

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
3.3	±5	+5 & ±12
5	±12	+5 & ±15
12	±15	
15		

DESCRIPTION

The Interpoint™ 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 “Table 11: Element Evaluation” on page 19 and “Table 12: Environmental Screening and RHA Levels” on page 20 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 triple output 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 helps 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 140% of the maximum rated output current.

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28 VOLT INPUT – 30 WATT

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. Refer to the low line dropout graphs ("Figure 23" on page 13, "Figure 31" on page 14 and "Figure 32" on page 14) for details.

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%.

INHIBIT FUNCTION

SMTR converters provide an inhibit terminal that can be used to disable internal switching, resulting in no output voltage and very low quiescent input current. The converter is inhibited when the inhibit pin is pulled below 0.8 V and enabled when its inhibit pin is left floating. An external inhibit interface should be capable of pulling the converter's inhibit pin below 0.8 V while sinking the maximum inhibit current and also allowing the inhibit pin to float high to enable the converter. A voltage should not be applied to the inhibit pin. The open circuit voltage present on the inhibit pin is 9 to 11 V.

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

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

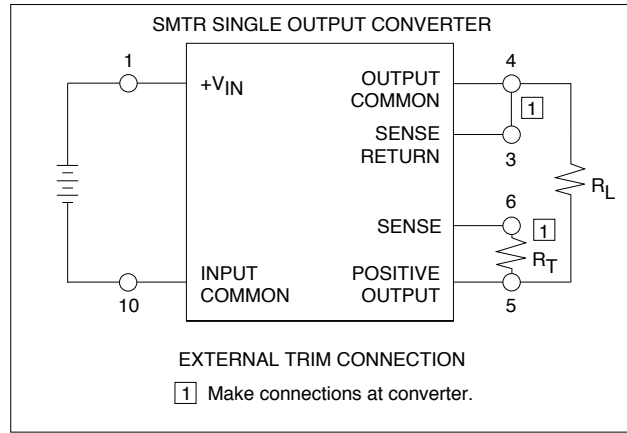


FIGURE 1: TRIM CONNECTION 1, 2, 3

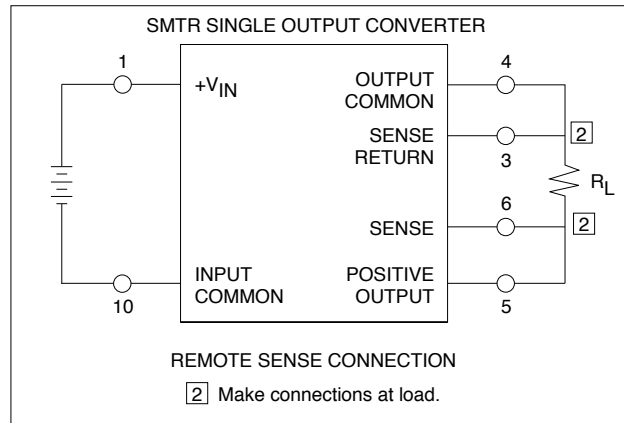


FIGURE 2: REMOTE SENSE 2, 3

Trim Formulas V_{out} = desired output voltage;
 R_T = trim resistor

$$\begin{aligned} 3.3V: \quad R_T &= \frac{1300 * V_{out} - 4304}{1.2475} \\ 5V: \quad R_T &= \frac{1300 * V_{out} - 6512}{1.2475} \\ 12V: \quad R_T &= \frac{1300 * V_{out} - 15631}{1.2475} \\ 15V: \quad R_T &= \frac{1300 * V_{out} - 19498}{1.2475} \end{aligned}$$

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

SMTR Single, Dual and Triple DC-DC Converters

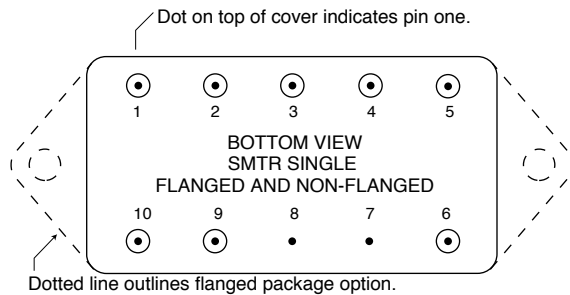
28 VOLT INPUT – 30 WATT

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

TABLE 1: PIN OUT

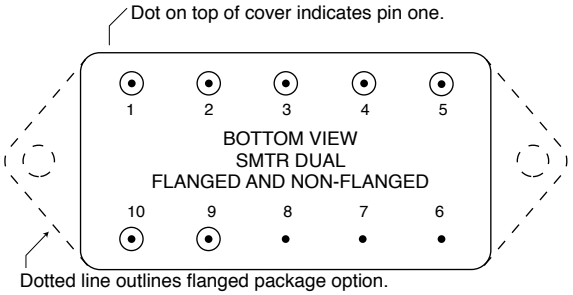
PINS NOT IN USE	
Inhibit	Leave unconnected
Sync In	Connect to Input Common
Sense Lines	Must be connected to appropriate outputs

TABLE 2: PINS NOT IN USE



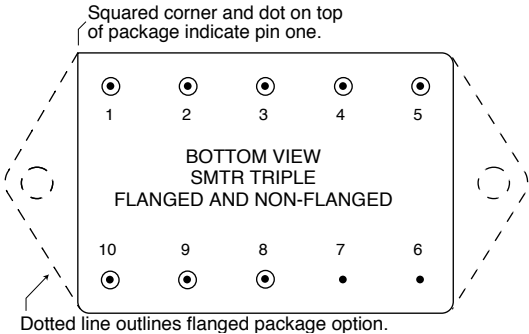
For dimensions see "Figure 34: Cases H2" on page 16 and "Figure 36: Cases K3" on page 18.

FIGURE 3: PIN OUT SMTR SINGLE OUTPUT MODELS



For dimensions see "Figure 34: Cases H2" on page 16 and "Figure 36: Cases K3" on page 18.

FIGURE 4: PIN OUT SMTR DUAL OUTPUT MODELS



For dimensions see "Figure 33: Case F1" on page 15 and "Figure 35: Case J1" on page 17.

FIGURE 5: PIN OUT SMTR TRIPLE

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

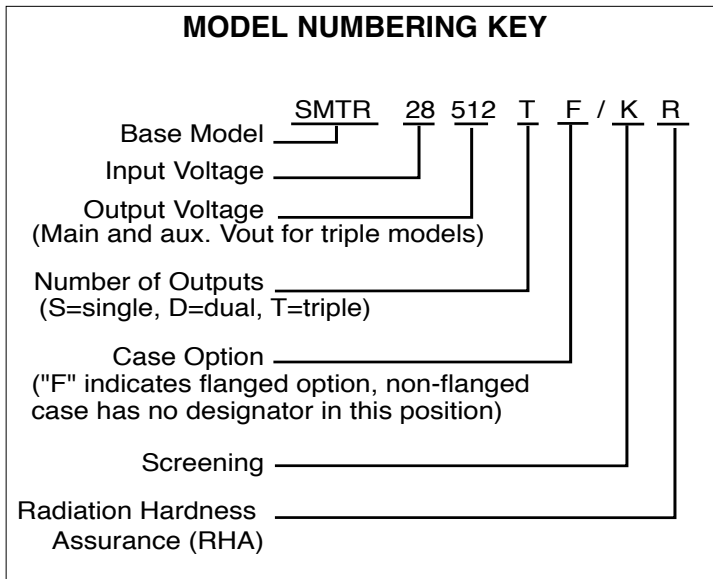


FIGURE 6: MODEL NUMBERING KEY

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/smcr>

TABLE 3: SMD NUMBERS

MODEL NUMBER OPTIONS TO DETERMINE THE MODEL NUMBER ENTER ONE OPTION FROM EACH CATEGORY IN THE FORM BELOW.						
CATEGORY	Base Model and Input Voltage	Output Voltage ¹	Number of Outputs ²	Case Options ³	Screening ⁴	RHA ⁵
OPTIONS	SMTR	3R3, 05, 12, 15	S	(non-flanged, leave blank)	O	O
		05, 12, 15	D	F (flanged)	H	P
		512, 515	T		K	R
FILL IN FOR MODEL #	SMTR				/	

Notes:

- Output Voltage: An R indicates a decimal point. 3R3 is 3.3 volts out. The 3R3 is 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 "Figure 33: Case F1" on page 15 and "Figure 34: Cases H2" on page 16) leave the case option blank. For the flanged case option (cases "Figure 35: Case J1" on page 17 and "Figure 36: Cases K3" on page 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 "Table 11: Element Evaluation" on page 19 and "Table 12: Environmental Screening and RHA Levels" on page 20 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 "Table 12: Environmental Screening and RHA Levels" on page 20 for more information.

TABLE 4: MODEL NUMBER OPTIONS

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

TABLE 5: OPERATING CONDITIONS - ALL MODELS - TESTED/ANALYZED AT 28 V_{IN}, RHA "O", UNLESS OTHERWISE SPECIFIED.

		ALL MODELS			
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
LEAD SOLDERING TEMPERATURE ¹	10 seconds max.	—	—	300	°C
STORAGE TEMPERATURE ¹		-65	—	+150	°C
CASE OPERATING TEMPERATURE	FULL POWER	-55	—	+125	°C
	ABSOLUTE ¹	-55	—	+135	
DERATING OUTPUT POWER/CURRENT ¹	LINEARLY	From 100% at 125°C to 0% at 135°C			
ESD RATING ¹ MIL-PRF-38534, 3.9.5.8.2	SINGLES AND DUALS CLASS 2	2000 - 3999			V
MIL-STD-883, METHOD 3015	TRIPLES CLASS 1	0 - 1999			
ISOLATION, ANY PIN TO CASE EXCEPT CASE PIN	@ 500 VDC AT 25°C	100	—	—	Megohms
CURRENT LIMIT ^{1, 2}	% OF FULL LOAD	—	140	—	%
AUDIO REJECTION ¹	SINGLES AND DUALS	—	40	—	dB
	TRIPLES	—	50	—	
CONVERSION FREQUENCY	FREE RUN -55° TO +125°C	550	600	650	kHz
SYNCHRONIZATION Sync is floating and isolated	INPUT FREQUENCY	500	—	675	kHz
	DUTY CYCLE ¹	40	—	60	%
	ACTIVE LOW	—	—	0.8	VDC
	ACTIVE HIGH ¹	4.5	—	5	
	REFERENCED TO	INPUT COMMON			
	IF NOT USED	CONNECT TO INPUT COMMON			
	INHIBIT ACTIVE LOW (OUTPUT DISABLED) Do not apply a voltage to the inhibit pin. ³	INHIBIT PIN PULLED LOW	—	—	0.8
INHIBIT PIN SOURCE CURRENT ¹		—	—	8	mA
REFERENCED TO		INPUT COMMON			
INHIBIT ACTIVE HIGH (OUTPUT ENABLED) Do not apply a voltage to the inhibit pin. ³	INHIBIT PIN CONDITION	OPEN COLLECTOR OR UNCONNECTED			
	OPEN PIN VOLTAGE ¹	9	—	11	V
RADIATION, RHA R Converter will operate through:	100 krad(Si) total ionizing dose (TID), >250-500 krad(Si)/sec dose rate				
	100 krad(Si) TID, <30 mrad(Si)/sec dose rate (LDRS)				
	SEE - LET to 40 MeV cm ² /mg				

Notes:

1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. Dual outputs: The over-current limit will trigger when the sum of the currents from both outputs reaches 140% (typical value) of the maximum rated "total" current of both outputs.
3. An external inhibit interface should be used to pull the inhibit low or leave it floating. The inhibit pin can be left unconnected if not used.

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

TABLE 6: ELECTRICAL CHARACTERISTICS: -55°C TO +125°C CASE, 28 VDC VIN, 100% LOAD, FREE RUN, RHA "O", UNLESS OTHERWISE SPECIFIED.

SINGLE OUTPUT MODELS		SMTR283R3S			SMTR2805S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		3.201	3.3	3.399	4.85	5.00	5.15	VDC
OUTPUT CURRENT	V _{IN} = 16 TO 40 VDC	0	—	5.45	0	—	5.0	A
OUTPUT POWER	V _{IN} = 16 TO 40 VDC	—	—	18	0	—	25	W
OUTPUT RIPPLE 10 kHz - 2 MHz	T _C = 25°C	—	20	40	—	20	50	mV p-p
	T _C = -55°C TO +125°C	—	—	50	—	—	90	
LINE REGULATION ²	V _{IN} = 16 TO 40 VDC	—	0	20	—	10	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	2	20	—	10	50	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	16	28	40	VDC
NO LOAD TO FULL	TRANSIENT 50 ms ¹	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	30	75	—	35	75	mA
	INHIBITED	—	—	8	—	—	8	
INPUT RIPPLE CURRENT ³	10 kHz - 10 MHz	—	25	50	—	25	50	mA p-p
EFFICIENCY	T _C = 25°C	70	73	—	74	78	—	%
	T _C = -55°C TO +125°C	66	—	—	71	—	—	
LOAD FAULT ⁴	POWER DISSIPATION	—	—	12	—	—	14	W
SHORT CIRCUIT	RECOVERY ¹	—	—	6	—	—	5	ms
STEP LOAD RESPONSE 0% - 100% - 50%	TRANSIENT	—	±130	±300	—	±180	±300	mV pk
	RECOVERY ⁵	—	—	200	—	—	200	μs
STEP LINE RESPONSE ¹ V _{IN} 16 - 40 - 16 VDC	TRANSIENT	—	—	±300	—	—	±300	mV pk
	RECOVERY ⁵	—	—	300	—	—	300	μs
START-UP ⁶	DELAY	—	—	5	—	—	5	ms
FULL LOAD	OVERSHOOT ¹	—	0	50	—	0	50	mV pk
CAPACITIVE LOAD ¹ T _C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	3000	—	—	3000	μF

Notes:

1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. Operation is limited below 16 V (see "Figure 23" on page 13).
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_{OUT} 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

TABLE 7: ELECTRICAL CHARACTERISTICS: -55°C TO +125°C CASE, 28 VDC VIN, 100% LOAD, FREE RUN, RHA "O", UNLESS OTHERWISE SPECIFIED.

SINGLE OUTPUT MODELS		SMTR2812S			SMTR2815S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		11.64	12.00	12.36	14.70	15.00	15.30	VDC
OUTPUT CURRENT	V _{IN} = 16 to 40 VDC	0	—	2.5	0	—	2.0	A
OUTPUT POWER	V _{IN} = 16 to 40 VDC	0	—	30	0	—	30	W
OUTPUT RIPPLE 10 kHz - 2 MHz	T _C = 25°C	—	15	40	—	15	40	mV p-p
	T _C = -55°C TO +125°C	—	—	90	—	—	90	
LINE REGULATION ²	V _{IN} = 16 TO 40 VDC	—	10	50	—	10	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	20	50	—	10	50	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	16	28	40	VDC
NO LOAD TO FULL	TRANSIENT 50 ms ¹	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	35	75	—	35	75	mA
	INHIBITED	—	—	8	—	—	8	
INPUT RIPPLE CURRENT ³	10 kHz - 10 MHz	—	35	50	—	35	50	mA p-p
EFFICIENCY	T _C = 25°C	78	83	—	79	83	—	%
	T _C = -55°C TO +125°C	75	—	—	76	—	—	
LOAD FAULT ⁴	POWER DISSIPATION	—	—	12	—	—	12	W
SHORT CIRCUIT	RECOVERY ¹	—	—	5	—	—	5	ms
STEP LOAD RESPONSE 50% - 100% - 50%	TRANSIENT	—	±270	±400	—	±310	±500	mV pk
	RECOVERY ⁵	—	—	200	—	—	300	μs
STEP LINE RESPONSE ¹ 16 - 40 - 16 VDC	TRANSIENT	—	—	±500	—	—	±600	mV pk
	RECOVERY ⁵	—	—	300	—	—	300	μs
START-UP ⁶	DELAY	—	—	5	—	—	5	m sec
FULL LOAD	OVERSHOOT ¹	—	0	120	—	0	150	mV pk
CAPACITIVE LOAD ¹ T _C = 25°C	NO EFFECT ON DC	—	—	3000	—	—	3000	μF
	PERFORMANCE	—	—	3000	—	—	3000	

Notes:

1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. Operation is limited below 16 V (see "Figure 23" on page 13).
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_{OUT} 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

TABLE 8: ELECTRICAL CHARACTERISTICS: -55°C TO +125°C CASE, 28 VDC VIN, 100% LOAD, FREE RUN, RHA "O", UNLESS OTHERWISE SPECIFIED.

DUAL OUTPUT MODELS		SMTR2805D			SMTR2812D			SMTR2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V _{OUT}	4.85	5.00	5.15	11.64	12.00	12.36	14.55	15.00	15.45	VDC
	- V _{OUT}	4.82	5.00	5.18	11.58	12.00	12.42	14.47	15.00	15.53	
OUTPUT CURRENT ^{2, 3} V _{IN} = 16 TO 40 VDC	EITHER OUTPUT	0	2.5	4.5 ¹	0	1.25	2.25 ¹	0	1.00	1.80 ¹	A
	TOTAL OUTPUT	—	—	5	—	—	2.5	—	—	2.00	
OUTPUT POWER ^{2, 3} V _{IN} = 16 TO 40 VDC	EITHER OUTPUT	0	12.5	22.5 ¹	0	15	27 ¹	0	15	27 ¹	W
	TOTAL OUTPUT	—	—	25	—	—	30	—	—	30	
OUTPUT RIPPLE 10 kHz - 2 MHz ± V _{OUT}	T _C = 25°C	—	20	50	—	30	120	—	25	80	mV p-p
	T _C = -55°C TO +125°C	—	—	90	—	—	150	—	—	120	
LINE REGULATION ⁴ V _{IN} = 16 TO 40 VDC	+ V _{OUT}	—	0	50	—	0	50	—	0	50	mV
	- V _{OUT}	—	10	100	—	15	150	—	10	180	
LOAD REGULATION NO LOAD TO FULL	+ V _{OUT}	—	5	50	—	5	50	—	—	50	mV
	- V _{OUT}	—	15	100	—	30	150	—	—	180	
CROSS REGULATION	SEE NOTE 5	—	—	12	—	—	8.3	—	—	8	%
EFFECT ON -V _{OUT} , 25°C	SEE NOTE 6	—	—	12	—	—	8.3	—	—	8	
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	16	28	40	16	28	40	16	28	40	VDC
	TRANSIENT 50 ms ¹	0	—	50	0	—	50	0	—	50	V
INPUT CURRENT	NO LOAD	—	28	75	—	40	75	—	48	75	mA
	INHIBITED	—	—	8	—	—	8	—	—	8	
INPUT RIPPLE CURRENT ⁷	10 kHz - 10 MHz	—	25	50	—	35	50	—	35	50	mA p-p
EFFICIENCY BALANCED LOAD	T _C = 25°C	74	76	—	77	80	—	78	81	—	%
	T _C = -55°C TO +125°C	72	—	—	75	—	—	75	—	—	
LOAD FAULT ⁸	POWER DISSIPATION	—	8	12	—	6	12	—	5	12	W
SHORT CIRCUIT	RECOVERY ¹	—	—	5.0	—	—	5.0	—	—	5.0	ms
STEP LOAD RESPONSE 50% - 100% - 50% ± V _{OUT}	TRANSIENT	—	±150	±300	—	±200	±300	—	±220	±400	mV pk
	RECOVERY ⁹	—	—	200	—	—	200	—	—	200	μs
STEP LINE RESPONSE ¹ 16 - 40 - 16 VDC ± V _{OUT}	TRANSIENT	—	—	±400	—	—	±400	—	—	±500	mV pk
	RECOVERY ⁹	—	—	300	—	—	300	—	—	300	μs
START-UP ¹⁰	DELAY	—	—	5	—	—	5	—	—	5	ms
FULL LOAD	OVERSHOOT ¹	—	0	180	—	0	150	—	0	150	mV pk
CAPACITIVE LOAD ¹ T _C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	3000	—	—	3000	—	—	3000	μF

Notes:

- Guaranteed by qualification test and/or analysis. Not an in-line test.
- The specified max current is available from either output.
- 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.
- Operation is limited below 16 V (see "Figure 23" on page 13).
- Effect on the negative output under the following conditions:
+P_{OUT} 20% to 80%; -P_{OUT} 80% to 20%.

- Effect on the negative output under the following conditions:
+P_{OUT} 50%; -P_{OUT} 10% to 50%. See "Figure 22" on page 13.
- Tested with 6800 pF ceramic bypass capacitor connected externally from input common to case.
- Indefinite short circuit protection not guaranteed above 125°C case temperature.
- Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of final value.
- Tested on release from inhibit.

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

TABLE 9: ELECTRICAL CHARACTERISTICS: -55°C TO +125°C CASE, 28 VDC VIN, 100% LOAD, FREE RUN, RHA "O", UNLESS OTHERWISE SPECIFIED.

TRIPLE OUTPUT MODEL – SMTR28512T		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 ²		0.3	—	4.0	0	±0.416	0.625 ¹	A
V _{in} = 16 to 40 VDC	MAX. TOTAL AUX	—	—	—	—	—	0.834	
OUTPUT POWER ²		0	—	20	0	±5	7.5 ¹	W
V _{in} = 16 to 40 VDC	MAX. TOTAL AUX	—	—	—	—	—	10	
OUTPUT RIPPLE	T _C = 25°C	—	—	125	—	—	120	mV p-p
10 kHz - 2 MHz	T _C = -55°C TO +125°C	—	—	180	—	—	120	
LINE REGULATION	V _{in} = 16 to 40 VDC	—	10	20	—	25	75	mV
LOAD REGULATION ^{3, 4}		—	30	50	—	30	75	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	—	—	—	VDC
	TRANSIENT 50 ms ¹	—	—	50	—	—	—	V
INPUT CURRENT	NO LOAD	—	40	110	—	—	—	mA
	INHIBITED	—	4	8	—	—	—	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	45	80	—	—	—	mA p-p
EFFICIENCY	T _C = 25°C	72	73	—	—	—	—	%
	T _C = -55°C TO +125°C	70	—	—	—	—	—	
LOAD FAULT ⁵	POWER DISSIPATION	—	—	14	—	—	—	W
ALL OUTPUTS SHORTED	RECOVERY ¹	—	—	6.0	—	—	6.0	ms
STEP LOAD RESPONSE	TRANSIENT ⁶	—	±150	±400	—	±500	±1500	mV pk
	RECOVERY ⁷	—	0.05	0.30	—	3	6	ms
STEP LINE RESPONSE ¹	TRANSIENT	—	—	±800	—	—	±800	mV pk
16 - 40 - 16 V _{IN}	RECOVERY ⁷	—	—	5	—	—	5	ms
START-UP ⁸	DELAY	—	—	6.0	—	—	6.0	ms
	OVERSHOOT ¹	—	—	500	—	—	2000	mV pk

Notes:

- Guaranteed by qualification test and/or analysis. Not an in-line test.
- 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).

- 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 V_{OUT} is within 1% of regulation.
- Tested on release from inhibit.

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

TABLE 10: ELECTRICAL CHARACTERISTICS: -55°C TO +125°C CASE, 28 VDC V_{IN} , 100% LOAD, FREE RUN, RHA "O", UNLESS OTHERWISE SPECIFIED.

TRIPLE OUTPUT MODEL – SMTR28515T		5 (MAIN)			±15 (AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		4.85	5.00	5.15	±14.77	15.00	±15.23	VDC
OUTPUT CURRENT ²		0.3	—	4.0	0	±0.333	0.50 ¹	A
$V_{in} = 16$ to 40 VDC	TOTAL	—	—	—	—	—	0.666	
OUTPUT POWER ²		0	—	20	0	±5	7.5 ¹	W
$V_{in} = 16$ to 40 VDC	TOTAL	—	—	—	—	—	10	
OUTPUT RIPPLE	$T_C = 25^\circ\text{C}$	—	—	125	—	—	120	mV p-p
10 kHz - 2 MHz	$T_C = -55^\circ\text{C}$ TO $+125^\circ\text{C}$	—	—	180	—	—	120	
LINE REGULATION	$V_{in} = 16$ to 40 VDC	—	10	20	—	30	75	mV
LOAD REGULATION ^{3, 4}		—	30	50	—	30	75	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	—	—	—	VDC
	TRANSIENT 50 ms ¹	—	—	50	—	—	—	V
INPUT CURRENT	NO LOAD	—	50	110	—	—	—	mA
	INHIBITED	—	4	6	—	—	—	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	40	80	—	—	—	mA p-p
EFFICIENCY	$T_C = 25^\circ\text{C}$	72	73	—	—	—	—	%
	$T_C = -55^\circ\text{C}$ TO $+125^\circ\text{C}$	70	—	—	—	—	—	
LOAD FAULT ⁵	POWER DISSIPATION	—	—	14	—	—	—	W
ALL OUTPUTS SHORTED	RECOVERY ¹	—	—	6.0	—	—	—	ms
STEP LOAD RESPONSE	TRANSIENT ⁶	—	±150	±400	—	±500	±1500	mV pk
	RECOVERY ⁷	—	0.05	0.30	—	2	6	ms
STEP LINE RESPONSE ¹	TRANSIENT	—	—	±800	—	—	±800	mV pk
16 - 40 - 16 V_{IN}	RECOVERY ⁷	—	—	5	—	—	5	ms
START-UP ⁸	DELAY	—	—	6.0	—	—	6.0	ms
	OVERSHOOT ¹	—	—	500	—	—	2000	mV pk

Notes:

1. Guaranteed by qualification test and/or analysis. Not an in-line test.
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_{OUT} is within 1% of regulation.
8. Tested on release from inhibit.

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

TYPICAL PERFORMANCE PLOTS:

28 V_{IN}, 25°C T_C, 100% LOAD, RHA "0", FREE RUN, UNLESS OTHERWISE SPECIFIED.

These are examples for reference only and are not guaranteed specifications.

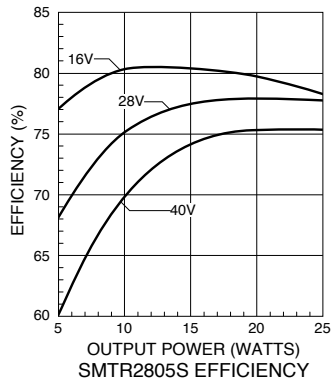


FIGURE 7

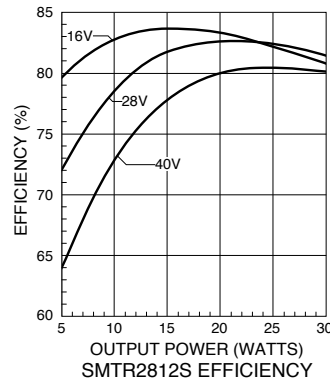


FIGURE 8

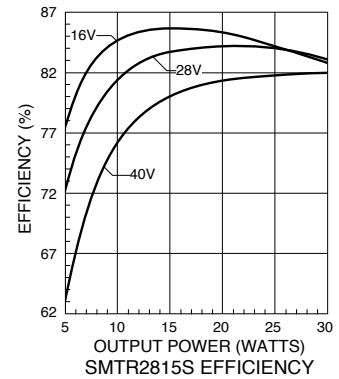


FIGURE 9

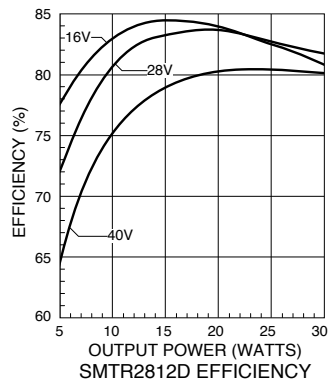


FIGURE 10

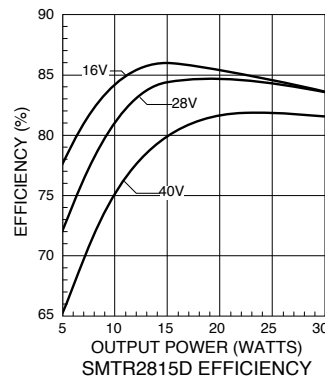


FIGURE 11

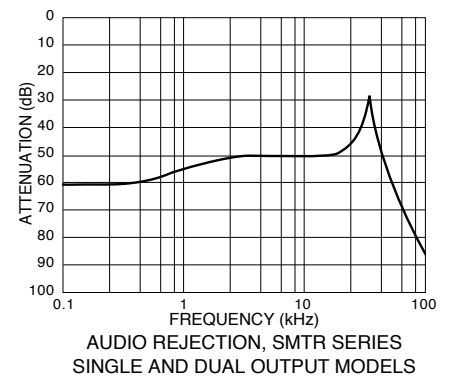


FIGURE 12

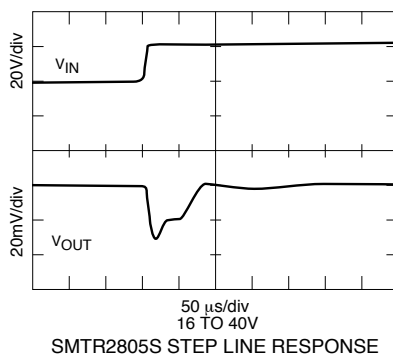


FIGURE 13

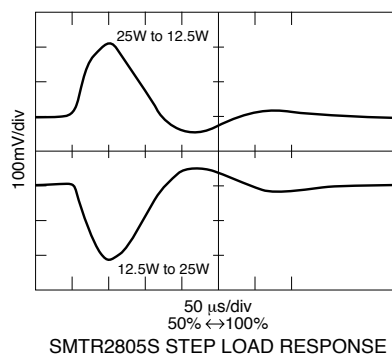


FIGURE 14

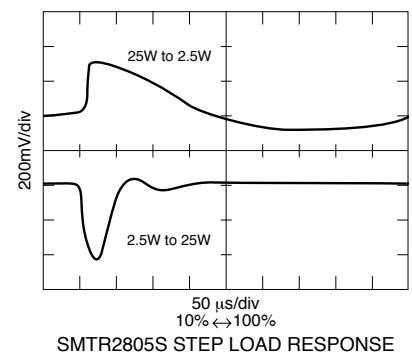


FIGURE 15

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

TYPICAL PERFORMANCE PLOTS:

28 V_{IN}, 25°C T_C, 100% LOAD, RHA "0", FREE RUN, UNLESS OTHERWISE SPECIFIED.

These are examples for reference only and are not guaranteed specifications.

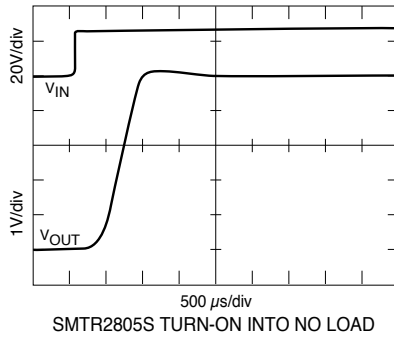


FIGURE 16

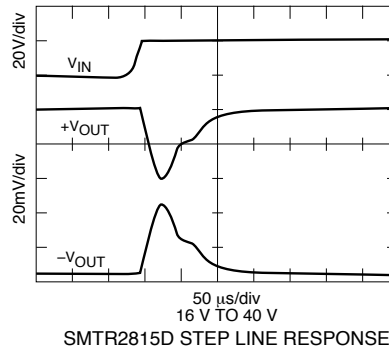


FIGURE 17

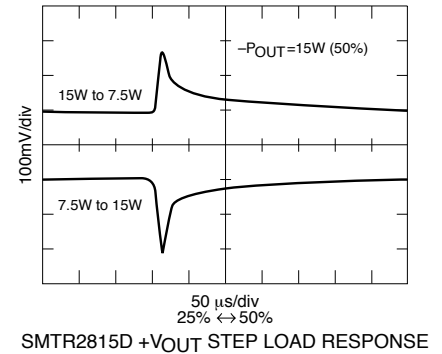
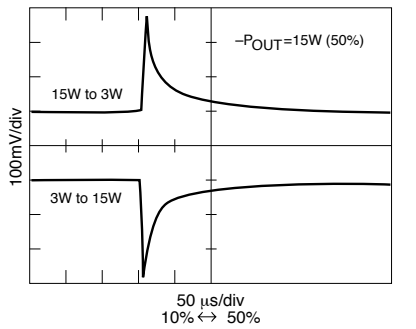
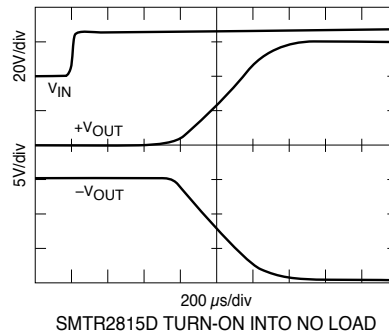
FIGURE 18¹FIGURE 19¹

FIGURE 20

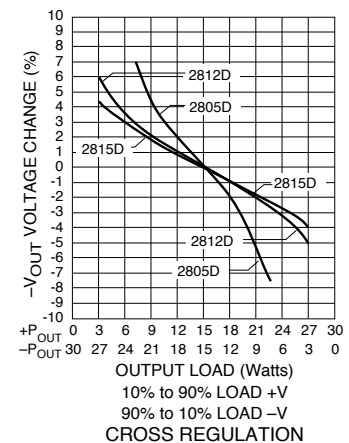
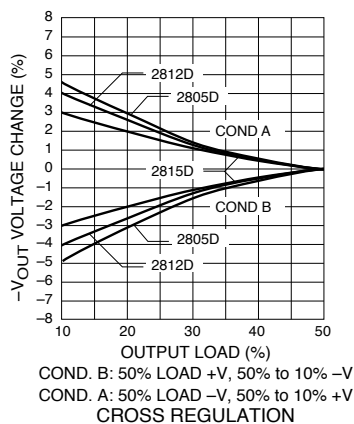
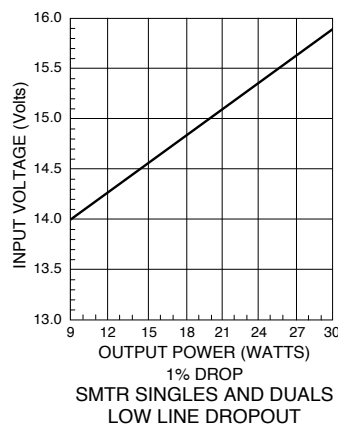
FIGURE 21¹FIGURE 22¹

FIGURE 23

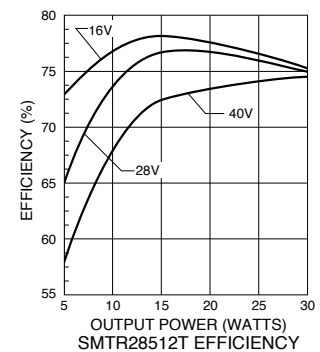


FIGURE 24

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 PLOTS:

28 V_{IN}, 25°C T_C, 100% LOAD, RHA "0", FREE RUN, UNLESS OTHERWISE SPECIFIED.

These are examples for reference only and are not guaranteed specifications.

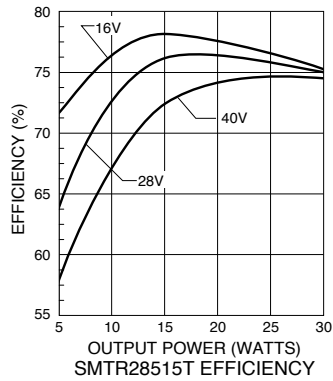


FIGURE 25

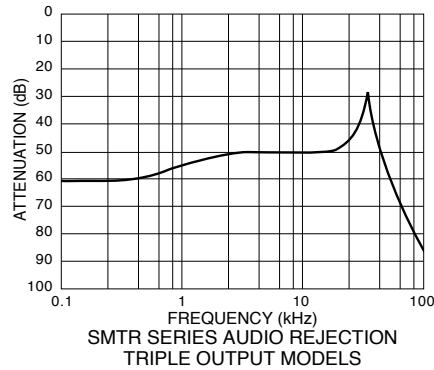


FIGURE 26

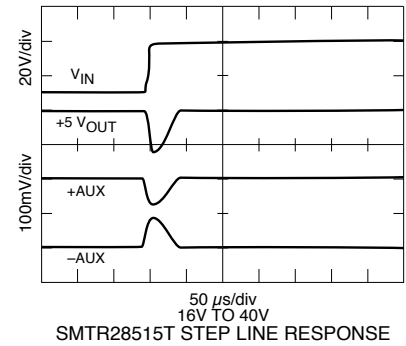


FIGURE 27

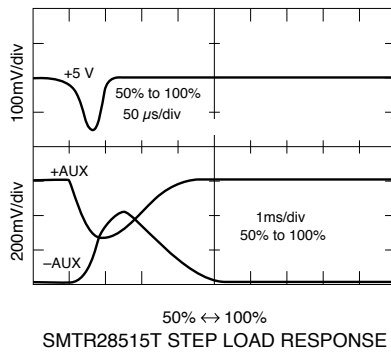


FIGURE 28

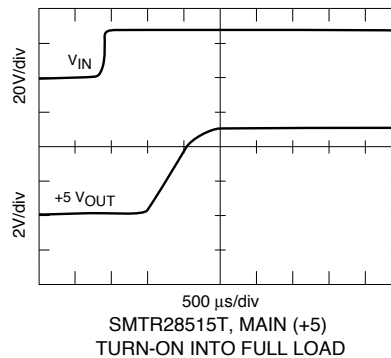


FIGURE 29

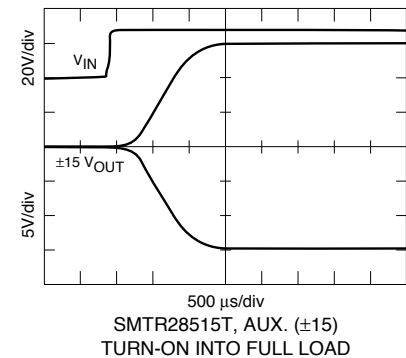


FIGURE 30

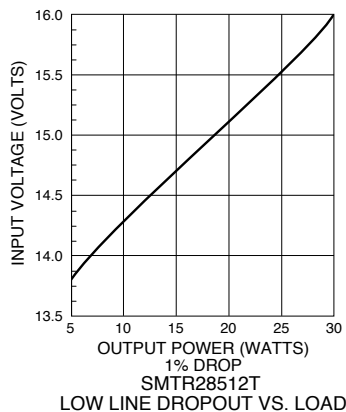


FIGURE 31

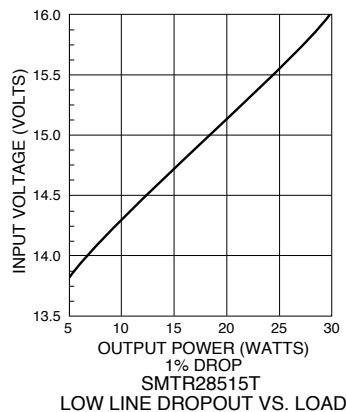
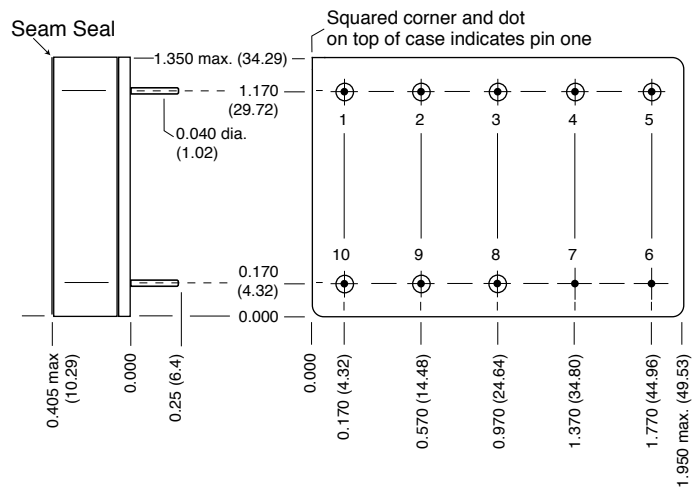


FIGURE 32

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE F1



Weight 58 grams max.

Case dimensions in inches (mm)

Tolerance ± 0.005 (0.13) for three decimal places
 ± 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
 Gold plating of 50 - 150 microinches is included in pin diameter
 Seal hole 0.120 ± 0.002 (3.05 ± 0.05)

Case F1 SMTR T, Rev G, 2013.04.18
 Please refer to the numerical dimensions for accuracy.

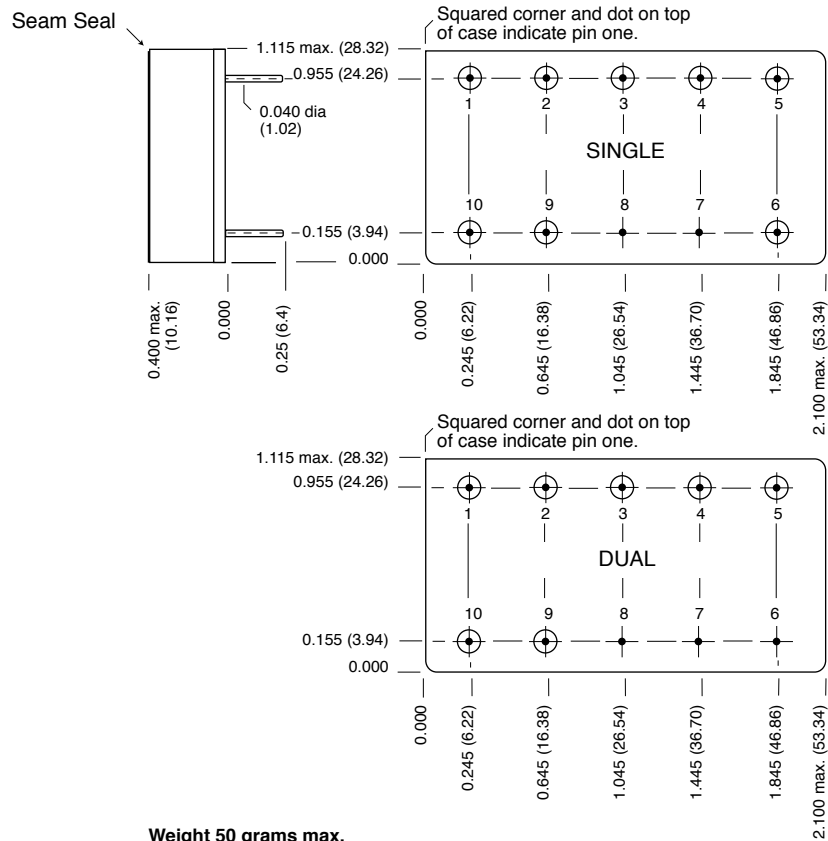
FIGURE 33: CASE F1

TRIPLE OUTPUT MODELS

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE H2



Weight 50 grams max.

Case dimensions in inches (mm)

Tolerance ± 0.005 (0.13) for three decimal places
 ± 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
 Gold plating of 50 - 150 microinches is included in pin diameter
 Seal hole 0.120 ± 0.002 (3.05 ± 0.05)

Case H2 SMTR S/D, Rev J, 2013.04.18
 Please refer to the numerical dimensions for accuracy.

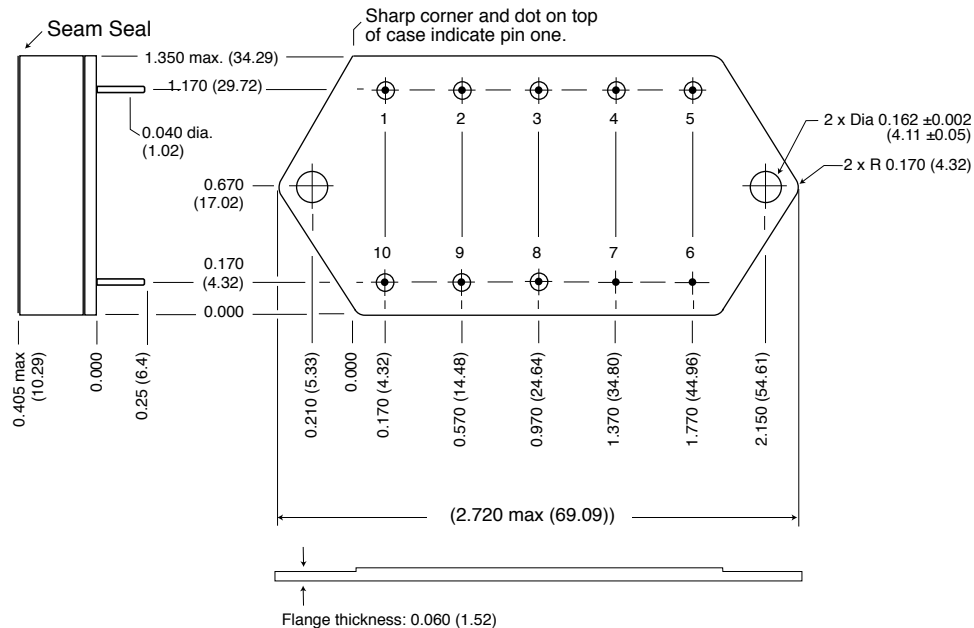
Figure 34: Cases H2
 SINGLE AND DUAL OUTPUT MODELS

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE J1

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



Weight 62 grams max.

Case dimensions in inches (mm)

Tolerance ± 0.005 (0.13) for three decimal places
 ± 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.
 Gold plating of 50 - 150 microinches is included in pin diameter
 Seal hole 0.120 ±0.002 (3.05 ±0.05)

Case J1 SMTR T F, Rev J, 2013.04.18

Please refer to the numerical dimensions for accuracy.

FIGURE 35: CASE J1

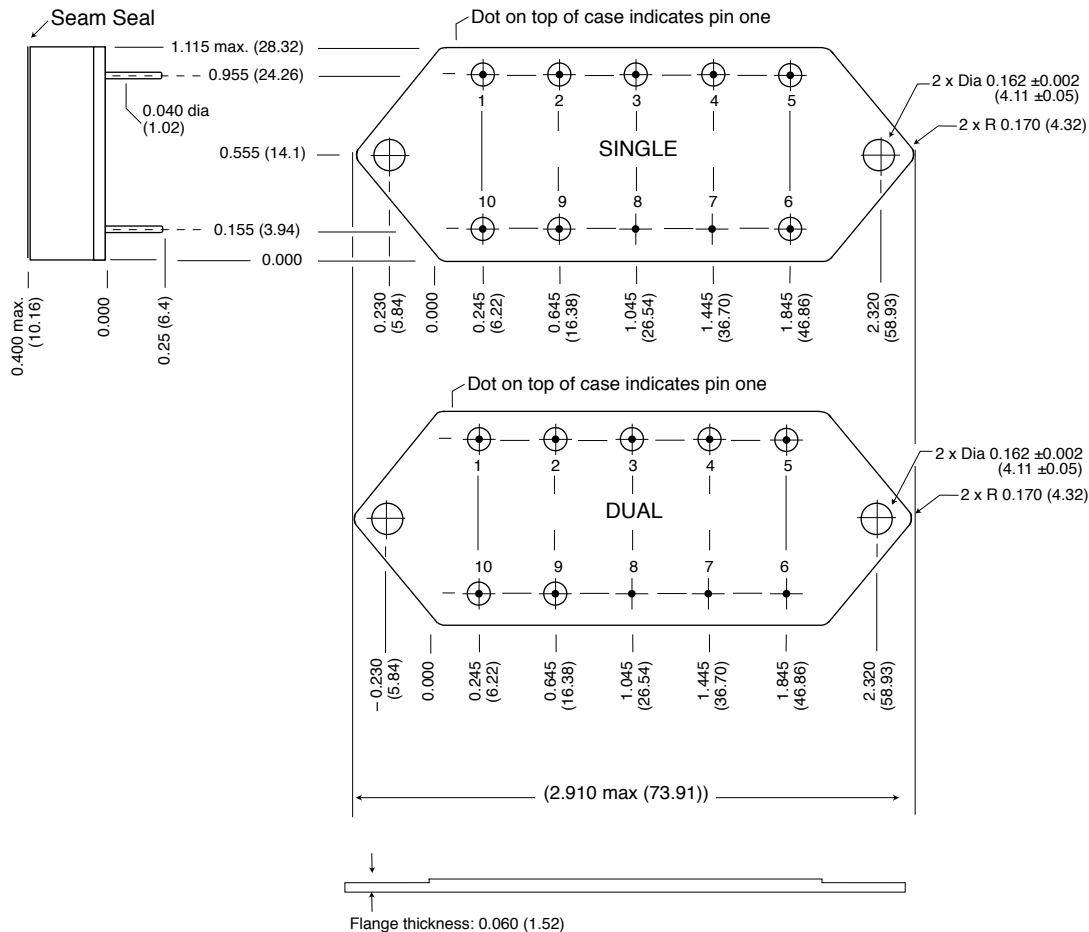
TRIPLE OUTPUT MODELS

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE K3

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



Weight 52 grams max.

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
 Gold plating of 50 - 150 microinches is included in pin diameter
 Seal hole 0.120 $\pm$ 0.002 (3.05 $\pm$ 0.05)

Case K3 SMTR S/D F, Rev H, 2013.04.18
 Please refer to the numerical dimensions for accuracy.

FIGURE 36: CASES K3
 SINGLE AND DUAL OUTPUT MODELS

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

DC-DC CONVERTERS PROTOTYPE, CLASS H AND CLASS K, MIL-PRF-38534 ELEMENT EVALUATION

COMPONENT-LEVEL TEST PERFORMED	NON-QML ¹	QML			
	PROTOTYPE	CLASS H		CLASS K	
	/O	/H		/K	
	M/S ²	M/S ²	P ³	M/S ²	P ³
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				■	

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

TABLE 11: ELEMENT EVALUATION

SMTR Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 30 WATT

DC-DC CONVERTERS PROTOTYPE, CLASS H AND CLASS K MIL-PRF-38534 ENVIRONMENTAL SCREENING AND RHA¹ P OR R

TEST PERFORMED	NON-QML ²	QML ³			
	PROTOTYPE	CLASS H		CLASS K	
	/OO	/HP	/HR	/KP	/KR
Non-destruct wire bond pull, Method 2023		■ ⁴	■ ⁴	■	■
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		■ ⁴	■ ⁴	■	■
Pre burn-in test, Group A, Subgroups 1 and 4	■	■ ⁴	■ ⁴	■	■
Burn-in Method 1015, +125°C case, typical ⁵					
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				■ ⁴	■ ⁴
Final visual inspection, Method 2009	■	■	■	■	■
RHA P: 30 krad(Si) total dose		■		■	
RHA R: 100 krad(Si) total dose			■		■
SEE LET 40 MeV-cm ² /mg		■	■	■	■

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

Notes:

1. Our Redmond facility has a DLA approved RHA plan for Interpoint power products. Our SMD products with RHA "P" or "R" code meet DLA requirements.
2. "OO" 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 DLA RHA "-" defined as no RHA.
3. All processes are QML qualified and performed by certified operators.
4. Not required by DLA but performed to assure product quality.
5. Burn-in temperature designed to bring the case temperature to +125°C minimum. Burn-in is a powered test.

TABLE 12: ENVIRONMENTAL SCREENING AND RHA LEVELS