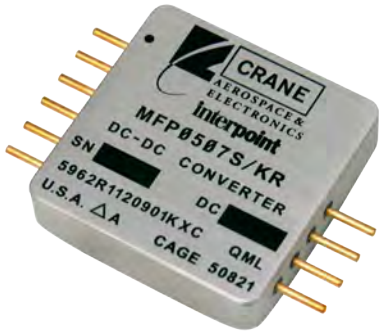
Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

MAXIMUM FLEXIBLE POWER (MFP) IN A SINGLE 7 AMP POINT OF LOAD.
A USE-ANYWHERE POWER SOLUTION FOR DIGITAL AND NON-DIGITAL SYSTEMS.



FEATURES

No external components required

- Up to 92% efficiency, flat down to 30% load
- Qualified up to MIL-PRF-38534 Class K
- Radiation hardness assurance (RHA) up to level R, 100 krad(Si) TID, available on request
- Input voltage range 3.0 to 6.0 VDC
- Input transient survivability to 15 V_{IN} for up to 1 sec.
- Inhibit and sync functions
- Current monitoring
- Current sharing pin for parallel operation
- Five pin-selectable, preset voltages
  - 0.64, 0.8, 1.6, 2.5 and 3.3
- Output voltage continuously adjustable
  - from 0.8 to 3.5 V with resistors
- Indefinite output short circuit protection
- Adjustable start-up sequencing
- Remote sense and voltage margining
- Internal solid state power switch provides many benefits including inrush current limiting

HISTORY OF PROVEN PERFORMANCE

Crane Aerospace & Electronics, Power Solutions was issued its first standard microcircuit drawing (SMD) in 1992 for an Interpoint™ Class H hybrid. Our first Class K hybrid SMD was issued in 1997 and we were one of the first companies to certify manufacturing to Class K. Our Redmond site has a Defense Logistics Agency (DLA) approved Radiation Hardness Assurance (RHA) plan. Our products are on DLA SMDs with RHA “P” or “R” code for 30, and 100 krad(Si), respectively.

DESCRIPTION

The MFP Series™ dc-dc converters do not require any external components to achieve all specified performance levels. They are a high-reliability, high-efficiency point of load converter for use with a 3.3 VDC input bus or a 5.0 VDC input bus with an undervoltage shutdown below 3.0 volts and an overvoltage shutdown above 6.0 volts. The MFP0507S model has the flexibility to be set for any output voltage from 0.64 VDC to 3.5 VDC. The converter can withstand up to a 15 V transient for up to 1 second.

The non-isolated, feature-rich MFP uses a Buck converter design with synchronous rectification. The design allows the unit to operate synchronously to no output load, ensuring high efficiency at the lightest loads without switching off the synchronous devices. Important features include a solid state switch, inrush current limiting, synchronization with an external system clock and the ability to current share allowing multiple devices to supply a common load.

The MFP includes an internal house keeping supply that is active at inputs as low as 2 VDC and provides a boosted and regulated voltage supply for internal use. This internal supply is one of the reasons that this product can provide full power at very high efficiency at input voltages as low as 3 VDC. No external power source or external bias is required.

The MFP converters are designed for the large, fast transient load currents typical to digital loads. See “Figure 6: Typical Connection Diagram” on page 13. The MFP Series is intended to be powered by a fully regulated power source.

Crane Aerospace & Electronics
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The RHA data in this document has been cleared by the Department of Defense (DoD) Office of Security Review (OSR) for public release. OSR case number 12-S-2048 dated May 29, 2012..

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MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

ELECTRICAL CHARACTERISTICS:

-55 to +125°C T_C, 5 VDC V_{IN} ($V_{IN\ NOM}$), 3.3 V_{OUT}, nominal frequency, unless otherwise specified.

TABLE 1: ABSOLUTE MAXIMUM RATINGS

PARAMETER	CONDITION	FIGURE	SYMBOL	MIN	TYP	MAX	UNITS
OPERATING TEMPERATURE ST, 883, HP, HR, KP AND KR	All	—	T_C	-55	—	+125	°C
STORAGE TEMPERATURE	All	—	T_{STG}	-65	—	+150	°C
MAXIMUM WEIGHT – MFP0507SM, DOWN-LEADED	—	Figure 2	—	—	—	29	grams
MAXIMUM WEIGHT – MFP0507SMF, DOWN-LEADED FLANGED	—	Figure 3	—	—	—	30	grams
MAXIMUM WEIGHT – MFP0507S, SIDE-LEADED	—	Figure 4	—	—	—	26	grams
LEAD SOLDERING TEMPERATURE [1]	10 seconds max	—	—	—	—	300	°C

Table 1 – Note 1. 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.

TABLE 2: INPUT SPECIFICATIONS

PARAMETER	STATE	CONDITION	FIGURE	SYMBOL	MIN	TYP	MAX	UNITS
Input Voltage Range	Continuous		Figure 8	V_{IN}	0	5.0	7.0	VDC
	Operating	$V_{OUT} = V_1, V_2$	Figure 8	V_{IN}	3.0	3.3 or 5.0	6.0	VDC
		$V_{OUT} = V_1, V_2, V_3$	Figure 8		3.3	3.3 or 5.0	6.0	
	See Note 2	$V_{OUT} = V_1, V_2, V_3, V_4$	Figure 8		4.5	5.0	6.0	
	Transient [1]		Figure 8	$V_{IN\ TRAN}$	7.0	—	15	V
Input Current	No Load	V_{IN} 3.3 V, V_{OUT} 0.8 V	—	I_{IN}	—	210	300	mA
		V_{IN} 5.0 V, V_{OUT} 3.3 V	—		—	135	180	
	Disabled	V_{IN} 3.3 V	—		—	105	145	
		V_{IN} 5.0 V	—		—	50	90	
Enable/Disable Input	Open Circuit Voltage	Pin 1 Open V_{IN} 3.0 to 6.0 V	Figure 7	$V_{PIN\ 1}$	1.6	2.0	2.6	VDC
	Threshold Unit Enabled	V_{IN} 3.0 to 6.0 V	Figure 7	$V_{PIN\ 1}$	2.3	—	—	
	Threshold Unit Disabled				—	—	1.4	
	ENABLE Pin Current Unit Disabled			$I_{PIN\ 1}$	—	—	2	mA
External Synchronization	Standard Sync Range	I_{OUT} 5 A	Figure 7	—	270	—	600	kHz
	Amplitude		—	—	3.0	5.0	6.0	V
	Duty Cycle [3]		—	—	40	50	60	%
	Frequency Source Impedance		—	—	—	—	50	Ohms

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

ELECTRICAL CHARACTERISTICS:

-55 to +125°C T_C, 5 VDC V_{IN} ($V_{IN\ NOM}$), 3.3 V_{OUT}, nominal frequency, unless otherwise specified.

TABLE 2: INPUT SPECIFICATIONS (CONTINUED)

PARAMETER	STATE	CONDITION	FIGURE	SYMBOL	MIN	TYP	MAX	UNITS
Switching Frequency	-55 to +125°C	I_{OUT} 5 A	Figure 20	—	270	—	400	kHz
Power Dissipation	No Load		—	—	—	—	0.9	W
	Fault Power, Output Short		—	—	—	2.8	4.25	
Input Ripple Current	$V_{1\ (0.8\ V)}$	V_{IN} 3.3, I_{OUT} 5 A	—		—	200	290	mA p-p
20 Hz – 20 MHz	$V_{4\ (3.3\ V)}$	V_{IN} 5.0, I_{OUT} 5 A	—		—	200	310	
	I_{RMS}	—	—	—	—	60	—	mA_{RMS}

Table 2 – Notes:
1. 50 microsecond minimum transition time. Transient duration less than 1 second.
2. V_{OUT}: V_1= 0.8 V, V_2 =1.6 V, V_3 = 2.5 V, V_4 = 3.3 V
3. T_{RISE}/T_{FALL} must be less than 50 ns.

TABLE 3: OUTPUT SPECIFICATIONS

PARAMETER	STATE	CONDITION	FIGURE	SYMBOL	MIN	TYP	MAX	UNITS
Operating Voltage Accuracy [1]	V_1 0.8, 25°C	2.5 A Load	Figure 6	V_1	0.789	0.800	0.815	VDC
	V_1 0.8, -55 to +125°C				0.772		0.826	
	V_2 1.6, 25°C		Figure 6	V_2	1.578	1.600	1.632	VDC
	V_2 1.6, -55 to +125°C				1.538		1.644	
	V_3 2.5, 25°C		Figure 6	V_3	2.447	2.500	2.531	VDC
	V_3 2.5, -55 to +125°C				2.381		2.546	
	V_4 3.3, 25°C		Figure 6	V_4	3.236	3.300	3.347	VDC
	V_4 3.3, -55 to +125°C				3.184		3.364	
	V_4 3.3, -70 to +150°C				TBD		TBD	
Load Regulation [1]	25°C	50% Load to Full	—	$V_{R\ LOAD}$	—	—	20	mV
V_{OUT} V_1, V_2, V_3, V_4	-55 to +125°C	Rated Load			—		20	
Line Regulation [1]	25°C	V_1 V_{IN} 3-6 V, I_{OUT} 7 A	—	$V_{R\ LINE}$	—		20	mV
V_{OUT} V_1, V_4	-55 to +125°C	V_4 V_{IN} 4.5-6 V, I_{OUT} 5 A			—	—	20	
Output Ripple and Noise	-55 to +125°C	V_{IN} 3.3 V, V_{OUT} 0.8 V, I_{OUT} 5 A	Figure 15	$V_{OUT-RIP}$	—	25	60	mV p-p
20 Hz to 20 MHz	-55 to +125°C	V_{IN} 5.0 V, V_{OUT} 3.3 V, I_{OUT} 5 A	Figure 16		—	40	80	
Output Current [1]	V_1 0.8, -55 to +125°C	V_{IN} 3.0 to 6.0 V	Figure 9	I_{OUT}	0	—	7.0	A
	V_2 1.6, -55 to +125°C				0	—	6.4	
	V_3 2.5, -55 to +125°C	V_{IN} 3.0 to 6.0 V			0	—	5.0	
	V4 3.3, -55 to +125°C	V_{IN} 4.5 to 6.0 V			0	—	5.0	
Output Power [1]	V_1 0.8, -55 to +125°C	V_{IN} 3.0 to 6.0 V	Figure 9	P_{OUT}	0	—	5.6	W
	V_2 1.6, -55 to +125°C				0	—	10.2	
	V_3 2.5, -55 to +125°C	V_{IN} 3.0 to 6.0 V			0	—	12.5	
	V_4 3.3, -55 to +125°C	V_{IN} 4.5 to 6.0 V			0	—	16.5	

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ELECTRICAL CHARACTERISTICS:

-55 to +125°C T_C, 5 VDC V_{IN} ($V_{IN\ NOM}$), 3.3 V_{OUT}, nominal frequency, unless otherwise specified.

TABLE 3: OUTPUT SPECIFICATIONS (CONTINUED)

PARAMETER	STATE	CONDITION	FIGURE	SYMBOL	MIN	TYP	MAX	UNITS
External Load Capacitance [2]	—	—	—	—	—	—	5000	µF
Efficiency [1]	V_1 0.8, 25°C	I_{OUT} 5 A	Figure 12	EFF_1	70.0	73	—	%
	V_1 0.8, -55 to +125°C				67.4	—	—	
	V_2 1.6, 25°C		Figure 12	EFF_2	81.8	84	—	%
	V_2 1.6, -55 to +125°C				80.0	—	—	
	V_3 2.5, 25°C		Figure 12	EFF_3	87.3	89	—	%
	V_3 2.5, -55 to +125°C				85.8	—	—	
	V_4 3.3, 25°C		Figure 12	EFF_4	90.1	92	—	%
	V_4 3.3, -55 to +125°C				88.8	—	—	
Turn On Peak Deviation, V_{OUT}, V_4 [1, 3]	Release of Enable	I_{OUT} No Load to Full	—	—	—	—	50	mV pk
	V_{IN} Step Start	V_{IN} 0 to 5.0 V		—	—	—	50	
Turn On Settling Time to 2%, V_{OUT}, V_4 [1, 3]	Release of Enable	I_{OUT} No Load to Full	—	—	—	3.2	—	ms
	V_{IN} Step Start	V_{IN} 0 to 5.0 V		—	—	3.2	—	
Output Load Transient Response	V_{IN} 3.3 V, V_{OUT} 0.8 V	I_O 2.5 to 5 A @ 1 A / µs settle to 2%	Figure 17 Figure 18	—	—	350	425	µs
	V_{IN} 5.0 V, V_{OUT} 3.3 V			—	—	140	200	
Load Transient Peak Deviation	V_{IN} 3.3 V, V_{OUT} 0.8 V	I_O 2.5 to 5 A @ 1 A/µs settle to 2%	Figure 17 Figure 18	—	—	210	260	mV pk
	V_{IN} 5.0 V, V_{OUT} 3.3 V			—	—	150	220	
Output Voltage Trim [1] V_1, V_2, V_3, V_4	–	See “Table 9: User Configurable Output Voltages” on page 18						
Sequence Time Delay	See “Table 8: Enable Capacitance Values” on page 14							
MTBF	MFP0507S/H	AIF @ 55°C	—	—	—	1680	—	kHrs
	MFP0507S/K		—	—	—	6722	—	

Table 3 – Notes

1. V_{OUT}: V_1= 0.8 V, V_2 =1.6 V, V_3 = 2.5 V, V_4 = 3.3 V
2. Guaranteed stable up to maximum capacitance.
3. Test condition at V_{OUT} at 3.3 V based on worst case setpoint condition.

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PIN OUT				
Down-leaded Pin Number	**Side-leaded Pin Number**	**Designation**	**Function**	**If Pin is not Used**
1	1	ENABLE	Enable, provides remote turn on and off	Leave open
2	2	+V IN	Positive Input	Always used
4 [1]	**3** [2]	V IN COM	Input Common	Always used
3 [1]	**4** [2]	SYNC	Synchronization	Leave open
5	5	SENSE	Sense, voltage drop compensation	Connect to + V_{OUT} pin 10
6	6	SHARE	Current Share, parallel operation, or current monitor	Leave open
7	7	TRIM A	Preset Output Voltage and Trim	See Figure 6 on page 13 and Table 9 on page 18
8	8	TRIM B	Preset Output Voltage and Trim	See Figure 6 on page 13 and Table 9 on page 18
9	9	V OUT COM	Output Common (also SENSE Return)	Always used
10	10	+V OUT	Positive Output	Always used

TABLE 4: MFP0507S PIN OUT

Table 4 – Note:
1. Pin 3 on the down-leaded case (M and MF) is SYNC. Pin 4 is V IN COM.
2. Pin 3 on the side-leaded case is V IN COM. Pin 4 is SYNC.

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MODEL NUMBERING KEY

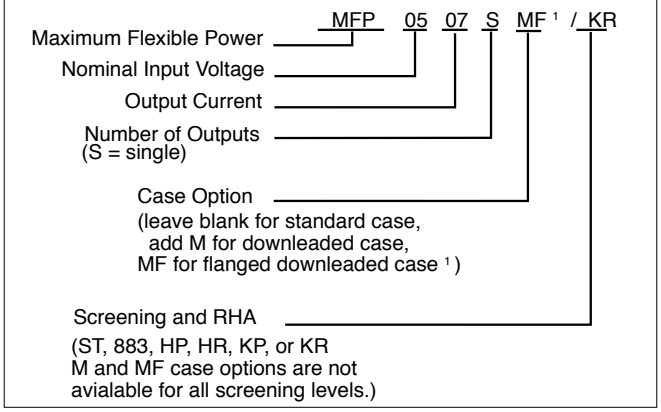


Figure 1 – Note:
1. No case option is needed for the side-leaded case. For the down-leaded case use case option “M”, for the down-leaded, flanged case use case option “MF” (M and MF are not available in 883, Class H, Class K or with RHA options).

FIGURE 1: MODEL NUMBERING KEY

SMD NUMBER	
STANDARD MICROCIRCUIT DRAWING (SMD)	**MFP SIMILAR PART**
5962R1120901KXC	MFP0507S/KR
The SMD number shown is for Class K screening and Radiation Hardness Assurance (RHA) level R. See the SMD for the numbers for other screening and radiation levels. For exact specifications for an SMD product, refer to the SMD drawing. SMDs can be downloaded from: http://www.landandmaritime.dla.mil/programs/smcr Class H, Class K and RHA options are not yet available in M or MF cases. They are not on SMDs.	

TABLE 5: SMD NUMBER

MODEL NUMBER OPTIONS

TO DETERMINE THE MODEL NUMBER ENTER ONE OPTION FROM EACH CATEGORY IN THE FORM BELOW.

CATEGORY	Base Model and Input Voltage	Case Options [1]	Screening [2]	RHA [3]
OPTIONS	MFP0507S	M (down-leaded) MF (down-leaded, flanged) (side-leaded, leave blank)	ST 883 H K	Not available P R
FILL IN FOR MODEL #	MFP0507S	_____	/ _____	_____

Notes:
1. Case Options: For the side-leaded case (“Figure 4: MFP0507S Case Dimensions – Side-Leaded” on page 10) leave the case option blank. For the down-leaded case option (“Figure 2: MFP0507SM Case Dimensions – Down-leaded” on page 8), insert the letter M in the Case Option position. For the down-leaded flanged case option (“Figure 3: MFP0507SMF Case Dimensions – Down-leaded, Flanged” on page 9), insert the letter MF in the Case Option position.
2. Screening: See “Table 10: Element Evaluation” on page 21 and “Table 11: Environmental Screening and RHA Levels” on page 22 for more information. 883, Class H and Class K are not available for the down-leaded cases M or MF.
3. RHA: RHA options are only available with Class H or Class K screening. See “Table 11: Environmental Screening and RHA Levels” on page 22 for more information. RHA options are not available for the down-leaded cases M or MF.

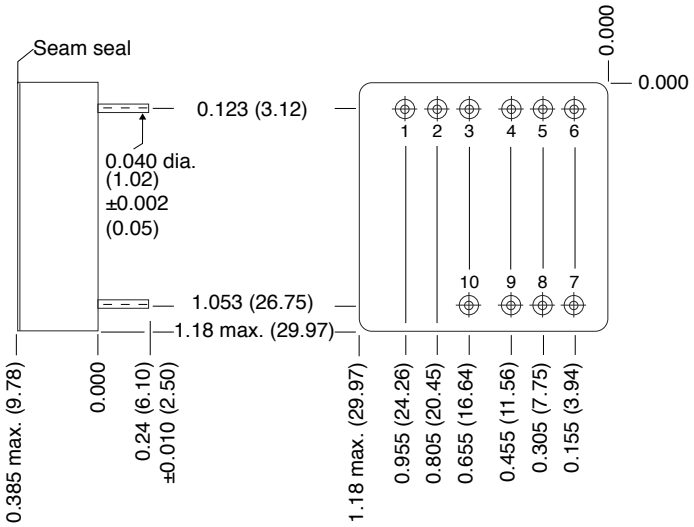
TABLE 6: MODEL NUMBER OPTIONS

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

MECHANICAL INFORMATION

BOTTOM VIEW CASE C4
MFP0507SM - Down-leaded



Weight: 29 grams maximum

Case dimensions in inches (mm)
Tolerances,unless otherwise specified,
X.XXX (X.XX) = ±0.005 (0.13)
X.XX (X.X) = ±0.01 (0.30)
Pin and hole placement ±0.0035 (±0.089)

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
Cover - Kovar/Nickel
Pins - 3:1 Cu Cored alloy 52/Gold over Nickel, compression glass seal
Gold plating of 50 - 150 microinches included in pin diameter
Seal hole: 0.091 ±0.003 (2.31 ±0.08)

Case C4, Rev A, 2013.04.16
Please refer to the numerical dimensions for accuracy.

FIGURE 2: MFP0507SM CASE DIMENSIONS – DOWN-LEADED

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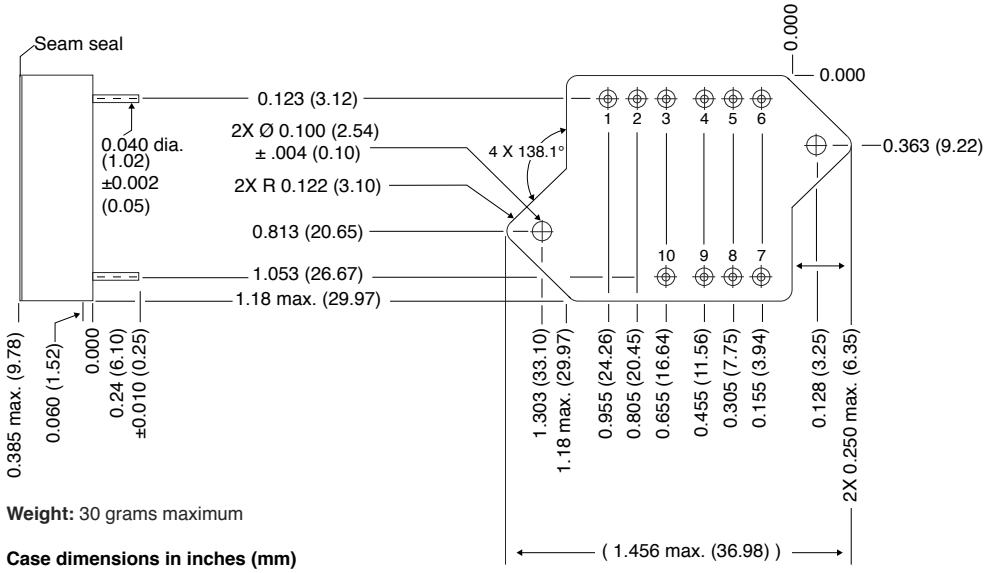
MECHANICAL INFORMATION

BOTTOM VIEW CASE C5
MFP0507SMF - Down-leaded Flanged



Weight: 30 grams maximum

Case dimensions in inches (mm)
Tolerances,unless otherwise specified,
X.XXX (X.XX) = ±0.005 (0.13)
X.XX (X.X) = ±0.01 (0.30)
Pin and hole placement ±0.0035 (±0.089)

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
Cover - Kovar/Nickel
Pins - 3:1 Cu Cored alloy 52/Gold over Nickel, compression glass seal
Gold plating of 50 - 150 microinches included in pin diameter
Seal hole: 0.091 ±0.003 (2.31 ±0.08)

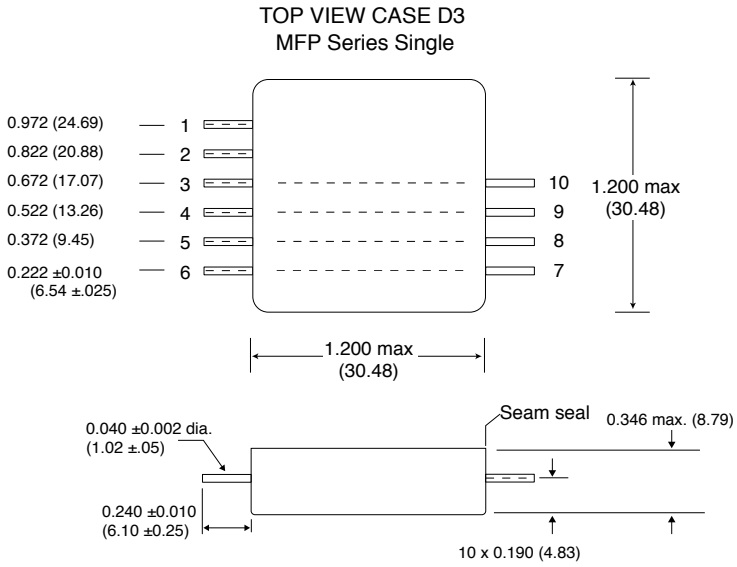
Case C5, Rev A, 2013.04.16
Please refer to the numerical dimensions for accuracy.

FIGURE 3: MFP0507SMF CASE DIMENSIONS – DOWN-LEADED, FLANGED

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

MECHANICAL INFORMATION



Weight: 26 grams maximum

Case dimensions in inches (mm)
Tolerances, unless otherwise specified,
X.XXX (X.XX) = ±0.005 (0.13)
X.XX (X.X) = ±0.01 (0.30)
Pin and hole placement ±0.0035 (±0.089)

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
Cover - Kovar/Nickel
Pins - 3:1 Cu Cored alloy 52/Gold over Nickel, compression glass seal
Gold plating of 50 - 150 microinches included in pin diameter
Seal hole: 0.091 ±0.003 (2.31 ±0.08)

Case D3, Rev B, 2013.04.16
Please refer to the numerical dimensions for accuracy.

FIGURE 4: MFP0507S CASE DIMENSIONS – SIDE-LEADED

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

THERMAL AND MOUNTING CONSIDERATIONS

Thermal Considerations

The MFP is designed to be mounted close to the point-of-use which, in many cases, may be on a printed circuit board. The high efficiency of the MFP reduces the issues normally associated with the converter's internal dissipation. The maximum internal dissipation occurs when the product is configured as a 3.3 volt output at full load. This condition will result in a dissipation of not more than 1.78 watts. This dissipation is nearly uniformly distributed over the base area of 1.4 square inches. Full load power loss is largely independent of output voltage, for instance at 0.8 volts and full load the internal power loss maximum is again 1.78 watts.

In order to determine the cooling or heat sinking requirements in the application, the maximum product power dissipation should be calculated from the product efficiency and output power. Graphs and tabled values in the specification table can be used to find the efficiency given the input voltage, selected output voltage and output load. The internal dissipation, difference between output and input power, can be calculated from the equation below.
where:

P_{OUT} = output power

ε = efficiency

$$P_{DISS} = P_{OUT} (1 - \varepsilon) / \varepsilon$$

Φ = thermal resistance of converter attachment to board

$$\Delta T = P_{DISS} \times \Phi$$

$$T_{CASE} = T_{BASE} + \Delta T$$

Many applications will not require special efforts at cooling, however, this depends on ambient temperatures, adjacent components, and other factors.

If product cooling is required for safe operation convention and/or conduction can be used. Thermal considerations require that the base of the MFP be maintained at a safe temperature of less than the maximum rating. All components internal to the MFP are bonded to the metal base of the package. The base is the surface that is important if conduction cooling is used. It is a good practice to bond the device to the PCB or mounting surface with a thermally conductive pad. Such pads provide some degree of conduction cooling to the mounting surface depending on the amount of voiding at the interface. In the case of the side leaded MFP package, this thermal pad will firmly locate the device to the surface so that the lead connections only manage the electrical requirements and not the mechanical requirements.

In Figure 5 below, the thermal rise internal to the MFP can be seen to be only 6°C. This low thermal rise gives the end user more flexibility in board design options to meet applicable derating guidelines.

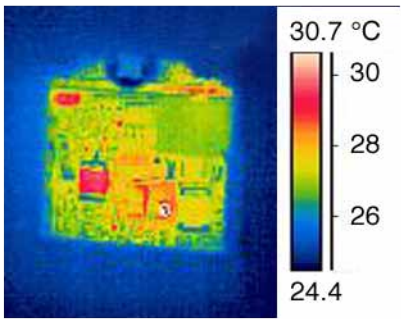


Figure 5: Infrared Image MFP at Full Load with 6 V_{IN}, 3.3 V_{OUT}

THERMAL AND MOUNTING CONSIDERATIONS (CONTINUED)

MOUNTING CONSIDERATIONS

The recommended mounting material is Chomeric's double-sided adhesive materials for attachment of the MFP to a circuit board or metal surface.

Because of the MFP's efficiency the thermal characteristics of the Chomeric materials are not required even though the Chomeric material provides good thermal conductivity.

The following information refers to products attached using Chomeric double-sided adhesive.

Vibration Testing

The MFP was tested in Random vibration using both the T1680 and T404 to mount the units to an aluminum vibration fixture. Testing was performed to the most severe level in MIL-STD-883 Method 2026; Condition 2, Letter K, overall G_{RMS} 51.1, for 15 minutes per axis, 3 axes and passed. No mounting detachment occurred.

Application

Recommended size for the adhesive tapes is 1.18 x 1.18 inches. Application of the tapes is a matter of peeling the release liners and attaching to the MFP and circuit board respectively. See Chomeric's data sheets and application notes for details. The T404 material does require higher application pressure. The T1680 material is specifically made for low pressure attachment of hybrids, ceramic and flat packages.

Removal

Refer to Chomeric's application notes for Thermattach Tape.

Specifications

Refer to Table 7: Chomeric Material Specifications for thermal conductivity, temperature range and out-gassing.

TABLE 7: CHOMERIC MATERIAL SPECIFICATIONS

MATERIAL	THERMAL CONDUCTIVITY	TEMPERATURE RANGE	OUTGASSING DATA		MOUNTING APPLICATION
	W/M-K	°C	% TVM	% CVCM	
CHO-THERM 1671 (Note 2)	2.6	-60 to +200	0.76	0.07	Rougher surfaces
CHO-THERM T1680 (Note 1)	0.65	-60 to +200	1.27	0.23	Smooth surfaces
THERMATTACH T404 (Note 1)	0.4	-30 to +125	0.53	0.02	Smooth surfaces

Table 7 – Notes:

1. Chomeric's Thermattach Tape T404 and Cho-Therm T1680 are two excellent choices for circuit board mounting. Both have a Kapton insulating barrier with pressure sensitive adhesive (PSA) on both sides.
2. Chomerics Cho-Therm 1671 is a good choice for mounting on rougher surfaces. This material has a fiberglass barrier with PSA on one side. It can be obtained with PSA on both sides if needed.

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

PIN FUNCTIONS AND APPLICATIONS

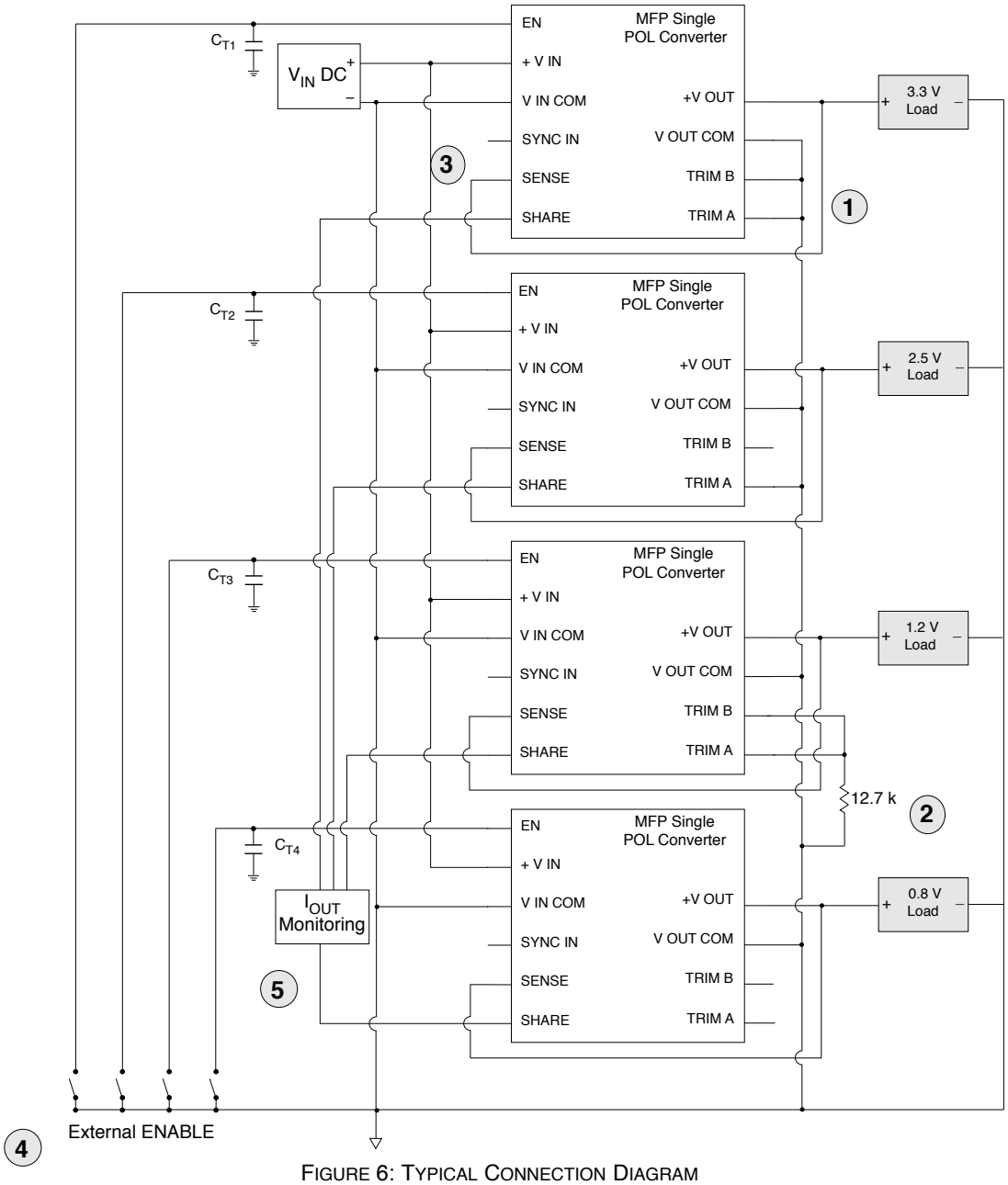


FIGURE 6: TYPICAL CONNECTION DIAGRAM
ENABLE, TRIM, SENSE, AND I_{OUT} MONITORING

For more information:

1 2 TRIM section

3 Remote SENSE section

4 ENABLE section, sequencing. Table 8 on page 14 lists C_T values.

5 SHARE section

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

PIN FUNCTIONS AND APPLICATIONS

ENABLE

The MFP provides an enable pin that will allow normal power conversion to occur if left open or unconnected. The ENABLE pin allows remote turn-on and turn-off control of the MFP. Connecting this pin to ground will disable power conversion, resulting in no output voltage and greatly reduced current consumption. The MFP ENABLE function will work with an open collector device connected to the pin or with a logic high voltage from a digital device as long as the logic high voltage is greater than the minimum voltage listed in the specification for enabled operation. The enable pin is active high at ≥ 2.3 V or with a floating input.

Sequencing: The start-up of the MFP can be delayed with the addition of an external capacitor connected to the ENABLE pin as shown in Figure 7. This feature is useful in sequencing the start-up of multiple point of load converters in a system requiring a specific startup sequence for various low-voltage loads. The startup delay is roughly equal to 1 millisecond per microfarad of capacitance. More precise external capacitance values can be found in Table 8 where it can be seen that there is a variation in startup delay time as the input voltage varies. The listed delay is from the beginning of application of power to the beginning of internal power conversion. There will be an additional delay as the power converter begins a normal start-up sequence and ramps to final output voltage.

SYNC

The MFP includes a synchronization feature, a key capability in low noise system design. The internal conversion oscillator can be synchronized with a system clock or with a bus voltage source. The MFP is designed to synchronize with a 300 kHz system but can be synchronized with sources up to 600 kHz, a frequency range used by many dc-dc converters. A synchronized system prevents the generation of low frequency sub harmonics in the audio range. The synchronization input amplitude can range from 3 VDC to 6 VDC. Figure 19 on page 20 illustrates the relationship between operating frequency, temperature and input voltage.

The external synchronization timing cycle can be varied cycle to cycle for systems employing spread-spectrum clocking or for slave sharing clock interleaving. The dc level of the sync pin can be used to detect the state of the input voltage protection switch.

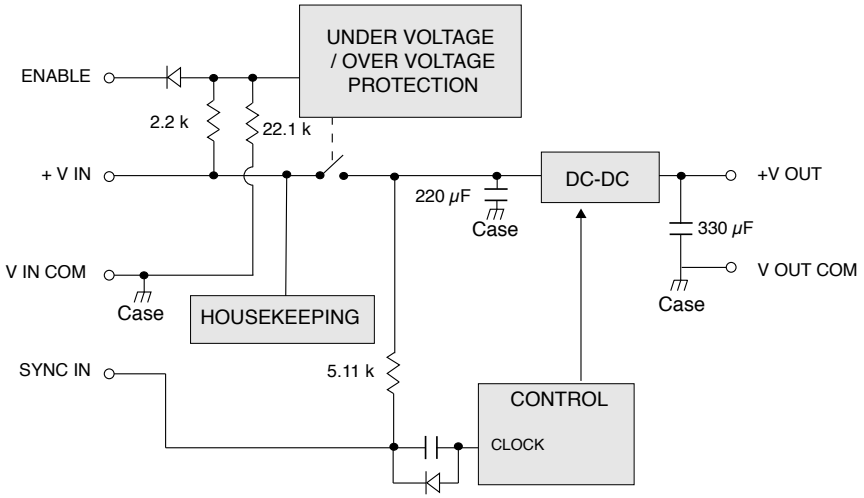


FIGURE 7: ENABLE AND SYNC EQUIVALENT CIRCUIT

TABLE 8: ENABLE CAPACITANCE VALUES FOR START-UP DELAY

ENABLE CAPACITANCE: DELAY FROM ENABLE RELEASE TO START OF OUTPUT RISE (25°C)												UNITS
CAPACITANCE (C_T)	0.22	0.33	0.47	0.68	1.0	1.5	2.2	3.3	4.7	6.8	10	µF
V_{IN} 3.3 V	0.8	1.1	1.6	2.2	3.1	4.6	6.7	1.0	14.1	20.2	29.7	ms
V_{IN} 5.0 V	0.4	0.5	0.7	0.9	1.3	1.8	2.6	3.9	5.5	7.8	11.4	ms

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

PIN FUNCTIONS AND APPLICATIONS

$+V_{IN}$ AND V_{IN} COMMON

Input Voltage
The input voltage range for normal operating conditions is 3.0 to 6.0 VDC (Figure 8). For input ripple current see Figure 13 and Figure 14 on page 19.

The V_{IN} Common pin is connected to V_{OUT} Common and case ground. The input and output should share the same ground plane in the power system design.

ADDITIONAL INPUT BLOCK FEATURES

Input Under and Over Voltage Protection
The MFP includes a solid state switch on the input section. This switch opens for fault conditions including input voltages below the minimum and transient voltages above the maximum. The safe operating range includes ground and extends to 7.0 VDC indefinitely and up to 15 volts as a time limited transient. The switch will only close when certain internal conditions are met, including the proper operation of the internal housekeeping supply and a safe input voltage range.

No Single Point Failure
The solid state switch (SSS) can be used to provide one additional level of reliability: “no single point failure” will result in a connection from input voltages to output loads. The SSS can be opened by grounding of the ENABLE Pin. The status of the SSS can be determined by detecting the voltage on the SYNC pin. A logic low on this pin indicates that the SSS is open.

No External Bias Required
An internal housekeeping supply that is active at inputs as low as 2 VDC provides a boosted and regulated voltage supply for internal use. This internal supply is one of the reasons that this product can provide full power at very high efficiency at input voltages as low as 3 VDC. No external power source or external bias is required.

Input Reflected Noise and Inrush Current Limit
Substantial input capacitance is included and the input solid state switch previously described is designed to provide associated inrush current limiting. The substantial input capacitance and high SSS provide a “pi” filter configuration that results in very low reflected ripple current. The very low input noise and inrush limiter make the MFP unique among point of load converters.

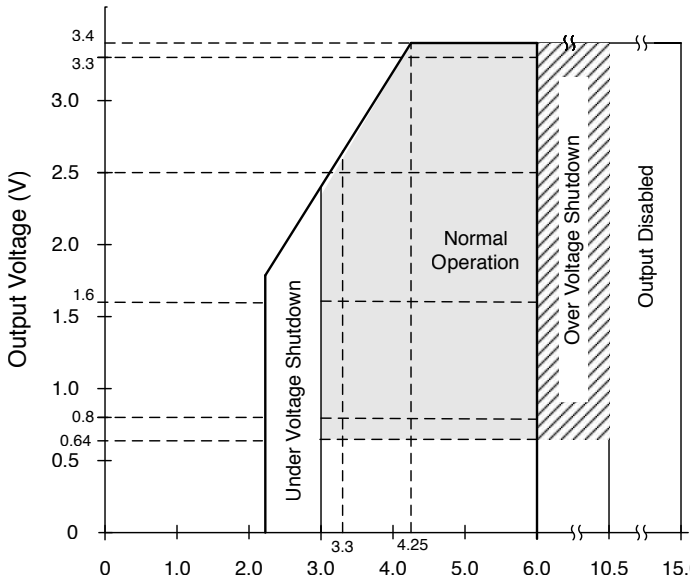


FIGURE 8: INPUT VOLTAGE VS MAXIMUM OUTPUT VOLTAGE

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

PIN FUNCTIONS AND APPLICATIONS

SENSE

The MFP includes a positive remote sense. The SENSE pin is intended to be used to maintain the desired preset voltage at the point-of-use by connecting the remote sense to the +Vout supply in close proximity to the load. Up to 0.27 volts of power line drop can be accommodated. If the SENSE pin lead is not connected to the output positive power pin, the output will rise a total of 0.27 volts.

The output voltage can be margined upward from the preset value as much as 0.2 volts by the addition of a resistor between the positive SENSE pin and the output power pin. The amount of increase in the output voltage by margining will reduce the available remote sense range by the same amount. The sum of margined voltage and voltage sense drop must be less than 0.2 volts.

Sense margining can be used to adjust V_{OUT} from 3.3 to 3.5. Connections must be made as close as possible to Common and to R_X. This method uses the SENSE pin's voltage compensation function to raise the output voltage. Therefore, there will not be an option to compensate for voltage drop at the load.

If connections have no voltage drop, the formula for the resistor is

$$R_X = \frac{1000}{\left[\frac{(0.2697)}{(V_{OUT} - 3.3)} - 1\right]} \quad \text{in ohms}$$

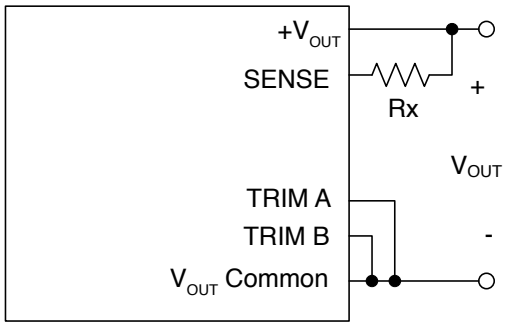


FIGURE 9: SENSE PIN VOLTAGE MARGINING
V_{OUT} FROM 3.3 TO 3.5 [1, 2, 3]

Figure 9 – Notes:
1. For external connections see Figure 6 on page 13.
2. See Table 9 on page 18 for output voltages from 0.64 to 3.3.
3. Not tested.

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

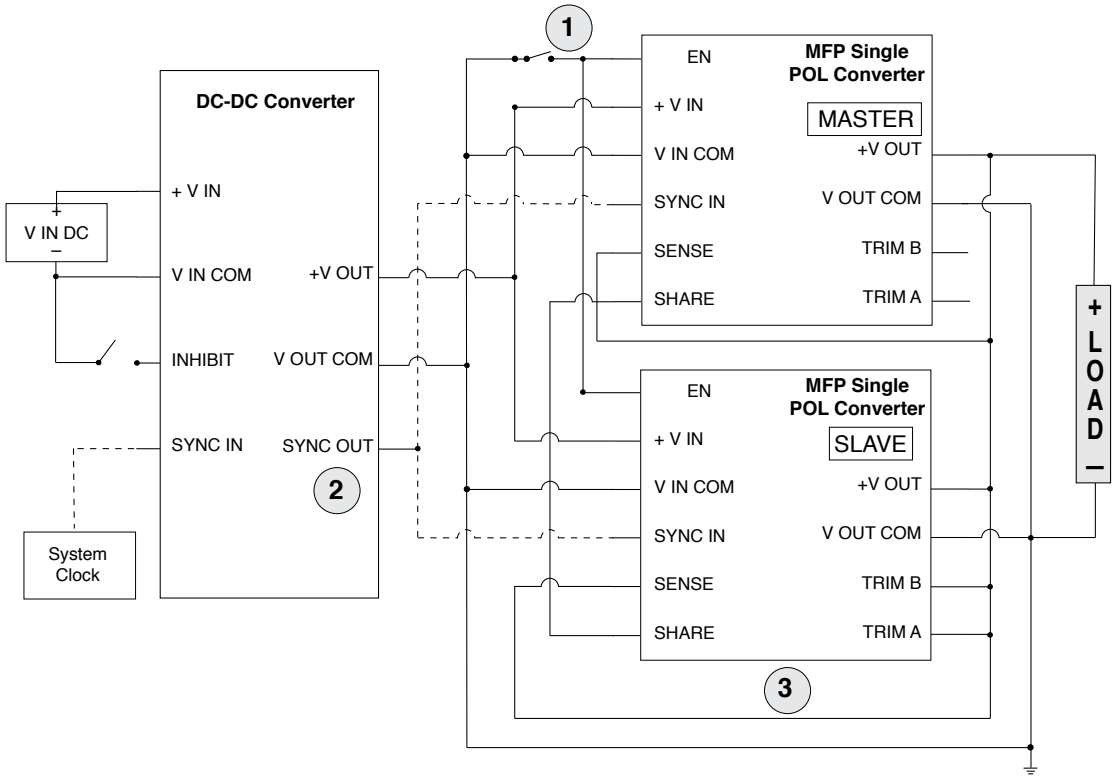
PIN FUNCTIONS AND APPLICATIONS

SHARE

The MFP includes a current share feature that allows multiple units to operate as a single supply capable of providing a total current that is the sum of the maximum from each of the units that are operated in parallel. In connecting units in parallel, the SHARE pin is connected between units and all but one unit, the master, will have TRIM A and TRIM B pins tied to the positive SENSE pin. The master will have the TRIM pins configured for the desired output voltage while the other units in parallel will match the current and voltage of the master unit.

The SHARE pin can be used as an output current monitor because the voltage on this pin is proportional to unit current. See “Figure 6: Typical Connection Diagram” on page 13, callout 5. Output currents corresponding to SHARE pin voltages are shown in Figure 19 on page 20. Connections for current monitoring are also shown in Figure 6 on page 13.

Two connections are critical to sharing between two units. The SHARE pins of the two (or more) units must be tied together and the TRIM A and TRIM B outputs must be tied together and shorted to +Vout and SENSE for each unit that is not the Master. The master unit will be the one with the highest pre-set output voltage. In the case of Figure 10: Typical Share Connection, callout 3, the master is configured with both TRIM pins open for a 0.8 V output.



For more information:

1. ENABLE section
2. SYNC section
3. SHARE section (above)

FIGURE 10: TYPICAL SHARE CONNECTION WITH OPTIONAL SYNC

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

PIN FUNCTIONS AND APPLICATIONS

TRIM A AND TRIM B

Output Voltage Set and Adjustment

The MFP0507S, single output model has the flexibility to be set for any voltage from 0.64 to 3.3 VDC. The MFP includes five precision set-points that can be accomplished with pin connections alone and no trim resistor. An open circuit on both TRIM pins results in a 0.80 VDC output, grounding one or the other or both pins results in precise output voltages of 1.6 VDC, 2.5 VDC or 3.3 VDC. One other preset voltage is possible using the SENSE pin. Connecting both trim pins to the positive SENSE pin results in 0.64 VDC. Output values of 0.8 to 3.5 volts can be set with the use of external trim resistors in series with the trim pins to ground.

Any voltage intermediate to the pre-set voltages is available by adding a trim resistor between Common and both TRIM pins. Table 9 lists available pin-configurable and adjust/trim output voltages. See Figure 11: Maximum Rated Output Current for output current under specific operating conditions.

OUTPUT VOLTAGE USING PIN CONFIGURATIONS OR TRIM RESISTORS			
Desired Voltage		Pin Configurable	TRIM Resistor (R_T) [1] from ground to TRIM A and TRIM B
0.64	Fixed SENSE pin V_S	Both TRIM A and TRIM B connected to SENSE	—
0.8	Fixed V_1	Both TRIM A and TRIM B open	–
0.9	Adjust	–	57.6 k
1.0	Adjust	–	27.4 k
1.2	Adjust	–	12.7 k
1.5	Adjust	–	6.19 k
1.6	Fixed V_2	TRIM A open TRIM B grounded	—
1.8	Adjust	—	3.57 k
2.0	Adjust	—	2.61 k
2.5	Fixed V_3	TRIM A grounded. TRIM B open	—
3.3	Fixed V_4	Both TRIM A and TRIM B grounded	—

TABLE 9: USER CONFIGURABLE OUTPUT VOLTAGES[1, 2]

$+V_{OUT}$ AND V_{OUT} COMMON

Due to the Buck topology, the required output voltage of the MFP must always be at least 0.8 V lower than the input. Precise values of achievable output voltages and currents as a function of V_{IN} are shown in Figure 10 on page 17.

See page Figure 13 and Figure 14 on page 19 for typical output ripple plots.

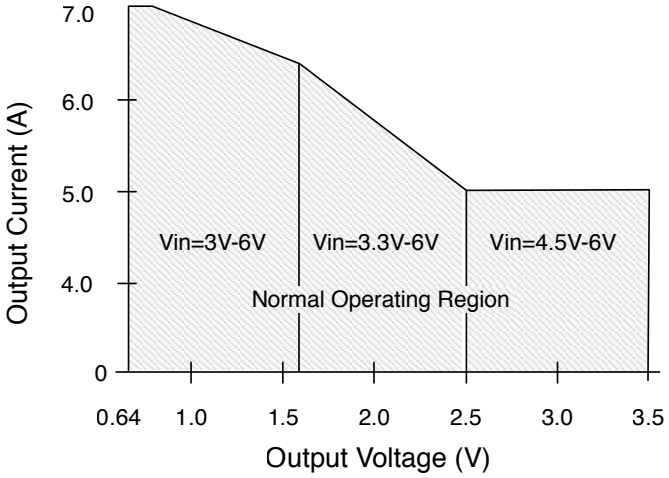


FIGURE 11: MAXIMUM RATED OUTPUT CURRENT

Table 9 – Notes:

1. Formula for R_T in Table 7 for V_{OUT} below 3.3 and above 0.8 V:

$$R_T = \frac{6.031}{V_{OUT} - 0.804} - 2.4 \quad \text{in kOhms}$$

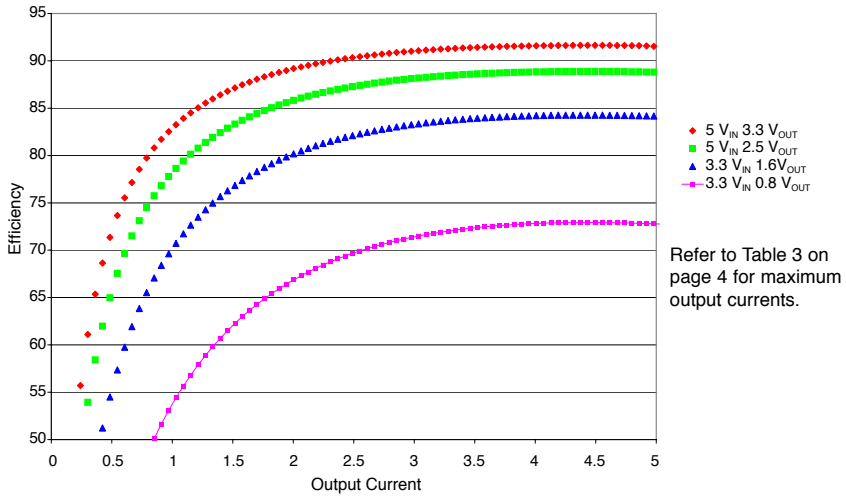
2. See page 14, “Figure 7 SENSE Pin Voltage Margining, V_{OUT} from 3.3 to 3.5.”

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

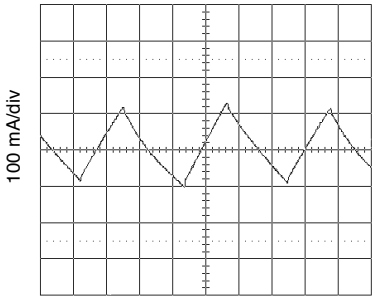
TYPICAL PERFORMANCE PLOTS

25°C T_C, 5 VDC V_{IN}, 100% load, free run, unless otherwise specified.

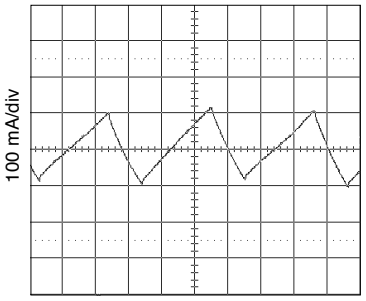


Refer to Table 3 on page 4 for maximum output currents.

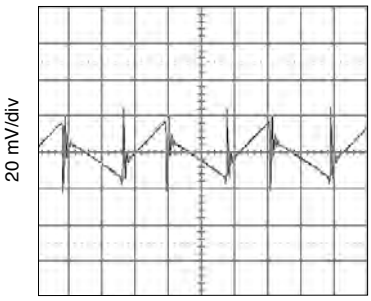
FIGURE 12: TYPICAL EFFICIENCIES



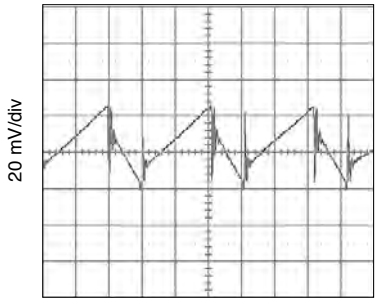
1 µs/div
3.3 V_{IN}, 1.2 V_{OUT}, 5 A load
MFP0507S Input Ripple (I_{IN})
FIGURE 13



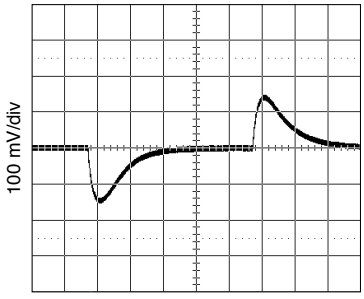
1 µs/div
5 V_{IN}, 3.3 V_{OUT}, 5 A load
MFP0507S Input Ripple (I_{IN})
FIGURE 14



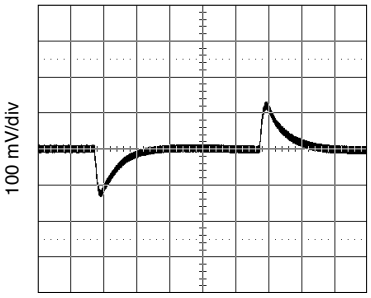
1 µs/div
3.3 V_{IN}, 1.2 V_{OUT}, 5 A load
MFP0507S Output Ripple
FIGURE 15



1 µs/div
5 V_{IN}, 3.3 V_{OUT}, 5 A load
MFP0507S Output Ripple
FIGURE 16



200 µs/div
3.3 V_{IN}, 1.2 V_{OUT}, 5 A load
MFP0507S Load Transient
FIGURE 17



200 µs/div
5 V_{IN}, 3.3 V_{OUT}, 5 A load
MFP0507S Load Transient
FIGURE 18

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

TYPICAL PERFORMANCE PLOTS

25°C T_C, 5 VDC V_{IN}, 100% load, free run, unless otherwise specified.

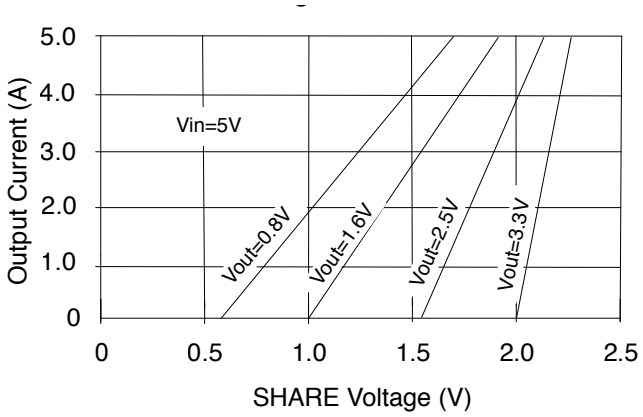


FIGURE 19 SHARE AS MONITOR FOR OUTPUT CURRENT

Note on SHARE: Because there is a predictable relationship between SHARE pin voltage and load current, the SHARE pin can be monitored to indicate load current when the share function is not being used. Due to initial tolerance related variations in the exact SHARE voltage vs. load current relationship, it is recommended that the user perform a calibration by measuring the SHARE pin voltage at two or more load currents and calculating the V-SHARE vs. load slop and intercept. The graph in Figure 19 is indicative of what should be expected when generating such a relationship.

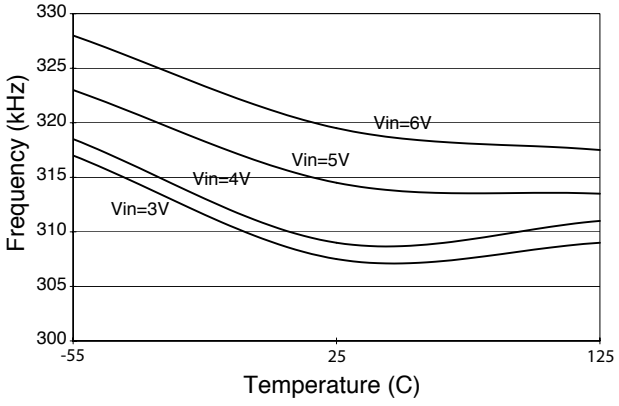


FIGURE 20TYPICAL OPERATING FREQUENCY VS TEMPERATURE AND V_{IN}

This graph illustrates the performance of proprietary Interpoint technology

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

MIL-PRF-38534 ELEMENT EVALUATION

COMPONENT-LEVEL TEST PERFORMED	/ST NON-QML [1] M/S [2, 3]	/883 CLASS H QML M/S [2]	/883 CLASS H QML P [3]	/H CLASS H QML M/S [2]	/H CLASS H QML P [3]	/K CLASS K QML M/S [2]	/K CLASS K QML P [3]
Element Electrical	■	■	■	■	■	■	■
Visual		■	■	■	■	■	■
Internal Visual		■		■		■	
Temperature Cycling						■	■
Constant Acceleration						■	■
Interim Electrical						■	
Burn-in						■	
Post Burn-in Electrical						■	
Steady State Life						■	
Voltage Conditioning Aging							■
Visual Inspection							■
Final Electrical		■	■	■	■	■	■
Wire Bond Evaluation		■	■	■	■	■	■
SEM						■	
C-SAM: Input capacitors only [4]					■		■

Table 10 – Notes:
1. Non-QML products may not meet all of the requirements of MIL-PRF-38534. Down-leaded cases are only available with ST screening.
2. M/S = Active components (Microcircuit and Semiconductor Die)
3. P = Passive components, Class H and K element evaluation. Not applicable to /ST element evaluation.
4. Additional test not required by H or K.

Definitions:
Element Evaluation: Component testing/screening per MIL-STD-883 as determined by MIL-PRF-38534
SEM: Scanning Electron Microscopy
C-SAM: C – Mode Scanning Acoustic Microscopy

TABLE 10: ELEMENT EVALUATION

Maximum Flexible Power (MFP) Single Output Point of Load

MFP0507S, 3 TO 6 VDC IN, 7 AMP, DC-DC CONVERTER

CLASS H AND K, MIL-PRF-38534 ENVIRONMENTAL SCREENING AND RHA[1]

	NON-QML [2]	QML [3]				
		CLASS H			CLASS K	
TEST PERFORMED	/ST	/883	/HP	/HR	/KP	/KR
Non-destruct bond pull, Method 2023			■ [4]	■ [4]	■	■
Pre-cap Inspection, Method 2017, 2032	■	■	■	■	■	■
Temperature Cycle (10 times)						
Method 1010, Cond. C, -65°C to +150°C, ambient		■	■	■	■	■
Constant Acceleration						
Method 2001, 3000 g (Qual 5000 g)		■	■	■	■	■
PIND, Test Method 2020, Cond. A		■ [4]	■ [4]	■ [4]	■	■
Pre burn-in test, Group A, Subgroups 1 and 4		■	■	■	■	■
Burn-in Method 1015, +125°C case, typical [5]						
96 hours						
160 hours		■	■	■		
2 x 160 hours (includes mid-BI test)					■	■
Final Electrical Test, MIL-PRF-38534, Group A,						
Subgroups 1 and 4: +25°C case	■					
Subgroups 1 through 6, -55°C, +25°C, +125°C case		■	■	■	■	■
Hermeticity Test						
Gross Leak, Dip	■					
Gross Leak, Method 1014, Cond. C		■	■	■	■	■
Fine Leak, Method 1014, Cond. A		■	■	■	■	■
Radiography, Method 2012					■	■
Post Radiography Electrical Test, +25°C case					■ [4]	■ [4]
Final visual inspection, Method 2009	■	■	■	■	■	■
RHA P: 30 krad(Si) total dose [6]			■		■	
RHA R: 100 krad(Si) total dose				■		■
SEE LET 85 MeV-cm^2/mg			■	■	■	■

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

Table 11 – Notes:
1. Redmond site has a DLA approved Radiation Hardness Assurance plan for Interpoint power products. Interpoint SMD products with RHA “P” or“R” code meet DLA requirements.
2. /ST (standard) products are non-QML products and may not meet all of the requirements of MIL-PRF-38534. Down-leaded cases are only available with ST screening.
3. All processes are QML qualified and performed by certified operators.
4. Not required by DLA but performed to assure product quality.
5. Burn-in temperature designed to bring the case temperature to +125°C minimum.
6. Includes low dose rate to the rated total dose (TID).

TABLE 11: ENVIRONMENTAL SCREENING AND RHA LEVELS

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