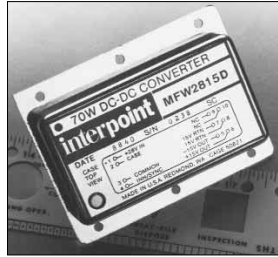


## FEATURES

- -55°C to + 85°C operation
- 19 to 40 VDC input
- Fully Isolated
- Optocoupler feedback
- Fixed frequency, 245 kHz typical
- Topology – Push-Pull Forward
- 50 V for up to 50 ms transient protection
- Inhibit/sync function
- Indefinite short circuit protection
- Remote sense on single models
- Up to 84% efficiency

# DC/DC CONVERTERS 28 VOLT INPUT



## MFW SERIES 70 WATTS

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

Size (max.): 3.20 x 2.46 x 0.595 inches (81.3 x 62.5 x 15.11 mm)  
See Section B8, case L, for dimensions.  
Weight: 140 grams typical  
Screening: Standard or ES. See Section C2 for screening options, see Section A5 for ordering information.

## DESCRIPTION

The MFW Series™ of DC/DC converters offers up to 70 watts of power from single, dual, or triple outputs in one package. Using hybrid thick film technology a power density of over 20 watts per cubic inch is achieved. These devices are packaged in hermetically sealed cold rolled steel enclosures with a tin plate finish making them ideal for use in military, aerospace, or other high reliability applications. Unscreened models are guaranteed to pass a gross leak test (maximum leak rate of 0.001 atm-cc/sec). Environmentally screened units (designated by the /ES suffix) are hermetically solder sealed. See Section C2 for screening specifications.

## DESIGN METHODOLOGY

The MFW Series converters utilize a quasi-square wave forward converter design with a nominal switching frequency of 245 kHz. Isolation between input and output is provided with a transformer in the forward power loop and a wideband, temperature insensitive optical link in the feedback control loop. Output regulation is accomplished with constant frequency pulse width modulation. In addition, the load regulation of the single output models is further enhanced through the use of remote output voltage sense pins to overcome the adverse effects of line resistance voltage drops. Short circuit protection is provided by detecting peak primary switching current on a cycle by cycle basis and limiting it to approximately 130% of the full load input current. This method results in quick and positive current limiting under short circuit conditions.

## LOW NOISE

The MFW Series converters offer low noise on both the input and output lines. A two section, four pole LC input filter is included to provide very low reflected line ripple current. Adherence to MIL-STD-461C (CE03) is possible with the addition of the FMB-461 filter. Output ripple is maintained at less than 50 mV p-p for single and dual output models and 85 mV for triple output models.

## WIDE VOLTAGE RANGE

All models of the MFW Series are designed to provide full power operation over an input voltage range of 19 to 40 VDC. Operation below an input of 19 volts, including operation in MIL-STD-704E emergency power conditions, is possible with derated output power. Please refer to the derating information and the low voltage drop-out graphs (Figures 10 and 11) on the following pages.

## WIDE TEMPERATURE RANGE

Full load operation of any of the MFW Series converters is available at case temperatures of -55°C to + 85°C. Operation up to +125°C is possible with derated output power. The MFW Series converters are provided in a flange mount case designed to facilitate the removal of internally generated heat. Because of this, heat sinking requirements are minimal. Sustained full power operation does however require that an efficient heat sink be attached to the baseplate. Please refer to the heat sink requirements section for more information.

## INHIBIT/SYNC FEATURE

Standard on all models of the MFW Series is a dual mode inhibit/sync pin. This pin serves as both an output inhibit and as a synchronization input. In the inhibit mode an open collector TTL compatible low (<0.8 V) will disable internal switching thereby inhibiting the unit's output. Inhibiting in this manner results in an extremely low quiescent current. Since a pull-up resistor is included internally, this pin may be left open should the inhibit function not be desired.

In a digital system it is often desirable to synchronize the input or output ripple with the system clock. For this reason each model of the MFW Series was designed to synchronize with a system clock applied to the inhibit/sync pin. Please refer to the technical data section for timing details for the external sync feature.

# MFW SERIES 70 WATT

# DC/DC CONVERTERS

### ABSOLUTE MAXIMUM RATINGS

- Output Power**
- 60 to 70 watts depending on model
- Lead Soldering Temperature (10 sec per lead)**
- 300°C
- Storage Temperature Range (Case)**
- -55°C to +125°C

### RECOMMENDED OPERATING CONDITIONS

- Input Voltage Range**
- 19 to 40 VDC continuous (see Derating)
- Case Operating Temperature (Tc)**
- -55°C to +85°C full power

### SYNC AND INHIBIT

- Sync In (245 to 370 kHz.)**
- Duty cycle 70% min, 98% max
  - Logic low 0.8 V max
  - Logic high 4.5 V min
  - Referenced to input common
  - If sync is not used, leave unconnected
- Inhibit TTL Open Collector**
- Logic low (output disabled)  
Inhibit pin current 1 mA max
  - Referenced to input common
  - Logic high (output enabled)  
 $V \geq 4.5$  V

### TYPICAL CHARACTERISTICS

- Output Voltage Temperature Coefficient**
- 150 ppm/°C, typical
- Input to Output Capacitance**
- 160 pF, typical
- Isolation**
- 100 megohm minimum at 500 V
- Conversion Frequency**
- Free run mode 245 kHz, typical
- Inhibit Pin Voltage (unit enabled)**
- 4.5 to 5.5 V

### DERATING OUTPUT POWER/CURRENT AND INPUT VOLTAGE

- Temperatures are referenced to the temperature at the converter's baseplate
- Linearly derate output power/current from 100% at 85°C to 0% at 125°C.
  - Above 105°C linearly derate steady state input voltage to 33 volts at 125°C.
  - Indefinite short circuit protection is not guaranteed above 85°C case.
  - Operation below an input voltage of 19 volts, including operation in MIL-STD-704E emergency power conditions, is possible with derated output power. See Figures 10 and 11.

**Electrical Characteristics: 25°C Tc, 28 VDC Vin, 100% load, free run, unless otherwise specified.**

SINGLE OUTPUTS		MFW2805S			MFW2812S			MFW2815S			UNITS
PARAMETER	CONDITION	MIN	TYP	MAX	MIN	TYP	MAX	MIN.	TYP	MAX	
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	$V_{IN} = 19$ TO 40	—	—	12.00	—	—	5.83	—	—	4.67	A
OUTPUT POWER	$T_c = -55^\circ\text{C}$ TO $+85^\circ\text{C}$	—	—	60	—	—	70	—	—	70	W
OUTPUT RIPPLE	FULL LOAD BW $\leq 2$ MHz	—	30	50	—	30	50	—	30	50	mV p-p
LINE REGULATION	$V_{IN} = 19$ TO 40	—	10	20	—	10	20	—	10	20	mV
LOAD REGULATION	NO LOAD TO FULL	—	10	20	—	10	25	—	10	25	mV
INPUT VOLTAGE		19	28	40	19	28	40	19	28	40	VDC
INPUT CURRENT	NO LOAD	—	75	90	—	70	90	—	70	90	mA
	INHIBITED	—	30	35	—	30	35	—	30	35	mA
INPUT REFL. RIPPLE	FULL LOAD BW $\leq 10$ MHz	—	10	25	—	10	25	—	10	25	mA p-p
EFFICIENCY		78	80	—	81	83	—	81	83	—	%
STARTUP DELAY	WITH LOW IMPEDANCE SOURCE	—	5	10	—	8	10	—	8	10	ms

# DC/DC CONVERTERS

# MFW SERIES 70 WATT

Electrical Characteristics: 25°C Tc, 28 VDC Vin, 100% load, free run, unless otherwise specified.

DUAL AND TRIPLE OUTPUTS			MFW2812D			MFW2815D			MFW28512T			MFW28515T			UNITS
PARAMETER	CONDITION		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	FULL LOAD	MAIN DUAL	—	—	—	—	—	—	4.95	5.05	5.10	4.90	4.95	5.05	VDC
			±11.88	±12.00	±12.12	±14.85	±15.00	±15.15	±11.65	±11.80	±12.05	±15.05	±15.30	±15.55	
OUTPUT CURRENT <sup>1, 2</sup>	V <sub>IN</sub> = 19 TO 40	MAIN DUAL	—	—	—	—	—	—	—	4.0	10.0	—	4.0	10.0	A
			—	2.92	5.5	—	2.33	4.4	—	1.67	4.2	—	1.33	3.33	
OUTPUT POWER <sup>1, 2</sup>		MAIN ±DUAL TOTAL	—	—	—	—	—	—	—	20	50	—	20	50	W
			—	35	66.5	—	35	66.5	—	20	50	—	20	50	
			—	—	70	—	—	70	—	—	60	—	—	60	
OUTPUT RIPPLE	FULL LOAD BW ≤ 2 MHz	MAIN DUAL	—	—	—	—	—	—	—	50	85	—	50	85	mV p-p
			—	30	50	—	30	50	—	50	85	—	50	85	
LINE REGULATION	V <sub>IN</sub> = 19 TO 40	MAIN DUAL	—	—	—	—	—	—	—	2	20	—	2	20	mV
			—	10	25	—	10	25	—	100	200	—	100	200	
LOAD <sup>3</sup> REGULATION	NO LOAD TO FULL	MAIN DUAL	—	—	—	—	—	—	—	5	20	—	5	20	mV
			—	25	50	—	25	50	—	480	600	—	300	450	
CROSS <sup>4</sup> REGULATION	DUAL +PO = 3 W TO 35 W -PO = 35 W		—	1.5	3.0	—	1.5	3.0	—	—	—	—	—	—	%
	DUAL +PO = 20 W TO 50 W -PO = 50 W TO 20 W		—	2.0	4.0	—	2.0	3.5	—	—	—	—	—	—	
CROSS <sup>5</sup> REGULATION	MAIN DUAL +PO = 33 W -PO = 27 W TO 3 W		—	—	—	—	—	—	—	2.3	6.0	—	2.3	5.0	%
	MAIN DUAL +PO = 3 W TO 30 W -PO = 15 W		—	—	—	—	—	—	—	5.4	9.0	—	5.0	7.0	
INPUT VOLTAGE			19	28	40	19	28	40	19	28	40	19	28	40	VDC
INPUT CURRENT	NO LOAD INHIBITED		—	75	90	—	75	90	—	60	110	—	60	110	mA
			—	30	35	—	30	35	—	30	35	—	30	35	
INPUT REFL. RIPPLE	FULL LOAD BW ≤ 10 MHz		—	15	40	—	15	40	—	15	40	—	15	40	mA p-p
EFFICIENCY			80	83	—	80	83	—	80	84	—	80	84	—	%
STARTUP DELAY			—	15	25	—	15	25	—	6	10	—	6	10	ms

#### Notes

1. On dual output models the maximum combined output power is 70 watts. A maximum of 95% (66.5 W) is available from any single output.
2. On triple output models the maximum combined output power is 60 watts. A maximum of 50 watts is available from a single output.

3. Balanced loads.
4. Regulation effect on the negative dual output during the defined conditions.
5. Regulation effect on both dual outputs during the defined conditions.

# MFW SERIES 70 WATT

# DC/DC CONVERTERS

## THERMAL MANAGEMENT

### CALCULATING MAXIMUM AMBIENT TEMPERATURE

The MFW Series of DC/DC converters has an upper operating temperature of + 85°C at the baseplate of the case. The degree of heat sinking required to remain within this limit may be determined from Figure 1 which shows the maximum allowed internal power dissipation ( $P_{DISS}$  vs. ambient temperature for various heat sink thermal resistances.  $P_{DISS}$  may be calculated as:

$$P_{DISS} = P_{OUT} / \text{efficiency} - P_{OUT}$$

The efficiency for all combinations of  $P_{OUT}$  and  $V_{IN}$  for the various models may be obtained from the graphs on the preceding pages.

Example: Converter = MFW2815D,  $T_{AMB} = 70^\circ\text{C}$ ,

$$V_{IN} = 28 \text{ VDC}, P_{OUT} = 45 \text{ watts}$$

$$\text{Efficiency} = 85\% \text{ (From Figure 7)}$$

$$P_{DISS} = (45 / 85) - 45 = 7.95 \text{ watts}$$

From Figure 1 we can see that this situation will require thermal resistance of approximately 4.5°C / watt.

Conversely we may also find the maximum ambient temperature which can be tolerated if we know the heat sink thermal resistance.

Example: Converter = MFW2805S,  $V_{IN} = 28 \text{ VDC}$ ,  $P_{OUT} = 45 \text{ W}$ .

$$\text{Thermal Resistance} = 3^\circ\text{C} / \text{watt.}$$

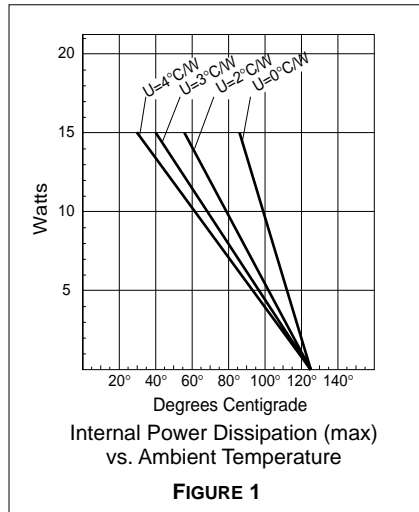
$$\text{Efficiency} = 83.5\% \text{ (From Figure 3)}$$

$$P_{DISS} = (45 / 0.835) - 45 = 8.89 \text{ watts.}$$

From Figure 1 we can see that the maximum allowed ambient temperature is approximately 75°C.

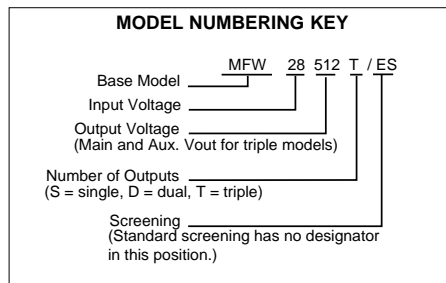
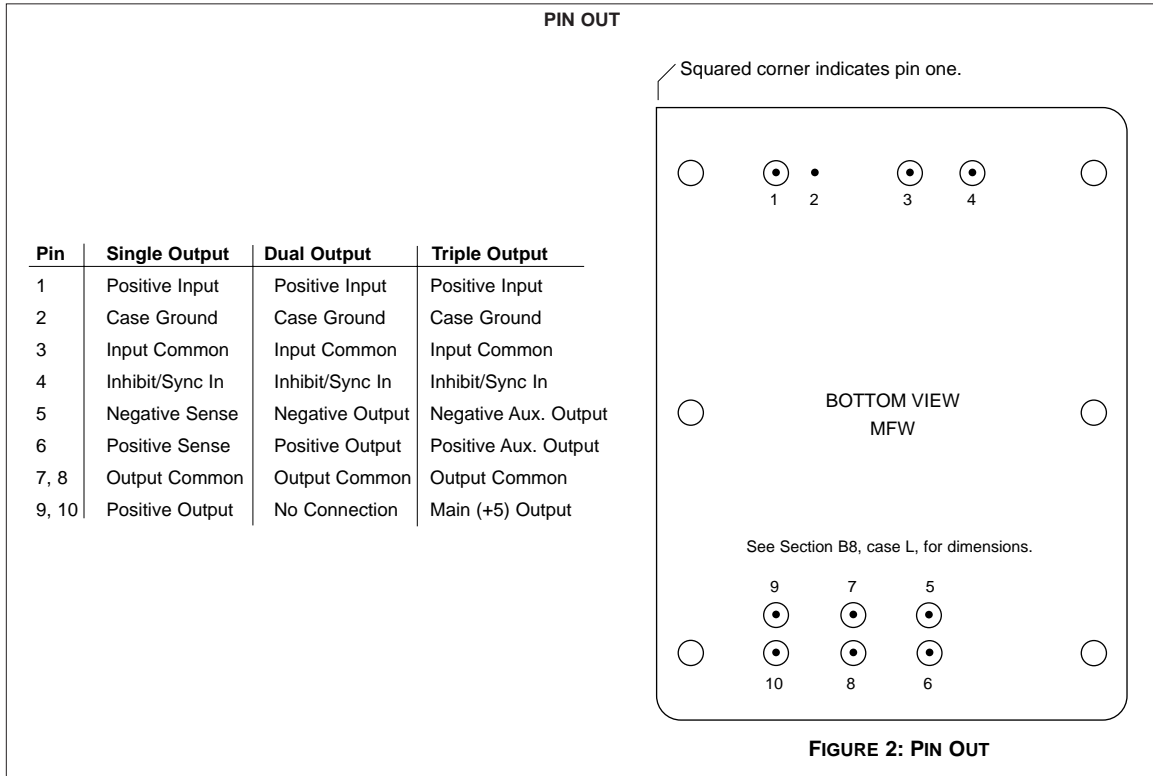
### HEAT SINK RECOMMENDATIONS

An MFW Series converter in still air (other than convective currents) and with no conductive cooling paths other than through electrical connections at the pins will exhibit a thermal resistance of approximately 4°C / watt. In cases where this value proves to be too high it is recommended that additional heat sinking be supplied. The simplest method of accomplishing this is to firmly attach the converter to a PCB thereby providing a conductive thermal path. Secondly it is recommended that airflow be provided over the converter. Although each situation requires a thorough thermal analysis these two measures can reduce the thermal resistance to as low as 2°C / watt. If calculations indicate further heat sinking is required it is recommended that additional thermal mass be provided either under the base plate or on top of the converter's mounting flanges or both.



# DC/DC CONVERTERS

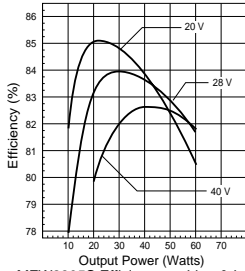
**MFW SERIES**  
**70 WATT**



# MFW SERIES 70 WATT

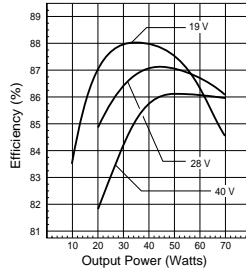
# DC/DC CONVERTERS

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



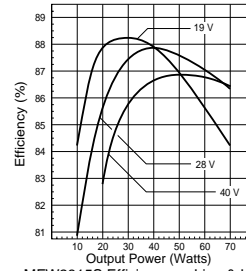
MFW2805S Efficiency vs Line & Load

FIGURE 3



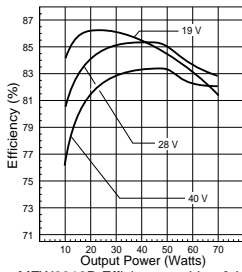
MFW2812S Efficiency vs Line & Load

FIGURE 4



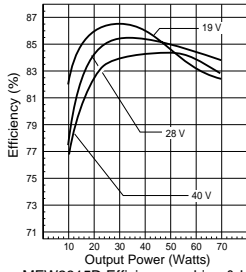
MFW2815S Efficiency vs Line & Load

FIGURE 5



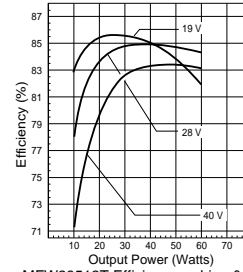
MFW2812D Efficiency vs Line & Load

FIGURE 6



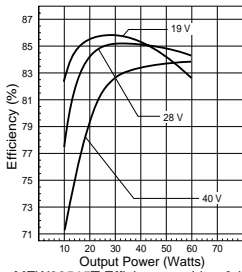
MFW2815D Efficiency vs Line & Load

FIGURE 7



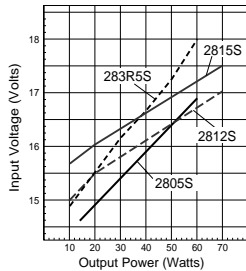
MFW28512T Efficiency vs Line & Load

FIGURE 8



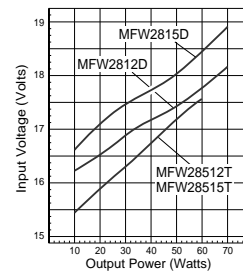
MFW28515T Efficiency vs Line & Load

FIGURE 9



Low Line Dropout vs. Load (50 mV drop)  
MFW Single Output Models

FIGURE 10

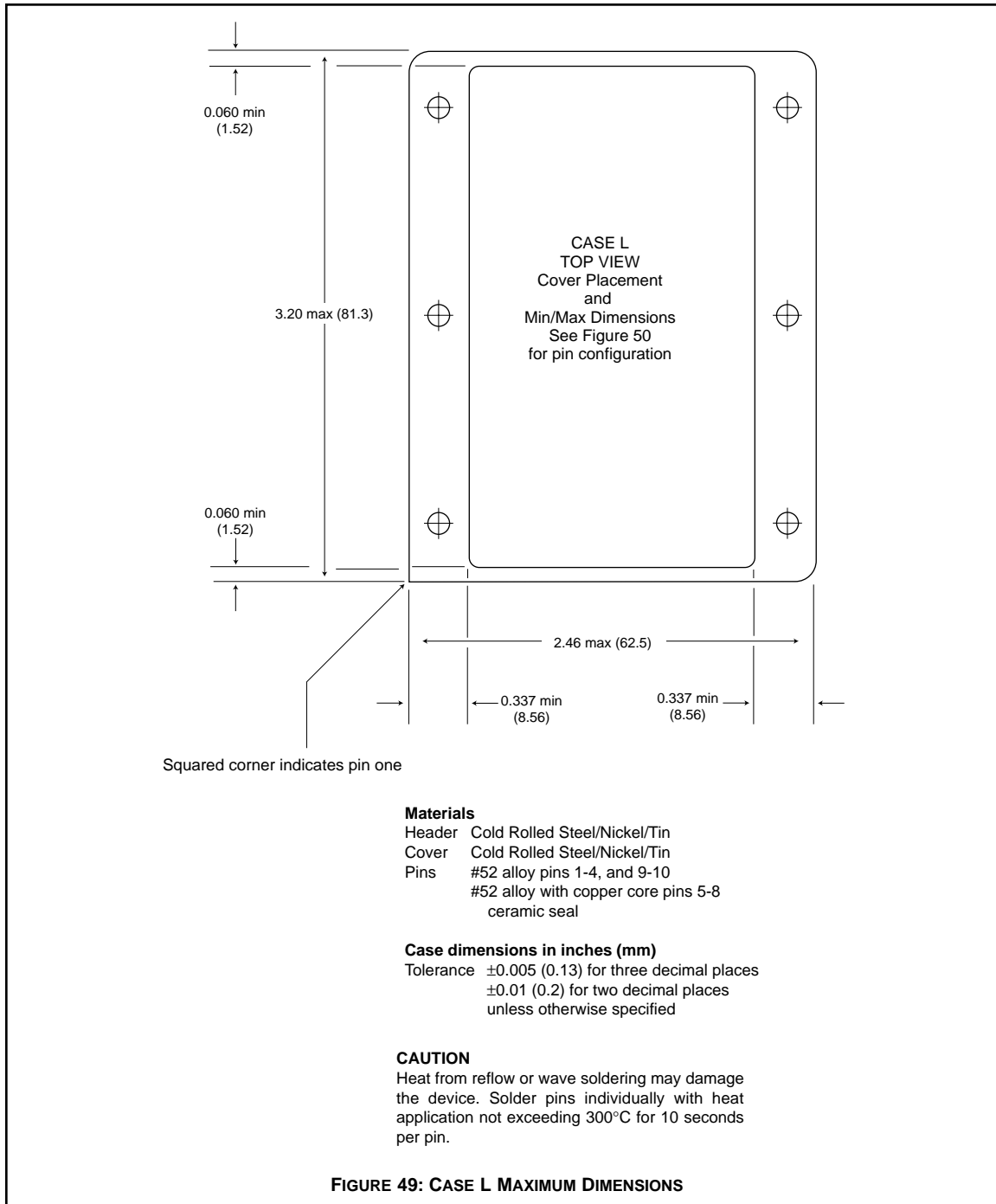


Low Line Dropout vs. Load (50 mV drop)  
MFW Dual and Triple Output Models

FIGURE 11

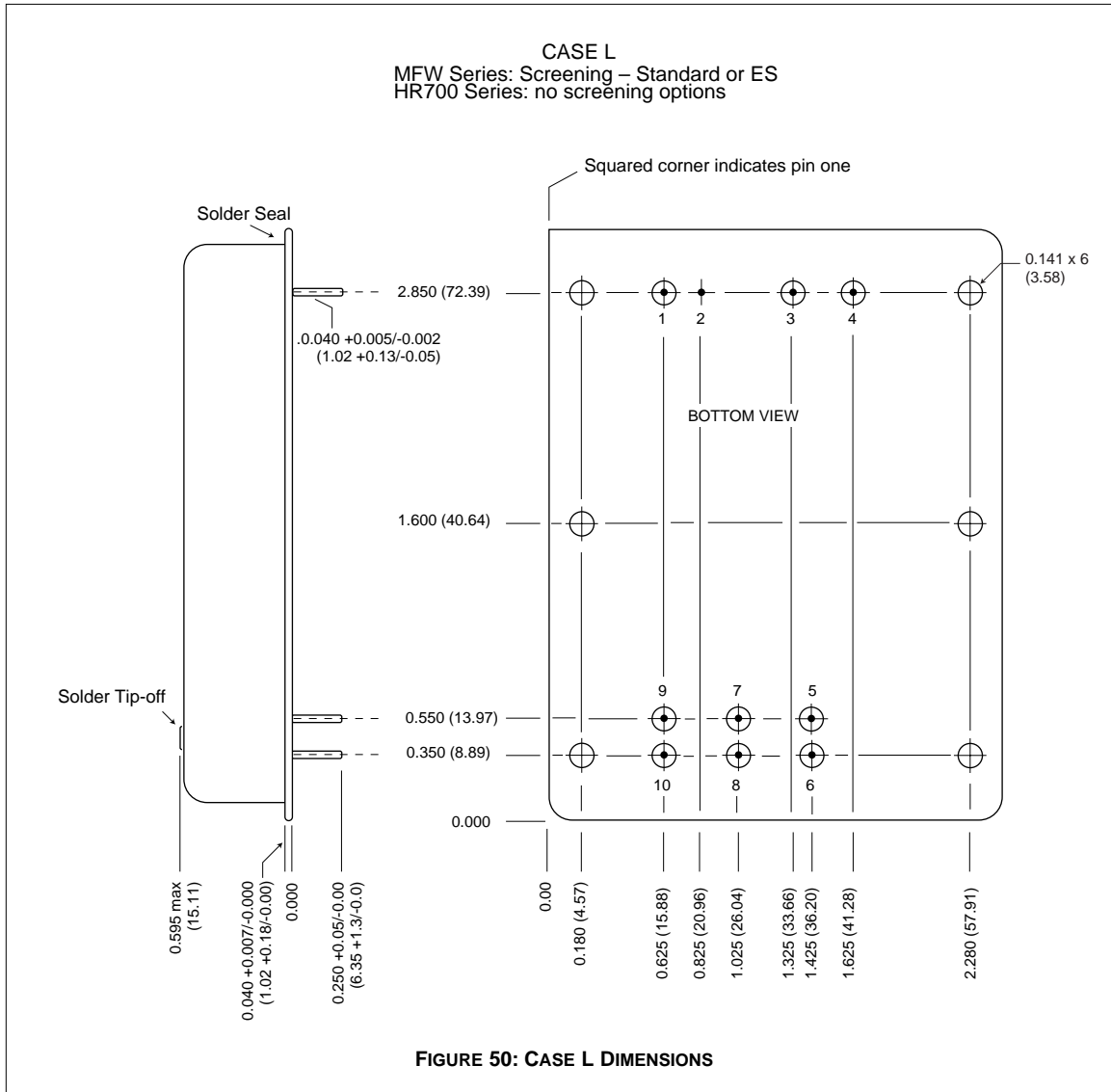
# CASES

# CASE L



# CASE L

# CASES





**QA SCREENING  
85°C PRODUCTS**

**85°C PRODUCTS**

<b>TEST (85°C Products excluding HR products)</b>	<b>STANDARD</b>	<b>/ES</b>
PRE-CAP INSPECTION Method 2017	yes	yes
TEMPERATURE CYCLE (10 times) Method 1010, Cond. B, -55°C to 125°C	no	yes
CONSTANT ACCELERATION Method 2001, 500 g	no	yes
BURN-IN 96 hours at 70°C ambient (typical)	no	yes
FINAL ELECTRICAL TEST MIL-PRF-38534, Group A Subgroups 1 and 4: +25°C case	yes	yes
HERMETICITY TESTING Fine Leak, Method 1014, Cond. A Gross Leak, Method 1014, Cond. C Gross Leak, Dip (1 x 10 <sup>-3</sup> )	no no yes	yes yes no
FINAL VISUAL INSPECTION Method 2009	yes	yes

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

Applies to the following products:

- MFW Series
- MTW Series
- MHE/MLP Series
- MHL Series
- MRH Series
- MTO Series
- MSR Series
- DCH Series
- FM/FMA/FMB EMI Filters
- MSF EMI Filter