

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

FEATURES

No cross-regulation error in triple output models

Operating temperature -55° to +125°C

- Input voltage range 16 to 40 volts
- Transient protection 50 Vin for 50 ms
- Fully isolated, magnetic feedback
- Fixed high frequency switching
- Inhibit and synchronization function
- Indefinite short circuit and overload protection



ALSO SEE OUR IMPROVED MTR (50)
16 - 50 Vin, 80 V transient per MIL-STD-704A.
Datasheet at www.interpoint.com/mtr50

MODELS		
OUTPUT VOLTAGE (V)		
SINGLE	DUAL	TRIPLE
3.3	±5	+5 & ±12
5	±12	+5 & ±15
12	±15	
15		
18		

DESCRIPTION

The Interpoint™ MTR Series™ of dc-dc converters offers up to 30 watts of output power from single, dual, or triple output configurations. MTR (40) models have an input voltage range of 16 to 40 and transient protection up to 50 Vin for up to 50 milliseconds. They operate over the full military temperature range with up to 84% efficiency. MTR converters are packaged in hermetically sealed metal cases, making them ideal for use in military, aerospace and other high reliability applications. The converters are offered with standard screening, “ES” screening, or fully compliant to “883” MIL-PRF-38534 Class H screening. See Table 12 on page 25 and Table 13 on page 26 for more information. Standard microcircuit drawings (SMD) are available. See Table 3 on page 8.

CONVERTER DESIGN

The MTR 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. On dual output models, the positive output is independently regulated and the negative output is cross regulated through the use of tightly coupled magnetics. The MTR Series triple output dc-dc converter’s design includes individual regulators on the auxiliary outputs which provide for no cross regulation error when a minimum 300 mA load is maintained on the main (+5) output.

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 125% of the maximum rated output current.

MTR converters are provided with internal filtering capacitors that help reduce the need for external components in normal operation. Use our FMCE-0328™, FMCE-0528™ or FMCE-0828™ EMI filter to meet the requirements of MIL-STD-461C CE03 and CS01 and/or MIL-STD-461D, E and F CE102 and CS101 levels of conducted emissions. Or use the FM-704A for transient suppression and to meet MIL-STD-461C CE03.

COVER MARKING

The cover marking for the MTR 40 is “MTR DC-DC CONVERTER” under the model number. See Figures on page 7.

SYNCHRONIZATION

Synchronizing the converter with the system clock allows the designer to confine switching noise to clock transitions, minimizing interference and reducing the need for filtering. In sync mode, the converter will run at any frequency between 500 kHz and 675 kHz for singles and duals and between 500 and 700 for triples. The sync control operates with a duty cycle between 40% and 60%. The sync pin must be connected to input common pin when not in use.

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WIDE INPUT VOLTAGE RANGE

MTR converters are designed to provide full power over a full 16 to 40 volts input voltage range. Operation below 16 volts, including MIL-STD-704A emergency power conditions is possible with derated power. Refer to the low line dropout graphs ("Figure 26", "Figure 34" and "Figure 35") for details.

DYNAMIC RESPONSE

The MTR Series feed-forward compensation system provides excellent dynamic response and noise rejection. Audio rejection is typically 40 dB for singles and duals and 50 dB for triples.

INHIBIT FUNCTION

MTR converters provide an inhibit terminal that can be used to disable internal switching, resulting in no output voltage and very low quiescent input current. The converter is inhibited when the inhibit pin is pulled below 0.8 V and enabled when its inhibit pin is left floating. An external inhibit interface should be capable of pulling the converter's inhibit pin below 0.8 V while sinking the maximum inhibit current and also allowing the inhibit pin to float high to enable the converter. A voltage should not be applied to the inhibit pin. The open circuit voltage present on the inhibit pin is 9 to 11 V.

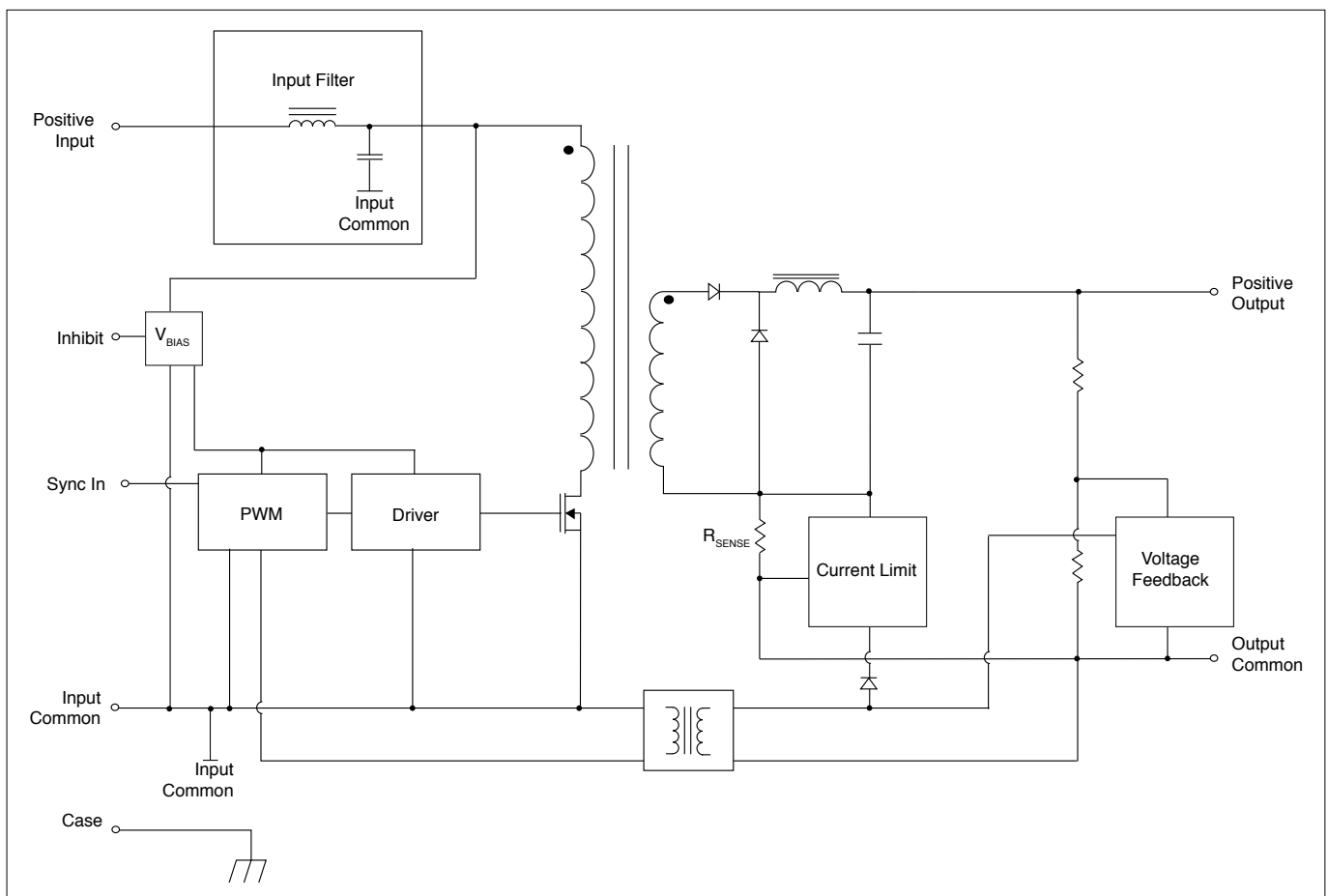


FIGURE 1: MTR SINGLE BLOCK DIAGRAM

MTR (40) Single, Dual and Triple DC-DC Converters

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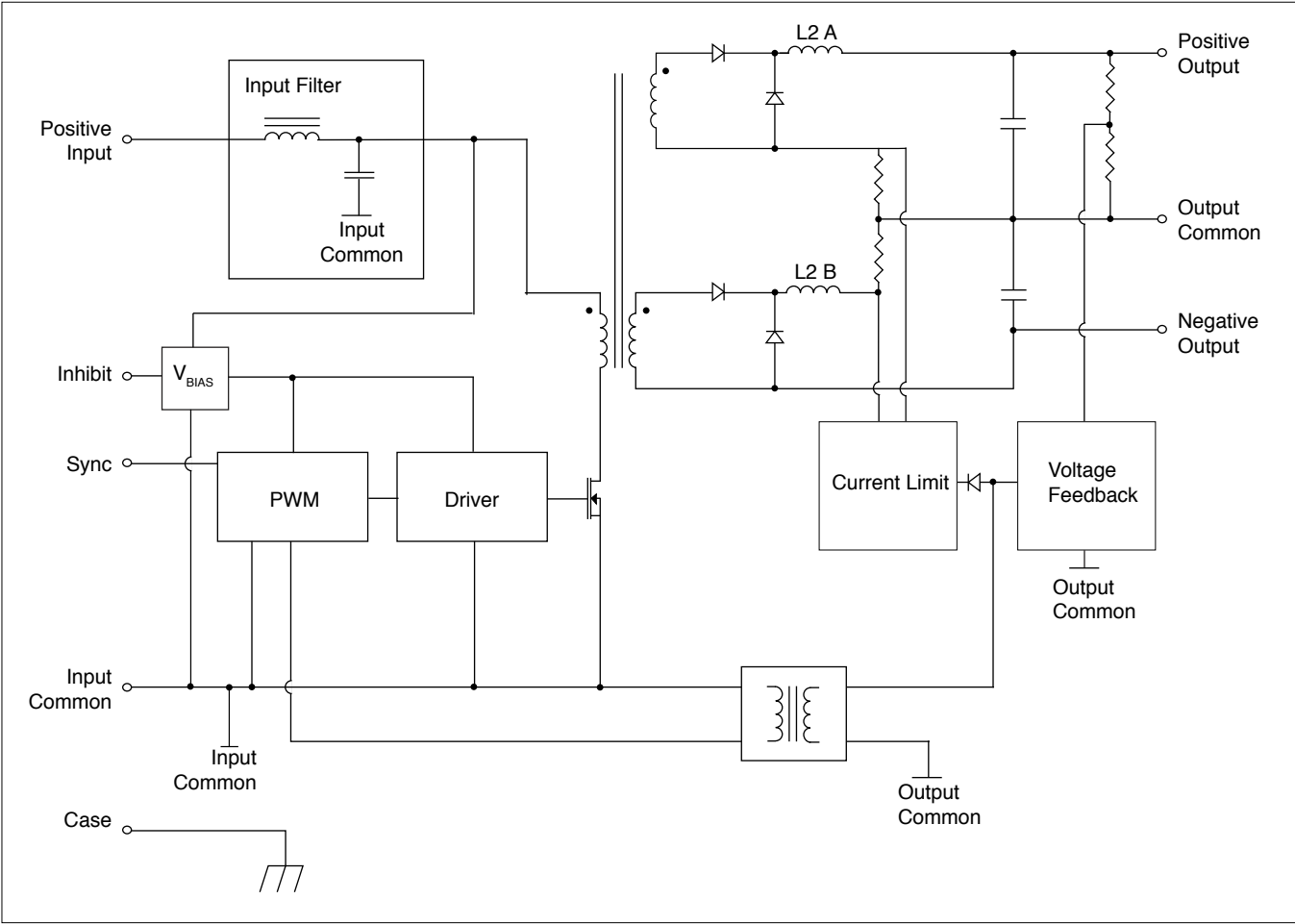


FIGURE 2: MTR DUAL /883 BLOCK DIAGRAM

MTR (40) Single, Dual and Triple DC-DC Converters

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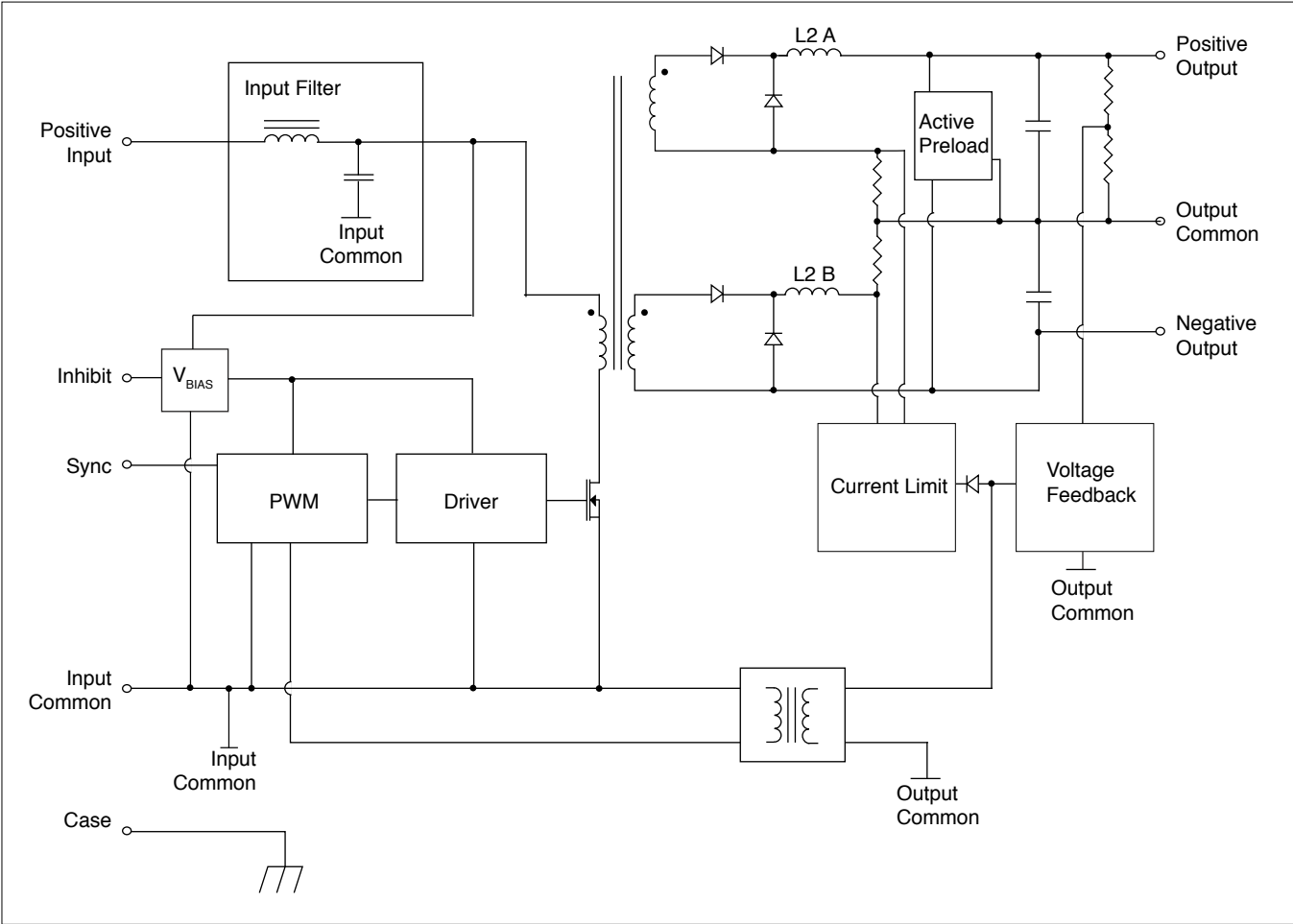


FIGURE 3: MTR DUAL NON-883 BLOCK DIAGRAM

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

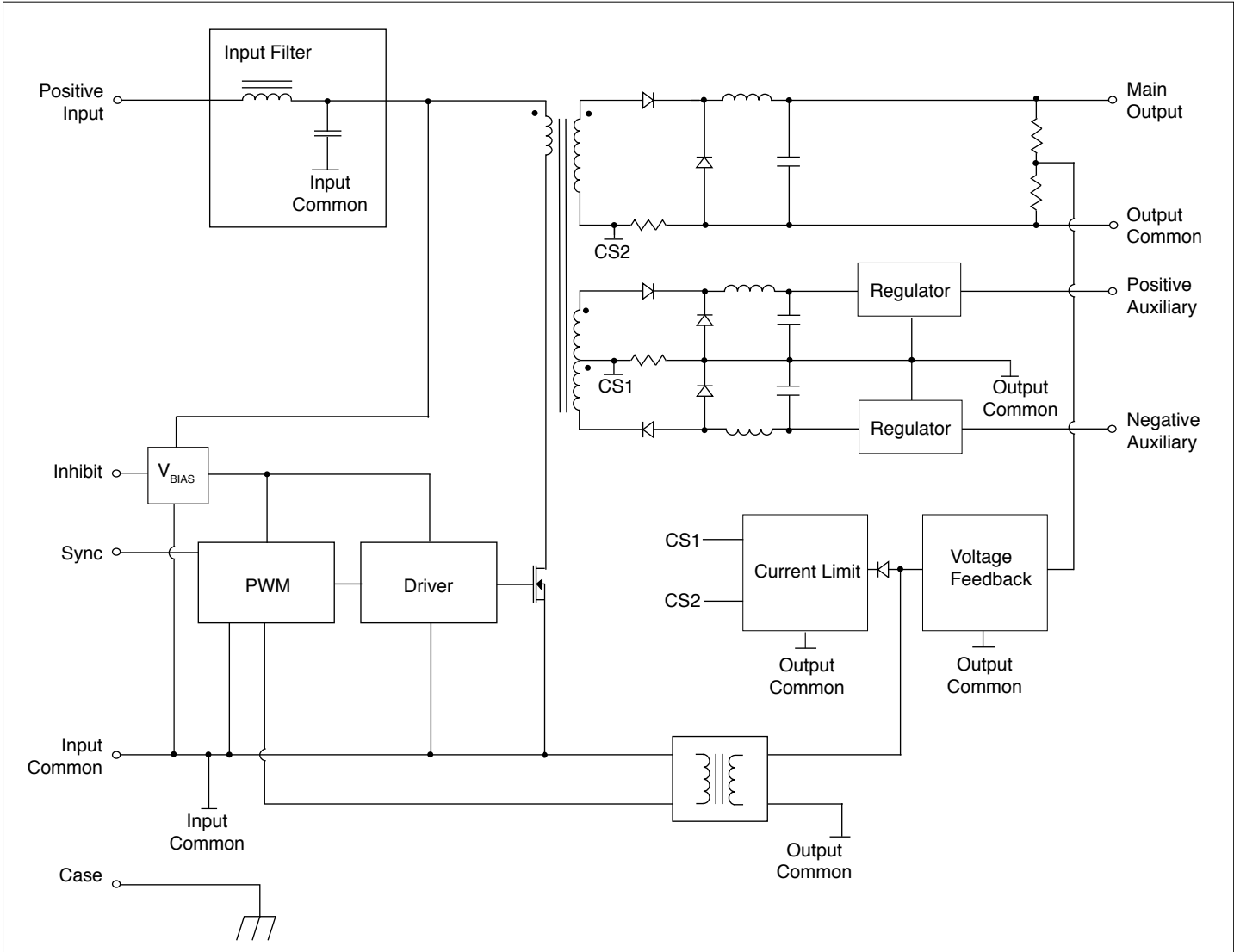


FIGURE 4: MTR TRIPLE BLOCK DIAGRAM

MTR (40) Single, Dual and Triple DC-DC Converters

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TRIM AND REMOTE SENSE (AVAILABLE ON SINGLE 5, 12 AND 15 OUTPUT MODELS ONLY)

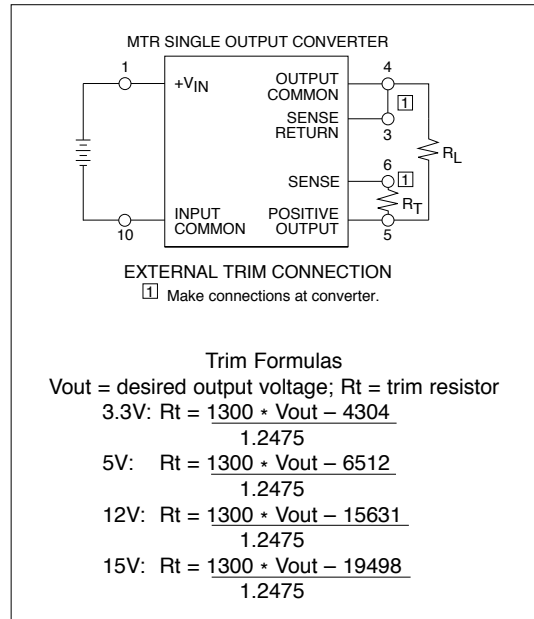


FIGURE 5: TRIM CONNECTION 1, 2, 3

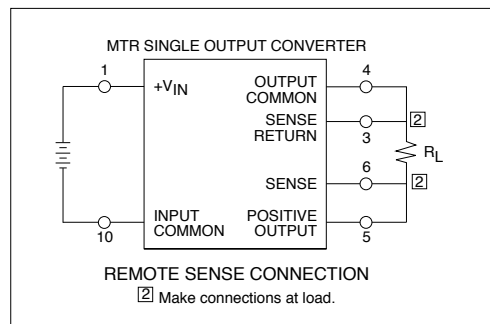


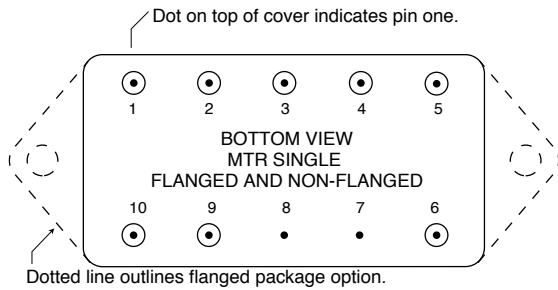
FIGURE 6: REMOTE SENSE CONNECTION 4

Notes for Remote Sense and Trim

- When trimming output voltage and/or remote sensing, the total output voltage increase must be less than 0.6 volts at the converters pins. Do not exceed the maximum power.
- If neither voltage trim nor remote sense will be used, connect pin 3 to pin 4 and pin 5 to pin 6.
- CAUTION:** The converter will be permanently damaged if the remote sense (pin 6) 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.
- When using remote sense for voltage compensation or when using remote sense for trim, the output will drift over temperature. Contact Applications Engineering for more information at powerapps@crane-eg.com

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See Figure 37 on page 20 and Figure 40 on page 23 for dimensions.

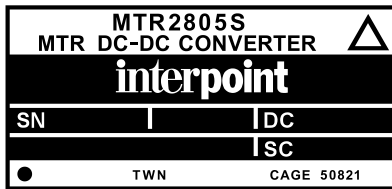


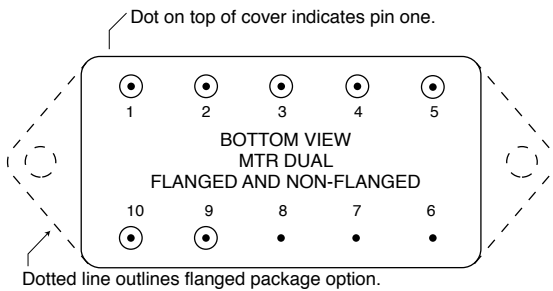
FIGURE 7: PIN OUT AND MARKING SINGLE OUTPUT MODELS

PIN OUT			
Pin	Single Output	Dual Output	Triple Output
1	Positive Input	Positive Input	Positive Input
2	Inhibit	Inhibit	Main (+5) Output
3	Sense Return	Positive Output	Output Common
4	Output Common	Output Common	Neg. Aux. Output
5	Positive Output	Negative Output	Pos. Aux. Output
6	Positive Sense	Case Ground	Case Ground
7	Case Ground	Case Ground	Case Ground
8	Case Ground	Case Ground	Inhibit
9	Sync	Sync	Sync
10	Input Common	Input Common	Input Common

TABLE 1: PIN OUT

PINS NOT IN USE	
Inhibit	Leave unconnected
Sync In	Connect to input common
Sense Lines	Must be connected to appropriate outputs

TABLE 2: PINS NOT IN USE



See Figure 37 on page 20, Figure 38 on page 21, Figure 40 on page 23 and Figure 41 on page 24 for dimensions.

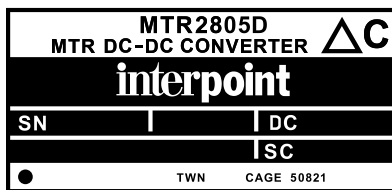
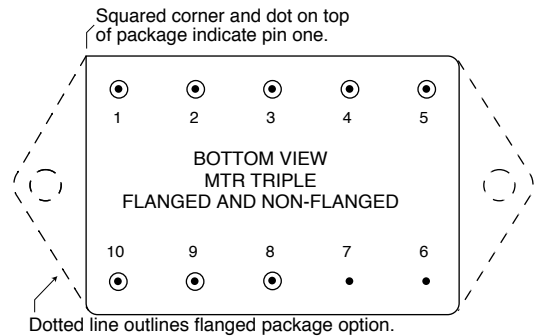


FIGURE 8: PIN OUT AND MARKING FOR DUAL OUTPUT MODELS



See Figure 36 on page 19 and Figure 39 on page 22 for dimensions.

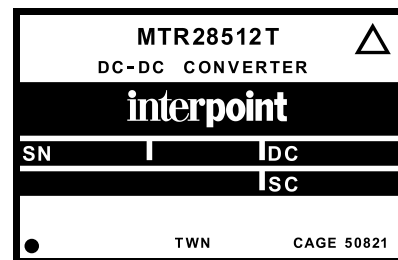


FIGURE 9: PIN OUT AND MARKING TRIPLE OUTPUT MODELS

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

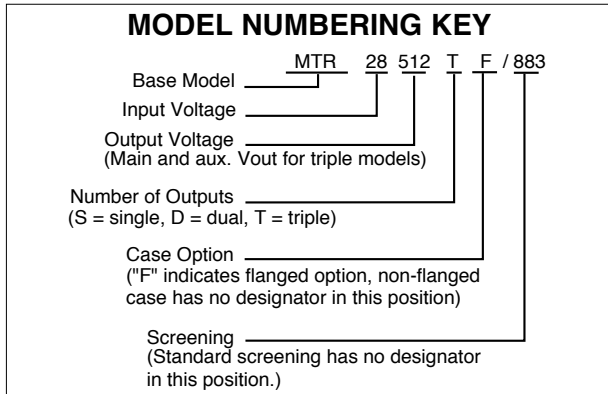


FIGURE 10: MODEL NUMBERING KEY

SMD NUMBERS	
STANDARD MICROCIRCUIT DRAWING (SMD)	MTR SIMILAR PART
5962-0150101HXC	MTR283R3S/883
5962-9306801HXC	MTR2805S/883
5962-9306901HXC	MTR2812S/883
5962-9307001HXC	MTR2815S/883
5962-9320201HXC	MTR2818S/883
5962-9320501HXC	MTR2805D/883
5962-9307101HXC	MTR2812D/883
5962-9307201HXC	MTR2815D/883
5962-9307301HXC	MTR28512T/883
5962-9307401HXC	MTR28515T/883

To indicate the flanged case option change the "X" to "Z" in the SMD number. The SMD number shown is for Class H screening, non-flanged. See the SMD for the numbers for other screening and radiation levels. For exact specifications for an SMD product, refer to the SMD drawing. SMDs can be downloaded from: <https://landandmaritimeapps.dla.mil/programs/smcr/default.aspx>

TABLE 3: SMD NUMBER CROSS REFERENCE

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	Case Options ³	Screening ⁴
OPTIONS	MTR28	3R3, 05, 12, 15, 18	S	(non-flanged, leave blank)	(standard, leave blank)
		05, 12, 15	D	F (flanged)	ES
		512, 515	T		883
FILL IN FOR MODEL #	MTR28	_____	_____	_____	/ _____

Notes

- Output Voltage: An R indicates a decimal point. 3R3 is 3.3 volts out. The value of 3R3 and 18 are only available in single output models. The 512 and 515 triple output converters are +5 volt main and ±12 or ±15 volt auxiliaries.
- Number of Outputs: S is a single output, D is a dual output, and T is a triple output
- Case Options: For the standard case (Figure 37 on page 20, Figure 38 on page 21 and Figure 36 on page 19) leave the case option blank. For the flanged case option (Figure 40 on page 23, Figure 41 on page 24 and Figure 39 on page 22), insert the letter F in the Case Option position.
- 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 25 and Table 13 on page 26.

TABLE 4: MODEL NUMBER OPTIONS

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

PARAMETER	CONDITIONS	ALL MODELS			UNITS	
		MIN	TYP	MAX		
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				
ESD RATING ¹ MIL-PRF-38534, 3.9.5.8.2	MIL-STD-883, METHOD 3015 CLASS 1 SINGLES AND TRIPLES	0 - 1999			V	
	CLASS 2 DUALS	2000 - 3999				
ISOLATION: INPUT TO OUTPUT OR ANY PIN TO CASE EXCEPT CASE PIN	@ 500 V AT 25°C	100	–	–	Megohms	
INPUT TO OUTPUT CAPACITANCE ¹	SINGLES AND DUALS	–	50	–	pF	
	TRIPLES	–	100	–		
CURRENT LIMIT ²	% OF FULL LOAD	–	125	–	%	
AUDIO REJECTION ¹	SINGLES AND DUALS	–	40	–	dB	
	TRIPLES	–	50	–		
CONVERSION FREQUENCY FREE RUN -55° TO +125°C	SINGLES AND DUALS	550	–	650	kHz	
	TRIPLES	525	–	650		
SYNCHRONIZATION	INPUT FREQUENCY SINGLES AND DUALS	500	–	675	kHz	
	TRIPLES	500	–	700		
	DUTY CYCLE ¹	40	–	60	%	
	ACTIVE LOW	–	–	0.8	V	
	ACTIVE HIGH ¹	4.5	–	5.0		
	REFERENCED TO	INPUT COMMON				
	IF NOT USED	CONNECT TO INPUT COMMON				
INHIBIT ACTIVE LOW (OUTPUT DISABLED) Do not apply a voltage to the inhibit pin. ³	INHIBIT PIN PULLED LOW	–	–	0.8	V	
	INHIBIT PIN SOURCE CURRENT ¹	SINGLES AND DUALS	–	–	6	mA
		TRIPLES	–	–	8	
REFERENCED TO	INPUT COMMON					
INHIBIT ACTIVE HIGH (OUTPUT ENABLED) Do not apply a voltage to the inhibit pin. ³	INHIBIT PIN CONDITION	OPEN COLLECTOR OR UNCONNECTED				
	OPEN INHIBIT PIN VOLTAGE ¹	9	–	11	V	

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

Notes

- Guaranteed by design and/or analysis. Not an in-line test.
- 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 125% (typical value) of the maximum rated "total" current of both outputs.
- An external inhibit interface should be used to pull the inhibit low or leave it floating. The inhibit pin can be left unconnected if not used.

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

SINGLE OUTPUT MODELS		MTR283R3S			MTR2805S			MTR2812S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		3.201	3.30	3.399	4.85	5.00	5.15	11.64	12.00	12.36	V
OUTPUT CURRENT		0	—	6.06	0	—	5.0	0	—	2.5	A
OUTPUT POWER	$V_{IN} = 16$ TO 50 V	0	—	20	0	—	25	0	—	30	W
OUTPUT RIPPLE	$T_C = 25^\circ\text{C}$	—	15	40	—	35	50	—	25	40	mV p-p
10 kHz - 2 MHz	$T_C = -55^\circ\text{C}$ TO $+125^\circ\text{C}$	—	—	50	—	50	90	—	40	90	
LINE REGULATION ²	$V_{IN} = 16$ TO 40 V	—	—	10	—	15	50	—	15	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	—	10	—	15	50	—	15	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	—	30	75	—	35	75	—	35	75	mA
	INHIBITED	—	7	8	—	3	8	—	3	8	
INPUT RIPPLE CURRENT ³	10 kHz - 10 MHz	—	25	50	—	20	50	—	20	50	mA p-p
EFFICIENCY	$T_C = 25^\circ\text{C}$	74	76	—	76	78	—	80	83	—	%
	$T_C = -55^\circ\text{C}$ TO $+125^\circ\text{C}$	71	—	—	73	—	—	77	—	—	
LOAD FAULT ⁴	POWER DISSIPATION	—	—	12	—	—	12	—	—	12	W
SHORT CIRCUIT	RECOVERY ¹	—	1.4	6	—	1.4	5	—	1.4	5	ms
STEP LOAD RESPONSE ⁵	TRANSIENT	—	± 125	± 250	—	± 200	± 300	—	± 250	± 400	mV pk
50% - 100% - 50%	RECOVERY ¹	—	—	200	—	60	200	—	60	200	μs
STEP LINE RESPONSE ^{1, 5}	TRANSIENT	—	—	± 300	—	± 200	± 300	—	± 400	± 625	mV pk
16 - 40 - 16 V	RECOVERY	—	—	300	—	—	300	—	—	350	μs
START-UP ⁶	DELAY	—	1.4	5	—	1.4	5	—	1.4	5	m sec
FULL LOAD	OVERSHOOT ¹	—	0	50	—	0	50	—	0	120	mV pk
CAPACITIVE LOAD ¹	NO EFFECT ON DC	—	—	300	—	—	300	—	—	300	μF
$T_C = 25^\circ\text{C}$	PERFORMANCE										

Notes

1. Guaranteed by design and/or analysis. Not an in-line test.
2. Operation is limited below 16V (see "Figure 26" on page 17).
3. Tested with 6800 pF ceramic bypass capacitor connected externally from input common to case.

4. Indefinite short circuit protection not guaranteed above 125°C case.
5. Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of final value.
6. Tested on release from inhibit.

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

SINGLE OUTPUT MODELS		MTR2815S			MTR2818S			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		14.70	15.00	15.30	17.46	18.00	18.54	V
OUTPUT CURRENT		0	—	2.0	0	—	1.67	A
OUTPUT POWER	$V_{IN} = 16 \text{ TO } 50 \text{ V}$	0	—	30	0	—	30	W
OUTPUT RIPPLE	$T_C = 25^\circ\text{C}$	—	25	40	—	—	40	mV p-p
10 kHz - 2 MHz	$T_C = -55^\circ\text{C TO } +125^\circ\text{C}$	—	40	90	—	—	90	
LINE REGULATION ²	$V_{IN} = 16 \text{ TO } 40 \text{ V}$	—	15	50	—	—	50	mV
LOAD REGULATION	NO LOAD TO FULL	—	15	50	—	—	50	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	—	35	75	—	—	75	mA
	INHIBITED	—	3	8	—	—	8	
INPUT RIPPLE CURRENT ³	10 kHz - 10 MHz	—	20	50	—	—	50	mA p-p
EFFICIENCY	$T_C = 25^\circ\text{C}$	81	84	—	81	84	—	%
	$T_C = -55^\circ\text{C TO } +125^\circ\text{C}$	78	—	—	78	—	—	
LOAD FAULT ⁴	POWER DISSIPATION	—	—	12	—	—	12	W
SHORT CIRCUIT	RECOVERY ¹	—	1.4	5	—	1.4	5	ms
STEP LOAD RESPONSE ⁵	TRANSIENT	—	±350	±500	—	—	±600	mV pk
50% - 100% - 50%	RECOVERY ¹	—	60	200	—	60	200	μs
STEP LINE RESPONSE ^{1, 5}	TRANSIENT	—	±500	±750	—	±500	±800	mV pk
16 - 40 -16 V	RECOVERY	—	—	350	—	—	350	μs
START-UP ⁶	DELAY	—	1.4	5	—	—	5	m sec
FULL LOAD	OVERSHOOT ¹	—	0	150	—	0	180	mV pk
CAPACITIVE LOAD ¹	NO EFFECT ON DC	—	—	300	—	—	300	μF
$T_C = 25^\circ\text{C}$	PERFORMANCE							

Notes

1. Guaranteed by design and/or analysis. Not an in-line test.
2. Operation is limited below 16V (see "Figure 26" on page 17).
3. Tested with 6800 pF ceramic bypass capacitor connected externally from input common to case.

4. Indefinite short circuit protection not guaranteed above 125°C case.
5. Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of final value.
6. Tested on release from inhibit.

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

DUAL OUTPUT MODELS - /883 ONLY		MTR2805D			MTR2812D			MTR2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V _{OUT}	4.850	5.00	5.150	11.64	12.00	12.36	14.55	15.00	15.45	V
	- V _{OUT}	4.825	5.00	5.172	11.58	12.00	12.42	14.47	15.00	15.53	
OUTPUT CURRENT ² V _{IN} = 16 TO 40 V	EITHER OUTPUT	0	2.5	4.5 ¹	0	1.25	2.25 ¹	0	1.00	1.80 ¹	A
	TOTAL OUTPUT	—	—	5	—	—	2.5	—	—	2.00	
OUTPUT POWER ² V _{IN} = 16 TO 40 V	EITHER OUTPUT	0	12.5	22.5 ¹	0	15	27 ¹	0	15	27 ¹	W
	TOTAL OUTPUT	—	—	25	—	—	30	—	—	30	
OUTPUT RIPPLE 10 kHz - 2 MHz ± V _{OUT}	T _C = 25°C	—	20	40	—	30	80	—	25	80	mV p-p
	T _C = -55°C TO +125°C	—	40	90	—	40	120	—	40	120	
LINE REGULATION ³ V _{IN} = 16 TO 40 V	+ V _{OUT}	—	10	50	—	10	50	—	10	50	mV
	- V _{OUT}	—	50	100	—	50	150	—	50	180	
LOAD REGULATION NO LOAD TO FULL	+ V _{OUT}	—	5	50	—	15	50	—	15	50	mV
	- V _{OUT}	—	25	100	—	30	150	—	30	180	
CROSS REGULATION ¹ EFFECT ON -V _{OUT} , 25°C	SEE NOTE 4	—	4	6	—	4	6	—	4	6	%
	SEE NOTE 5	—	7	12	—	4	8.3	—	3	8	
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	16	28	40	16	28	40	16	28	40	V
	TRANSIENT 50 ms ¹	0	—	50	0	—	50	0	—	50	
INPUT CURRENT	NO LOAD	—	35	75	—	50	75	—	50	75	mA
	INHIBITED	—	3	8	—	3	8	—	3	8	
INPUT RIPPLE CURRENT ⁶ 10 kHz - 10 MHz		—	15	50	—	20	50	—	20	50	mA p-p
EFFICIENCY BALANCED LOAD	T _C = 25°C	76	78	—	79	81	—	80	83	—	%
	T _C = -55°C TO +125°C	73	—	—	76	—	—	77	—	—	
LOAD FAULT ⁷ SHORT CIRCUIT	POWER DISSIPATION	—	10	12	—	10	12	—	10	12	W
	RECOVERY ¹	—	1.4	5.0	—	1.4	5.0	—	1.4	5.0	ms
STEP LOAD RESPONSE ⁸ 50% - 100% - 50% ± V _{OUT}	TRANSIENT	—	±200	±300	—	±150	±300	—	±200	±400	mV pk
	RECOVERY ¹	—	100	200	—	100	200	—	100	200	μs
STEP LINE RESPONSE ^{1, 8} V _{IN} = 16 TO 40 V ± V _{OUT}	TRANSIENT	—	±200	±400	—	±200	±400	—	±400	±500	mV pk
	RECOVERY	—	—	300	—	—	300	—	—	300	μs
START-UP ⁹ FULL LOAD	DELAY	—	1.4	5	—	1.4	5	—	1.4	5	ms
	OVERSHOOT ¹	—	0	180	—	0	120	—	0	150	mV pk
CAPACITIVE LOAD ¹ T _C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	500	—	—	500	—	—	500	μF

Notes

1. Guaranteed by design and/or analysis. Not an in-line test.
2. Up to 90% of the total output current/power is available from either output providing the opposite output is carrying at least 10% of the total output power.
3. Operation is limited below 16 V ("Figure 26" on page 17).
4. Effect on negative V_{OUT} from 50%/50% loads to 80%/20% or 20%/80% loads.
5. Effect on negative V_{OUT} from 50%/50% loads to 90%/10% or 10%/90% loads. See Figure 20.

6. Tested with 6800 pF ceramic bypass capacitor connected externally from input common to case.
7. Indefinite short circuit protection not guaranteed above 125°C case.
8. Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of final value.
9. Tested on release from inhibit.

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

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

DUAL OUTPUT MODELS - STANDARD AND /ES		MTR2805D ²			MTR2812D			MTR2815D			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	+ V _{OUT}	4.850	5.00	5.150	11.88	12.00	12.12	14.85	15.00	15.15	V
	- V _{OUT}	4.825	5.00	5.172	11.58	12.00	12.42	14.47	15.00	15.53	
OUTPUT CURRENT ² V _{IN} = 16 TO 40 V	EITHER OUTPUT	0	2.5	4.5 ¹	0	1.25	2.25 ¹	0	1.00	1.80 ¹	A
	TOTAL OUTPUT	—	—	5	—	—	2.5	—	—	2.00	
OUTPUT POWER ² V _{IN} = 16 TO 40 V	EITHER OUTPUT	0	12.5	22.5 ¹	0	15	27 ¹	0	15	27 ¹	W
	TOTAL OUTPUT	—	—	25	—	—	30	—	—	30	
OUTPUT RIPPLE 10 kHz - 2 MHz ± V _{OUT}	T _C = 25°C	—	20	80	—	30	80	—	25	80	mV p-p
	T _C = -55°C TO +125°C	—	—	—	—	40	120	—	40	120	
LINE REGULATION ³ V _{IN} = 16 TO 40 V	+ V _{OUT}	—	10	50	—	10	50	—	10	50	mV
	- V _{OUT}	—	50	100	—	50	150	—	50	180	
LOAD REGULATION NO LOAD TO FULL	+ V _{OUT}	—	5	50	—	15	50	—	15	50	mV
	- V _{OUT}	—	25	100	—	30	150	—	30	180	
CROSS REGULATION ¹ EFFECT ON -V _{OUT} , 25°C	SEE NOTE 4	—	4	6	—	4	6	—	4	6	%
	SEE NOTE 5	—	7	12	—	4	8.3	—	3	8	
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	16	28	40	16	28	40	16	28	40	V
	TRANSIENT 50 ms ¹	0	—	50	0	—	50	0	—	50	
INPUT CURRENT	NO LOAD	—	35	50	—	50	75	—	50	75	mA
	INHIBITED	—	3	8	—	3	8	—	3	8	
INPUT RIPPLE CURRENT ⁶	10 kHz - 10 MHz	—	15	40	—	20	50	—	20	50	mA p-p
EFFICIENCY BALANCED LOAD	T _C = 25°C	76	78	—	78	81	—	80	83	—	%
	T _C = -55°C TO +125°C	—	—	—	76	—	—	77	—	—	
LOAD FAULT ⁷ SHORT CIRCUIT	POWER DISSIPATION	—	10	12	—	10	12	—	10	12	W
	RECOVERY ¹	—	1.4	5.0	—	1.4	5.0	—	1.4	5.0	
STEP LOAD RESPONSE ⁸ 50% - 100% - 50% ± V _{OUT}	TRANSIENT	—	±200	±300	—	±150	±300	—	±200	±400	mV pk
	RECOVERY ¹	—	100	200	—	100	200	—	100	200	
STEP LINE RESPONSE ^{1, 8} V _{IN} = 16 TO 40 V ± V _{OUT}	TRANSIENT	—	±200	±400	—	±200	±400	—	±400	±500	mV pk
	RECOVERY	—	—	300	—	—	300	—	—	300	
START-UP ⁹ FULL LOAD	DELAY	—	1.4	5	—	1.4	5	—	1.4	5	ms
	OVERSHOOT ¹	—	0	180	—	0	120	—	0	150	
CAPACITIVE LOAD ¹ T _C = 25°C	NO EFFECT ON DC	—	—	500	—	—	500	—	—	500	μF
	PERFORMANCE	—	—	500	—	—	500	—	—	500	

Notes

- Guaranteed by design and/or analysis. Not an in-line test.
- MTR2805D (standard and /ES) is specified at 25°C only.
- Up to 90% of the total output current/power is available from either output providing the opposite output is carrying at least 10% of the total output power.
- Operation is limited below 16 V. See "Figure 26" on page 17.
- Effect on negative V_{OUT} from 50%/50% loads to 80%/20% or 20%/80% loads.
- Effect on negative V_{OUT} from 50%/50% loads to 90%/10% or 10%/90% loads. See "Figure 24" on page 17.
- Tested with 6800 pF ceramic bypass capacitor connected externally from input common to case.
- Indefinite short circuit protection not guaranteed above 125°C case.
- Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of final value.
- Tested on release from inhibit.

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

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

TRIPLE OUTPUT MODEL – MTR28512T		5 (MAIN)			±12 (AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		4.85	5.00	5.15	±11.58	12.00	±12.42	V
OUTPUT CURRENT ²		0.3	—	4.0	0	±0.416	0.750 ¹	A
V _{IN} = 16 TO 40 V	MAX TOTAL AUX	—	—	—	—	—	0.833	
OUTPUT POWER ²		0	—	20	0	±5	9.00 ¹	W
V _{IN} = 16 TO 40 V	MAX TOTAL AUX	—	—	—	—	—	10	
OUTPUT RIPPLE	T _C = 25°C	—	50	125	—	20	60	mV p-p
10 kHz - 2 MHz	T _C = -55°C TO +125°C	—	—	180	—	—	60	
LINE REGULATION	V _{IN} = 16 TO 40 V	—	10	20	—	25	75	mV
LOAD REGULATION ^{3, 4}		—	10	50	—	30	75	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	—	—	—	V
	TRANSIENT 50 ms ¹	—	—	50	—	—	—	V
INPUT CURRENT	NO LOAD	—	70	110	—	—	—	mA
	INHIBITED	—	3.0	6	—	—	—	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	20	80	—	—	—	mA p-p
EFFICIENCY	T _C = 25°C	72	75	—	—	—	—	%
	T _C = -55°C TO +125°C	70	—	—	—	—	—	
LOAD FAULT ⁵	POWER DISSIPATION	—	—	14	—	—	14	W
ALL OUTPUTS SHORTED	RECOVERY ¹	—	4	6.0	—	4	6.0	ms
STEP LOAD RESPONSE ^{6, 7}	TRANSIENT	—	—	±400	—	—	±1500	mV pk
	RECOVERY	—	—	0.300	—	—	6	ms
STEP LINE RESPONSE ^{1, 7}	TRANSIENT	—	—	±800	—	—	±800	mV pk
16 - 40 - 16 V _{IN}	RECOVERY ⁷	—	—	5	—	—	5	ms
START-UP ⁸	DELAY	—	4	6.0	—	4	6.0	ms
	OVERSHOOT ¹	—	—	500	—	—	1500	mV pk

Notes

1. Guaranteed by design and/or analysis. Not an in-line test.
2. The sum of the two aux outputs is not to exceed 10 watts. The maximum load per aux output is 9 watts.
3. To maintain regulation when operating the ±aux at full load, a minimum load of 300 mA is required on the main.
4. Measured on each output one at a time with the other outputs at full load.
5. Indefinite short circuit protection not guaranteed above 125°C (case).

6. Response of each output as all outputs are simultaneously transitioned.
Main: 50% - 100% - 50% of main full load
Auxiliaries: 25% - 50% - 25% each, of total auxiliary full load
7. Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of regulation.
8. Tested on release from inhibit.

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

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

TRIPLE OUTPUT MODEL – MTR28515T		5 (MAIN)			±15 (AUXILIARIES)			UNITS
PARAMETER	CONDITIONS	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE		4.85	5.00	5.15	±14.47	15.00	±15.52	V
OUTPUT CURRENT ²		0.3	—	4.0	0	±0.333	0.600 ¹	A
V _{IN} = 16 TO 40 V	MAX TOTAL AUX	—	—	—	—	—	0.666	
OUTPUT POWER ²		0	—	20	0	±5	9.00 ¹	W
V _{IN} = 16 TO 40 V	MAX TOTAL AUX	—	—	—	—	—	10	
OUTPUT RIPPLE	T _C = 25°C	—	50	125	—	20	60	mV p-p
10 kHz - 2 MHz	T _C = -55°C TO +125°C	—	—	180	—	—	60	
LINE REGULATION	V _{IN} = 16 TO 40 V	—	10	20	—	30	75	mV
LOAD REGULATION ^{3, 4}		—	10	50	—	30	75	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	—	—	—	V
	TRANSIENT 50 ms ¹	—	—	50	—	—	—	V
INPUT CURRENT	NO LOAD	—	70	120	—	—	—	mA
	INHIBITED	—	3.0	6	—	—	—	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	20	80	—	—	—	mA p-p
EFFICIENCY	T _C = 25°C	73	75	—	—	—	—	%
	T _C = -55°C TO +125°C	71	—	—	—	—	—	
LOAD FAULT ⁵	POWER DISSIPATION	—	—	14	—	—	14	W
ALL OUTPUTS SHORTED	RECOVERY ¹	—	4	6.0	—	4	6.0	ms
STEP LOAD RESPONSE ^{6, 7}	TRANSIENT	—	—	±400	—	—	±1500	mV pk
	RECOVERY	—	—	0.300	—	—	6	ms
STEP LINE RESPONSE ^{1, 7}	TRANSIENT	—	—	±800	—	—	±800	mV pk
16 - 40 - 16 V _{IN}	RECOVERY ⁷	—	—	5	—	—	5	ms
START-UP ⁸	DELAY	—	4	6.0	—	4	6.0	ms
	OVERSHOOT ¹	—	—	500	—	—	1500	mV pk

Notes

1. Guaranteed by design and/or analysis. Not an in-line test.
2. The sum of the two aux outputs is not to exceed 10 watts. The maximum load per aux output is 9 watts.
3. To maintain regulation when operating the ±aux at full load, a minimum load of 300 mA is required on the main.
4. Measured on each output one at a time with the other outputs at full load.
5. Indefinite short circuit protection not guaranteed above 125°C (case).

6. Response of each output as all outputs are simultaneously transitioned.
Main: 50% - 100% - 50% of main full load
Auxiliaries: 25% - 50% - 25% each, of total auxiliary full load
7. Recovery time is measured from application of the transient to point at which V_{OUT} is within 1% of regulation.
8. Tested on release from inhibit.

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

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

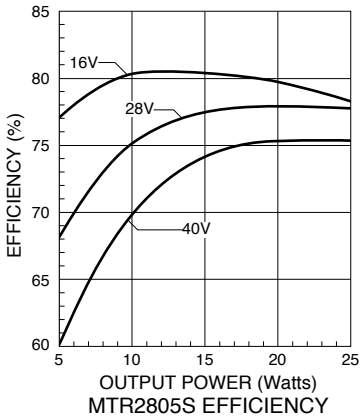


FIGURE 11

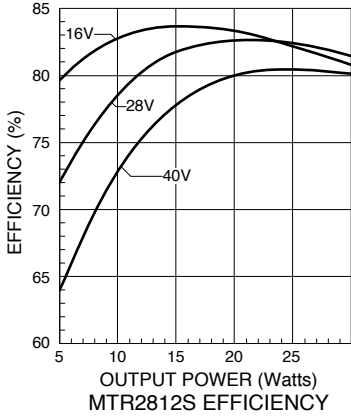


FIGURE 12

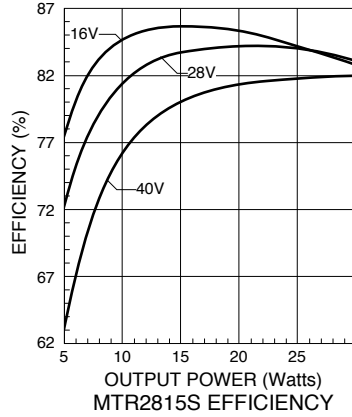


FIGURE 13

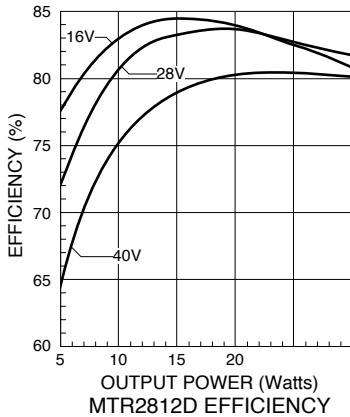


FIGURE 14

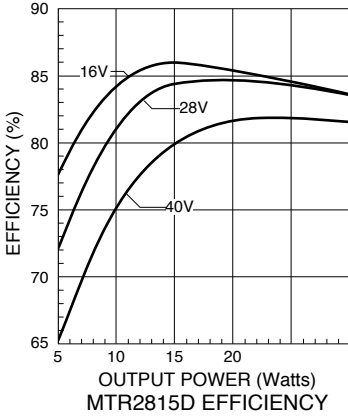


FIGURE 15

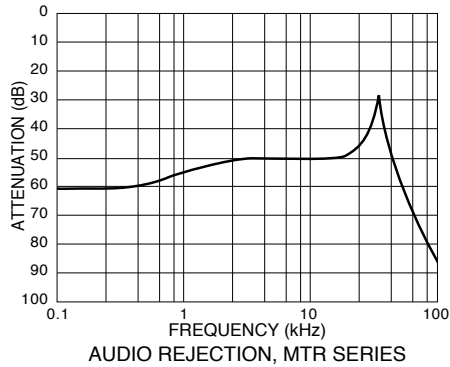


FIGURE 14

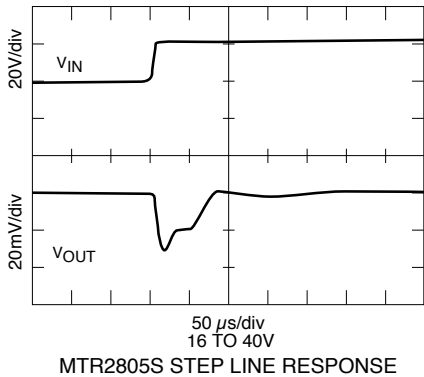


FIGURE 16

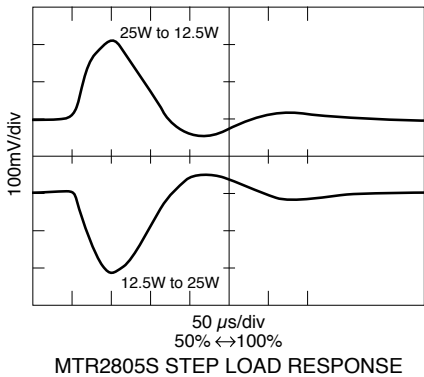


FIGURE 17

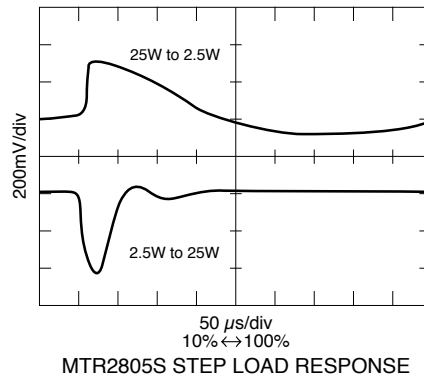
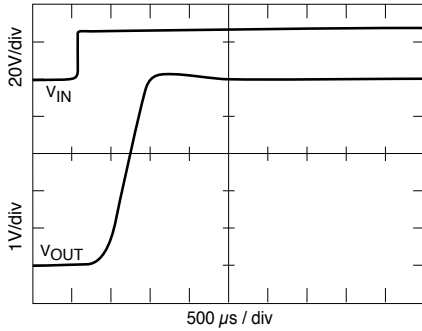


FIGURE 18

MTR (40) Single, Dual and Triple DC-DC Converters

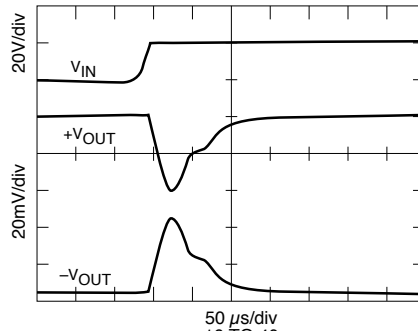
28 (16-40) VOLT INPUT – 30 WATT

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



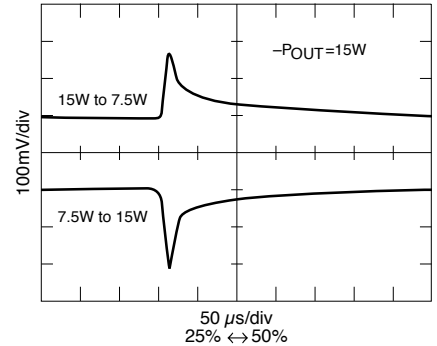
MTR2805S TURN-ON INTO NO LOAD

FIGURE 19



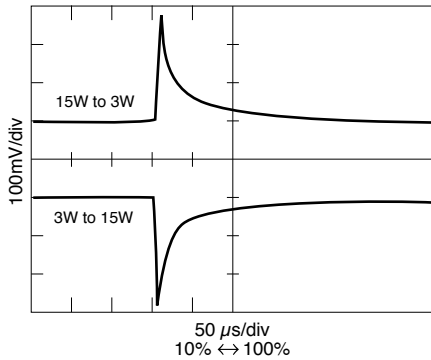
MTR2815D STEP LINE RESPONSE

FIGURE 20



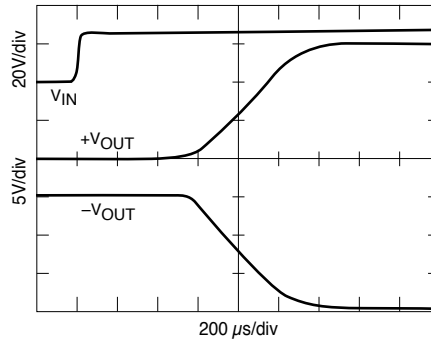
MTR2815D +VOUT STEP LOAD RESPONSE

FIGURE 21



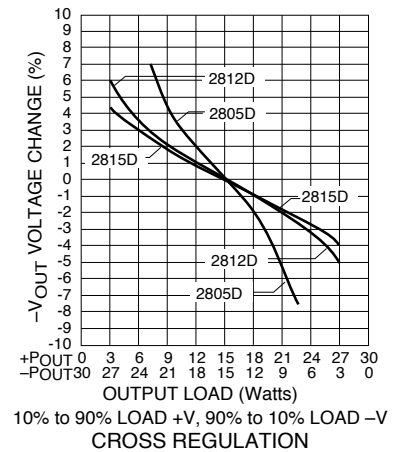
MTR2815D +VOUT STEP LOAD RESPONSE

FIGURE 22



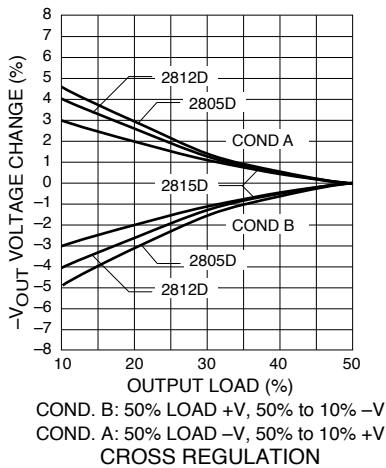
MTR2815D TURN-ON INTO NO LOAD

FIGURE 23



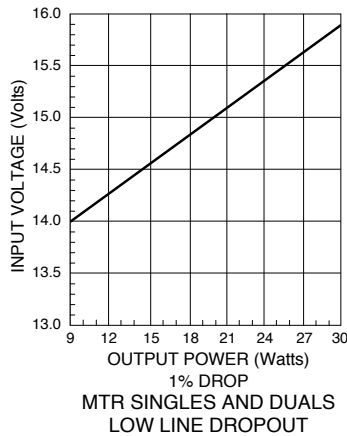
10% to 90% LOAD +V, 90% to 10% LOAD -V
CROSS REGULATION

FIGURE 24



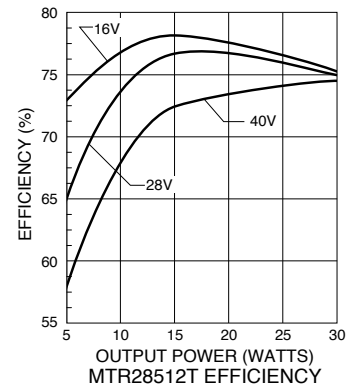
COND. B: 50% LOAD +V, 50% to 10% -V
COND. A: 50% LOAD -V, 50% to 10% +V
CROSS REGULATION

FIGURE 25



1% DROP
MTR SINGLES AND DUALS
LOW LINE DROPOUT

FIGURE 26



MTR28512T EFFICIENCY

FIGURE 27

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

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

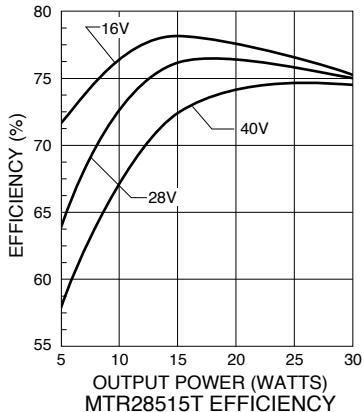


FIGURE 28

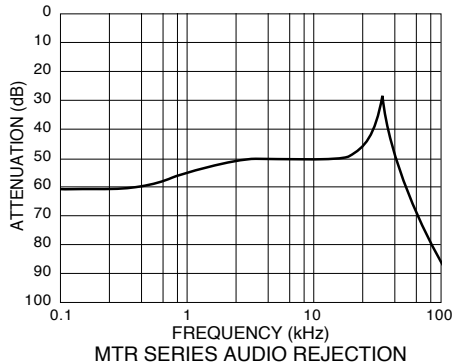


FIGURE 29

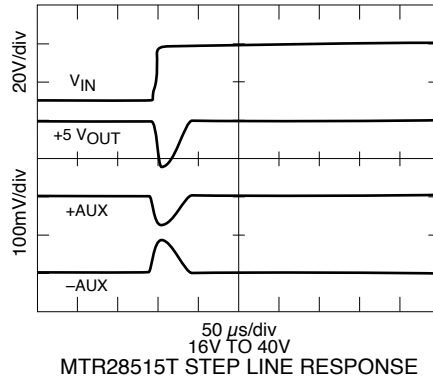


FIGURE 30

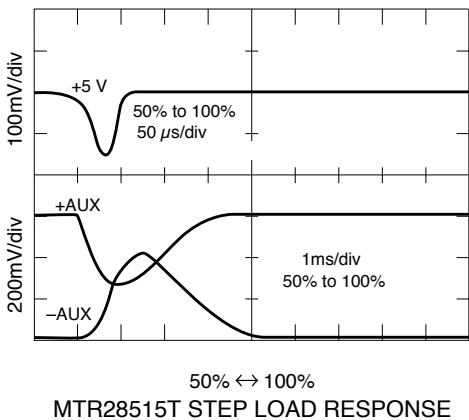


FIGURE 31

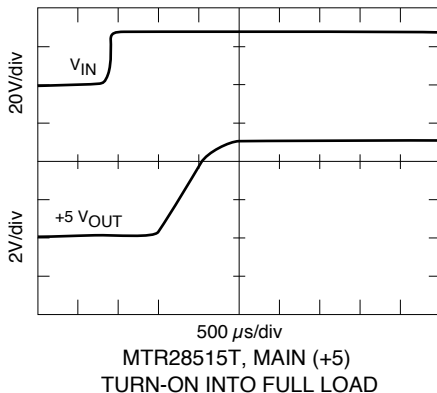


FIGURE 32

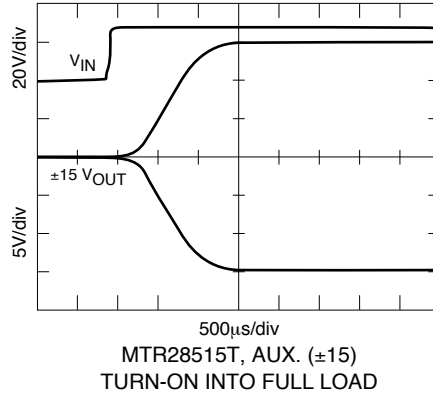


FIGURE 33

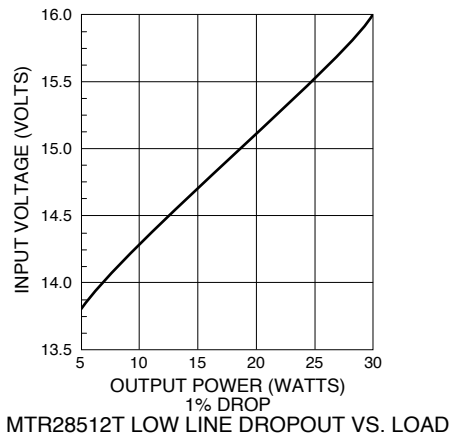


FIGURE 34

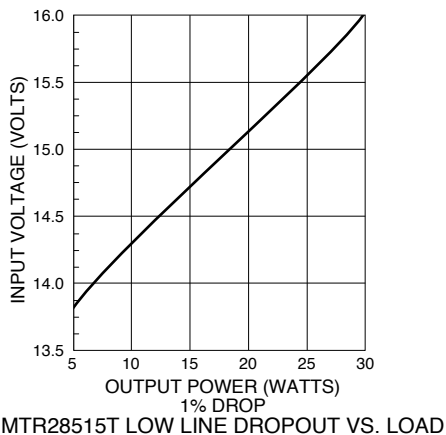
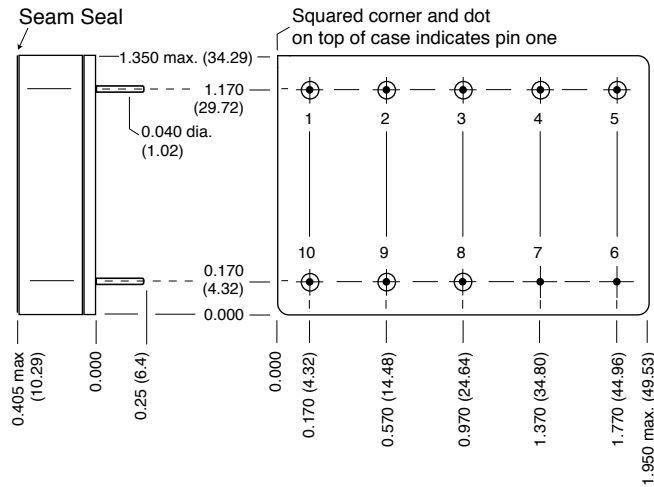


FIGURE 35

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

BOTTOM VIEW CASE F1



Weight: 58 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 ceramic seal
 Gold plating of 50 - 150 microinches included in pin diameter
 Seal hole 0.120 ± 0.002 (3.05 ± 0.05)

Please refer to the numerical dimensions for accuracy.

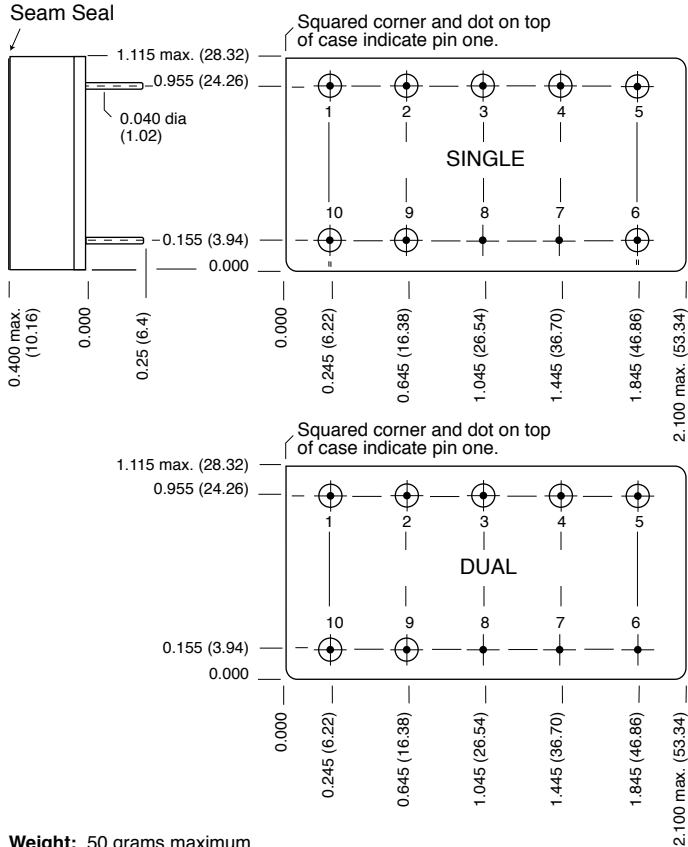
Case F1 MTR T, Rev G, 2016.09.27

FIGURE 36: CASE F1 – TRIPLE MODELS

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

BOTTOM VIEW MTR SINGLE AND DUAL



Weight: 50 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 ceramic seal
Gold plating of 50 - 150 microinches included in pin diameter
Seal hole 0.120 ± 0.002 (3.05 \pm 0.05)

Please refer to the numerical dimensions for accuracy.

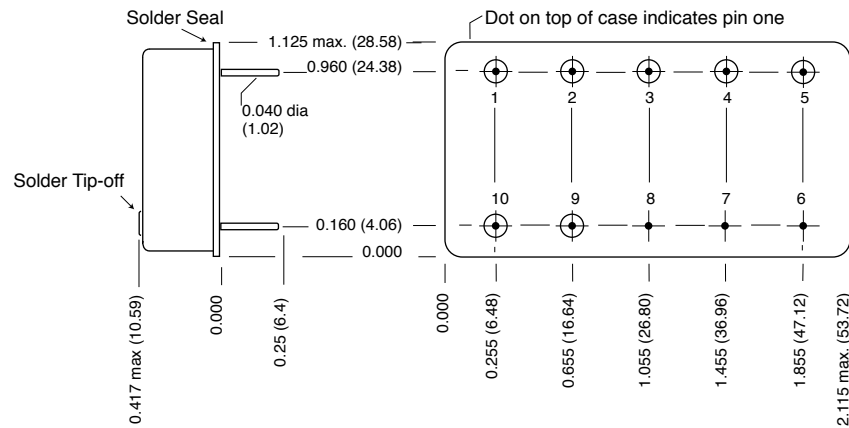
FIGURE 37: CASE H2 – SINGLE AND 883 DUAL MODELS

APPLIES TO ALL SINGLE MODELS, APPLIES ONLY TO 883 DUAL MODELS,
SEE CASE H4 FOR NON-883 DUAL MODELS

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

BOTTOM VIEW CASE H4



Weight 50 grams max.

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/Tin
 Cover Cold Rolled Steel/Nickel/Tin
 Pins #52 alloy, compression glass seal
 Tin plating, 150 microinches minimum, included in pin diameter.
 Seal hole 0.092 ± 0.002 (2.34 ± 0.05)

Please refer to the numerical dimensions for accuracy.

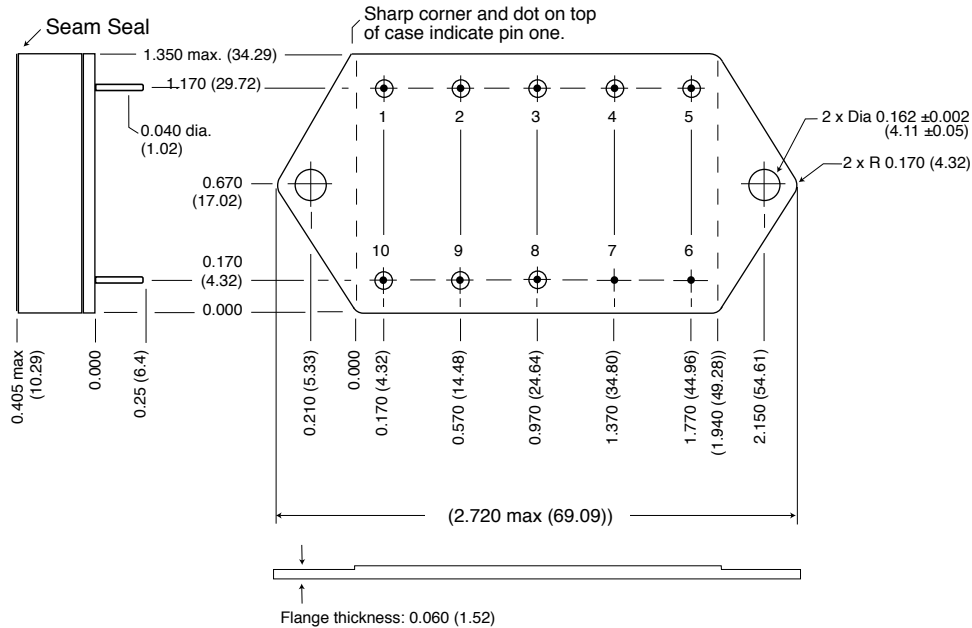
FIGURE 38: CASE H4 – DUAL MODELS - NON 883

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

BOTTOM VIEW CASE J1

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



Weight: 62 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 ceramic seal
 Gold plating of 50 - 150 microinches included in pin diameter
 Seal Hole: 0.120 ±0.002 (3.04 ±0.05)

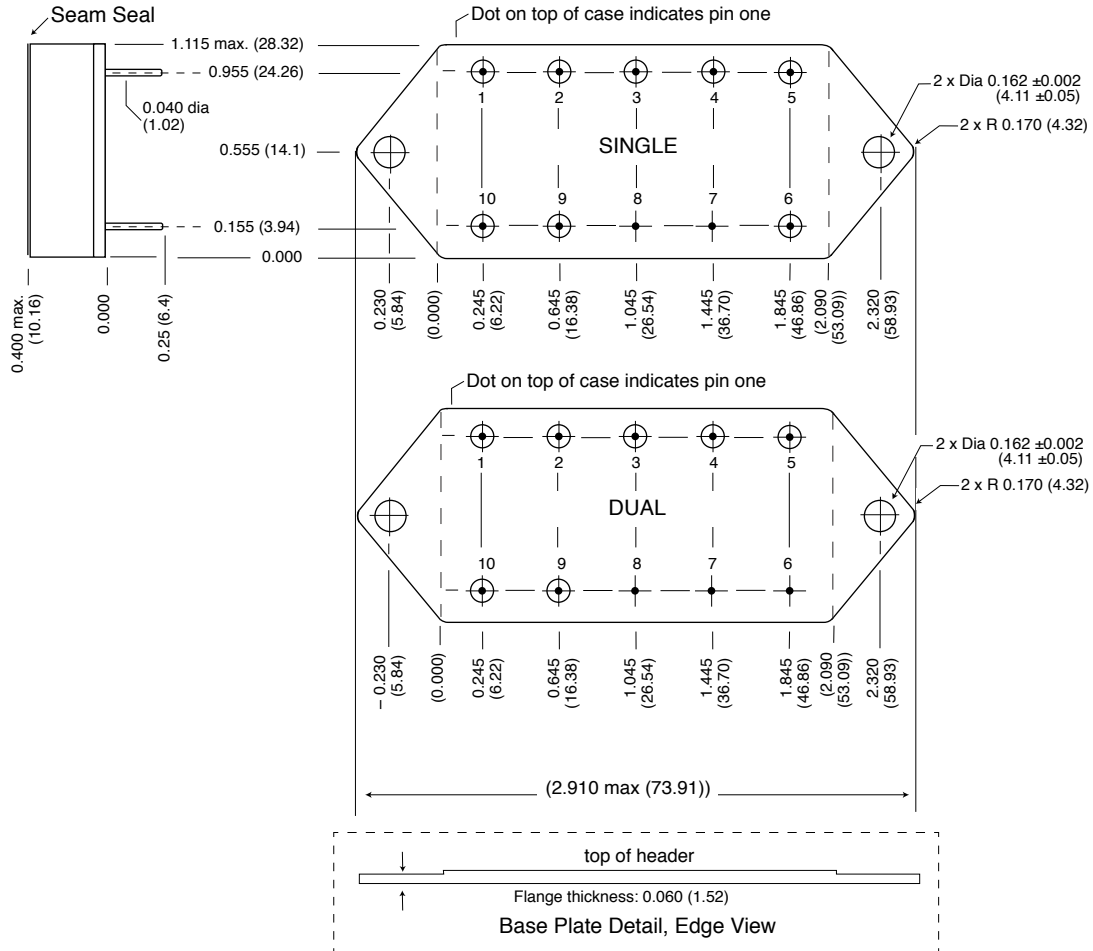
Please refer to the numerical dimensions for accuracy.

FIGURE 39: CASE J1 – TRIPLE MODELS

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

BOTTOM VIEW MTR SINGLE AND DUAL FLANGED
 Flanged cases: Designator "F" required in Case Option position of model number.



Weight: 52 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

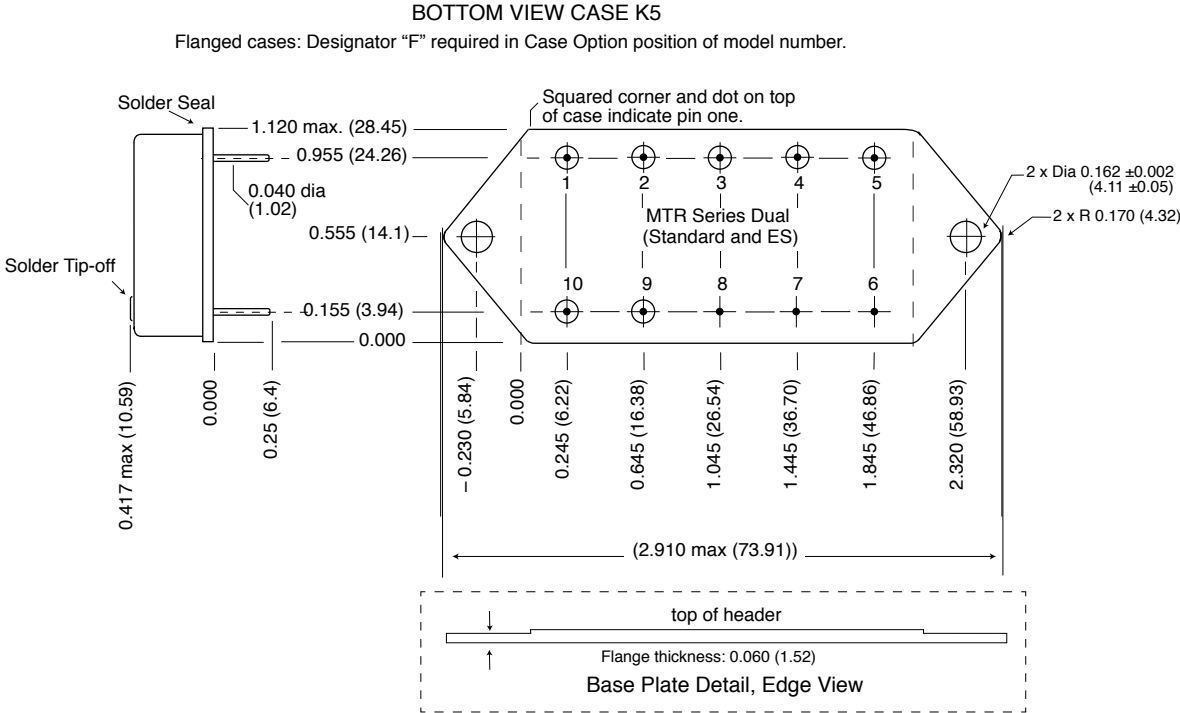
Header Cold Rolled Steel/Nickel/Gold
 Cover Kovar/Nickel
 Pins #52 alloy/Gold, ceramic seal
 Gold plating of 50 - 150 microinches included in pin diameter
 Seal hole 0.120 ±0.002 (3.04 ±0.05)

Please refer to the numerical dimensions for accuracy.

FIGURE 40: CASE K3 – SINGLE AND DUAL 883 MODELS
 APPLIES TO ALL SINGLE MODELS, APPLIES ONLY TO 883 DUAL MODELS

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT



Weight: 52 grams max.

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/Tin
 Cover Cold Rolled Steel/Nickel/Tin
 Pins #52 alloy, compression glass seal
 Tin plating, 150 microinches minimum included in pin diameter.
 Seal hole 0.092 ±0.002 (2.34 ± 0.05)

Please refer to the numerical dimensions for accuracy.

FIGURE 41: CASE K5 – DUAL MODELS - NON 883

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

ELEMENT EVALUATION ¹ HIGH RELIABILITY /883 (CLASS H)

COMPONENT-LEVEL TEST PERFORMED	QML	
	CLASS H /883	
	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

MTR (40) Single, Dual and Triple DC-DC Converters

28 (16-40) VOLT INPUT – 30 WATT

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

TEST PERFORMED	NON-QML ¹			CLASS H QML ²	
	STANDARD	/ES	/883 SX	/883 CH ³	/883 QML ⁴
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			■	■ ⁵	■ ⁵
Burn-in Method 1015, +125°C case, typical ⁶					
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. Non-QML products may not meet all of the requirements of MIL-PRF-38534.
2. All processes are QML qualified and performed by certified operators.
3. Class H QML products with no SMD number are marked "CH" per MIL-STD-38534 Rev J, 3.9.5.8.3, Table III.
4. Class H QML products have an SMD number
5. Not required by DLA but performed to assure product quality.
6. Burn-in temperature designed to bring the case temperature to +125°C minimum.
Burn-in is a powered test.

TABLE 13: ENVIRONMENTAL SCREENING