

- LVD-Only Active Termination
- 2.7 V to 5.25 V Operation
- Differential Failsafe Bias
- Built-In SPI-3 Mode Change Filter/Delay

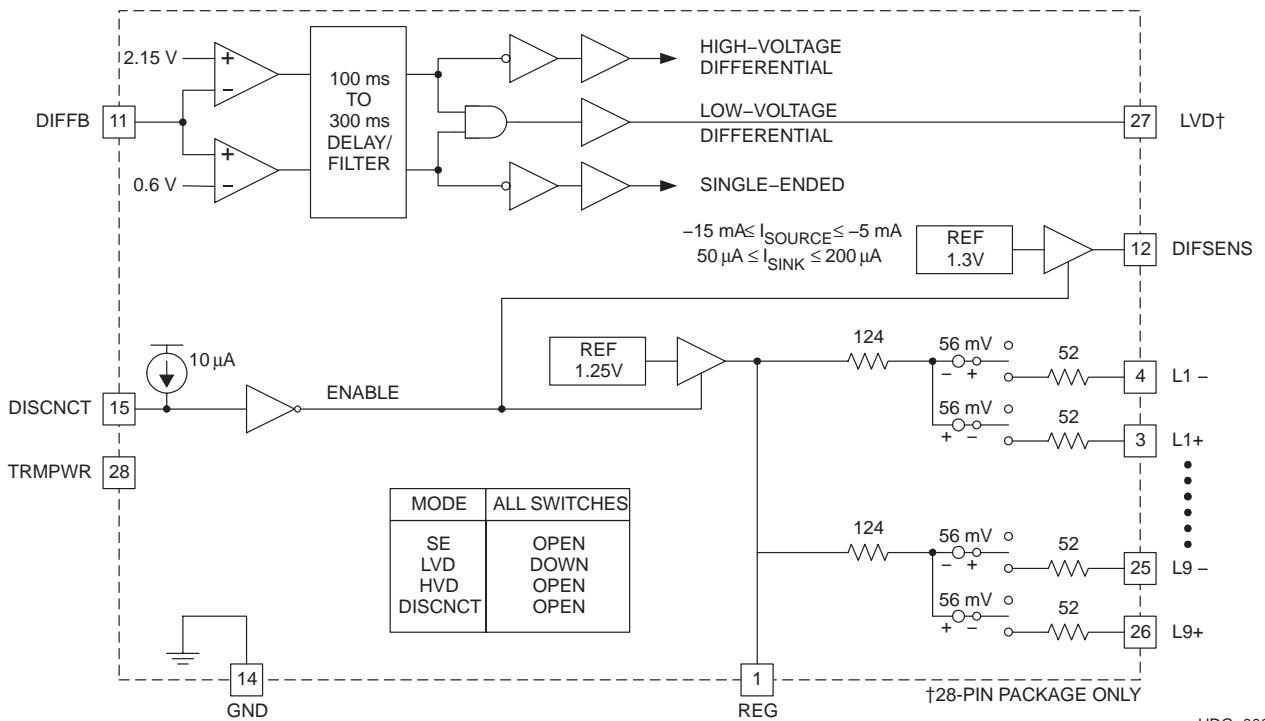
- Standards Supported: SPI-2, SPI-3, SPI-4, Ultra2 (Fast 40), Ultra3/Ultra160 (Fast 80) and Ultra320 (Fast 160)

**description**

The UCC5680 is an LVD-only Small Computer System Interface (SCSI) terminator that integrates the mode change delay function required by the SPI-3 specification. The device senses what types of SCSI drivers are present on the bus via the voltage on the DIFFSENS SCSI control line. Single-ended (SE) and high-voltage differential (HVD) SCSI drivers (EIA485) are not supported. If the chip detects the presence of an SE or HVD SCSI driver, it disconnects itself by switching all terminating resistors off the bus and enters a high-impedance state. The terminator can also be commanded to disconnect the terminating resistors with the DISCNCT input. Impedance is trimmed for accuracy and maximum effectiveness. Bus lines are biased to a failsafe state to ensure signal integrity.

The UCC5680 is offered in both 24-pin and 28-pin TSSOP (PW) packages for a temperature range of 0°C to 70°C.

**functional block diagram**



UDG-00067



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

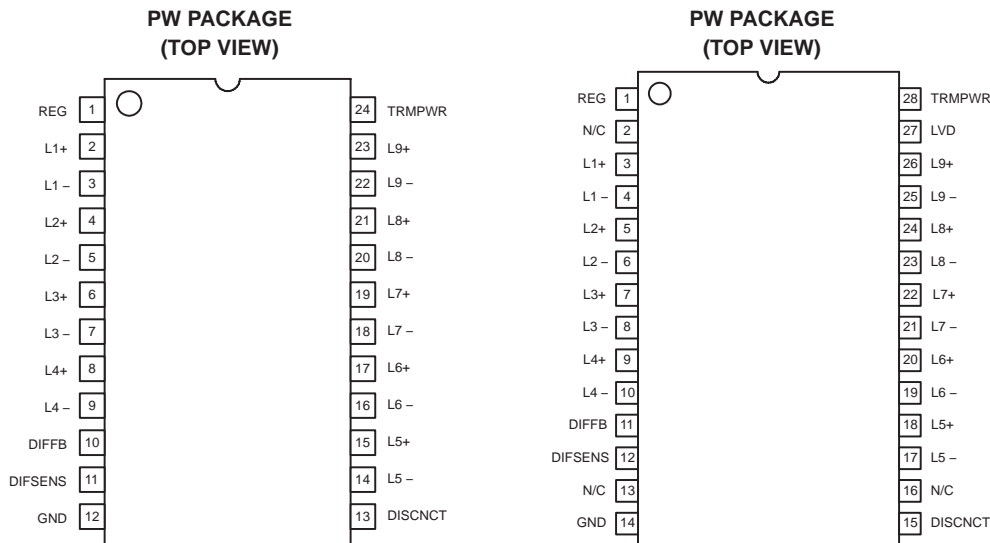
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 2000, Texas Instruments Incorporated

**UCC5680**  
**9-LINE LVD ONLY SCSI TERMINATOR**  
**WITH INTEGRATED SPI-3 DELAYS**

SLUS313D – MARCH 1999 - REVISED NOVEMBER 2003

**TSSOP PACKAGE (TOP VIEW)**



**ordering information**

T <sub>A</sub> = T <sub>J</sub>	PACKAGED DEVICE†	
	TSSOP-24 (PW)	TSSOP-28 (PW)
0°C to 70°C	UCC5680PW24	UCC5680PW28

† The PW package is available taped and reeled in quantities of 2,000. Add TR suffix to device type (e.g. UCC5680PWTR) to order quantities of 2,000 devices per reel.

**absolute maximum ratings over operating free-air temperature (unless otherwise noted)†**

TERMPWR Voltage	6 V
Signal Line Voltage	0 V to 5 V
Package Dissipation	0.5 W
Storage Temperature	-65°C to 150°C
Junction Temperature	-55°C to 150°C
Lead Temperature (Soldering, 10 sec.)	300°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**recommended operating conditions**

TERMPWR Voltage	2.7 V to 5.25 V
Operating Temperature Range	0°C to 70°C

electrical characteristics over recommended operating free-air temperature range,  
 $T_A = T_J = 0^\circ\text{C}$  to  $70^\circ\text{C}$ , TRMPWR = 2.7 V to 5.25 V

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>TRMPWR Supply Current Section</b>					
TRMPWR supply current	LVD Mode (No Load)			35	mA
	Disabled Mode			500	$\mu\text{A}$
<b>Regulator Section</b>					
Regulator output voltage	$0.5\text{ V} \leq V_{\text{CM}} \leq 2.0$ , See Note 1	1.15	1.25	1.35	V
Regulator short-circuit source current	$V_{\text{REG}} = 0\text{ V}$		-100	-80	mA
Regulator short-circuit sink current	$V_{\text{REG}} = 3.0\text{ V}$	80	100		mA
<b>DIFSENS Output Section</b>					
Output voltage	$-5\text{ mA} \leq I_{\text{DIFSENS}} \leq 50\ \mu\text{A}$	1.2	1.3	1.4	V
Short-circuit source current	$V_{\text{DIFSENS}} = 0\text{ V}$	-15		-5	mA
Short-circuit sink current	$V_{\text{DIFSENS}} = 2.75\text{ V}$	50		200	$\mu\text{A}$
<b>Differential Termination Section</b> (Applies to each line pair, 1-9, in LVD mode)					
Differential impedance		100	105	110	$\Omega$
Common-mode impedance	L+ and L- shorted together, See Note 2	110	150	165	$\Omega$
Differential bias voltage		100		125	mV
Common-mode bias voltage	L+ and L- shorted together	1.15	1.25	1.35	V
<b>Disconnected Termination Section</b> (Applies to each line pair, 1-9, in DISCNCT, SE or HVD mode)					
Output leakage				400	nA
Output capacitance	Single-ended measurement to ground, See Note 3			3	pF
<b>DISCNCT and DIFFB Input Section</b>					
DISCNCT threshold		0.8		2.0	V
DISCNCT input current	$V_{\text{DISCNCT}} = 0\text{ V}$ and $2.0\text{ V}$	-30	-10		$\mu\text{A}$
DIFFB SE to LVD threshold		0.5		0.7	V
DIFFB LVD to HVD threshold		1.9		2.4	V
DIFFB input current	$0\text{ V} \leq V_{\text{DIFFB}} \leq 2.75\text{ V}$	-10		10	$\mu\text{A}$
<b>Low Voltage Differential (LVD) Status Bit Section</b> (See Note 4)					
$I_{\text{SOURCE}}$	$V_{\text{LOAD}} = 2.4\text{ V}$		-6	-4	mA
$I_{\text{SINK}}$	$V_{\text{LOAD}} = 0.4\text{ V}$	2	5		mA
<b>Time Delay/Filter Section</b>					
Mode change delay	A new mode change can start any time after a previous mode change has been detected	100	190	300	ms
<b>Thermal Shutdown Section</b>					
Thermal shutdown threshold	For increasing temperature	140	155	170	$^\circ\text{C}$
Thermal shutdown hysteresis			10		$^\circ\text{C}$

- NOTES: 1.  $V_{\text{CM}}$  is applied to all L+ and L- lines simultaneously.
2.  $Z_{\text{CM}} = \frac{(2.0\text{V} - 0.5\text{V})}{[I_{\text{VCM}(\text{max})} - I_{\text{VCM}(\text{min})}]}$  @  $V_{\text{CM}(\text{max})} = 2.0$ ,  $V_{\text{CM}(\text{min})} = 0.5\text{ V}$
3. Ensured by design, not production tested.
4. This applies to the 28-pin package only.

# UCC5680

## 9-LINE LVD ONLY SCSI TERMINATOR WITH INTEGRATED SPI-3 DELAYS

SLUS313D – MARCH 1999 - REVISED NOVEMBER 2003

---

### pin descriptions

**DIFFB:** DIFFSENS input pin. Connect through a 20-k $\Omega$  resistor to DIFSENS and through a 0.1- $\mu$ F capacitor to ground. Input to comparators that detect what types of drivers are connected to the SCSI bus.

**DIFSENS:** SCSI bus DIFSENS line driver.

**DISCNCT:** Disconnect pin. Shuts down the terminator (switches terminating resistors off the bus) when open or active (high). The disconnect pin low enables the terminator.

**GND:** Power supply return.

**LINE $n$ -:** Line termination pins. Negative line in differential pair.

**LINE $n$ +:** Line termination pins. Positive line in differential pair.

**LVD:** (28-pin package only) Indicates that the bus is in LVD mode.

**REG:** Regulator bypass pin. Bypass near the terminator with a 4.7- $\mu$ F and a high-frequency, low-ESR 0.01- $\mu$ F capacitor to ground.

**TRMPWR:**  $V_{IN}$  2.75 V to 5.25 V supply. Bypass near the terminator with a 4.7- $\mu$ F and a high-frequency, low-ESR 0.01- $\mu$ F capacitor to ground.

---

## APPLICATION INFORMATION

All SCSI buses require a termination network at each end to function properly. Specific termination requirements differ, depending on which types of SCSI driver devices are present on the bus. The UCC5680 is a low-voltage differential (LVD)-only device. It senses which types of drivers are present on the bus. If it detects the presence of a single-ended (SE) or high-voltage differential (HVD) driver, the UCC5680 will place itself in a high-impedance input state, effectively disconnecting the chip from the bus.

The UCC5680 senses what kinds of drivers are present on the bus by the voltage on SCSI bus control line DIFFSENS, which is monitored by the DIFFB input pin. The DIFSENS output pin on the UCC5680 attempts to drive a DIFFSENS control line to 1.3 V. If only LVD devices are present, the DIFFSENS line will be successfully driven to that voltage. If HVD drivers are present, they will pull the DIFFSENS line high. If any single-ended drivers are present, they pull the DIFSENS line to ground (even if HVD drivers are also present on the bus). If the voltage on the DIFFB is below 0.5 V or above 2.4 V, the UCC5680 enters the high-impedance SE/HVD state. If it is between 0.7 V and 1.9 V, the UCC5680 enters the LVD mode. These thresholds accommodate differences in ground potential that can occur between the ends of long bus lines.

Three UCC5680 ICs are required at each end of the SCSI bus to terminate 27 lines (18 data, 9 control). Every UCC5680 contains a DIFSENS driver, but only one should be used to drive the line at each end. The DIFSENS pin on the other devices should be left unconnected.

On power up (the voltage on the TRMPWR pin rising above 2.7 V), the UCC5680 assumes the SE/HVD mode. If the voltage on the DIFFB input indicates LVD mode, the chip waits 100 ms to 300 ms before changing the mode of the bus. If the voltage at the DIFFB input later crosses one of the thresholds, the UCC5680 again waits 100 ms to 300 ms before changing the mode of the bus. The magnitude of the delay is the same when changing in or out of either bus mode. A new mode change can start anytime after a previous mode change has been detected.

The DIFFB inputs on all three chips at each end of the bus should be connected together. Properly filtered, noise on DIFFB will not cause a false mode change. There should be a shared 50-Hz noise filter implemented on DIFFB at each end of the bus as close as possible to the DIFFB pins. This is implemented with a 20-k $\Omega$  resistor between the DIFFB and DIFSENS pins, and a 0.1- $\mu$ F capacitor from DIFFB to ground. See the *Typical Application* diagram at the end of this datasheet.

**APPLICATION INFORMATION (continued)**

In LVD mode, the regulated voltage is switched to 1.25 V and a resistor network is presented to each line pair that provides common-mode impedance of 150 Ω and differential impedance of 105 Ω. The lines in each differential pair are biased so that when not driven, Line(n)+ and Line(n)– are driven 56 mV below and above the common-mode bias voltage (1.25 V) respectively.

In SE/HVD mode, all the terminating resistors are switched off the bus. The 1.25-V and 1.3-V (DIFSENS) regulators are left on.

When the disconnect input (DISCNCT) is active (high), the terminating resistors are switched off the bus and both voltage regulators are turned off to save power. The mode change filter/delay function is still active and the LVD pin (in the 28-pin package) continues to indicate the correct bus mode.

The UCC5680 operates down to a TRMPWR voltage of 2.7 V. This accommodates a 3.3-V system with allowance for supply tolerance (±10%), a unidirectional fusing device, and cable drop. The UCC3916 is recommended in place of a fuse and diode implementation, as its lower voltage drop provides additional voltage margin for the system.

Layout is important in all SCSI implementations and critical in SPI-3 systems, which have stringent requirements on both the absolute value of capacitance on differential signal lines and the balancing of capacitance between paired lines and from pair to pair.

Feedthroughs, through-hole connections, and etch lengths need to be carefully balanced. Standard multilayer power and ground plane spacing adds about 1 pF to each plane. Each feed-through will add 2.5 pF to 3.5 pF. Enlarging the clearance holes on both power and ground planes reduces capacitance. Opening up the power and ground planes under a through-hole connector reduces added capacitance in those applications. Capacitance is also affected by components in close proximity on both sides of the board.

**maximum capacitance**

SCSI Class	Trace to GND: REQ, ACK, DATA, Parity, P_CRCA	Trace to Trace: REQ, ACK, DATA, Parity, P_CRCA	Trace to GND: Other signals	Trace to Trace: Other Signals
Ultra1	25 pF	N/A	25 pF	N/A
Ultra2	20 pF	10 pF	25 pF	13 pF
Ultra3/Ultra160	15 pF	8 pF	25 pF	13 pF
Ultra320	13 pF	6.5 pF	21 pF (est.)	10 pF (est.)

TI terminators are designed with very tightly controlled capacitance on their signal lines. Between the positive and negative lines in a differential pair the difference is typically no more than 0.1 pF, and only 0.3 pF between pairs.

Multi-layer boards need to adhere to the 120-Ω impedance standard, including the connector and feedthroughs. Bus traces are normally run on the outer layers of the board with 4-mil etch and 4-mil spacing between the two lines in each differential pair, and a minimum of 8-mil spacing to adjacent pairs to minimize crosstalk. Microstrip technology is too low in impedance and should not be used—it is designed for 50 Ω rather than 120-Ω differential systems.

Decoupling capacitors should be installed as close as possible to the following input pins of the UCC5680:

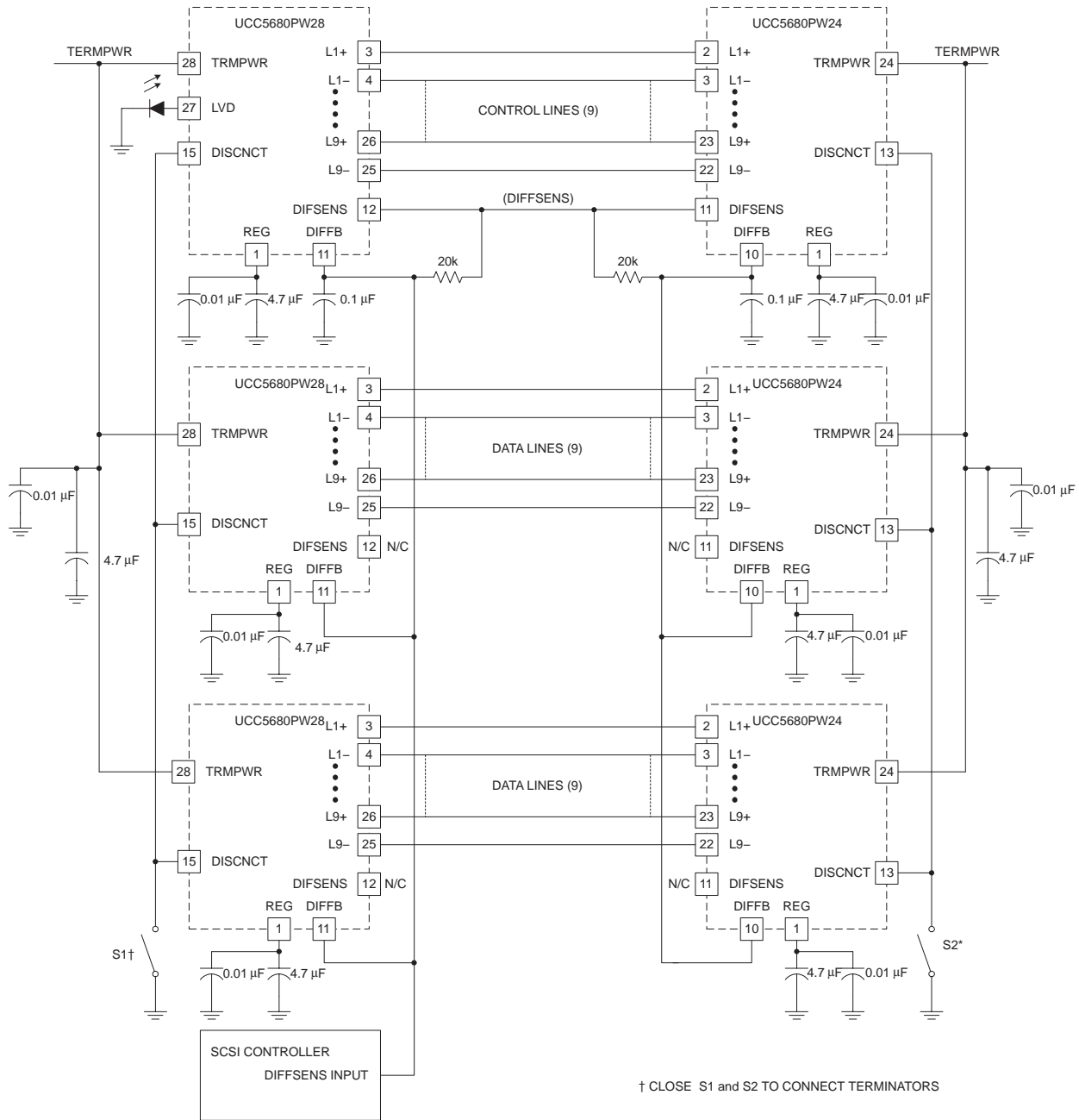
TRMPWR: 4.7-μF capacitor to ground, 0.01-μF capacitor to ground (high-frequency, low ESR)

REG: 4.7-μF capacitor to ground, 0.01-μF capacitor to ground (high-frequency, low ESR)

# UCC5680 9-LINE LVD ONLY SCSI TERMINATOR WITH INTEGRATED SPI-3 DELAYS

SLUS313D – MARCH 1999 - REVISED NOVEMBER 2003

## TYPICAL APPLICATION



UDG-00005

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
UCC5680PW24	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Request Free Samples</a>
UCC5680PW24G4	ACTIVE	TSSOP	PW	24	60	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Request Free Samples</a>
UCC5680PW28	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Request Free Samples</a>
UCC5680PW28G4	ACTIVE	TSSOP	PW	28	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Request Free Samples</a>
UCC5680PW28TR	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Purchase Samples</a>
UCC5680PW28TRG4	ACTIVE	TSSOP	PW	28	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Purchase Samples</a>

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.



**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
UCC5680PW28TR	TSSOP	PW	28	2000	330.0	16.4	7.1	10.4	1.6	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



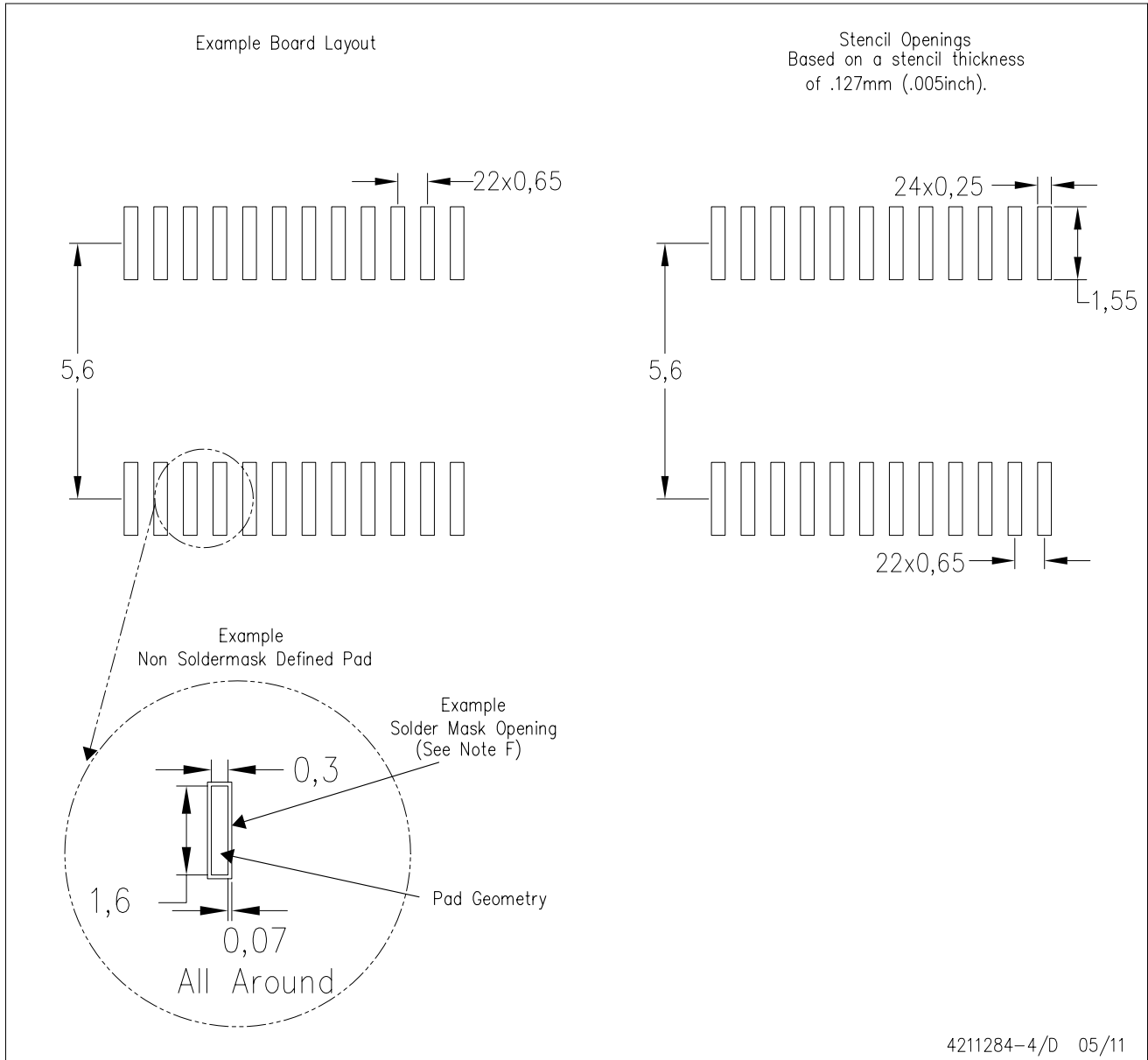
\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
UCC5680PW28TR	TSSOP	PW	28	2000	346.0	346.0	33.0



PW (R-PDSO-G24)

PLASTIC SMALL OUTLINE

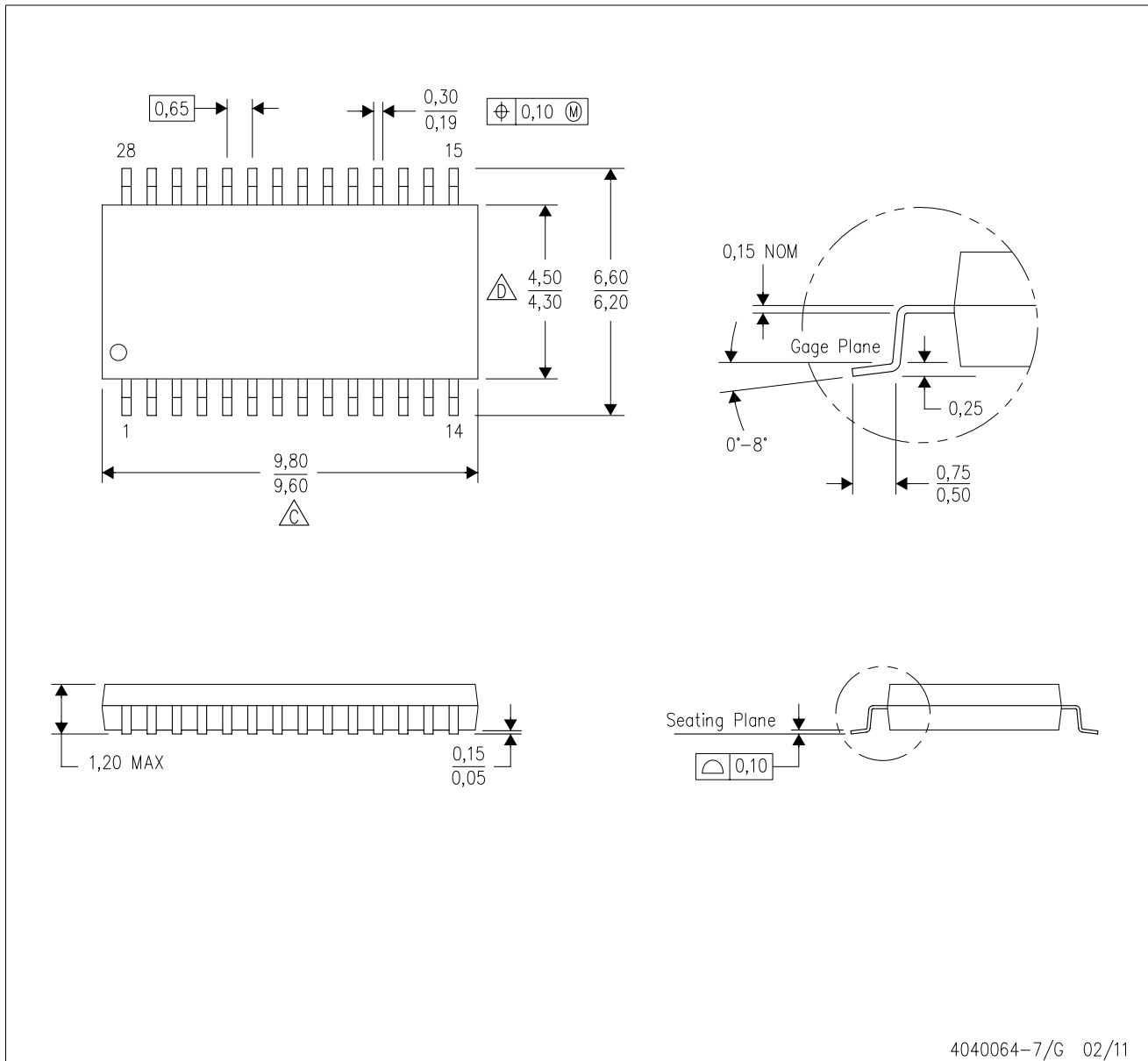


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate design.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# MECHANICAL DATA

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE



4040064-7/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

## 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

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>

TI E2E Community Home Page

[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated

[www.BDTIC.com/TI](http://www.BDTIC.com/TI)