interpoint

MTR SERIES DC-DC CONVERTERS

10301 Willows Road P.O. Box 97005 Redmond, WA 98073-9705 TEL: (206) 882-3100 TEL: (800) 822-8782 FAX: (206) 882-1990

- **Up to 30 watts output power**
- **–55° to +125°C full power operation**
- **0.4 inch height**
- **Less than 2.4 sq. in. footprint**
- **Pin compatible with industry standard MHE/MLP converters**
- **5, 12, 15 Vdc single or dual outputs**
- **Constant current overload protection**
- **Constant frequency PWM design**
- **External synchronization (500 to 675 kHz)**
- **50 dB audio rejection (typical)**
- **SMD models available**

The MTR Series™ of high frequency dc-dc converters offers up to 30 watts of output power over the full military temperature range with up to 84% efficiency. Thick-film hybrid techniques provide military/aerospace reliability levels and optimum miniaturization. The MTR Series is packaged in a case that has the same footprint as Interpoint's industry standard 15-watt converters (MHE Series) but that is only 0.4 inch in height. The MTR power density rating is up to 35 watts/in^3.

MTR converters are packaged in hermetically sealed metal enclosures, making them ideal for use in military, aerospace and other high reliability applications. Units are available in both unscreened, screened, and fully compliant SMD versions (see table for screening conditions). Unscreened parts undergo gross leak, hermeticity testing, and full electrical tests. Custom versions, screened per customer specification control drawings, are also 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 (5 mV typical) 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 and shunt regulators.

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. (See the characteristics tables below for the set point for each model.) Following load fault conditions, a soft-restart feature reduces stress on internal components, increasing reliability.

MTR converters are provided with internal filtering capacitors that help reduce the need for external components in normal operation. For systems that require compliance with MIL-STD-461B's CE03 standard, Interpoint offers filter/transient suppression modules (including the FMC-461, FMD-461 and FM-704A series filters) which will result in compliance. Contact your Interpoint representative for further details.

SYNCHRONIZATION

The MTR offers a synchronization feature that allows the designer to match the switching frequency of the converter to the frequency of the system clock. In free-run (unsynchronized) mode, the MTR unit switches at 625 kHz (nominal). In sync mode, the converter will run at any frequency between 500 kHz and 675 kHz. The sync control operates with a TTL logic level signal at any duty cycle between 40% and 60%.

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.

WIDE VOLTAGE RANGE

The MTR converters are designed to provide full power operation over a full 16 to 40 Vdc voltage range. Operation below 16 volts, including MIL-STD-704D emergency power conditions is possible with derated power. Refer to the low line dropout graph (Figure 4) for details. A low voltage lockout feature keeps the converter shutdown below approximately 9 Vdc to ensure smooth initialization.

IMPROVED DYNAMIC RESPONSE

The MTR feed-forward compensation system provides excellent dynamic response and noise rejection. Audio rejection is typically 50 dB. The min. to max. step line transient response is typically less than 4%.

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 a TTL compatible low (≤0.8V) is applied to the inhibit pin. The unit is enabled when the pin, which is internally connected to a pull-up resistor, is left unconnected or is connected to an open-collector gate. The open circuit output voltage associated with the inhibit pin is 9 to 11 Vdc. In the inhibit mode, a maximum of 8 mA must be sunk from the inhibit pin.

OUTPUT VOLTAGE TRIM

The output on single output MTR models can be trimmed as much as 0.6 V upward by connecting resistors between pin 5 and pin 6. See page 3 for voltage changes with different resistor values.

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CHARACTERISTICS (ALL MODELS): Tc = 25°, V_{IN} = 28 Vdc, no external sync applied, unless otherwise specified.

OPERATING TEMPERATURE RANGE:
Full Power: –55°C to +125°C (case)
Absolute: –55°C to +135°C (case)
STORAGE TEMPERATURE RANGE: –65°C to +135°C (case)
OUTPUT VOLTAGE TEMPERATURE COEFFICIENT:
0.01%/°C (typical)
TEMPERATURE RISE (STILL AIR) 12.5°C/W dissipated (typ)
ISOLATION: 100 megohm minimum at 500 Vdc
INPUT TO OUTPUT CAPACITANCE: 50 pF (typical)
AUDIO REJECTION: 50 dB (typical)
WEIGHT: Unflanged case: 52 grams (max.); flanged case: 55 grams (max.)

CONVERSION FREQUENCY
Free run mode: 550 kHz min., 625 typ., 650 max.
Synchronized mode: 500 kHz min. to 675 max.
SYNCHRONIZATION
Duty cycle: 40% min., 60% max.
Logic low = 0.8V max., 0.0V min.
Logic high = 4.0V min., 10.0V max.
OUTPUT INHIBIT PIN: TTL Open collector compatible
TTL logic high = output enabled
TTL logic low = output disabled
Open circuit voltage = 9 to 11 Vdc
Logic low current = 8.0 mA (max.)
Logic low voltage level = 0.8V (max.)
MEAN TIME BETWEEN FAILURES: 456,000 hrs. (AIT, 85°C)

DUAL OUTPUT MODELS

PARAMETER	CONDITION	MTR2805S			MTR2812S			MTR2815S			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
INPUT VOLTAGE	Tc = –55°C TO +125°C NO LOAD TO FULL NORMAL TRANSIENT[1]	 16 0	 28 —	 40 50	 16 0	 28 —	 40 50	 16 0	 28 —	 40 50	Vdc
INPUT CURRENT	Tc = –55°C TO+125°C NO LOAD FULL LOAD INHIBITED	 — — —	 35 1.15 3	 75 — 8	 — — —	 35 1.30 3	 75 — 8	 — — —	 35 1.25 3	 75 — 8	 mA A mA
OUTPUT VOLTAGE	FULL LOAD	4.95	5.00	5.05	11.88	12.00	12.12	14.85	15.00	15.15	Vdc
OUTPUT CURRENT[2]	V_{IN} = 16 TO 40 Vdc Tc = –55°C TO +125°C	0	—	5	0	—	2.5	0	—	2.0	A
OUTPUT POWER[2]	V_{IN} = 16 TO 40 Vdc Tc = –55°C TO +125°C	0	—	25	0	—	30	0	—	30	W
EFFICIENCY	FULL LOAD	76	78	—	80	83	—	81	84	—	%
LINE REGULATION[3]	FULL LOAD, V_{IN} = 16 TO 40 Vdc Tc = 25°C Tc = –55°C TO +125°C	 — —	 10 15	 30 50	 — —	 10 15	 30 50	 — —	 10 15	 30 50	mV
LOAD REGULATION	NO LOAD TO FULL, Tc = 25°C Tc = –55°C TO +125°C	 — —	 5 15	 30 50	 — —	 5 15	 30 50	 — —	 5 15	 30 50	mV
OUTPUT RIPPLE VOLTAGE	FULL LOAD, 10 kHz–2 MHz Tc = 25°C Tc = –55°C TO +125°C	 — —	 35 50	 50 90	 — —	 25 40	 50 90	 — —	 25 40	 50 90	mVp-p
INPUT RIPPLE CURRENT	FULL LOAD, 10 kHz–10 MHz Tc = –55°C TO +125°C	—	20	50	—	20	50	—	20	50	mAp-p
LOAD FAULT[4] POWER DISS.	SHORT CIRCUIT	—	—	10	—	—	10	—	—	10	W
LOAD FAULT RECOVERY[5]	Tc = –55°C to +125°C SHORT CIRCUIT TO FULL LOAD	—	1.4	5.0	—	1.4	5.0	—	1.4	5.0	mS
STEP LOAD RESPONSE, TRANSIENT	50% TO100%; 100% TO 50%	—	±200	±300	—	±250	±400	—	±350	±500	mVpk
	10% TO 100%	—	–400	–600	—	–600	–1000	—	–800	–1200	mVpk
	100% TO 10%	—	+350	+600	—	+500	+750	—	+600	+1000	mVpk
RECOVERY[5]	50% TO 100%; 100% TO 50%	—	60	200	—	60	200	—	60	200	µS
	10% TO 100%	—	60	600	—	150	300	—	250	500	µS
	100% TO 10%	—	200	600	—	250	500	—	250	500	µS
STEP LINE RESPONSE, TRANSIENT[6]	16 ↔ 40 Vdc	—	±200	±300	—	±400	±500	—	±500	±600	mVpk
RECOVERY[5]	16 ↔ 40 Vdc	—	—	300	—	—	300	—	—	300	µS
START UP DELAY	Tc = –55°C TO +125°C FULL LOAD	 —	 1.4	 5.0	 —	 1.4	 5.0	 —	 1.4	 5.0	 mS
OVERSHOOT	FULL LOAD	—	0	50	—	0	120	—	0	150	mVpk
	NO LOAD	—	50	250	—	120	600	—	150	750	mV

Notes:
1 50V limit rated for up to 50 mS.
2 Derate output power/current linearly from 100% at +125°C to 0 at +135°C.
3 Operation is limited below 16V (see figure 4).
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 Transition time ≥ 10µS.

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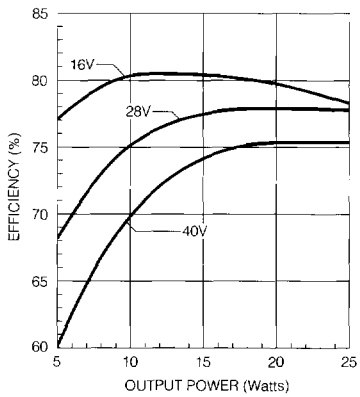
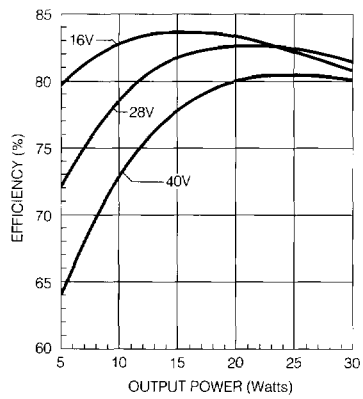
TYPICAL PERFORMANCE CURVES



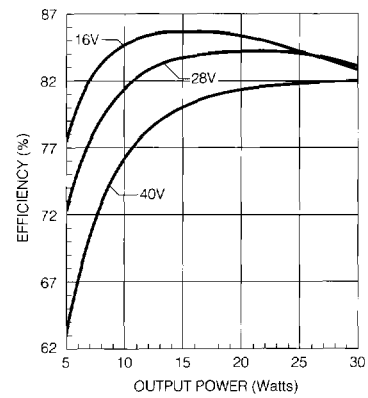
MTR2805S
EFFICIENCY VS. LINE & LOAD

Figure 1



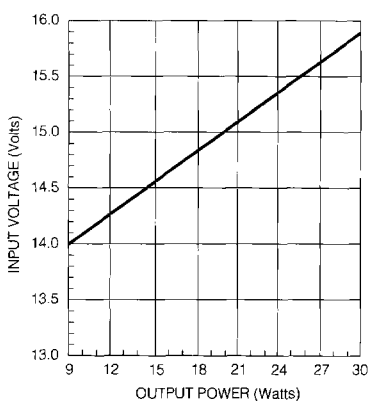
MTR2812S
EFFICIENCY VS. LINE & LOAD

Figure 2



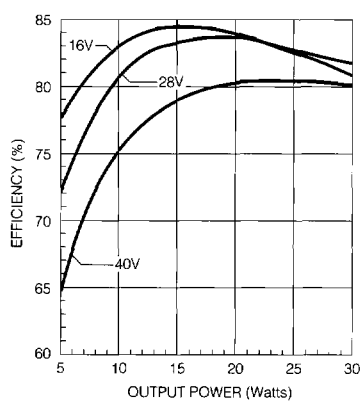
MTR2815S
EFFICIENCY VS. LINE & LOAD

Figure 3



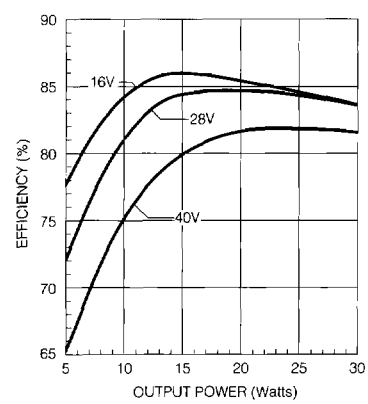
LOW LINE DROPOUT VS. LOAD
(1% DROP)

Figure 4



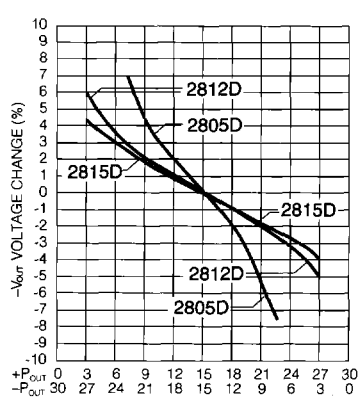
MTR2812D
EFFICIENCY VS. LINE & LOAD

Figure 5



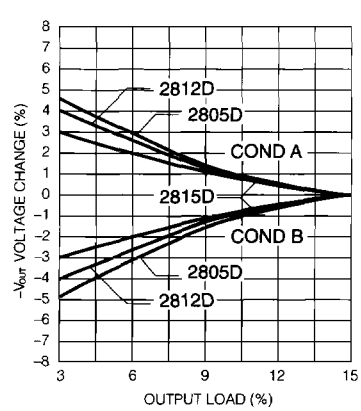
MTR2815D
EFFICIENCY VS. LINE & LOAD

Figure 6



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

Figure 7



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

Figure 8

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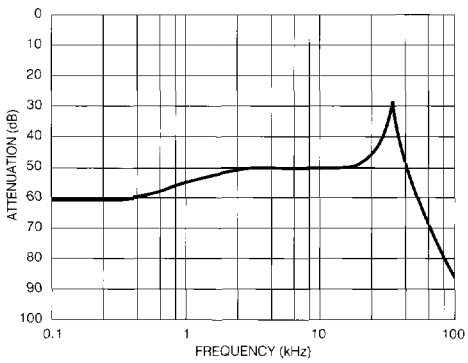
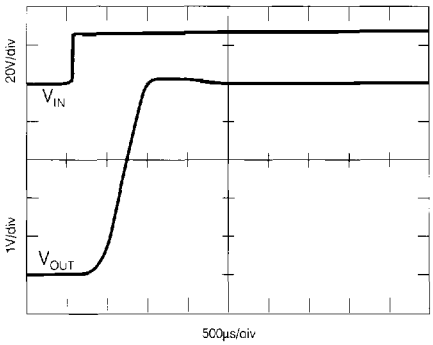
TYPICAL PERFORMANCE CURVES



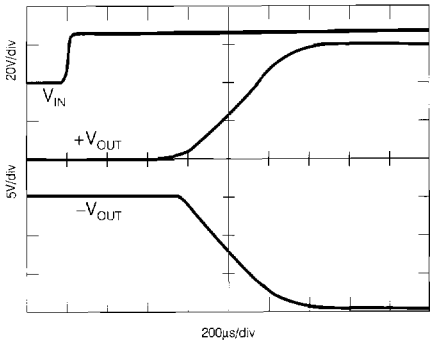
AUDIO REJECTION, MTR SERIES

Figure 9



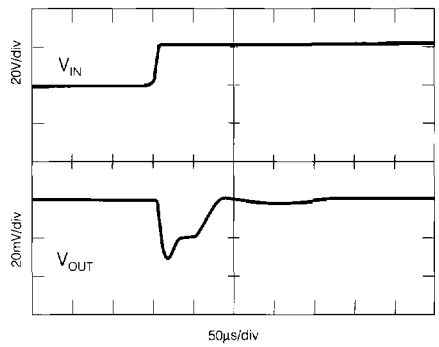
TURN-ON INTO NO LOAD, MTR2805S

Figure 10



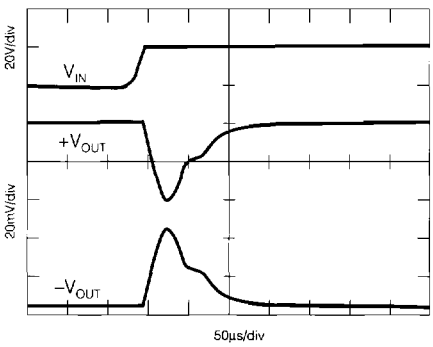
TURN-ON INTO NO LOAD, MTR2815D

Figure 11



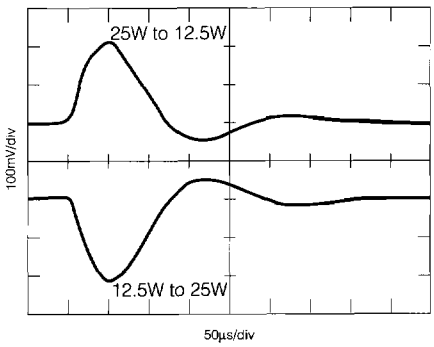
INPUT LINE TRANSIENT RESPONSE
(16 TO 40V), MTR2805S

Figure 12



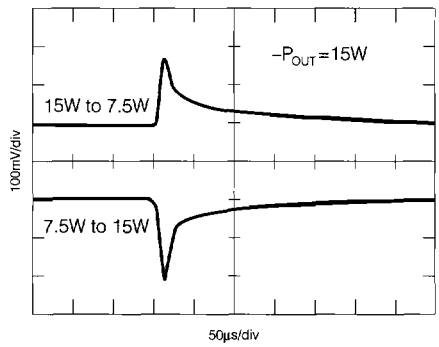
INPUT LINE TRANSIENT RESPONSE
(16 TO 40 V), MTR2815D

Figure 13



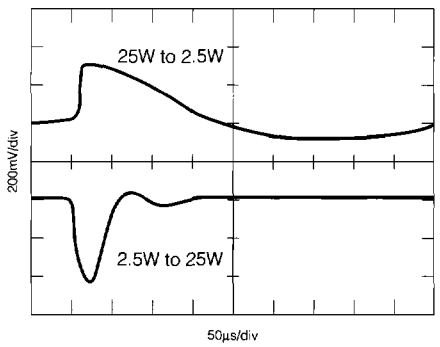
LOAD TRANSIENT RESPONSE
(50%↔100%), MTR2805S

Figure 14



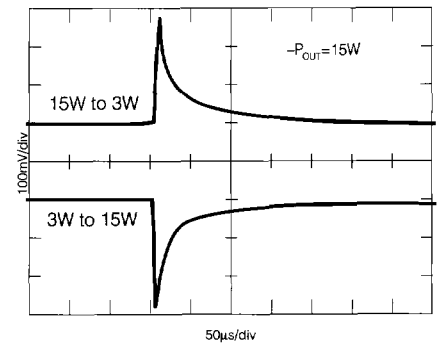
LOAD TRANSIENT RESPONSE
(25%↔50%), $+V_{OUT}$, MTR2815D

Figure 15



LOAD TRANSIENT RESPONSE
(10%↔100%) MTR2805S

Figure 16



LOAD TRANSIENT RESPONSE
(10%↔100%), $+V_{OUT}$, MTR2815D

Figure 17

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DUAL OUTPUT MODELS

PARAMETER	CONDITION	MTR2805D			MTR2812D			MTR2815D			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
INPUT VOLTAGE	Tc = –55°C TO +125°C NO LOAD TO FULL NORMAL TRANSIENT[1]	 16 0	 28 —	 40 50	 16 0	 28 —	 40 50	 16 0	 28 —	 40 50	Vdc
INPUT CURRENT	NO LOAD FULL LOAD INHIBITED	— — —	35 1.10 3	75 — 8	— — —	50 1.34 3	75 — 8	— — —	50 1.29 3	75 — 8	mA A mA
OUTPUT VOLTAGE	FULL LOAD +V_{OUT} –V_{OUT}	+4.95 –4.92	+5.00 –5.00	+5.05 –5.07	+11.88 –11.82	+12.00 –12.00	+12.12 –12.18	+14.85 –14.77	+15.00 –15.00	+15.15 –15.23	Vdc
OUTPUT CURRENT[2, 3]	V_{IN} = 16 TO 40 Vdc Tc = –55°C TO +125°C	0	2.5	4.5	0	1.25	2.25	0	1.0	1.8	A
OUTPUT POWER[2, 3]	VIN = 16 TO 40 Vdc Tc = – 55°C TO +125°C	0	—	25	0	—	30	0	—	30	W
EFFICIENCY	V_{IN} = 28, FULL LOAD	76	78	—	78	81	—	80	83	—	%
LINE REGULATION[4]	FULL LOAD, V_{IN} = 16 TO 40 Vdc Tc = 25°C +V_{OUT} –V_{OUT} Tc = –55°C TO +125°C +V_{OUT} –V_{OUT}	 — —	 10 50 10 50	 50 100 50 100	 — —	 10 50 10 50	 30 120 50 180	 — —	 10 50 10 50	 30 150 50 180	mV
LOAD REGULATION	NO LOAD TO FULL, BALANCED LOADS Tc = 25°C +V_{OUT} –V_{OUT} Tc = –55°C TO +125°C +V_{OUT} –V_{OUT}	 — — — —	 5 25 5 25	 30 50 50 100	 — — — —	 15 30 15 30	 30 120 50 150	 — — — —	 15 30 15 30	 30 150 50 180	mV
CROSS REGULATION[5] (EFFECT ON –V_{OUT})	+P_{OUT} = 20% TO 80% –P_{OUT} = 80% TO 20% –P_{OUT} = 10% TO 50% +P_{OUT} = 50%	— —	7 4	12 6	— —	4 4	8.3 6	— —	3 4	8 6	% %
OUTPUT RIPPLE VOLTAGE	FULL LOAD, 10 kHz–2 MHz Tc = 25°C Tc = –55°C TO +125°C	— —	20 40	50 80	— —	30 40	80 120	— —	25 40	80 120	mVp-p
INPUT RIPPLE CURRENT	FULL LOAD, 10 kHz–10 MHz Tc = –55°C TO +125°C	—	15	50	—	20	50	—	20	50	mAp-p
LOAD FAULT[6] POWER DISS.	SHORT CIRCUIT	—	—	10	—	—	10	—	—	10	W
LOAD FAULT RECOVERY[7]	Tc = –55°C to +125°C	—	1.4	5.0	—	1.4	5.0	—	1.4	5.0	mS
STEP LOAD RESPONSE, TRANSIENT RECOVERY[7]	 50% ↔100% 10% ↔ 100% 50% ↔ 100% 10% ↔ 100%	 — — — —	 ±200 ±400 200 400	 ±300 ±600 200 200	 — — — —	 ±150 ±200 100 100	 ±300 ±400 200 200	 — — — —	 ±200 ±300 100 250	 ±400 ±500 200 200	 mVpk mVpk µS µS
STEP LINE RESPONSE, TRANSIENT[8] RECOVERY[7]	 16 ↔ 40 Vdc 16 ↔ 40 Vdc	 — —	 ±200 —	 ±400 300	 — —	 ±200 —	 ±400 300	 — —	 ±400 —	 ±500 300	 mVpk µS
START UP DELAY OVERSHOOT	Tc = –55°C TO +125°C FULL LOAD FULL LOAD NO LOAD	 — — —	 1.4 0 50	 5.0 50 250	 — — —	 1.4 0 120	 5.0 120 600	 — — —	 1.4 0 150	 5.0 150 750	 mS mVpk mV

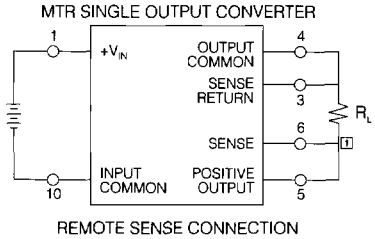
Notes:

1 50V limit rated for up to 50 mS.
2 Derate output power/current linearly from 100% at +125°C to 0% at +135°C.
3 Shows maximum power/current of combined outputs. Up to 90% is available from either output.
4 Operation is limited below 16V (see figure 4).
5 Shows regulation effect on the minus output during the defined cross loading conditions. See figures 7 and 8.
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 V_{OUT} is within 1% of final value.
8 Transition time ≥ 10µS.

REMOTE SENSE AND EXTERNAL TRIM CONNECTIONS

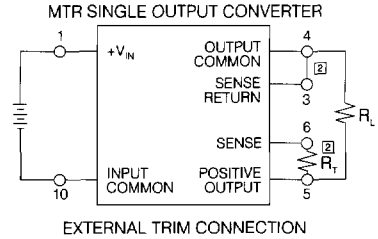
VOLTAGE INCREASE (Vdc)	RESISTOR R_T VALUE (Ohms)
0.1	105
0.2	210
0.3	315
0.4	420
0.5	525
0.6	630

MTR SINGLE OUTPUT CONVERTER



REMOTE SENSE CONNECTION
[1] Make connection at load.

MTR SINGLE OUTPUT CONVERTER



EXTERNAL TRIM CONNECTION
[2] Make connections at converter.

External Trim Resistor Values

On single output models, if neither voltage trim nor remote sense will be used, connect pin 3 to pin 4 and pin 5 to pin 6 or output voltage will increase by 1.2V

CAUTION: Permanent damage will result to any single output MTR converter if the positive remote sense pin (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.

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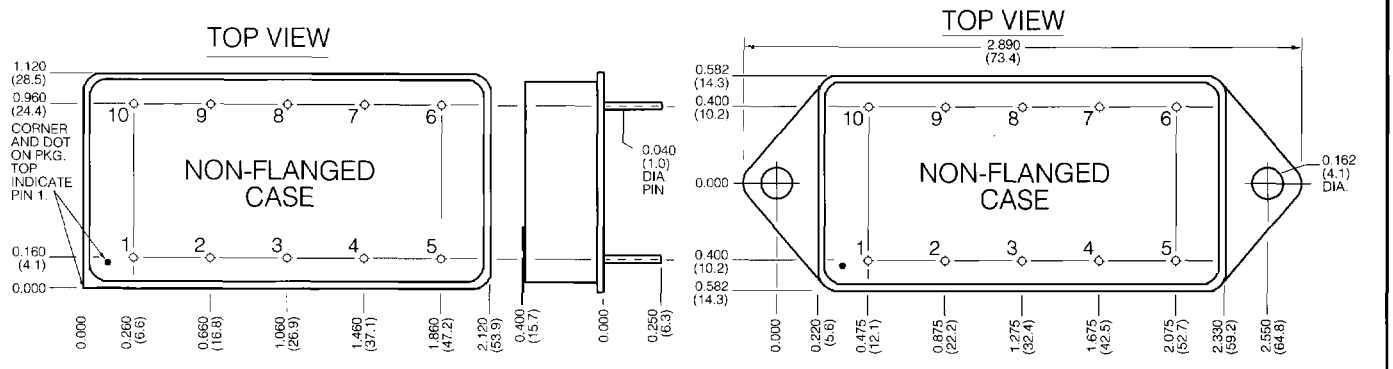
SCREENING OPTIONS*

	/ES	/SX /883		/ES	/SX /883
PRE-CAP INSPECTION Method 2017, 2032	•	•	FINAL VISUAL INSPECTION Method 2009	•	•
TEMPERATURE CYCLE (10 times) Method 1010, Cond. C. (–65°C to +150°C) Method 1010, –55 to +125°C	•	•	FINAL ELECTRICAL TEST MIL-H 38534, Group A 25°C case	•	•
CONSTANT ACCELERATION Method 2001, Cond. A (5000 g) Method 2001, 500 g	•	•	HERMETICITY TESTING Fine Leak, Method 1014, Cond. A Gross Leak, Method 1014, Cond., C	• •	• •
BURN-IN Method 1015, 160 hours at 125°C 96 hours at 125°C case (typ.)	•	•	*All methods and conditions referenced to MIL-STD-883.		

To order model options, enter screening designation as suffix to the part number. For example, MSA 2805S/883. On unscreened parts, the screening code block is marked "01"; on /ES screened parts, it is marked "02". For /SX or /883 parts, "SX" or "883" appears in the screening code block. /SX parts receive the same screening levels as /883 parts but may not be built exclusively with MIL-H-38534 qualified processes and element evaluated components.

METAL HERMETIC PACKAGE:



MTR SERIES CASE

NOMINAL CASE DIMENSIONS IN INCHES (MM)

TOLERANCE ±0.005 (±0.01)

For flanged version, add F to part number

CASE AND COVER: /SX and /883 grade products use gold-plated, cold-rolled steel cases with nickel-plated Kovar covers. /ES and non /ES products are cold-rolled steel with fused tin finish.

CAUTION: Permanent damage will result to any single output MTR converter if the positive remote sense pin (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.

STANDARD MILITARY DRAWING (SMD) MODELS AVAILABLE

STANDARD MILITARY DRAWING	MTR SIMILAR PART
5962–9306801HXC	MTR2805S/883
5962–9306901HXC	MTR2812S/883
5962–9307001HXC	MTR2815S/883
5962–9320501HXC	MTR2805D/883
5962–9307101HXC	MTR2812D/883
5962–9307201HXC	MTR2815D/883
5962–9306801HZC	MTR2805SF/883
5962–9306901HZC	MTR2812SF/883
5962–9307001HZC	MTR2815SF/883
5962–9320501HZC	MTR2805DF/883
5962–9307101HZC	MTR2812DF/883
5962–9307201HZC	MTR2815DF/883

CAUTION: Heat from reflow or wave soldering may damage this part. Solder pins individually with heat application NOT exceeding 300°C for 10 seconds per pin.

	MTR 2805S MTR 2812S MTR 2815S	MTR 2805D MTR 2812D MTR 2815D
DESIGNATION	PIN NO.	PIN NO.
Positive input	1	1
Inhibit	2	2
Sense return*	3	N/A
Output common	4	4
Positive output	5	3
Negative output	N/A	5
Positive sense*	6	N/A
Case ground	7, 8	6, 7, 8
Sync	9	9
Input common	10	10
All Other Pins — No Connection		

* On single output models, if neither voltage trim nor remote sense will be used, connect pin 3 to pin 4 and pin 5 to pin 6 or output voltage will increase by 1.2V.