



DCP0105 Series

Miniature 5V Input, 1W Isolated UNREGULATED DC/DC CONVERTERS

FEATURES

- STANDARD JEDEC PLASTIC PACKAGE
- LOW PROFILE: 0.15" (3.8mm)
- SYNCHRONIZABLE
- OUTPUT SHORT CIRCUIT PROTECTION
- THERMAL SHUTDOWN
- STARTS INTO ANY CAPACITIVE LOAD
- EFFICIENCY: 70% (at Full Load)
- 1000Vrms ISOLATION
- 400kHz SWITCHING
- 108 MILLION HOURS MTTF

APPLICATIONS

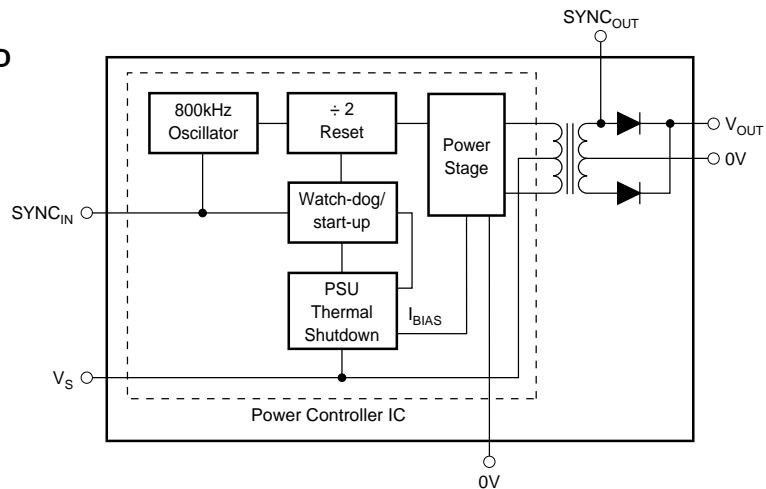
- POINT OF USE POWER CONVERSION
- DIGITAL INTERFACE POWER
- GROUND LOOP ELIMINATION
- DATA ACQUISITION
- INDUSTRIAL CONTROL AND INSTRUMENTATION
- TEST EQUIPMENT

DESCRIPTION

The DCP0105 family is a series of high efficiency, 5V input isolated DC/DC converters. In addition to 1W nominal galvanically isolated output power capability, the range of DC/DCs are also fully synchronizable. The devices feature thermal shutdown, and overload protection is implemented via watchdog circuitry⁽¹⁾. Advanced power-on reset techniques give superior reset performance and the devices will start into any capacitive load up to full power output.

The DCP01 family is implemented in standard-molded IC packaging, giving outlines suitable for high volume assembly.

NOTE: (1) Patents Pending.



SPECIFICATIONS (Common)

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, unless otherwise specified.

PARAMETER	CONDITIONS	DCP0105 SERIES			UNITS
		MIN	TYP	MAX	
OUTPUT Power	$V_S + 4\%$ 100% Full Load		1 0.92		W W
Voltage vs Temperature			± 0.08		$\% / ^\circ\text{C}$
Short Circuit Duration	$V_S \pm 10\%$	Indefinite			
Ripple	$C_L = \text{O/P Capacitor} = 10\mu\text{F}$		20		mVp-p
INPUT Voltage Range	100% Full Load	-10	250	10	% mA
Supply Current	$C_{IN} = \text{I/P Capacitor} = 1\mu\text{F}$		20		mArms
Reflected Ripple Current	50% Full Load				
ISOLATION Voltage ⁽¹⁾	1s Flash Test	1			kVrms
Continuous Voltage ⁽²⁾			1		kVrms
Insulation Resistance			>1		G Ω
Input/Output Capacitance			2.5		pF
SWITCHING/SYNCHRONIZATION Oscillator Frequency (F_{OSC})	Switching Frequency = $F_{OSC}/2$	0	800	0.8	kHz V
Sync Input Low	$V_{SYNC} = +2\text{V}$		48		μA
Sync Input Current			3.8		μs
Reset Time			400		kHz
$SYNC_{OUT}$ Frequency					
GENERAL MTTF ⁽²⁾	$T_A = +85^\circ\text{C}$ $T_A = +55^\circ\text{C}$ $T_A = +25^\circ\text{C}$	158,000 3,050,000 108,000,000			hrs hrs hrs
Weight	14-Pin PDIP		1.08		g
THERMAL SHUTDOWN Die Temperature		115		140	$^\circ\text{C}$
Shutdown Current			3		mA
TEMPERATURE RANGE Operating		-40		100	$^\circ\text{C}$

SPECIFICATIONS (DCP010505P Specific)

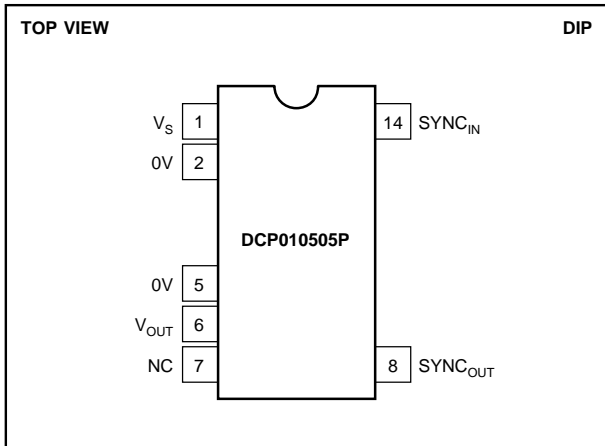
At $T_A = +25^\circ\text{C}$, V_{OUT} nominal = +5V, and $V_S = +5\text{V}$, unless otherwise specified.

PARAMETER	CONDITIONS	DCP010505P			UNITS
		MIN	TYP	MAX	
OUTPUT Voltage (V_{NOM})	75% Full Load ⁽³⁾	4.75	5	5.15	V
INPUT Nominal Voltage (V_S)			5		V
REGULATION Load Regulation	100% to 75% Full Load			11	%
	75% to 10% Full Load			20	%
Line Regulation	75% Full Load		1.003		$\%/1\%$ of V_S
GENERAL Quiescent Current	0% Full Load		38		mA
Efficiency	100% Full Load		71		%
	10% Full Load		40		%

NOTES: (1) Rated Working Voltage = 130Vrms (IEC950 convention). (2) Life test data. (3) 100% load current = $1\text{W}/V_{NOM}$ typical. Specifications for other V_{OUT} versions are available as product data sheet addendums.

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PIN CONFIGURATION (Single Out)



ABSOLUTE MAXIMUM RATINGS

Input Voltage	7V
Storage Temperature	-60°C to +150°C
Lead Temperature (soldering, 10s)	300°C

PACKAGE INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER ⁽¹⁾
DCP010505P	14-Pin Plastic DIP	010-1

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

ORDERING INFORMATION

Basic Model Number: 1W Product	DCP01	05	05	()
Voltage Input: 5V In				
Voltage Output: 5V Out				
Package Code: P = 14-pin Plastic DIP				

PIN DEFINITION

PIN #	PIN NAME	DESCRIPTION
1	V _S	Voltage Input.
2	0V	Input Side Common.
5	0V	Output Side Common.
6	V _{OUT}	Voltage Out.
7	NC	Not Connected.
8	SYNC _{OUT}	Unregulated 400kHz Output from Transformer.
14	SYNC _{IN}	Synchronization Pin.



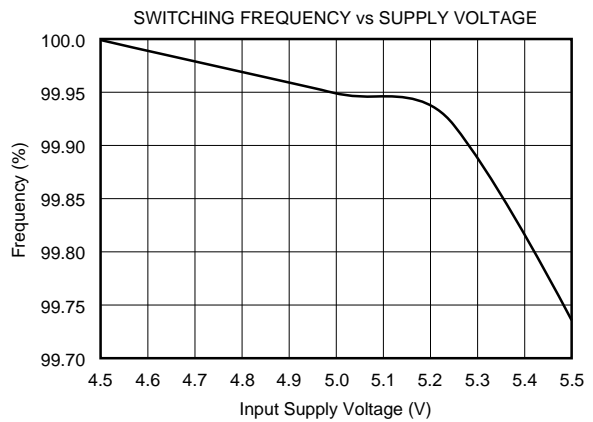
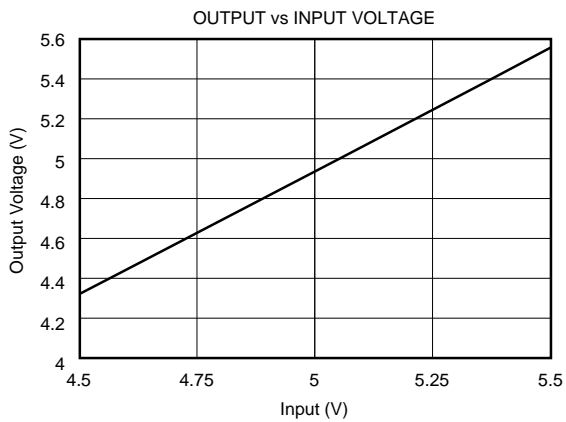
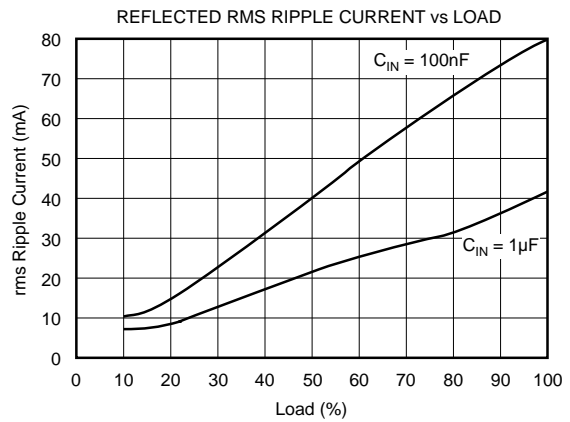
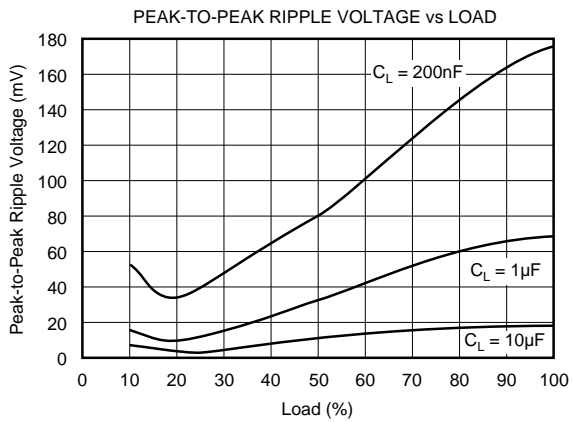
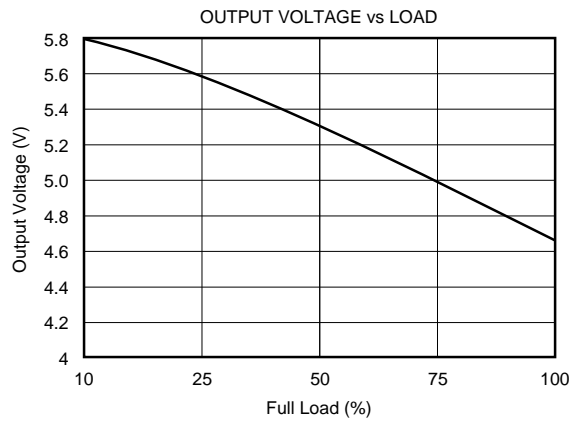
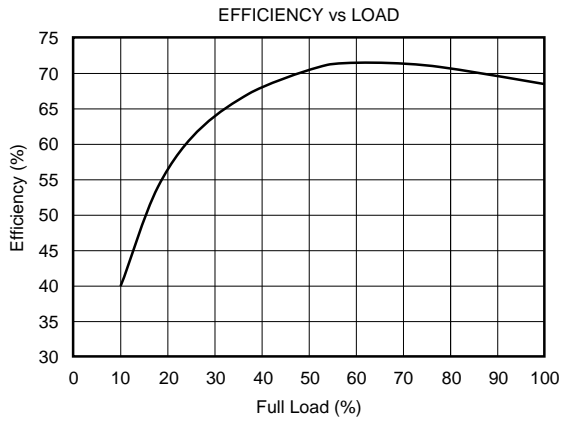
ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

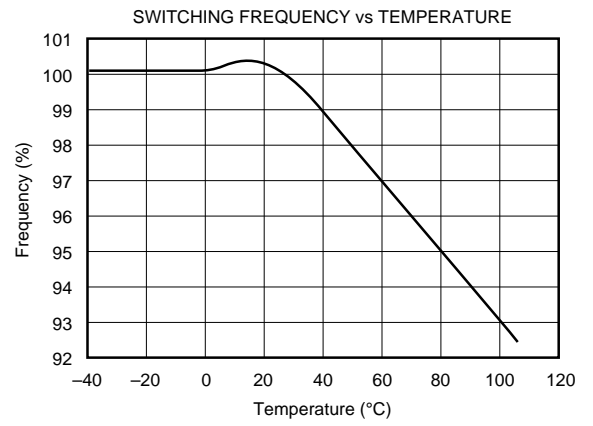
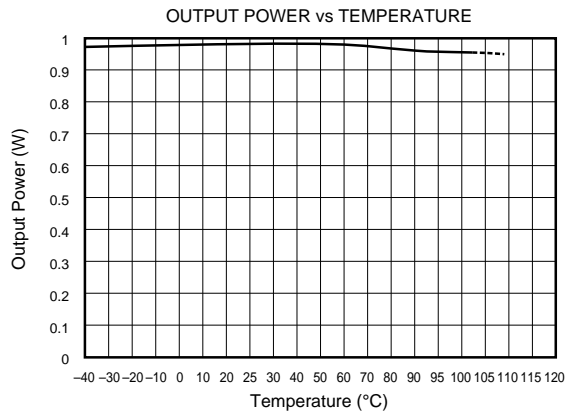
TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, unless otherwise noted.



TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25^\circ\text{C}$, unless otherwise noted.



FUNCTIONAL DESCRIPTION

OVERVIEW

The DCP0105 offers 1W of unregulated output power from a 5V input source with a typical efficiency of 70%. This is achieved through highly integrated packaging technology and the implementation of a custom power stage and control IC.

POWER STAGE

This uses a pull-pull, center-tapped topology switching at 400kHz (divide by 2 from 800kHz oscillator).

OSCILLATOR AND WATCHDOG

The on-board 800kHz oscillator provides the switching frequency via a divide by 2 circuit and allows synchronization via the SYNC_{IN} pins. To synchronize any number of DCP0105 family of devices, simply tie the SYNC_{IN} pins together (see the Synchronization section). The watchdog circuitry protects the DC/DC against a stopped oscillator and checks the oscillator frequency which will shut down the output stage if it drops below a certain threshold—i.e., it will be tri-stated after approximately 10μs.

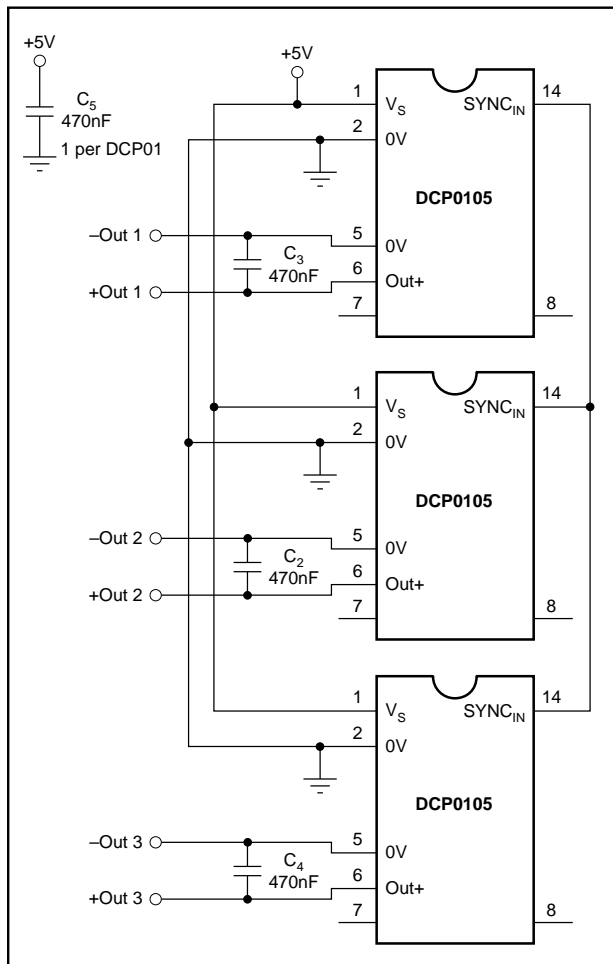


FIGURE 1. Standard Interface.

THERMAL SHUTDOWN

The DCP0105 is also protected by thermal shutdown. If the on-chip temperature reaches a predetermined value, the DC/DC will shutdown. This effectively gives indefinite short circuit protection for the DC/DC.

SYNCHRONIZATION

Any number of DCP0105 devices can be synchronized by connecting the SYNC_{IN} pins on the devices together (see Figure 1). All the DCP0105 devices will then self-synchronize.

This same synchronization method will apply to other V_{IN} versions of the DCP01 family, allowing synchronization of various V_{OUT} and V_{IN} DC/DCs.

The SYNC_{OUT} pin gives an unrectified 400kHz signal from the transformer. This can be used to set the timing of external circuitry on the output side. In noise sensitive applications any pick-up from the SYNC_{OUT} pin can be minimized by putting a guard ring round the pin (see Figure 2).

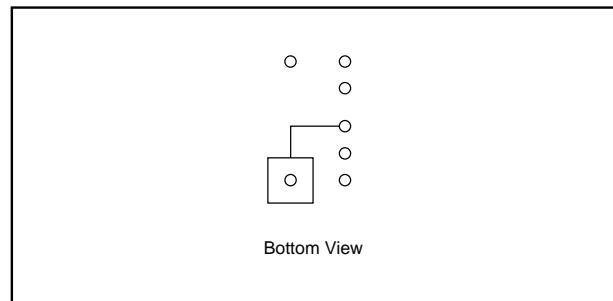


FIGURE 2. SYNC_{OUT} Guard Ring.

DIVIDE BY 2 RESET

Isolated DC/DC converter performance normally suffers after power reset. This is because a change in the steady state transformer flux creates an offset after power-up. The DCP01 family does not suffer from this problem. This is achieved through a patented⁽¹⁾ technique employed on the divide by 2 reset circuitry resulting in no change in output phase after power interruption.

CONSTRUCTION

The DCP0105's basic construction is the same as standard ICs. There is no substrate within the molded package. The DCP0105 is constructed using an IC, rectifier diodes, and a wound magnetic toroid on a leadframe. As there is no solder within the package, the DCP0105 does not require any special PCB assembly processing. This results in an isolated DC/DC with inherently high reliability.

ADDITIONAL FUNCTIONS

DISABLE/ENABLE

The DCP0105 can be disabled or enabled by driving the SYNC_{IN} pin with an open drain CMOS gate. If the SYNC_{IN} pin is pulled low, the DCP0105 will disable. The disable time depends on the output loading but the internal shutdown takes up to 10μs. Making the gate open drain will re-enable the DCP0105. However, there is a trade-off in using this function; the DCP0105 quiescent current may increase and the on-chip oscillator may run slower. This degradation in performance is dependent on the external CMOS gate capacitance, therefore the smaller the capacitance, the lower the performance decrease. Driving the SYNC_{IN} pin with a CPU type tri-state output, which has a low output capacitance, offers the lowest reduction in performance.

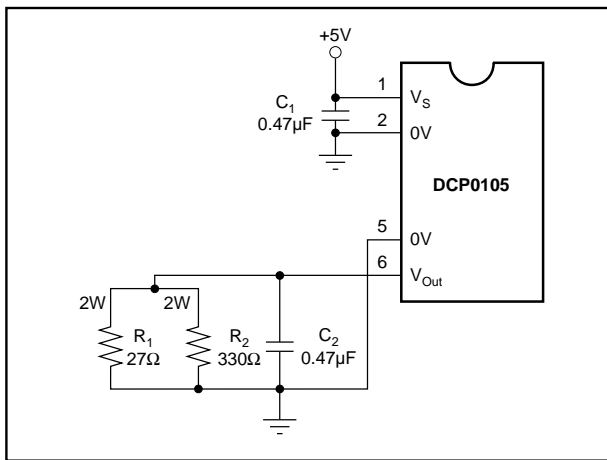


FIGURE 3. DCP010505 Fully Loaded.

DECOUPLING

Ripple Reduction

The high switching frequency of 400kHz allows simple filtering. To reduce ripple, it is recommended that 0.47μF capacitors are used on V_S and V_{OUT}. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a 2.2μF capacitor on the input to insure startup.

There is no restriction on the size of the output capacitor used to reduce ripple. The DCP0105 will start into any capacitive load. Low ESR capacitors will give the best reduction.

EXTERNAL SYNCHRONIZATION

The DCP0105 can be synchronized externally if required using a simple external interface. Figure 4 shows a universal interface using a 4066 quad switch. The CTL and SYNC_{ON} pins are used to select external synchronization or self-synchronization.

This interface can also be used to stop (disable) the DCP0105.

CTL	SYNC _{ON}	FUNCTION
1	1	External Sync
—	0	Self-Sync
0	1	Device Stop

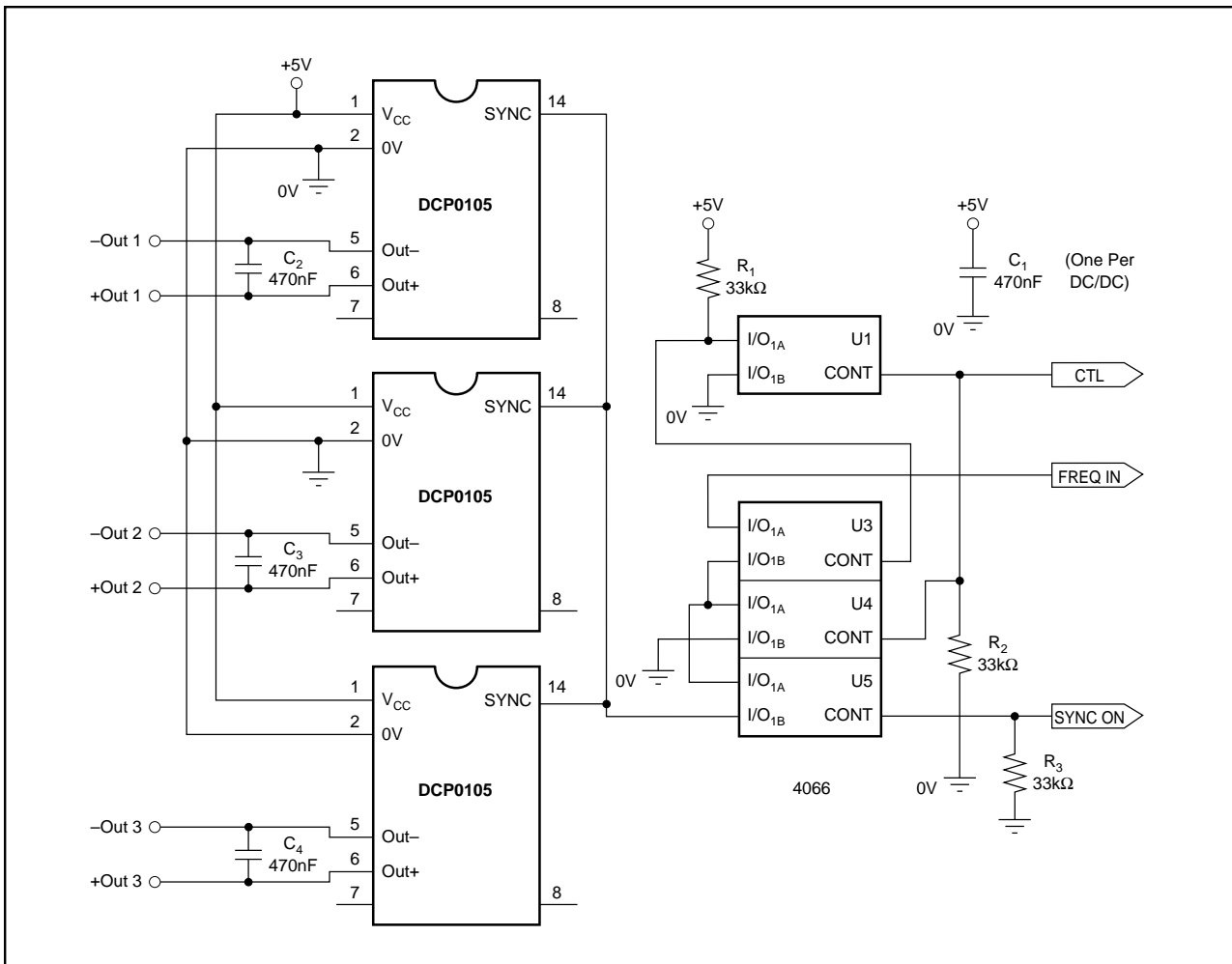


FIGURE 4. Universal Interface.

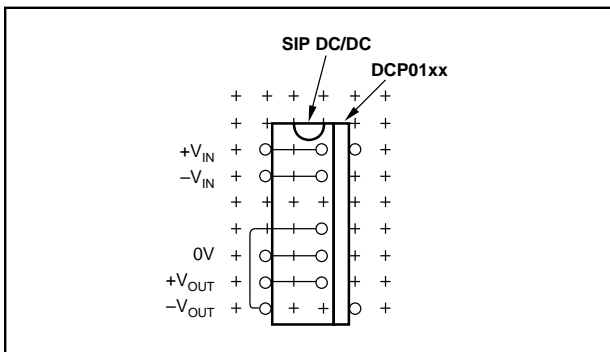


FIGURE 5. PCB Layout for DCP0105 and Competitive SIP DC/DC.

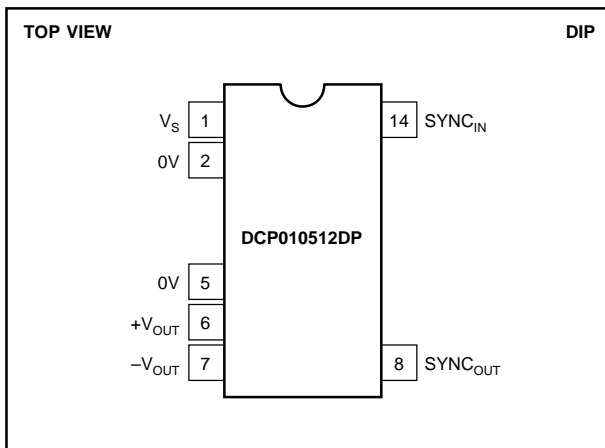
DCP0105 ADDENDUM

SPECIFICATIONS (DCP010512DP)

At $T_A = +25^\circ\text{C}$, V_{OUT} nominal (V_{NOM}) = $\pm 12\text{V}$, and $V_S = +5\text{V}$, unless otherwise specified.

PARAMETER	CONDITIONS	DCP010512			UNITS
		MIN	TYP	MAX	
OUTPUT Voltage (V_{NOM}) Noise and Ripple	75% Full Load $C_L = \text{O/P Capacitor} = 10\mu\text{F}$	± 11.4	± 12 20	± 12.6	V mVp-p
INPUT Supply Current	Full Load		240		mA
REGULATION Load Regulation	100% to 75% Load 75% to 25% Load 25% to 10% Load 75% Full Load		7 12 7 1.003	10 16 11	% % % %/1% of V_S
EFFICIENCY Efficiency Input/Output Capacitance	100% Load 10% Load		72 36 2.5		% % pF
TEMPERATURE Thermal Shutdown	Die Temperature	115		140	$^\circ\text{C}$
QUIESCENT CURRENT Quiescent Current			33		mA

PIN CONFIGURATION



PIN DEFINITION

PIN #	PIN NAME	DESCRIPTION
1	V_S	Voltage Input.
2	0V	Input Side Common.
5	0V	Output Side Common.
6	$+V_{OUT}$	+Voltage Out.
7	$-V_{OUT}$	-Voltage Out.
8	$SYNC_{OUT}$	Unregulated 400kHz Output from Transformer.
14	$SYNC_{IN}$	Synchronize Pin.

ORDERING INFORMATION

Basic Model Number: 1W Product	DCP01	05	12	D	()
Voltage Input:	5V In				
Voltage Output:	12V Out				
Dual Output					
Package Code:	P = 14-pin Plastic DIP				

ADDITIONAL INFORMATION

RIPPLE REDUCTION

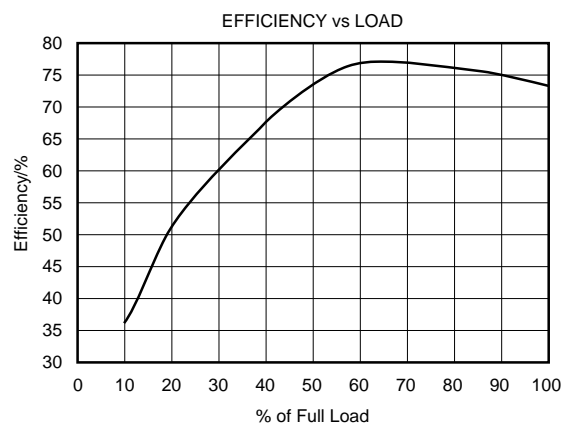
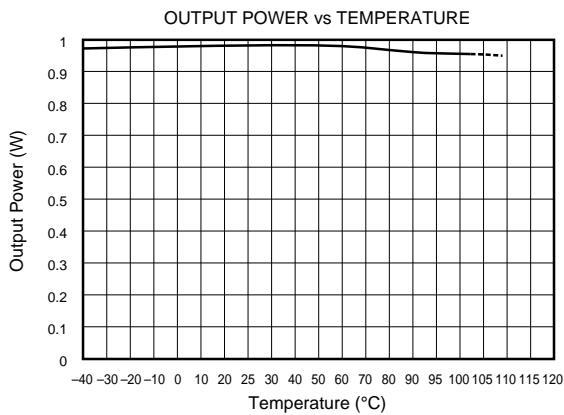
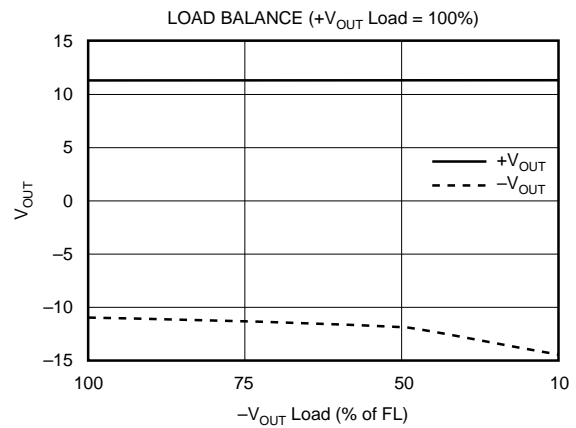
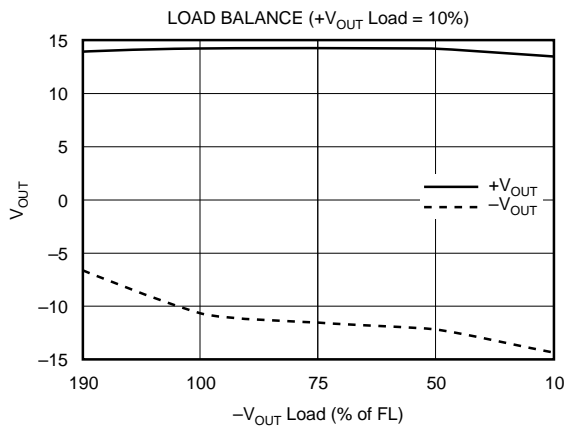
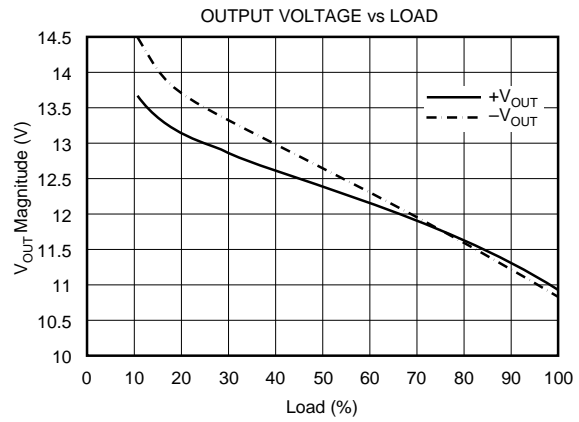
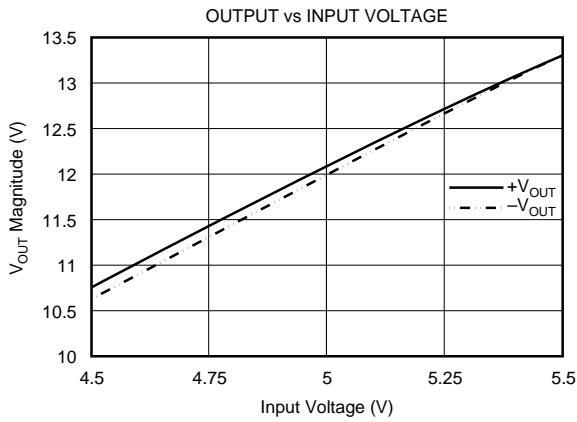
It is recommended that at least $0.1\mu\text{F}$ capacitors are used on the outputs to reduce ripple. Connecting $0.47\mu\text{F}$ capacitors from $+V_{OUT}$ and $-V_{OUT}$ to 0V (pin 5) close to the DC/DC will give good ripple reduction.

SINGLE OUT OPERATION

As the DCP010512DP has floating outputs, it can be configured for $+24\text{V}$ output or -24V output by connecting pin 7 ($-V_{OUT}$) or pin 6 ($+V_{OUT}$) respectively to the output side system common. It is still necessary to connect the two ripple reduction capacitors to pin 5.

TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, V_{OUT} nominal (V_{NOM}) = $\pm 12\text{V}$, and $V_S = +5\text{V}$, unless otherwise specified.



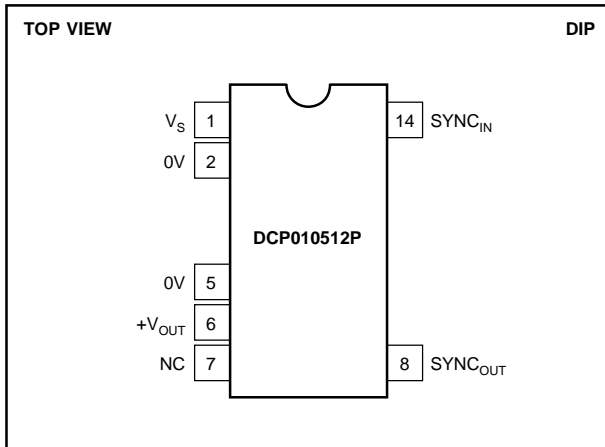
DCP0105 ADDENDUM

SPECIFICATIONS (DCP010512P)

At $T_A = +25^\circ\text{C}$, V_{OUT} nominal (V_{NOM}) = +12V, and $V_S = +5V$, unless otherwise specified.

PARAMETER	CONDITIONS	DCP010512P			UNITS
		MIN	TYP	MAX	
OUTPUT Voltage (V_{NOM}) Noise and Ripple	75% Full Load $C_L = O/P$ Capacitor = 10 μ F	11.4	12 20	12.6	V mVp-p
INPUT Supply Current	Full Load		240		mA
REGULATION Load Regulation	100% to 75% Load 75% to 25% Load 25% to 10% Load 75% Full Load		7 12 7 1.003	9 17 12	% % % %/1% of V_S
EFFICIENCY Efficiency	100% Load 10% Load		72 38		% %
TEMPERATURE Thermal Shutdown	Die Temperature	115		140	$^\circ\text{C}$
QUIESCENT CURRENT Quiescent Current			30		mA

PIN CONFIGURATION



PIN DEFINITION

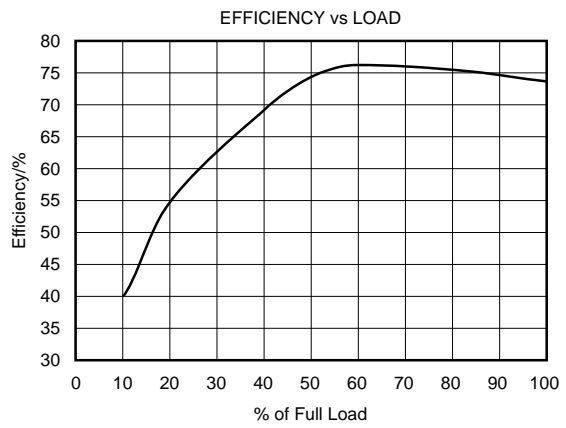
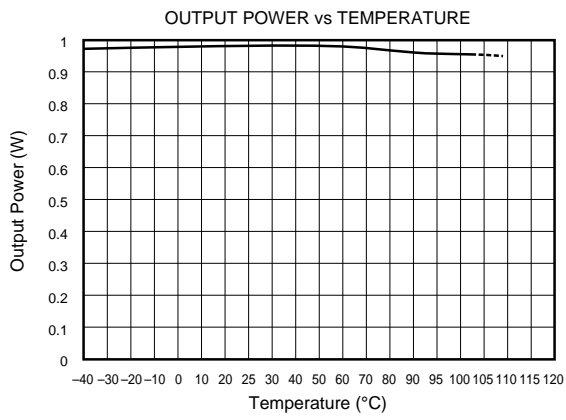
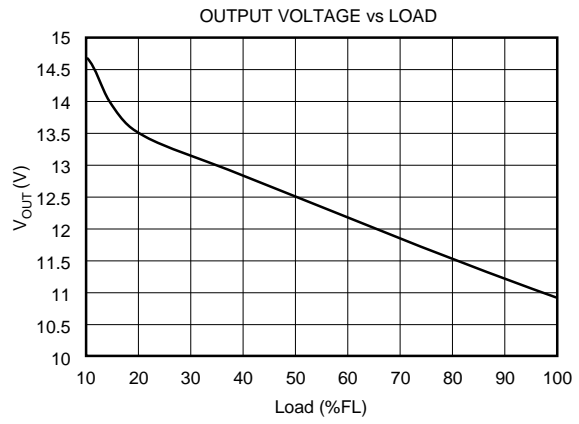
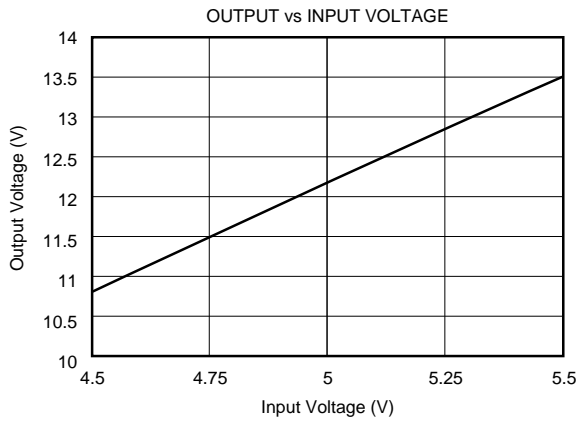
PIN #	PIN NAME	DESCRIPTION
1	V_S	Voltage Input.
2	0V	Input Side Common.
5	0V	Output Side Common.
6	+ V_{OUT}	+Voltage Out.
7	NC	No Connection.
8	$SYNC_{OUT}$	Unregulated 400kHz Output from Transformer.
14	$SYNC_{IN}$	Synchronize Pin.

ORDERING INFORMATION

Basic Model Number: 1W Product	<u>DCP01</u>	<u>05</u>	<u>12</u>	()
Voltage Input:	5V In			
Voltage Output:	12V Out			
Package Code:	P = 14-pin Plastic DIP			

TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, V_{OUT} nominal (V_{NOM}) = +12V, and $V_S = +5\text{V}$, unless otherwise specified.



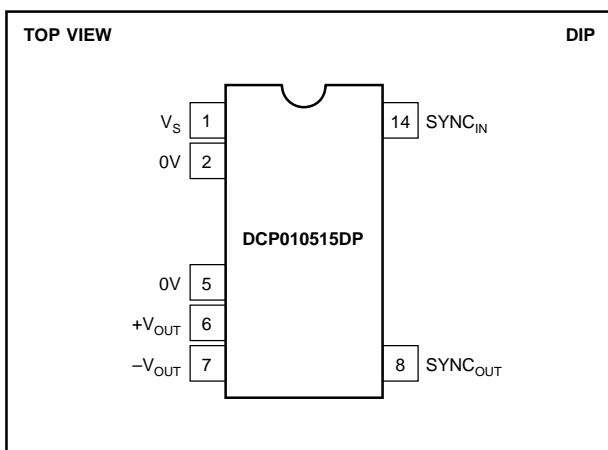
DCP0105 ADDENDUM

SPECIFICATIONS (DCP010515DP)

At $T_A = +25^\circ\text{C}$, V_{OUT} nominal (V_{NOM}) = $\pm 15\text{V}$, and $V_S = +5\text{V}$, unless otherwise specified.

PARAMETER	CONDITIONS	DCP010515			UNITS
		MIN	TYP	MAX	
OUTPUT Voltage (V_{NOM}) Noise and Ripple	75% Full Load $C_L = \text{O/P Capacitor} = 10\mu\text{F}$	± 14.25	± 15 20	± 15.75	V mVp-p
INPUT Supply Current	Full Load		240		mA
REGULATION Load Regulation	100% to 75% Load 75% to 25% Load 25% to 10% Load		7 12 11	10 16 15	% % %
Line Regulation	75% Full Load		1.003		%/1% of V_S
EFFICIENCY Efficiency	100% Load 10% Load		75 39		% %
Input/Output Capacitance			2.5		pF
TEMPERATURE Thermal Shutdown	Die Temperature	115		140	$^\circ\text{C}$
QUIESCENT CURRENT Quiescent Current			34		mA

PIN CONFIGURATION



PIN DEFINITION

PIN #	PIN NAME	DESCRIPTION
1	V_S	Voltage Input.
2	0V	Input Side Common.
5	0V	Output Side Common.
6	$+V_{OUT}$	+Voltage Out.
7	$-V_{OUT}$	-Voltage Out.
8	$SYNC_{OUT}$	Unregulated 400kHz Output from Transformer.
14	$SYNC_{IN}$	Synchronize Pin.

ORDERING INFORMATION

Basic Model Number: 1W Product	DCP01	05	15	D	()
Voltage Input:	5V In				
Voltage Output:	15V Out				
Dual Output					
Package Code:	P = 14-pin Plastic DIP				

ADDITIONAL INFORMATION

RIPPLE REDUCTION

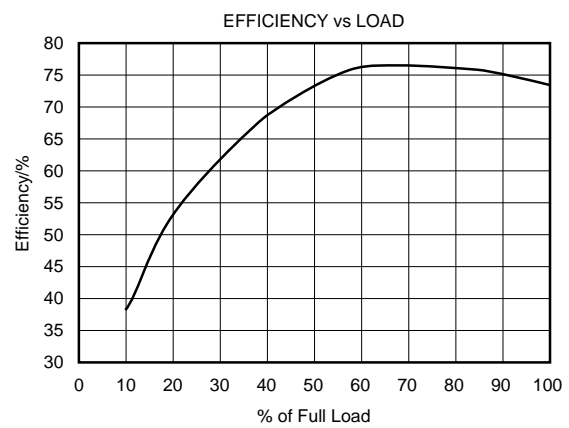
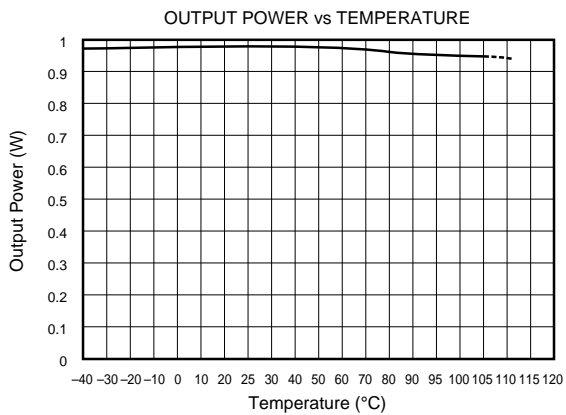
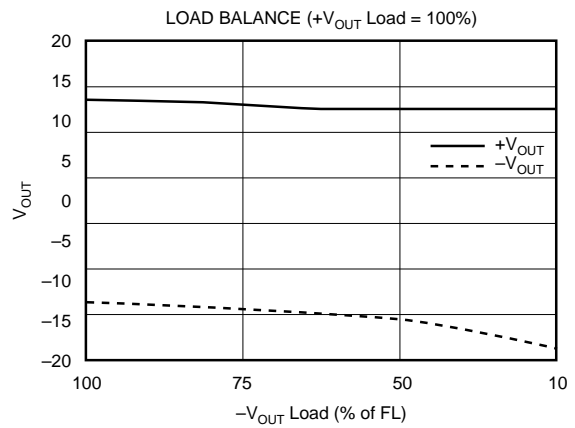
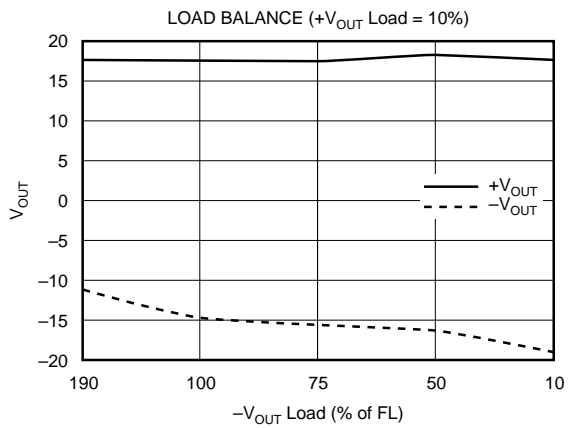
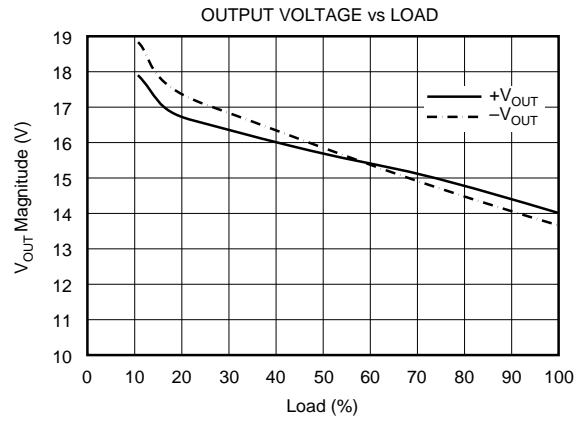
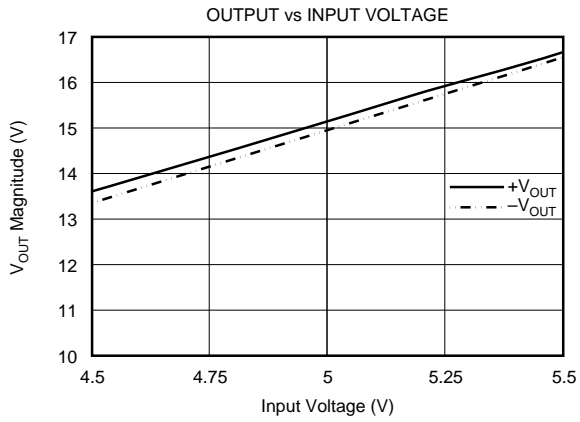
It is recommended that at least $0.1\mu\text{F}$ capacitors are used on the outputs to reduce ripple. Connecting $0.47\mu\text{F}$ capacitors from $+V_{OUT}$ and $-V_{OUT}$ to 0V (pin 5) close to the DC/DC will give good ripple reduction.

SINGLE OUT OPERATION

As the DCP010515DP has floating outputs, it can be configured for $+30\text{V}$ output or -30V output by connecting pin 7 ($-V_{OUT}$) or pin 6 ($+V_{OUT}$) respectively to the output side system common. It is still necessary to connect the two ripple reduction capacitors to pin 5.

TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, V_{OUT} nominal (V_{NOM}) = $\pm 15\text{V}$, and $V_S = +5\text{V}$, unless otherwise specified.



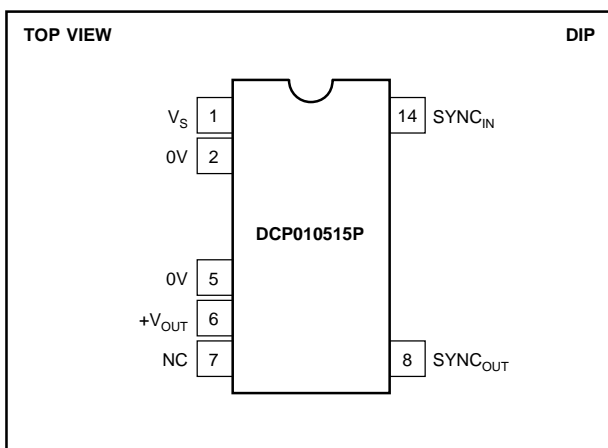
DCP0105 ADDENDUM

SPECIFICATIONS (DCP010515P)

At $T_A = +25^\circ\text{C}$, V_{OUT} nominal (V_{NOM}) = +15V, and $V_S = +5V$, unless otherwise specified.

PARAMETER	CONDITIONS	DCP010515P			UNITS
		MIN	TYP	MAX	
OUTPUT Voltage (V_{NOM}) Noise and Ripple	75% Full Load $C_L = O/P$ Capacitor = 10 μ F	14.25	15 20	15.75	V mVp-p
INPUT Supply Current	Full Load		240		mA
REGULATION Load Regulation	100% to 75% Load 75% to 25% Load 25% to 10% Load 75% Full Load		7 12 11 1.003	9 17 16	% % % %/1% of V_S
EFFICIENCY Efficiency	100% Load 10% Load		73 40		% %
TEMPERATURE Thermal Shutdown	Die Temperature	115		140	$^\circ\text{C}$
QUIESCENT CURRENT Quiescent Current			34		mA

PIN CONFIGURATION



PIN DEFINITION

PIN #	PIN NAME	DESCRIPTION
1	V_S	Voltage Input.
2	0V	Input Side Common.
5	0V	Output Side Common.
6	+ V_{OUT}	+Voltage Out.
7	NC	No Connection.
8	$SYNC_{OUT}$	Unregulated 400kHz Output from Transformer.
14	$SYNC_{IN}$	Synchronize Pin.

ORDERING INFORMATION

Basic Model Number: 1W Product DCP01 05 15 ()

Voltage Input: _____
5V In

Voltage Output: _____
15V Out

Package Code:
P = 14-pin Plastic DIP _____

TYPICAL PERFORMANCE CURVES

At $T_A = +25^\circ\text{C}$, V_{OUT} nominal (V_{NOM}) = +15V, and $V_S = +5\text{V}$, unless otherwise specified.

