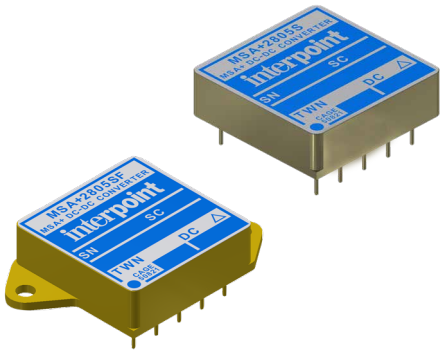
MSA+ Single and Dual DC-DC Converters

PRELIMINARY - 15 TO 50 VOLT INPUT – 6 WATT

FEATURES

- Trim function ±10%, single and duals
- Small size, 1.13 in^2 (7.31 cm^2)
- -55° to +125°C operation
- 15 to 50 volt input
- Low output ripple
- 80 volts for 1 second transient protection
- Magnetic isolation
- Fixed high frequency switching
- Inhibit function
- Indefinite short circuit protection
- Efficiency up to 78% typical



MODELS OUTPUT VOLTAGE (V)	
SINGLE	DUAL
3.3	±5
5	±6.3
6.3	±12
12	±15
15	

DESCRIPTION

The Interpoint® MSA+ Series™ of DC-DC converters offers up to 6 watts of power. The low profile MSA+ converters are manufactured in our fully certified and qualified MIL-PRF-38534 Class H production facility and packaged in hermetically sealed steel cases. Thick-film hybrid techniques provide military/aerospace reliability levels and optimum miniaturization. The hermetically sealed case is 1.065 by 1.065 inches with a height of 0.350 inches. Power density for the MSA+ Series converters is 15 watts per cubic inch.

CONVERTER DESIGN

The converters are switching regulators that use a flyback converter design with a constant switching frequency of 400 kHz typical. They are regulated, isolated units using a pulse width modulated topology and are built as high reliability thick-film hybrids. Isolation between input and output circuits is provided with a transformer in the forward power path and in the feedback control loop.

Excellent input line transient response and audio rejection is achieved by an advanced feed-forward compensation technique. For dual outputs, negative output regulation is maintained by tightly coupled magnetics. Up to 4.8 watts, 80% of the total output power, is available from either output, provided that the opposite output is simultaneously carrying 20% of the total power in order to maintain the specified regulation on the negative output.

A predictable current limit is accomplished by direct monitoring of the output load current, which results in a constant current output. Internal input and output filters eliminate the need for external capacitors for stable operation.

WIDE VOLTAGE RANGE

The MSA+ converters are designed to provide full power operation over a 15 to 50 volt input range.

TRIM FUNCTION

When trimming, ensure that neither the maximum current nor the maximum power is exceeded.

The MSA+ singles and duals can be trimmed ±10% using trim pin 4. However, the 3.3 single model's trim range is -5% and +10%. The dual outputs will then both be trimmed by the same percentage.

See Figure 1 and Figure 2 on page 2 for external trim resistor selection.

DYNAMIC RESPONSE

The feed-forward compensation system provides excellent dynamic response and audio rejection. Audio rejection is typically 50 dB.

SPAN VOLTAGE

Our duals can be configured as a single output where the positive output is used as one rail and the negative output is used as the other rail. As an example the positive and negative 15 volt dual can be configured as a single 30 volt output. If the dual is configured as a positive 30 volt output the negative output would be used as system ground and the positive output would be used as the positive 30 volt output. In all cases Output Common of the converter is not connected. The maximum capacitance when using a span voltage on a dual is half the value specified for each output.

SCREENING

The converters are offered with /883 (Class H), ES or standard screening. For screening options and descriptions see Table 10 on page 13 and Table 11 on page 14.

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Inhibit Function

The inhibit feature can be used to disable internal switching and inhibit the unit's output. Inhibiting in this manner results in low standby current and no generation of switching noise.

The converter is inhibited when the inhibit pin is pulled below 0.8 volts and enabled when its inhibit pin is left floating. An external inhibit interface should be used to pull the converter's inhibit pin below 0.8 volts while sinking the maximum inhibit current. It also allows the inhibit pin to float high to enable the converter. A voltage should not be applied to the inhibit pin. The open circuit output voltage associated with the inhibit pin is 9.5 to 11.5 volts. In the inhibit mode, a maximum of 4 is sourced from the inhibit pin. See Figure 4 and Figure 3 on page 3.

Undervoltage Lockout

Undervoltage lockout helps keep system current levels low during initialization or re-start operations. A low voltage lockout feature keeps the converter shutdown below approximately 12.7 volts to ensure smooth initialization.

Transient Protection

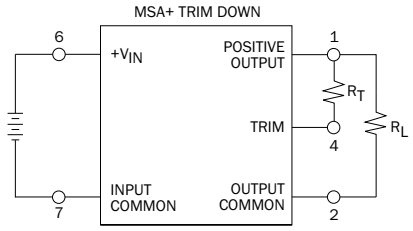
The MSA+ can withstand short term transients of up to 80 volts for up to one second without damage.

MIL-STD-461

Use our FMCE-0328 filter to pass the CE03 requirements of MIL-STD-461C.

Packaging

The MSA+ Series converters are packaged in hermetically sealed, seam-sealed steel cases which provide EMI/RFI shielding. The small size, 1.065 x 1.065 x 0.350 inches (27.05 x 27.05 x 8.89 mm), saves space and weight in critical applications. They are available in non-flange or offset flange cases. See Figure 8 on page 12 and Figure 7 on page 11.



EXTERNAL TRIM CONNECTION

MSA+ Trim Down Formulas for Singles and Duals
Vout = desired output voltage; Rt = trim resistor

3.3 V: $Rt = \frac{53460}{Vout - 3.3} - 72000$

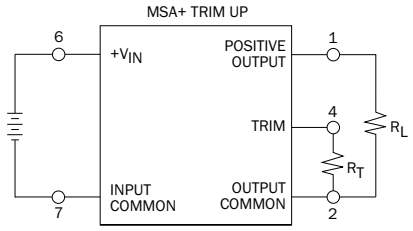
5 V: $Rt = \frac{54000}{Vout - 5} - 78000$

6.3 V: $Rt = \frac{153720}{Vout - 6.3} - 146600$

12 V: $Rt = \frac{600000}{Vout - 12} - 151000$

15 V: $Rt = \frac{1014000}{Vout - 15} - 169000$

FIGURE 1: MSA+ TRIM DOWN



EXTERNAL TRIM CONNECTION

MSA+ Trim Up Formulas for Singles and Duals
Vout = desired output voltage; Rt = trim resistor

3.3 V: $Rt = \frac{23760}{Vout - 3.3} - 60000$

5 V: $Rt = \frac{36000}{Vout - 5} - 60000$

6.3 V: $Rt = \frac{76860}{Vout - 6.3} - 110000$

12 V: $Rt = \frac{120000}{Vout - 12} - 91000$

15 V: $Rt = \frac{156000}{Vout - 15} - 91000$

FIGURE 2: MSA+ TRIM UP

MSA+ Single and Dual DC-DC Converters

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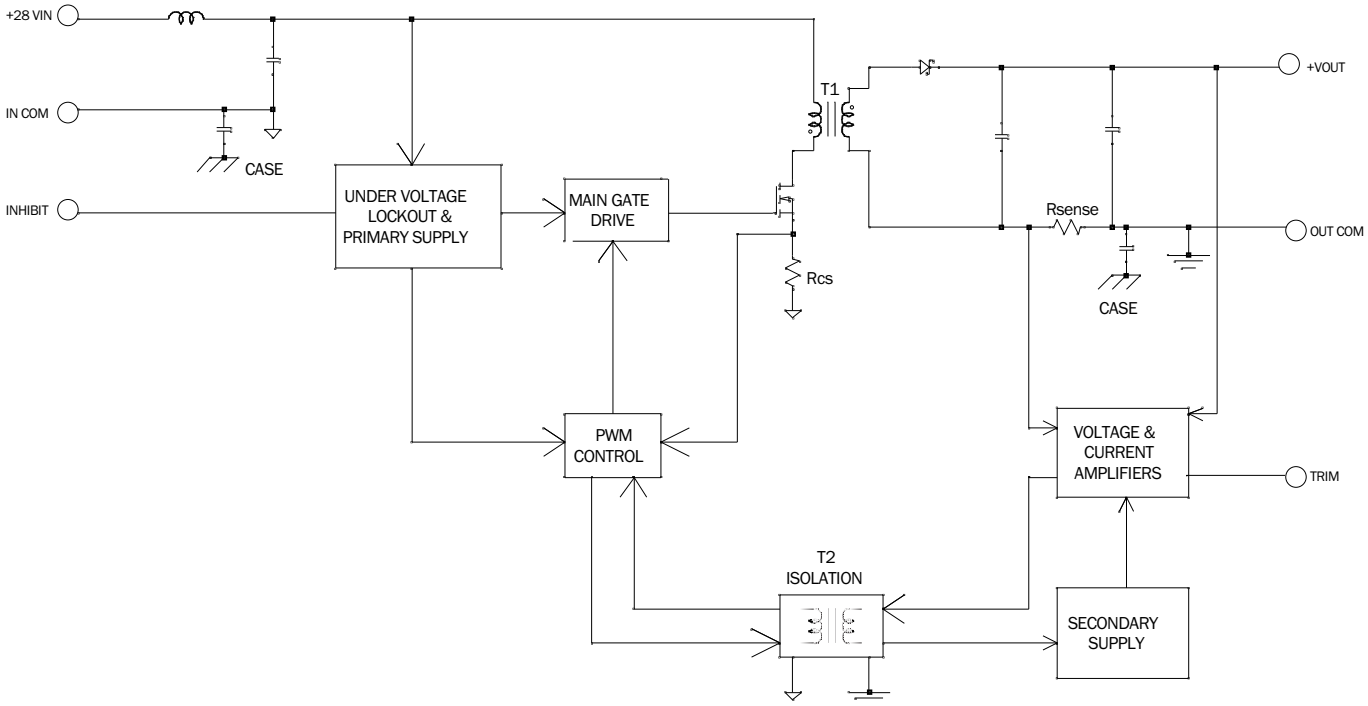

FIGURE 3: BLOCK DIAGRAM MSA+ SINGLE OUTPUT

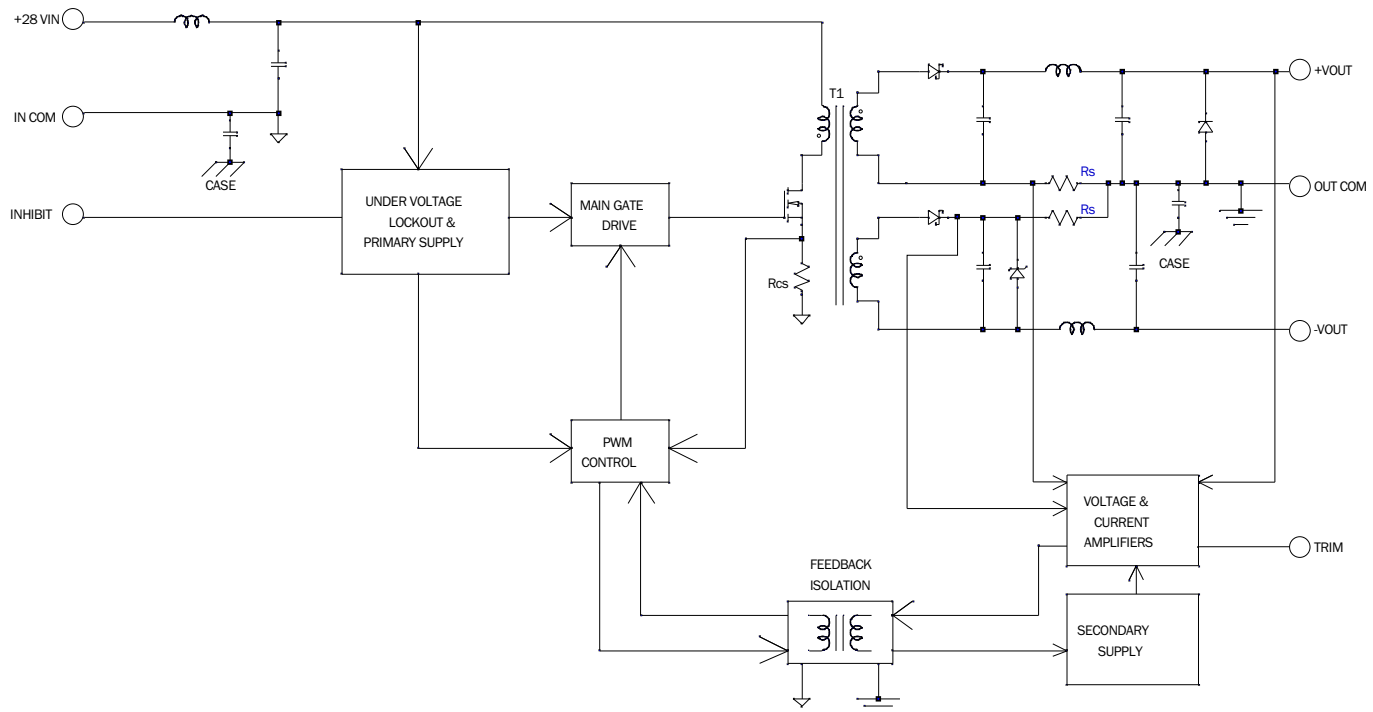

FIGURE 4: BLOCK DIAGRAM MSA+ DUAL OUTPUT

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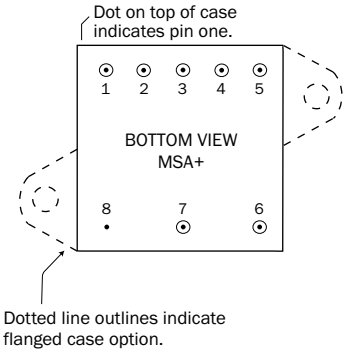
PIN OUT		
Pin	**Single Output**	**Dual Output**
1	Positive Output	Positive Output
2	Output Common	Output Common
3	No Connection	Negative Output
4	Trim	Trim
5	Inhibit	Inhibit
6	Positive Input	Positive Input
7	Input Common	Input Common
8	Case Ground	Case Ground

TABLE 1: MSA+ PIN OUT

MSA+ PINS NOT IN USE	
Inhibit	Leave unconnected
“No Connection” pin	Leave unconnected
Trim	Leave unconnected

TABLE 2: MSA+ PINS NOT IN USE



See Figure 7 on page 11 and Figure 8 on page 12.

FIGURE 5: MSA+ PIN OUT BOTTOM VIEW

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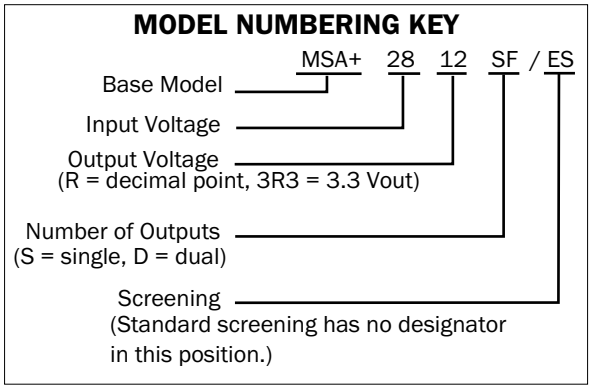

FIGURE 6: MSA+ MODEL NUMBERING KEY

SMD NUMBERS	
STANDARD MICROCIRCUIT DRAWING (SMD)	**MSA+ SIMILAR PART**
IN PROCESS	MSA+283R3S/883
IN PROCESS	MSA+2805S/883
IN PROCESS	MSA+286R3S/883
IN PROCESS	MSA+2812S/883
IN PROCESS	MSA+2815S/883
IN PROCESS	MSA+2805D/883
IN PROCESS	MSA+286R3D/83
IN PROCESS	MSA+2812D/883
IN PROCESS	MSA+2815D/883
For exact specifications for an SMD product, refer to the SMD drawing. SMDs can be downloaded from: https://landandmaritimeapps.dla.mil/programs/smcr	

TABLE 3: SMD NUMBER CROSS REFERENCE

MODEL NUMBER OPTIONS [1]

TO DETERMINE THE MODEL NUMBER ENTER ONE OPTION FROM EACH CATEGORY IN THE FORM BELOW.

CATEGORY	Base Model and Input Voltage	Output Voltage [2]	Number of Outputs [3]	Case Options [4]	Screening [5]
OPTIONS	MSA+28	3R3, 05, 6R3, 12, 15	S	(non-flanged, leave blank)	(standard, leave blank)
		05, 6R3, 12, 15	D	F (flanged)	ES
					/883
FILL IN FOR MODEL # [6]	MSA+28	_____	_____	_____	/ _____

Noes
1. See Figure 6 above for an example of a model number.
2. Output Voltage: An R indicates a decimal point. 3R3 is 3.3 volts out. The values of 3.3 is only available in single output models.
3. Number of Outputs: S is a single output and D is a dual output.
4. Case Options: For the standard case (Figure 7 on page 11) leave the Case Option blank. For the flanged case option (Figure 8 on page 12), insert the letter F in the Case Option position.
5. Screening: For standard screening leave the screening option blank. For other screening options, insert the desired screening level. For more information see Table 10 on page 13 and Table 11 on page 14.
6. If ordering by model number add suffix "-Q" to request solder dipped leads (MSA+2805S/ES-Q).

TABLE 4: MODEL NUMBER OPTIONS

TABLE 5: OPERATING CONDITIONS - ALL MODELS, 25°C CASE, 28 VIN, UNLESS OTHERWISE SPECIFIED.

		ALL MODELS			
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
LEAD SOLDERING TEMPERATURE	10 SECONDS MAX. PER LEAD	—	—	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			
ISOLATION: INPUT TO OUTPUT, INPUT TO CASE, OUTPUT TO CASE [2]	@ 500 VDC AT 25°C	100	—	—	Megohms
INPUT TO OUTPUT CAPACITANCE [1]		—	50	—	pF
UNDERVOLTAGE LOCKOUT [1]		—	13	—	V
CURRENT LIMIT [1, 3]	% OF FULL LOAD	—	130	—	%
AUDIO REJECTION [1]		—	50	—	dB
SWITCHING FREQUENCY	-55° TO +125°C	350	—	450	kHz
INHIBIT ACTIVE LOW (OUTPUT DISABLED) Do not apply a voltage to the inhibit pin. [4]	INHIBIT PIN PULLED LOW	—	—	0.8	V
	INHIBIT PIN SOURCE CURRENT [1]	—	—	4	mA
	REFERENCED TO	INPUT COMMON			
INHIBIT ACTIVE HIGH (OUTPUT ENABLED) Do not apply a voltage to the inhibit pin. [4]	INHIBIT PIN CONDITION	OPEN COLLECTOR OR UNCONNECTED			
	OPEN PIN VOLTAGE [1]	9.5	—	11.5	V

Notes
1. Guaranteed by qualification test and/or analysis. Not a production test.
2. When testing isolation, input pins are tied together and output pins are tied together. They are tested against each other and against case. Discharge the pins before and after testing.
3. Current limit is defined as the point at which the output voltage decreases by 1%.
   Dual outputs: The over-current limit will trigger when the sum of the currents from both outputs reaches 130% (typical value) of the maximum rated "total" current of both outputs.
4. 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.

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TABLE 6: ELECTRICAL CHARACTERISTICS -55°C TO +125°C CASE, 28 VIN, 100% LOAD, UNLESS OTHERWISE SPECIFIED.

MSA+ SINGLE OUTPUT MODELS		MSA+283R3S			MSA+2805S			MSA+286R3S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		3.15	3.30	3.45	4.80	5.00	5.20	6.10	6.30	6.50	V
OUTPUT CURRENT	V_{IN} = 15 to 50	0	—	1500	0	—	1200	0	—	950	mA
OUTPUT POWER	V_{IN} = 15 to 50	0	—	5	0	—	6	0	—	6	W
OUTPUT RIPPLE	T_C = 25°C	—	20	40	—	20	40	—	40	80	mV p-p
10 kHZ - 10 MHZ	T_C = -55°C TO +125°C	—	20	40	—	20	40	—	40	80	
LINE REGULATION	V_{IN} = 15 TO 50	—	10	50	—	10	50	—	10	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	10	50	—	10	50	—	10	50	mV
INPUT VOLTAGE	CONTINUOUS	15	28	50	15	28	50	15	28	50	V
NO LOAD TO FULL	TRANSIENT 1 sec [1]	—	—	80	—	—	80	—	—	80	V
INPUT CURRENT	NO LOAD	—	27	40	—	27	40	—	28	40	mA
	INHIBITED	—	3	6	—	3	6	—	3	6	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	95	150	—	95	150	—	95	150	mA p-p
EFFICIENCY	T_C = 25°C	66	70	—	69	73	—	68	73	—	%
	T_C = -55°C TO +125°C	64	—	—	67	72	—	67	72	—	
LOAD FAULT [2, 3]	POWER DISSIPATION	—	—	2.5	—	—	2.5	—	—	2.5	W
SHORT CIRCUIT	RECOVERY [1]	—	—	30	—	—	30	—	—	30	ms
STEP LOAD RESPONSE [3, 4]	TRANSIENT	—	—	±500	—	—	±500	—	—	±500	mV pk
50% - 100% - 50%	RECOVERY	—	—	1200	—	—	1200	—	—	1200	µs
STEP LINE RESPONSE [1, 3, 5]	TRANSIENT	—	—	±500	—	—	±500	—	—	±500	mV pk
16 - 40 - 16 V	RECOVERY	—	—	1500	—	—	1500	—	—	1500	µs
START-UP [3]	DELAY	—	—	30	—	—	30	—	—	30	ms
0 - 28 V_{IN}, FULL LOAD	OVERSHOOT [1]	—	—	200	—	—	200	—	—	200	mV pk
CAPACITIVE LOAD [1] T_C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	500	—	—	500	—	—	500	µF

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Indefinite short circuit protection not guaranteed above 125°C (case).
3. Recovery time is measured from application of the transient to point at which Vout is within 1% of Vout at final value.
4. Step load test is performed at 10 microseconds typical.
5. Step line test is performed at 100 microseconds ± 20 microseconds.

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TABLE 7: ELECTRICAL CHARACTERISTICS -55°C TO +125°C CASE, 28 VIN, 100% LOAD, UNLESS OTHERWISE SPECIFIED.

MSA+ SINGLE OUTPUT MODELS		MSA+2812S			MSA+2815S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		11.52	12.00	12.48	14.40	15.00	15.60	V
OUTPUT CURRENT	V_{IN} = 15 to 50	0	—	500	0	—	400	mA
OUTPUT POWER	V_{IN} = 15 to 50	0	—	6	0	—	6	W
OUTPUT RIPPLE	T_C = 25°C	—	50	100	—	50	100	mV p-p
10 kHZ - 10 MHZ	T_C = -55°C TO +125°C	—	—	120	—	—	120	
LINE REGULATION	V_{IN} = 15 to 50	—	10	50	—	10	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	10	50	—	10	50	mV
INPUT VOLTAGE	CONTINUOUS	15	28	50	15	28	50	V
NO LOAD TO FULL	TRANSIENT 1 sec [1]	—	—	80	—	—	80	V
INPUT CURRENT	NO LOAD	—	29	42	—	31	44	mA
	INHIBITED	—	3	6	—	3	6	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	70	150	—	70	150	mA p-p
EFFICIENCY	T_C = 25°C	70	76	—	73	78	—	%
	T_C = -55°C TO +125°C	68	—	—	72	77	—	
LOAD FAULT [2, 3]	POWER DISSIPATION	—	—	2.5	—	—	2.5	W
SHORT CIRCUIT	RECOVERY [1]	—	—	30	—	—	30	ms
STEP LOAD RESPONSE [3, 4]	TRANSIENT	—	—	±750	—	—	±750	mV pk
50% - 100% - 50%	RECOVERY	—	—	1200	—	—	1200	µs
STEP LINE RESPONSE [1, 3, 5]	TRANSIENT	—	—	±1300	—	—	±1600	mV pk
16 - 40 - 16 V	RECOVERY	—	—	2000	—	—	2000	µs
START-UP [3]	DELAY	—	—	30	—	—	30	ms
0 - 28 V_{IN}, FULL LOAD	OVERSHOOT [1]	—	—	200	—	—	200	mV pk
CAPACITIVE LOAD [1] T_C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	500	—	—	500	µF

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Indefinite short circuit protection not guaranteed above 125°C (case).
3. Recovery time is measured from application of the transient to point at which Vout is within 1% of Vout at final value.
4. Step load test is performed at 10 microseconds typical.
5. Step line test is performed at 100 microseconds ± 20 microseconds.

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TABLE 8: ELECTRICAL CHARACTERISTICS -55°C TO +125°C CASE, 28 VIN, 100% LOAD, UNLESS OTHERWISE SPECIFIED.

MSA+ DUAL OUTPUT MODELS		MSA+2805D			MSA+286R3D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	$+V_{OUT}$	4.80	5.00	5.20	6.10	6.30	6.50	V
	$-V_{OUT}$	4.75	5.00	5.25	6.05	6.30	6.55	
OUTPUT CURRENT [2]	EITHER OUTPUT	–	±600	960	–	±475	760	mA
V_{IN} = 15 to 50	TOTAL OUTPUT	–	–	1200	–	–	950	
OUTPUT POWER [2]	EITHER OUTPUT	–	±3	4.8	–	±3	4.8	W
V_{IN} = 15 to 50	TOTAL OUTPUT	–	–	6	–	–	6	
OUTPUT RIPPLE	T_C = 25°C	–	–	80	–	–	100	mV p-p
10 kHZ - 10 MHZ ± V_{OUT}	T_C = -55°C TO +125°C	–	–	100	–	–	120	
LINE REGULATION	$+V_{OUT}$	–	10	25	–	10	50	mV
V_{IN} = 15 TO 50	$-V_{OUT}$	–	40	75	–	40	150	
LOAD REGULATION	$+V_{OUT}$	–	10	50	–	–	75	mV
NO LOAD TO FULL	$-V_{OUT}$	–	115	200	–	50	200	
CROSS REGULATION [1, 3]	20-80%	–	10	–	–	10	–	%
EFFECT ON $-V_{OUT}$	50-20%	–	5	8	–	5	8	
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	15	28	50	15	28	50	V
	TRANSIENT 1 sec [1]	–	–	80	–	–	80	V
INPUT CURRENT	NO LOAD	–	30	35	–	30	40	mA
	INHIBITED	–	3	6	–	3	6	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	–	90	160	–	90	160	mA p-p
EFFICIENCY	T_C = 25°C	68	72	–	69	75	–	%
	T_C = -55°C TO +125°C	65	–	–	67	–	–	
LOAD FAULT [4, 5]	POWER DISSIPATION	–	–	2.0	–	–	2.0	W
SHORT CIRCUIT	RECOVERY [1]	–	–	30	–	–	30	ms
STEP LOAD RESPONSE [5, 6]	TRANSIENT	–	–	±500	–	–	±500	mV pk
50% - 100% - 50%	RECOVERY	–	–	1000	–	–	3000	µs
STEP LINE RESPONSE [1, 4, 7]	TRANSIENT	–	–	±600	–	–	±600	mV pk
16 - 40 - 16 V	RECOVERY	–	–	1500	–	–	1500	µs
START-UP [5]	DELAY	–	–	30	–	–	30	ms
0 TO 28 V_{IN}, FULL LOAD	OVERSHOOT [1]	–	–	200	–	–	200	mV pk
CAPACITIVE LOAD [1, 8] T_C = 25°C	NO EFFECT ON DC PERFORMANCE	–	–	500	–	–	500	µF

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Up to 4.8 watts (80% of full power) is available from either output providing the opposite output is carrying 20% of total power.
3. Shows regulation effect on the minus output during defined cross loading conditions.
4. Indefinite short circuit protection not guaranteed above 125°C (case).
5. Recovery time is measured from application of the transient to point at which Vout is within 1% of Vout at final value.
6. Step load test is performed at 10 microseconds typical.
7. Step line test is performed at 100 microseconds ± 20 microseconds.
8. Each output.

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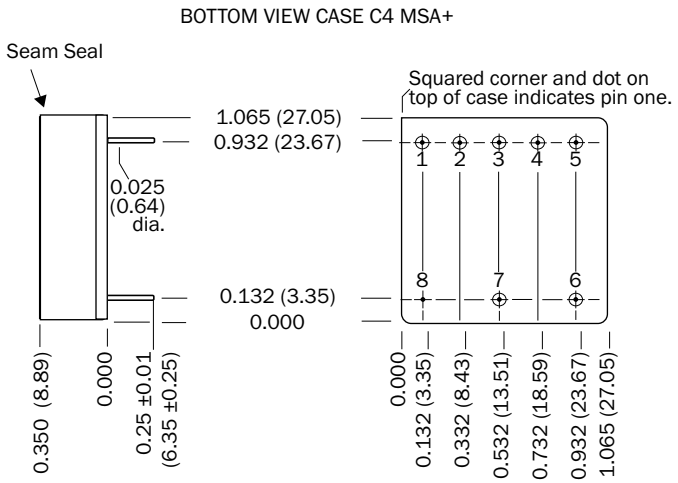
TABLE 9: ELECTRICAL CHARACTERISTICS -55°C TO +125°C CASE, 28 VIN, 100% LOAD, UNLESS OTHERWISE SPECIFIED.

MSA+ DUAL OUTPUT MODELS		MSA+2812D			MSA+2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	$+V_{OUT}$	11.52	12.00	12.48	14.40	15.00	15.60	V
	$-V_{OUT}$	11.04	12.00	12.96	13.80	15.00	16.20	
OUTPUT CURRENT [2]	EITHER OUTPUT	—	±250	400	—	±200	320	mA
V_{IN} = 15 to 50	TOTAL OUTPUT	—	—	500	—	—	400	
OUTPUT POWER [2]	EITHER OUTPUT	—	±3	4.8	—	±3	4.8	W
V_{IN} = 15 to 50	TOTAL OUTPUT	—	—	6	—	—	6	
OUTPUT RIPPLE	T_C = 25°C	—	—	100	—	—	100	mV p-p
10 kHZ - 10 MHZ ± V_{OUT}	T_C = -55°C TO +125°C	—	—	120	—	—	120	
LINE REGULATION	$+V_{OUT}$	—	10	50	—	10	50	mV
V_{IN} = 15 TO 50	$-V_{OUT}$	—	—	50	—	—	50	
LOAD REGULATION	$+V_{OUT}$	—	10	50	—	10	50	mV
NO LOAD TO FULL	$-V_{OUT}$	—	90	200	—	—	200	
CROSS REGULATION [1, 3]	20-80%	—	4	—	—	3	—	%
EFFECT ON $-V_{OUT}$	50-20%	—	3.7	6	—	3	6	
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	15	28	50	15	28	50	V
	TRANSIENT 1 sec [1]	—	—	80	—	—	80	V
INPUT CURRENT	NO LOAD	—	25	40	—	20	40	mA
	INHIBITED	—	3	6	—	3	6	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	70	150	—	70	150	mA p-p
EFFICIENCY	T_C = 25°C	74	—	—	73	—	—	%
	T_C = -55°C TO +125°C	74	—	—	72	—	—	
LOAD FAULT [4, 5]	POWER DISSIPATION	—	—	2.0	—	—	2.0	W
SHORT CIRCUIT	RECOVERY [1]	—	—	30	—	—	30	ms
STEP LOAD RESPONSE [5, 6]	TRANSIENT	—	—	±450	—	—	±450	mV pk
50% - 100% - 50%	RECOVERY	—	—	2000	—	—	2000	µs
STEP LINE RESPONSE [1, 4, 7]	TRANSIENT	—	—	±1300	—	—	±1500	mV pk
16 - 40 - 16 V	RECOVERY	—	—	2000	—	—	1200	µs
START-UP [5]	DELAY	—	—	30	—	—	30	ms
0 TO 28 V_{IN}, FULL LOAD	OVERSHOOT [1]	—	—	200	—	—	200	mV pk
CAPACITIVE LOAD [1, 8] T_C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	500	—	—	500	µF

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Up to 4.8 watts (80% of full power) is available from either output providing the opposite output is carrying 20% of total power.
3. Shows regulation effect on the minus output during defined cross loading conditions.
4. Indefinite short circuit protection not guaranteed above 125°C (case).
5. Recovery time is measured from application of the transient to point at which Vout is within 1% of Vout at final value.
6. Step load test is performed at 10 microseconds typical.
7. Step line test is performed at 100 microseconds ± 20 microseconds.
8. Each output.

MSA+ Single and Dual DC-DC Converters

PRELIMINARY - 15 TO 50 VOLT INPUT – 6 WATT



Weight: 23 grams maximum

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

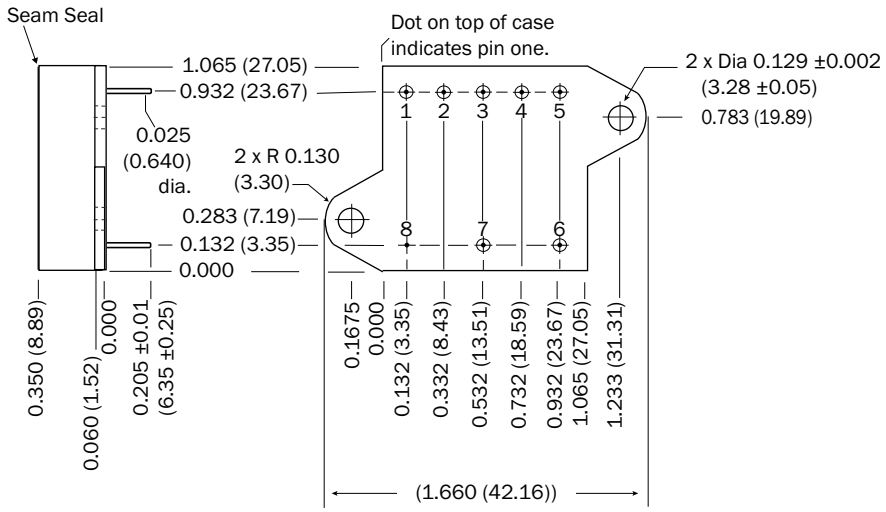
Header	Cold Rolled Steel/Nickel/Gold
Cover	Cold Rolled Steel/Nickel
Pins	#52 alloy, gold, compression glass seal Gold plating of 50 - 100 microinches included in pin diameter Seal hole: 0.070 ±0.003 (1.78 ±0.08)

Please refer to the numerical dimensions for accuracy.

FIGURE 7: MSA+ CASE DIMENSIONS

BOTTOM VIEW CASE D6 MSA+ OFFSET FLANGE

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



Weight: 25 grams maximum

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	Cold Rolled Steel/Nickel
Pins	#52 alloy, gold, compression glass seal Gold plating of 50 - 100 microinches included in pin diameter Seal hole: 0.070 ±0.003 (1.78 ±0.08)

FIGURE 8: MSA+ OFFSET FLANGED CASE DIMENSIONS

MSA+ Single and Dual DC-DC Converters

PRELIMINARY - 15 TO 50 VOLT INPUT – 6 WATT

ELEMENT EVALUATION [1] HIGH RELIABILITY /883 (CLASS H)

	QML	
	CLASS H /883	
COMPONENT-LEVEL TEST PERFORMED	M/S [2]	P [3]
Element Electrical	■	■
Visual	■	■
Internal Visual	■	
Final Electrical	■	■
Wire Bond Evaluation	■	■

Notes
1. Element evaluation does not apply to standard and /ES product.
2. M/S = Active components (microcircuit and semiconductor die).
3. P = Passive components, Class H element evaluation. Not applicable to standard and /ES element evaluation.

TABLE 10: ELEMENT EVALUATION

MSA+ Single and Dual DC-DC Converters

PRELIMINARY - 15 TO 50 VOLT INPUT – 6 WATT

ENVIRONMENTAL SCREENING HIGH RELIABILITY STANDARD, /ES AND /883 (CLASS H)

	NON-QML [1]		CLASS H QML [2]
TEST PERFORMED	**STANDARD**	**/ES**	**/883**
Pre-cap Inspection, Method 2017, 2032	■	■	■
Temperature Cycle (10 times)			
Method 1010, Cond. C, -65°C to +150°C, ambient			■
Method 1010, Cond. B, -55°C to +125°C, ambient		■	
Constant Acceleration			
Method 2001, 3000 g			■
Method 2001, 500 g		■	
PIND, Test Method 2020, Cond. A			■ [3]
Burn-in Method 1015, +125°C case, typical [4]			
96 hours		■	
160 hours			■
Final Electrical Test, MIL-PRF-38534, Group A,			
Subgroups 1 through 6, -55°C, +25°C, +125°C case			■
Subgroups 1 and 4, +25°C case	■	■	
Hermeticity Test, Method 1014			
Gross Leak, Cond. C_1, fluorocarbon		■	■
Fine Leak, Cond. A_2, helium		■	■
Gross Leak, Dip	■		
Final visual inspection, Method 2009	■	■	■

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

Notes
1. Non-QML products may not meet all of the requirements of MIL-PRF-38534.
2. All processes are QML qualified and performed by certified operators.
3. Not required by DLA but performed to assure product quality.
4. Burn-in temperature designed to bring the case temperature to +125°C minimum. Burn-in is a powered test.

TABLE 11: ENVIRONMENTAL SCREENING