MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

FEATURES

- Hermetically sealed case, 0.33 inches (8.38 mm) high
- Operating temperature –55° to +125°C
- Input voltage 16 to 40 volts
- MHF+281R9S 20 to 32 volts
  - Triple output models 16 to 48 volts
- Transient protection
  - Single and dual: 50 volts for 50 ms
  - MHF+281R9S: 35 volts for 50 ms
  - Triple: 80 volts for 120 ms
- Fully isolated
- Fixed high frequency switching
- Inhibit and synchronization functions
- Indefinite short circuit protection
- Under voltage lockout

MODELS OUTPUT VOLTAGE (V)		
SINGLE	DUAL	TRIPLE
1.9	±5	+5 & ±12
3.3	±12	+5 & ±15
5	±15	
5.2		
5.3		
12		
15		
28		

MHF+ SERIES™ SINGLES AND DUALS

DESCRIPTION

Interpoint® MHF+ Series singles and duals are high frequency DC-DC converters offering a wide input voltage range of 16 to 40 volts (MHF+281R9S, 20 to 32 volts) and up to 15 watts of output power. Transient protection up to 50 volts for up to 50 ms. The converters are offered with standard screening, “ES” screening, or fully compliant to “883” MIL-PRF-38534 Class H screening (see Table 13 on page 23). Standard Microcircuit Drawings (SMD) are available (see Table 3 on page 7.

CONVERTER DESIGN

The MHF+ Series single and dual converters are switching regulators that use a quasi-square wave, single-ended forward converter design with a constant switching frequency of 550 kHz typical. Isolation between input and output circuits is provided with a transformer in the forward path and a temperature compensated optical link in the feedback control loop. See Figure 1 and Figure 2 on page 3.

For the MHF+ dual output models, good cross regulation is maintained by tightly coupled output magnetics. Up to 90% of the total output power (80% on 2805D) is available from either output, providing the opposite output is simultaneously carrying 10% of the total output power (20% on 2805D models). Predictable current limit is accomplished by directly monitoring the output load current and providing a constant current output above the overload point.

INHIBIT FUNCTION

MHF+ converters provide an inhibit terminal that can be used to disable internal switching, resulting in no output current and very low quiescent input current. The converter is inhibited when the inhibit pin is pulled low (≤0.8 V = output disabled).

The unit is enabled when the pin, which is internally connected to a pull-up resistor, is left unconnected or is connected to an open-collector gate. The open circuit output voltage associated with the inhibit pin is 8.5 to 12 volts. In the inhibit mode with 28 volts in, a maximum of 5 mA must be sunk from the inhibit pin. See Figure 6 on page 5

SYNCHRONIZATION

An external synchronization feature is included that allows the user to adjust the nominally 550 kHz operating frequency to any frequency within the range of 500 kHz to 600 kHz. This is initiated by applying a signal input of the desired frequency to pin 5. The capacitively coupled sync input will synchronize on a differential signal of as low as 4 volts to as high as 5 volts. For single and dual output models, if the sync function is not used, connect the terminal to input common.

SHORT CIRCUIT PROTECTION

MHF+ Series single and dual output converters provide short circuit protection by restricting the output current to approximately 115% of the full load output current. The output current is sensed in the secondary stage to provide highly predictable and accurate current limiting, and to eliminate foldback characteristics.

UNDERVOLTAGE LOCKOUT

Undervoltage lockout prevents the single and dual output converters from operating below approximately 14 Volts input voltage to keep system current levels smooth, especially during initialization or re-start operations.

PACKAGING

MHF+ Series of converters are packaged in hermetically sealed metal cases and can be purchased in a flanged or non-flanged case. The flanged option provides increased heat dissipation and also provides greater stability when mechanically secured.

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

MHF+ SERIES™ TRIPLE DC-DC CONVERTERS

DESCRIPTION

MHF+ Series™ Triple DC-DC converters provide a wide input voltage range of 16 to 48 volts delivering 15 watts of total output power with output voltages of +5 and ±12 or +5 and ±15 volts. The main output, +5 volts, will supply up to 7.5 watts and the auxiliaries will supply up to 7.5 watts of combined power. Full power operation at -55°C to +125°C plus the ability to withstand transients of up to 80 V for up to 120 milliseconds make these converters an ideal choice for your high reliability systems.

Converter Design

MHF+ Triple Series of DC-DC converters incorporate dual-phase, phase-shifted technology with a continuous flyback topology. This design eliminates a minimum load requirement on the main output and eliminates cross regulation effects between the main output voltage and auxiliary output voltages. See Figure 3 on page 4.

The phase-shifted design offers reduced input and output ripple. To meet MIL-STD-461 requirements use an EMI filter, see Figure 4 on page 4. FMCE-0328 is the recommended filter.

Inhibit Function

MHF+ converters provide an inhibit terminal that can be used to disable internal switching, resulting in no output current and very low quiescent input current. The converter is inhibited when the inhibit pin is pulled low (≤0.8 V = output disabled). The unit is enabled when the inhibit pin, which is internally connected to a pull-up resistor, is left unconnected or is connected to an open-collector gate. When inhibited, input current is reduced to 5 mA or less and there is no generation of switching noise. The inhibit terminal typically sinks 5 mA when the converter is inhibited. See Figure 7 on page 5.

Soft Start Feature

The soft-start feature provides a controlled 25 milliseconds maximum turn-on to minimize inrush current and reduce overshoot at initial start-up or when inhibit is released.

Synchronization

To synchronize the converter's switching frequency to a system clock apply the clock signal to the sync terminal (pin 7). When multiple converters are powered from a single power source, asynchronous (free run) operation will result in lower peak noise for common spectral peaks, but synchronous operation will eliminate any possibility of interference frequencies in the low audio band. Source impedance of the signal should be less than 100 ohms and the transition time should be less than 100 nanoseconds. The capacitively coupled sync input will synchronize on a differential signal of as low as 4 volts to as high as 5 V. For triple output models, if the sync function is not used, the terminal should be left open. See Figure 5 on page 4.

Short Circuit Protection

On the triple output models, internal current limiting circuitry protects on all three outputs against short circuits. When output power exceeds approximately 130% of maximum output power, the output power is limited. In addition, separate current limiting circuitry protects each output individually resulting in normal operation of either the main or the auxiliaries, whichever is not in a shorted condition.

Undervoltage Lockout

Undervoltage lockout prevents the triple output models units from operating below approximately 8.5 volts input voltage to keep system current levels smooth, especially during initialization or re-start operations.

Packaging

MHF+ Series of converters are packaged in hermetically sealed metal cases and can be purchased in a flanged or non-flanged case. The flanged option provides increased heat dissipation and also provides greater stability when mechanically secured.

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

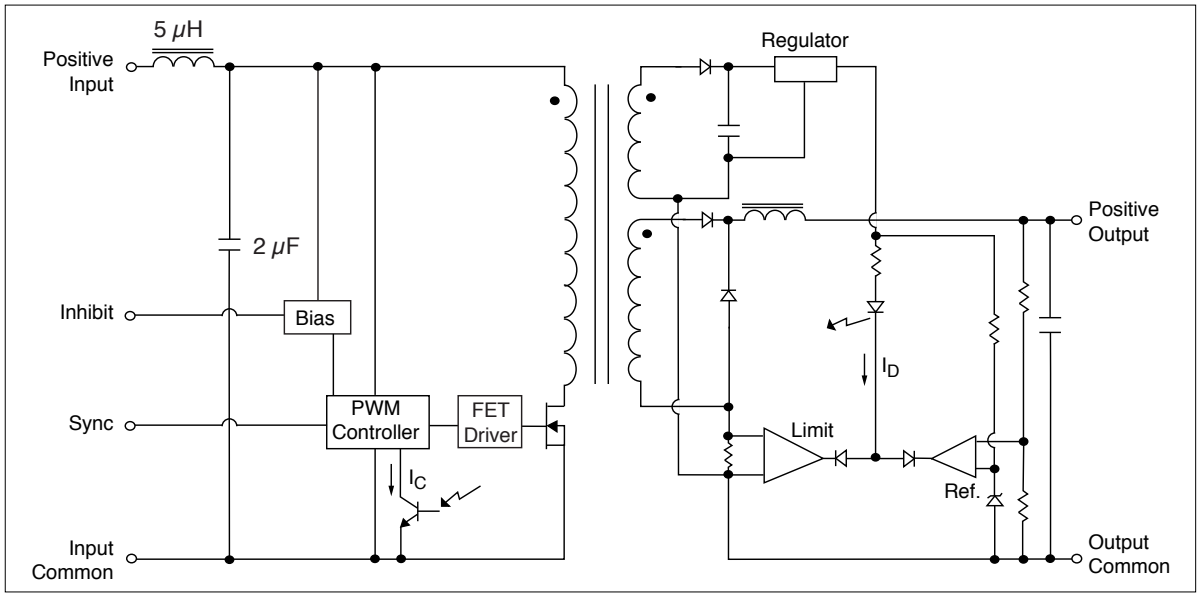


FIGURE 1: MHF+ SINGLE OUTPUT BLOCK DIAGRAM

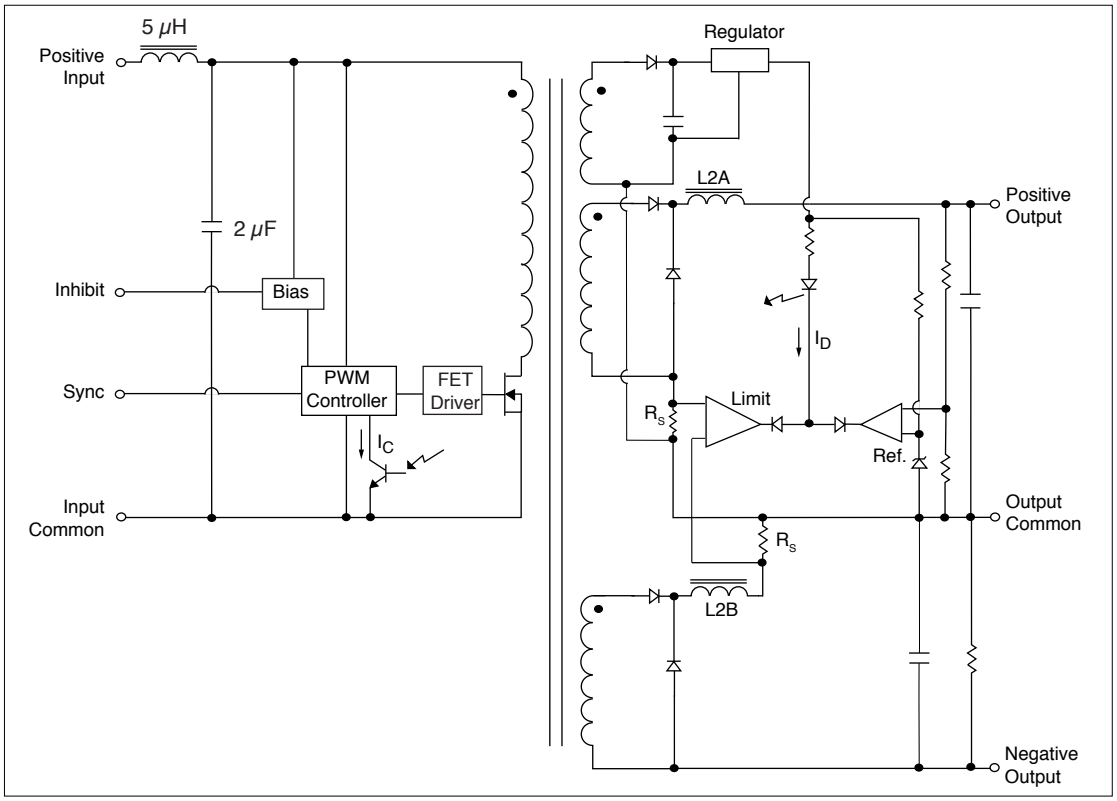


FIGURE 2: MHF+ DUAL OUTPUT BLOCK DIAGRAM

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

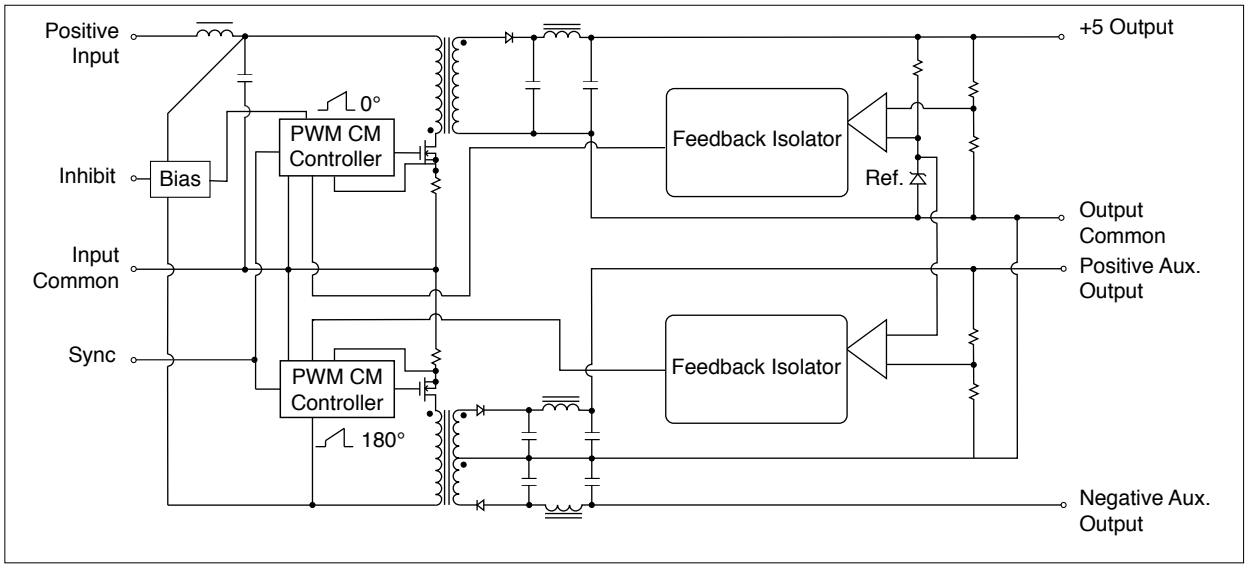


FIGURE 3: MHF+ TRIPLE OUTPUT BLOCK DIAGRAM

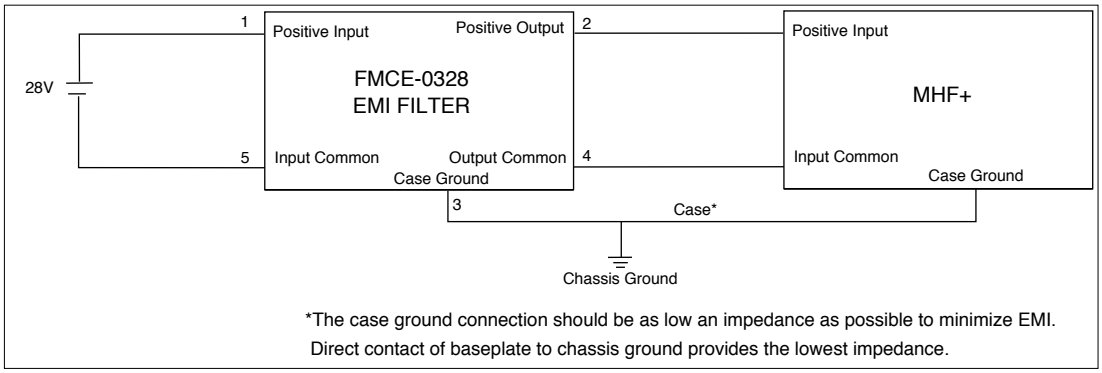
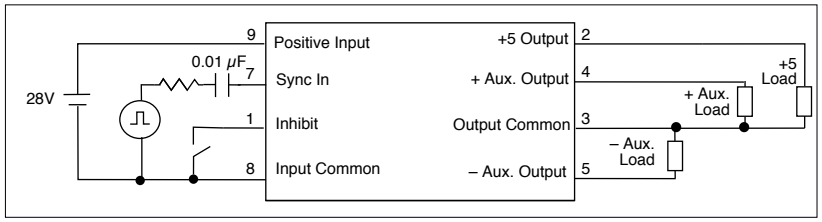


FIGURE 4: EMI FILTER CONNECTION



If the sync terminal (pin 7) is not used, it must be left floating.
The ac coupling shown will prevent sync signal failure.

FIGURE 5: AC COUPLING OF SYNC SIGNAL, TRIPLE MODELS

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

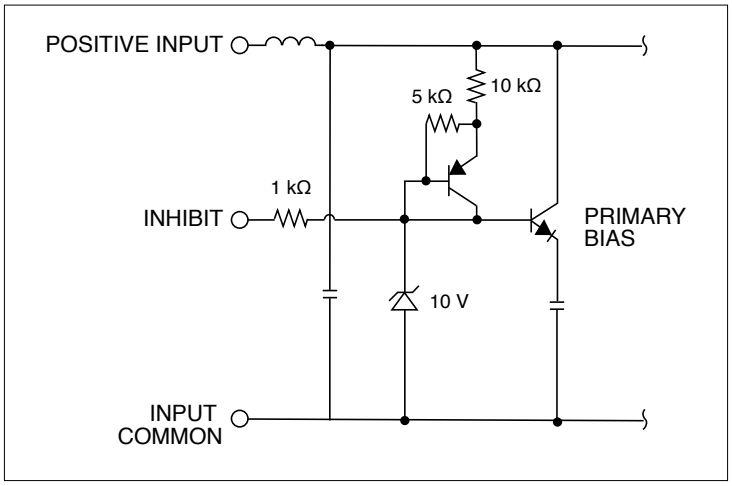


FIGURE 6: INHIBIT INTERFACE SINGLES AND DUALS

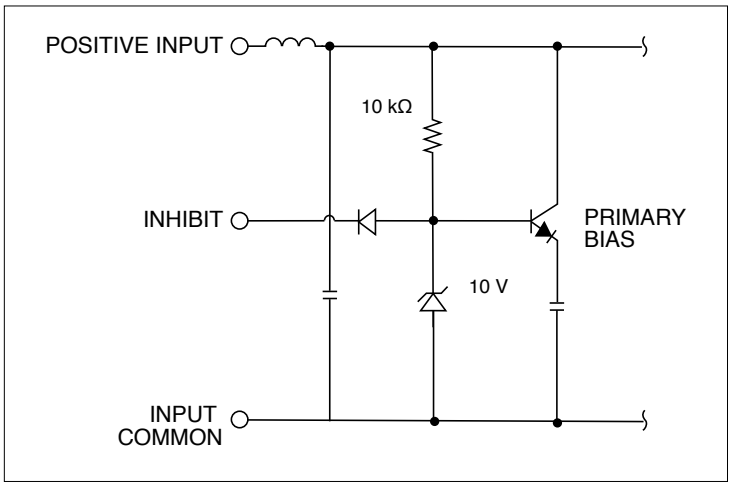


FIGURE 7: INHIBIT INTERFACE TRIPLES

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

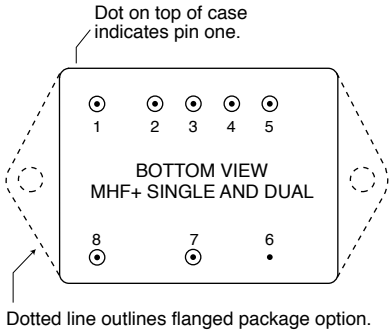
PIN OUT				
Pin	**Single Output**	**MHF+2828S**	**Dual Output**	**Triple Output**
1	Inhibit	Inhibit	Inhibit	Inhibit
2	No Connection	Positive Output	Positive Output	Main (+5) Output
3	Output Common	(See note 1)	Output Common	Output Common
4	Positive Output	Output Common	Negative Output	Pos. Aux. Output
5	Sync In	Sync In	Sync In	Neg. Aux. Output
6	Case Ground	Case Ground	Case Ground	Case Ground
7	Input Common	Input Common	Input Common	Sync
8	Positive Input	Positive Input	Positive Input	Input Common
9	—	—	—	Positive Input

1. Pin 3 of MHF+2828S will provide 14 V_{OUT} referenced to output common (pin 4).

TABLE 1: PIN OUT

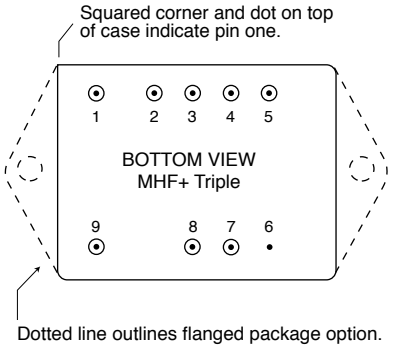
PINS NOT IN USE	
Inhibit: single, dual and triple, pin 1	Leave unconnected
MHF+2828S, pin 3	Leave unconnected
Sync: single and dual, pin 5	Connect to input common
Sync: triple, pin 7	Leave unconnected

TABLE 2: PINS NOT IN USE



See Figure 34 on page 18 and Figure 36 on page 20 for dimensions.

FIGURE 8: MHF+ SINGLE AND DUAL PIN OUT



See Figure 35 on page 19 and Figure 37 on page 21 for dimensions.

FIGURE 9: MHF+ TRIPLE PIN OUT

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

MODEL NUMBERING KEY

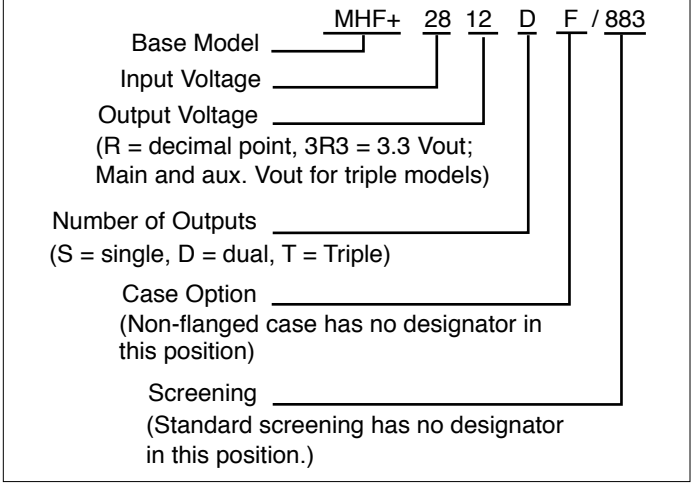


FIGURE 10: MODEL NUMBERING KEY

SMD NUMBERS

STANDARD MICROCIRCUIT DRAWING (SMD)	MHF+ SIMILAR PART
5962-0251001HXC	MHF+283R3S/883
5962-9213901HXC	MHF+2805S/883
5962-0325301HXC	MHF+285R2S/883
5962-9166401HXC	MHF+2812S/883
5962-9160101HXC	MHF+2815S/883
5962-9689801HXC	MHF+2828S/883
5962-9555901HXC	MHF+2805D/883
5962-9214401HXC	MHF+2812D/883
5962-9161401HXC	MHF+2815D/883
5962-9560101HXC	MHF+28512T/883
5962-9560201HXC	MHF+28515T/883

Flanged SMDs have the suffix HZC instead of HXC.
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 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 Option [4]	Screening [5]
OPTIONS	MHF+28	1R9, 3R3, 05, 5R2, 5R3, 12, 15, 28	S	(non-flanged, leave blank)	Standard (leave blank)
		05, 12, 15	D	F (flanged)	/ES
		512, 515	T		/883 (Class H)
FILL IN FOR MODEL #	MHF+28	_____	_____	_____	/ _____

Notes
1. See Figure 10 on page 7 above for an example of a model number.
2. Output Voltage: An R indicates a decimal point. 1R9 is 1.9 volts out. The values of 1R9, 3R3, 5R2 and 5R3 are only available in single output models. The 512 and 515 triple output converters are +5 volt main and ±12 or ±15 volt auxiliaries.
3. Number of Outputs: S is a single output, D is a dual output, and T is a triple output
4. Case Options: For the standard, non-flanged, case leave the case option blank. See non-flanged cases Figure 34 on page 18 and Figure 35 on page 19. For the flanged case use an F in the case option position. See flanged cases Figure 36 on page 20 and Figure 37 on page 21).
5. Screening: For standard screening leave the screening option blank. For other screening options, insert the desired screening level. For more information see Table 12 on page 22 and Table 13 on page 23.

TABLE 4: MODEL NUMBER OPTIONS

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

TABLE 5: OPERATING CONDITIONS, ALL MODELS : 25°C CASE, 28 VIN, 100% LOAD, UNLESS OTHERWISE SPECIFIED.

		ALL MODELS			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	
LEAD SOLDERING TEMPERATURE [1]	10 SECONDS MAX.	—	—	300	°C
STORAGE TEMPERATURE [1]		-65	—	+150	°C
CASE OPERATING	FULL POWER	-55	—	+125	°C
TEMPERATURE	ABSOLUTE [1]	-55	—	+135	
DERATING OUTPUT POWER/CURRENT [1]	LINEARLY	From 100% at 125°C to 0% at 135°C			
ESD RATING [1]	MIL-STD-883, METHOD 3015	>8000			V
MIL-PRF-38534, 3.9.5.8.2	CLASS 3				
ISOLATION: INPUT TO OUTPUT OR ANY	@ 500 VDC AT 25°C	100	—	—	Megohms
PIN TO CASE EXCEPT CASE PIN					
UNDERVOLTAGE LOCKOUT	SINGLES AND DUALS	—	14	—	V
	TRIPLES	—	8.5	—	
INPUT TO OUTPUT CAPACITANCE [1]		—	60	—	pF
CURRENT LIMIT [2]	SINGLES AND DUALS	—	115	—	%
% OF FULL LOAD	TRIPLES	—	130	—	
AUDIO REJECTION [1]		—	50	—	dB
CONVERSION FREQUENCY	SINGLES AND DUALS	480	—	620	kHz
FREE RUN -55°C TO +125°C	TRIPLES	375	—	500	
SYNCHRONIZATION [3]	INPUT FREQUENCY				
	SINGLES AND DUALS	500	—	600	kHz
	TRIPLES	400	—	600	
	DUTY CYCLE [1]	40	—	60	%
	ACTIVE LOW	—	—	0.8	V
	ACTIVE HIGH [1]	4.0	—	5.0	
	REFERENCED TO	INPUT COMMON			
	IF NOT USED, SINGLES AND DUALS	CONNECT TO INPUT COMMON			
	IF NOT USED, TRIPLES	LEAVE UNCONNECTED			
INHIBIT ACTIVE LOW (OUTPUT DISABLED)	INHIBIT PIN PULLED LOW	—	—	0.8	V
Do not apply a voltage to the inhibit pin. [4]	INHIBIT PIN SOURCE CURRENT [1, 5]	—	—	5	mA
	REFERENCED TO	INPUT COMMON			
INHIBIT ACTIVE HIGH (OUTPUT ENABLED)	INHIBIT PIN CONDITION	OPEN COLLECTOR OR UNCONNECTED			
Do not apply a voltage to the inhibit pin. [4]					
	OPEN INHIBIT PIN VOLTAGE [1]				
	SINGLE AND DUAL	8.5	10	12	V
	TRIPLE	—	11	—	

For mean time between failures (MTBF) contact Applications Engineering: powerapps@crane-eg.com or +1 425.882.3100 option 7

Notes
1. Guaranteed by design and/or analysis. Not an in-line test.
2. Dual and triple outputs: The over-current limit will trigger when the sum of the currents from both dual outputs or both auxiliary outputs (triple) reaches the maximum rated “total” current of both outputs. Typical values are stated in the table.
3. Triple models: Source impedance should be <100 ohms and the transition times should be <100 nanoseconds.
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.
5. Inhibit source current is equal to V_{IN} / 10 k ohms.

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

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

SINGLE OUTPUT MODELS		MHF+281R9S			MHF+283R3S			MHF+2805S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		1.84	1.90	1.96	3.20	3.30	3.40	4.85	5.00	5.15	V
OUTPUT CURRENT [2]	V_{IN} = 16 TO 40 V	0	–	3.5	0	—	2.4	0	—	2.4	A
OUTPUT POWER [2]	V_{IN} = 16 TO 40 V	0	—	6.65	0	—	8	0	—	12	W
OUTPUT RIPPLE	T_C = 25°C	—	7	30	—	30	80	—	30	80	mV p-p
10 kHz - 2 MHz	T_C = -55°C TO +125°C	—	12	40	—	50	240	—	60	100	
LINE REGULATION	V_{IN} = 16 TO 40 V	—	1	40	–	5	100	—	5	50	mV
LOAD REGULATION [3]	NO LOAD TO FULL	—	35	55	–	20	50	—	20	50	mV
INPUT VOLTAGE	CONTINUOUS	20	28	32	16	28	40	16	28	40	V
NO LOAD TO FULL	TRANSIENT 50 ms [1]	—	—	35	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	16	35	—	25	40	—	25	40	mA
	INHIBITED	—	2	7	—	5	12	—	5	12	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	30	70	–	45	120	—	35	100	mA p-p
EFFICIENCY	T_C = 25°C	58	62	—	70	75	–	75	77	—	%
	T_C = -55°C TO +125°C	56	—	—	67	—	—	72	—	—	
LOAD FAULT [4]	POWER DISSIPATION	—	4	8	—	5	8	—	3.5	6	W
SHORT CIRCUIT	RECOVERY [1]	—	5	30	—	7.5	30	—	7.5	30	ms
STEP LOAD RESPONSE [5, 6]	TRANSIENT	—	±75	±500	—	±150	±400	—	±150	±400	mV pk
50% - 100% - 50%	RECOVERY	—	500	2000	—	150	300	—	150	300	µs
STEP LINE RESPONSE [1, 5, 7, 8]	TRANSIENT	—	±300	±600	—	±550	±800	—	±550	±800	mV pk
V_{IN} = 16 - 40 - 16 V	RECOVERY	—	0.5	1.2	—	0.8	1.2	—	0.8	1.2	ms
START-UP [9]	DELAY	—	12	35	–	10	25	—	10	25	ms
	OVERSHOOT [1]	—	500	850	—	200	300	—	100	600	mV pk
CAPACITIVE LOAD [1, 10]	T_C = 25°C	—	—	100	–	–	300	–	–	300	µF

Notes
1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. V_{IN} is 20 to 32 volts for MHF+281R9S.
3. For MHF+281R9, load regulation is tested from a 10 mA load to full load.
4. Indefinite short circuit protection not guaranteed above 125°C (case).
5. Recovery time is measured from application of the transient to the point at which V_{OUT} is within regulation.
6. Step load test is performed at 10 microseconds typical.
7. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
8. Step line is 20 - 32 - 20 volts for MHF+281R39S.
9. Measured on release from inhibit.
10. No effect on dc performance.

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

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

SINGLE OUTPUT MODELS		MHF+285R2S			MHF+285R3S			MHF+2812S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		5.04	5.20	5.36	5.19	5.30	5.51	11.76	12.00	12.24	V
OUTPUT CURRENT	V_{IN} = 16 TO 40 V	0	—	2.4	0	—	2.83	0	—	1.25	A
OUTPUT POWER	V_{IN} = 16 TO 40 V	0	—	12.48	0	—	15	0	—	15	W
OUTPUT RIPPLE	T_C = 25°C	—	30	50	—	30	50	—	30	80	mV p-p
10 kHz - 2 MHz	T_C = -55°C TO +125°C	—	60	100	—	60	100	—	50	120	
LINE REGULATION	V_{IN} = 16 TO 40 V	—	5	50	—	5	50	—	5	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	20	50	—	20	50	—	20	50	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	16	28	40	16	28	40	V
NO LOAD TO FULL	TRANSIENT 50 ms [1]	—	—	50	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	25	43	—	24	43	—	25	50	mA
	INHIBITED	—	5	12	—	5	12	—	5	12	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	35	120	—	35	120	—	35	120	mA p-p
EFFICIENCY	T_C = 25°C	75	77	—	75	77	—	78	79	—	%
	T_C = -55°C TO +125°C	72	—	—	72	—	—	74	—	—	
LOAD FAULT [2]	POWER DISSIPATION	—	3.5	6	—	3.5	6	—	3.5	6	W
SHORT CIRCUIT	RECOVERY [1]	—	7.5	30	—	7.5	30	—	7.5	30	ms
STEP LOAD RESPONSE [3, 4]	TRANSIENT	—	±150	±400	—	±150	±400	—	±150	±500	mV pk
50% - 100% - 50%	RECOVERY	—	150	300	—	150	300	—	150	300	µs
STEP LINE RESPONSE [1, 3, 5]	TRANSIENT	—	±550	±800	—	±550	±800	—	±550	±800	mV pk
V_{IN} = 16 - 40 - 16 V	RECOVERY	—	0.8	1.2	—	0.8	1.2	—	0.8	1.2	ms
START-UP [6]	DELAY	—	10	25	—	10	25	—	10	25	ms
	OVERSHOOT [1]	—	100	600	—	100	600	—	200	1200	mV pk
CAPACITIVE LOAD [1, 7]	T_C = 25°C	—	—	300	—	—	300	—	—	100	µF

Notes
1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. Indefinite short circuit protection not guaranteed above 125°C case.
3. Recovery time is measured from application of the transient to the point at which V_{OUT} is within regulation.
4. Step load test is performed at 10 microseconds typical.
5. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
6. Measured on release from inhibit.
7. No effect on dc performance.

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

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

SINGLE OUTPUT MODELS		MHF+2815S			MHF+2828S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		14.70	15.00	15.30	27.44	28.00	28.56	V
OUTPUT CURRENT	V_{IN} = 16 TO 40 V	0	—	1.00	0	—	0.536	A
OUTPUT POWER	V_{IN} = 16 TO 40 V	0	—	15	0	—	15	W
OUTPUT RIPPLE	T_C = 25°C	—	30	80	—	60	120	mV p-p
10 kHz - 2 MHz	T_C = -55°C TO +125°C	—	50	120	—	100	180	
LINE REGULATION	V_{IN} = 16 TO 40 V	—	5	50	—	50	150	mV
LOAD REGULATION	NO LOAD TO FULL	—	20	50	—	50	150	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	16	28	40	V
NO LOAD TO FULL	TRANSIENT 50 ms [1]	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	25	62	—	25	60	mA
	INHIBITED	—	5	12	—	5	12	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	35	120	—	35	120	mA p-p
EFFICIENCY	T_C = 25°C	78	80	—	82	84	—	%
	T_C = -55°C TO +125°C	74	—	—	78	—	—	
LOAD FAULT [2]	POWER DISSIPATION	—	3.5	6	—	3.5	6	W
SHORT CIRCUIT	RECOVERY [1]	—	7.5	30	—	7.5	30	ms
STEP LOAD RESPONSE [3, 4]	TRANSIENT	—	±200	±600	—	±600	±800	mV pk
50% - 100% - 50%	RECOVERY	—	150	300	—	200	400	µs
STEP LINE RESPONSE [1, 3, 5]	TRANSIENT	—	±550	±800	—	±1100	±1200	mV pk
V_{IN} = 16 - 40 - 16 V	RECOVERY	—	0.8	1.2	—	0.8	1.2	ms
START-UP [6]	DELAY	—	10	25	—	10	25	ms
	OVERSHOOT [1]	—	200	1500	—	200	280	mV pk
CAPACITIVE LOAD [1, 7]	T_C = 25°C	—	—	100	—	—	100	µF

Notes
1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. Indefinite short circuit protection not guaranteed above 125°C case.
3. Recovery time is measured from application of the transient to the point at which V_{OUT} is within regulation.
4. Step load test is performed at 10 microseconds typical.
5. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
6. Measured on release from inhibit.
7. No effect on dc performance.

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

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

DUAL OUTPUT MODELS		MHF+2805D			MHF+2812D			MHF+2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V_{OUT}	4.85	5.00	5.15	11.76	12.00	12.24	14.70	15.00	15.30	V
	- V_{OUT}	4.82	5.00	5.18	11.70	12.00	12.30	14.63	15.00	15.38	
OUTPUT CURRENT [2, 3]	EITHER OUTPUT	0	±1.2	1.92[1]	0	±0.625	1.125[1]	0	±0.50	0.90[1]	A
V_{IN} = 16 TO 40 V	TOTAL OUTPUT	—	—	2.4	—	—	1.25	—	—	1.0	
OUTPUT POWER [2, 3]	EITHER OUTPUT	0	±6	9.6[1]	0	±7.5	13.5[1]	0	±7.5	13.5[1]	W
V_{IN} = 16 TO 40 V	TOTAL OUTPUT	—	—	12	—	—	15	—	—	15	
OUTPUT RIPPLE	T_C = 25°C	—	30	80	—	30	80	—	30	60	mV p-p
±V_{OUT}, 10 kHz - 2 MHz	T_C = -55°C TO +125°C	—	60	80	—	60	120	—	50	120	
LINE REGULATION	+ V_{OUT}	—	5	50	—	5	50	—	5	50	mV
V_{IN} = 16 TO 40 V	- V_{OUT}	—	—	80	—	—	100	—	—	100	
LOAD REGULATION	+ V_{OUT}	—	20	50	—	20	50	—	20	50	mV
NL TO FULL, BALANCED	- V_{OUT}	—	—	100	—	—	100	—	—	100	
CROSS REGULATION [4]	T_C = 25°C	—	—	375	—	—	720	—	—	900	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	16	28	40	16	28	40	V
NO LOAD TO FULL	TRANSIENT 50 ms [1]	—	—	50	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	20	40	—	25	50	—	25	50	mA
	INHIBITED	—	6	12	—	5	12	—	5	12	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	20	80	—	35	100	—	35	100	mA p-p
EFFICIENCY	T_C = 25°C	77	79	—	76	83	—	76	84	—	%
	T_C = -55°C TO +125°C	75	—	—	74	—	—	74	—	—	
LOAD FAULT [5]	POWER DISSIPATION	—	3	6	—	3	6	—	3	6	W
SHORT CIRCUIT	RECOVERY [1]	—	7.5	30	—	7.5	50	—	7.5	50	ms
STEP LOAD RESPONSE [6, 7]	TRANSIENT +V_{OUT}	—	±200	±600	—	±300	±700	—	±300	±700	mV pk
50% - 100% - 50%	TRANSIENT -V_{OUT}	—	±200	±600	—	±300	±700	—	±300	±700	
BALANCED LOADS	RECOVERY	—	150	500	—	200	500	—	200	500	µs
STEP LINE RESPONSE [1, 6, 8]	TRANSIENT	—	±600	±800	—	±550	±750	—	±550	±750	mV pk
V_{IN} = 16 - 40 - 16 V ±V_{OUT}	RECOVERY	—	0.8	1.2	—	0.8	1.2	—	0.8	1.2	ms
START-UP [9]	DELAY	—	12	20	—	12	25	—	12	25	ms
V_{IN} = 40 V	OVERSHOOT [1]	—	80	250	—	200	750	—	200	750	mV pk
CAPACITIVE LOAD [1, 10, 11]	T_C = 25°C	—	—	47	—	—	10	—	—	10	µF

Notes
1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. Up to 90% (80% 2805D) of the total output current/power is available from either output providing the opposite output is carrying at least 10% (20% 2805D) of the total output power. Loads that are both very light and unbalanced between the outputs may create higher output ripple voltage in some applications. Please contact Applications Engineering (powerapps@crane-eg.com) for additional information.
3. The "total" specification is the maximum combined current/power of both outputs.
4. Effect on negative V_{OUT} referenced to 50%/50% loads. 50% to 10% with the opposite output held at 50% (applied to both outputs), see Figure 21 on page 16. Simultaneously 30%-70% 70%-30%.
5. Indefinite short circuit protection not guaranteed above 125°C (case). Both outputs shorted at the same time.
6. Recovery time is measured from application of the transient to point at which V_{OUT} is within regulation.
7. Step load test is performed at 10 microseconds typical.
8. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
9. Measured on release from inhibit.
10. Applies to each output.
11. No effect on dc performance.

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

TABLE 10: ELECTRICAL CHARACTERISTICS -55°C TO +125°C CASE, 28 VIN, 100% LOAD, FREE RUN, UNLESS OTHERWISE SPECIFIED.

TRIPLE OUTPUT MODEL – MHF+28512T		5 (MAIN)			±12 (AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE [2]	V_{OUT}	4.85	5.00	5.15	±11.52	±12.00	±12.48	V
OUTPUT CURRENT [3]	EITHER OUTPUT	—	—	1.5	0	±0.313	0.416 [1]	A
V_{IN} = 16 TO 48 V	TOTAL	—	—	1.5	—	—	0.625	
OUTPUT POWER [4]	EITHER OUTPUT	—	—	7.5	—	±3.75	5 [1]	W
V_{IN} = 16 TO 48 V	TOTAL	—	—	7.5	—	—	7.5	
OUTPUT RIPPLE	T_C = 25°C	—	20	60	—	±30	±90	mV p-p
10 kHz - 2 MHz	T_C = -55°C TO +125°C	—	—	90	—	—	±180	
LINE REGULATION	V_{IN} = 16 TO 48 V	—	25	75	—	±120	±240	mV
LOAD REGULATION [5]	NO LOAD TO FULL	—	22	75	—	±120	±240	mV
CROSS REGULATION [6] T_C = 25°C	EFFECT ON NEGATIVE AUXILIARY	—	—	—	—	—	750	mV
INPUT VOLTAGE	CONTINUOUS	16	28	48	—	—	—	V
NO LOAD TO FULL	TRANSIENT [1] 120 ms	—	—	80	—	—	—	V
INPUT CURRENT	NO LOAD	—	30	45	—	—	—	mA
	INHIBITED	—	3	5	—	—	—	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	20	50	—	—	—	mA p-p
EFFICIENCY	T_C = 25°C	74	76	—	—	—	—	%
	T_C = -55°C TO +125°C	72	—	—	—	—	—	
LOAD FAULT [7, 8]	POWER DISSIPATION	—	—	12	—	—	±12	W
SHORT CIRCUIT	RECOVERY [1]	—	—	25	—	—	25	ms
STEP LOAD RESPONSE [9, 10]	TRANSIENT	—	—	±850	—	—	±950	mV pk
	RECOVERY	—	5	8	—	2	3	ms
STEP LINE RESPONSE [1, 9, 11]	TRANSIENT	—	—	±800	—	—	±800	mV pk
V_{IN} = 16 - 40 - 16 V	RECOVERY	—	—	5	—	—	5	ms
START-UP [12]	DELAY	—	10	25	—	10	±25	ms
	OVERSHOOT [1]	—	—	500	—	—	±500	mV pk
CAPACITIVE LOAD [1, 13, 14]	T_C = 25°C	—	—	150	—	—	50	µF

Notes
1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. If running with external sync, at temperature extremes V_{OUT} main may be a minimum of 4.80 volts to a maximum of 5.20 volts.
3. The sum of the 12 volt auxiliary output currents may not exceed 625 mA.
4. The maximum power available from either auxiliary output is 5 watts and the sum of the auxiliary outputs may not exceed 7.5 watts.
5. Load regulation for the +5 is specified at 0.0 to 1.5 A with the auxiliaries both held at 3.75 W (313 mA). Load regulation for the auxiliaries is specified as both auxiliaries from 0.0 to 3.75 W (313 mA) at the same time with the +5 held at 1.5 A.
6. Cross regulation only occurs between the two auxiliaries and is measured on –aux. +5 is held constant at 1.0 A. Cross regulation is specified for two conditions:
   Condition 1: Negative auxiliary = 0.417 A and positive auxiliary = 0.178 A
   Condition 2: Negative auxiliary = 0.178 A and positive auxiliary = 0.417 A
7. Load fault = < 0.100 Ω. All three outputs shorted simultaneously.
8. Indefinite short circuit protection not guaranteed above 125°C case.
9. Time to settle to within 1% of V_{OUT} final value.
10. Step load test is performed at 10 microseconds typical.
11. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
12. Measured on release from inhibit.
13. Auxiliary capacitive load applies to each output.
14. No effect on dc performance.

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

TABLE 11: ELECTRICAL CHARACTERISTICS -55°C TO +125°C CASE, 28 VIN, 100% LOAD, FREE RUN, UNLESS OTHERWISE SPECIFIED.

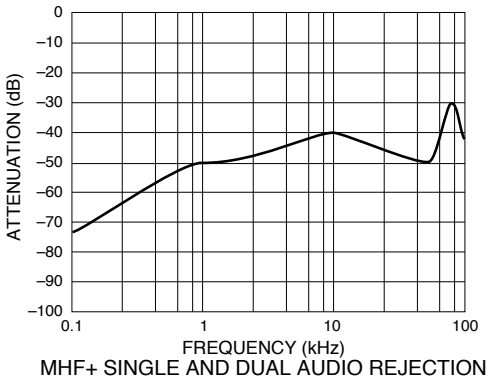
TRIPLE OUTPUT MODEL – MHF+28515T		5 (MAIN)			±15 (AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE [2]	V_{OUT}	4.85	5.00	5.15	14.40	15.00	15.60	V
OUTPUT CURRENT [3]	EITHER OUTPUT	—	—	1.5	0	±0.250	0.333 [1]	A
V_{IN} = 16 TO 48 V	TOTAL	—	—	1.5	—	—	0.500	
OUTPUT POWER [4]	EITHER OUTPUT	—	—	7.5	—	±3.75	5 [1]	W
V_{IN} = 16 TO 48 V	TOTAL	—	—	—	—	—	7.5	
OUTPUT RIPPLE	T_C = 25°C	—	20	60	—	±30	±112	mV p-p
10 kHz - 2 MHz	T_C = -55°C TO +125°C	—	—	90	—	—	±225	
LINE REGULATION	V_{IN} = 16 TO 48 V	—	25	75	—	±150	±300	mV
LOAD REGULATION [5]	NO LOAD TO FULL	—	25	75	—	±150	±300	mV
CROSS REGULATION [6] T_C = 25°C	EFFECT ON NEGATIVE AUXILIARY	—	—	—	—	—	750	mV
INPUT VOLTAGE	CONTINUOUS	16	28	48	—	—	—	V
	TRANSIENT [1] 120 ms	—	—	80	—	—	—	V
INPUT CURRENT	NO LOAD	—	30	45	—	—	—	mA
	INHIBITED	—	3	5	—	—	—	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	20	50	—	—	—	mA p-p
EFFICIENCY	T_C = 25°C	74	76	—	—	—	—	%
	T_C = -55°C TO +125°C	72	—	—	—	—	—	
LOAD FAULT [7, 8]	POWER DISSIPATION SHORT CIRCUIT	—	—	12	—	—	±12	W
	RECOVERY [1]	—	—	25	—	—	25	ms
STEP LOAD RESPONSE [9, 10]	TRANSIENT	—	—	±850	—	—	±950	mV pk
	RECOVERY	—	5	8	—	2	3	ms
STEP LINE RESPONSE [1, 9, 11]	TRANSIENT	—	—	±800	—	—	±800	mV pk
V_{IN} = 16 - 40 - 16 V	RECOVERY	—	—	5	—	—	5	ms
START-UP [12]	DELAY	—	10	25	—	10	25	ms
	OVERSHOOT [1]	—	—	500	—	—	±500	mV pk
CAPACITIVE LOAD [1, 13, 14]	T_C = 25°C	—	—	150	—	—	50	µF

Notes
1. Guaranteed by qualification test and/or analysis. Not an in-line test.
2. If running with external sync, at temperature extremes V_{OUT} main may be a minimum of 4.80 volts to a maximum of 5.20 volts.
3. The sum of the 12 volt auxiliary output currents may not exceed 625 mA.
4. The maximum power available from either auxiliary output is 5 watts and the sum of the auxiliary outputs may not exceed 7.5 watts.
5. Load regulation for the +5 is specified at 0.0 to 1.5 A with the auxiliaries both held at 3.75 W (313 mA). Load regulation for the auxiliaries is specified as both auxiliaries from 0.0 to 3.75 W (313 mA) at the same time with the +5 held at 1.5 A.
6. Cross regulation only occurs between the two auxiliaries and is measured on –aux. +5 is held constant at 1.0 A. Cross regulation is specified for two conditions:
   Condition 1: Negative auxiliary = 0.417 A and positive auxiliary = 0.178 A
   Condition 2: Negative auxiliary = 0.178 A and positive auxiliary = 0.417 A
7. Load fault = < 0.100 Ω. All three outputs shorted simultaneously.
8. Indefinite short circuit protection not guaranteed above 125°C case.
9. Time to settle to within 1% of V_{OUT} final value.
10. Step load test is performed at 10 microseconds typical.
11. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
12. Measured on release from inhibit.
13. Auxiliary capacitive load applies to each output.
14. No effect on dc performance.

MHF+ Single, Dual and Triple DC-DC Converters

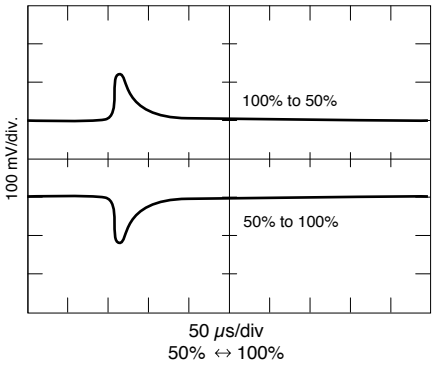
28 VOLT INPUT – 15 WATT

TYPICAL PERFORMANCE PLOTS: 25°C CASE, 28 VIN, 100% LOAD, FREE RUN, UNLESS OTHERWISE SPECIFIED.
THESE ARE EXAMPLES FOR REFERENCE ONLY AND ARE NOT GUARANTEED SPECIFICATIONS.



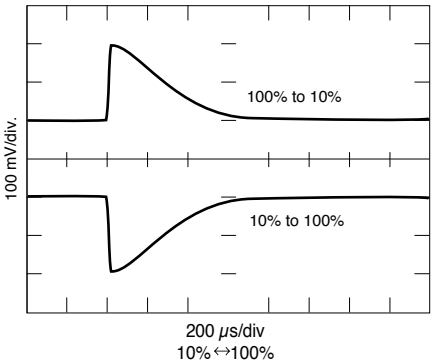
MHF+ SINGLE AND DUAL AUDIO REJECTION

FIGURE 11



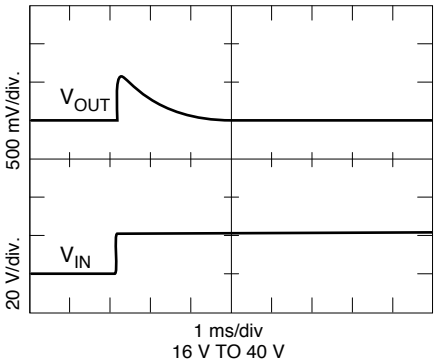
MHF+2805S STEP LOAD RESPONSE

FIGURE 12



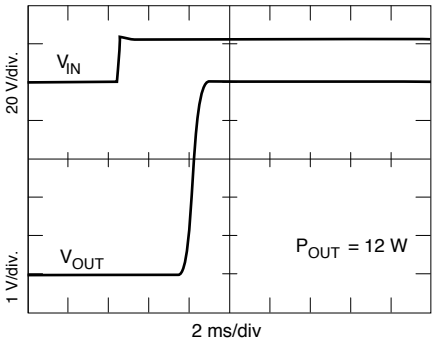
MHF+2805S STEP LOAD RESPONSE

FIGURE 13



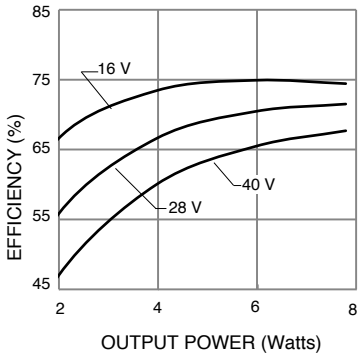
MHF+2805S STEP LINE RESPONSE

FIGURE 14



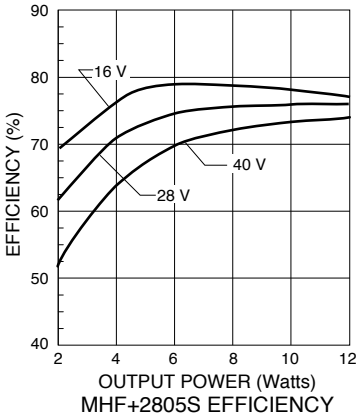
MHF+2805S TURN-ON INTO FULL LOAD

FIGURE 15



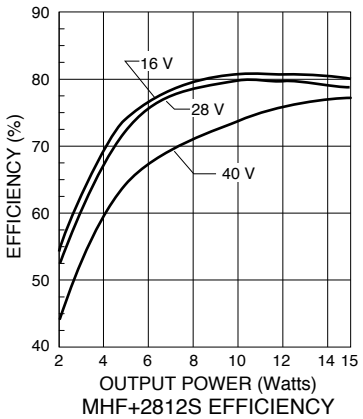
MHF+283R3S EFFICIENCY

FIGURE 16



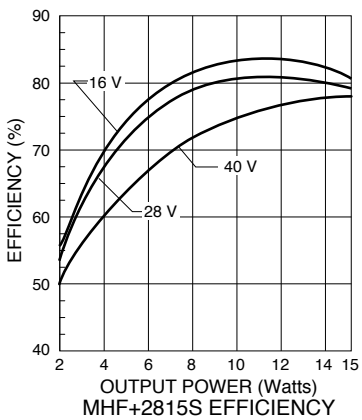
MHF+2805S EFFICIENCY

FIGURE 17



MHF+2812S EFFICIENCY

FIGURE 18



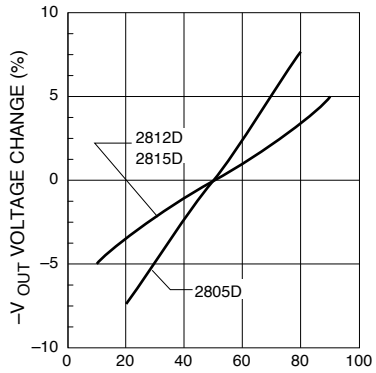
MHF+2815S EFFICIENCY

FIGURE 19

MHF+ Single, Dual and Triple DC-DC Converters

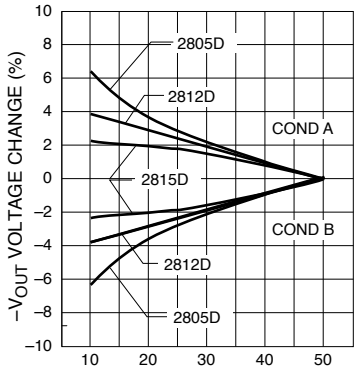
28 VOLT INPUT – 15 WATT

TYPICAL PERFORMANCE PLOTS: 25°C CASE, 28 VIN, 100% LOAD, FREE RUN, UNLESS OTHERWISE SPECIFIED.
THESE ARE EXAMPLES FOR REFERENCE ONLY AND ARE NOT GUARANTEED SPECIFICATIONS.



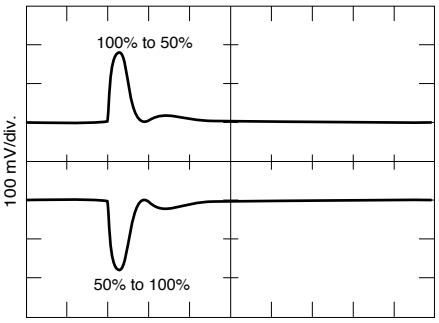
POSITIVE OUTPUT LOAD (% OF TOTAL LOAD)
$-V_{OUT}$ WITH SHIFT IN LOAD BALANCE
CROSS REGULATION

FIGURE 20



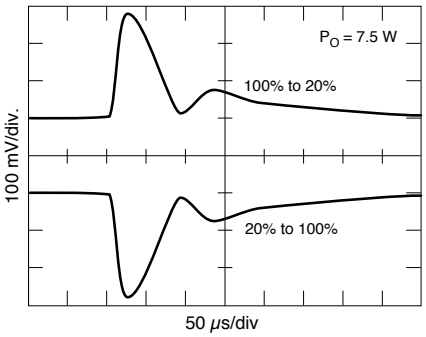
OUTPUT LOAD (%)
COND. A: 50% LOAD +V; 50% to 10% –V
COND. B: 50% LOAD –V; 50% to 10% +V
MHF+2805D/MHF+2812D/MHF+2815D
CROSS REGULATION

FIGURE 21



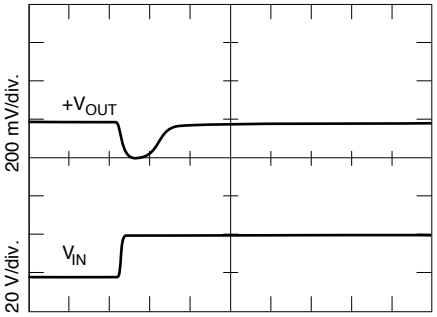
50 µs/div
50% ↔100%
MHF+2815D $+V_{OUT}$ STEP LOAD RESPONSE

FIGURE 22



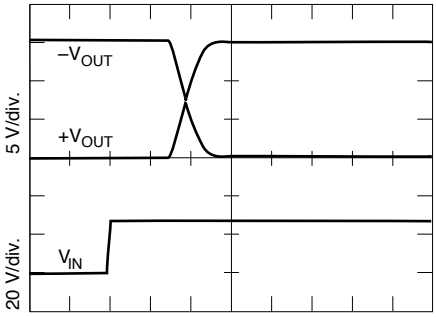
50 µs/div
20% ↔100%
MHF+2815D +VOUT STEP LOAD RESPONSE

FIGURE 23



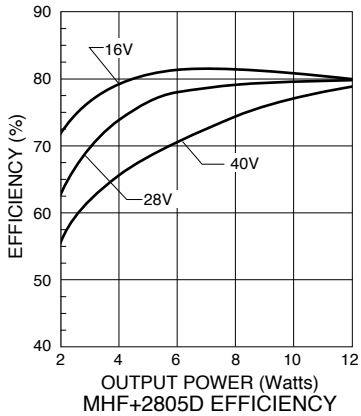
1 ms/div
16V TO 40V
MHF+2815D STEP LINE RESPONSE

FIGURE 24



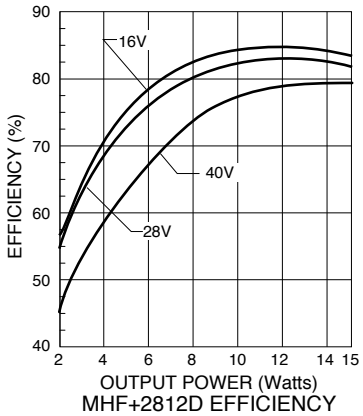
2 ms/div
MHF+2815D TURN-ON INTO FULL LOAD

FIGURE 25



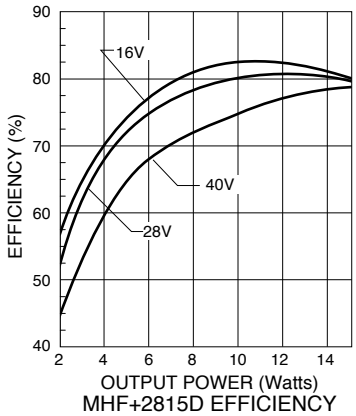
OUTPUT POWER (Watts)
MHF+2805D EFFICIENCY

FIGURE 26



OUTPUT POWER (Watts)
MHF+2812D EFFICIENCY

FIGURE 27



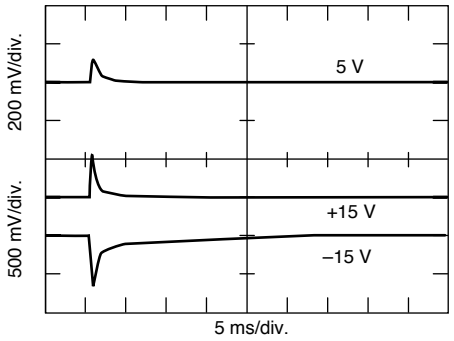
OUTPUT POWER (Watts)
MHF+2815D EFFICIENCY

FIGURE 28

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

TYPICAL PERFORMANCE PLOTS: 25°C CASE, 28 VIN, 100% LOAD, FREE RUN, UNLESS OTHERWISE SPECIFIED.
THESE ARE EXAMPLES FOR REFERENCE ONLY AND ARE NOT GUARANTEED SPECIFICATIONS.

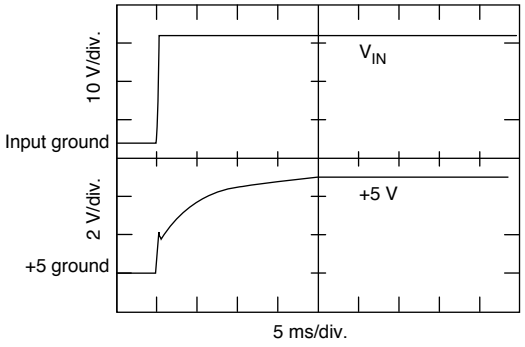


16 TO 40 V_{IN}, 15 = 250 mA EACH, +5 = 1.5 A

MHF+ 28515T STEP LINE RESPONSE

MHF+28512T has a similar response

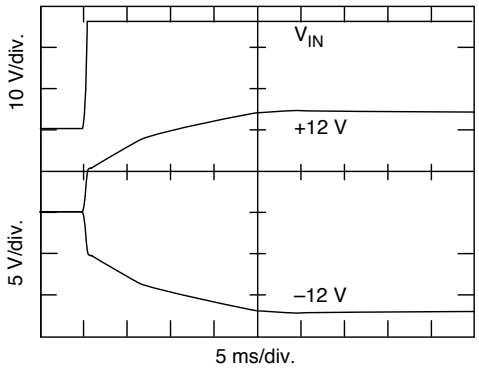
FIGURE 29



MHF+28512T TURN ON INTO FULL LOAD MAIN

MHF+28515T has a similar response

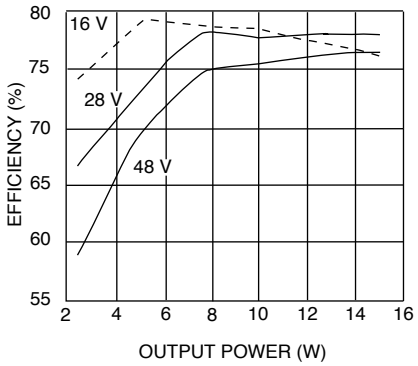
FIGURE 30



MHF+28512T TURN ON INTO FULL LOAD AUXILIARIES

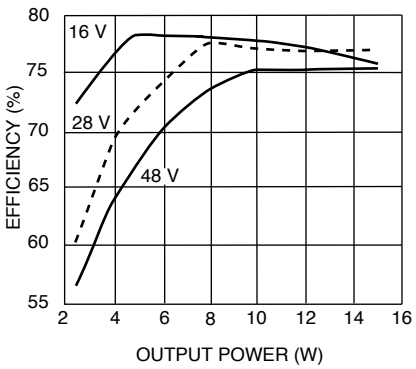
MHF+28515T has a similar response

FIGURE 31



MHF+28512T EFFICIENCY

FIGURE 32



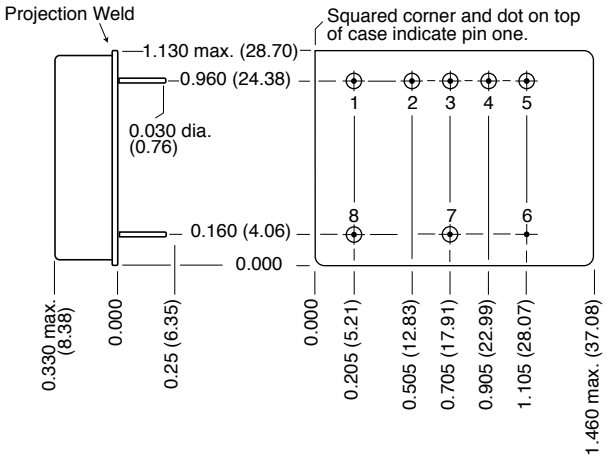
MHF+28515T EFFICIENCY

FIGURE 33

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

BOTTOM VIEW CASE E1



Weight: 30 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	Kovar/Nickel
Pins	#52 alloy/Gold compression glass seal. Gold plating of 50 - 150 microinches included in pin diameter Seal Hole: 0.080 ±0.002 (2.03 ±0.05)

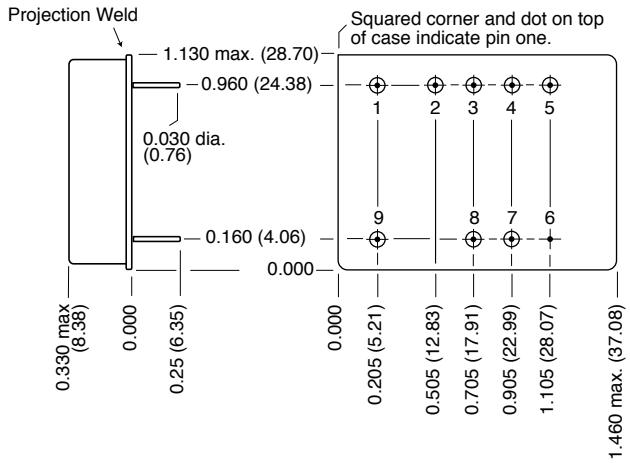
Please refer to the numerical dimensions for accuracy.

FIGURE 34: CASE E1— SINGLE AND DUAL MODELS

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

BOTTOM VIEW CASE E2



Weight: 35 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	Kovar/Nickel
Pins	#52 alloy/Gold compression glass seal. Gold plating of 50 - 150 microinches included in pin diameter Seal Hole: 0.080 ±0.002 (2.03 ±0.05)

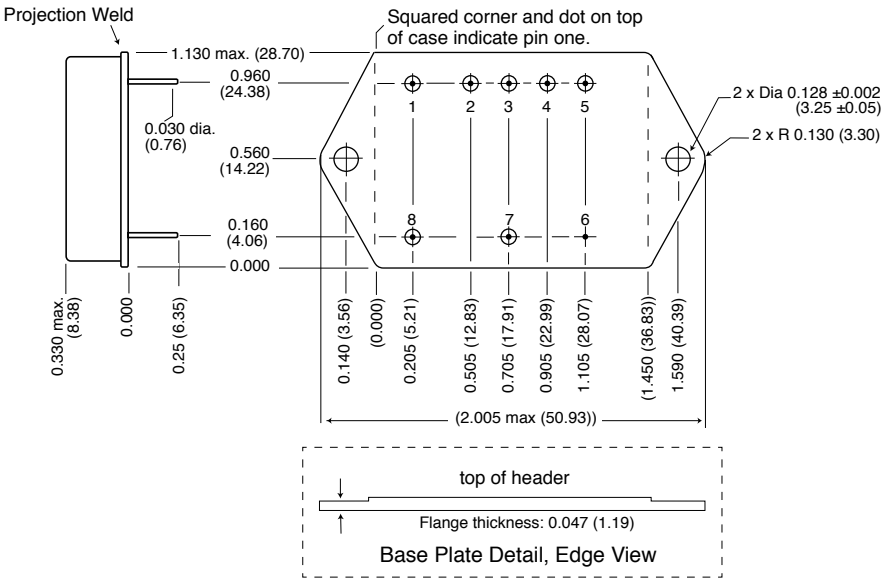
Please refer to the numerical dimensions for accuracy.

FIGURE 35: CASE E2 — TRIPLE MODELS

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

BOTTOM VIEW CASE G1
Flanged cases: Designator "F" required in Case Option position of model number



Weight: 30 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	Kovar/Nickel
Pins	#52 alloy/Gold compression glass seal Gold plating of 50 - 150 microinches included in pin diameter Seal Hole: 0.080 ±0.002 (2.03 ±0.05)

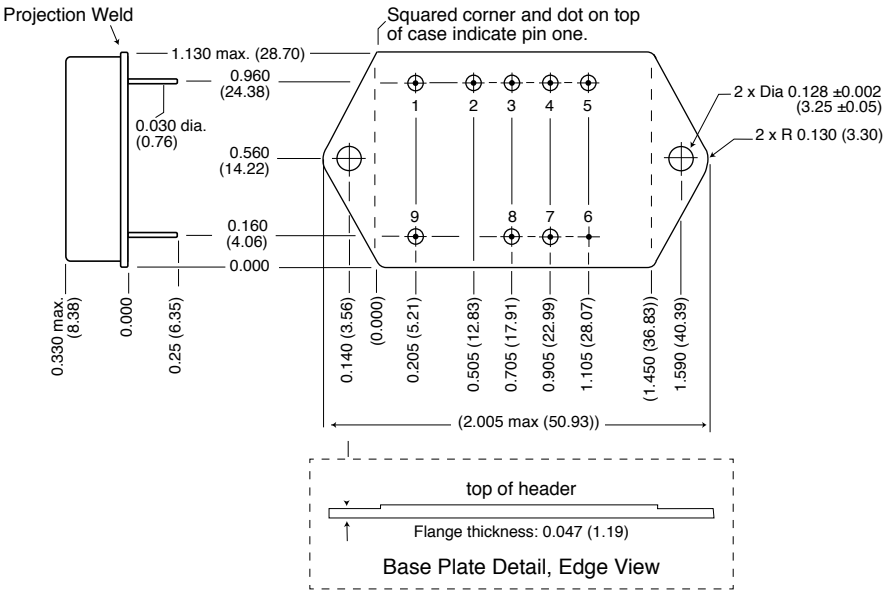
Please refer to the numerical dimensions for accuracy.

FIGURE 36: CASE G1 — SINGLE AND DUAL MODELS

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

BOTTOM VIEW CASE G2
Flanged cases: Designator "F" required in Case Option position of model number



Weight: 35 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	Kovar/Nickel
Pins	#52 alloy/Gold compression glass seal. Gold plating of 50 - 150 microinches included in pin diameter Seal Hole: 0.080 ±0.002 (2.03 ±0.05)

Please refer to the numerical dimensions for accuracy.

FIGURE 37: CASE G2 — TRIPLE MODELS

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 12: ELEMENT EVALUATION

MHF+ Single, Dual and Triple DC-DC Converters

28 VOLT INPUT – 15 WATT

Environmental Screening High Reliability Standard, /ES and /883 (Class H)

Test Performed	non-QML [1]		QML [2]
	Standard	/ES	Class H /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			
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. Standard and ES are non-QML products and 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 13: Environmental Screening