
	TOTAL	—	—	25	—	—	30	—	—	30	
OUTPUT RIPPLE ±V <sub>OUT</sub> 10 kHz TO 2 MHz	T <sub>C</sub> = 25°C	—	20	40	—	30	80	—	25	80	mV p-p
	T <sub>C</sub> = -55°C TO +125°C	—	—	90	—	—	150	—	—	120	
LINE REGULATION V <sub>IN</sub> = 16 TO 40 VDC	+V <sub>OUT</sub>	—	0	50	—	0	50	—	0	50	mV
	-V <sub>OUT</sub>	—	10	100	—	15	150	—	10	180	
LOAD REGULATION BALANCED, NO LOAD TO FULL	+V <sub>OUT</sub>	—	5	50	—	5	50	—	—	50	mV
	-V <sub>OUT</sub>	—	15	100	—	30	150	—	—	180	
CROSS REGULATION EFFECT ON -V <sub>OUT</sub> <sup>1</sup>	SEE NOTE 5	—	—	12	—	—	8.3	—	—	8	%
	SEE NOTE 6	—	—	6	—	—	6	—	—	6	
INPUT VOLTAGE	NO LOAD TO FULL CONTINUOUS	16	28	40	16	28	40	16	28	40	VDC
	TRANSIENT 50 ms <sup>1</sup>	—	—	50	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	28	75	—	40	75	—	48	75	mA
	INHIBITED	—	—	8	—	—	8	—	—	8	
INPUT RIPPLE CURRENT <sup>7</sup>	10 kHz - 10 MHz	—	25	50	—	35	50	—	35	50	mA p-p
EFFICIENCY	T <sub>C</sub> = 25°C	74	76	—	77	80	—	78	81	—	%
	T <sub>C</sub> = -55°C TO +125°C	72	—	—	75	—	—	75	—	—	
LOAD FAULT <sup>8</sup> ±V <sub>OUT</sub>	SHORT CIRCUIT POWER DISSIPATION	—	8	12	—	6	12	—	5	12	W
	RECOVERY <sup>1, 9</sup>	—	—	5.0	—	—	5.0	—	—	5.0	ms
STEP LOAD RESPONSE ±V <sub>OUT</sub> BALANCED LOAD	50% - 100% - 50% LOAD TRANSIENT	—	±150	±300	—	±200	±300	—	±220	±400	mV pk
	RECOVERY <sup>1, 9</sup>	—	—	200	—	—	200	—	—	200	μs
STEP LINE RESPONSE <sup>1</sup> ±V <sub>OUT</sub> , 16 - 40 -16 VDC	TRANSIENT	—	—	±400	—	—	±400	—	—	±500	mV pk
	RECOVERY <sup>9</sup>	—	—	300	—	—	300	—	—	300	μs
START-UP ±V <sub>OUT</sub>	DELAY <sup>7</sup>	—	—	5	—	—	5	—	—	5	ms
	OVERSHOOT FULL LOAD <sup>1</sup>	—	—	180	—	—	150	—	—	150	mV pk
	OVERSHOOT NO LOAD <sup>1</sup>	—	—	250	—	—	600	—	—	750	
CAPACITIVE LOAD <sup>1</sup> T <sub>C</sub> = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	500	—	—	500	—	—	500	μF

Notes: See page 9

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

### Notes SMTR Dual Output Models

**1. Guaranteed by design, not tested.**

2. The specified max current is available from either output.
3. Up to 90% of the total output current/power is available from either output providing the positive output is carrying at least 10% of the total output power.
4. Operation is limited below 16 V (see Figure 22).
5. Effect on the negative output under the following conditions:  
+Pout 20% to 80%; -Pout 80% to 20%.
6. Effect on the negative output under the following conditions:  
+Pout 50%; -Pout 10% to 50%. See Figure 21.
7. Tested with 6800 pF ceramic bypass capacitor connected externally from input common to case.
8. Indefinite short circuit protection not guaranteed above 125°C case temperature.
9. Recovery time is measured from application of the transient to point at which Vout is within 1% of final value.

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

Electrical Characteristics: -55°C to +125°C T<sub>C</sub>, 28 VDC Vin, 100% load, no irradiation, unless otherwise specified.

TRIPLE OUTPUT MODEL – SMRT28512T		5 (MAIN)			±12 (AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		4.85	5.00	5.15	±11.58	±12.00	±12.42	VDC
OUTPUT CURRENT <sup>2, 3</sup>		0.30	—	4.00	—	±0.416	0.625 <sup>1</sup>	A
	MAX TOTAL AUX	—	—	—	—	—	0.834	
OUTPUT POWER <sup>2, 3</sup>		—	—	20	—	5.0	7.5 <sup>1</sup>	W
	MAX TOTAL AUX	—	—	—	—	—	10	
OUTPUT RIPPLE 10 kHz - 2 MHz	T <sub>C</sub> = 25°C	—	—	125	—	—	120	mV p-p
	T <sub>C</sub> = -55°C TO +125°C	—	—	180	—	—	120	
LINE REGULATION <sup>4</sup>	V <sub>IN</sub> 16 TO 40 VDC	—	10	20	—	25	75	mV
LOAD REGULATION <sup>3, 4</sup>		—	30	50	—	30	75	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	—	—	—	VDC
	TRANSIENT 50 ms <sup>1</sup>	—	—	50	—	—	—	V
INPUT CURRENT	NO LOAD	—	40	110	—	—	—	mA
	INHIBITED	—	4	8	—	—	—	
INPUT RIPPLE CURRENT <sup>3</sup>	10 kHz - 10 MHz	—	45	80	—	—	—	mA p-p
EFFICIENCY	T <sub>C</sub> = 25°C	72	73	—	—	—	—	%
	T <sub>C</sub> = -55°C TO +125°C	70	—	—	—	—	—	
LOAD FAULT <sup>5</sup>	POWER DISSIPATION	—	—	14	—	—	—	W
ALL OUTPUTS SHORTED								
	RECOVERY EACH OUTPUT <sup>1</sup>	—	—	6	—	—	—	ms
STEP LOAD RESPONSE <sup>6, 7</sup>	TRANSIENT	—	±150	±400	—	±500	±1500	mV pk
	RECOVERY	—	0.05	0.30	—	3	6	ms
STEP LINE RESPONSE <sup>1</sup>	V <sub>IN</sub> 16 TO 40 VDC	—	—	±800	—	—	±800	mV pk
	TRANSIENT							
START-UP	RECOVERY	—	—	5	—	—	5	ms
	DELAY	—	—	6	—	—	6	ms
	OVERSHOOT <sup>1</sup>	—	—	500	—	—	2000	mV pk

### Notes:

1. **Guaranteed by design, not tested.**

2. The sum of the two Aux outputs is not to exceed 10 watts. The maximum load per Aux output is 7.5 watts.

3. To maintain regulation when operating the ±Aux at full load, a minimum load of 300 mA is required on the main output. For Aux loads less than full load, a lower load (<300 mA) on the main output will maintain regulation.

4. Measured on each output one at a time with the other outputs at full load.

5. Indefinite short circuit protection not guaranteed above 125°C (case).

6. Response of each output as all outputs are simultaneously transitioned.

Main: 50% - 100% - 50% of main full load

Auxiliaries: 25% - 50% - 25% each, of total auxiliary full load

7. Recovery time is measured from application of the transient to point at which V<sub>out</sub> is within 1% of regulation.

8. Tested on release from inhibit.

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

Electrical Characteristics: -55°C to +125°C T<sub>C</sub>, 28 VDC Vin, 100% load, no irradiation, unless otherwise specified.

TRIPLE OUTPUT MODEL – SMRT28515T		5 (MAIN)			±15 (+AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	25°C	4.95	5.00	5.05	±14.77	±15.00	±15.23	VDC
		4.85	—	5.15	±14.47	—	±15.52	
OUTPUT CURRENT <sup>2, 3</sup>		0.30	—	4.00	—	±0.333	0.50 <sup>1</sup>	A
	MAX TOTAL AUX	—	—	—	—	—	0.666	
OUTPUT POWER <sup>2, 3</sup>		—	—	20	—	±5	7.5 <sup>1</sup>	W
	MAX TOTAL AUX	—	—	—	—	—	10	
OUTPUT RIPPLE 10 kHz - 2 MHz	T <sub>C</sub> = 25°C	—	—	125	—	—	120	mV p-p
	T <sub>C</sub> = -55°C TO +125°C	—	—	180	—	—	120	
LINE REGULATION <sup>4</sup>	V <sub>IN</sub> 16 TO 40 VDC	—	10	20	—	30	75	mV
LOAD REGULATION <sup>3, 4</sup>		—	10	50	—	30	75	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	—	—	—	VDC
	TRANSIENT 50 ms <sup>1</sup>	—	—	50	—	—	—	V
INPUT CURRENT	NO LOAD	—	50	110	—	—	—	mA
	INHIBITED	—	4	6	—	—	—	
INPUT RIPPLE CURRENT <sup>3</sup>	10 kHz - 10 MHz	—	40	80	—	—	—	mA p-p
EFFICIENCY	25°C	72	73	—	—	—	—	%
		70	—	—	—	—	—	
LOAD FAULT <sup>5</sup> ALL OUTPUTS SHORTED	POWER DISSIPATION	—	—	14	—	—	—	W
	RECOVERY EACH OUTPUT <sup>1</sup>	—	1.4	6	—	—	—	ms
STEP LOAD RESPONSE <sup>6, 7</sup>	TRANSIENT	—	±150	±400	—	±500	±1500	mV pk
	RECOVERY	—	0.05	0.30	—	2	6	ms
STEP LINE RESPONSE <sup>1</sup>	V <sub>IN</sub> 16 TO 40 VDC TRANSIENT	—	±150	±800	—	±100	±800	mV pk
	RECOVERY	—	—	5	—	—	5	ms
START-UP	DELAY	—	1.4	6	—	—	6	ms
	OVERSHOOT <sup>1</sup>	—	—	500	—	—	2000	mV pk

### Notes:

#### 1. Guaranteed by design, not tested.

- The sum of the two Aux outputs is not to exceed 10 watts. The maximum load per Aux output is 7.5 watts.
- To maintain regulation when operating the ±Aux at full load, a minimum load of 300 mA is required on the main output. For Aux loads less than full load, a lower load (<300 mA) on the main output will maintain regulation.
- Measured on each output one at a time with the other outputs at full load.
- Indefinite short circuit protection not guaranteed above 125°C (case).

#### 6. Response of each output as all outputs are simultaneously transitioned.

Main: 50% - 100% - 50% of main full load  
Auxiliaries: 25% - 50% - 25% each, of total auxiliary full load

- Recovery time is measured from application of the transient to point at which Vout is within 1% of regulation.
- Tested on release from inhibit.

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

Typical Performance Curves: 25°C T<sub>C</sub>, 28 VDC Vin, 100% load, free run, unless otherwise specified.

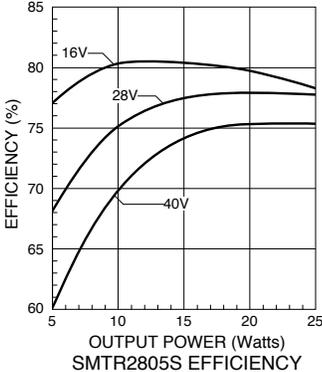


FIGURE 6

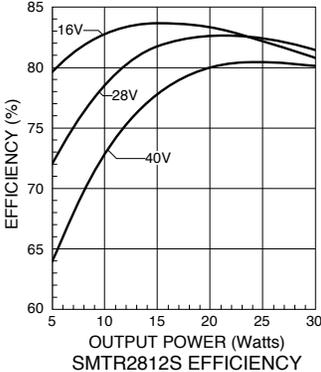


FIGURE 7

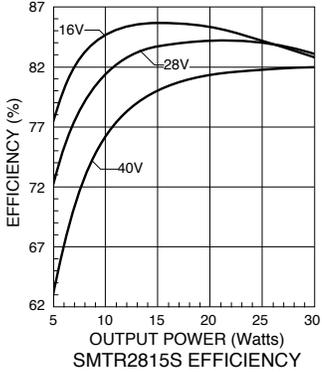


FIGURE 8

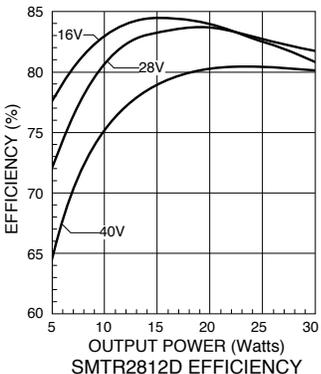


FIGURE 9

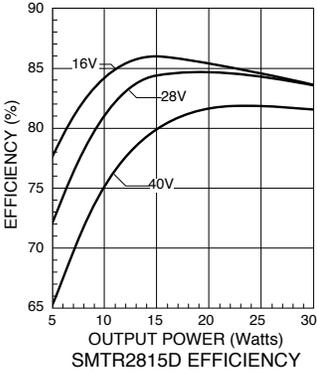


FIGURE 10

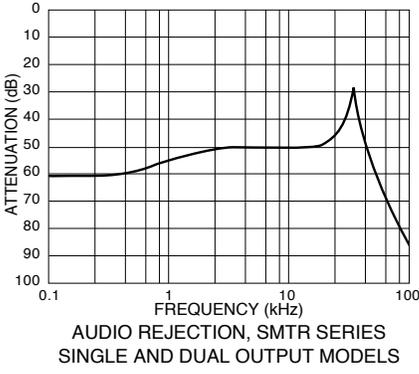


FIGURE 11

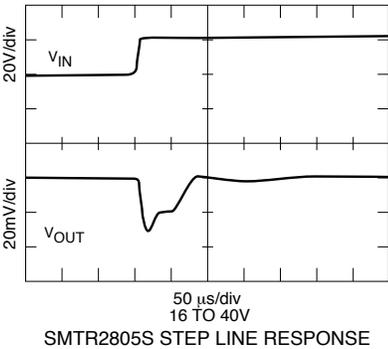


FIGURE 12

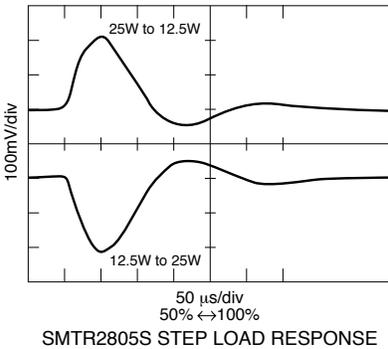


FIGURE 13

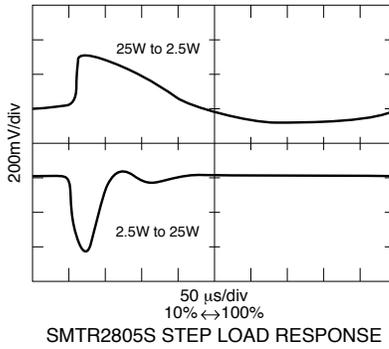


FIGURE 14

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

Typical Performance Curves: 25°C T<sub>C</sub>, 28 VDC Vin, 100% load, free run, unless otherwise specified.

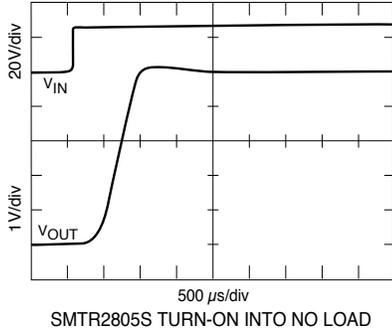


FIGURE 15

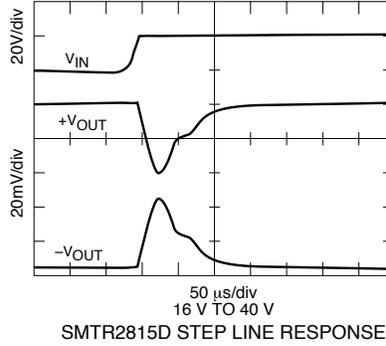


FIGURE 16

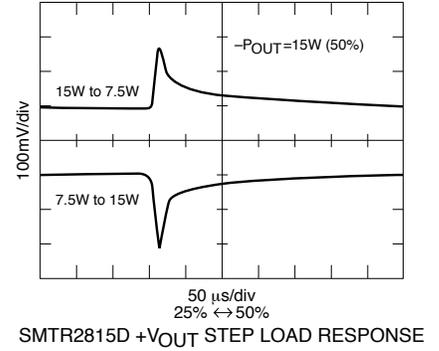


FIGURE 17<sup>1</sup>

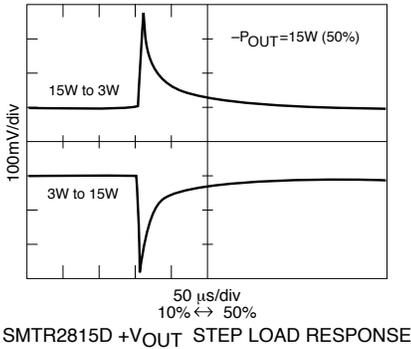


FIGURE 18<sup>1</sup>

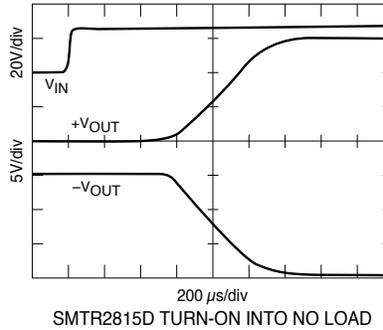


FIGURE 19

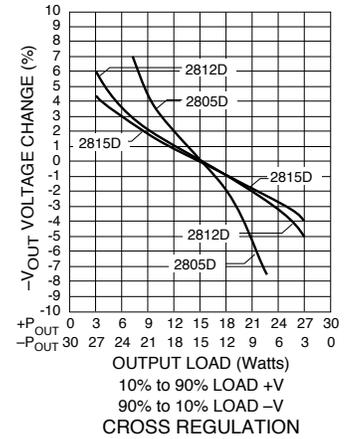


FIGURE 20<sup>1</sup>

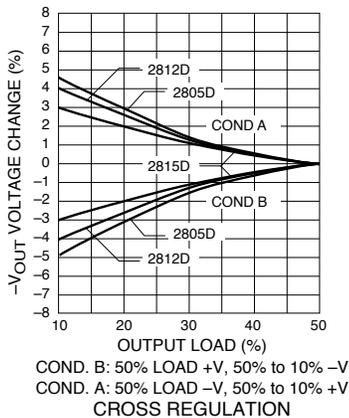


FIGURE 21<sup>1</sup>

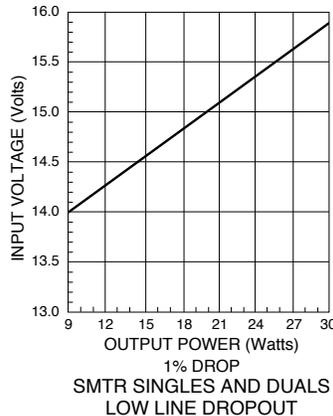


FIGURE 22

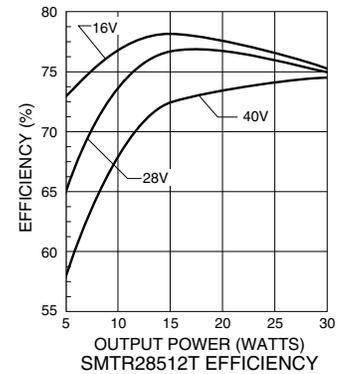


FIGURE 23

Notes: 1. Percent (%) of power refers to the percent of the total output power of the converter.

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

Typical Performance Curves: 25°C T<sub>C</sub>, 28 VDC Vin, 100% load, free run, unless otherwise specified.

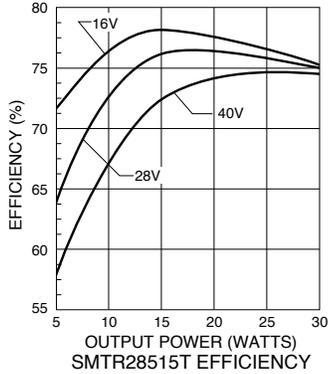


FIGURE 24

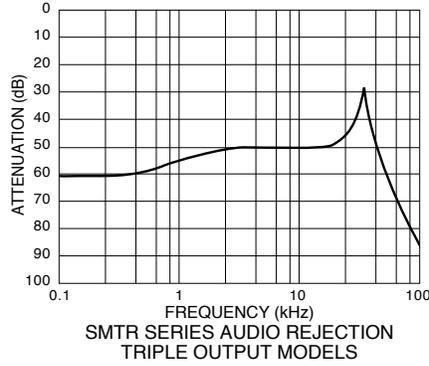


FIGURE 25

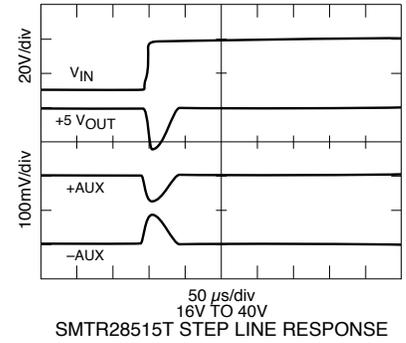


FIGURE 26

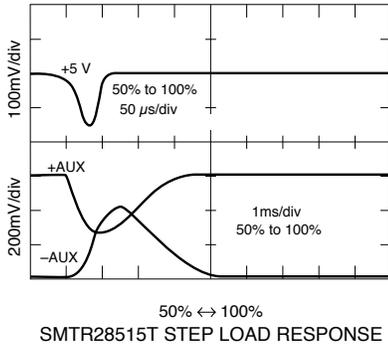


FIGURE 27

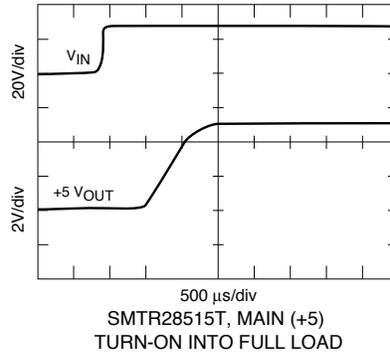


FIGURE 28

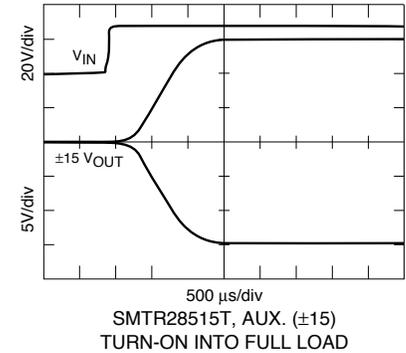


FIGURE 29

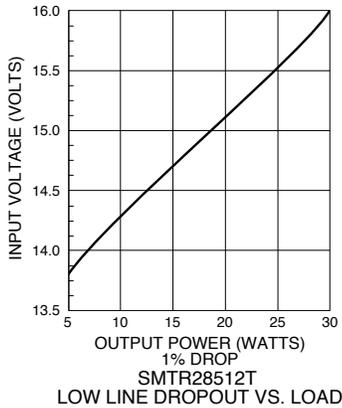


FIGURE 30

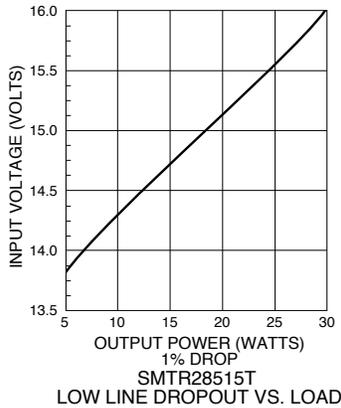
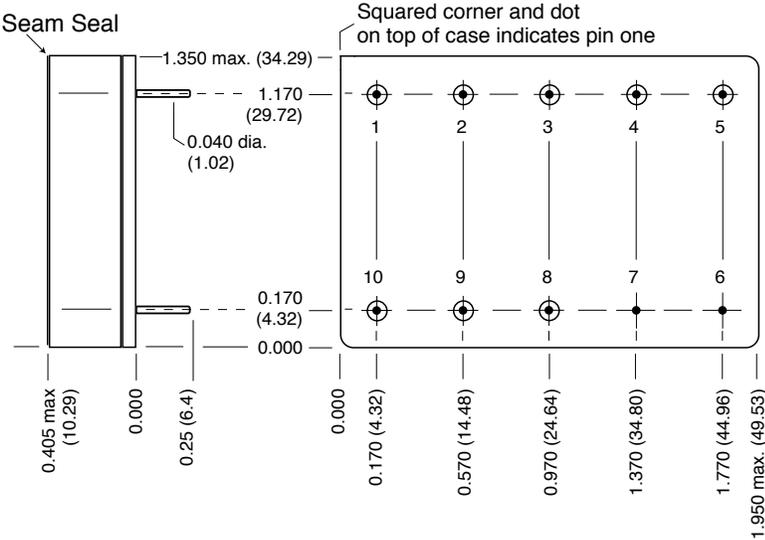


FIGURE 31

# SMTR Single, Dual and Triple DC/DC Converter Cases

## 28 VOLT INPUT – 30 WATT

### BOTTOM VIEW CASE F1



**Case dimensions in inches (mm)**  
 Tolerance  $\pm 0.005$  (0.13) for three decimal places  
 $\pm 0.01$  (0.3) for two decimal places  
 unless otherwise specified

**CAUTION**  
 Heat from reflow or wave soldering may damage the device.  
 Solder pins individually with heat application not exceeding 300°C for 10 seconds per pin.

**Materials**  
 Header Cold Rolled Steel/Nickel/Gold  
 Cover Kovar/Nickel  
 Pins #52 alloy/Gold ceramic seal  
 Seal hole  $0.120 \pm 0.002$  ( $3.05 \pm 0.05$ )

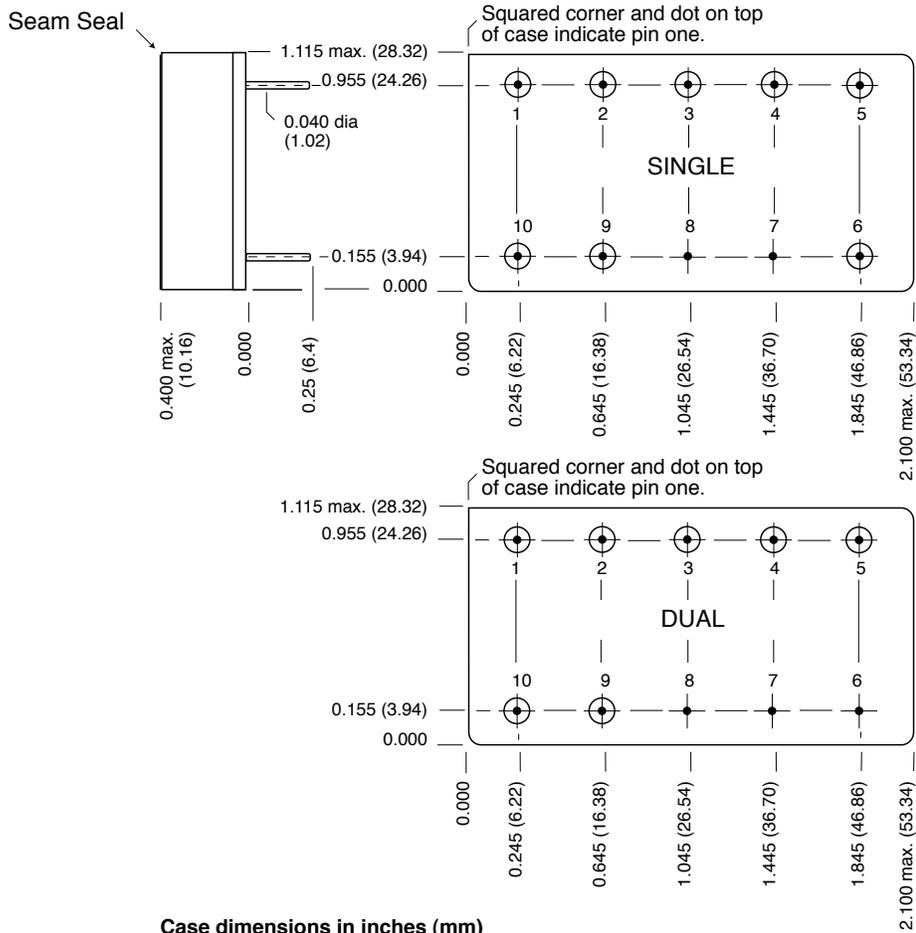
Case F1 SMTR T, Rev F, 20100429  
 Please refer to the numerical dimensions for accuracy.

FIGURE 32: CASE F1 - TRIPLE OUTPUT MODELS

# SMTR Single, Dual and Triple DC/DC Converter Cases

## 28 VOLT INPUT – 30 WATT

### BOTTOM VIEW CASE H2



**Case dimensions in inches (mm)**  
 Tolerance  $\pm 0.005$  (0.13) for three decimal places  
 $\pm 0.01$  (0.3) for two decimal places  
 unless otherwise specified

**CAUTION**  
 Heat from reflow or wave soldering may damage the device.  
 Solder pins individually with heat application not exceeding 300°C for 10 seconds per pin.

**Materials**  
 Header Cold Rolled Steel/Nickel/Gold  
 Cover Kovar/Nickel  
 Pins #52 alloy/Gold ceramic seal  
 Seal hole  $0.120 \pm 0.002$  ( $3.05 \pm 0.05$ )

Case H2 SMTR S/D, Rev H - 2011.03.14  
 Please refer to the numerical dimensions for accuracy.

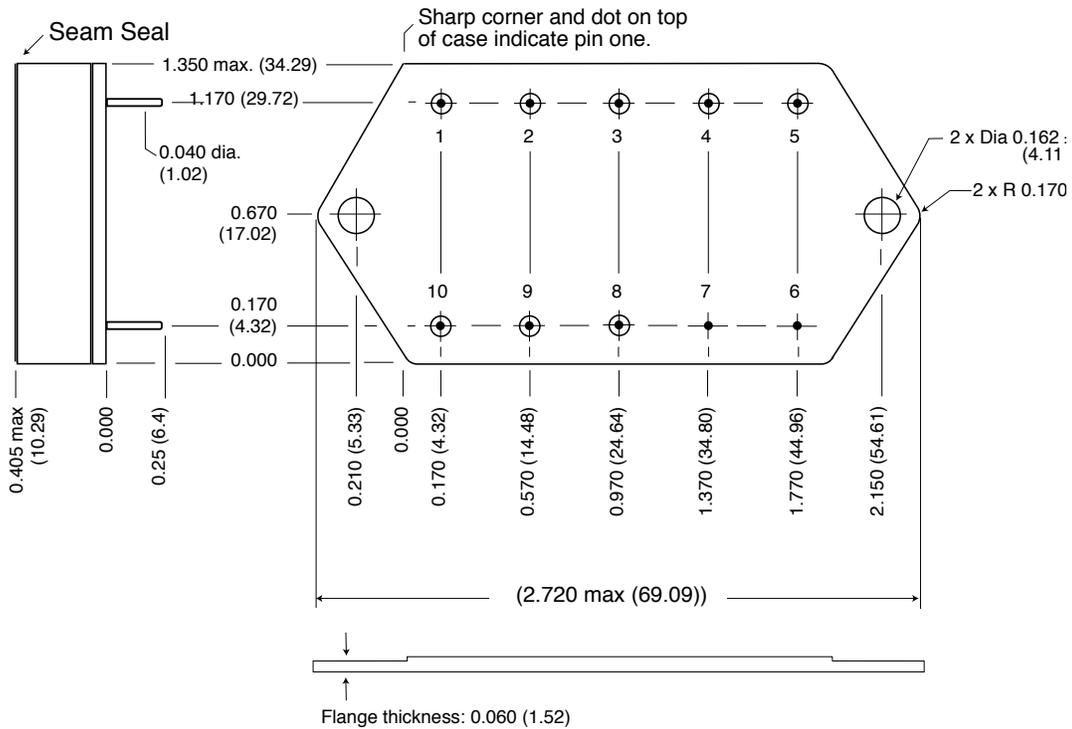
FIGURE 33: CASE H2 - SINGLE & DUAL OUTPUT MODELS

# SMTR Single, Dual and Triple DC/DC Converter Cases

## 28 VOLT INPUT – 30 WATT

### BOTTOM VIEW CASE J1

Flanged cases: Designator "F" required in Case Option position of model number.



**Case dimensions in inches (mm)**

Tolerance  $\pm 0.005$  (0.13) for three decimal places  
 $\pm 0.01$  (0.3) for two decimal places  
 unless otherwise specified

**CAUTION**

Heat from reflow or wave soldering may damage the device. Solder pins individually with heat application not exceeding 300°C for 10 seconds per pin.

**Materials**

Header Cold Rolled Steel/Nickel/Gold  
 Cover Kovar/Nickel  
 Pins #52 alloy/Gold ceramic seal.  
 Seal Hole: 0.120  $\pm$  0.002 (3.04  $\pm$  0.05)

Case J1 SMTR T F, Rev G, 20100419  
 Please refer to the numerical dimensions for accuracy.

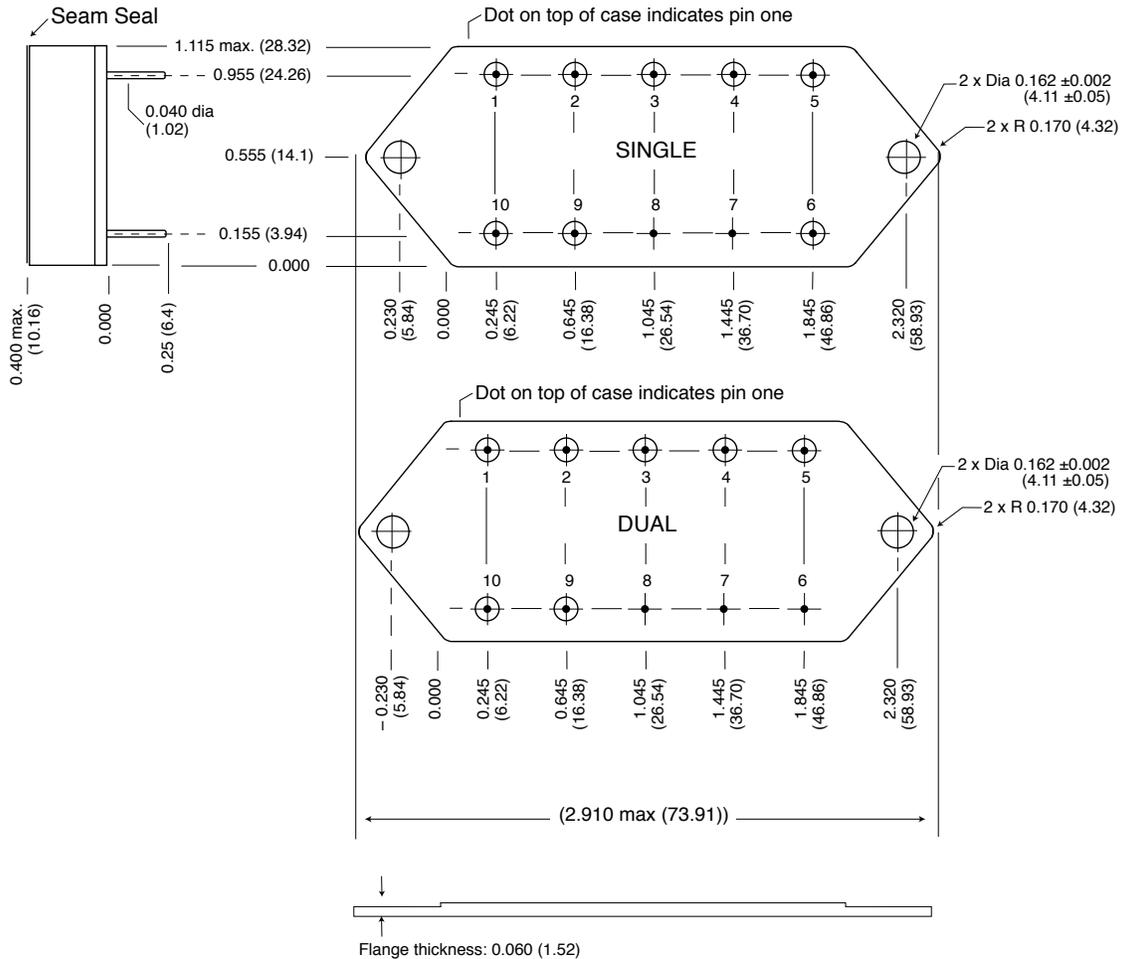
FIGURE 34: CASE J1 - TRIPLE OUTPUT MODELS

# SMTR Single, Dual and Triple DC/DC Converter Cases

## 28 VOLT INPUT – 30 WATT

### BOTTOM VIEW CASE K3

Flanged cases: Designator "F" required in Case Option position of model number.



#### Case dimensions in inches (mm)

Tolerance  $\pm 0.005$  (0.13) for three decimal places  
 $\pm 0.01$  (0.3) for two decimal places  
 unless otherwise specified

#### CAUTION

Heat from reflow or wave soldering may damage the device. Solder pins individually with heat application not exceeding 300°C for 10 seconds per pin.

#### Materials

Header Cold Rolled Steel/Nickel/Gold  
 Cover Kovar/Nickel  
 Pins #52 alloy/Gold, ceramic seal  
 Seal hole  $0.120 \pm 0.002$  ( $3.04 \pm 0.05$ )

Case K3 SMTR S/D F, Rev G, 2011.03.14  
 Please refer to the numerical dimensions for accuracy.

FIGURE 35: CASE K3 - SINGLE & DUAL OUTPUT MODELS

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

### CLASS H AND K, MIL-PRF-38534 ELEMENT EVALUATION

COMPONENT-LEVEL TEST PERFORMED	SPACE PROTOTYPE (O) <sup>1</sup> NON-QML	/H CLASS H QML		/K CLASS K QML	
	M/S <sup>2</sup>	M/S <sup>2</sup>	P <sup>3</sup>	M/S <sup>2</sup>	P <sup>3</sup>
Element Electrical	■	■	■	■	■
Visual		■	■	■	■
Internal Visual		■		■	
Temperature Cycling				■	■
Constant Acceleration				■	■
Interim Electrical				■	
Burn-in				■	
Post Burn-in Electrical				■	
Steady State Life				■	
Voltage Conditioning Aging					■
Visual Inspection					■
Final Electrical		■	■	■	■
Wire Bond Evaluation		■	■	■	■
SEM				■	
C-SAM: Input capacitors only Add'l test, not req. by H or K			■		■

Notes:

1. Non-QML products may not meet all of the requirements of MIL-PRF-38534.
2. M/S = Active components (Microcircuit and Semiconductor Die)
3. P = Passive components, Class H and K element evaluation. Not applicable to Space Prototype ("O") element evaluation.

Definitions:

Element Evaluation: Component testing/screening per MIL-STD-883 as determined by MIL-PRF-38534

SEM: Scanning Electron Microscopy

C-SAM: C - Mode Scanning Acoustic Microscopy

SCREENING TABLE 1: ELEMENT EVALUATION

# SMTR Single, Dual and Triple DC/DC Converters

## 28 VOLT INPUT – 30 WATT

# CLASS H AND K, MIL-PRF-38534 ENVIRONMENTAL SCREENING AND RHA<sup>1</sup>

TEST PERFORMED	NON-QML <sup>2</sup>		QML <sup>3</sup>		
	/OO	CLASS H		CLASS K	
		/HP	/HR	/KP	/KR
Non-destruct bond pull, Method 2023		■ <sup>4</sup>	■ <sup>4</sup>	■	■
Pre-cap Inspection, Method 2017, 2032	■	■	■	■	■
Temperature Cycle (10 times) Method 1010, Cond. C, -65°C to +150°C, ambient	■	■	■	■	■
Constant Acceleration Method 2001, 3000 g (Qual 5000 g)	■	■	■	■	■
PIND, Test Method 2020, Cond. A		■ <sup>4</sup>	■ <sup>4</sup>	■	■
Pre burn-in test, Group A, Subgroups 1 and 4	■	■ <sup>4</sup>	■ <sup>4</sup>	■	■
Burn-in Method 1015, +125°C case, typical <sup>5</sup>					
96 hours	■				
160 hours		■	■		
2 x 160 hours (includes mid-BI test)				■	■
Final Electrical Test, MIL-PRF-38534, Group A, Subgroups 1 and 4: +25°C case	■				
Subgroups 1 through 6, -55°C, +25°C, +125°C case		■	■	■	■
Hermeticity Test					
Gross Leak, Method 1014	■	■	■	■	■
Fine Leak, Method 1014	■	■	■	■	■
Radiography, Method 2012				■	■
Post Radiography Electrical Test, +25°C case				■ <sup>4</sup>	■ <sup>4</sup>
Final visual inspection, Method 2009	■	■	■	■	■
RHA P: 30 kRad(Si) total dose <sup>6</sup>		■		■	
RHA R: 100 kRad(Si) total dose <sup>6</sup>			■		■
SEE LET 40 MeV-cm <sup>2</sup> /mg <sup>7</sup>		■	■	■	■

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

- Notes:
1. Redmond site, Interpoint brand, has a DSCC approved Radiation Hardness Assurance plan. Our SMD products with RHA "P" or "R" code met DSCC requirements.
  2. Space Prototypes are non-QML products and may not meet all of the requirements of MIL-PRF-38534. "O" in the RHA designator position in Interpoint model numbers indicates DSCC RHA "-" defined as no RHA.
  3. All processes are QML qualified and performed by certified operators.
  4. Not required by DSCC but performed to assure product quality.
  5. Burn-in temperature designed to bring the case temperature to +125°C minimum.
  6. Includes low dose rate to the rated total dose (TID)
  7. No upset at the pins.

SCREENING TABLE 2: ENVIRONMENTAL SCREENING AND RHA