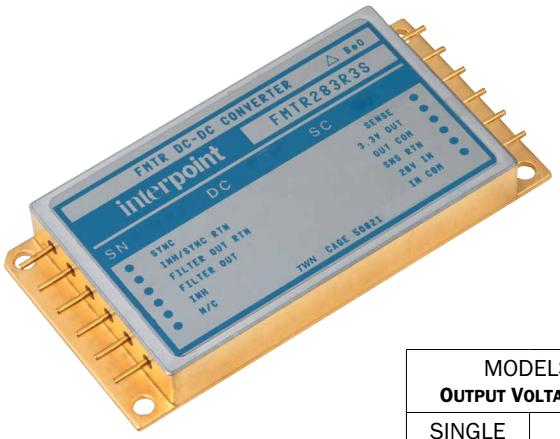
FMTR Single and Dual EMI Filtered DC-DC Converters

17 TO 40 VOLT INPUT - 20 TO 30 WATT

FEATURES

- EMI input filter, up to 50 dB attenuation
- High frequency output filter
- –55°C to +125°C operation
- 17 to 40 volt input
- Up to 50 volts for 50 ms transient protection
- Fully isolated, magnetic feedback
- Fixed high frequency switching
- Trim and remote sense on singles
- Inhibit and synchronization functions
- Indefinite short circuit protection
- High power density, up to 83% efficiency



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

DESCRIPTION

The Interpoint® FMTR-461 Series™ of DC-DC converters offers up to 30 watts of power in a low profile package. The FMTR converters are manufactured in our fully certified and qualified MIL-PRF-38534 Class H production facility and packaged in hermetically sealed steel cases. They are ideal for use in programs requiring high reliability, small size, and high efficiency. The FMTR Series™ of DC-DC converters offers up to 30 watts of output power from single or dual output configurations. They operate over the full military temperature range with up to 83% efficiency. FMTR converters are packaged in hermetically sealed metal cases, making them ideal for use in military, aerospace and other high reliability applications.

CONVERTER DESIGN

The FMTR converters are constant frequency, pulse-width modulated switching regulators which use a quasi-square wave, single ended, forward converter design. Tight load regulation is maintained via wide bandwidth magnetic feedback and, on single output models, through use of remote sense. Indefinite short circuit protection and overload protection are provided by a constant current-limit feature. This protective system senses current in the converter's secondary stage and limits it to approximately 115% of the maximum rated output current.

BUILT-IN FILTERS

The built-in input and output filters reduce layout issues and conserve board space. The 2.7 amp EMI input filter meets MIL-STD-461C, CE03 and allows filtering of additional converters through the filter output pins. The output filter reduces high frequency common and differential mode noise. It allows a higher bandwidth ripple voltage measurement and eliminates the need for external output decoupling capacitors.

WARNING: REQUIRED DAMPING NETWORK

To prevent damage to the internal circuitry an external capacitor and resistor are required across the filter outputs (pins 3 and 4) as shown in Figure 1. This applies to both single and dual output models. The recommended capacitor type is wet tantalum, MIL-C-39006.

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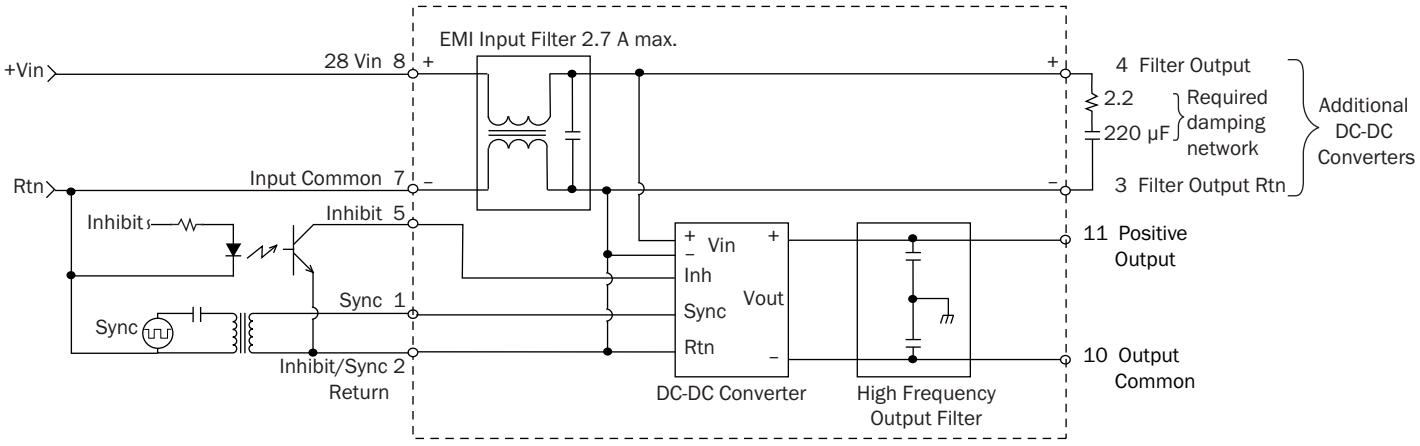
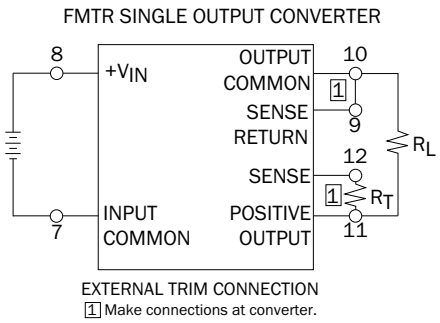


FIGURE 1: FMTR TYPICAL INPUT INTERFACE APPLIES TO SINGLES AND DUALS (SHOWN WITH SINGLE OUTPUT)

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



Trim Formulas

Vout = desired output voltage; Rt = trim resistor

3.3 V: $Rt = \frac{1300 * Vout - 4304}{1.2475}$

5 V: $Rt = \frac{1300 * Vout - 6512}{1.2475}$

12 V: $Rt = \frac{1300 * Vout - 15631}{1.2475}$

15 V: $Rt = \frac{1300 * Vout - 19498}{1.2475}$

FIGURE 2: TRIM CONNECTION [1, 2, 3]

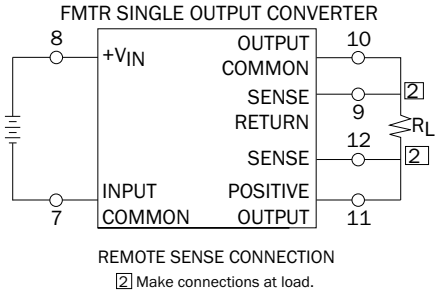


FIGURE 3: REMOTE SENSE [1, 2, 3]

Notes

1. When trimming output voltage and/or remote sensing, the total output voltage increase must be less than 0.6 volts at the converters pins to maintain specified performance.
2. If neither voltage trim nor remote sense will be used, connect pin 9 to pin 10 and pin 11 to pin 12 or the output voltage will increase by 1.2 volts
3. CAUTION: The converter will be permanently damaged if the positive remote sense (pin 12) is shorted to ground. Damage may also result if the output common or positive output is disconnected from the load with the remote sense leads connected to the load.

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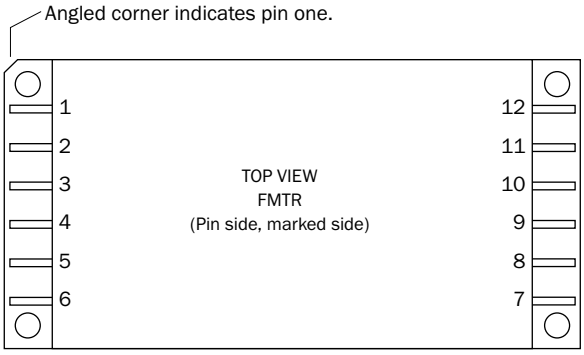
PIN OUT		
Pin	**Single Output**	**Dual Output**
1	Sync	Sync
2	Inhibit Sync/Rtn	Inhibit Sync/Rtn
3	Filter Out Rtn	Filter Out Rtn
4	Filter Out	Filter Out
5	Inhibit	Inhibit
6	No Connection	No Connection
7	Input Common	Input Common
8	Vin	Vin
9	Sense Rtn	No Connection
10	Output Common	Negative Output
11	Positive Output	Output Common
12	Positive Sense	Positive Output

TABLE 1: PIN OUT



See case U for dimensions.

FIGURE 4 PIN OUT

FMTR Single and Dual EMI Filtered DC-DC Converters

17 TO 40 VOLT INPUT - 20 TO 30 WATT

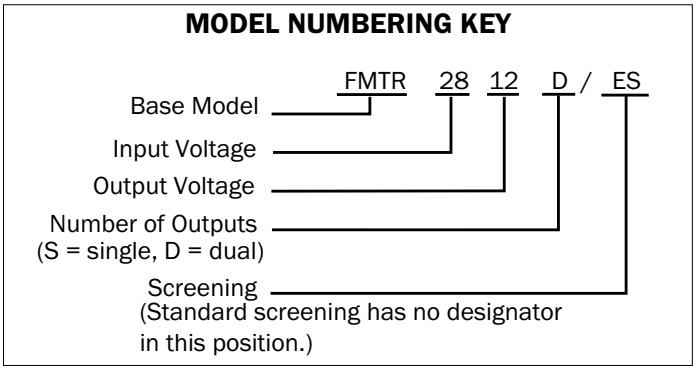


FIGURE 5: MODEL NUMBERING KEY

MODEL NUMBER OPTIONS

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

CATEGORY	Base Model and Input Voltage	Output Voltage [1]	Number of Outputs [2]		Screening [3]
OPTIONS	FMTR28	3R3, 05, 12, 15	S		(standard, leave blank)
		05, 12, 15	D		ES
FILL IN FOR MODEL # [4]	FMTR28	_____	_____	/	_____

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.
2. Number of Outputs: S is a single output and D is a dual output.
3. Screening: For standard screening leave the screening option blank. For other screening options, insert the desired screening level. For more information see Table 7 on page 12.
4. If ordering by model number add a "-Q" to request solder dipped leads (FMTR2805S/ES-Q).

TABLE 2: MODEL NUMBER OPTIONS

FMTR Single and Dual EMI Filtered DC-DC Converters

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TABLE 3: OPERATING CONDITIONS, ALL MODELS, 25°C CASE, 28 VIN, 100% LOAD, UNLESS OTHERWISE SPECIFIED.

		ALL MODELS			
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
LEAD SOLDERING TEMPERATURE [1]	10 SECONDS MAX.	—	—	300	°C
STORAGE TEMPERATURE [1]		-65	—	+150	°C
CASE OPERATING TEMPERATURE	FULL POWER	-55	—	+125	°C
	ABSOLUTE [1]	-55	—	+135	
DERATING OUTPUT POWER/CURRENT [1]	LINEARLY	From 100% at 125°C to 0% at 135°C			
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
CURRENT LIMIT [3]	% OF FULL LOAD	—	115	—	%
AUDIO REJECTION [1]		—	40	—	dB
DC RESISTANCE (R_{DC}) [1]		—	—	0.2	ohms
NOISE REJECTION -55°C TO +125°C	500 kHz	55	—	—	dB
	1 MHz	60	—	—	
SWITCHING FREQUENCY	-55°C TO +125°C	550	600	650	kHz
SYNCHRONIZATION IN -55°C TO +125°C	INPUT FREQUENCY	500	—	675	kHz
	DUTY CYCLE [1]	40	—	60	%
	ACTIVE LOW	—	—	0.8	V
	ACTIVE HIGH [1]	4.5	—	5.0	
	REFERENCED TO	INHIBIT/SYNC RETURN			
	IF NOT USED	CONNECT TO INHIBIT/SYNC RETURN			
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]	—	—	8	mA
	REFERENCED TO	INHIBIT/SYNC RETURN			
INHIBIT ACTIVE HIGH (OUTPUT ENABLED) Do not apply a voltage to the inhibit pin. [4]	INHIBIT PIN CONDITION	OPEN COLLECTOR OR UNCONNECTED			
	OPEN INHIBIT PIN VOLTAGE [1]	9	—	11	V

Notes
1. Guaranteed by characterization 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. Dual outputs: The over-current limit will trigger when the sum of the currents from both outputs reaches 115% (typical value) of the maximum rated "total" current of both outputs.
4. An external inhibit interface should be used to pull the inhibits low or leave them floating. The inhibit pins can be left unconnected if not used.

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TABLE 4: ELECTRICAL CHARACTERISTICS: -55°C TO +125°C CASE, 28 VIN, 100% LOAD, UNLESS OTHERWISE SPECIFIED.

SINGLE OUTPUT MODELS		FMTR283R3S			FMTR2805S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		3.20	3.30	3.40	4.85	5.00	5.15	V
OUTPUT CURRENT	V_{IN} = 17 TO 40	0	—	6.06	0	—	5.0	A
OUTPUT POWER	V_{IN} = 17 TO 40	0	—	20	0	—	25	W
OUTPUT RIPPLE	T_C = 25°C	—	70	140	—	110	220	mV p-p
10 kHz - 2 MHz	T_C = -55°C TO +125°C	—	—	180	—	—	260	
LINE REGULATION	V_{IN} = 17 TO 40	—	—	10	—	15	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	—	10	—	15	50	mV
INPUT VOLTAGE	CONTINUOUS	17	28	40	17	28	40	V
NO LOAD TO FULL	TRANSIENT 50 ms [1]	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	30	75	—	35	75	
	INHIBITED [1]	—	7	8	—	3	8	mA
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	5	10	—	5	10	mA p-p
EFFICIENCY	T_C = 25°C	73	75	—	75	77	—	%
INCLUDES BUILT-IN FILTER	T_C = -55°C TO +125°C	70	72	—	72	74		
LOAD FAULT [2]	POWER DISSIPATION	—	—	12	—	—	12	W
	RECOVERY [1]	—	1.4	6	—	1.4	5	ms
STEP LOAD RESPONSE [2, 3]	TRANSIENT	—	±125	±300	—	±200	±300	mV pk
50% - 100% - 50%	RECOVERY [1]	—	—	200	—	60	200	µs
STEP LINE RESPONSE [1, 2, 4]	TRANSIENT	—	—	±300	—	±200	±300	mV pk
V_{IN} = 17 - 40 - 17	RECOVERY	—	—	300	—	—	300	µs
START-UP [2, 5]	DELAY	—	1.4	5	—	1.4	5	ms
	OVERSHOOT [1]	—	0	50	—	0	50	mV pk

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Recovery time is measured from application of the transient to the point at which V_{OUT} is within 1% of final value.
3. Step load test is performed at 10 microseconds typical.
4. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
5. Tested on release from inhibit.

FMTR Single and Dual EMI Filtered DC-DC Converters

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TABLE 5: ELECTRICAL CHARACTERISTICS: -55°C TO +125°C CASE, 28 VIN, 100% LOAD, UNLESS OTHERWISE SPECIFIED.

SINGLE OUTPUT MODELS		FMTR2812S			FMTR2815S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		11.64	12.00	12.36	14.55	15.00	15.45	V
OUTPUT CURRENT	V_{IN} = 17 TO 40	0	—	2.5	0	—	2.0	A
OUTPUT POWER	V_{IN} = 17 TO 40	0	—	30	0	—	30	W
OUTPUT RIPPLE	T_C = 25°C	—	60	120	—	25	50	mV p-p
10 kHZ - 2 MHZ	T_C = -55°C TO +125°C	—	—	160	—	—	90	
LINE REGULATION	V_{IN} = 17 TO 40	—	15	50	—	15	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	15	50	—	15	50	mV
INPUT VOLTAGE	CONTINUOUS	17	28	40	17	28	40	V
NO LOAD TO FULL	TRANSIENT 50 ms [1]	—	—	50	—	—	50	V
INPUT CURRENT	NO LOAD	—	35	75	—	35	75	
	INHIBITED [1]	—	3	8	—	3	8	mA
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	5	10	—	5	10	mA p-p
EFFICIENCY	T_C = 25°C	79	82	—	80	83	—	%
INCLUDES BUILT-IN FILTER	T_C = -55°C TO +125°C	76	78	—	77	79		
LOAD FAULT [2]	POWER DISSIPATION	—	—	12	—	—	12	W
	RECOVERY [1]	—	1.4	5	—	1.4	5	ms
STEP LOAD RESPONSE [2, 3]	TRANSIENT	—	±250	±400	—	±350	±500	mV pk
50% - 100% - 50%	RECOVERY [1]	—	60	200	—	60	200	µs
STEP LINE RESPONSE [1, 2, 4]	TRANSIENT	—	±400	±500	—	±500	±600	mV pk
V_{IN} 17 - 40 - 17	RECOVERY	—	—	300	—	—	300	µs
START-UP [2, 5]	DELAY	—	1.4	5	—	1.4	5	ms
	OVERSHOOT [1]	—	0	120	—	0	150	mV pk

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Recovery time is measured from application of the transient to the point at which V_{OUT} is within 1% of final value.
3. Step load test is performed at 10 microseconds typical.
4. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
5. Tested on release from inhibit.

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

DUAL OUTPUT MODELS		FMTR2805D			FMTR2812D			FMTR2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V_{OUT}	4.85	5.00	5.15	11.64	12.00	12.36	14.55	15.00	15.45	V
	- V_{OUT}	4.80	5.00	5.18	11.56	12.00	12.42	14.46	15.00	15.53	
OUTPUT CURRENT [2]	EACH OUTPUT	0	±2.5	4.5	0	±1.25	2.25	0	±1.0	1.8	A
V_{IN} = 17 TO 40	TOTAL OUTPUT	0	—	5	0	—	2.5	0	—	2	
OUTPUT POWER [2] V_{IN} = 17 TO 40	TOTAL OUTPUT	—	—	25	—	—	30	—	—	30	W
OUTPUT RIPPLE	T_C = 25°C +V_{OUT}	—	—	140	—	—	80	—	—	80	mV p-p
10 kHz - 2 MHz	-55°C TO +125°C +V_{OUT}	—	—	140	—	—	80	—	—	80	
	T_C = 25°C -V_{OUT}	—	—	180	—	—	120	—	—	120	
	-55°C TO +125°C -V_{OUT}	—	—	180	—	—	120	—	—	120	
LINE REGULATION	+ V_{OUT}	—	10	50	—	10	50	—	10	50	mV
V_{IN} = 17 TO 40	- V_{OUT}	—	50	100	—	50	150	—	50	180	
LOAD REGULATION	+ V_{OUT}	—	5	50	—	15	50	—	15	50	mV
NO LOAD TO FULL	- V_{OUT}	—	45	120	—	45	170	—	40	190	
CROSS REGULATION	SEE NOTE 3	—	8	—	—	5	—	—	3	—	%
T_C = 25°C	SEE NOTE 4	—	5	—	—	4	—	—	4	—	
INPUT VOLTAGE	CONTINUOUS	17	28	40	17	28	40	17	28	40	V
NO LOAD TO FULL	TRANSIENT 50 ms [1]	—	—	50	—	—	50	—	—	5 0	V
INPUT CURRENT	NO LOAD	—	35	75	-	50	75	—	50	75	mA
	INHIBITED [1]	—	3	8	—	3	8	—	3	8	
INPUT RIPPLE CURRENT	10 kHz TO 10 MHz	—	5	10	—	5	10	—	5	10	mA p-p
EFFICIENCY	T_C = 25°C	75	77	—	78	80	—	79	82	—	%
BALANCED LOAD	T_C = -55°C TO +125°C	72	74	—	75	77	—	76	78	—	
LOAD FAULT [5]	POWER DISSIPATION	—	—	12	—	—	12	—	—	12	W
	RECOVERY [1]	—	1.4	5	—	1.4	5	—	1.4	5	ms
STEP LOAD RESPONSE [5, 6]	TRANSIENT	—	±200	±300	—	±150	±300	—	±200	±400	mV pk
50% TO 100% TO 50% ± V_{OUT}	RECOVERY [1]	—	100	200	—	100	200	—	100	200	µs
STEP LINE RESPONSE [1, 5, 7]	TRANSIENT	—	±200	±400	—	±250	±400	—	±400	±500	mV pk
VIN = 17 TO 40 -17 ± V_{OUT}	RECOVERY	—	—	300	—	—	300	—	—	300	µs
START-UP [5, 8]	DELAY	—	1.4	5	—	1.4	5	—	1.4	5	ms
	OVERSHOOT [1]	—	0	50	—	0	120	—	0	150	mV pk

Notes
1. Guaranteed by characterization test and/or analysis. Not a production test.
2. Up to 90% of the total output power is available from either output providing the opposite output is simultaneously carrying 10% of the total power.
3. Effect on negative Vout from 50%/50% loads to 90%/10% or 10%/90% loads.
4. Effect on negative Vout from 50%/50% loads to 50% then 10% load on negative Vout.
5. Recovery time is measured from application of the transient to point at which Vout is within 1% of final value.
6. Step load test is performed at 10 microseconds typical.
7. Step line characterization test is performed at 100 microseconds ± 20 microseconds.
8. Tested on release from inhibit.

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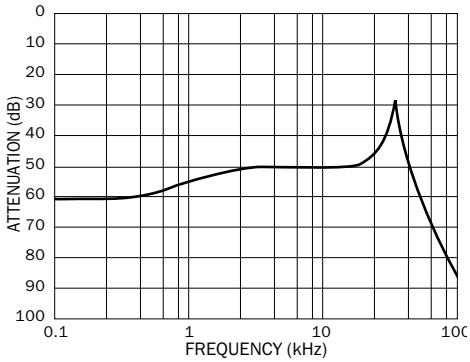
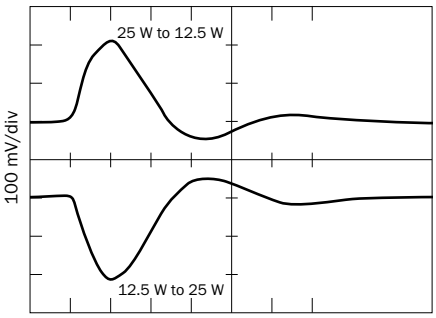
17 TO 40 VOLT INPUT - 20 TO 30 WATT

Typical Performance Plots: 25°C case, unless otherwise specified.
For reference only. Not guaranteed specifications.



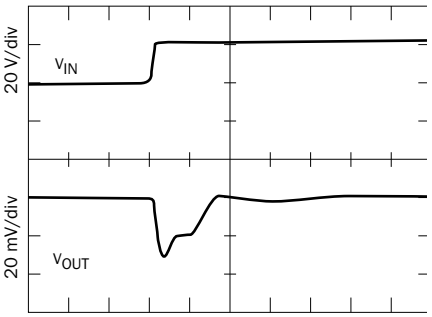
AUDIO REJECTION, FMTR SERIES

FIGURE 6



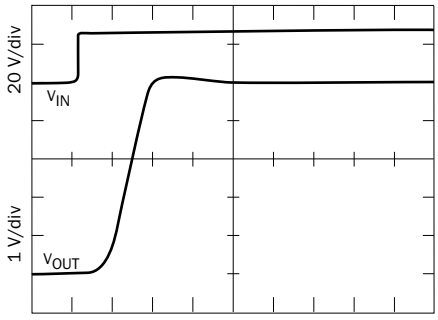
FMTR2805S STEP LOAD RESPONSE

FIGURE 7



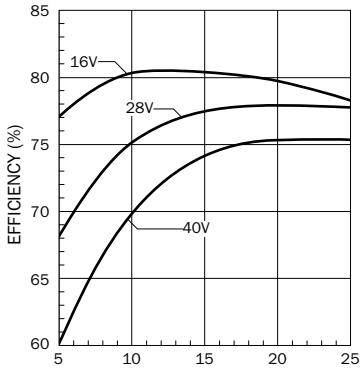
FMTR2805S STEP LINE RESPONSE

FIGURE 8



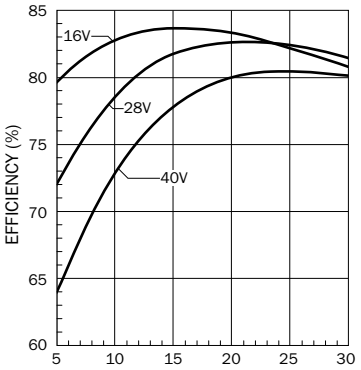
FMTR2805S TURN-ON INTO NO LOAD

FIGURE 9



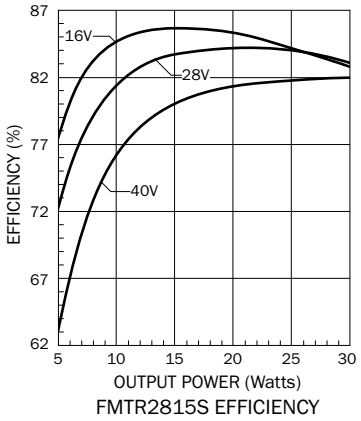
FMTR2805S EFFICIENCY

FIGURE 10



FMTR2812S EFFICIENCY

FIGURE 11



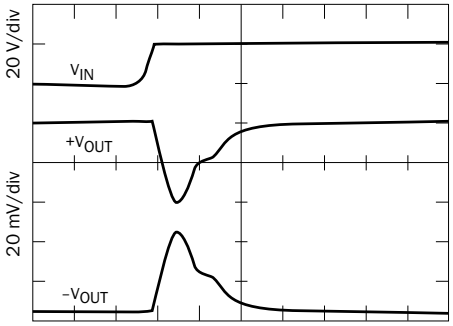
FMTR2815S EFFICIENCY

FIGURE 12

FMTR Single and Dual EMI Filtered DC-DC Converters

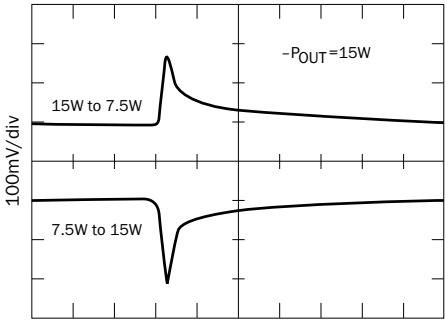
17 TO 40 VOLT INPUT - 20 TO 30 WATT

Typical Performance Plots: 25°C case, unless otherwise specified.
For reference only. Not guaranteed specifications.



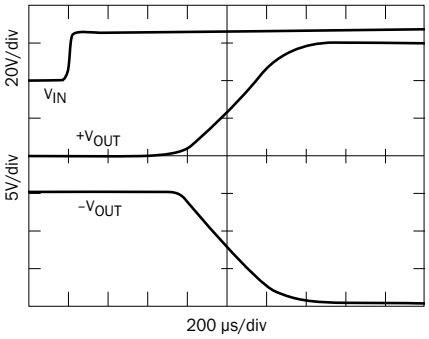
FMTR2815D STEP LINE RESPONSE

FIGURE 13



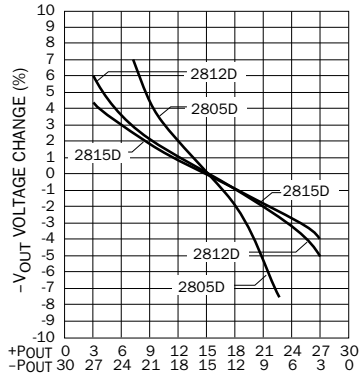
FMTR2815D +VOUT STEP LOAD RESPONSE

FIGURE 14



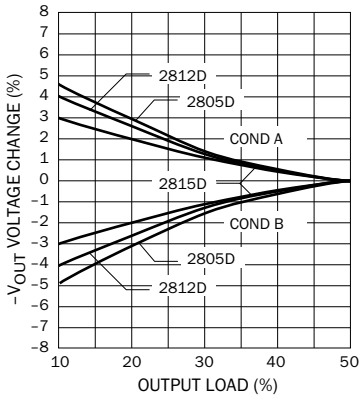
FMTR2815D TURN-ON INTO NO LOAD

FIGURE 15



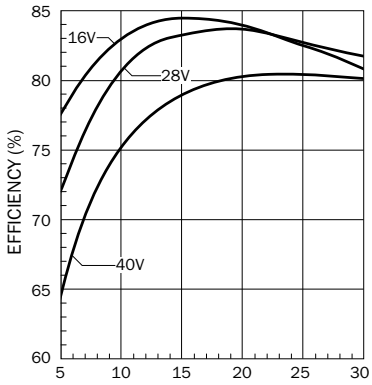
10% to 90% LOAD +V
90% to 10% LOAD –V
CROSS REGULATION

FIGURE 16



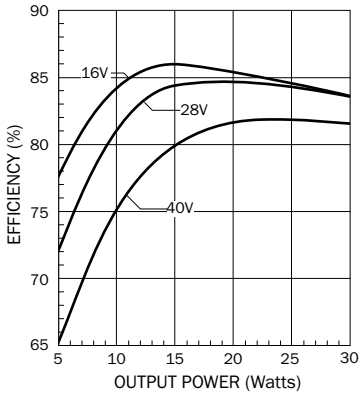
COND. B: 50% LOAD +V, 50% to 10% –V
COND. A: 50% LOAD –V, 50% to 10% +V
CROSS REGULATION

FIGURE 17



FMTR2812D EFFICIENCY

FIGURE 18

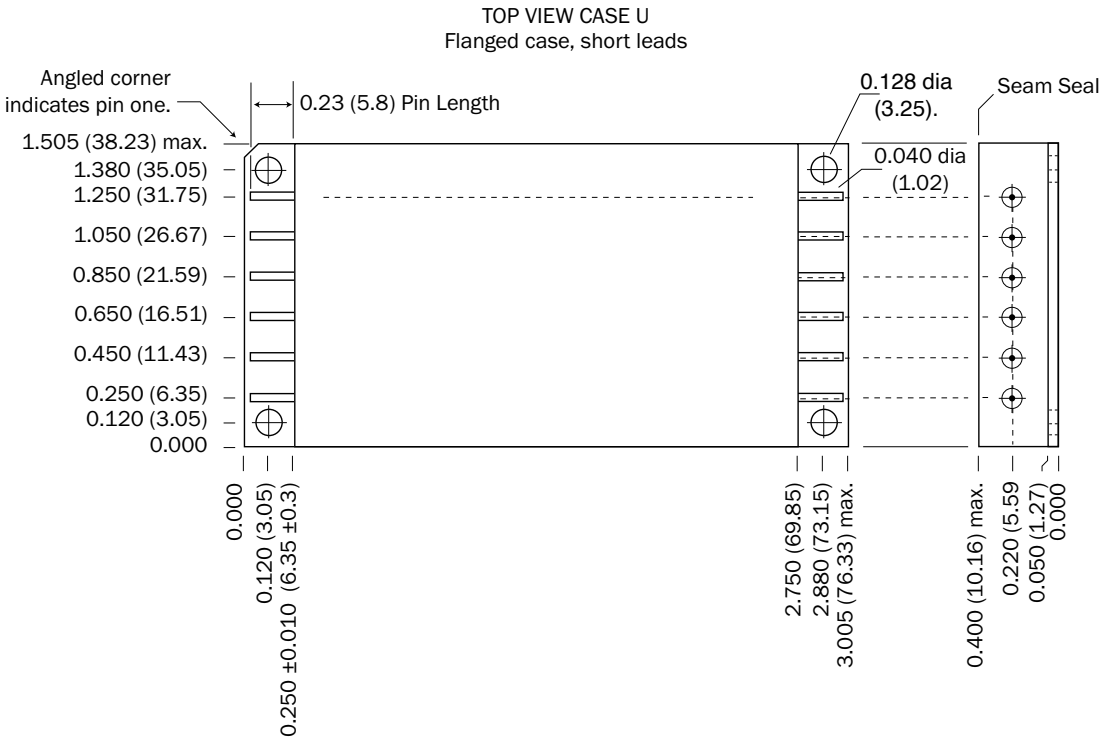


FMTR2815D EFFICIENCY

FIGURE 19

FMTR Single and Dual EMI Filtered DC-DC Converters

17 TO 40 VOLT INPUT - 20 TO 30 WATT



Weight: 100 grams maximum

Substrate is Beryllium oxide (BeO).

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
	Gold plating of 50 - 150 microinches is included in pin diameter
	Seal Hole: 0.120 ±0.002 (3.05 ±0.05)

FIGURE 20: CASE U

FMTR Single and Dual EMI Filtered DC-DC Converters

17 TO 40 VOLT INPUT - 20 TO 30 WATT

ENVIRONMENTAL SCREENING DC-DC CONVERTERS AND EMI FILTERS STANDARD AND /ES [1]

TEST PERFORMED	STANDARD	/ES
Pre-cap Inspection Method 2017, 2032	■	■
Temperature Cycle (10 times) Method 1010, Cond. B, -55°C to +125°C, ambient		■
Constant Acceleration Method 2001, 500 g		■
Burn-in Method 1015 [2] 96 hours		■
Final Electrical Test MIL-PRF-38534, Group A 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. Standard and /ES products may not meet all of the requirements of MIL-PRF-38534.
2. Burn-in temperature designed to bring the case temperature to the maximum case temperature of the product. Refer to the specific product information for the maximum case temperature. Burn-in is a powered test.

TABLE 7: ENVIRONMENTAL SCREENING