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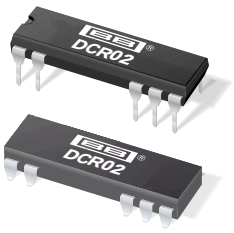


DCR02 Series

www.ti.com

Miniature, 2W Isolated REGULATED DC/DC CONVERTERS

FEATURES

- UL1950 RECOGNIZED
- DIP-18 AND GULL-WING(1) PACKAGES
- 55W/in^3 (3.3W/cm^3) POWER DENSITY
- DEVICE-TO-DEVICE SYNCHRONIZATION
- THERMAL PROTECTION
- 1000Vrms ISOLATION
- 400kHz SWITCHING
- 125 FITS AT 55°C
- SHORT-CIRCUIT PROTECTED
- 12V, 24V INPUTS
- 5V OUTPUTS

NOTE: (1) Gull-wing package available Q1 2001.

APPLICATIONS

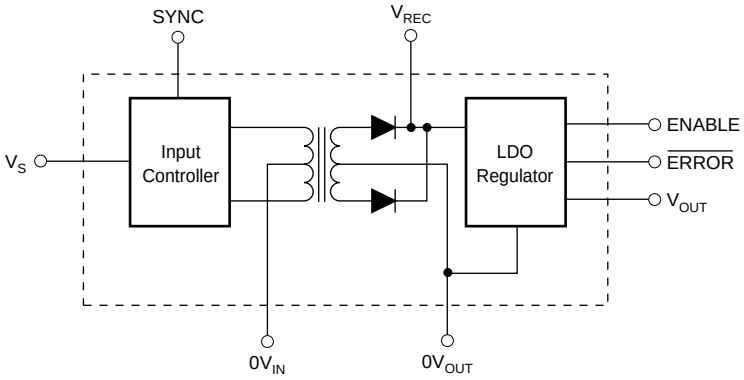
- POINT-OF-USE POWER CONVERSION
- DIGITAL INTERFACE POWER
- GROUND LOOP ELIMINATION
- POWER-SUPPLY NOISE REDUCTION

DESCRIPTION

DCR02 family is a series of high-efficiency, input-isolated, output-regulated DC/DC converters. In addition to 2W nominal, galvanically-isolated output power capability, this range of DC/DCs offer very low output noise, and high accuracy.

The DCR02 family is implemented in standard molded IC packaging, giving standard JEDEC outlines suitable for high-volume assembly.

The DCR02 is manufactured using the same technology as standard IC packages, thereby achieving very high reliability.



TEXAS INSTRUMENTS

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SPECIFICATIONS

At T_A = +25°C, V_S = nominal, I_O = 10mA, C_O = 0.1µF, unless otherwise specified.

PARAMETER	CONDITIONS	DCR02 SERIES MIN	DCR02 SERIES TYP	DCR02 SERIES MAX	UNITS
OUTPUT					
Setpoint					
DCR021205			5		V
DCR022405			5		V
Setpoint Accuracy			0.5	2.0	%
Maximum Output Current					
DCR021205		400			mA
DCR022405		400			mA
Output Short-Circuit Protected	Duration		Infinite		
Line Regulation					
DCR021205			1		mV/V
DCR022405			1		mV/V
Over Line and Load					
DCR021205	10mA to 400mA Load, 4.5V to 5.5V Line		1.0	2.5	%
DCR022405	10mA to 400mA Load, 4.5V to 5.5V Line		1.0	2.5	%
Versus Temperature	–40°C to +70°C		1.0		%
Ripple and Noise					
DCR0212 Ripple	20MHz Bandwidth, 50% Load(1)		18		mVp-p
DCR0212 Noise	100MHz Bandwidth, 50% Load(1)		20		mVp-p
DCR0224 Ripple	20MHz Bandwidth, 50% Load(1)		18		mVp-p
DCR0224 Noise	100MHz Bandwidth, 50% Load(1)		25		mVp-p
INPUT					
Nominal Voltage (V_S)	DCR021205		12		V
	DCR022405		24		V
Voltage Range		–10		+10	%
Supply Current					
DCR021205	I_O = 0mA		15		mA
	I_O = 10mA		23		mA
	I_O = 400mA		250		mA
DCR022405	I_O = 0mA		15		mA
	I_O = 10mA		17		mA
	I_O = 400mA		129		mA
Reflected Ripple Current					
DCR021205, DCR022405	MHz Bandwidth, 100% Load C_{IN} = 2.2µF, C_{FILTER} = 1µF		8		mAp-p
ISOLATION					
Voltage	1s Flash Test	1			kVrms
	60s Test, UL1950(2)	1			kVrms
Input/Output Capacitance			25		pF
OUTPUT ENABLE CONTROL					
Logic High Input Voltage		2.0		V_{REC}	V
Logic High Input Current	2.0 < V_{ENABLE} < V_{REC}		100		nA
Logic Low Input Voltage		–0.2		0.5	V
Logic Low Input Current	0 < V_{ENABLE} < 0.5		100		nA
DCR021205					V
DCR022405					V
ERROR FLAG					
Logic High Open Collector Leakage	V_{ERROR} = 5V			10	µA
Logic Low Output Voltage	Sinking 2mA			0.4	V
THERMAL SHUTDOWN					
Junction Temperature					
Temperature Activated			150		°C
Temperature Deactivated			130		°C
SYNCHRONIZATION PIN					
Max External Capacitance on SYNC Pin				3	pF
Internal Oscillator Frequency		720	800	880	kHz
External Synchronization Frequency		720		880	kHz
External Synchronization Signal High		2.5	2.5	5.0	V
External Synchronization Signal Low		0		0.4	V
TEMPERATURE RANGE					
Operating		–40		+70	°C

NOTE: (1) C_{IN} = 2.2µF, C_{FILTER} = 1µF, C_{OUT} = 0.1µF. (2) During UL approval only.

ABSOLUTE MAXIMUM RATINGS

Input Voltage:
- DCR0212 ..... 15V
- DCR0224 ..... 29V

Storage Temperature ..... –60°C to +125°C
Lead Temperature (soldering, 10s) ..... 270°C

ORDERING INFORMATION

DCR02 12 05 (P)

- Basic Model Number: 1W Product
- Voltage Input: 12V In
- Voltage Output: 5V Out
- Package Code: P = 18-Pin Plastic DIP, P-U = DIP-18 Gull Wing(1)

NOTE: (1) P-U available Q1 2001.

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.

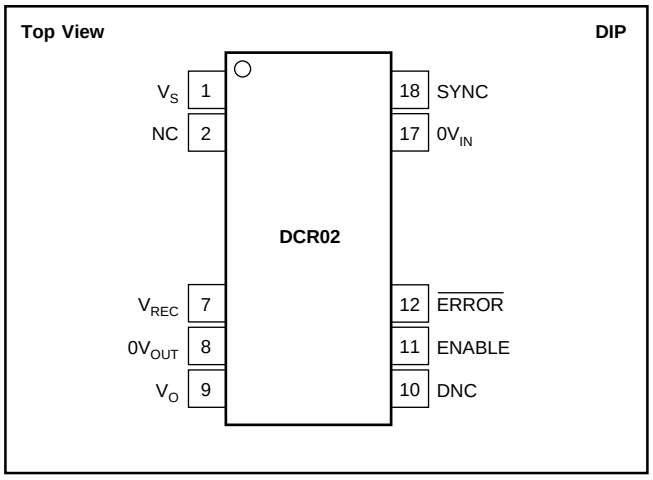
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER(1)	TRANSPORT MEDIA
DCR021205P	DIP-18	218-1	–40°C to +70°C	DCR021205P	DCR021205P	Rails
DCR022405P	DIP-18	218-1	–40°C to +70°C	DCR022405P	DCR022405P	Rails
DCR021205P-U(2)	DIP-18 Gull Wing	218-2	–40°C to +70°C	DCR021205P-U	DCR021205P-U/700	Tape and Reel
DCR022405P-U(2)	DIP-18 Gull Wing	218-2	–40°C to +70°C	DCR022405P-U	DCR022405P-U/700	Tape and Reel

NOTE: (1) Models with a slash (/) are available only in Tape and Reel in the quantities indicated (e.g., /700 indicates 700 devices per reel). Ordering 700 pieces of “DCR021205P-U/700” will get a single 700-piece Tape and Reel. (2) P-U available Q1 2001.

PIN CONFIGURATION



PIN DEFINITIONS

PIN #	PIN NAME	DESCRIPTION
1	V_S	Voltage Input
2	NC	No Connection
7	V_{REC}	Rectified Output
8	$0V_{OUT}$	Output Ground
9	V_O	Voltage Output
10	DNC	Do Not Connect
11	ENABLE	Output Voltage Enable
12	$\overline{ERROR}$	Error Flag Active Low
17	$0V_{IN}$	Input Ground
18	SYNC	Synchronization Input

FUNCTIONAL DESCRIPTION

OVERVIEW

The DCR02 series offers isolation from an unregulated power supply operating from a choice of input voltages. The DCR02s provide a variety of regulated output voltages at a nominal output power of 2W.

POWER STAGE

The input supply is chopped at a frequency of 400kHz (internal oscillator divided by 2), which is used to drive the center-tapped toroidal transformer.

RECTIFICATION

The transformer's output is full wave rectified and smoothed by the external capacitor connected to V_{REC}.

REGULATOR

The internal low dropout regulator provides a well-regulated output voltage throughout the operating range of the device.

OSCILLATOR AND WATCHDOG

The DCR02 uses an internal saw-tooth generator to provide the 800kHz on-board oscillator that is used to drive the power switching circuit. The operation of the oscillator is monitored by the watchdog, which will tri-state the output driver circuit if the oscillator fails, or if the SYNC pin is taken LOW, (shutdown mode). When the SYNC pin is returned HIGH, normal operation resumes.

SYNCHRONIZATION

If more than one DCR02 is being used, beat frequencies and other electrical interference can be generated. This is due to the small variations in switching frequencies between the converters.

The DCR02 overcomes this by allowing devices to be synchronized to one another. Up to eight devices can be synchronized by connecting the SYNC pins together, with care being taken to minimize the capacitance of tracking.

Significant stray capacitance on the SYNC pin will have the effect of reducing the frequency of the internal oscillator. If this is large, the DCR02 may be taken out with its optimized operating parameters, and saturation of the magnetics may result, damaging the device.

If devices are synchronized, it should be noted that all devices will draw maximum current simultaneously at start up. This can cause the input voltage to dip. Should it fall below the minimum input voltage, the devices may not start up. A 2.2µF capacitor (low ESR) should be connected as close to the device input pins as possible.

If more than eight devices are required to be synchronized, it is recommended that external synchronization be used. Details are contained in Burr-Brown's Application Bulletin AB-153 (literature number SBAA035) available at www.ti.com.

CONSTRUCTION

The DCR02 is manufactured using the same technology as standard IC packages. There is no substrate within the package. The DCR02 is constructed using a driver IC, low-dropout voltage regulator, rectifier diodes, and a wound magnetic toroid, all mounted on a leadframe. The DCR02 requires no special PCB assembly processing, as there is no solder within the package. The result is an isolated DC/DC converter with inherently high reliability.

ADDITIONAL FUNCTIONS

DISABLE/ENABLE

The DCR02 can be disabled or enabled by driving the SYNC pin using an open drain CMOS gate. If the SYNC pin is pulled LOW, the DCR02 will be disabled. The disable time depends upon the external loading. The internal disable function is implemented in 2µs. Removal of the pull down will enable the DCR02.

Capacitance loading on the SYNC pin should be minimized in order to prevent a reduction in the internal oscillator's frequency. See Application Bulletin AB-153, "External Synchronization of the DCP01/02 Series of DC/DC Converters". This document contains information on how to null the effects of additional capacitance on the SYNC pin. The oscillators frequency can be measured at V_{REC}, as this is the fundamental frequency of the ripple component.

OUTPUT ENABLE/DISABLE

The regulated output of the DCR02 can be disabled by pulling the ENABLE pin LOW. Holding the ENABLE pin HIGH enables the regulated output voltage, thus allowing the output to be controlled from the isolated side.

$\overline{\text{ERROR}}$ FLAG

The DCR02 has an $\overline{\text{ERROR}}$ pin which provides a "power good" flag, as long as the internal regulator is in regulation.

DECOUPLING

Ripple Reduction

Due to the very low forward resistance of the DMOS switching transistors, high current demands are placed upon the input supply for a short time. By placing a good quality low Equivalent Series Resistance (ESR) capacitor of 2.2µF close to the IC supply input pins, the effects on the power supply can be minimized.

The high switching frequency of 400kHz allows relatively small values of capacitors to be used for filtering the rectified output voltage. A good quality low ESR capacitor of 1µF placed close to the V_{REC} pin and output ground will reduce the ripple.

It is not recommended that the DCR02 be fitted using an IC socket as this will degrade performance.

The output at V_{REC} is full wave rectified and produces a ripple of 800kHz.

It is recommended that a 0.1µF low ESR capacitor is connected close to the output pin and ground to reduce noise on the output. The capacitor values listed are minimum values. If lower ripple is required, the filter capacitor should be increased in value to 0.47µF.

NOTE: As with all switching power supplies, the best performance is only obtained with low ESR capacitors connected close to the switcher. If low ESR capacitors are not used, the ESR will generate a voltage drop when the capacitor is supplying the load power. Often a larger capacitor is chosen for this purpose when a low ESR smaller capacitance would perform as well.

PCB LAYOUT

RIPPLE AND NOISE

Careful consideration should be given to the layout of the PCB in order for the best results to be obtained.

The DCR02 is a switching power supply and as such can place high peak current demands on the input supply. In order to avoid the supply falling momentarily during the fast switching pulses, ground and power planes should be used to track the power to the input of DCR02; this will also serve to reduce noise on the circuit. If this is not possible, the supplies must be connected in a star formation, with the tracks made as wide as possible.

If the SYNC pin is being used, the tracking between device SYNC pins should be short to avoid stray capacitance. If the SYNC pin is not being used, it is advisable to place a guard ring (connected to input ground) around this pin to avoid any noise pickup.

The output should be taken from the device using ground and power planes. This will ensure minimum losses.

A good quality low ESR capacitor placed as close as practicable across the input will reduce reflected ripple and ensure a smooth start up.

A good quality low ESR capacitor placed as close as practicable across the rectifier output terminal and output ground will give the best ripple and noise performance.

THERMAL MANAGEMENT

Due to the high power density of this device, it is advisable to provide a ground plane on the output. The output regulator is mounted on a copper leadframe, and a ground plane will serve as an efficient heatsink.

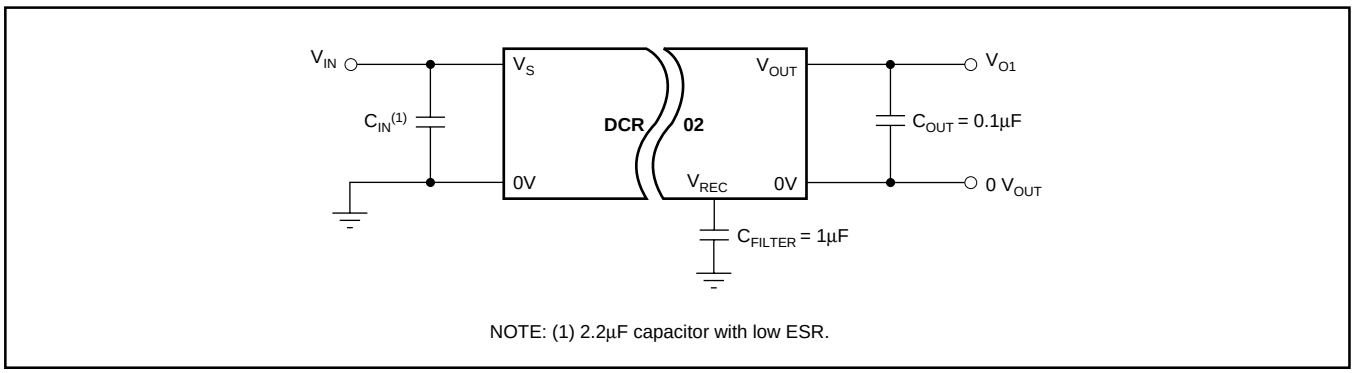


FIGURE 1. DCR02 with a Single Output.

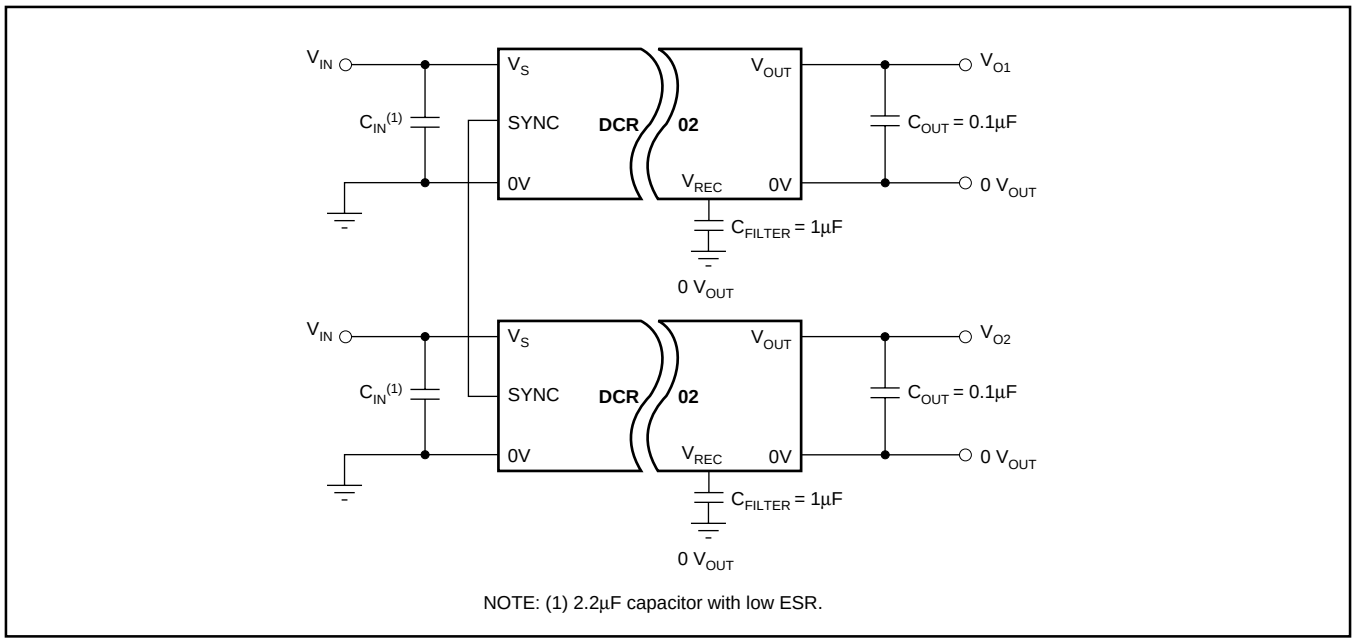


FIGURE 2. Self-Synchronizing DCR02s with a Dual Output.

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