

FEATURES

- -55° to +125°C operation
- 16 to 40 VDC input
- Fully Isolated
- Magnetic feedback
- Fixed frequency, 600 kHz typical
- Topology – Single Ended Forward
- 50 V for up to 50 ms transient protection
- Inhibit (input & output side)
- Sync function (in and out)
- Output trim on single output models
- Indefinite short circuit protection
- Remote sense on single output models
- Up to 87% efficiency / 43 W/in³
- Parallelable up to 148 watts

DC/DC CONVERTERS 28 VOLT INPUT

MFL SERIES 65 WATT



| MODELS | |
|------------|------|
| VDC OUTPUT | |
| SINGLE | DUAL |
| 5 | ±5 |
| 12 | ±12 |
| 15 | ±15 |
| 28 | |

Size (max): 3.005 x 1.505 x 0.400 inches (76.33 x 38.23 x 10.16 mm)
Case U
Weight: 100 grams maximum
Screening: Standard, ES, or 883 (Class H).

DESCRIPTION

The MFL Series™ 28-volt DC/DC converters are rated up to 65 watts of output power over a -55°C to +125°C temperature range with a 28 Vdc nominal input. On dual output models up to 70% of the rated output power can be drawn from either the positive or negative output. Current sharing allows the units to be paralleled for total power of up to 148watts. The welded, hermetically sealed package is only 3.005 x 1.505 x 0.400 inches, giving the series an overall power density of up to 43 watts per cubic inch.

DESIGN FEATURES

The MFL Series converters are switching regulators that use a quasi-square wave, single ended forward converter design with a constant switching frequency of 600 kHz.

Isolation between input and output circuits is provided with a transformer in the forward path and a wide bandwidth magnetic coupling in the feedback control loop. The MFL uses a unique dual loop feedback technique that controls output current with an inner feedback loop and an output voltage with a cascaded voltage mode feedback loop.

The additional secondary current mode feedback loop improves transient response in a manner similar to primary current mode control and allows for ease of paralleling, but without the cost and complexity.

The cascaded constant frequency, pulse-width modulated converters use a quasi-square wave single-ended forward design. Tight load regulation is achieved through a wide-bandwidth magnetic feedback circuit. The output on single MFL models can be trimmed (see Figure 1 for voltage changes with different resistor values).

INHIBIT

The MFL Series converters have two TTL compatible inhibit terminals (INH1 and INH2) that can be used to disable power conversion, resulting in a very low quiescent input current and no generation of switching noise. An open collector TTL compatible low (<0.8 volts) is required to inhibit the converter between INH1 (pin 4) and Input Common (pin 2). An open collector TTL compatible low (<0.5 volts) is required to inhibit the converter between INH2 (pin 12) and Output Common (pin 8). The application of intermediate voltages to these pins (1.5 to 10.5 volts) should be avoided.

CURRENT AND PARALLEL OPERATION

Multiple MFL converters may be used in parallel to drive a common load (see Figure 2). In this mode of operation the load current is shared by two or three MFL converters. In current sharing mode, one MFL converter is designated as a master. The SLAVE pin (pin 11) of the master is left unconnected and the MSTR/INH2 pin (pin 12) of the master is connected to the SLAVE pin (pin 11) of the slave units. The units designated as slaves have the MSTR/INH2 pin (pin 12) connected to the SNS RTN pin (pin 9). Figure 2 shows the typical setup for two or three units in parallel. Note that synchronizing the units together (though shown in the figure) is not required for current sharing operation. A second slave unit may be placed in parallel with a master and slave; this requires the TRI pin (pin 3) of the master unit to be connected to the SNS RTN pin (pin 9).

When paralleled, 76% of the total combined power ratings of the MFL converters are available at the load. Overload and short circuit performance are not adversely affected during parallel operation.

MFL SERIES 65 WATT

DC/DC CONVERTERS

| ABSOLUTE MAXIMUM RATINGS | |
|---|--|
| Input Voltage | • 16 to 40 VDC |
| Power Dissipation (Pd) | • 14 watts (16 watts MFL2805S, MFL2805D) |
| Output Power | • 50 to 65 watts depending on model |
| Lead Soldering Temperature (10 sec per lead) | • 300°C |
| Storage Temperature Range (Case) | • -65°C to +150°C |

| RECOMMENDED OPERATING CONDITIONS | |
|--|--|
| Input Voltage Range | • 16 to 40 VDC continuous • 50 V for 120 msec transient |
| Case Operating Temperature (Tc) | • -55°C to +125°C full power • -55°C to +135°C absolute |
| Derate Output Power/Current | • Linearly from 100% at 125°C to 0% at 135°C |

| SYNC AND INHIBIT (INH1, INH2) | |
|--|---|
| Sync In (525 to 675 kHz) | • Duty cycle 40% min, 60% max • Logic low 0.8 V max • Logic high 4.5 V min, 9 V max • Referenced to input common • If not used, connect to input common |
| Sync Out | • Referenced to input common |
| Inhibit (INH1, INH2) TTL Open Collector | • Logic low (output disabled) INH1 referenced to input common Logic low 0.8 V max Inhibit pin current 10 mA max INH2 referenced to output common Logic low 0.5 V max Inhibit pin current 5 mA max |
| | • Logic high (output enabled) Open collector |

| TYPICAL CHARACTERISTICS | |
|---|---|
| Output Voltage Temperature Coefficient | • 100 ppm/°C typical |
| Input to Output Capacitance | • 150 pF, typical |
| Isolation | • 100 megohm minimum at 500 V |
| Audio Rejection | • 50 dB typical |
| Conversion Frequency | • Free run mode 600 kHz typical 550 kHz min, 650 kHz max • External sync range 525 to 675 kHz |
| Inhibit Pin Voltage (unit enabled) | • INH1 = 9 to 12 V, INH2 = 6 to 9 V |

PINS NOT USED
TR1, Master, and Slave
If not used, leave unconnected

Electrical Characteristics: -55°C to +125°C¹ Tc, 28 VDC Vin, 100% load, free run, unless otherwise specified.

| SINGLE OUTPUT MODELS | | MFL2805S | | | MFL2812S | | | MFL2815S | | | MFL2828S ¹ | | | UNITS |
|-------------------------|--------------------------------|----------|------|------|----------|-------|-------|----------|-------|-------|-----------------------|-------|------------------|--------|
| PARAMETER | CONDITION | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX ¹ | |
| OUTPUT VOLTAGE | Tc = 25°C | 4.95 | 5.00 | 5.05 | 11.88 | 12.00 | 12.12 | 14.85 | 15.00 | 15.15 | 27.72 | 28.00 | 28.28 | VDC |
| OUTPUT CURRENT | V _{IN} = 16 TO 40 VDC | 0 | — | 10 | 0 | — | 5 | 0 | — | 4.33 | 0 | — | 2.32 | A |
| OUTPUT POWER | V _{IN} = 16 TO 40 VDC | 0 | — | 50 | 0 | — | 60 | 0 | — | 65 | 0 | — | 65 | W |
| OUTPUT RIPPLE | Tc = 25°C | — | 15 | 35 | — | 30 | 75 | — | 30 | 85 | — | 100 | 200 | mV p-p |
| VOLTAGE 10 k - 2 MHz | Tc = -55°C to +125°C | — | 30 | 50 | — | 45 | 100 | — | 45 | 110 | — | — | — | |
| LINE REGULATION | V _{IN} = 16 to 40 VDC | — | 0 | 20 | — | 0 | 20 | — | 0 | 20 | — | 20 | 60 | mV |
| LOAD REGULATION | NO LOAD TO FULL | — | 0 | 20 | — | 0 | 20 | — | 0 | 20 | — | 20 | 75 | mV |
| INPUT VOLTAGE | CONTINUOUS | 16 | 28 | 40 | 16 | 28 | 40 | 16 | 28 | 40 | 16 | 28 | 40 | VDC |
| NO LOAD TO FULL | TRANSIENT ² 50 ms | — | — | 50 | — | — | 50 | — | — | 50 | — | — | 50 | V |
| INPUT CURRENT | NO LOAD | — | 70 | 120 | — | 50 | 80 | — | 50 | 80 | — | 60 | 100 | mA |
| | FULL LOAD | — | — | 2.5 | — | — | 2.8 | — | — | 3.0 | — | — | 2.8 | A |
| | INHIBITED - INH1 | — | 9 | 14 | — | 9 | 14 | — | 9 | 14 | — | 9 | 14 | mA |
| | INHIBITED - INH2 | — | 35 | 70 | — | 35 | 70 | — | 35 | 70 | — | 35 | 70 | |
| INPUT RIPPLE CURRENT | 10 kHz - 10 MHz | — | 15 | 50 | — | 15 | 50 | — | 15 | 50 | — | 20 | 50 | mA pp |
| EFFICIENCY | Tc = 25°C | 77 | 80 | — | 83 | 86 | — | 84 | 87 | — | 83 | 86 | — | % |
| LOAD FAULT ³ | POWER DISSIPATION | | | | | | | | | | | | | |
| | SHORT CIRCUIT | | | | | | | | | | | | | |
| | Tc = 25°C | — | 12.5 | 16 | — | 10 | 14 | — | 10 | 14 | — | 7 | 14 | A |
| | RECOVERY | — | 1.5 | 4 | — | 1.5 | 4 | — | 1.5 | 4 | — | 1.0 | 4 | ms |
| STEP LOAD RESP. | 50% - 100% - 50% | | | | | | | | | | | | | |
| | TRANSIENT | — | 250 | 350 | — | 450 | 600 | — | 500 | 600 | — | 800 | 1400 | mV pk |
| | RECOVERY ⁴ | — | 1.5 | 3.0 | — | 1.5 | 3.0 | — | 1.5 | 3.0 | — | 1.5 | 3.0 | ms |
| STEP LINE RESP. | 16 - 40 - 16 VDC | | | | | | | | | | | | | |
| | TRANSIENT ⁵ | — | 250 | 300 | — | 250 | 400 | — | 250 | 400 | — | 250 | 800 | mV pk |
| | RECOVERY ⁴ | — | 200 | 300 | — | 200 | 300 | — | 200 | 300 | — | 200 | 400 | µs |
| START-UP | DELAY | — | 3.5 | 6 | — | 3.5 | 6 | — | 3.5 | 6 | — | 3.5 | 6 | ms |
| | OVERSHOOT | — | 0 | 25 | — | 0 | 50 | — | 0 | 50 | — | 0 | 100 | mV pk |

Notes

- MFL2828S specifications are at 25°C Tc, contact your Interpoint representative for more information.
- Unit will shut down above approximately 45V but will be undamaged and will restart when voltage drops into normal range.
- Indefinite short circuit protection not guaranteed above 125°C case.
- Recovery time is measured from application of the transient to point at which Vout is within 1% of final value.
- Transition time ≥ 10 µs.

DC/DC CONVERTERS

MFL SERIES 65 WATT

Electrical Characteristics: -55°C to +125°C Tc, 28 VDC Vin, 100% load, free run, unless otherwise specified.

| DUAL OUTPUT MODELS | | MFL2805D | | | MFL2812D | | | MFL2815D | | | UNITS |
|---|--|----------|------|------|----------|-------|-------|----------|-------|-------|---------------|
| PARAMETER | CONDITIONS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| OUTPUT VOLTAGE | $T_c = 25^\circ\text{C}$ $+V_{\text{OUT}}$ | 4.95 | 5.00 | 5.05 | 11.88 | 12.00 | 12.12 | 14.85 | 15.00 | 15.15 | VDC |
| | $-V_{\text{OUT}}$ | 4.92 | 5.00 | 5.08 | 11.82 | 12.00 | 12.18 | 14.77 | 15.00 | 15.23 | |
| OUTPUT CURRENT ¹ $V_{\text{IN}} = 16$ TO 40 VDC | EACH OUTPUT | 0 | — | 7 | 0 | — | 3.5 | 0 | — | 3.03 | A |
| | TOTAL OUTPUT | 0 | — | 10 | 0 | — | 5 | 0 | — | 4.34 | |
| OUTPUT POWER | $V_{\text{IN}} = 16$ TO 40 VDC | 0 | — | 50 | 0 | — | 60 | 0 | — | 65 | W |
| OUTPUT RIPPLE VOLTAGE $\pm V_{\text{OUT}}$ | 10 kHz - 2 MHz | — | 50 | 100 | — | 50 | 120 | — | 50 | 150 | mV p-p |
| LINE REGULATION $V_{\text{IN}} = 16$ TO 40 VDC | $+V_{\text{OUT}}$ | — | 0 | 50 | — | 0 | 50 | — | 0 | 50 | mV |
| | $-V_{\text{OUT}}$ | — | 25 | 100 | — | 25 | 100 | — | 25 | 100 | |
| LOAD REGULATION NO LOAD TO FULL | $+V_{\text{OUT}}$ | — | 0 | 50 | — | 10 | 100 | — | 10 | 100 | mV |
| | $-V_{\text{OUT}}$ | — | 25 | 100 | — | 50 | 120 | — | 50 | 150 | |
| CROSS REGULATION $T_c = 25^\circ\text{C}$ | SEE NOTE 2 | — | 5 | 8 | — | 2 | 4 | — | 2 | 4 | % |
| | SEE NOTE 3 | — | 3 | 6 | — | 2 | 4 | — | 2 | 4 | |
| INPUT VOLTAGE | CONTINUOUS | 16 | 28 | 40 | 16 | 28 | 40 | 16 | 28 | 40 | VDC |
| NO LOAD TO FULL | TRANSIENT ⁴ 50 ms. | 0 | — | 50 | 0 | — | 50 | 0 | — | 50 | V |
| INPUT CURRENT $T_c = 25^\circ\text{C}$ | NO LOAD | — | 50 | 120 | — | 50 | 100 | — | 50 | 100 | mA |
| | FULL LOAD | — | — | — | — | — | 2.80 | — | — | 3.00 | A |
| | INHIBITED - INH1 | — | 9 | 14 | — | 9 | 14 | — | 9 | 14 | mA |
| | INHIBITED - INH2 | — | 35 | 70 | — | 35 | 70 | — | 35 | 70 | |
| INPUT RIPPLE CURRENT | 10 kHz - 10 MHz | — | 15 | 50 | — | 15 | 50 | — | 15 | 50 | mA p-p |
| EFFICIENCY 25°C T_c | BALANCED LOAD | 77 | 80 | — | 83 | 86 | — | 84 | 87 | — | % |
| LOAD FAULT ⁵ $T_c = 25^\circ\text{C}$ | POWER DISSIPATION | — | 12.5 | 16 | — | 10 | 14 | — | 10 | 14 | W |
| | SHORT CIRCUIT | — | 1.5 | 4.0 | — | 1.5 | 4.0 | — | 1.5 | 4.0 | ms |
| | RECOVERY | — | 1.5 | 4.0 | — | 1.5 | 4.0 | — | 1.5 | 4.0 | ms |
| STEP LOAD RESPONSE $\pm V_{\text{OUT}}$ | 50 %-100%- 50% LOAD TRANSIENT | — | 250 | 350 | — | 450 | 600 | — | 500 | 600 | mV pk |
| | RECOVERY ⁶ | — | 1.5 | 3.0 | — | 1.5 | 3.0 | — | 1.5 | 3.0 | ms |
| | RECOVERY ⁶ | — | 1.5 | 3.0 | — | 1.5 | 3.0 | — | 1.5 | 3.0 | ms |
| STEP LINE RESPONSE $\pm V_{\text{OUT}}$ | 16 - 40 - 16 V_{IN} TRANSIENT ⁷ | — | 250 | 300 | — | 250 | 400 | — | 250 | 400 | mV pk |
| | RECOVERY ⁶ | — | 200 | 300 | — | 200 | 300 | — | 200 | 300 | μs |
| | RECOVERY ⁶ | — | 200 | 300 | — | 200 | 300 | — | 200 | 300 | μs |
| START-UP | DELAY | — | 3.5 | 6 | — | 3.5 | 6 | — | 3.5 | 6 | ms |
| | OVERSHOOT | — | 0 | 25 | — | 0 | 50 | — | 0 | 50 | mV p |

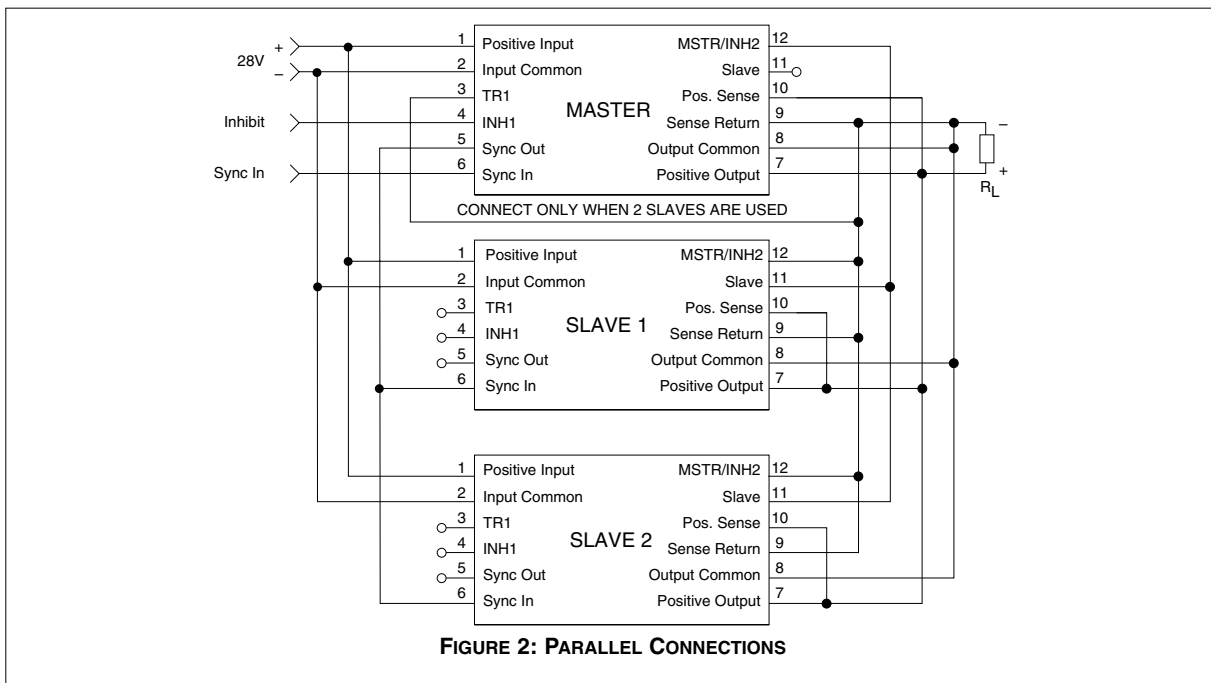
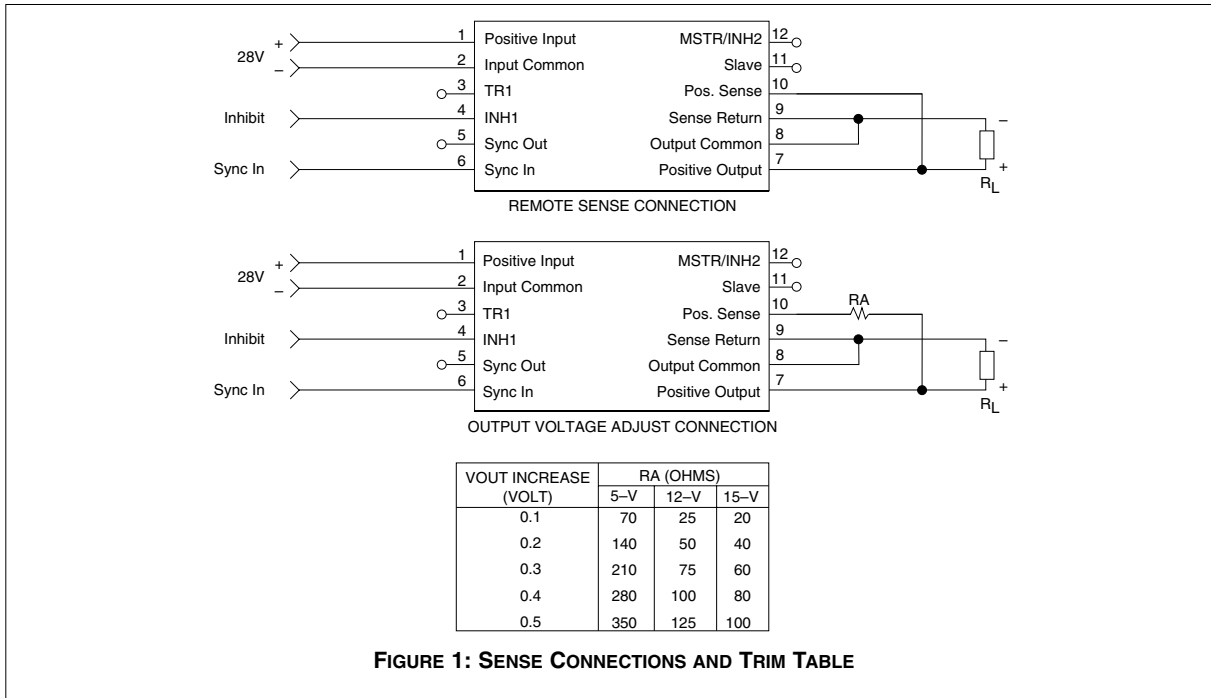
Notes

- Up to 70% of the total output power is available from either output providing the opposite output is simultaneously carrying 30% of the total power.
- Effect on the negative output under the following conditions:
+P_{out} 30% to 70%; -P_{out} 70% to 30%
- Effect on the negative output under the following conditions:
+P_{out} 50%; -P_{out} 10% to 50%
- Unit will shut down above approximately 45V but will be undamaged and will restart when voltage drops into normal range.
- Indefinite short circuit protection not guaranteed above 125°C case.
- Recovery time is measured from application of the transient to point at which V_{out} is within 1% of final value.
- Transition time $\geq 10 \mu\text{s}$.

MFL SERIES 65 WATT

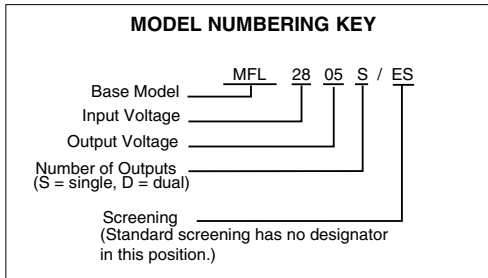
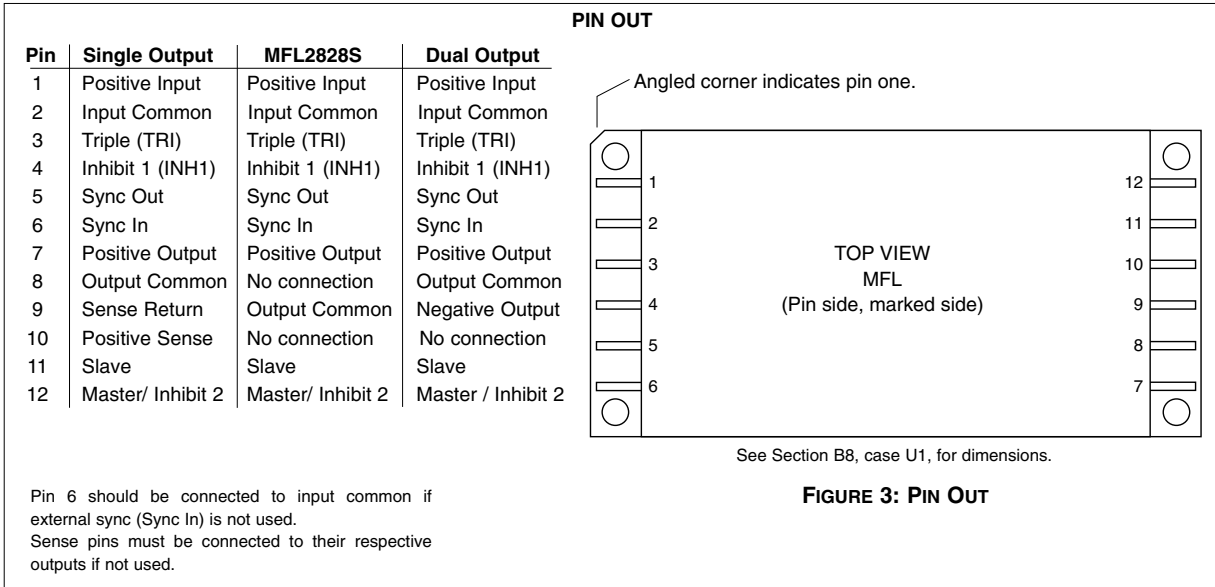
DC/DC CONVERTERS

SINGLE OUTPUT MODELS CONNECTION DIAGRAMS - SENSE AND PARALLEL



DC/DC CONVERTERS

MFL SERIES 65 WATT



| STANDARD MICROCIRCUIT DRAWING (SMD) | MFL SERIES SIMILAR PART |
|-------------------------------------|-------------------------|
| 5962-9316301HXC | MFL2805S/883 |
| 5962-9316201HXC | MFL2812S/883 |
| 5962-9316101HXC | MFL2815S/883 |
| IN PROCESS | MFL2828S/883 |
| 5962-9319101HXC | MFL2805D/883 |
| 5962-9319201HXC | MFL2812D/883 |
| 5962-9319301HXC | MFL2815D/883 |

For exact specifications for an SMD product, refer to the SMD drawing. See Section A3, SMDs, for more information.

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

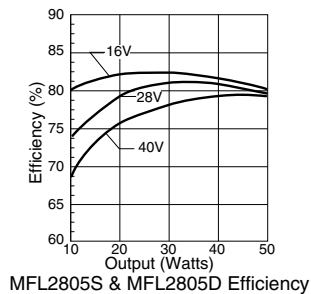


FIGURE 4

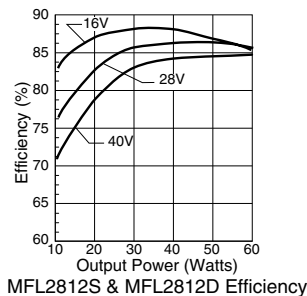


FIGURE 5

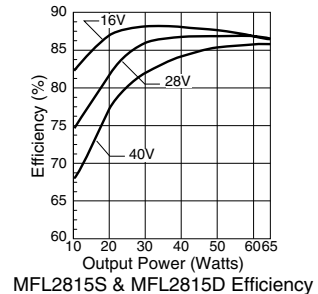


FIGURE 6

MFL SERIES 65 WATT

DC/DC CONVERTERS

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

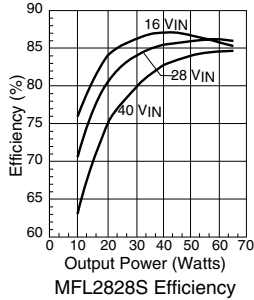


FIGURE 7

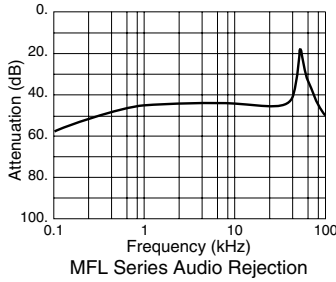
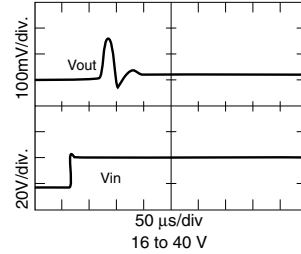
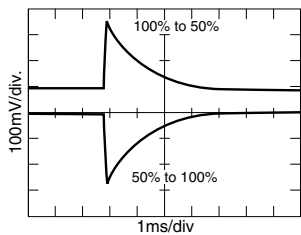


FIGURE 8



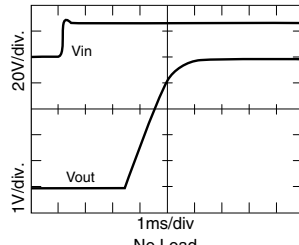
MFL2805S Step Line Response

FIGURE 9



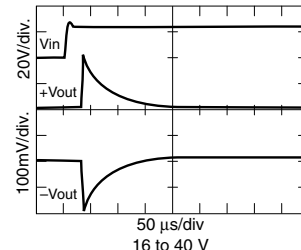
MFL2805S Step Load Response

FIGURE 10



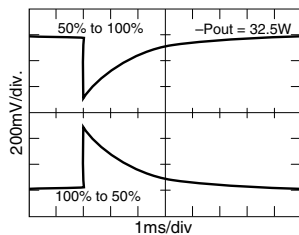
MFL2805S Turn On Response

FIGURE 11



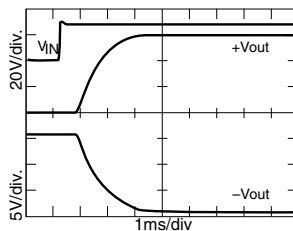
MFL2815D Step Line Response

FIGURE 12



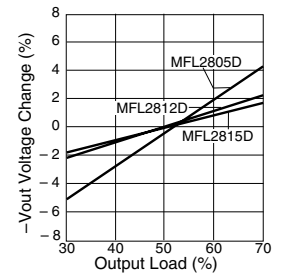
MFL2815D Step Load Response

FIGURE 13



MFL2815D Turn On Response

FIGURE 14



+Pout 80 to 20%, -Pout 20 to 80%
Cross Regulation

FIGURE 15

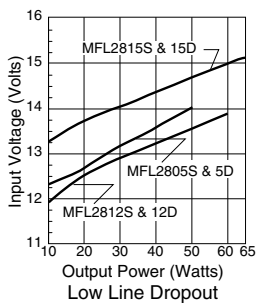
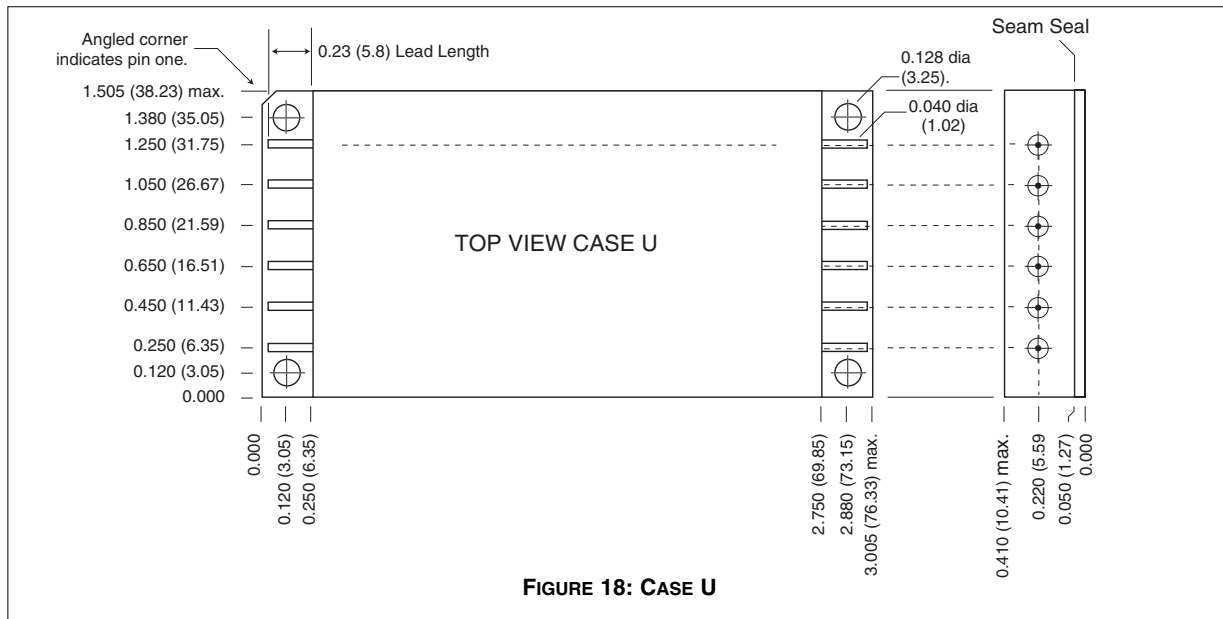
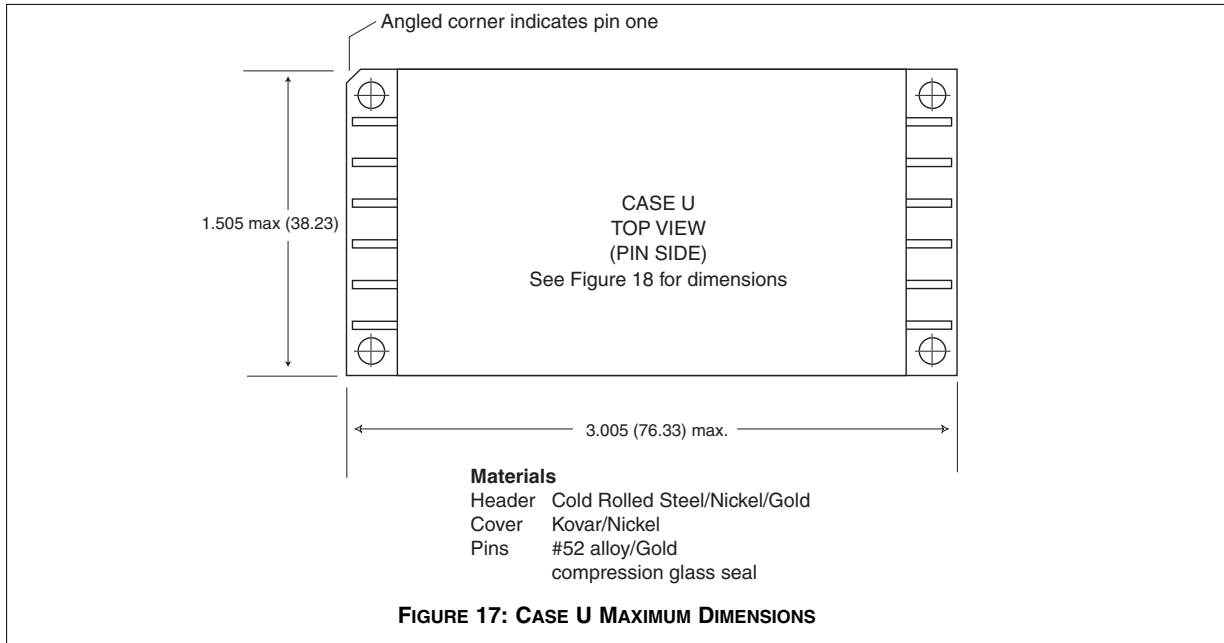


FIGURE 16

DC/DC CONVERTERS

MFL SERIES 65 WATT



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.

Case dimensions in inches (mm)

Tolerance ± 0.005 (0.13) for three decimal places, ± 0.01 (0.2) for two decimal places unless otherwise specified

Although every effort has been made to render the case drawings at actual size, variations in the printing process may cause some distortion. Please refer to the numerical dimensions for accuracy.

**MFL SERIES
65 WATT**

DC/DC CONVERTERS

ENVIRONMENTAL SCREENING

| TEST | STANDARD | /ES | /883 (Class H)* |
|---|-----------------|------------------|------------------|
| PRE-CAP INSPECTION Method 2017, 2032 | yes | yes | yes |
| TEMPERATURE CYCLE (10 times) Method 1010, Cond. C, -65°C to 150°C Method 1010, Cond. B, -55°C to 125°C | no no | no yes | yes no |
| CONSTANT ACCELERATION Method 2001, 3000 g Method 2001, 500 g | no no | no yes | yes no |
| BURN-IN Method 1015, 160 hours at 125°C 96 hours at 125°C case (typical) | no no | no yes | yes no |
| FINAL ELECTRICAL TEST MIL-PRF-38534, Group A Subgroups 1 through 6: -55°C, +25°C, +125°C Subgroups 1 and 4: +25°C case | no yes | no yes | yes no |
| HERMETICITY TESTING 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 | yes yes no |
| FINAL VISUAL INSPECTION Method 2009 | yes | yes | yes |

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

*883 products are built with element evaluated components and are 100% tested and guaranteed over the full military temperature range of -55°C to +125°C.

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