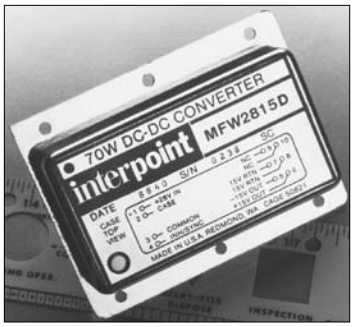
DC/DC CONVERTERS
28 VOLT INPUT

NOT RECOMMENDED FOR NEW DESIGNS

FEATURES

- –55°C to + 85°C operation
- 19 to 40 VDC input
- 50 V for 50 ms transient protection
- Fully isolated
- Fixed frequency switching
- Remote sense on single models
- Inhibit/sync function
- Indefinite short circuit protection
- Up to 84% efficiency



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

Size (max.): 3.20 x 2.46 x 0.595 inches (81.3 x 62.5 x 15.11 mm)
See case L for dimensions.
Weight: 140 grams typical
Screening: Standard or ES. See screening table for more information.

DESCRIPTION

The MFW Series™ of DC/DC converters offers up to 70 watts of power from 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.

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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)
- –40°C to +85°C full power

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.

SYNC AND INHIBIT

Sync In (245 to 370 kHz.)
- Duty cycle 70% min, 98% max.
- Logic low 0.8V 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 = ≥ 4.5V

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

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

DUAL AND TRIPLE OUTPUT MODELS			MFW2812D			MFW2815D			MFW2812T			MFW2815T			UNITS
PARAMETER	CONDITIONS		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
OUTPUT VOLTAGE	FULL LOAD	MAIN	—	—	—	—	—	—	4.95	5.05	5.10	4.90	4.95	5.05	VDC
		DUAL	±11.88	±12	±12.12	±14.85	±15	±15.15	±11.65	±11.80	±12.05	±15.05	±15.30	±15.55	
OUTPUT CURRENT[1,2]	V_{IN} = 19 TO 40	MAIN	—	—	—	—	—	—	—	4.0	10.0	—	4.0	10.0	A
		DUAL	—	2.92	5.5	—	2.33	4.4	—	1.67	4.2	—	1.33	3.33	
OUTPUT POWER[1,2]	MAIN		—	—	—	—	—	—	—	20	50	—	20	50	W
	±DUAL		—	35	66.5	—	35	66.5	—	20	50	—	20	50	
	TOTAL		—	—	70	—	—	70	—	—	60	—	—	60	
OUTPUT RIPPLE	FULL LOAD BW ≤ 2 MHz	MAIN	—	—	—	—	—	—	—	50	85	—	50	85	mV p-p
		DUAL	—	30	50	—	30	50	—	50	85	—	50	85	
LINE REGULATION	V_{IN} = 19 TO 40	MAIN	—	—	—	—	—	—	—	2	20	—	2	20	mV
		DUAL	—	10	25	—	10	25	—	100	200	—	100	200	
LOAD REGULATION[3]	NO LOAD TO FULL	MAIN	—	—	—	—	—	—	—	5	20	—	5	20	mV
		DUAL	—	25	50	—	25	50	—	480	600	—	300	450	
CROSS REGULATION[4]	DUAL $+P_O$ = 3 W TO 35 W $-P_O$ = 35 W		—	1.5	3.0	—	1.5	3.0	—	—	—	—	—	—	%
	$+P_O$ = 20 W TO 50 W $-P_O$ = 50 W TO 20 W		—	2.0	4.0	—	2.0	3.5	—	—	—	—	—	—	
CROSS REGULATION[5]	MAIN $+P_O$ = 33 W DUAL $+P_O$ = 3 W TO 27 W $-P_O$ = 27 W TO 3 W		—	—	—	—	—	—	—	2.3	6.0	—	2.3	5.0	%
	MAIN +PO = 3 W TO 30 W DUAL $\pm P_O$ = 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		—	75	90	—	75	90	—	60	110	—	60	110	mA
	INHIBITED		—	30	35	—	30	35	—	30	35	—	30	35	
INPUT RIPPLE CURRENT	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.

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:

$P_{DISS} = P_{OUT}$ / efficiency – P_{OUT}

The efficiency for all combinations of POUT and VIN for the various models may be obtained from the graphs on the preceding pages.

Example: Converter = MFW2815D, T_{AMB} = 70°C,
V_{IN} = 28 VDC, P_{OUT} = 45 watts
Efficiency = 85% (From Figure 7)
P_{DISS} = (45 / 85) – 45 = 7.95 watts

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

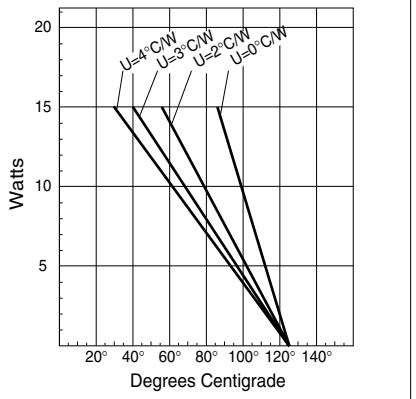
Conversely we may also find the maximum ambient temperature which can be tolerated if we know the heat sink thermal resistance.

Example: Converter = MFW2805S, VIN = 28 VDC, P_{OUT} = 45 W.
Thermal Resistance = 3°C / watt.
Efficiency = 83.5% (From Figure 3)
P_{DISS} = (45 / 0.835) – 45 = 8.89 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.



Internal Power Dissipation (max)
vs. Ambient Temperature

FIGURE 1

PIN OUT

Pin	Dual Output	Triple Output
1	Positive Input	Positive Input
2	Case Ground	Case Ground
3	Input Common	Input Common
4	Inhibit/Sync In	Inhibit/Sync In
5	Negative Output	Neg. Aux. Output
6	Positive Output	Positive Aux. Output
7, 8	Output Common	Output Common
9, 10	No Connection	Main (+5) Output

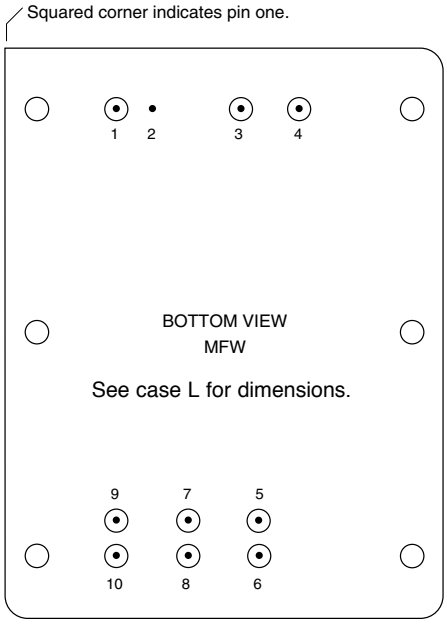
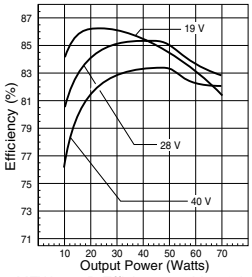


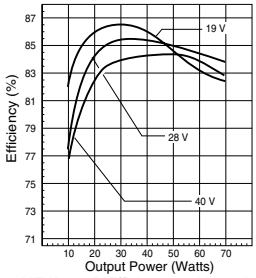
FIGURE 2: PIN OUT

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



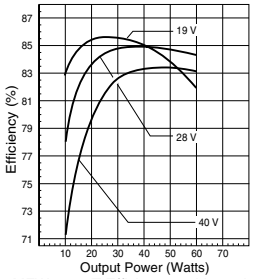
MFW2812D Efficiency vs Line & Load

FIGURE 3



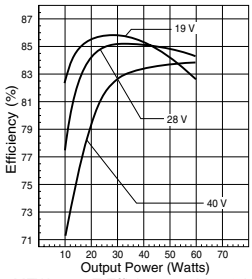
MFW2815D Efficiency vs Line & Load

FIGURE 4



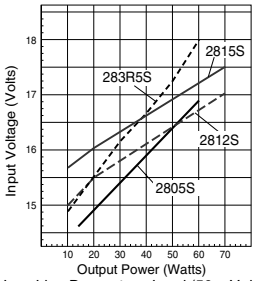
MFW28512T Efficiency vs Line & Load

FIGURE 5



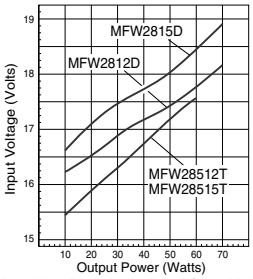
MFW28515T Efficiency vs Line & Load

FIGURE 6



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

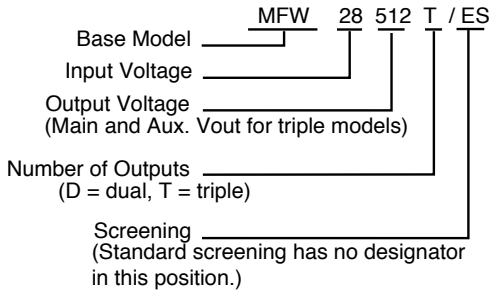
FIGURE 7



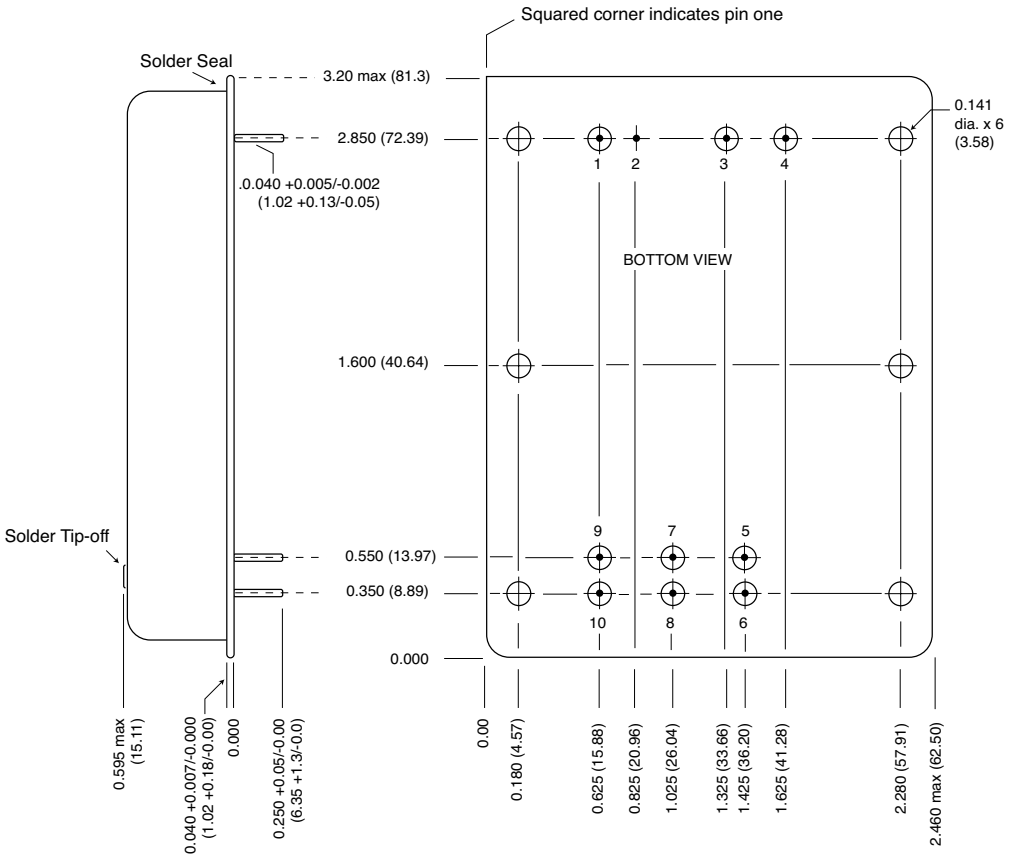
Low Line Dropout vs. Load (50 mV drop)
MFW Dual and Triple Output Models

FIGURE 8

MODEL NUMBERING KEY



CASE L



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 pins 1-4, and 9-10
#52 alloy with copper core pins 5-8, ceramic seal

Case L, Rev C, 20060803
Please refer to the numerical dimensions for accuracy. All information is believed to be accurate, but no responsibility is assumed for errors or omissions. Interpoint reserves the right to make changes in products or specifications without notice.

FIGURE 9: CASE L

STANDARD AND /ES (NON-QML) PRODUCTS ENVIRONMENTAL SCREENING [1]

TEST PERFORMED	STANDARD NON-QML[2]	/ES NON-QML[2]
Pre-cap Inspection Method 2017, 2032	yes	yes
Temperature Cycle (10 times) Method 1010, Cond. B, -55°C to +125°C, ambient	no	yes
Constant Acceleration Method 2001, 500 g	no	yes
Burn-in Method 1015 [3] 96 hours	no	yes
Final Electrical Test MIL-PRF-38534, Group A Subgroups 1 and 4: +25°C case	yes	yes
Hermeticity Test Fine Leak, Method 1014, Cond. A Gross Leak, Method 1014, Cond. C Gross Leak, Dip (1 x 10^{-3})	 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.

Notes:
1. Refers to products that do not offer QML screening.
2. Standard and /ES, non-QML products, do not meet all of the requirements of MIL-PRF-38534.
3. Burn-in designed to bring the case temperature to the maximum case temperature of 85°C.