

High Power Factor Preregulator

FEATURES

- Complete 8-pin Power Factor Solution
- Reduced External Components
- RMS Line Voltage Compensation
- Precision Multiplier/Squarer/Divider
- Internal 63kHz Synchronizable Oscillator
- Average Current Mode PWM Control
- Overvoltage Protection Comparator
- High Current, Clamped Gate Driver

DESCRIPTION

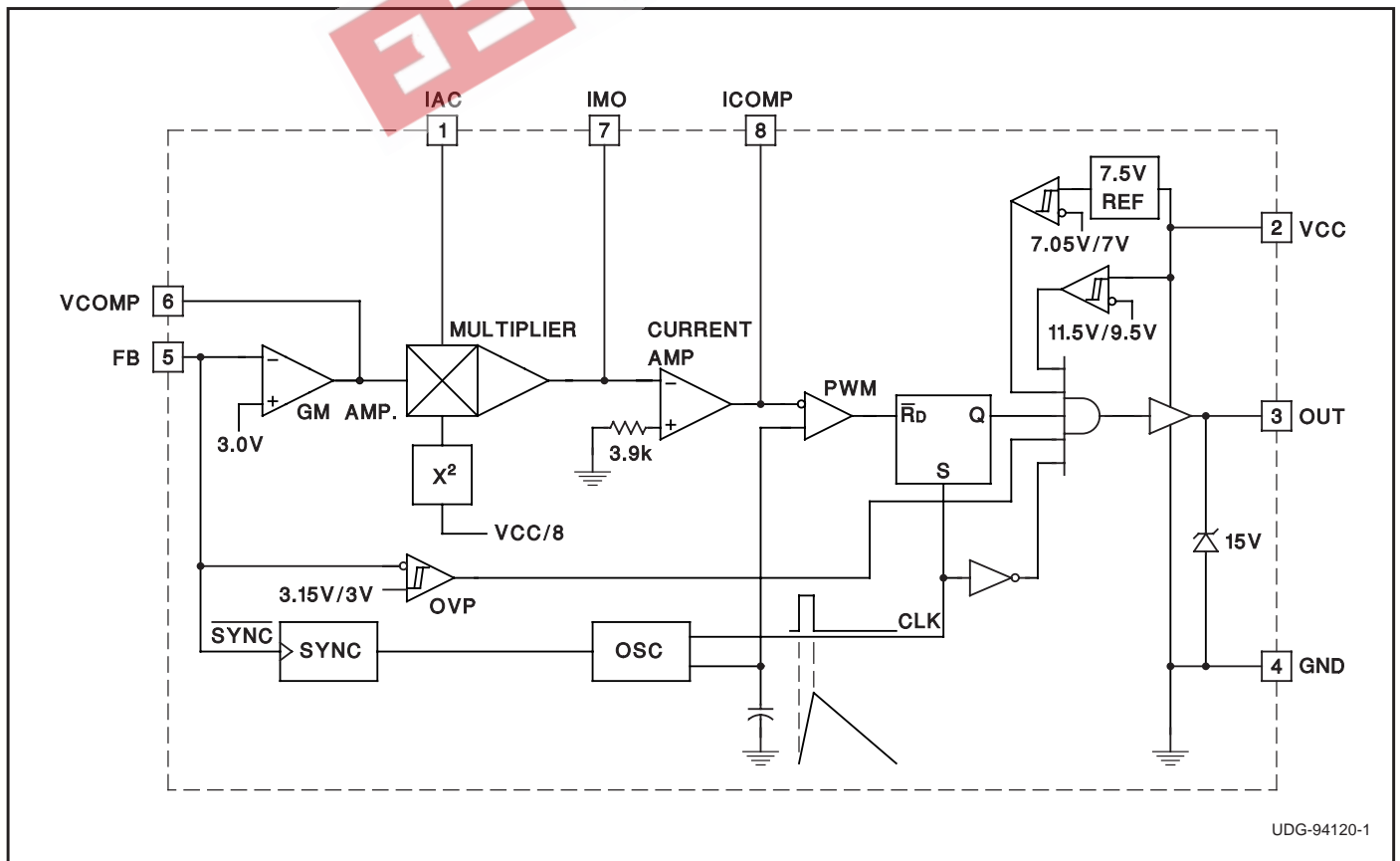
The UC2853A provides simple, yet high performance active power factor correction. Using the same control technique as the UC1854, this 8-pin device exploits a simplified architecture and an internal oscillator to minimize external component count. The UC2853A incorporates a precision multiplier/squarer/divider circuit, voltage and current loop error amplifiers, and a precision voltage reference to implement average current mode control with RMS line voltage compensation. This control technique maintains constant loop gain with changes in input voltage, which minimizes input line current distortion over the worldwide input voltage range.

The internal 63kHz oscillator includes an external clock input, allowing synchronization to downstream converters. Additionally, the device features an overvoltage protection comparator, a clamped MOSFET gate driver which self-biases low during undervoltage lockout, and low startup and supply current.

The UC2853A is identical to the UC2853 except the internal oscillator frequency has been reduced from 75kHz to 63kHz. The switching frequency is lowered in order to keep the second harmonic of the switching frequency below a 150kHz. For EMI specifications at 150kHz this makes it easier for a design to meet system requirements.

BLOCK DIAGRAM

These devices are available in 8-pin PDIP (P) and SOIC (D) packages. The UC2853A is specified for operation from -40°C to 105°C .

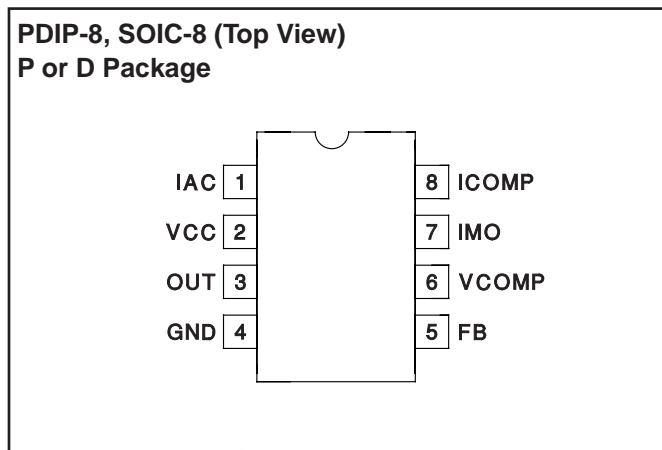


ABSOLUTE MAXIMUM RATINGS

Supply Voltage (VCC)	40V
Output Drive Current, Continuous	0.125A
Peak	0.5A
Output Minimum Voltage	-0.3V
IAC Maximum Input Current	1mA
IMO Maximum Output Current	-2mA
IMO Minimum Voltage	-0.3V
FB Maximum Input Voltage	5V
VCOMP Maximum Voltage	6.2V
ICOMP Sourcing Current	Self-Limiting
ICOMP Sinking Current	20mA
ICOMP Maximum Voltage	7.2V
Storage Temperature	-65°C to +150°C
Junction Temperature	-55°C to +150°C
Lead Temperature (Soldering, 10 sec.)	+300°C

All voltages with respect to GND. Currents are positive into, negative out of the specified terminal. Consult Packaging Section of Databook for thermal limitations and considerations of packages.

CONNECTION DIAGRAM



ELECTRICAL CHARACTERISTICS

Unless otherwise stated, these parameters apply for $T_A = -40^\circ\text{C}$ to 105°C for the UC2853A; $V_{CC} = 16\text{V}$, $V_{FB} = 3\text{V}$, $I_{AC} = 100\mu\text{A}$, $V_{VCOMP} = 3.75\text{V}$, $V_{ICOMP} = 3\text{V}$, $T_A = T_J$.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Undervoltage Lockout Section					
VCC Turn-on Threshold	V_{VCOMP} , V_{ICOMP} Open		11.5	13	V
Hysteresis		1.5	1.8	2.1	V
Supply Current Section					
I_{VCC} Startup	$V_{CC} = 8\text{V}$, $I_{AC} = 100\mu\text{A}$; V_{VCOMP} , V_{ICOMP} Open		250	500	μA
I_{VCC}	$I_{AC} = 0\mu\text{A}$, $V_{ICOMP} = 0\text{V}$		10	15	mA
Voltage Loop Error Amplifier Section					
Transconductance	$I_{OUT} = \pm 20\mu\text{A}$ 0-70C	300	450	575	μmho
	Temperature	135		640	μmho
Input Voltage	0-70C	2.925	3	3.075	V
	Temperature	2.9		3.1	V
AVOL	$V_{VCOMP} = 1\text{V} - 4\text{V}$	50	60		dB
Output Sink Current	$V_{FB} = 3.2\text{V}$, $V_{VCOMP} = 3.75\text{V}$	20	50		μA
Output Source Current	$V_{FB} = 2.8\text{V}$, $V_{VCOMP} = 3.75\text{V}$		-50	-20	μA
Output Voltage High		5.5	6		V
Output Voltage Low			0.6	0.9	V
Current Loop Error Amplifier Section					
Offset Voltage		0		6	mV
Voltage Gain	$V_{ICOMP} = 1\text{V} - 4\text{V}$		70		dB
Sink Current	$V_{IMO} = 100\text{mV}$, $V_{ICOMP} = 3\text{V}$	1			mA
Source Current	$V_{IMO} = -0.1\text{V}$, $V_{ICOMP} = 3\text{V}$		-150	-80	μA
Output High	$I_{ICOMP} = -50\text{mA}$	6	6.8		V
Output Low	$I_{ICOMP} = 50\mu\text{A}$		0.3	0.8	V
PWM Modulator Gain	$V_{ICOMP} = 2\text{V} - 3\text{V}$ (Note 1)		20		%/V

ELECTRICAL CHARACTERISTICS**(continued)**

Unless otherwise stated, these parameters apply for $T_A = -40^{\circ}\text{C}$ to 105°C for the UC2853A; $V_{CC} = 16\text{V}$, $V_{FB} = 3\text{V}$, $I_{AC} = 100\mu\text{A}$, $V_{VCOMP} = 3.75\text{V}$, $V_{ICOMP} = 3\text{V}$, $T_A = T_J$.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Multiplier Section					
Output Current – IAC Limited	$V_{CC} = 11\text{V}$, $V_{VCOMP} = 6\text{V}$	-230	-200	-170	μA
Output Current – Zero	$I_{AC} = 0\mu\text{A}$	-2	-0.2	2	μA
Output Current – Power Limited	$V_{CC} = 12\text{V}$, $V_{VCOMP} = 5.5\text{V}$	-236	-178	-168	μA
Output Current	$V_{CC} = 12\text{V}$, $V_{VCOMP} = 2\text{V}$		-22		μA
	$V_{CC} = 12\text{V}$, $V_{VCOMP} = 5\text{V}$		-156		μA
	$V_{CC} = 40\text{V}$, $V_{VCOMP} = 2\text{V}$		-2		μA
	$V_{CC} = 40\text{V}$, $V_{VCOMP} = 5\text{V}$		-14		μA
Multiplier Gain Constant	$V_{CC} = 12\text{V}$, $V_{VCOMP} = 5.5\text{V}$ (Note 2)	-1.05	-0.9	-0.75	V^{-1}
Oscillator Section					
Oscillator Initial Frequency	$T_A = 25^{\circ}\text{C}$	56	63	70	kHz
Oscillator Frequency	Line, Load, Temperature	50	63	74	kHz
Synchronization Frequency Range				100	kHz
Synchronization Pulse Amplitude	Pulse slew rate = $100\text{V}/\mu\text{sec}$ (Note 3)		2		V
Output Driver Section					
Maximum Output Voltage	0mA load, $V_{CC} = 20\text{V}$	12	15	17.5	V
Output High	0mA load, $V_{CC} = 12\text{V}$, ref. to V_{CC}	-2.7	-1.7		V
	-50mA load, $V_{CC} = 12\text{V}$, ref. to V_{CC}	-3	-2.2		V
Output Low (Device Inactive)	$V_{CC} = 0\text{V}$, 20mA load (Sinking)		0.9	2.0	V
Output Low (Device Active)	50mA load (Sinking)		0.5	1	V
OUT Rise Time	1nF from OUT to GND		55	100	ns
OUT Fall Time	1nF from OUT to GND		35	100	ns
OUT Maximum Duty Cycle	$V_{ICOMP} = 0\text{V}$	88	93		%
OVP Comparator Section					
Threshold Voltage	Volts Above EA Input V	90	150		mV
Hysteresis			80		mV

Note 1:

$$1\text{PWM modulator gain} = \frac{\Delta\text{DutyCycle}}{\Delta V_{ICOMP}}$$

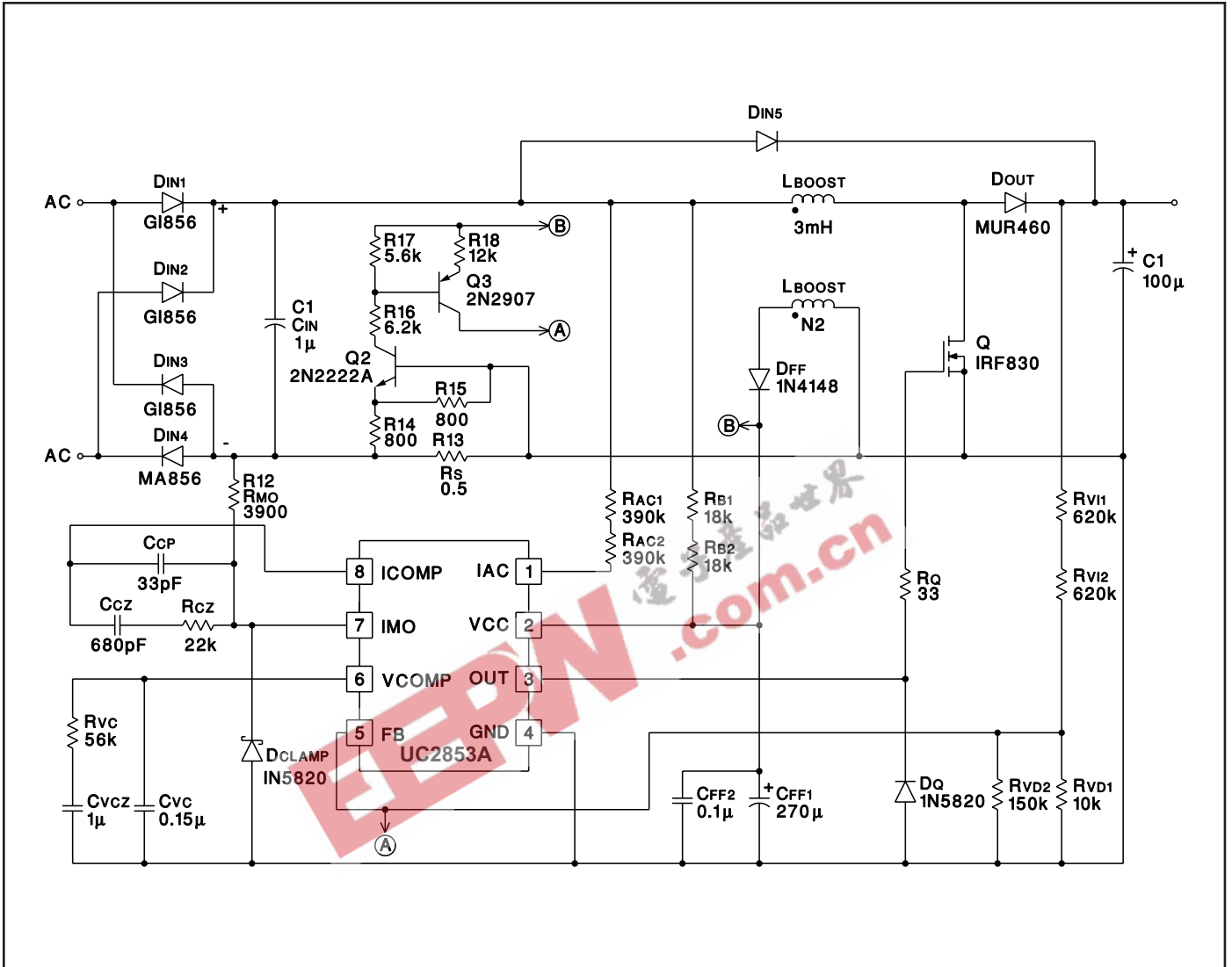
Note 2:

$$\text{Gain constant (K)} = \frac{I_{AC} \cdot (V_{COMP} - 1.5\text{V})}{I_{MO} \cdot V_{CC} \cdot \frac{V_{CC}}{64}}, \quad V_{CC} = 12\text{V}.$$

Note 3:

Synchronization is accomplished with a falling edge of 2V magnitude and $100\text{V}/\mu\text{sec}$ slew rate.

UC2853A TYPICAL APPLICATION



Note: the application circuit shown is a 100W, 63KHz design. Additional application information can be found in Application Note U-159 (TI literature Number SLUA080) and Design Note DN-78.

PIN DESCRIPTIONS

FB: Voltage Amplifier Inverting Input, Overvoltage Comparator Input, Sync Input. This pin serves three functions. FB accepts a fraction of the power factor corrected output voltage through a voltage divider, and is nominally regulated to 3V. FB voltages 5% greater than nominal will trip the overvoltage comparator, and shut down the output stage until the output voltage drops 5%. The internal oscillator can be synchronized through FB by injecting a 2V clock signal through a capacitor. To prevent false tripping of the overvoltage comparator, the clock signal must have a fast falling edge, but a slow rising edge. See Application Note U-159 for more information.

GND: Ground. All voltages are measured with respect to GND. The VCC bypass capacitor should be connected to ground as close to the GND pin as possible.

IAC: AC Waveform Input. This input provides voltage waveform information to the multiplier. The current loop will try to produce a current waveform with the same shape as the IAC signal. IAC is a low impedance input, nominally at 2V, which accepts a current proportional to the input voltage. Connect a resistor from the rectified input line to IAC which will conduct 500 μ A at maximum line voltage.

IMO: Multiplier Output and Current Sense Inverting Input. The output of the multiplier and the inverting input of the current amplifier are connected together at IMO. Avoid bringing this input below $-0.5V$ to prevent the internal protection diode from conducting. The multiplier output is a current, making this a summing node and allowing a differential current error amplifier configuration to reject ground noise. The input resistance at this node should be 3.9k to minimize input bias current induced offset voltage. See the Applications section for the recommended circuit configuration.

OUT: Gate Driver Output. OUT provides high current gate drive for the external power MOSFET. A 15V clamp pre-

vents excessive MOSFET gate-to-source voltage so that the UC2853A can be operated with VCC and high as 40V. A series gate resistor of at least 5 ohms should be used to minimize clamp voltage overshoot. In addition, a Schottky diode such as a 1N5818 connected between OUT and GND may be necessary to prevent parasitic substrate diode conduction.

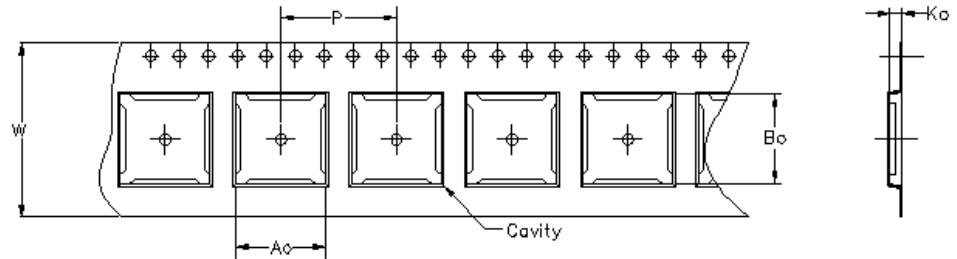
ICOMP: Current Loop Error Amplifier Output. The current loop error amplifier is a conventional operational amplifier with a 150 μ A current source class A output stage. Compensate the current loop by placing an impedance between ICOMP and IMO. This output can swing above the oscillator peak voltage, allowing zero duty cycle when necessary.

VCC: Input Supply Voltage. This pin serves two functions. It supplies power to the chip, and an input voltage level signal to the squarer circuit. When this input is connected to a DC voltage proportional to the AC input RMS voltage, the voltage loop gain is reduced by

$$\frac{64}{V_{CC}^2}$$

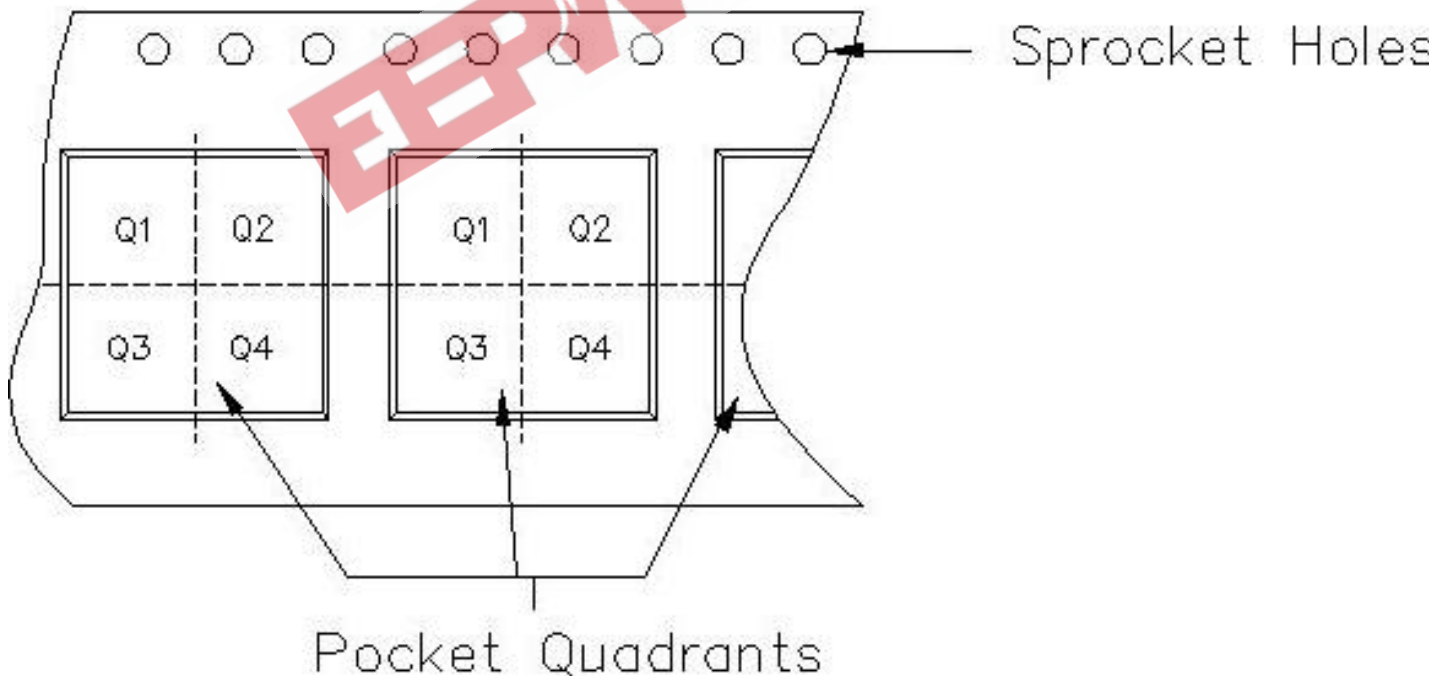
This configuration maintains constant loop gain. The UC2853A input voltage range extends from 12V to 40V, allowing an AC supply voltage range in excess of 85VAC to 265VAC. Bypass VCC with at least a 0.1 μ F ceramic capacitor to ensure proper operation. See the Applications section for the recommended circuit configuration.

VCOMP: Voltage Loop Error Amplifier Output. The voltage loop error amplifier is a transconductance type operational amplifier. A feedback impedance between VCOMP and FB for loop compensation must be avoided to maintain proper operation of the overvoltage protection comparator. Instead, compensate the voltage loop with an impedance between VCOMP and GND. When VCOMP is below 1.5V, the multiplier output current is zero.



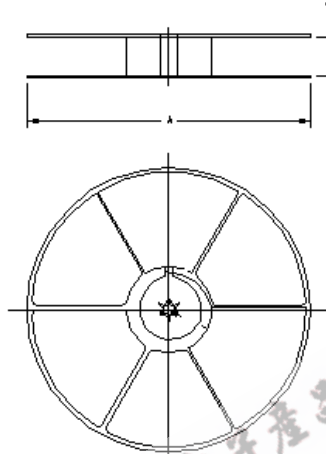
Carrier tape design is defined largely by the component length, width, and thickness.

A_o = Dimension designed to accommodate the component width.
B_o = Dimension designed to accommodate the component length.
K_o = Dimension designed to accommodate the component thickness.
W = Overall width of the carrier tape.
P = Pitch between successive cavity centers.



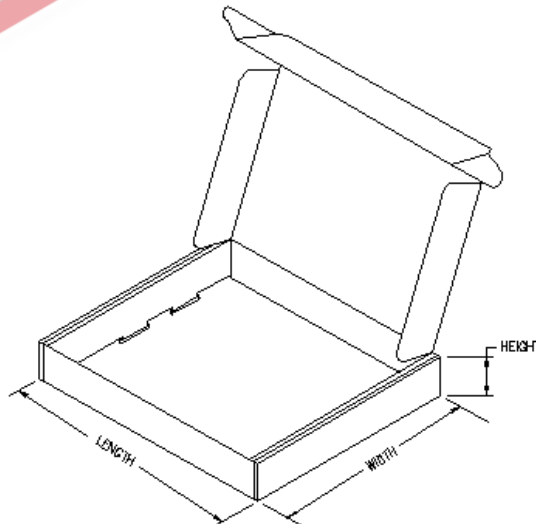
TAPE AND REEL INFORMATION

Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
UC2853ADTR	D	8	MLA	330	12	6.4	5.2	2.1	8	12	Q1



TAPE AND REEL BOX INFORMATION

Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
UC2853ADTR	D	8	MLA	346.0	346.0	29.0



MECHANICAL DATA

MPDI001A – JANUARY 1995 – REVISED JUNE 1999

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

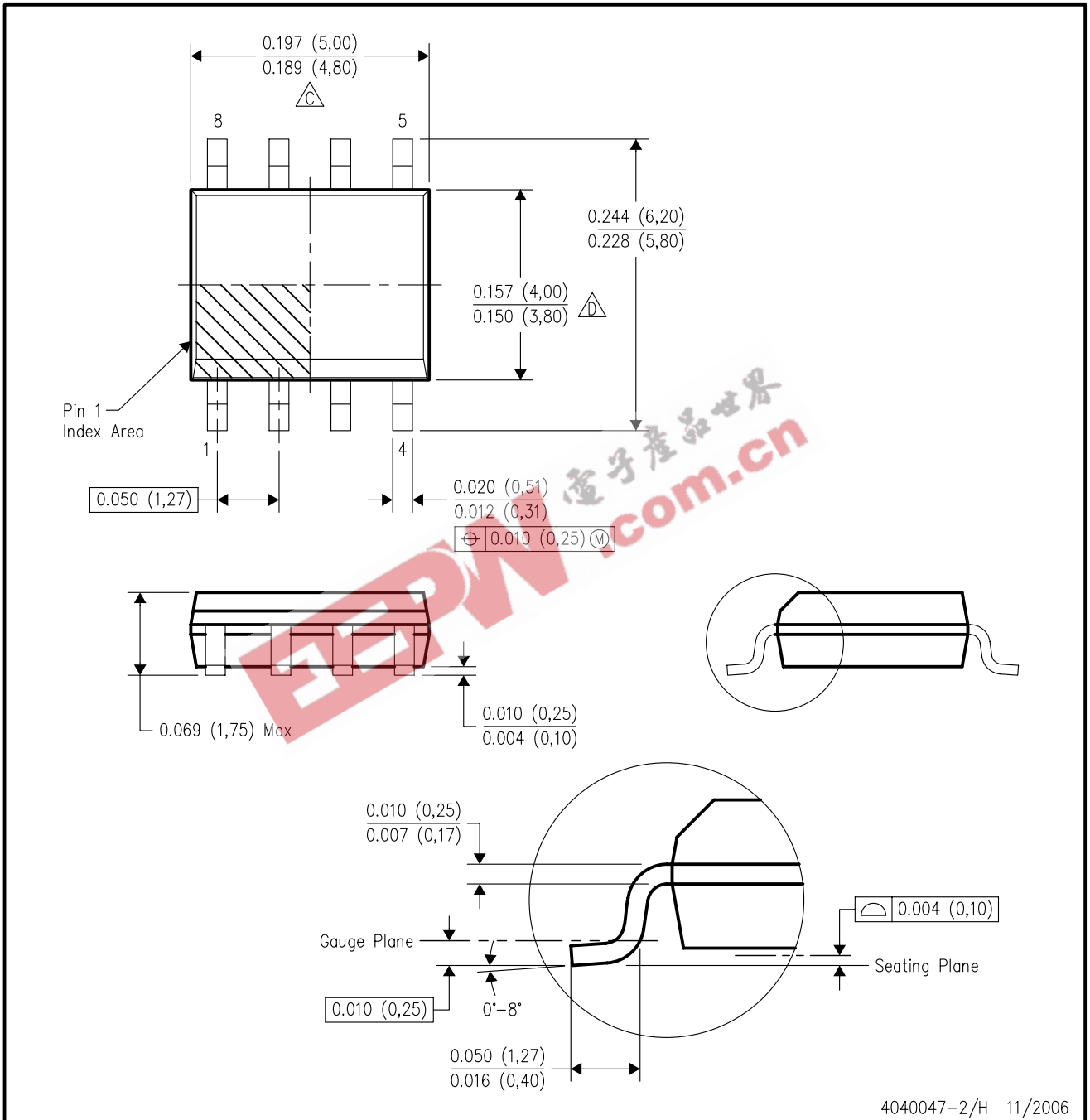


POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

MECHANICAL DATA

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated