Burr-Brown Products
from Texas Instruments

Miniature,
REGULATED DC/

FEATURES

- UL1950 Recognized
- DIP-18 and SO-10 Packages
- 55 W/in^3 (3.3 W/cm^3) Power Density
- Device-to-Device Synchronization
- Thermal Protection
- 1000 Vrms Isolation
- 400 kHz Switching
- 125 FITS at 55°C
- Short-Circuit Protection
- 12−V, 24−V Inputs
- 5−V Outputs

APPLICATIONS

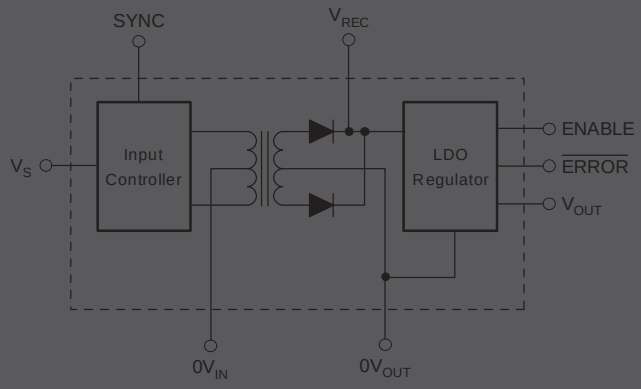
- Point-of-Use Power Conversion
- Digital Interface Power
- Ground Loop Elimination
- Power-Supply Noise Reduction

DESCRIPTION

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

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

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



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ELECTRICAL CHARACTERISTICS (continued)

At T_A = +25°C, V_S = nominal, I_{OUT} = 10mA, C_{OUT} = 0.1µF ceramic, and C_{IN} = 2.2µF ceramic, unless otherwise noted(1).

PARAMETER	TEST CONDITIONS	DCR02 SERIES			UNITS
		MIN	TYP	MAX	
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

(1) Ceramic capacitors, C_{IN} = 2.2 µF, C_{FILTER} = 1 µF, and C_{OUT} = 0.1 µF.
(2) During UL1950 recognition test only.

TYPICAL CHARACTERISTICS

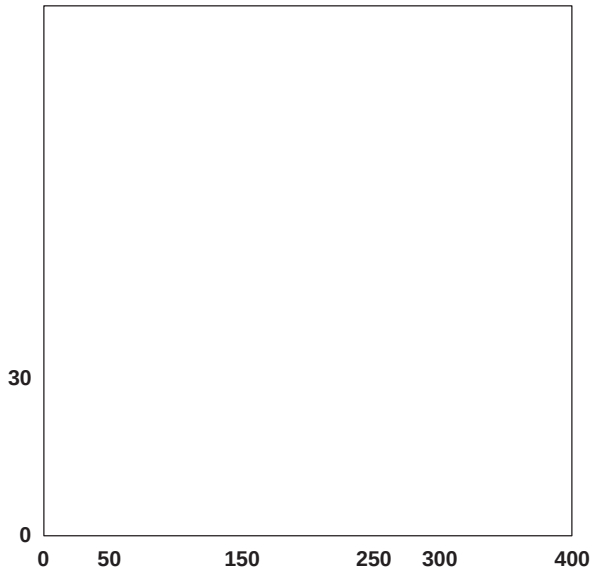


Figure 1

FUNCTIONAL DESCRIPTION

OVERVIEW

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

POWER STAGE

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

RECTIFICATION

The transformer 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 800−kHz onboard oscillator that is used to drive the power switching circuit. The operation of the oscillator is monitored by the watchdog, which three-states 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 interference 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 reduces the frequency of the internal oscillator. If this reduction 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 draws 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 low equivalent series resistance (ESR) 2.2−µF ceramic capacitor 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 of this procedure are contained in application report SBAA035, *External Synchronization of the DCP01/02 Series of DC/DC Converters,* available for download 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 printed circuit board (PCB) assembly processing, since 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 is disabled. The disable time depends upon the external loading. The internal disable function is implemented in 2 μs. Removal of the pull down enables the DCR02.

Capacitance loading on the SYNC pin should be minimized in order to prevent a reduction in the internal oscillator frequency. See application report SBAA035 for information on how to nullify the effects of additional capacitance on the SYNC pin. The oscillator 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 (by connecting ENABLE to $0V_{OUT}$). Holding the ENABLE pin high (connect ENABLE to V_{REC}) enables the regulated output voltage, thus allowing the output to be controlled from the isolated side, as shown in Figure 3.

$\overline{\text{ERROR}}$ 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 ESR 2.2−μF ceramic capacitor close to the IC supply input pins, the effects on the power supply can be minimized.

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

It is not recommended that the DCR02 be fitted using an IC socket because this degrades performance.

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

It is recommended that a 0.1−μF, low ESR ceramic capacitor be 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 ceramic filter capacitor should be increased in value to 2.2

APPLICATION NOTES

DCR02 SINGLE VOLTAGE OUTPUT

The DCR02 can be used to provide a single voltage output by connecting the circuit as shown in Figure 3. The $\overline{\text{ERROR}}$ output signal is pulled up to the value of V_{OUT} for the particular DCR02 being used. The value of R_{ERR} depends on the loading on the $\overline{\text{ERROR}}$ line; however, the total load on the $\overline{\text{ERROR}}$ line must not exceed the value given in the specification.

The output can be permanently enabled by connecting the ENABLE pin to the V_{REC} pin. The DCR02 can be enabled remotely by connecting the ENABLE pin to V_{REC} via a pull-up resistor (R_{EN}); the value of this resistor is not critical for the DCR02 since only a small current flows. Switch SW1 can be used to pull the ENABLE pin low, thus disabling the output. The switching devices can be a bipolar transistor, FET, or a mechanical device; the main load that it senses is R_{EN}.

GENERATING TWO POSITIVE OUTPUT VOLTAGES

Two DCR02s can be used to create two +5−V output voltages, as shown in Figure 4. The two DCR02s are connected in self-synchronization, thus locking the oscillators of both devices to a single frequency.

The $\overline{\text{ERROR}}$ and ENABLE facilities can be used in a similar configuration for a single DCR02. The filter capacitors connected to the V_{REC} pins (C_{FILTER}) should be kept separate from each other and connected in close proximity to the respective DCR02. If similar output voltages are being used, it is not recommended that a single filter capacitor (with an increased capacitance) be used with both V_{REC}

GENERATION OF DUAL POLARITY VOLTAGES FROM TWO SELF-SYNCHRONIZED DCR02s

Two DCR02s can be configured to produce a dual polarity supply (that is, ±5 V); the circuit must be connected as shown in Figure 5.

It should be observed that both DCR02s are positive voltage regulators; therefore the $\overline{\text{ERROR}}$, ENABLE, and V_{REC} pins are relative to their respective devices, 0 V, and must not be connected together.

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.

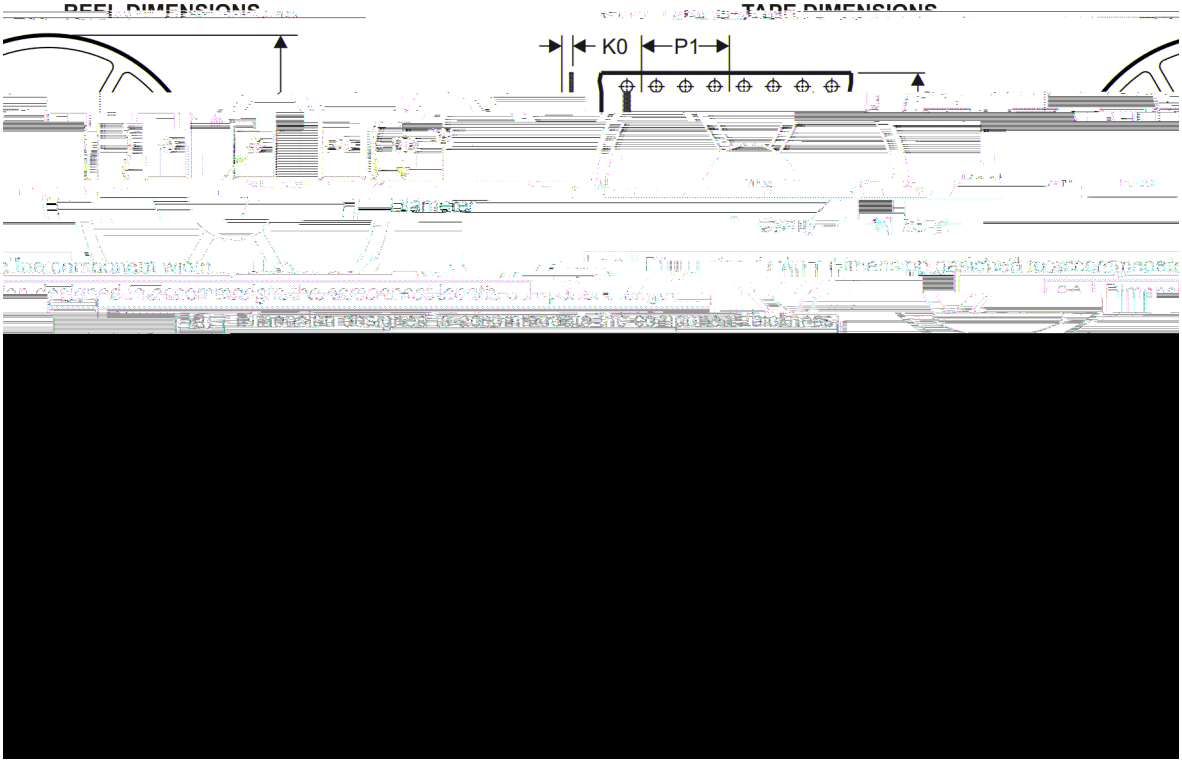
The DCR02 is a switching power supply and as such can place high peak current demands on the input supply. In order to avoid the supply falling momentarily during the fast switching pulses, ground and power planes should be used to track the power to the input of DCR02; this also serves to reduce noise 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.

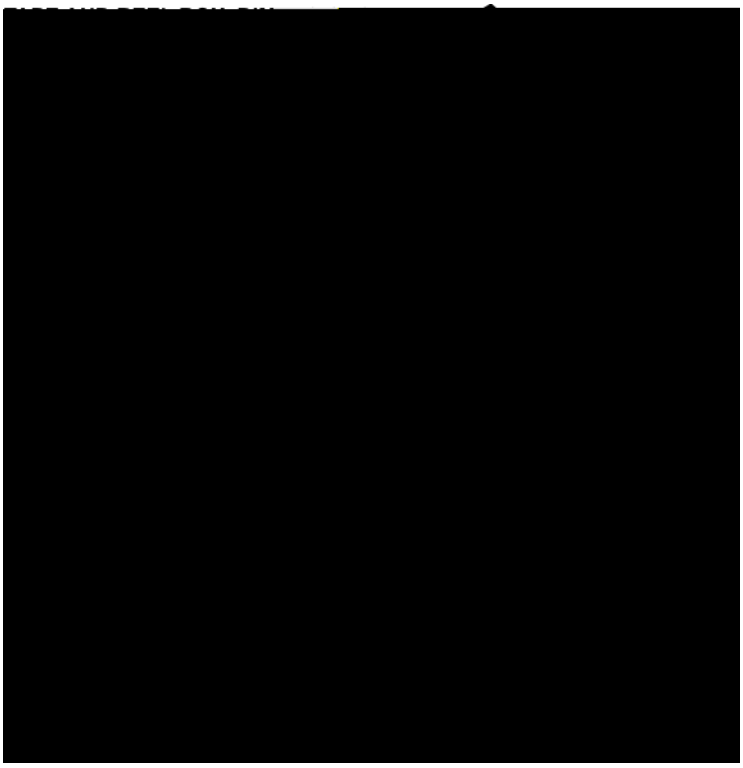
If the SYNC pin is being used, the tracking between device SYNC pins should be short, to avoid stray capacitance. If the SYNC pin is not being used, it is advisable to place a guardSYN to ltsg b T*,3 28.c6b T*,3 ion, withalsoservesfguard be

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty

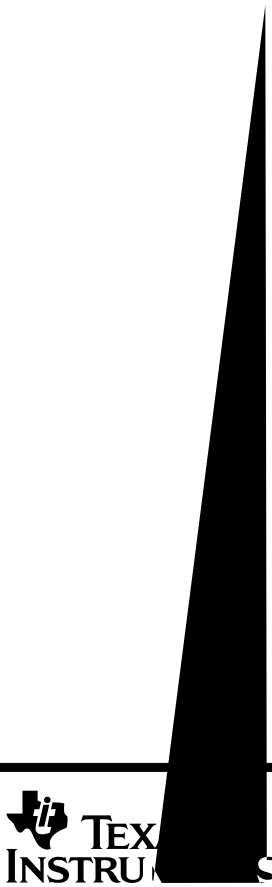
TAPE AND REEL INFORMATION





*All dimensions are nominal

Device	Package Type	Package Drawing	Pins



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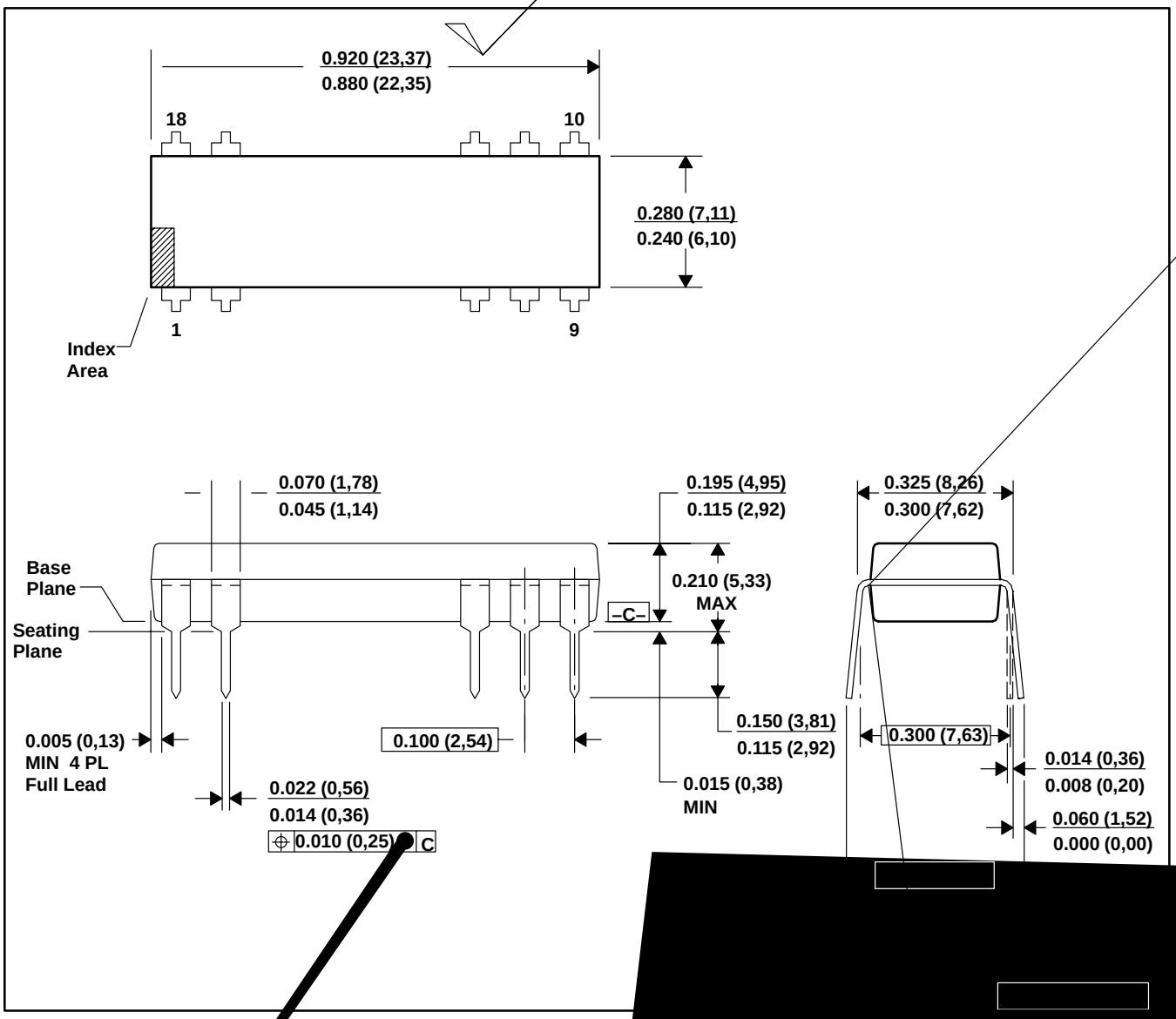

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