MTR Single, Dual and Triple DC/DC Converters

28 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 VDC
- Transient protection 50 V for 50 ms
- Fully isolated, magnetic feedback
- Fixed high frequency switching
- Inhibit and synchronization function
- Indefinite short circuit and overload protection

MODELS VDC OUTPUT		
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. 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. Standard microcircuit drawings (SMD) are available.

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 115% 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.

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. 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.

WIDE INPUT VOLTAGE RANGE

MTR converters are designed to provide full power over a full 16 to 40 VDC voltage range. Operation below 16 volts, including MIL-STD-704A emergency power conditions is possible with derated power. Refer to the low line dropout graph (Figures 22, 30 and 31) for details.

IMPROVED 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. The minimum to maximum step line transition response is typically less than 4%.

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INHIBIT FUNCTION

MTR converters provide an inhibit terminal that can be used to disable internal switching, resulting in no output and very low quiescent input current. The converter is inhibited when the inhibit pin is pulled below (≤0.8 V). The unit is enabled when the inhibit pin, which is internally connected to a pull-up resistor, is left unconnected or is connected to an open-collector gate. The open circuit voltage associated with the inhibit pin is 9 to 11 V. In the inhibit mode, a maximum of 8 mA must be sunk from the inhibit pin.

OPERATING CONDITIONS AND CHARACTERISTICS

Input Voltage
- 16 to 40 VDC continuous
- 50 V for 50 msec transient

Output Power
- 20 to 30 watts depending on model

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

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

Case Operating Temperature (Tc)
- -55°C to +125°C full power
- -55°C to +135°C absolute

Derating Output Power/Current
- Linearly from 100% at 125°C to 0% at 135°C

Output Voltage Temperature Coefficient
- 100 ppm/°C typical single and dual outputs
- 200 ppm/°C main typical, 300 ppm/°C aux triple output typical

Input to Output Capacitance
- 50 pF typ (100 pF typical triple outputs)

Current Limit
- 115% of full load typical

Isolation
- 100 megohm minimum at 500 V

Audio Rejection
- 40 dB typ (50 dB typical triple output)

Conversion Frequency
- Free run
  - 550 min, 600 typical, 650 max kHz duals and singles
  - 525 min, 600 typical, 650 max kHz triples
- External sync
  - 500 to 675 kHz singles and duals
  - 500 to 700 kHz triples

SYNC AND INHIBIT

Sync (500 to 675 kHz)
- Duty cycle 40% min, 60% max
- Active low 0.8 V max
- Active high 4.5 V min, 5 V max
- Referenced to input common
- If not used, connect to input common

Inhibit (do not apply a voltage to the inhibit pin)
- Converter Disabled (active low)
  - Pull voltage to 0.8 V or below by connecting to ground or other method. Do not apply voltage.
  - Inhibit pin source current
    - 8.0 mA max for singles and duals
    - 6.0 mA max for triples
- Converter Enabled (active high)
  - Inhibit pin open or through an open collector
  - Inhibit open pin voltage is 9 to 11 V

MECHANICAL AND ENVIRONMENTAL

Size (maximum)
- Non-flanged
  - Single (all models) and dual output (for dual 883 only)
    - 2.100 x 1.115 x 0.400 inches (53.34 x 28.32 x 10.16 mm) See case H2 for dimensions.
    - MTR dual with standard or ES screening, 2.115 x 1.125 x 0.417 inches (53.72 x 28.58 x 10.59 mm) See Case H4 for dimensions.
  - Triple output
    - 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 (all models) and dual output (for dual 883 only)
    - 2.910 x 1.115 x 0.400 inches (73.91 x 28.32 x 10.16 mm) See case K3 for dimensions.
    - MTR dual with standard or ES screening, 2.910 x 1.120 x 0.417 inches (73.91 x 28.45 x 10.59 mm) See case K5 for dimensions.
  - Triple output
    - 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)
- Single and dual non-flanged 50 grams, flanged 52 grams
- Triple non-flanged 58 grams, flanged 62 grams

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

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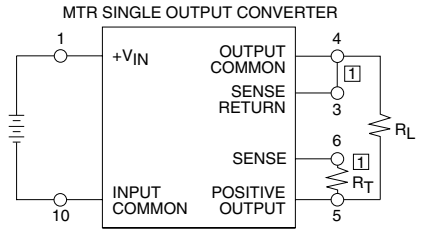
TRIM AND REMOTE SENSE (AVAILABLE ON SINGLE 5, 12 AND 15 OUTPUT MODELS ONLY)



EXTERNAL TRIM CONNECTION

[1] Make connections at converter.

Trim Formulas

Vout = desired output voltage; Rt = trim resistor

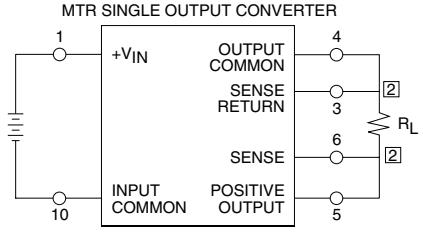
3.3V: $Rt = \frac{1300 * Vout - 4304}{1.2475}$

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

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

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

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



REMOTE SENSE CONNECTION

[2] Make connections at load.

FIGURE 2: REMOTE SENSE CONNECTION

Notes for Remote Sense and Trim

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. Do not exceed the maximum power.
2. If neither voltage trim nor remote sense will be used, connect pin 3 to pin 4 and pin 5 to pin 6.
3. 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.
4. 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 power-apps@crane-eg.com

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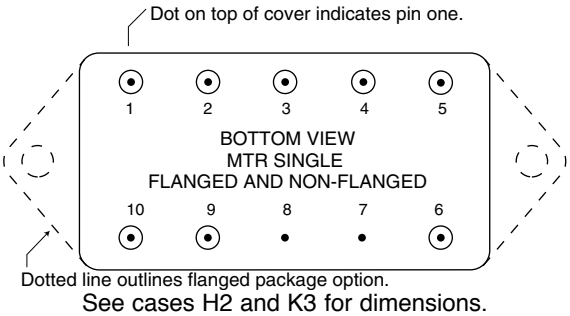
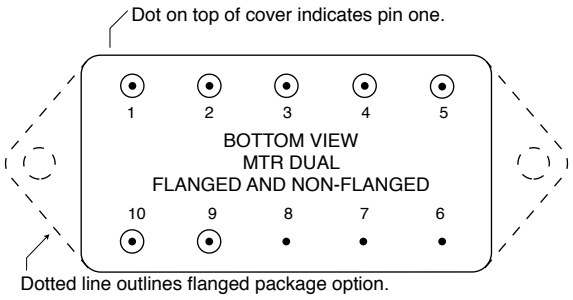
PIN OUT			
Pin	**Single Output**	**Dual Output**	**Triple Output**
1	Positive Input	Positive Input	Positive Input
2	Inhibit	Inhibit	Main (+5) Output
3	Sense Return	Positive Output	Output Common
4	Output Common	Output Common	Neg. Aux. Output
5	Positive Output	Negative Output	Pos. Aux. Output
6	Positive 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

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



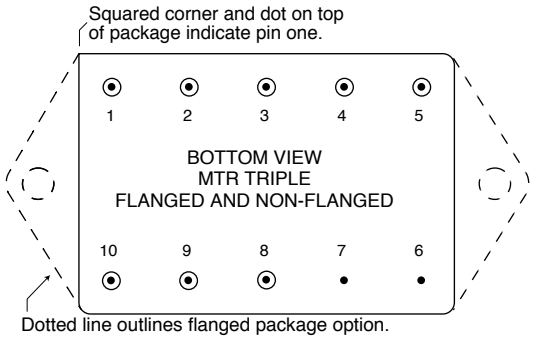
See cases H2 and K3 for dimensions.

FIGURE 3: PIN OUT SINGLE OUTPUT MODELS



See cases H2, H4, K3 and K5 for dimensions.

FIGURE 4: PIN OUT DUAL OUTPUT MODELS



See cases F1 and J1 for dimensions.

FIGURE 5: PIN OUT TRIPLE OUTPUT MODELS

MTR Single, Dual and Triple DC/DC Converters

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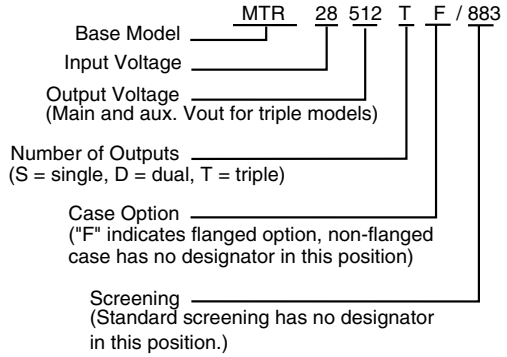
MODEL NUMBERING KEY



SMD NUMBERS

STANDARD MICROCIRCUIT DRAWING (SMD)	MTR SERIES 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. For exact specifications for an SMD product, refer to the SMD drawing. SMDs can be downloaded from:
http://www.dscc.dla.mil/programs/smcr

MODEL SELECTION

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

CATEGORY	MTR28 Base Model and Input Voltage	_____ Output Voltage [1]	_____ Number of Outputs [2]	_____ Case Option [3]	/	_____ Screening [4]
SELECTION	MTR28 is the only available selection	**3R3, 05, 12, 15, 18**	**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, H2 and H4) leave the case option blank. For the flanged case option (cases J1, K3 and K5), 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.

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Electrical Characteristics: -55°C to +125°C T_C, 28 VDC 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	VDC
OUTPUT CURRENT	VIN = 16 TO 40 VDC	0	—	6.06	0	—	5.0	0	—	2.5	A
OUTPUT POWER	VIN = 16 TO 40 VDC	0	—	20	0	—	25	0	—	30	W
OUTPUT RIPPLE 10 KHZ - 2 MHZ	T_C = 25°C	—	15	40	—	35	50	—	25	40	mV p-p
	T_C = -55°C TO +125°C	—	—	50	—	50	90	—	40	90	
LINE REGULATION [2] V_{IN} = 16 TO 40 VDC	T_C = 25°C	—	5	10	—	10	50	—	10	50	mV
	T_C = -55°C TO +125°C	—	—	10	—	15	50	—	15	50	
LOAD REGULATION NO LOAD TO FULL	T_C = 25°C	—	2	10	—	5	50	—	5	50	mV
	T_C = -55°C TO +125°C	—	—	10	—	15	50	—	15	50	
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	16	28	40	16	28	40	16	28	40	VDC
	TRANSIENT 50 msec.	—	—	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	10 KHZ - 10 MHZ	—	25	50	—	20	50	—	20	50	mA p-p
EFFICIENCY	T_C = 25°C	74	76	—	76	78	—	80	83	—	%
	T_C = -55°C TO +125°C	71	—	—	73	—	—	77	—	—	
LOAD FAULT [3]	POWER DISSIPATION SHORT CIRCUIT	—	—	12	—	—	14	—	—	12	W
	RECOVERY [1]	—	1.4	6	—	1.4	5	—	1.4	5	ms
STEP LOAD RESPONSE	50% - 100% - 50% TRANSIENT	—	±125	±250	—	±200	±300	—	±250	±400	mV pk
	RECOVERY [1, 4]	—	—	200	—	60	200	—	60	200	µs
STEP LINE RESPONSE [1]	16 - 40 -16 VDC TRANSIENT	—	—	±300	—	±200	±300	—	±400	±500	mV pk
	RECOVERY [4]	—	—	300	—	—	300	—	—	300	µs
START-UP [5]	DELAY	—	1.4	5	—	1.4	5	—	1.4	5	m sec
	OVERSHOOT FULL LOAD [1]	—	0	50	—	0	50	—	0	120	mV pk
	NO LOAD [1]	—	33	150	—	50	250	—	120	600	
CAPACITIVE LOAD [1] T_C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	300	—	—	300	—	—	300	µF

Notes
1. Guaranteed by design, not tested.
2. Operation is limited below 16V (see Figure 22).
3. Indefinite short circuit protection not guaranteed above 125°C case.
4. Recovery time is measured from application of the transient to point at which Vout is within 1% of final value.
5. Tested on release from inhibit.

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Electrical Characteristics: -55°C to +125°C T_C, 28 VDC 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	VDC
OUTPUT CURRENT	VIN = 16 TO 40 VDC	0	—	2.0	0	—	1.67	A
OUTPUT POWER	VIN = 16 TO 40 VDC	0	—	30	0	—	30	W
OUTPUT RIPPLE	T_C = 25°C	—	25	40	—	—	40	mV p-p
	T_C = -55°C TO +125°C	—	40	90	—	—	90	
LINE REGULATION [2]	T_C = 25°C	—	10	50	—	—	50	mV
	T_C = -55°C TO +125°C	—	15	50	—	—	50	
LOAD REGULATION	T_C = 25°C	—	5	50	—	—	50	mV
	T_C = -55°C TO +125°C	—	15	50	—	—	50	
INPUT VOLTAGE NO LOAD TO FULL	CONTINUOUS	16	28	40	16	28	40	VDC
	TRANSIENT 50 msec.	—	—	50	—	_	50	V
INPUT CURRENT	NO LOAD	—	35	75	—	—	75	mA
	INHIBITED	—	3	8	—	—	8	
INPUT RIPPLE CURRENT	10 kHz - 10 MHz	—	20	50	—	—	50	mA p-p
EFFICIENCY	T_C = 25°C	81	84	—	81	84	—	%
	T_C = -55°C TO +125°C	78	—	—	78	—	—	
LOAD FAULT [3]	POWER DISSIPATION SHORT CIRCUIT	—	—	12	—	—	12	W
	RECOVERY [1]	—	1.4	5	—	1.4	5	ms
STEP LOAD RESPONSE	50% - 100% - 50% TRANSIENT	—	±350	±500	—	—	±600	mV pk
	RECOVERY [1, 4]	—	60	200	—	60	200	µs
STEP LINE RESPONSE [1]	16 - 40 -16 VDC TRANSIENT	—	±500	±600	—	±500	±800	mV pk
	RECOVERY [4]	—	—	300	—	—	300	µs
START-UP [5]	DELAY	—	1.4	5	—	—	5	m sec
	OVERSHOOT FULL LOAD [1]	—	0	150	—	0	180	mV pk
	NO LOAD [1]	—	150	750	—	—	—	
CAPACITIVE LOAD [1] T_C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	300	—	—	300	µF

Notes
1. Guaranteed by design, not tested.
2. Operation is limited below 16V (see Figure 22).
3. Indefinite short circuit protection not guaranteed above 125°C case.
4. Recovery time is measured from application of the transient to point at which Vout is within 1% of final value.
5. Tested on release from inhibit.

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Electrical Characteristics: -55°C to +125°C T_C, 28 VDC 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	14.85	15.00	15.45	VDC
	- V_{OUT}	4.825	5.00	5.172	11.58	12.00	12.42	14.47	15.00	15.53	
OUTPUT CURRENT [2]	EACH OUTPUT	0	2.5	4.5 [1]	0	1.25	2.25 [1]	0	—	1.80 [1]	A
V_{IN} = 16 TO 40 VDC	TOTAL OUTPUT	—	—	5	—	—	2.5	—	—	2.00	
OUTPUT POWER [2]	EACH OUTPUT	0	—	22.5 [1]	0	—	27 [1]	0	—	27 [1]	W
V_{IN} = 16 TO 40 VDC	TOTAL OUTPUT	—	—	25	—	—	30	—	—	30	
OUTPUT RIPPLE	T_C = 25°C	—	20	80	—	30	80	—	25	80	mV p-p
10 KHz - 2 MHz ± V_{OUT}	T_C = -55°C TO +125°C	—	40	90	—	40	120	—	40	120	
LINE REGULATION [3]	+ V_{OUT}	—	10	50	—	10	50	—	10	50	mV
V_{IN} = 16 TO 40 VDC	- 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}	—	25	100	—	30	150	—	30	180	
CROSS REGULATION [1]	SEE NOTE 4	—	4	6	—	4	6	—	4	6	%
EFFECT ON -V_{OUT}, 25°C	SEE NOTE 5	—	7	12	—	4	8.3	—	3	8	
INPUT VOLTAGE	CONTINUOUS	16	28	40	16	28	40	16	28	40	VDC
NO LOAD TO FULL	TRANSIENT 50 msec.[1]	0	—	50	0	—	50	0	—	50	V
INPUT CURRENT	NO LOAD	—	35	50	–	50	75	—	50	75	mA
	INHIBITED	—	3	8	—	3	8	—	3	8	
INPUT RIPPLE CURRENT	10 KHz - 10 MHz	—	15	40	—	20	50	—	20	50	mA p-p
EFFICIENCY	T_C = 25°C	76	78	—	79	81	—	80	83	—	%
BALANCED LOAD	T_C = -55°C TO +125°C	73	—	—	76	—	—	79	—	—	
LOAD FAULT [6]	POWER DISSIPATION SHORT CIRCUIT	—	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	50% - 100% - 50% TRANSIENT	—	±200	±300	—	±150	±300	—	±200	±400	mV pk
± V_{OUT}	RECOVERY [1, 7]	—	100	200	—	100	200	—	100	200	µs
STEP LINE RESPONSE [1]	16 - 40 -16 VDC TRANSIENT [7]	—	±200	±400	—	±200	±400	—	±400	±500	mV pk
± V_{OUT}	RECOVERY [7]	—	—	300	—	—	300	—	—	300	µs
START-UP [8]	DELAY	—	1.4	5	—	1.4	5	—	1.4	5	ms
	OVERSHOOT FULL LOAD [1]	—	0	180	—	0	120	—	0	150	mV pk
	NO LOAD [1]	—	180	250	—	120	600	—	150	750	
CAPACITIVE LOAD [1] T_C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	500	—	—	500	—	—	500	µF

Notes
1. Guaranteed by design, not tested.
2. Up to 90% of the total output current/power is available from either output providing the positive output is carrying at least 10% of the total output power.
3. Operation is limited below 16 V (see Figure 22).
4. Effect on negative Vout from 50%/50% loads to 80%/20% or 20%/80% loads.
5. Effect on negative Vout from 50%/50% loads to 90%/10% or 10%/90% loads. See Figure 20.
6. Indefinite short circuit protection not guaranteed above 125°C case.
7. Recovery time is measured from application of the transient to point at which Vout is within 1% of final value.
8. Tested on release from inhibit.

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Electrical Characteristics: -55°C to +125°C T_C, 28 VDC 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	VDC
	- V_{OUT}	4.825	5.00	5.172	11.58	12.00	12.42	14.47	15.00	15.53	
OUTPUT CURRENT [3]	EACH OUTPUT	0	2.5	4.5 [1]	0	1.25	2.25 [1]	0	—	1.80 [1]	A
V_{IN} = 16 TO 40 VDC	TOTAL OUTPUT	—	—	5	—	—	2.5	—	—	2.00	
OUTPUT POWER [3]	EACH OUTPUT	0	—	22.5 [1]	0	—	27 [1]	0	—	27 [1]	W
V_{IN} = 16 TO 40 VDC	TOTAL OUTPUT	—	—	25	—	—	30	—	—	30	
OUTPUT RIPPLE	T_C = 25°C	—	20	80	—	30	80	—	25	80	mV p-p
10 KHZ - 2 MHZ ± V_{OUT}	T_C = -55°C TO +125°C	—	—	—	—	40	120	—	40	120	
LINE REGULATION [4]	+ V_{OUT}	—	10	50	—	10	50	—	10	50	mV
V_{IN} = 16 TO 40 VDC	- 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}	—	25	100	—	30	150	—	30	180	
CROSS REGULATION [1]	SEE NOTE 5	—	4	6	—	4	6	—	4	6	%
EFFECT ON -V_{OUT}, 25°C	SEE NOTE 6	—	7	12	—	4	8.3	—	3	8	
INPUT VOLTAGE	CONTINUOUS	16	28	40	16	28	40	16	28	40	VDC
NO LOAD TO FULL	TRANSIENT 50 msec.[1]	0	—	50	0	—	50	0	—	50	V
INPUT CURRENT	NO LOAD	—	35	50	–	50	75	—	50	75	mA
	INHIBITED	—	3	8	—	3	8	—	3	8	
INPUT RIPPLE CURRENT	10 KHZ - 10 MHZ	—	15	40	—	20	50	—	20	50	mA p-p
EFFICIENCY	T_C = 25°C	76	78	—	78	81	—	80	83	—	%
BALANCED LOAD	T_C = -55°C TO +125°C	—	—	—	76	—	—	77	—	—	
LOAD FAULT [7]	POWER DISSIPATION SHORT CIRCUIT	—	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	50% - 100% - 50% TRANSIENT	—	±200	±300	—	±150	±300	—	±200	±400	mV pk
± V_{OUT}	RECOVERY [1, 8]	—	100	200	—	100	200	—	100	200	µs
STEP LINE RESPONSE [1]	16 - 40 -16 VDC TRANSIENT	—	±200	±400	—	±200	±400	—	±400	±500	mV pk
± V_{OUT}	RECOVERY [8]	—	—	300	—	—	300	—	—	300	µs
START-UP [9]	DELAY	—	1.4	5	—	1.4	5	—	1.4	5	ms
	OVERSHOOT FULL LOAD [1]	—	0	180	—	0	120	—	0	150	mV pk
	NO LOAD [1]	—	180	250	—	120	600	—	150	750	
CAPACITIVE LOAD [1] T_C = 25°C	NO EFFECT ON DC PERFORMANCE	—	—	500	—	—	500	—	—	500	µF

Notes
1. Guaranteed by design, not tested.
2. MTR2805D is specified at 25°C only.
3. Up to 90% of the total output current/power is available from either output providing the positive output is carrying at least 10% of the total output power.
4. Operation is limited below 16 V (see Figure 22).
5. Effect on negative Vout from 50%/50% loads to 80%/20% or 20%/80% loads.
6. Effect on negative Vout from 50%/50% loads to 90%/10% or 10%/90% loads. See Figure 20.
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 Vout is within 1% of final value.
9. Tested on release from inhibit.

MTR Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 30 WATT

Electrical Characteristics: -55°C to +125°C T_C, 28 VDC 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	VDC
OUTPUT CURRENT [2]		0.3	—	4.0	0	±0.416	0.750 [1]	A
V_{IN} = 16 TO 40 VDC	TOTAL	—	—	—	—	—	0.833	
OUTPUT POWER [2]		0	—	20	0	±5	9.00 [1]	W
V_{IN} = 16 TO 40 VDC	TOTAL	—	—	—	—	—	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 50 VDC	—	10	20	—	25	75	mV
LOAD REGULATION [3, 4]		—	10	50	—	30	75	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	—	—	—	VDC
	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] ALL OUTPUTS SHORTED	POWER DISSIPATION	—	—	14	—	—	14	W
	RECOVERY [1]	—	4	6.0	—	4	6.0	ms
STEP LOAD RESPONSE	TRANSIENT [6]	—	—	±400	—	—	±1500	mV pk
	RECOVERY [7]	—	—	0.300	—	—	6	ms
STEP LINE RESPONSE [1]	16 - 50 - 16 V_{IN} TRANSIENT	—	—	±800	—	—	±800	mV pk
	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, not tested.

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 Vout is within 1% of regulation.
8. Tested on release from inhibit.

MTR Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 30 WATT

Electrical Characteristics: -55°C to +125°C T_C, 28 VDC 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	MAIN AND POS. AUX	4.85	5.00	5.15	14.47	15.00	15.52	VDC
OUTPUT CURRENT [2]		0.3	—	4.0	0	±0.333	0.600 [1]	A
V_{IN} = 16 TO 40 VDC	TOTAL	—	—	—	—	—	0.666	
OUTPUT POWER [2]		0	—	20	0	±5	9.00 [1]	W
V_{IN} = 16 TO 40 VDC	TOTAL	—	—	—	—	—	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 50 VDC	—	10	20	—	30	75	mV
LOAD REGULATION [3, 4]		—	10	50	—	30	75	mV
INPUT VOLTAGE	CONTINUOUS	16	28	40	—	—	—	VDC
	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] ALL OUTPUTS SHORTED	POWER DISSIPATION	—	—	14	—	—	14	W
	RECOVERY [1]	—	4	6.0	—	4	6.0	ms
STEP LOAD RESPONSE	TRANSIENT [6]	—	—	±400	—	—	±1500	mV pk
	RECOVERY [7]	—	—	0.300	—	—	6	ms
STEP LINE RESPONSE [1]	16 - 50 - 16 V_{IN} TRANSIENT	—	—	±800	—	—	±800	mV pk
	RECOVERY [7]	—	—	5	—	—	5	ms
START-UP [8]	DELAY	—	4	6.0	—	4	6.0	ms
	OVERSHOOT [1]	—	—	500	—	—	1500	mV pk

Notes

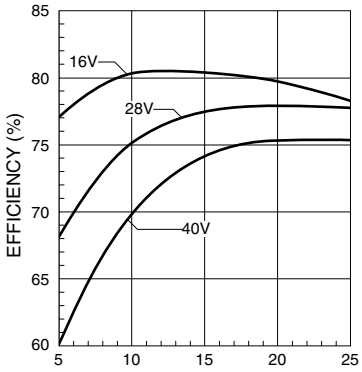
1. Guaranteed by design, not tested.

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 Vout is within 1% of regulation.
8. Tested on release from inhibit.

MTR Single, Dual and Triple DC/DC Converters

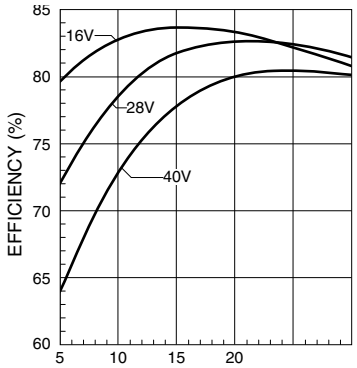
28 VOLT INPUT – 30 WATT

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



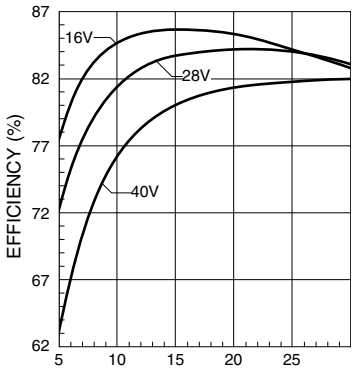
MTR2805S EFFICIENCY

FIGURE 6



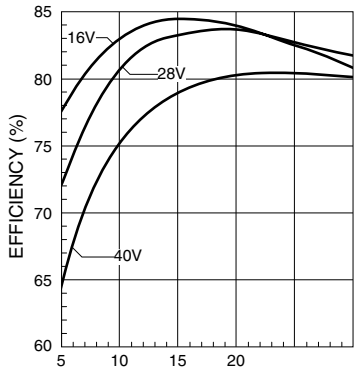
MTR2812S EFFICIENCY

FIGURE 7



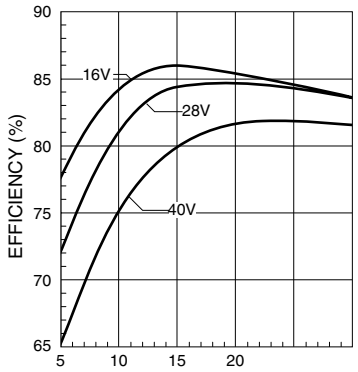
MTR2815S EFFICIENCY

FIGURE 8



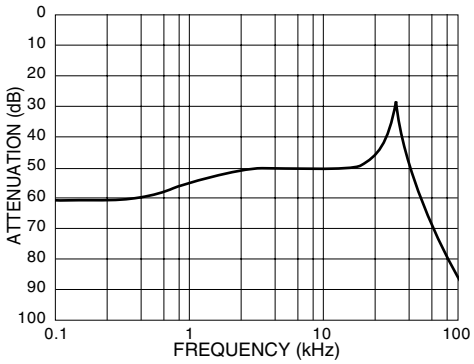
MTR2812D EFFICIENCY

FIGURE 9



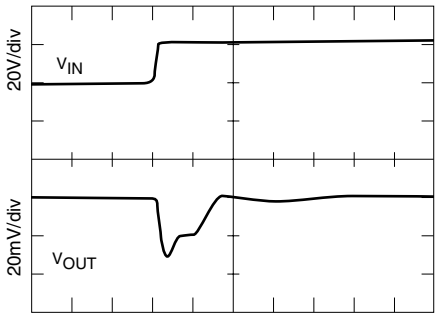
MTR2815D EFFICIENCY

FIGURE 10



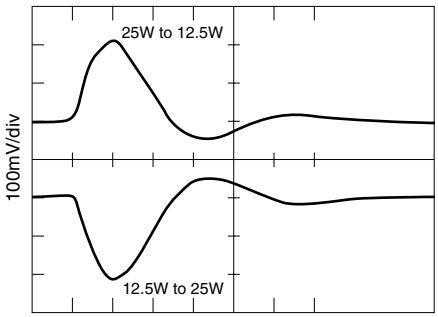
AUDIO REJECTION, MTR SERIES

FIGURE 11



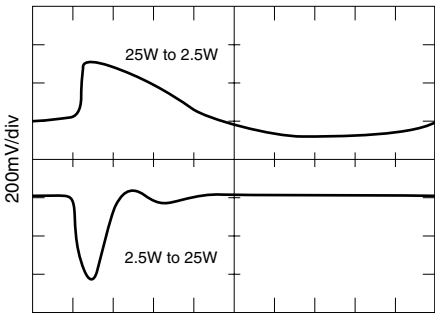
MTR2805S STEP LINE RESPONSE

FIGURE 12



MTR2805S STEP LOAD RESPONSE

FIGURE 13



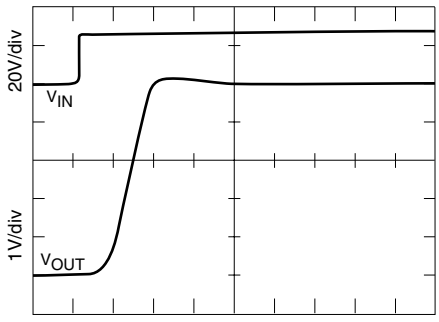
MTR2805S STEP LOAD RESPONSE

FIGURE 14

MTR Single, Dual and Triple DC/DC Converters

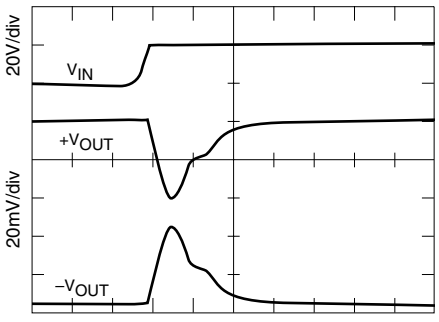
28 VOLT INPUT – 30 WATT

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



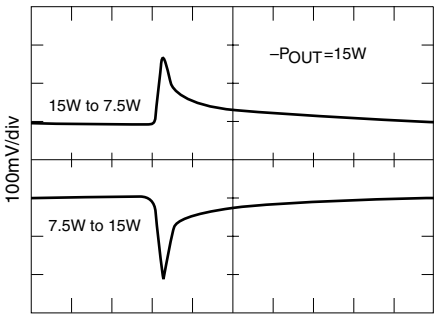
500 µs / div
MTR2805S TURN-ON INTO NO LOAD

FIGURE 15



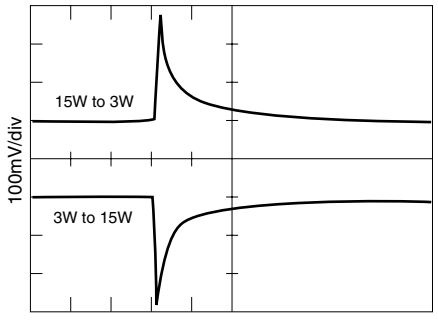
50µs/div
16 TO 40
MTR2815D STEP LINE RESPONSE

FIGURE 16



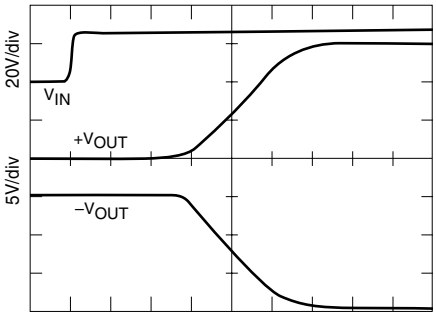
50µs/div
25% ↔ 50%
MTR2815D $+V_{OUT}$ STEP LOAD RESPONSE

FIGURE 17



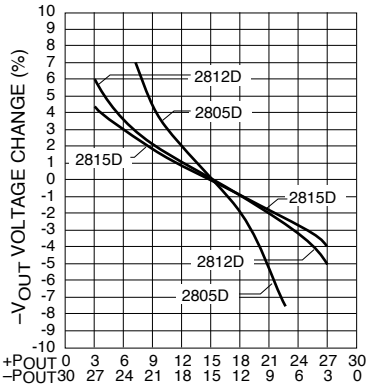
50µs/div
10% ↔ 100%
MTR2815D $+V_{OUT}$ STEP LOAD RESPONSE

FIGURE 18



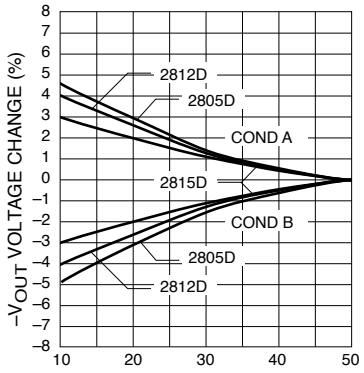
200µs/div
MTR2815D TURN-ON INTO NO LOAD

FIGURE 19



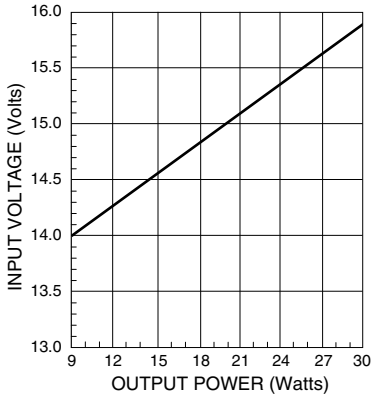
10% to 90% LOAD +V, 90% to 10% LOAD –V
CROSS REGULATION

FIGURE 20



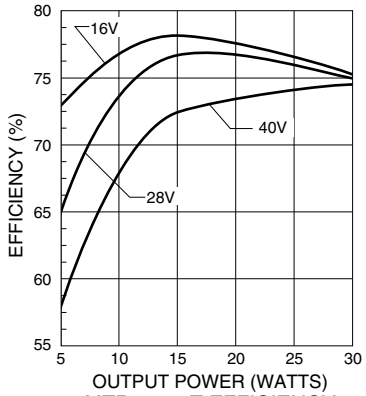
COND. B: 50% LOAD +V, 50% to 10% –V
COND. A: 50% LOAD –V, 50% to 10% +V
CROSS REGULATION

FIGURE 21



1% DROP
MTR SINGLES AND DUALS
LOW LINE DROPOUT

FIGURE 22



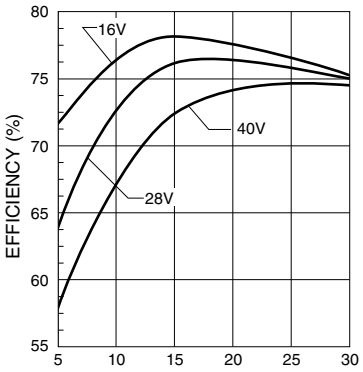
MTR28512T EFFICIENCY

FIGURE 23

MTR Single, Dual and Triple DC/DC Converters

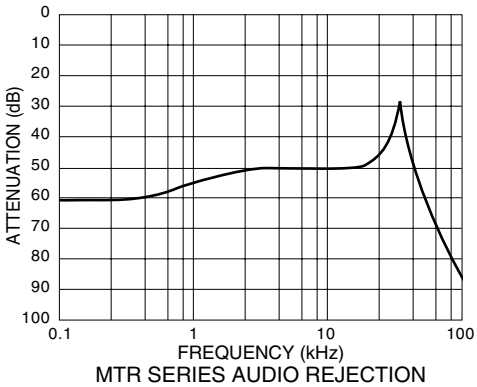
28 VOLT INPUT – 30 WATT

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



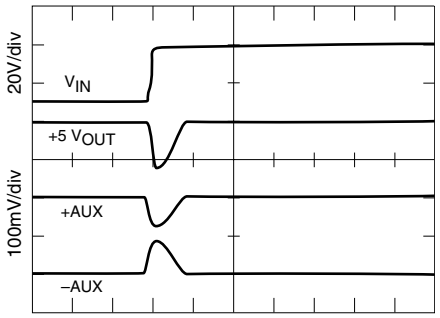
MTR28515T EFFICIENCY

FIGURE 24



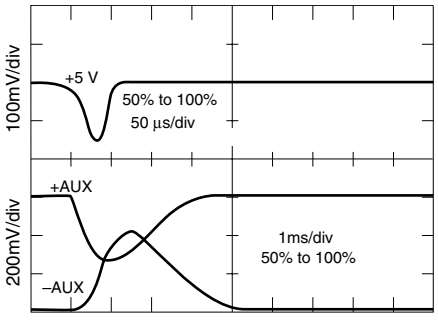
MTR SERIES AUDIO REJECTION

FIGURE 25



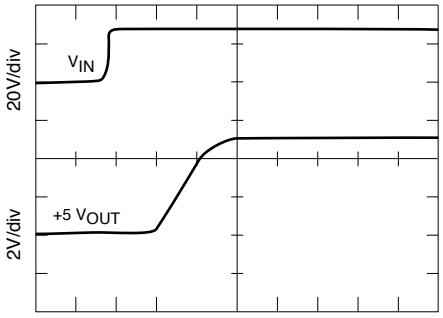
MTR28515T STEP LINE RESPONSE

FIGURE 26



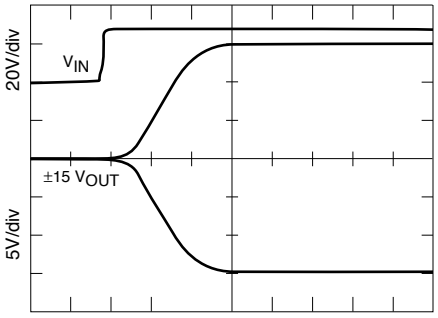
50% ↔ 100%
MTR28515T STEP LOAD RESPONSE

FIGURE 27



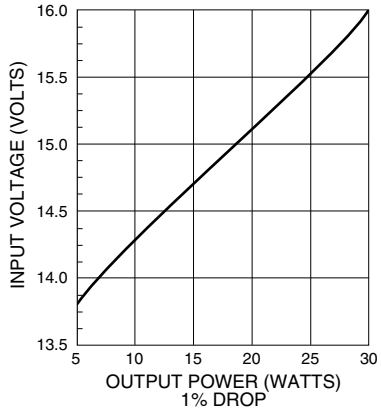
MTR28515T, MAIN (+5)

FIGURE 28



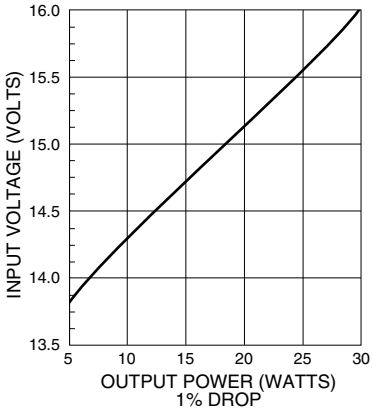
MTR28515T, AUX. (±15)
TURN-ON INTO FULL LOAD

FIGURE 29



MTR28512T LOW LINE DROPOUT VS. LOAD

FIGURE 30



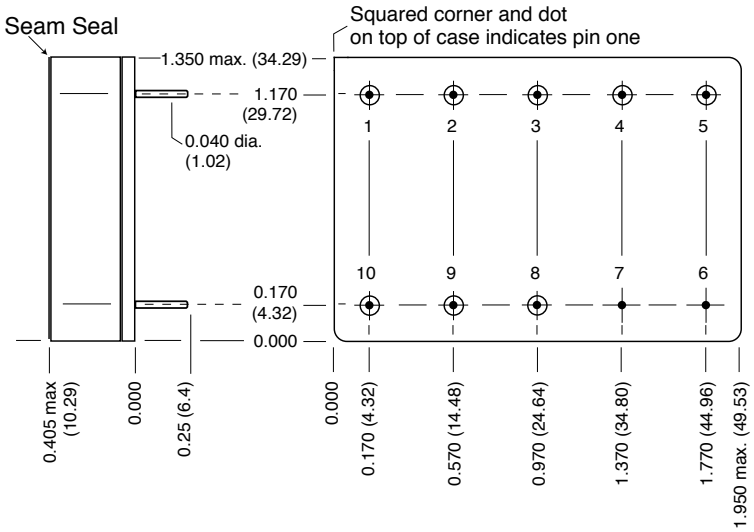
MTR28515T LOW LINE DROPOUT VS. LOAD

FIGURE 31

MTR Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE F1



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)

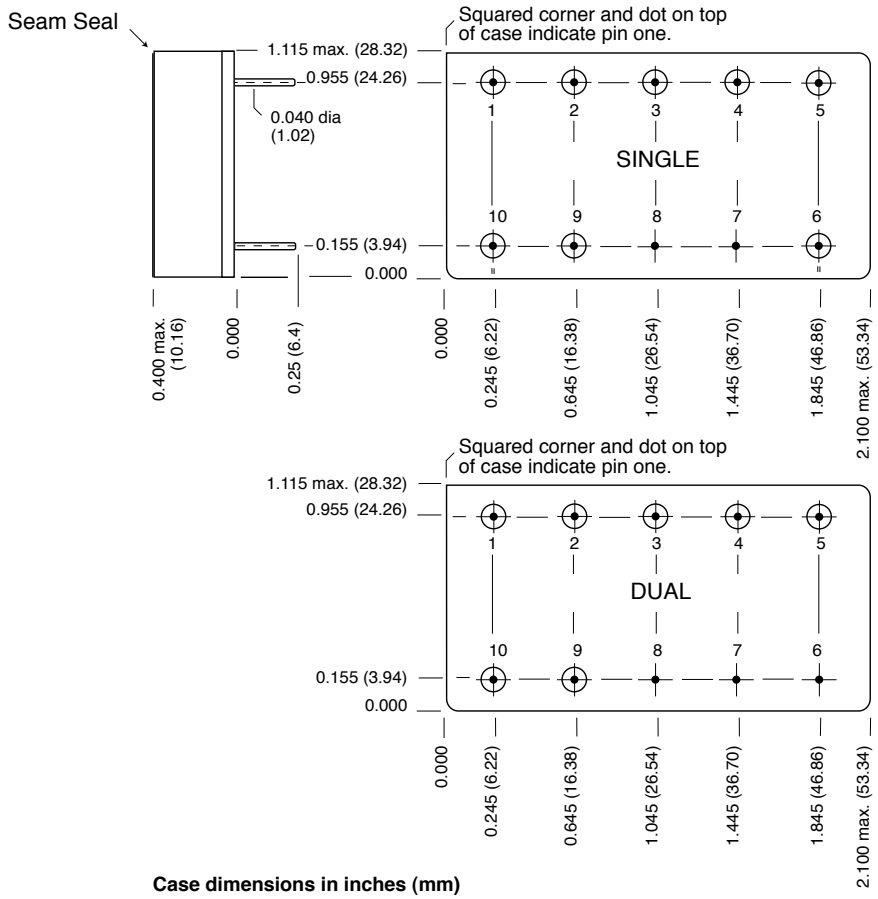
Case F1 MTR T, Rev F, 20100429
Please refer to the numerical dimensions for accuracy.

FIGURE 32: CASE F1 – TRIPLE MODELS

MTR Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE H2



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)

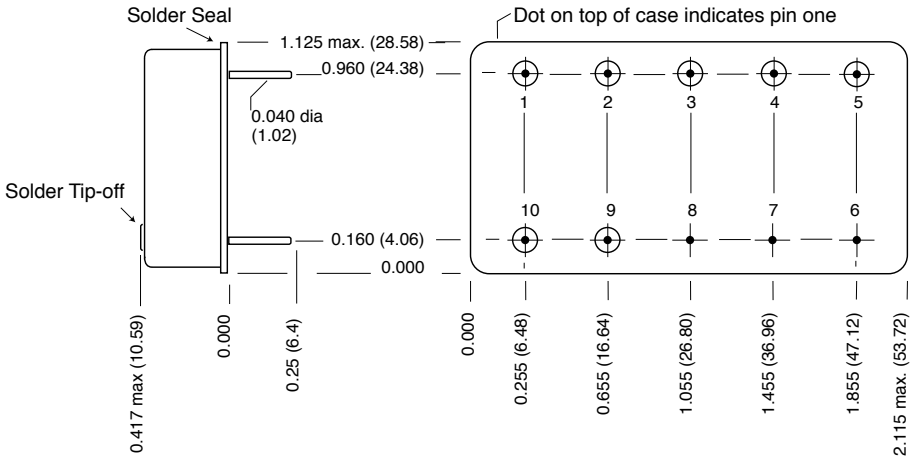
Case H2 MTR SD, Rev H - 2011.03.14
Please refer to the numerical dimensions for accuracy..

FIGURE 33: CASE H2 – SINGLE AND DUAL MODELS
APPLIES TO ALL SINGLE MODELS, APPLIES ONLY TO 883 DUAL MODELS, SEE CASE H4 FOR NON-883 DUAL MODELS

MTR Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE H4



Seal hole: 0.091 ±0.005 (2.31 ±0.13)

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 Seal hole 0.092 ±0.002 (2.34 ± 0.05)

Case H4 MTR D non883, Rev E - 20100429
Please refer to the numerical dimensions for accuracy.

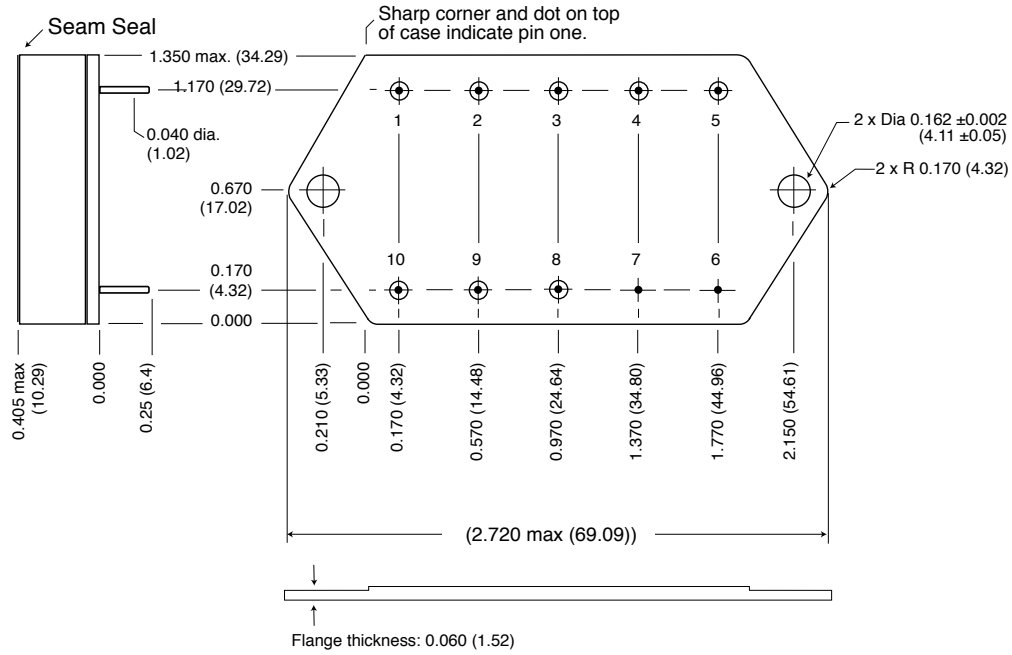
FIGURE 34: CASE H4 – DUAL MODELS - NON 883

MTR Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE J1

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 (3.04 ±0.05)

Case J1 MTR T F, Rev H, 20100916
Please refer to the numerical dimensions for accuracy.

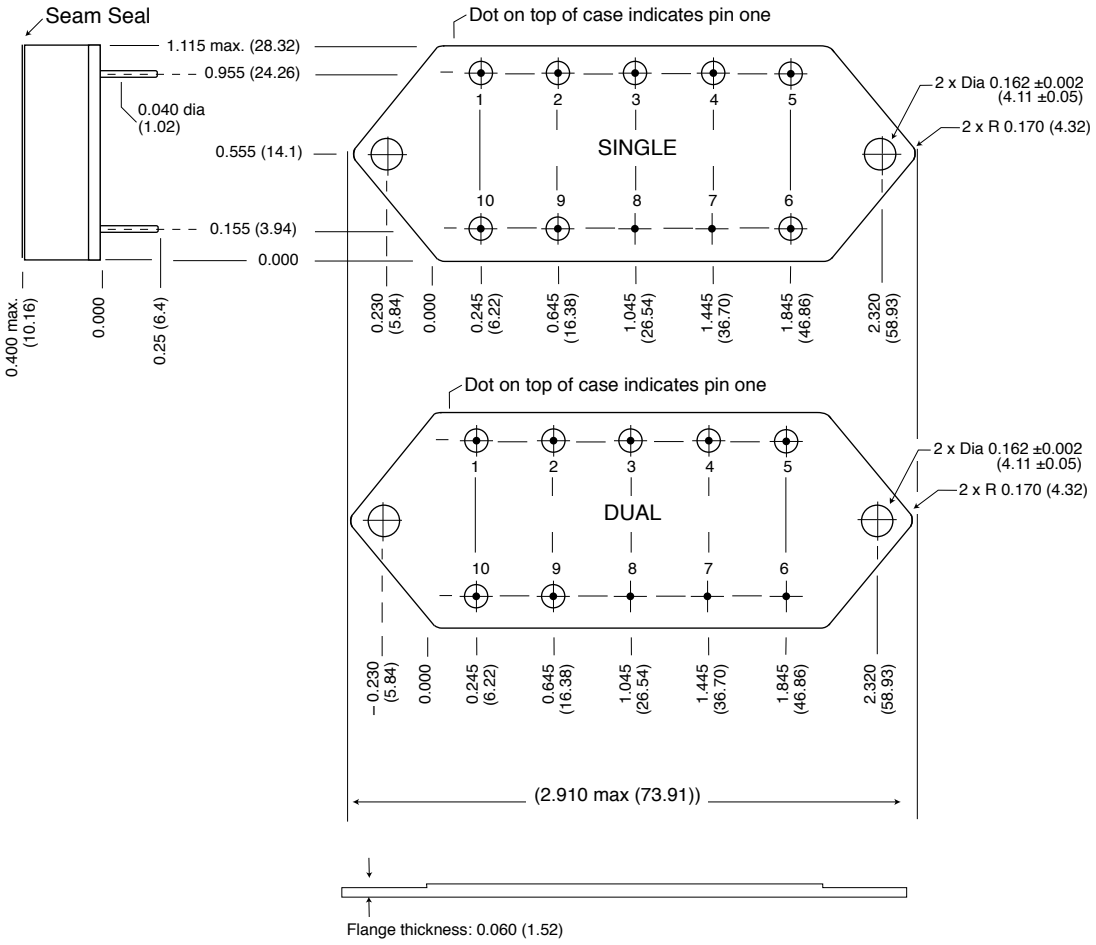
FIGURE 35: CASE J1 – TRIPLE MODELS

MTR Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE K3

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 (3.04 ±0.05)

Case K3 MTR SD F, Rev G, 20100916
Please refer to the numerical dimensions for accuracy.

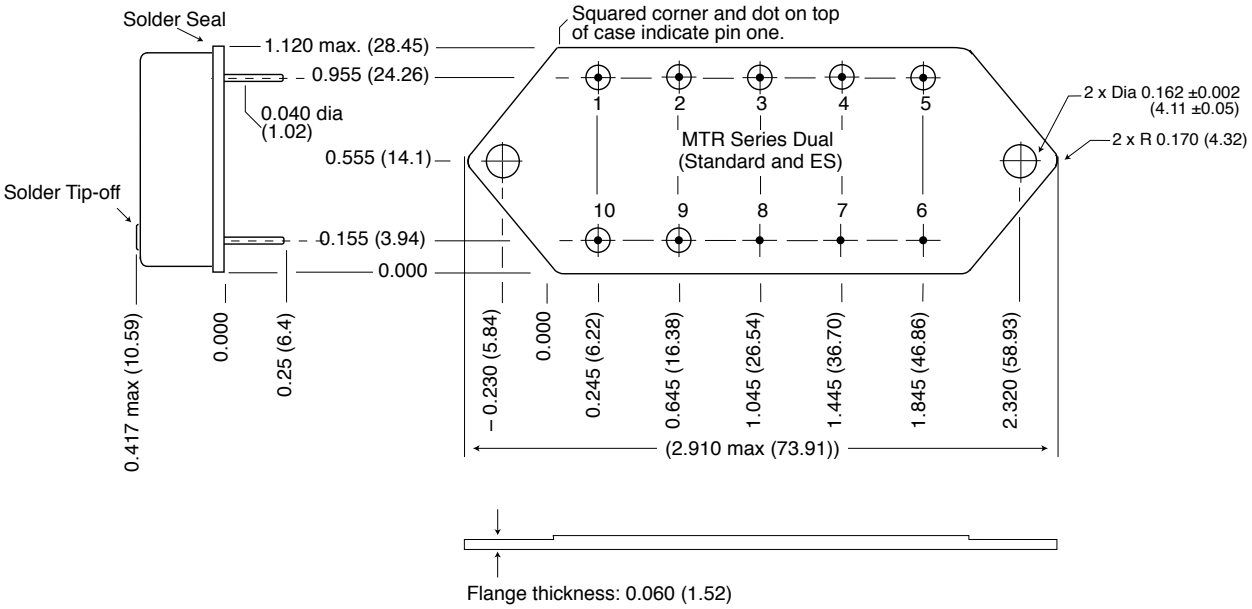
FIGURE 36: CASE K3 – SINGLE AND DUAL MODELS
APPLIES TO ALL SINGLE MODELS, APPLIES ONLY TO 883 DUAL MODELS, SEE CASE K5 FOR NON-883 DUAL MODELS

MTR Single, Dual and Triple DC/DC Converter Cases

28 VOLT INPUT – 30 WATT

BOTTOM VIEW CASE K5

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/Tin
Cover	Cold Rolled Steel/Nickel/Tin
Pins	#52 alloy, compression glass seal
	Seal hole 0.092 ±0.002 (2.34 ± 0.05)

Case K3 MTR D F non-883, Rev G, 20100916
Please refer to the numerical dimensions for accuracy.

FIGURE 37: CASE K5 – DUAL MODELS - NON 883

MTR Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 30 WATT

STANDARD AND /ES (NON-QML) AND /883 (CLASS H, QML) MIL-PRF-38534 ELEMENT EVALUATION

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

Notes:
1. Non-QML products may not meet all of the requirements of MIL-PRF-38534.
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.

SCREENING TABLE 6: ELEMENT EVALUATION—HIGH RELIABILITY STANDARD, /ES AND /883 (CLASS H)

SCREENING TABLE 1: ELEMENT EVALUATION

MTR Single, Dual and Triple DC/DC Converters

28 VOLT INPUT – 30 WATT

STANDARD AND /ES (NON-QML) AND /883 (CLASS H, QML) MIL-PRF-38534 ENVIRONMENTAL SCREENING

TEST PERFORMED	NON-QML [1]		QML
	STANDARD	/ES	/883
Pre-cap Inspection, Method 2017, 2032	■	■	■
Temperature Cycle (10 times)			
Method 1010, Cond. C, -65°C to +150°C, ambient			■
Method 1010, Cond. B, -55°C to +125°C, ambient		■	
Constant Acceleration			
Method 2001, 3000 g			■
Method 2001, 500 g		■	
Burn-in Method 1015, +125°C case, typical [2]			
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, Method 1014, Cond. C		■	■
Fine Leak, Method 1014, Cond. A		■	■
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, non-QML products, may not meet all of the requirements of MIL-PRF-38534.
2. Burn-in temperature designed to bring the case temperature to +125°C minimum. Burn-in is a powered test.

SCREENING TABLE 2: ENVIRONMENTAL SCREENING