

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

FEATURES

- -55°C to +125°C operation
- 19 to 56 VDC input
- 80 V for 100 ms transient protection
- Dual Magnetic feedback
- Topology – Two-Phase Flyback
- Inhibit function and output trim
- Indefinite short circuit protection
- Radiation tolerant to
 - 1 x 10¹² protons/cm² neutron or proton fluence
 - 10¹¹ rads(Si)/sec dose rate
 - 3 x 10⁵ rads(Si) total dose
 - SEU 60 MeV cm²/mg
- Meets MIL-STD-704A emergency operation and transient standards
- No minimum load required
- 5 port isolated design
- Isolated synchronization input
- Output trimmable up to +25% and -45% (see trim instructions)



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

DESCRIPTION

The SMRT Series™ of DC/DC converters offers up to 35 watts of power in a radiation tolerant design. The low profile SMRT converters are manufactured in Interpoint's fully certified and qualified MIL-STD-1772 production facility and packaged in hermetically sealed steel cases. They are ideal for use in programs requiring high reliability, small size, and high levels of radiation hardening assurance.

The SMRT converters are switching regulators which use a two-phase, phase shifted flyback design with a nominal switching frequency of 300 kHz. Close regulation is maintained with advanced constant frequency pulse width modulation design techniques. The SMRT's feed-forward compensation and discontinuous topologies provide high levels (80 dB peak) of input-to-output ripple rejection. A minimum load of 2% of full load should be used on outputs at TID of 100k rads(Si) or greater to ensure tight regulation over the full input range.

Two independent feedback loops are used to regulate the dual and triple outputs, one feedback loop regulates the two-phased single output. Each set of outputs is electrically isolated from

the other and from the input. Sets are defined as follows:

Two paralleled power trains supplying a single output; one independent power train providing a single output; and one independent power train providing two outputs (neg. output is cross-regulated). This product configuration eliminates cross regulation effects between output sets.

Configurations include:

- Single Output: One two-phased single output
- Dual Output: Two single phase single outputs
- Triple Output: One single phase independent Main output and one single phase dual output. (± Auxiliary output).

UNDERVOLTAGE LOCKOUT

The converters have an undervoltage lockout that will allow power conversion at 17 volts on a rising input voltage and a conversion shut-down on a falling voltage at approximately 14.5 volts.

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INHIBIT FUNCTION

The SMRT Series incorporates an inhibit terminal that can be used to disable internal switching. The converter is inhibited when a low (≤ 0.4 V) signal is applied to the inhibit pin. In the inhibit mode the inhibit pin current requirement is less than ~ 2 mA. The converter resumes normal operation when a high (≥ 2.4 V) signal or open circuit is applied to the inhibit pin. The open circuit voltage of the inhibit is 5 to 6 volts. The maximum allowable voltage applied to the inhibit pin is 10 VDC.

SYNCHRONIZATION

An isolated sync input allows this input to be connected to any of the devices three returns. It can be referenced to the input return or any of the output returns. Input current into this pin is limited by a series 1k ohm resistance.

OUTPUT VOLTAGE TRIM

The output voltage of each set can be trimmed up by up to 25%, or down by up to 45% of nominal (varies by model, see trim instructions). The following are “sets” of voltages in relation to trim:

- Triple output models: Main output is one set, the dual outputs are another set.
- Dual outputs: Each output is a “set.”
One set can be trimmed using the trim pin, the other set can be trimmed (up only) using the sense pin.
- Single: One set

RADIATION HARDENED

The SMRT DC/DC converters are designed to provide continuous normal operation through radiation levels associated with space missions and in tactical and strategic military environments. The converters will operate normally in radiation environments with up to 1×10^{12} neutrons per square centimeter neutron fluence, 10^{11} rads(Si) per second dose rate, and 3×10^5 rads(Si) total dose. These levels of radiation tolerance make the SMRT converters suitable for electronics in programs where operation in high radiation environments is required.

At the highest dose rate (10^{11} rads(Si)/sec dose rate) there will be an upset resulting in a dip in the voltage. This is non-destructive to the unit. The converter will operate through the upset.

SCREENING

SMRT converters offer the following screening options: Space Prototype (O), Class H, or Class K. Radiation tolerant to Radiation Hardness Assurance (RHA) levels of “-” (O), “P”, “R” or “F”, per MIL-PRF-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 “Class H and K, MIL-PRF-38534 Screening” tables for more information.

EMI

The SMRT has a built-in EMI input filter which brings the conducted emissions into compliance with both methods of MIL-STD-461, revisions C-CE03 and D-/E-CE102.

SENSE

Tight load regulation is maintained via wide bandwidth magnetic feedback and through the use of remote sense on single output models and one output (Output “A”) of the dual units. The sense feature can be used to adjust the output voltage by connecting a resistor between the sense line and the positive output.

SENSE ADJUST INSTRUCTIONS (UP ONLY) - DUAL UNITS OUTPUT A ONLY

(See trim tables on page 4)

5V Dual Sense Adjust: Max. 5.40 V

$$R_{\text{EXTERNAL}} = 30 \left(\frac{V_{\text{desired}} - 5}{0.675 - 0.125 V_{\text{desired}}} \right)$$

12V Dual Sense Adjust: Max. 12.48 V

$$R_{\text{EXTERNAL}} = 600 \left(\frac{5 \times V_{\text{desired}} - 60.42}{156 - 12.5 V_{\text{desired}}} \right)$$

15V Dual Sense Adjust: Max 15.36 V

$$R_{\text{EXTERNAL}} = 600 \left(\frac{V_{\text{desired}} - 15}{38.4 - 2.5 V_{\text{desired}}} \right)$$

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OPERATING CONDITIONS AND CHARACTERISTICS

Input Voltage Range

- 19 to 56 VDC continuous

Output Power

- up to 35 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

Power Dissipation (Pd)

- 20 to 28 W

Output Voltage Temperature Coefficient

- 100 ppm/°C max

Current Limit

- 125% of full load typical

Isolation

- 100 megohm minimum at 500 V

Audio Rejection

- 50 dB typical

Conversion Frequency

- 300 kHz typical, 270 kHz min., 330 kHz max.

Radiation (will operate through)

- 1×10^{12} neutrons/cm² neutron or proton fluence
- Radiation dose rate 10^{11} rads (Si) /sec
- Total dose up to 300 K rads (Si)
- SEU 60 MeV-cm²/mg

Cross Regulation

- 2.5% typical
- Applies to -V_OAUX on triple models only
- Variation of -V_OAUX from +P_O=80%, -P_O=20% to +P_O=20%, -P_O=80%
- Referenced to 50%/50% balanced $\pm V_{O}$ AUX loads

SYNC AND INHIBIT

Sync In 270-330 kHz typical

- Duty cycle 20% min, 80% max
- 2.5V p-p minimum amplitude
- 10V p-p maximum amplitude
- Can be referenced to input or output return
- If sync is used at lower end of the range, full load operation is not guaranteed.

Inhibit

- Active low (output disabled)
INH referenced to input common
Active low 0.4 V max
Inhibit pin current ≤ 2 mA
- Open collector (output enabled)
High >3.0 V
Not to exceed 10V

Open Collector

Inhibit Pin Voltage

- 5 to 6 V

MECHANICAL AND ENVIRONMENTAL

Size (maximum)

2.705 x 2.205 x 0.400 inches (68.71 x 56.01 x 10.16 mm)

See case S for dimensions.

Weight (maximum)

100 grams maximum

Screening

Space Prototype, Class H, or Class K

Radiation tolerant to Radiation Hardness Assurance (RHA) levels of “-” (O), “P”, “R”, or “F” per MIL-PRF-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 “Class H and K, MIL-PRF-38534 Screening” tables for more information.

Available configurations: OO, HP, HR, KP, KR, KF

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TRIM TABLES

TRIM DOWN

Singles

R_{TRIM} should be connected between the Trim pin and Positive Sense pin.

Duals

R_{TRIM} should be connected between the Trim B pin and Positive Vout B pin. This only trims output B, output A can use the sense pin to trim up only.

Triples

R_{TRIM} should be connected between the Trim A pin and Positive Vout A pin to adjust the Main output.

R_{TRIM} should be connected between the Trim B pin and Positive Vout B pin to adjust the Auxiliary outputs.

$$R_{TRIM} = K \left(\frac{V_{out} - V_{min}}{V_{nom} - V_{out}} \right)$$

Vout = Desired Voltage; K/Vmin/Vnom come from table below.

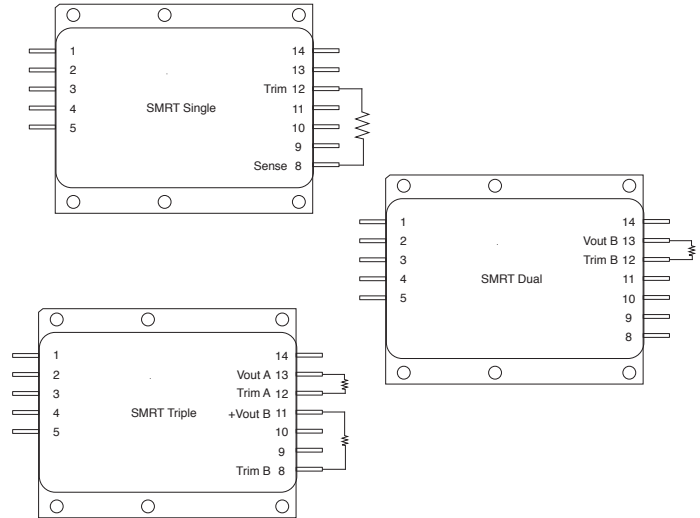


FIGURE 1: TRIM DOWN DIAGRAMS

V_{NOM}	K	V_{MIN}	% OF RATED
3.3	3500	3.18	96
5.0	4520	4.16	83
12	11030	7.05	58
15	12900	7.65	51

TRIM UP

Singles

R_{TRIM} should be connected between the Trim pin and Sense Return pin.

Duals

R_{TRIM} should be connected between the Trim B pin and Vout B Return pin. This only trims output B, output A can use the sense pin to trim up only.

Triples

R_{TRIM} should be connected between the Trim A pin and Vout A Return pin to adjust the Main outputs.

R_{TRIM} should be connected between the Trim B pin and Vout B Return pin to adjust the Auxiliary outputs.

$$R_{TRIM} = K \left(\frac{V_{max} - V_{out}}{V_{out} - V_{nom}} \right)$$

Vout = Desired Voltage; K/Vmax/Vnom come from table below.

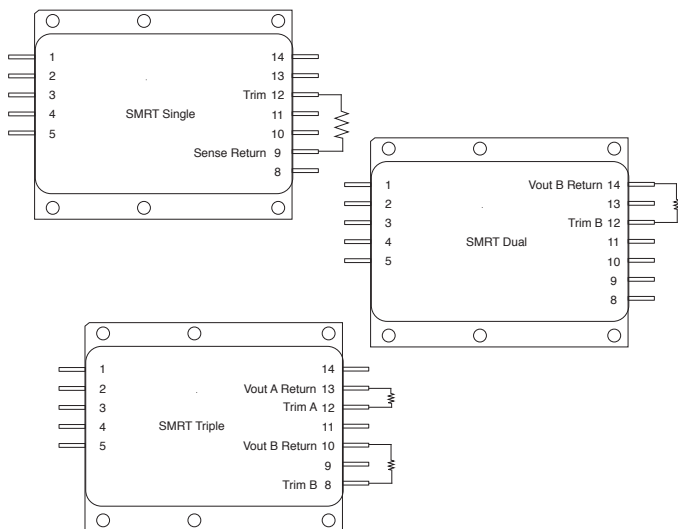


FIGURE 2: TRIM UP DIAGRAMS

V_{NOM}	K	V_{MIN}	% OF RATED	MIN V_{IN}
3.3	3000	3.70	112	22
5.0	3000	6.26	125	22
12	5300	14.69	122	19
15	5300	18.54	124	22

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PIN OUT

Pin	Single Output	Dual Output	Triple Output
1	Vin	Vin	Vin
2	Vin Return	Vin Return	Vin Return
3	Inhibit	Inhibit	Inhibit
4	Sync In	Sync In	Sync In
5	Sync Return	Sync Return	Sync Return
8	Sense	Sense A	Trim B
9	Sense Return	Sense A Return	Vout B Neg.
10	Vout A Return	Vout A Return	Vout B Return
11	Vout A	Vout A	Vout B Pos.
12	Trim	Trim B	Trim A
13	Vout A	Vout B	Vout A
14	Vout A Return	Vout B Return	Vout A Return

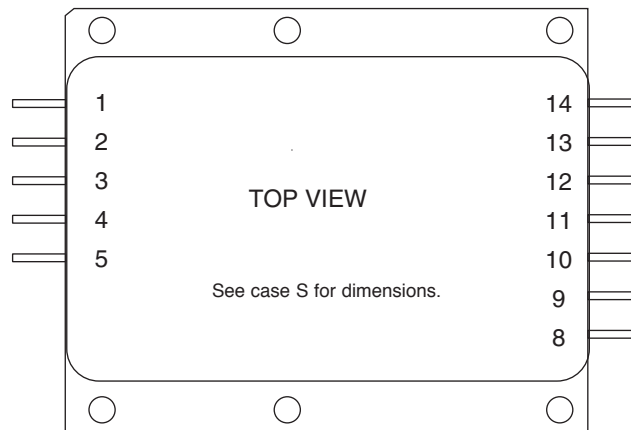


FIGURE 3: PIN OUT

SMRT Single, Dual and Triple DC/DC Converters

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Electrical Characteristics: -55°C to +125°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

SINGLE OUTPUT MODELS		SMRT283R3S			SMRT2805S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		3.23	3.30	3.37	4.90	5.00	5.10	VDC
OUTPUT CURRENT ⁴		—	—	6.97	0	—	6.0	A
OUTPUT POWER ⁴	VIN = 19 TO 56 VDC	0	—	23	0	—	30	W
OUTPUT RIPPLE	10 KHZ - 20 MHZ	—	—	200	—	—	200	mV p-p
LINE REGULATION	VIN = 19, 28, 50 VDC	—	5	30	—	5	30	mV
LOAD REGULATION		—	5	40	—	5	40	mV
TOTAL REGULATION	ALL CONDITIONS OF LINE, LOAD, AGING, TEMP AND RADIATION	3.0	—	3.6	4.7	—	5.3	VOU
INPUT VOLTAGE ^{6, 7}	CONTINUOUS	19	28	56	19	28	56	VDC
	TRANSIENT 100 ms	0	—	80	0	—	80	V
INPUT CURRENT	INHIBITED ⁶	—	—	50	—	—	50	mA
	NO LOAD	—	—	110	—	—	110	
INPUT RIPPLE CURRENT ⁸	10 kHz - 20 MHz	—	10	50	—	10	50	mA p-p
EFFICIENCY		65	—	—	66	—	—	%
LOAD FAULT	POWER DISSIPATION ²	—	—	28	—	—	28	W
STEP LOAD RESPONSE ⁵	TRANSIENT	-450	—	450	-450	—	450	mV pk
	RECOVERY	—	—	3	—	—	3	ms
STEP LINE RESPONSE ¹	19 - 56 - 19 VIN TRANSIENT	-500	—	500	-500	—	500	mV pk
	RECOVERY	—	—	4	—	—	4	ms
START-UP	DELAY ³ NO LOAD AND FULL	—	—	35	—	—	25	ms
	OVERSHOOT ³	—	—	50	—	—	50	mV pk
CAPACITIVE LOAD ¹	UNCONDITIONALLY STABLE, START-UP DELAY INCREASED TC = 25°C	—	—	5000	—	—	5000	μF

Notes

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

2. Maximum power dissipation when output is shorted.

3. Measured from release of inhibit or input voltage step.

4. Minimum value pre-load on all outputs of 2% of full load should be used on all outputs at TID of 100k rads(Si) and greater to ensure tight regulation over full input voltage range.

5. Half load to/from full load; Transition time $\geq 10 \mu\text{s}$.

6. Converter should not be inhibited or operated below 19 Vin above 5×10^4 rads (Si) total dose.

7. If 3.3S model is trimmed to the high end of its range, then minimum Vin = 22 V.

8. Converters meet MIL-STD-461 specification revisions for conducted emissions C-CE03 and D-/E-CE-102. The actual value of input ripple current is much less, the limit in the characteristic table is based on measurement resolution.

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Electrical Characteristics: -55°C to +125°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

SINGLE OUTPUT MODELS		SMRT2812S			SMRT2815S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		11.76	12.00	12.24	14.70	15.00	15.30	VDC
OUTPUT CURRENT ⁴		—	—	2.92	—	—	2.33	A
OUTPUT POWER ⁴	VIN = 19 TO 56 VDC	0	—	35	0	—	35	W
OUTPUT RIPPLE	10 KHZ - 20 MHZ	—	—	200	—	—	180	mV p-p
LINE REGULATION	VIN = 19, 28, 50 VDC	—	5	30	—	5	30	mV
LOAD REGULATION		—	5	40	—	5	40	mV
TOTAL REGULATION	ALL CONDITIONS OF LINE, LOAD, AGING, TEMP AND RADIATION	10.9	—	13.1	14.0	—	16.0	V _{out}
INPUT VOLTAGE ^{6, 7}	CONTINUOUS	19	28	56	19	28	56	VDC
	TRANSIENT 100 ms	0	—	80	0	—	80	V
INPUT CURRENT	INHIBITED ⁶	—	—	50	—	—	50	mA
	NO LOAD	—	—	110	—	—	110	mA
INPUT RIPPLE CURRENT ⁸	10 KHZ - 20 MHZ	—	10	50	—	10	50	mA p-p
EFFICIENCY		75	—	—	75	—	—	%
LOAD FAULT	POWER DISSIPATION ²	—	—	20	—	—	20	W
STEP LOAD RESPONSE ⁵	TRANSIENT	-575	—	575	-575	—	575	mV pk
	RECOVERY	—	—	3	—	—	3	ms
STEP LINE RESPONSE ¹	19 - 56 - 19 VIN TRANSIENT	-700	—	700	-700	—	700	mV pk
	RECOVERY	—	—	4	—	—	4	ms
START-UP	DELAY ³ NO LOAD AND FULL	—	—	25	—	—	25	ms
	OVERSHOOT ³	—	—	120	—	—	150	mV pk
CAPACITIVE LOAD ¹	UNCONDITIONALLY STABLE, START-UP DELAY INCREASED TC = 25°C	—	—	5000	—	—	5000	μF

Notes

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

2. Maximum power dissipation when output is shorted.

3. Measured from release of inhibit or input voltage step.

4. Minimum value pre-load on all outputs of 2% of full load should be used on all outputs at TID of 100k rads(Si) and greater to ensure tight regulation over full input voltage range.

5. Half load to/from full load; Transition time $\geq 10 \mu\text{s}$.

6. Converter should not be inhibited or operated below 19 Vin above 5×10^4 rads (Si) total dose.

7. If 3.3S model is trimmed to the high end of its range, then minimum Vin = 22 V.

8. Converters meet MIL-STD-461 specification revisions for conducted emissions C-CE03 and D-/E-CE-102. The actual value of input ripple current is much less, the limit in the characteristic table is based on measurement resolution.

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

Electrical Characteristics: -55°C to +125°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

DUAL OUTPUT MODELS		SMRT2805D			SMRT2812D			SMRT2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	VOUT A	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	VDC
	VOUT B	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	
OUTPUT CURRENT ^{2, 5}		—	—	3.0	0	—	1.46	—	—	1.17	A
OUTPUT POWER ^{2, 5} VIN = 19 TO 56 VDC	VOUT A	0	—	15	0	—	17.5	0	—	17.5	W
	VOUT B	0	—	15	0	—	17.5	0	—	17.5	
	TOTAL	0	—	30	0	—	35	0	—	35	
OUTPUT RIPPLE	10 kHz - 20 MHz	—	—	200	—	—	200	—	—	180	mV p-p
LINE REGULATION	VIN = 19 TO 50 VDC	—	—	30	—	5	25	—	5	30	mV
LOAD REGULATION	VIN = 19, 28, 50 VDC	—	5	40	—	5	50	—	5	40	mV
TOTAL REGULATION	ALL CONDITIONS OF LINE, LOAD, AGING, TEMP AND RADIATION	4.6	—	5.4	10.9	—	13.1	14.0	—	16.0	V _{out}
INPUT VOLTAGE ^{7, 8}	CONTINUOUS	19	28	56	19	28	56	19	28	56	VDC
	TRANSIENT 100 ms	0	—	80	0	—	80	0	—	80	V
INPUT CURRENT	INHIBITED ⁷	—	—	50	—	—	50	—	—	50	mA
	NO LOAD	—	—	110	—	—	100	—	—	110	
INPUT RIPPLE CURRENT ⁹	10 kHz - 20 MHz	—	10	50	—	10	150	—	10	50	mA p-p
EFFICIENCY		66	—	—	75	—	—	75	—	—	%
LOAD FAULT	POWER DISSIPATION ³	—	—	28	—	—	20	—	—	20	W
STEP LOAD RESPONSE ⁶	TRANSIENT	-450	—	450	-450	—	450	-575	—	575	mV pk
	RECOVERY	—	—	3	—	—	2	—	—	3	ms
STEP LINE RESPONSE ¹	19 - 56 - 19 VIN TRANSIENT	-500	—	500	-1000	—	1000	-700	—	700	mv pk
	RECOVERY	—	—	4	—	—	3	—	—	4	ms
START-UP	DELAY ⁴ NO LOAD AND FULL	—	—	25	—	—	20	—	—	25	ms
	OVERSHOOT ⁴	—	—	50	—	—	350	—	—	150	mV pk
CAPACITIVE LOAD ¹	UNCONDITIONALLY STABLE, START-UP DELAY INCREASED TC = 25°C	—	—	5000	—	—	5000	—	—	5000	μF

Notes

1. Guaranteed by design, not tested.

2. The specified maximum current/power is available from each output.

3. Maximum power dissipation when both outputs are shorted simultaneously.

4. Measured from release of inhibit or input voltage step.

5. A minimum output load on all outputs of 2% of full load should be used on all outputs at TID of 100k rad(Si) or greater to ensure tight regulation over the full input voltage range.

6. Half load to/from full load; Transition time ≥ 10 μs.

7. Converter should not be inhibited or operated below 19 Vin above 5x10⁴ rads (Si) total dose.

8. If 3.3S model is trimmed to the high end of its range, then minimum Vin = 22 V.

9. Converters meet MIL-STD-461 specification revisions for conducted emissions C-CE03 and D-E-CE-102. The actual value of input ripple current is much less, the limit in the characteristic table is based on measurement resolution.

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

Electrical Characteristics: -55°C to +125°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

TRIPLE OUTPUT MODEL – SMRT283R312T		3.3			±12			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V _{OUT}	3.23	3.30	3.37	11.76	12.00	12.24	VDC
	- V _{OUT}	—	—	—	-11.58	12.00	-12.42	
OUTPUT CURRENT ^{5, 10}		—	—	3	0	±0.625	±1	A
OUTPUT POWER ¹⁰	V _{IN} = 19 TO 56 VDC	0	—	9.9	0	±7.5	15	W
OUTPUT RIPPLE	10 KHZ - 20 MHZ	—	—	200	—	—	150	mV p-p
LINE REGULATION	+ V _{OUT}	—	—	30	—	5	30	mV
	- V _{OUT}	—	—	—	—	10	70	
LOAD REGULATION NO LOAD TO FULL	+ V _{OUT}	—	5	40	—	5	40	mV
	- V _{OUT}	—	—	—	—	10	300	
TOTAL REGULATION	ALL CONDITIONS OF LINE, LOAD, AGING, TEMP AND RADIATION	3.0	—	3.6	±10.9	—	±13.1	V _{OUT}
INPUT VOLTAGE ^{7, 8}	CONTINUOUS	19	28	56	19	28	56	VDC
	TRANSIENT 100 ms	0	—	80	0	—	80	V
INPUT CURRENT	INHIBITED ⁷	—	—	50	—	—	50	mA
	NO LOAD	—	—	110	—	—	110	
INPUT RIPPLE CURRENT ⁹	10 kHz - 20 MHz	—	10	50	—	10	50	mA p-p
EFFICIENCY ⁴		68	—	—	68	—	—	%
LOAD FAULT	POWER DISSIPATION ²	—	—	28	—	—	28	W
STEP LOAD RESPONSE ⁶	TRANSIENT	-450	—	450	-450	—	450	mV pk
	RECOVERY	—	—	3	—	—	3	ms
STEP LINE RESPONSE ¹	19 - 56 - 19 V _{IN} TRANSIENT	-500	—	500	-750	—	750	mV pk
	RECOVERY	—	—	4	—	—	4	ms
START-UP	DELAY ³ NO LOAD AND FULL	—	—	35	—	—	25	ms
	OVERSHOOT ³	—	0	50	—	0	120	mV pk
CAPACITIVE LOAD ¹	UNCONDITIONALLY STABLE, START-UP DELAY INCREASED TC = 25°C	—	—	5000	—	—	1000	μF

Notes

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

2. Maximum power dissipation when all outputs are shorted simultaneously.

3. Measured from release of inhibit or input voltage step.

4. Efficiency measured with all outputs at full load.

5. Up to 1 A is available from either auxiliary output provided the total auxiliary output power does not exceed 15 watts.

6. Half load to/from full load; Transition time ≥ 10 μs.

7. Converter should not be inhibited or operated below 19 V_{in} above 5x10⁴ rads (Si) total dose.

8. If 3.3S model is trimmed to the high end of its range, then minimum V_{in} = 22 V.

9. Converters meet MIL-STD-461 specification revisions for conducted emissions C-CE03 and D-/E-CE-102. The actual value of input ripple current is much less, the limit in the characteristic table is based on measurement resolution.

10. Minimum value pre-load on all outputs of 2% of full load should be used on all outputs at TID of 100k rads(Si) and greater to ensure tight regulation over full input voltage range.

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

Electrical Characteristics: -55°C to +125°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

TRIPLE OUTPUT MODEL – SMRT283R315T		3.3			±15			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V _{OUT}	3.23	3.30	3.37	14.70	15.00	15.30	VDC
	- V _{OUT}	—	—	—	-14.48	-15.00	-15.53	
OUTPUT CURRENT ^{5, 10}		—	—	3	0	±0.5	±0.8	A
OUTPUT POWER ¹⁰	V _{IN} = 19 TO 56 VDC	0	—	9.9	0	±7.5	15	W
OUTPUT RIPPLE	10 KHZ - 20 MHZ	—	—	200	—	—	150	mV p-p
LINE REGULATION	+ V _{OUT}	—	—	30	—	5	30	mV
	- V _{OUT}	—	—	—	—	10	70	
V _{IN} = 19 TO 50 VDC								
LOAD REGULATION NO LOAD TO FULL	+ V _{OUT}	—	5	40	—	5	40	mV
	- V _{OUT}	—	—	—	—	10	300	
V _{IN} = 19, 28, 50 VDC								
TOTAL REGULATION	ALL CONDITIONS OF LINE, LOAD, AGING, TEMP AND RADIATION	3.0	—	3.6	±10.9	—	±13.1	V _{OUT}
INPUT VOLTAGE ^{7, 8}	CONTINUOUS	19	28	56	19	28	56	VDC
	TRANSIENT 100 ms	0	—	80	0	—	80	V
INPUT CURRENT	INHIBITED ⁷	—	—	50	—	—	50	mA
	NO LOAD	—	—	110	—	—	110	
INPUT RIPPLE CURRENT ⁹	10 kHz - 20 MHz	—	10	50	—	10	50	mA p-p
EFFICIENCY ⁴		68	—	—	68	—	—	%
LOAD FAULT	POWER DISSIPATION ²	—	—	28	—	—	28	W
STEP LOAD RESPONSE ⁶	TRANSIENT	-450	—	450	-450	—	450	mV pk
	RECOVERY	—	—	3	—	—	3	ms
STEP LINE RESPONSE ¹	19 - 56 - 19 V _{IN} TRANSIENT	-500	—	500	-750	—	750	mV pk
	RECOVERY	—	—	4	—	—	4	ms
START-UP	DELAY ³ NO LOAD AND FULL	—	—	35	—	—	25	ms
	OVERSHOOT ³	—	0	50	—	0	150	mV pk
CAPACITIVE LOAD ¹	UNCONDITIONALLY STABLE, START-UP DELAY INCREASED TC = 25°C	—	—	5000	—	—	1000	μF

Notes

1. Guaranteed by design, not tested.

2. Maximum power dissipation when all outputs are shorted simultaneously.

3. Measured from release of inhibit or input voltage step.

4. Efficiency measured with all outputs at full load.

5. Up to 800 mA is available from either auxiliary output provided the total auxiliary output power does not exceed 15 watts.

6. Half load to/from full load; Transition time ≥ 10 μs.

7. Converter should not be inhibited or operated below 19 V_{in} above 5x10⁴ rads (Si) total dose.

8. If 3.3S model is trimmed to the high end of its range, then minimum V_{in} = 22 V.

9. Converters meet MIL-STD-461 specification revisions for conducted emissions C-CE03 and D-/E-CE-102. The actual value of input ripple current is much less, the limit in the characteristic table is based on measurement resolution.

10. Minimum value pre-load on all outputs of 2% of full load should be used on all outputs at TID of 100k rads(Si) and greater to ensure tight regulation over full input voltage range.

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

Electrical Characteristics: -55°C to +125°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

TRIPLE OUTPUT MODEL – SMRT28512T		5			±12			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V _{OUT}	4.90	5.00	5.10	11.76	12.00	12.24	VDC
	- V _{OUT}	—	—	—	-11.58	12.00	-12.42	
OUTPUT CURRENT ^{5, 10}		—	—	3.0	0	±0.63	±1	A
OUTPUT POWER ¹⁰	V _{IN} = 19 TO 56 VDC	0	—	15	0	±7.5	15	W
OUTPUT RIPPLE	10 KHZ - 20 MHZ	—	—	200	—	—	150	mV p-p
LINE REGULATION	+ V _{OUT}	—	—	30	—	5	30	mV
	- V _{OUT}	—	—	—	—	20	70	
V _{IN} = 19 TO 50 VDC								
LOAD REGULATION NO LOAD TO FULL	+ V _{OUT}	—	5	40	—	5	40	mV
	- V _{OUT}	—	—	—	—	10	300	
V _{IN} = 19, 28, 50 VDC								
TOTAL REGULATION	ALL CONDITIONS OF LINE, LOAD, AGING, TEMP AND RADIATION	4.7	—	5.3	±10.9	—	±13.1	V _{OUT}
INPUT VOLTAGE ^{7, 8}	CONTINUOUS	19	28	56	19	28	56	VDC
	TRANSIENT 100 ms	0	—	80	0	—	80	V
INPUT CURRENT	INHIBITED ⁷	—	—	50	—	—	50	mA
	NO LOAD	—	—	110	—	—	110	
INPUT RIPPLE CURRENT ⁹	10 kHz - 20 MHz	—	10	50	—	10	50	mA p-p
EFFICIENCY ⁴		68	—	—	68	—	—	%
LOAD FAULT	POWER DISSIPATION ²	—	—	25	—	—	25	W
STEP LOAD RESPONSE ⁶	TRANSIENT	-450	—	450	-450	—	450	mV pk
	RECOVERY	—	—	3	—	—	3	ms
STEP LINE RESPONSE ¹	19 - 56 - 19 V _{IN} TRANSIENT	-500	—	500	-750	—	750	mV pk
	RECOVERY	—	—	4	—	—	4	ms
START-UP	DELAY ³ NO LOAD AND FULL	—	—	25	—	—	25	ms
	OVERSHOOT ³	—	0	50	—	0	120	mV pk
CAPACITIVE LOAD ¹	UNCONDITIONALLY STABLE, START-UP DELAY INCREASED TC = 25°C	—	—	5000	—	—	1000	μF

Notes

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

2. Maximum power dissipation when all outputs are shorted simultaneously.

3. Measured from release of inhibit or input voltage step.

4. Efficiency measured with all outputs at full load.

5. Up to 1 A is available from either auxiliary output provided the total auxiliary output power does not exceed 15 watts.

6. Half load to/from full load; Transition time ≥ 10 μs.

7. Converter should not be inhibited or operated below 19 Vin above 5x10⁴ rads (Si) total dose.

8. If 3.3S model is trimmed to the high end of its range, then minimum Vin = 22 V.

9. Converters meet MIL-STD-461 specification revisions for conducted emissions C-CE03 and D-/E-CE-102. The actual value of input ripple current is much less, the limit in the characteristic table is based on measurement resolution.

10. Minimum value pre-load on all outputs of 2% of full load should be used on all outputs at TID of 100k rads(Si) and greater to ensure tight regulation over full input voltage range.

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

Electrical Characteristics: -55°C to +125°C Tc, 28 VDC Vin, 100% load, unless otherwise specified.

TRIPLE OUTPUT MODEL – SMRT28515T		5			±15			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V _{OUT}	4.92	5.00	5.08	14.77	15.00	15.23	VDC
	- V _{OUT}	—	—	—	-14.70	-15.00	-15.30	
OUTPUT CURRENT ^{5, 10}		—	—	3.0	0	±0.5	±0.75	A
OUTPUT POWER ¹⁰	V _{IN} = 19 TO 56 VDC	0	—	15	0	±7.5	15	W
OUTPUT RIPPLE	10 KHZ - 20 MHZ	—	—	200	—	—	200	mV p-p
LINE REGULATION V _{IN} = 19 TO 50 VDC	+ V _{OUT}	—	5	25	—	—	25	mV
	- V _{OUT}	—	—	—	—	20	35	
LOAD REGULATION NO LOAD TO FULL V _{IN} = 19, 28, 50 VDC	+ V _{OUT}	—	5	50	—	5	50	mV
	- V _{OUT}	—	—	—	—	10	500	
TOTAL REGULATION	ALL CONDITIONS OF LINE, LOAD, AGING, TEMP AND RADIATION	4.7	—	5.3	±14	—	±16.0	V _{OUT}
INPUT VOLTAGE ^{7, 8}	CONTINUOUS	19	28	56	19	28	56	VDC
	TRANSIENT 100 ms	0	—	80	0	—	80	V
INPUT CURRENT	INHIBITED ⁷	—	—	50	—	—	50	V
	NO LOAD	—	—	110	—	—	110	mA
INPUT RIPPLE CURRENT ⁹	10 kHz - 20 MHz	—	10	150	—	10	150	mA p-p
EFFICIENCY ⁴		70	—	—	70	—	—	%
LOAD FAULT	POWER DISSIPATION ²	—	—	25	—	—	25	W
STEP LOAD RESPONSE ⁶	TRANSIENT	-250	—	250	-350	—	350	mV pk
	RECOVERY	—	—	1	—	—	1	ms
STEP LINE RESPONSE ¹	19 - 56 - 19 V _{IN} TRANSIENT	-500	—	500	-750	—	750	mV pk
	RECOVERY	—	—	1.5	—	—	1.5	ms
START-UP	DELAY ³ NO LOAD AND FULL	—	—	25	—	—	20	ms
	OVERSHOOT ³	—	0	200	—	0	350	mV pk
CAPACITIVE LOAD ¹	UNCONDITIONALLY STABLE, START-UP DELAY INCREASED TC = 25°C	—	—	5000	—	—	1000	μF

Notes

1. Guaranteed by design, not tested.

2. Maximum power dissipation when all outputs are shorted simultaneously.

3. Measured from release of inhibit or input voltage step.

4. Efficiency measured with all outputs at full load.

5. Up to 750 mA is available from either auxiliary output provided the total auxiliary output power does not exceed 15 watts.

6. Half load to/from full load; Transition time ≥ 10 μs.

7. Converter should not be inhibited or operated below 19 V_{in} above 5x10⁴ rads (Si) total dose.

8. If 3.3S model is trimmed to the high end of its range, then minimum V_{in} = 22 V.

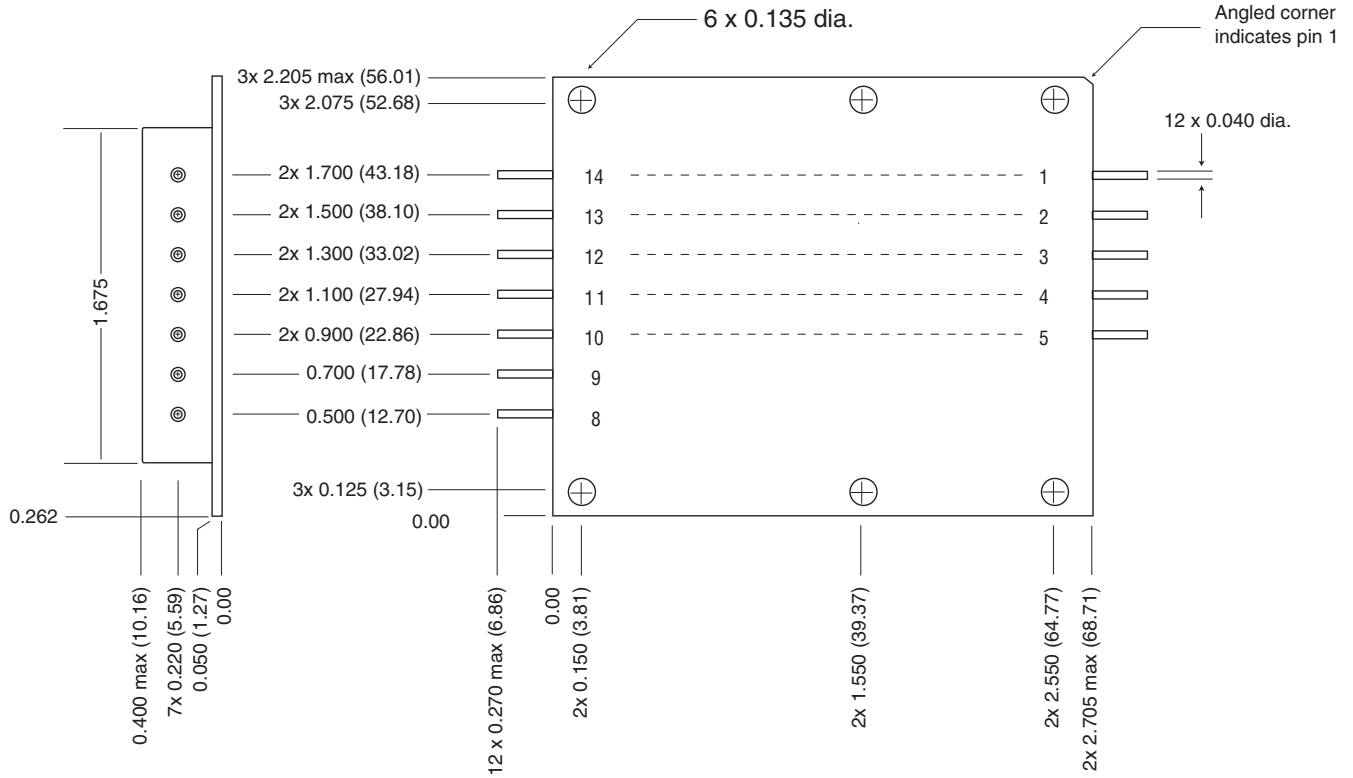
9. Converters meet MIL-STD-461 specification revisions for conducted emissions C-CE03 and D-/E-CE-102. The actual value of input ripple current is much less, the limit in the characteristic table is based on measurement resolution.

10. Minimum value pre-load on all outputs of 2% of full load should be used on all outputs at TID of 100k rads(Si) and greater to ensure tight regulation over full input voltage range.

SMRT Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 35 WATT

BOTTOM VIEW CASE S



Seal hole: 0.123 ±0.002 (3.124 ±0.05)

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
Cover Kovar/Nickel
Pins #52 alloy, ceramic seal

Case S, Rev B, 20060711
Please refer to the numerical dimensions for accuracy. All information is believed to be accurate, but no responsibility is assumed for errors or omissions. Interpoint reserves the right to make changes in products or specifications without notice.
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FIGURE 4: CASE S

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

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

COMPONENT-LEVEL TEST PERFORMED	SPACE PROTOTYPE (O) NON-QML ¹		CLASS H QML		CLASS K QML	
	M/S ²	P ³	M/S ²	P ³	M/S ²	P ³
Element Electrical	yes	no	yes	yes	yes	yes
Element Visual	no	no	yes	yes	yes	yes
Internal Visual	no	N/A	yes	N/A	yes	N/A
Temperature Cycling	no	no	no	no	yes	yes
Constant Acceleration	no	no	no	no	yes	yes
Interim Electrical	no	N/A	no	N/A	yes	N/A
Burn-in	no	N/A	no	N/A	yes	N/A
Post Burn-in Electrical	no	N/A	no	N/A	yes	N/A
Steady State Life	no	N/A	no	N/A	yes	N/A
Voltage Conditioning Aging	N/A	no	N/A	no	N/A	yes
Visual Inspection	no	no	N/A	no	N/A	yes
Final Electrical	no	no	yes	yes	yes	yes
Wire Bond Evaluation ⁴	no	no	yes	yes	yes	yes
SEM	no	N/A	no	N/A	yes	N/A
SLAM™/C-SAM: Input capacitors only (Add'l test, not req. by H or K)	no	no	no	yes	no	yes

Notes:

1. Non-QML products do not meet all of the requirements of MIL-PRF-38534.
2. M/S = Active components (Microcircuit and Semiconductor Die)
3. P = Passive components
4. Not applicable to EMI filters that have no wirebonds.

Definitions:

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

SEM: Scanning Electron Microscopy

SLAM™: Scanning Laser Acoustic Microscopy

C-SAM: C - Mode Scanning Acoustic Microscopy

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

CLASS H AND K, MIL-PRF-38534 ENVIRONMENTAL SCREENING

END ITEM-LEVEL TEST PERFORMED	SPACE PROTOTYPE (O) NON-QML ¹	CLASS H QML	CLASS K QML
Non-destruct bond pull ² Method 2023	no	yes ³	yes
Pre-cap Inspection Method 2017, 2032	yes	yes	yes
Temperature Cycle (10 times) Method 1010, Cond. C, -65°C to 150°C, ambient	yes	yes	yes
Constant Acceleration Method 2001, 3000 g	yes	yes	yes
PIND Test Method 2020, Cond. A	no	yes ³	yes
Pre burn-in test	yes	yes	yes
Burn-in Method 1015, 125°C case, typical			
96 hours	yes	no	no
160 hours	no	yes	no
2 x 160 hours (includes mid-BI test)	no	no	yes
Final Electrical Test MIL-PRF-38534 Group A, Subgroups 1 through 6 -55°C, +25°C, +125°C case	yes	yes	yes
Radiography Method 2012	N/A	N/A	N/A
Post Radiography Electrical Test Room temperature	N/A	N/A	yes ³
Hermeticity Test Fine Leak, Method 1014, Cond. A Gross Leak, Method 1014, Cond. C	yes yes	yes yes	yes yes
Final visual inspection Method 2009	yes	yes	yes

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

Notes:

1. Space Prototype (O), non-QML products, do not meet all of the requirements of MIL-PRF-38534.
2. Not applicable to EMI filters that have no wirebonds.
3. Not required by DSCC but performed to assure product quality.

SMRT Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 35 WATT

CLASS H AND K, MIL-PRF-38534 RADIATION ASSURANCE

RADIATION HARDNESS ASSURANCE LEVELS	ENVIRONMENTAL SCREENING LEVELS		
	SPACE PROTOTYPE (O) NON-QML ³	CLASS H QML	CLASS K QML
O² : Standard, no radiation guarantee	OO	N/A	N/A
P : Radiation tolerant—Tested lots up to 30 K Rads (Si) total dose SEU guarantee up to 40 MeV	N/A	HP ⁴	KP ⁴
R : Radiation tolerant—Tested lots up to 100 K Rads (Si) total dose SEU guarantee up to 40 MeV	N/A	HR ⁴	KR ⁴
F : Radiation tolerant—Tested lots up to 300 K Rads (Si) total dose SEU guarantee up to 60 MeV	N/A	N/A	KF ⁴

Notes:

1. Our EMI filters are designed exclusively with passive components providing maximum tolerance for space environment requirements.
2. 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".
3. Space Prototype (O), non-QML, products do not meet all of the requirements of MIL-PRF-38534.
4. Redmond site, Interpoint, has a Radiation Hardness assurance plan on file with DSCC. Our SMD products with RHA "P", "R," "F" and "H" code meet DSCC requirements.