MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

FEATURES

No cross regulation on dual outputs

- Operating temperature -55° to +125°C
- Input voltage range 16 to 50 VDC
- Transient protection 80 V for 120 ms
  - 12 Vout single and dual to 75 V
  - 15 Vout single and dual to 60 V
- Fully isolated
- Fixed frequency switching
- Output trim on single output models
- Inhibit and sync functions
- High power density, up to 83% efficiency

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

DESCRIPTION

Interpoint's MHV Series™ of DC/DC converters offers a wide input voltage range of 16 to 50 VDC and a choice of nine different output voltage configurations comprised of single, dual or triple outputs. The 3.3 volt single, 5 volt single and dual and the triple output models will withstand transients of up to 80 volts for up to 120 milliseconds while maintaining output voltages. The 12 volt single and dual outputs will withstand transients up to 75 volts and the 15 volt single and dual outputs will withstand up to 60 volts for 120 milliseconds. The MHV Series operates at 15 watts of output power (10 watts for the 3.3 volt single output) over the military temperature range of -55°C to +125°C while maintaining low input and output noise.

CONVERTER DESIGN

MHV Series DC/DC converters are switching regulators that use continuous flyback conversion topology with a clock frequency of approximately 600 kHz. MHV Series converters incorporate two pulse width modulators (PWM) with one PWM phase shifted 180° from the other to create a dual phase/phase-shifted operation. Each of the PWMs operates at approximately one-half (300 kHz) of the clock frequency. This proprietary technology minimizes input ripple and improves efficiency. On singles the output ripple is reduced. Cross regulation is eliminated on dual output models which are independently regulated and do not require load balancing or minimum loading. On triple output models, this design provides completely independent regulation with no cross regulation effect between the main and auxiliary outputs and no minimum loading is required on the main output.

INHIBIT FUNCTION

The converter is enabled when the inhibit terminal is left unconnected. When the inhibit terminal is pulled low (<0.8 V) the converter shuts down, typically drawing 8.4 mA at 28 Vin or 15 mA at 50 Vin. Sinking current required is Vin / 3.3 K ohm.

SYNCHRONIZATION FUNCTION

Applying an external signal of 40% to 60% duty cycle and 490 to 710 kHz for singles and duals output models will synchronize the converter to your system requirements. For triple output models the external frequency range is 500 to 700 kHz. Free run clock frequency is approximately 600 kHz. If not used, the sync terminal must be left unconnected.

TRIM

Single output converters feature a trim range of as low as 80% to as high as 110% of Vout nominal, depending on the model. To trim up, connect a resistor from output common (pin 4) to the trim terminal (pin 3). To trim down, connect a resistor from the positive output (pin 5) to the trim terminal (pin 3). See Figure 4 and trim tables for more information.

SCREENING

The converters are offered with standard screening, "ES" screening, or fully compliant to "883" MIL-PRF-38534 Class H screening. Standard microcircuit drawings (SMD) are available.

Crane Aerospace & Electronics
Electronics Group (Interpoint Brand)
PO Box 97005 • Redmond WA 98073-9705
425.882.3100 • power@crane-eg.com
www.interpoint.com

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

Undervoltage Lockout
An undervoltage lockout of approximately 7 VDC keeps system current levels low during startup. Low line dropout typically occurs at approximately 12 Vin to 17 Vin depending on model. See Figures 12, 16 and 17.

Short Circuit Protection
Under short circuit conditions of 130% or more of full load current, the converter will protect itself by shutting down. Short circuit duration should be brief because power dissipation may cause internal temperatures to rise rapidly. Restart is automatic upon removal of the short circuit.

Output Voltage Options
The MHV Series converters are capable of providing other output voltage options in addition to those characterized on this datasheet. Contact your sales representative to discuss other output voltage options, www.interpoint.com/contacts.

US Patents
Interpoint converters may use one or more of the following US patents 5,521,807, 5,694,303, and 5,631,822.

SIMPLIFIED SCHEMATIC DIAGRAM

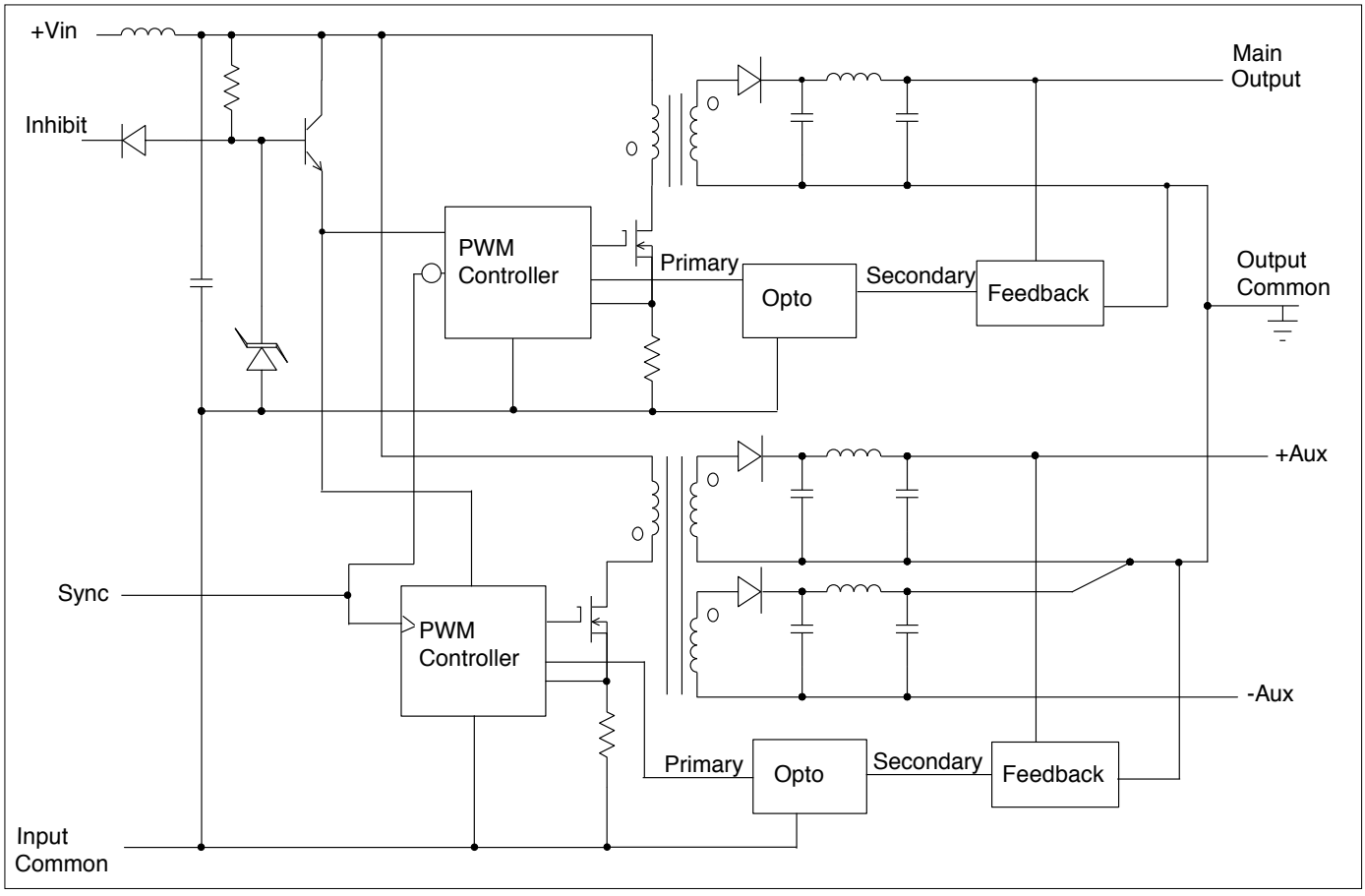


Figure 1: MHV Triple Block Diagram

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

OPERATING CONDITIONS AND CHARACTERISTICS

Input Voltage Range
- 16 to 50 VDC continuous
- 80 VDC for 120 ms transient
  - 12 Vout single and dual to 75 V
  - 15 Vout single and dual to 60 V

Output Power
- 15 watts (10 watts MHV283R3S)

Lead Soldering Temperature (10 sec per lead)
- 300°C

Storage Temperature Range (T_C)
- -65°C to +150°C

Case Operating Temperature (T_C)
- -55°C to +125°C full power
- -55°C to +130°C absolute

Derating Output Power/Current
- Linearly from 100% at 125°C to 0% at 130°C

Output Voltage Temperature Coefficient
- 100 ppm/°C typical

Current Limit
- 130% of full load typical at 25° T_C

Isolation at 25° T_C
- 100 megohm minimum at 500 V

Audio Rejection
- 30 dB typical

Conversion (Switching) Frequency
- Free run mode (each PWM) 300 kHz typical
  - 245 kHz. min, 355 kHz. max (T_C = -55° to +125°C)

Undervoltage Lockout
- 7 V input typical

Low Line Dropout
- Typically occurs at 12 Vin to 17 Vin depending on model
- See Figures 12, 15 and 21

SYNC AND INHIBIT

Sync In (twice the PWM conversion frequency)
- Input (clock) frequency
  - Single and dual output models 490 to 710 kHz
  - Triple output models 500 to 700 kHz
- Duty cycle 40% min, 60% max
- Active low 0.8 V max
- Active high 4.5 V min, 10 V max
- Referenced to input common
- If not used, leave unconnected

Inhibit
- Active low (output disabled)
  - Active low voltage ≤0.8 V
  - Inhibit pin source current
    - Typically 8.4 mA at 28 Vin, or 15 mA at 50 Vin
    - Sinking current required is Vin / 3.3 K ohms
  - Referenced to input common
- Active high (output enabled)
  - Open collector
  - Unconnected or 11.5 to 50 V
  - Open pin voltage 11 V typ

MECHANICAL AND ENVIRONMENTAL

Size (maximum)
- Non-flanged Single and dual output models
  - 2.125 x 1.125 x 0.400 inches (53.98 x 28.58 x 10.16 mm). See case H2 for dimensions.
- Triple output models
  - 1.950 x 1.350 x 0.405 inches (49.53 x 34.29 x 10.29 mm). See case F1 for dimensions.
- Flanged Single and dual output models
  - 2.910 x 1.125 x 0.400 inches (73.91 x 28.58 x 10.16 mm). See case K3 for dimensions.
- Triple output models
  - 2.720 x 1.350 x 0.405 inches (69.09 x 34.29 x 10.29 mm). See case J1 for dimensions.

Weight (maximum)
- 60 grams typical

Screening
- Standard, ES, or 883 (Class H). See Screening Tables 1 and 2 for more information.

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

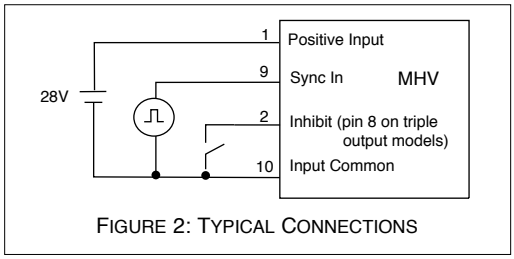
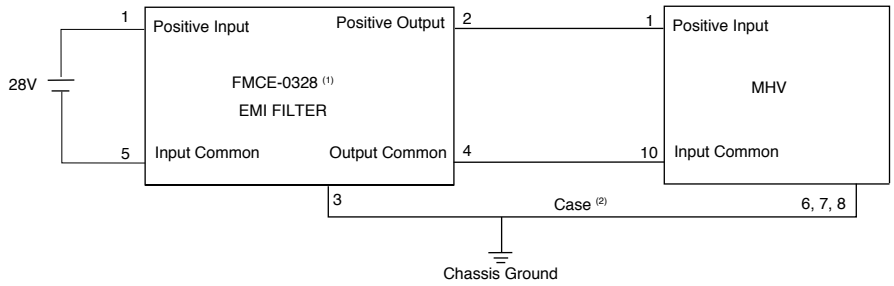


FIGURE 2: TYPICAL CONNECTIONS



(1) FMCE-0328 can provide up to 84 watts throughput current at 28 volts in and will bring the converter into compliance with MIL-STD-461C CE03 and CS01 and/or MIL-STD-461D, E and F CE102 and CS101 levels of conducted emissions.
(2) The case ground connection should be as low an impedance as possible to minimize EMI. Direct contact of baseplate to chassis ground provides the lowest impedance.

FIGURE 3: EMI FILTER CONNECTION

TRIM – SINGLE OUTPUT MODELS ONLY

CALCULATED TRIM

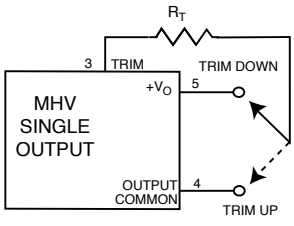
Trim down: $R_T\ (K\Omega) = \left(\frac{(V_o - 2.5)}{V_{o\ nominal} - V_0}\right) A - B$

Trim up: $R_T\ (K\Omega) = \left(\frac{2.5A}{V_o - V_{o\ nominal}}\right) - B$

V_o = desired output voltage

FORMULA VALUES BY MODEL				
MODEL:	3.3 V	5 V	12 V	15 V
A	3.7	3.7	14	18.0
B	10	10	30	80

QUICK REFERENCE TRIM TABLE						
MODEL	V_{OUT} NOMINAL					
	110%	106%	102%	95%	90%	80%
	R_{TRIM} (R_T) K ohms					
MHV283R3S	18	36	128	4	N/A	N/A
MHV2805S	8	20	81	23	5	N/A
MHV2812S	N/A	19	116	177	67	11
MHV2815S	0.3	21	122	255	104	28



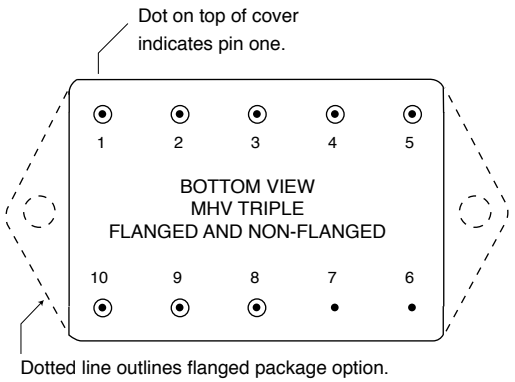
Notes
If calculated result is a negative value, the desired output voltage is outside the allowed trim range.
Calculated values of R_T are ±15%.
When trimming up, do not exceed the maximum output power.
When trimming down, do not exceed the maximum output current.

FIGURE 4: MHV SINGLE OUTPUT TRIM

MHV Single, Dual and Triple DC/DC Converters

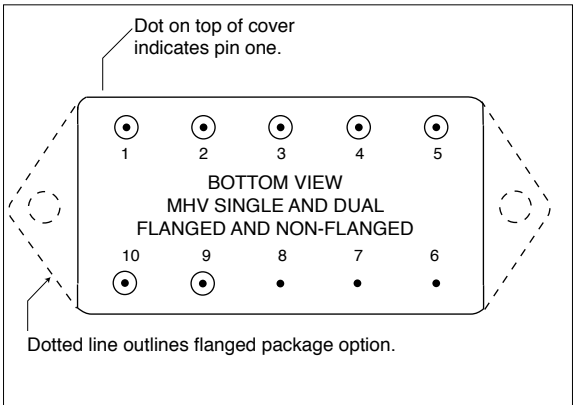
28 VOLT INPUT – 15 WATT

PIN OUT			
Pin	**Single Output**	**Dual Output**	**Triple Output**
1	Positive Input	Positive Input	Positive Input
2	Inhibit	Inhibit	Main (+5) Output
3	Trim	Positive Output	Output Common
4	Output Common	Output Common	Negative Aux. Output
5	Positive Output	Negative Output	Positive Aux. Output
6, 7	Case Ground	Case Ground	Case Ground
8	Case Ground	Case Ground	Inhibit
9	Sync In	Sync In	Sync In
10	Input Common	Input Common	Input Common



See cases H2 and K3 for dimensions.

FIGURE 5: PIN OUT SINGLES AND DUALS



See cases F1 and J1 for dimensions.

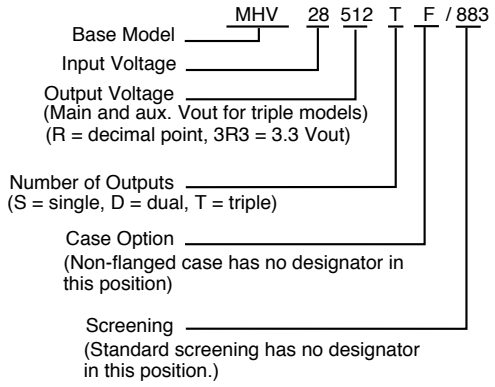
FIGURE 6: PIN OUT TRIPLE

PINS NOT IN USE	
Case	User's discretion
Inhibit	Leave unconnected
Sync In	Leave unconnected

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

MODEL NUMBERING KEY



SMD NUMBERS

Standard Microcircuit Drawing (SMD)	MHV Similar Part
5962-9852801HXC	MHV283R3S/883
5962-9852201HXC	MHV2805S/883
5962-9852301HXC	MHV2812S/883
5962-9852401HXC	MHV2815S/883
5962-9852501HXC	MHV2805D/883
5962-9852601HXC	MHV2812D/883
5962-9852701HXC	MHV2815D/883
5962-9673001HXC	MHV28512T/883
5962-9673101HXC	MHV28515T/883

Flanged SMD numbers for the MHV Series of converters have the suffix HZC instead of HXC. For exact specifications for an SMD product, refer to the SMD drawing available at www.dscc.dla.mil/programs/smcr.

MODEL SELECTION

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

CATEGORY	MHV28 Base Model and Input Voltage	_____ Output Voltage [1]	_____ Number of Outputs [2]	_____ Case Option [3]	/	_____ Screening [4]
SELECTION	MHV28 is the only available selection	**3R3, 05, 12, 15**	**S**	(NON-FLANGED leave blank)		(STANDARD leave blank)
		05, 12, 15	**D**			**ES**
		512, 515	**T**	**F (FLANGED)**		**883 (CLASS H)**

Notes:
1. Output Voltage: An R indicates a decimal point. 3R3 is 3.3 volts out. The value of 3R3 is only available in single output models. The 512 and 515 triple output converters are +5 volt main and ±12 or ±15 volt auxiliaries.
2. Number of Outputs: S is a single output, D is a dual output, and T is a triple output
3. Case Options: For the standard case (cases F1 and H2) leave the case option blank. For the flanged case option (cases J1 and K3), insert the letter F in the Case Option position.
4. Screening: For standard screening leave the screening option blank. For other screening options, insert the desired screening level. For more information see Screening Tables 1 and 2.

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

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

SINGLE OUTPUT MODELS		MHV283R3S			MHV2805S			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	V_{IN} = 16 TO 50 VDC	0	—	3.03	0	—	3.00	A
OUTPUT POWER	V_{IN} = 16 TO 50 VDC	0	—	10	0	—	15	W
OUTPUT RIPPLE	10 KHZ - 2 MHZ	—	5	25	—	5	25	mV p-p
LINE REGULATION	V_{IN} = 16 TO 50 VDC	–	0	10	—	0	10	mV
LOAD REGULATION	NO LOAD TO FULL	–	15	35	—	15	45	mV
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	16	28	50	16	28	50	VDC
	TRANSIENT 120 ms [1]	—	—	80	—	—	80	V
INPUT CURRENT	NO LOAD	—	34	45	—	44	55	mA
	INHIBITED	—	8.4	10	—	8.4	10	
INPUT RIPPLE CURRENT	10 KHZ - 10 MHZ	—	10	45	—	10	40	mA p-p
EFFICIENCY		68	72	–	73	77	—	%
LOAD FAULT [2]	POWER DISSIPATION SHORT CIRCUIT	—	—	7.5	—	—	9	W
	RECOVERY [1]	—	—	20	—	—	20	ms
STEP LOAD RESPONSE [3]	50% - 100% - 50% TRANSIENT	—	—	±350	—	—	±350	mV pk
	RECOVERY	—	—	1.2	—	—	2	ms
STEP LINE RESPONSE [1, 4]	16 - 50 - 16 VDC TRANSIENT	—	—	±175	—	—	±550	mV pk
	RECOVERY	—	—	0.90	—	—	2.0	ms
START-UP	DELAY	–	14	20	—	14	20	ms
	OVERSHOOT [1]	—	0	150	—	0	100	mV pk
CAPACITIVE LOAD [1]	25°C	–	–	200	–	–	200	µF

Notes

1. Guaranteed by design, not tested.

2. Load fault is a short circuit (<50 mΩ). Recovery is into a resistive load.

3. Step load transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.

4. Step line transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

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

SINGLE OUTPUT MODELS		MHV2812S			MHV2815S			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	V_{IN} = 16 TO 50 VDC	0	—	1.25	0	—	1.00	A
OUTPUT POWER	V_{IN} = 16 TO 50 VDC	0	—	15	0	—	15	W
OUTPUT RIPPLE	10 KHz - 2 MHz	—	5	25	—	5	25	mV p-p
LINE REGULATION	V_{IN} = 16 TO 50 VDC	–	1	12	—	4	13	mV
LOAD REGULATION	NO LOAD TO FULL	–	8	35	—	10	35	mV
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	16	28	50	16	28	50	VDC
	TRANSIENT 120 ms [1]	—	—	75	—	—	60	V
INPUT CURRENT	NO LOAD	—	43	58	—	45	62	mA
	INHIBITED	—	8.4	10	—	8.4	10	
INPUT RIPPLE CURRENT	10 KHz - 10 MHz	—	10	40	—	10	40	mA p-p
EFFICIENCY		78	81	–	78	81	—	%
LOAD FAULT [2]	POWER DISSIPATION SHORT CIRCUIT	—	—	7.5	—	—	7.5	W
	RECOVERY [1]	—	—	20	—	—	20	ms
STEP LOAD RESPONSE [3]	50% - 100% - 50% TRANSIENT	—	—	±400	—	—	±550	mV pk
	RECOVERY	—	—	1.5	—	—	1.5	ms
STEP LINE RESPONSE [1, 4]	16 - 50 - 16 VDC TRANSIENT	—	—	±550	—	—	±650	mV pk
	RECOVERY	—	—	2.5	—	—	2.5	ms
START-UP	DELAY	–	14	20	—	14	20	ms
	OVERSHOOT [1]	—	0	240	—	0	300	mV pk
CAPACITIVE LOAD [1]	25°C	–	–	200	–	–	200	µF

Notes
1. Guaranteed by design, not tested.
2. Load fault is a short circuit (<50 mΩ). Recovery is into a resistive load.
3. Step load transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.
4. Step line transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

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

DUAL OUTPUT MODELS		MHV2805D			MHV2812D			MHV2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	$\pm V_{OUT}$	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	VDC
OUTPUT CURRENT	EACH OUTPUT	0	—	1.5	0	—	0.625	0	—	0.50	A
V_{IN} = 16 TO 50 VDC	TOTAL	—	—	3	—	—	1.25	—	—	1.0	
OUTPUT POWER [2]	EACH OUTPUT	0	—	7.5	0	—	7.5	0	—	7.5	W
V_{IN} = 16 TO 50 VDC	TOTAL	—	—	15	—	—	15	—	—	15	
OUTPUT RIPPLE	$\pm V_{OUT}$, 10 KHZ - 2 MHZ	—	5	35	—	5	25	—	10	50	mV p-p
LINE REGULATION BALANCED LOADS	VIN = 16 TO 50 VDC	—	0	10	—	0	10	—	0	10	mV
LOAD REGULATION BALANCED LOADS	NO LOAD TO FULL	—	5	20	—	2	20	—	2	20	mV
INPUT VOLTAGE	CONTINUOUS	16	28	50	16	28	50	16	28	50	VDC
	TRANSIENT 120 ms [1]	—	—	80	—	—	75	—	—	60	V
INPUT CURRENT	NO LOAD	—	22	30	—	32	43	—	37	50	mA
	INHIBITED	—	8.4	10	—	8.4	10	—	8.4	10	
INPUT RIPPLE CURRENT	10 KHZ - 10 MHZ	—	5	40	—	5	40	—	10	45	mA p-p
EFFICIENCY		75	79	—	79	83	—	78	83	—	%
LOAD FAULT [3]	POWER DISSIPATION SHORT CIRCUIT	—	—	8.5	—	—	10	—	—	10	W
	RECOVERY [1]	—	—	20	—	—	25	—	—	30	ms
STEP LOAD RESPONSE [4] BALANCED LOADS	50% - 100% - 50% TRANSIENT	—	—	±350	—	—	±400	—	—	±500	mV pk
	RECOVERY	—	—	3.0	—	—	1.5	—	—	1.5	ms
STEP LINE RESPONSE [1, 5] $\pm V_{OUT}$	16 - 50 - 16 V_{IN} TRANSIENT	—	—	±400	—	—	±500	—	—	±500	mV pk
	RECOVERY	—	—	4.0	—	—	3.0	—	—	3.0	ms
START-UP VIN = 40 V	$+V_{OUT}$ DELAY	—	10	18	—	10	20	—	12	22	ms
	$-V_{OUT}$ DELAY	—	10	20	—	10	25	—	12	30	
	OVERSHOOT [1]	—	0	100	—	0	240	—	0	300	mV pk
CAPACITIVE LOAD [1]	25°C	—	—	100	—	—	100	—	—	100	µF

Notes
1. Guaranteed by design, not tested.
2. Up to 7.5 watts is available from either output.
3. Load fault is a short circuit (<50 mΩ). Recovery is into a resistive load.
4. Step load transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.
5. Step line transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

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

TRIPLE OUTPUT MODEL – MHV28512T		5 (MAIN)			±12 (AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	MAIN AND POS. AUX	4.90	5.00	5.10	11.76	12.00	12.24	VDC
	NEG. AUX.				-11.70	-12.00	-12.30	
OUTPUT CURRENT [2]		0	—	2.0	0	±0.208	0.333 [1]	A
	TOTAL	—	—	—	—	—	0.416	
OUTPUT POWER [3]		0	—	10	0	±2.50	4.00 [1]	W
V_{IN} = 16 TO 50 VDC	TOTAL	—	—	—	—	—	5	
OUTPUT RIPPLE	10 KHZ - 2 MHZ	—	8	22	—	9	22	mV p-p
LINE REGULATION	MAIN AND POS. AUX	—	0	5	—	5	35	mV
V_{IN}= 16 TO 50 VDC	NEG. AUX.				—	7	40	
LOAD REGULATION [4]	MAIN AND POS. AUX	—	10	20	—	10	30	mV
	NEG. AUX.	—	—	—	—	40	70	
CROSS REGULATION [5]	EFFECT ON NEGATIVE AUXILIARY	—	—	—	—	400	800	mV
INPUT VOLTAGE	CONTINUOUS	16	28	50	—	—	—	VDC
	TRANSIENT 120 ms [1]	—	—	80	—	—	—	V
INPUT CURRENT	NO LOAD	—	30	37	—	—	—	mA
	INHIBITED	—	8.4	10	—	—	—	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	10	30	—	—	—	mA p-p
EFFICIENCY		74	78	—	—	—	—	%
LOAD FAULT [6]	POWER DISSIPATION	—	—	9.5	—	—	9.5	W
	RECOVERY [1]	—	—	25	—	—	25	ms
STEP LOAD RESPONSE [7]	TRANSIENT	—	—	±350	—	—	±600	mV pk
	NEG. AUX. [1]	—	—	—	—	—	±600	
	RECOVERY	—	—	3	—	—	4	ms
	NEG. AUX. [1]	—	—	—	—	—	4	
STEP LINE RESPONSE [1, 8]	16 - 50 - 16 V_{IN} TRANSIENT	—	—	±400	—	—	±500	mV pk
	RECOVERY	—	—	3	—	—	4	ms
START-UP	DELAY	—	7	15	—	7	15	ms
	OVERSHOOT [1]	—	—	100	—	—	240	mV pk
CAPACITIVE LOAD [1]	25°C	—	—	200	—	—	100	µF

Notes for Triple Output Models

1. Guaranteed by design, not tested.

2. The sum of the 12 volt auxiliary output currents may not exceed 416 mA.
3. The sum of the auxiliary output power may not exceed 5 watts. Up to 80% of the total power (5W) is available from either auxiliary providing the opposite auxiliary is carrying 20% of the total auxiliary power used.
4. Load regulation for the +5 is specified at 0.0 to 2.0 A with the aux. both held at 2.5 W (208 mA). Load regulation for the auxiliary. is specified as both auxiliaries from 0.0 to 2.5 W (208 mA) at the same time with the +5 held at 2.0 A.
5. Cross regulation occurs between the two auxiliaries and is measured on –aux. +5 is held constant at 2.0 A. Cross regulation is specified for two conditions:
   A. Positive aux. = 2.5 W (50%); negative aux. = 2.5 W to 0.5 W (50% to 10%).
   B. From +Po = 70% and -Po = 30% to + Po = 30% and -Po =70%.
   Above conditions are referenced to 50%/50% balanced loads.
6. Load fault is a short circuit (<50 mΩ). Recovery is into a resistive load.
7. Step load transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.
8. Step line transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.

MHV Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 15 WATT

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

TRIPLE OUTPUT MODEL – MHV28515T		5 (MAIN)			±15 (AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	MAIN AND POS. AUX	4.90	5.00	5.10	14.70	15.00	15.30	VDC
	NEG. AUX.				-14.62	-15.00	-15.38	
OUTPUT CURRENT [2]		—	—	2.0	0	±0.167	0.267 [1]	A
	TOTAL	—	—	—	—	—	0.333	
OUTPUT POWER [3]		0	—	10	0	±2.50	4.00 [1]	W
V_{IN} = 16 TO 50 VDC	TOTAL	—	—	—	—	—	5	
OUTPUT RIPPLE	10 KHZ - 2 MHZ	—	8	22	—	9	22	mV p-p
LINE REGULATION	MAIN AND POS. AUX	—	0	5	—	7	35	mV
V_{IN}= 16, 50 VDC	NEG. AUX.				—	7	40	
LOAD REGULATION [4]	MAIN AND POS. AUX	—	10	20	—	10	30	mV
	NEG. AUX.	—	—	—	—	40	80	
CROSS REGULATION [5]	EFFECT ON NEGATIVE AUXILIARY	—	—	—	—	400	800	mV
INPUT VOLTAGE	CONTINUOUS	16	28	50	—	—	—	VDC
	TRANSIENT 120 ms [1]	—	—	80	—	—	—	V
INPUT CURRENT	NO LOAD	—	34	41	—	—	—	mA
	INHIBITED	—	8.4	10	—	—	—	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	10	30	—	—	—	mA p-p
EFFICIENCY		74	78	—	—	—	—	%
LOAD FAULT [6]	POWER DISSIPATION	—	—	9.5	—	—	9.5	W
	RECOVERY [1]	—	—	25	—	—	25	ms
STEP LOAD RESPONSE [7]	TRANSIENT	—	—	±350	—	—	±600	mV pk
	NEG. AUX. [1]	—	—	—	—	—	±600	
	RECOVERY	—	—	3	—	—	4	ms
	NEG. AUX. [1]	—	—	—	—	—	4	
STEP LINE RESPONSE [1, 8]	16 - 50 - 16 V_{IN} TRANSIENT	—	—	±400	—	—	±500	mV pk
	RECOVERY	—	—	3	—	—	4	ms
START-UP	DELAY	—	—	15	—	—	15	ms
	OVERSHOOT [1]	—	—	100	—	—	300	mV pk
CAPACITIVE LOAD [1]	25°C	—	—	200	—	—	100	µF

Notes for Triple Output Models

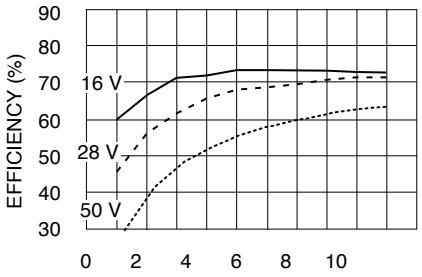
1. Guaranteed by design, not tested.

2. The sum of the 15 volt auxiliary output currents may not exceed 333 mA.
3. The sum of the auxiliary output power may not exceed 5 watts. Up to 80% of the total power (5W) is available from either auxiliary providing the opposite auxiliary is carrying 20% of the total auxiliary power used.
4. Load regulation for the +5 is specified at 0.0 to 2.0 A with the aux. both held at 2.5 W (167 mA). Load regulation for the auxiliary. is specified as both auxiliaries from 0.0 to 2.5 W (167 mA) at the same time with the +5 held at 2.0 A.
5. Cross regulation occurs between the two auxiliaries and is measured on –aux. +5 is held constant at 2.0 A. Cross regulation is specified for two conditions:
   A. Positive aux. = 2.5 W (50%); negative aux. = 2.5 W to 0.5 W (50% to 10%).
   B. From +Po = 70% and -Po = 30% to + Po = 30% and -Po =70%.
   Above conditions are referenced to 50%/50% balanced loads.
6. Load fault is a short circuit (<50 mΩ). Recovery is into a resistive load.
7. Step load transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.
8. Step line transition ≥ 10 µs. Recovery = time to settle to within 1% of V_{OUT} final value.

MHV Single, Dual and Triple DC/DC Converters

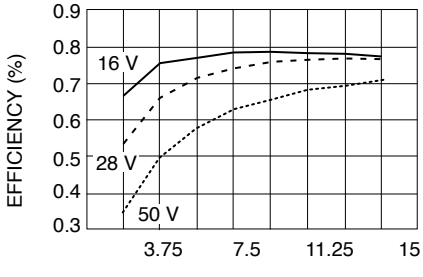
28 VOLT INPUT – 15 WATT

Typical Performance Curves: 25°C Tc, 28 VDC Vin, 100% load, 20 MHz BW, free run, unless otherwise specified.



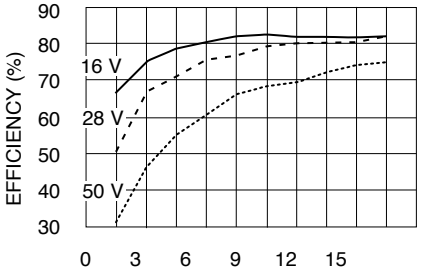
MHV283R3S EFFICIENCY

FIGURE 7



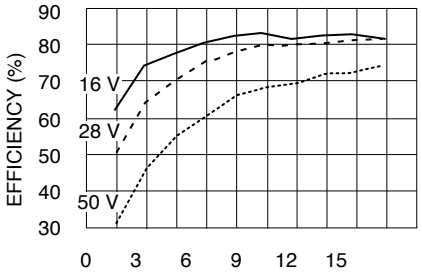
MHV2805S EFFICIENCY

FIGURE 8



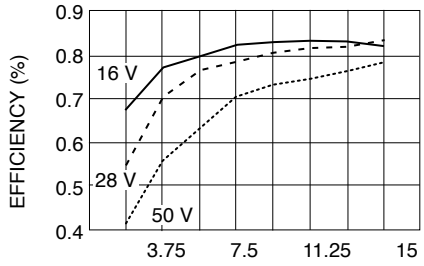
MHV2812S EFFICIENCY

FIGURE 9



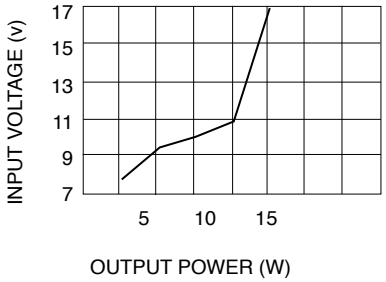
MHV2815S EFFICIENCY

FIGURE 10



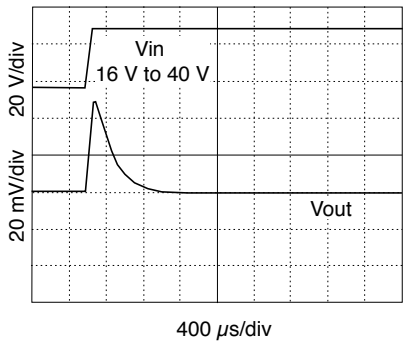
MHV2815D EFFICIENCY

FIGURE 11



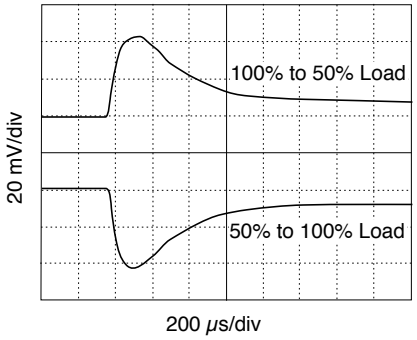
LOW LINE DROPOUT vs. LOAD
MHV283R3S

FIGURE 12



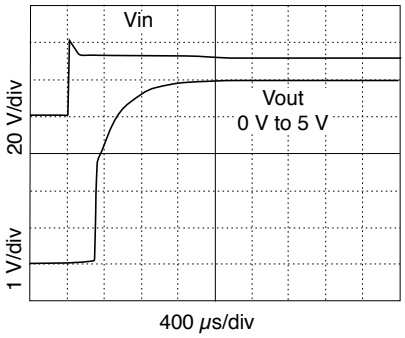
STEP LINE RESPONSE MHV2805S

FIGURE 13



STEP LOAD RESPONSE MHV2805S

FIGURE 14



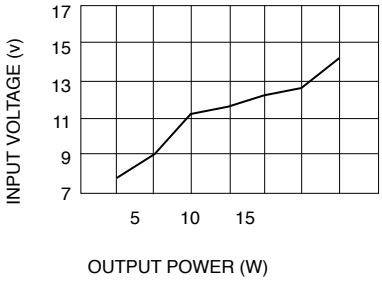
TURN ON RESPONSE MHV2805S

FIGURE 15

MHV Single, Dual and Triple DC/DC Converters

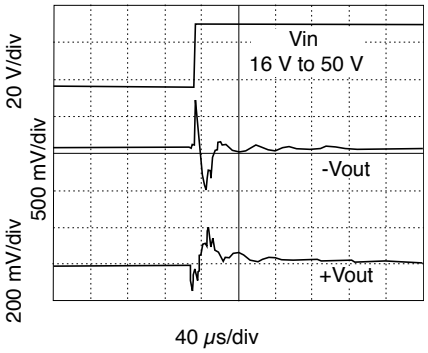
28 VOLT INPUT – 15 WATT

Typical Performance Curves: 25°C Tc, 28 VDC Vin, 100% load, 20 MHz BW, free run, unless otherwise specified.



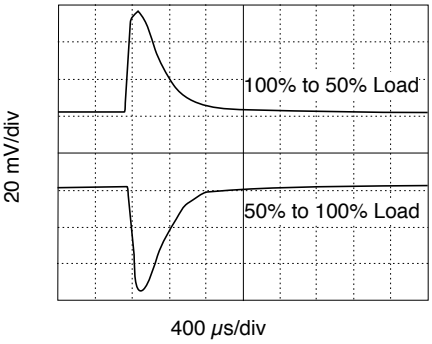
LOW LINE DROPOUT vs. LOAD
MHV2805S

FIGURE 16



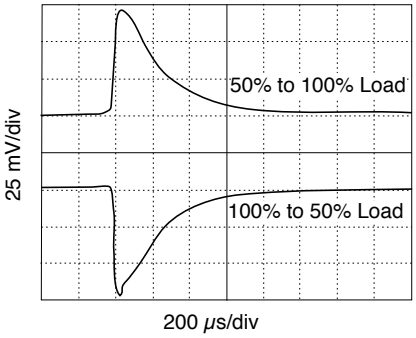
STEP LINE RESPONSE MHV2815D

FIGURE 17



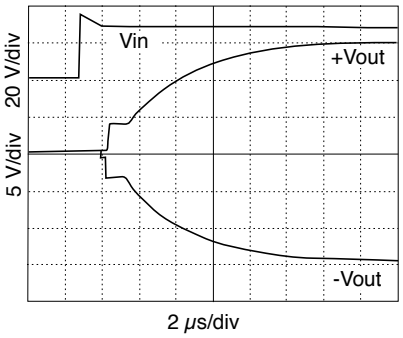
+Vout STEP LOAD RESPONSE
MHV2815D

FIGURE 18



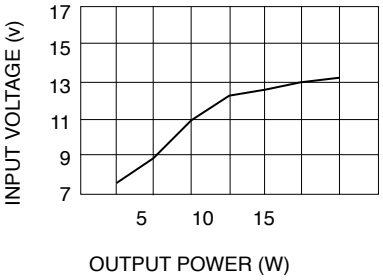
-Vout STEP LOAD RESPONSE
MHV2815D

FIGURE 19



TURN ON RESPONSE MHV2815D

FIGURE 20



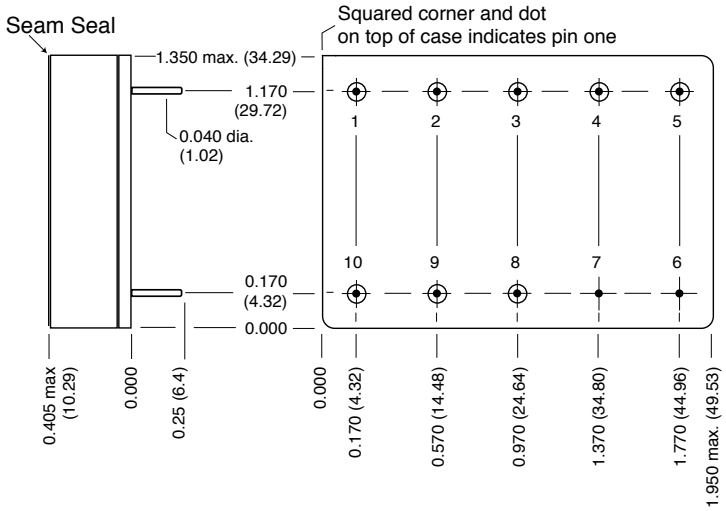
LOW LINE DROPOUT vs. LOAD
MHV2815D

FIGURE 21

MHV Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 15 WATT

BOTTOM VIEW CASE F1 - MHV Triple



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

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

Materials

Header	Cold Rolled Steel/Nickel/Gold
Cover	Kovar/Nickel
Pins	#52 alloy/Gold, ceramic Seal hole 0.124 ±0.002 (3.15 ± 0.05)

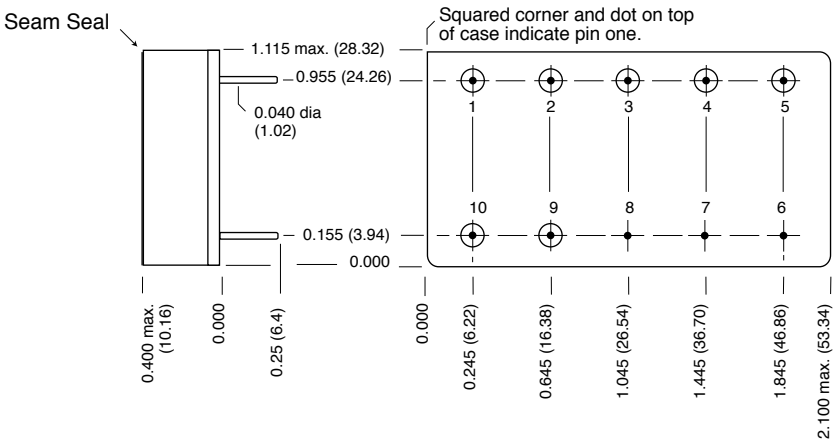
Case F1 MHV T, Rev F, 20100503
Please refer to the numerical dimensions for accuracy.

FIGURE 22: CASE F1- MHV TRIPLE

MHV Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 15 WATT

BOTTOM VIEW CASE H2 - MHV Single and Dual



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

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

Materials

Header	Cold Rolled Steel/Nickel/Gold
Cover	Kovar/Nickel
Pins	#52 alloy/Gold, ceramic glass seal Seal hole 0.120 ±0.002 (3.05 ± 0.05)

Case H2 MHV S&D, Rev G - 20100503
Please refer to the numerical dimensions for accuracy.

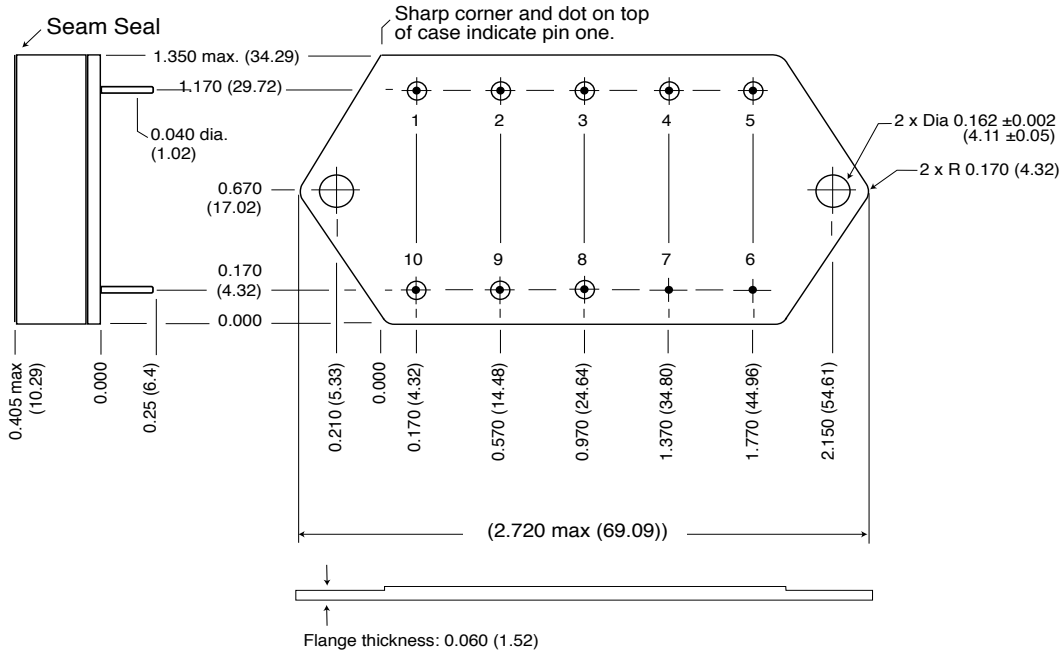
FIGURE 23: CASE H2 - MHV SINGLE AND DUAL

MHV Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 15 WATT

BOTTOM VIEW CASE J1 - MHV Triple

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



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

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

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

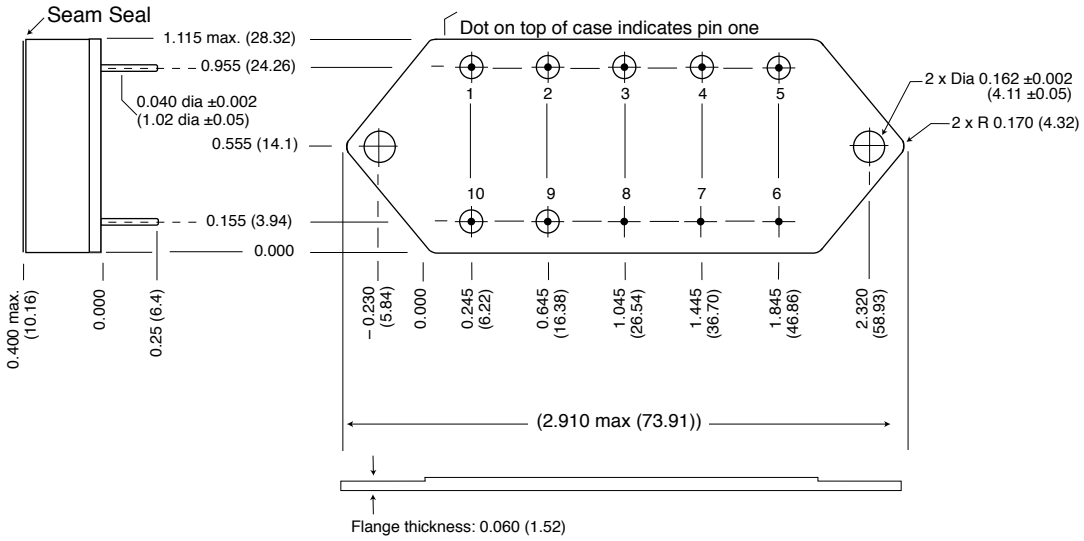
Case J1 MHV T F, Rev E, 20100503

FIGURE 24: CASE J1 - MHV TRIPLE

MHV Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 15 WATT

BOTTOM VIEW CASE K3 - MHV Single and Dual
Flanged cases: Designator “F” required in Case Option position of model number.



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

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

Materials

Header	Cold Rolled Steel/Nickel/Gold
Cover	Kovar/Nickel
Pins	#52 alloy/Gold, ceramic seal
	Seal hole 0.120 ±0.002 (3.05 ± 0.05)

Case K3 MHV S&D F, Rev G, 20100503
Please refer to the numerical dimensions for accuracy.

FIGURE 25: CASE K3 - MHV SINGLE AND DUAL

STANDARD AND /ES (NON-QML) AND /883 (CLASS H, QML) PRODUCT ELEMENT EVALUATION

COMPONENT-LEVEL TEST PERFORMED	STANDARD AND /ES NON-QML [1]		/883 CLASS H QML	
	M/S [2]	P [3]	M/S [2]	P [3]
Element Electrical (probe)	yes	no	yes	yes
Element Visual	no	no	yes	yes
Internal Visual	no	N/A	yes	N/A
Final Electrical	no	no	yes	yes
Wire Bond Evaluation [4]	no	no	yes	yes
SLAM™/C-SAM: Input capacitors only (Add'l test, not req. by H)	no	no	no	yes

Notes:
1. Standard and /ES, non-QML products, do no 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 wire bonds.

Definitions:
Element Evaluation: Component testing/screening per MIL-STD-883 as determined by MIL-PRF-38534
SLAM™: Scanning Laser Acoustic Microscopy
C-SAM: C - Mode Scanning Acoustic Microscopy

SCREENING TABLE 1: ELEMENT EVALUATION

STANDARD AND /ES (NON-QML) AND /883 (CLASS H, QML) PRODUCT ENVIRONMENTAL SCREENING

TEST PERFORMED	125°C STANDARD NON-QML[1]	125°C /ES NON-QML[1]	/883 CLASS H QML
Pre-cap Inspection			
Method 2017, 2032	yes	yes	yes
Temperature Cycle (10 times)			
Method 1010, Cond. C, -65°C to 150°C, ambient	no	no	yes
Method 1010, Cond. B, -55°C to 125°C, ambient	no	yes	no
Constant Acceleration			
Method 2001, 3000 g	no	no	yes
Method 2001, 500 g	no	yes	no
Burn-in [2]			
Method 1015, 125°C case, typical			
96 hours	no	yes	no
160 hours	no	no	yes
Final Electrical Test MIL-PRF-38534, Group A			
Subgroups 1 through 6: -55°C, +25°C, +125°C case	no	no	yes
Subgroups 1 and 4: +25°C case	yes	yes	no
Hermeticity Test			
Fine Leak, Method 1014, Cond. A	no	yes	yes
Gross Leak, Method 1014, Cond. C	no	yes	yes
Gross Leak, Dip (1 x 10^{-3})	yes	no	no
Final visual inspection			
Method 2009	yes	yes	yes

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

Notes:
1. Standard and /ES, non-QML products, do not meet all of the requirements of MIL-PRF-38534.
2. Burn-in temperature designed to bring the case temperature to +125°C

SCREENING TABLE 2: ENVIRONMENTAL SCREENING