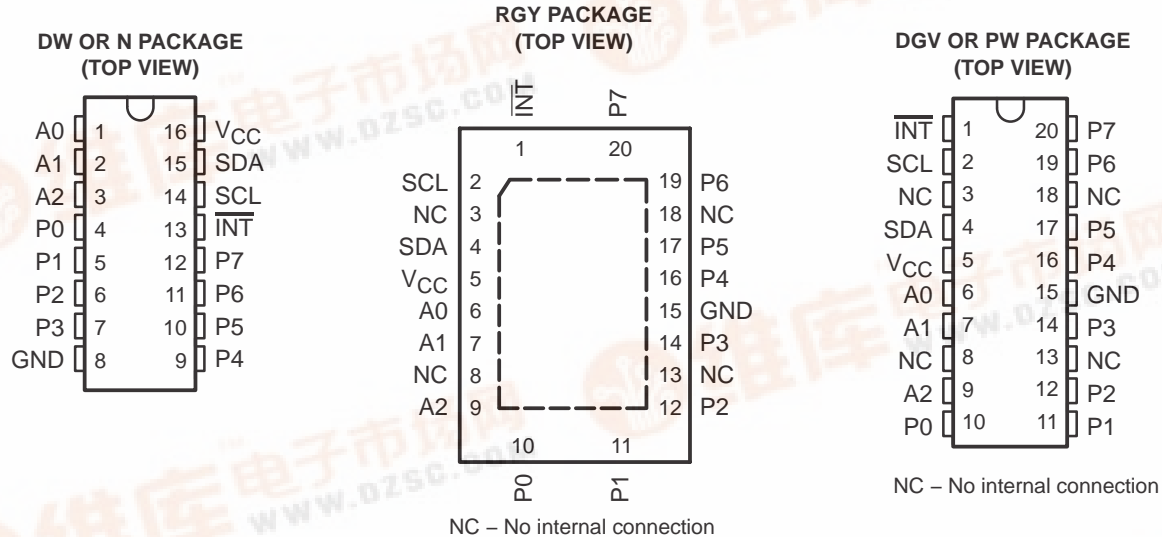


- Low Standby-Current Consumption of 10  $\mu$ A Maximum
- I<sup>2</sup>C to Parallel-Port Expander
- Open-Drain Interrupt Output
- Compatible With Most Microcontrollers
- Latched Outputs With High-Current Drive Capability for Directly Driving LEDs
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II



## description/ordering information

This 8-bit input/output (I/O) expander for the two-line bidirectional bus (I<sup>2</sup>C) is designed for 2.5-V to 6-V V<sub>CC</sub> operation.

The PCF8574 provides general-purpose remote I/O expansion for most microcontroller families via the I<sup>2</sup>C interface [serial clock (SCL), serial data (SDA)].

The device features an 8-bit quasi-bidirectional I/O port (P0–P7), including latched outputs with high-current drive capability for directly driving LEDs. Each quasi-bidirectional I/O can be used as an input or output without the use of a data-direction control signal. At power on, the I/Os are high. In this mode, only a current source to V<sub>CC</sub> is active. An additional strong pullup to V<sub>CC</sub> allows fast rising edges into heavily loaded outputs. This device turns on when an output is written high and is switched off by the negative edge of SCL. The I/Os should be high before being used as inputs.

## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	QFN – RGY	Tape and reel	PCF8574RGYR	PF574
	PDIP – N	Tube	PCF8574N	PCF8574N
	SOIC – DW	Tube	PCF8574DW	PCF8574
		Tape and reel	PCF8574DWR	
	TSSOP – PW	Tape and reel	PCF8574PWR	PF574
	TVSOP – DGV	Tape and reel	PCF8574DGVR	PF574

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

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.

# PCF8574

## REMOTE 8-BIT I/O EXPANDER FOR I<sup>2</sup>C BUS

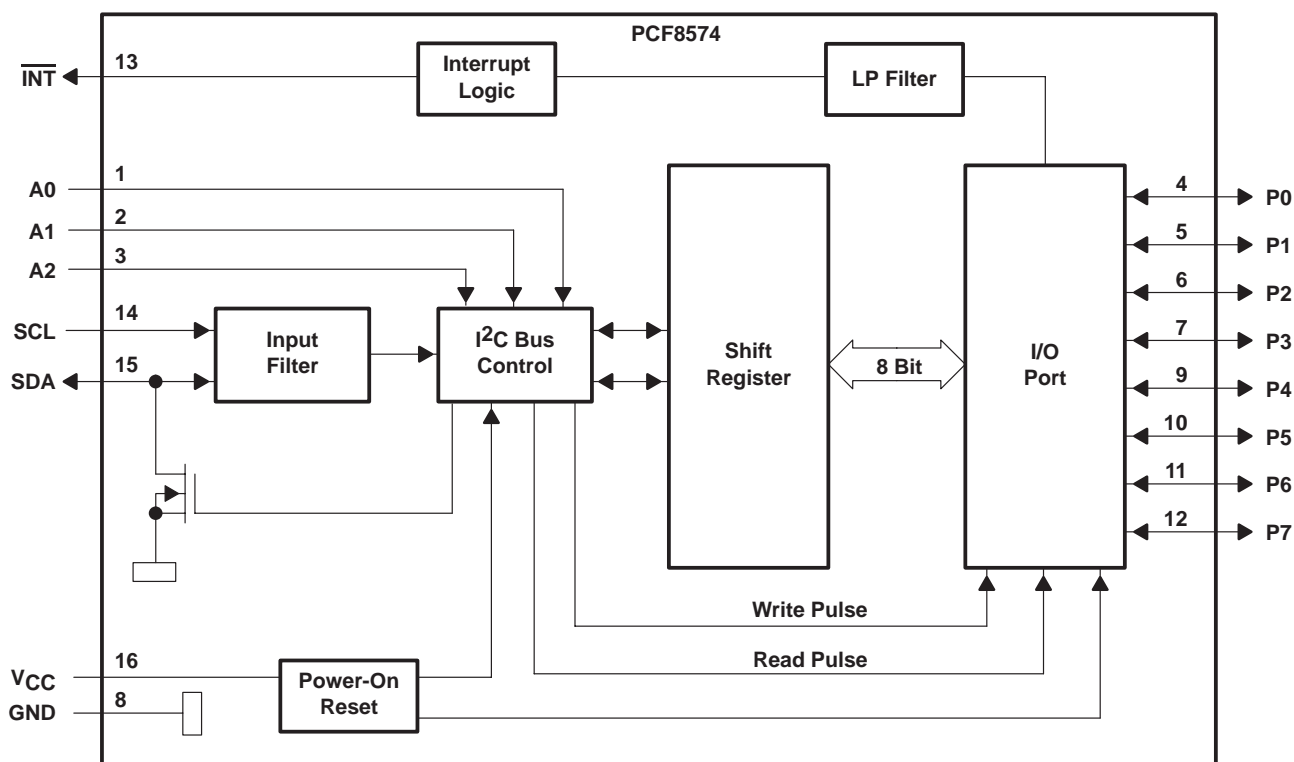
SCPS068C - JULY 2001 – REVISED JANUARY 2004

### description/ordering information (continued)

The PCF8574 provides an open-drain output ( $\overline{\text{INT}}$ ) that can be connected to the interrupt input of a microcontroller. An interrupt is generated by any rising or falling edge of the port inputs in the input mode. After time  $t_{\text{IV}}$ ,  $\overline{\text{INT}}$  is valid. Resetting and reactivating the interrupt circuit is achieved when data on the port is changed to the original setting or data is read from, or written to, the port that generated the interrupt. Resetting occurs in the read mode at the acknowledge bit after the rising edge of the SCL signal or in the write mode at the acknowledge bit after the high-to-low transition of the SCL signal. Interrupts that occur during the acknowledge clock pulse can be lost (or be very short) due to the resetting of the interrupt during this pulse. Each change of the I/Os after resetting is detected and, after the next rising clock edge, is transmitted as  $\overline{\text{INT}}$ . Reading from, or writing to, another device does not affect the interrupt circuit.

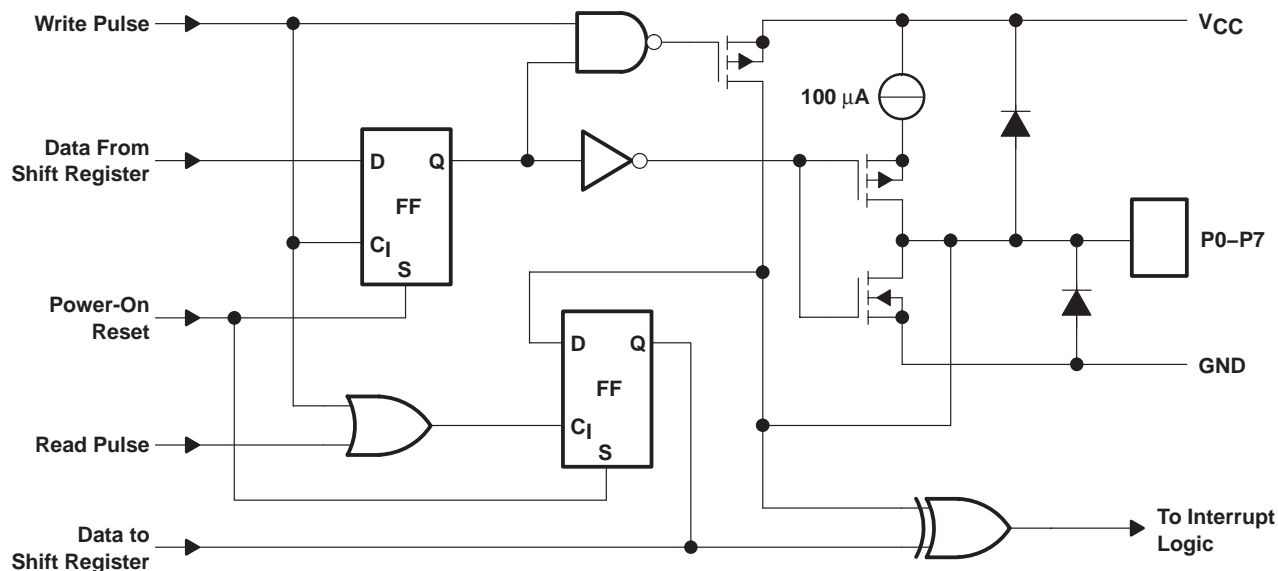
By sending an interrupt signal on this line, the remote I/O can inform the microcontroller if there is incoming data on its ports without having to communicate via the I<sup>2</sup>C bus. Therefore, the PCF8574 can remain a simple slave device.

### logic diagram (positive logic)



Pin numbers shown are for the DW and N packages.

**simplified schematic diagram of each P-port input/output**



## I<sup>2</sup>C interface

2C communication with this device is initiated by a master sending a start condition, a high-to-low transition on the SDA I/O while the SCL input is high. After the start condition, the device address byte is sent, most-significant bit (MSB) first, including the data direction bit ( $R/\overline{W}$ ). This device does not respond to the general call address. After receiving the valid address byte, this device responds with an acknowledge, a low on the SDA I/O during the high of the acknowledge-related clock pulse. The address inputs (A0–A2) of the slave device must not be changed between the start and the stop conditions.

The data byte follows the address acknowledge. If the  $\overline{R}/\overline{W}$  bit is high, the data from this device are the values read from the P port. If the  $\overline{R}/\overline{W}$  bit is low, the data are from the master, to be output to the P port. The data byte is followed by an acknowledge sent from this device. If other data bytes are sent from the master, following the acknowledge, they are ignored by this device. Data are output only if complete bytes are received and acknowledged. The output data will be valid at time  $t_{pv}$  after the low-to-high transition of SCL and during the clock cycle for the acknowledge.

A stop condition, which is a low-to-high transition on the SDA I/O while the SCL input is high, is sent by the master.

## INTERFACE DEFINITION

BYTE	BIT							
	7 (MSB)	6	5	4	3	2	1	0 (LSB)
I <sup>2</sup> C slave address	L	H	L	L	A2	A1	AO	R/ $\overline{W}$
I/O data bus	P7	P6	P5	P4	P3	P2	P1	P0

# PCF8574

## REMOTE 8-BIT I/O EXPANDER FOR I<sup>2</sup>C BUS

SCPS068C - JULY 2001 – REVISED JANUARY 2004

ADDRESS REFERENCE

INPUTS			I <sup>2</sup> C-BUS SLAVE ADDRESS
A2	A1	A0	
L	L	L	32 (decimal), 20 (hexadecimal)
L	L	H	33 (decimal), 21 (hexadecimal)
L	H	L	34 (decimal), 22 (hexadecimal)
L	H	H	35 (decimal), 23 (hexadecimal)
H	L	L	36 (decimal), 24 (hexadecimal)
H	L	H	37 (decimal), 25 (hexadecimal)
H	H	L	38 (decimal), 26 (hexadecimal)
H	H	H	39 (decimal), 27 (hexadecimal)

### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage range, $V_{CC}$	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range, $V_O$ (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ )	–20 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ )	–20 mA
Input/Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )	±400 $\mu$ A
Continuous output low current, $I_{OL}$ ( $V_O = 0$ to $V_{CC}$ )	50 mA
Continuous output high current, $I_{OH}$ ( $V_O = 0$ to $V_{CC}$ )	–4 mA
Continuous current through $V_{CC}$ or GND	±100 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DGV package	92°C/W
(see Note 2): DW package	57°C/W
(see Note 2): N package	67°C/W
(see Note 2): PW package	83°C/W
(see Note 3): RGY package	37°C/W
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> 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.

- NOTES: 1. The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.  
3. The package thermal impedance is calculated in accordance with JESD 51-5.

### recommended operating conditions

	MIN	MAX	UNIT
$V_{CC}$ Supply voltage	2.5	6	V
$V_{IH}$ High-level input voltage	$0.7 \times V_{CC}$	$V_{CC} + 0.5$	V
$V_{IL}$ Low-level input voltage	–0.5	$0.3 \times V_{CC}$	V
$I_{OH}$ High-level output current		–1	mA
$I_{OL}$ Low-level output current		25	mA
$T_A$ Operating free-air temperature	–40	85	°C

# PCF8574

## REMOTE 8-BIT I/O EXPANDER FOR I<sup>2</sup>C BUS

SCPS068C - JULY 2001 – REVISED JANUARY 2004

**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	V <sub>CC</sub>	MIN	TYP†	MAX	UNIT
V <sub>IK</sub>	Input diode clamp voltage	I <sub>I</sub> = –18 mA	2.5 V to 6 V	–1.2			V
V <sub>POR</sub>	Power-on reset voltage‡	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	6 V		1.3	2.4	V
I <sub>OH</sub>	P port	V <sub>O</sub> = GND	2.5 V to 6 V	30		300	μA
I <sub>OHT</sub>	P-port transient pullup current	High during acknowledge V <sub>OH</sub> = GND	2.5 V		–1		mA
I <sub>OL</sub>	SDA	V <sub>O</sub> = 0.4 V	2.5 V to 6 V	3			mA
	P port	V <sub>O</sub> = 1 V	5 V	10	25		
	$\overline{\text{INT}}$	V <sub>O</sub> = 0.4 V	2.5 V to 6 V	1.6			
I <sub>I</sub>	SCL, SDA	V <sub>I</sub> = V <sub>CC</sub> or GND	2.5 V to 6 V			±5	μA
	$\overline{\text{INT}}$					±5	
	A0, A1, A2					±5	
I <sub>IHL</sub>	P port	V <sub>I</sub> ≥ V <sub>CC</sub> or V <sub>I</sub> ≤ GND	2.5 V to 6 V			±400	μA
I <sub>CC</sub>	Operating mode	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0, f <sub>SCL</sub> = 100 kHz	6 V		40	100	μA
	Standby mode	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0			2.5	10	
C <sub>i</sub>	SCL	V <sub>I</sub> = V <sub>CC</sub> or GND	2.5 V to 6 V		1.5	7	pF
C <sub>io</sub>	SDA	V <sub>IO</sub> = V <sub>CC</sub> or GND	2.5 V to 6 V		3	7	pF
	P port				4	10	

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

‡ The power-on reset circuit resets the I<sup>2</sup>C-bus logic with V<sub>CC</sub> < V<sub>POR</sub> and sets all I/Os to logic high (with current source to V<sub>CC</sub>).

**I<sup>2</sup>C interface timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)**

			MIN	MAX	UNIT
f <sub>scl</sub>	I <sup>2</sup> C clock frequency		100		kHz
t <sub>sch</sub>	I <sup>2</sup> C clock high time		4		μs
t <sub>scl</sub>	I <sup>2</sup> C clock low time		4.7		μs
t <sub>sp</sub>	I <sup>2</sup> C spike time		100		ns
t <sub>sds</sub>	I <sup>2</sup> C serial data setup time		250		ns
t <sub>sdh</sub>	I <sup>2</sup> C serial data hold time		0	900	ns
t <sub>icr</sub>	I <sup>2</sup> C input rise time		1		μs
t <sub>icf</sub>	I <sup>2</sup> C input fall time		0.3		μs
t <sub>ocf</sub>	I <sup>2</sup> C output fall time (10-pF to 400-pF bus)		300		ns
t <sub>buf</sub>	I <sup>2</sup> C-bus free time between stop and start		4.7		μs
t <sub>sts</sub>	I <sup>2</sup> C start or repeated start condition setup		4.7		μs
t <sub>sth</sub>	I <sup>2</sup> C start or repeated start condition hold		4		μs
t <sub>sps</sub>	I <sup>2</sup> C stop-condition setup		4		μs
t <sub>vd</sub>	Valid data time	SCL low to SDA output valid	3.4		μs
C <sub>b</sub>	I <sup>2</sup> C-bus capacitive load		400		pF

## PCF8574

### REMOTE 8-BIT I/O EXPANDER FOR I<sup>2</sup>C BUS

SCPS068C - JULY 2001 – REVISED JANUARY 2004

switching characteristics over recommended operating free-air temperature range,  $C_L \leq 100$  pF (unless otherwise noted) (see Figure 2)

PARAMETER		FROM (INPUT)	TO (OUTPUT)	MIN	MAX	UNIT
$t_{pv}$	Output data valid	SCL	P port		4	$\mu s$
$t_{su}$	Input data setup time	P port	SCL	0		$\mu s$
$t_h$	Input data hold time	P port	SCL	4		$\mu s$
$t_{iv}$	Interrupt valid time	P port	$\overline{INT}$		4	$\mu s$
$t_{ir}$	Interrupt reset delay time	SCL	$\overline{INT}$		4	$\mu s$

PARAMETER MEASUREMENT INFORMATION

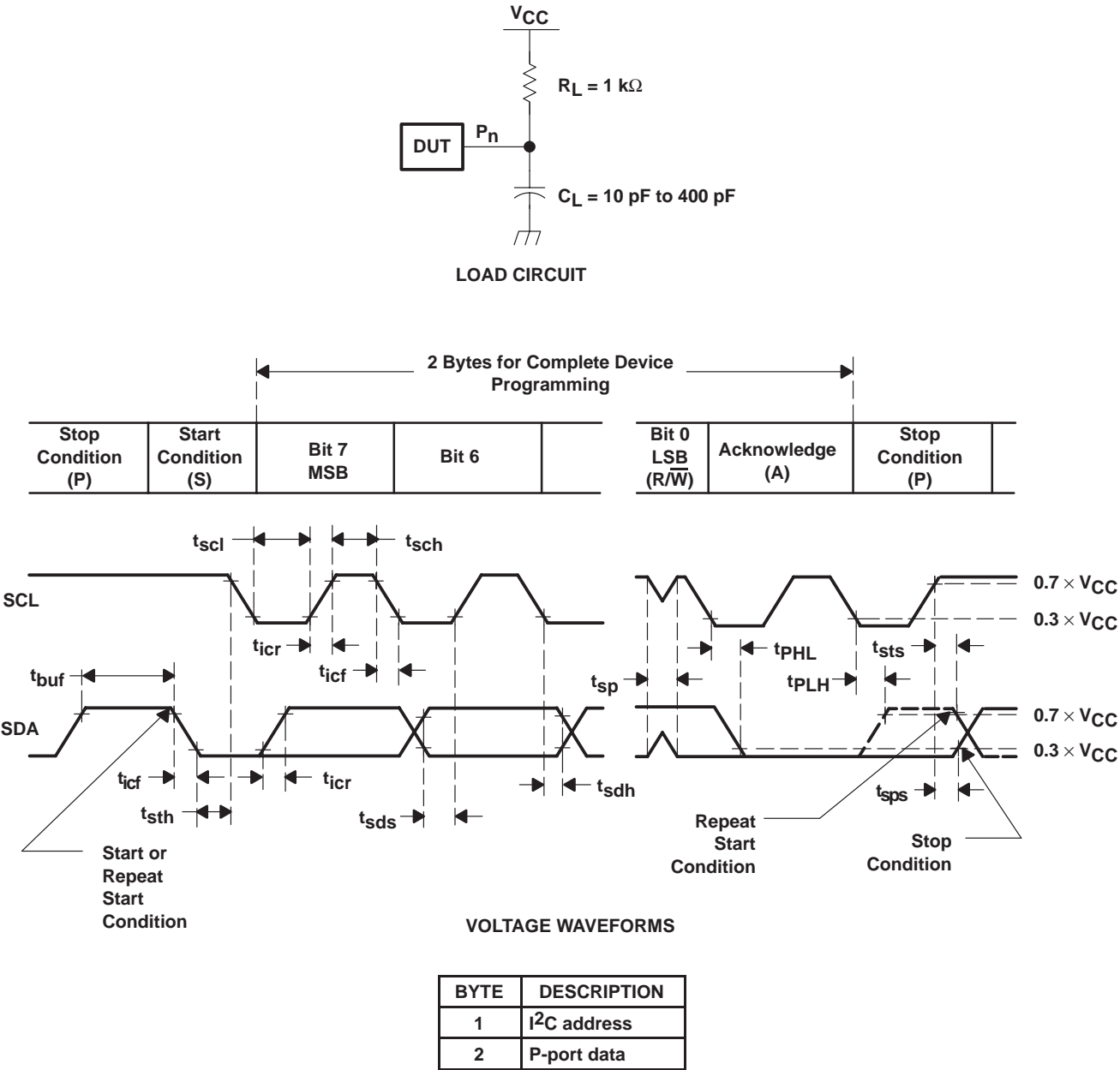


Figure 1. I<sup>2</sup>C Interface Load Circuit and Voltage Waveforms

PCF8574  
REMOTE 8-BIT I/O EXPANDER FOR I<sup>2</sup>C BUS

SCPS068C - JULY 2001 – REVISED JANUARY 2004

PARAMETER MEASUREMENT INFORMATION

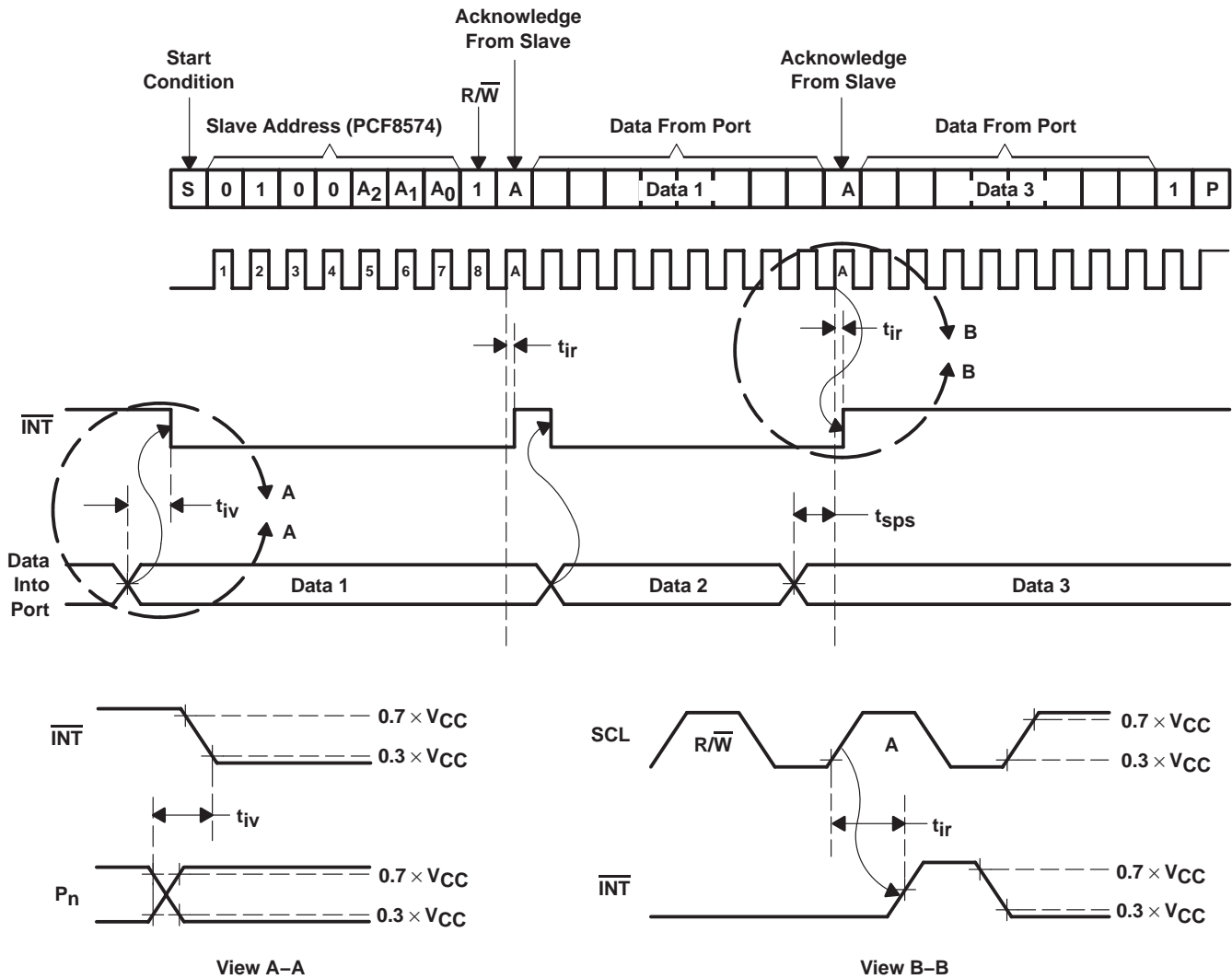
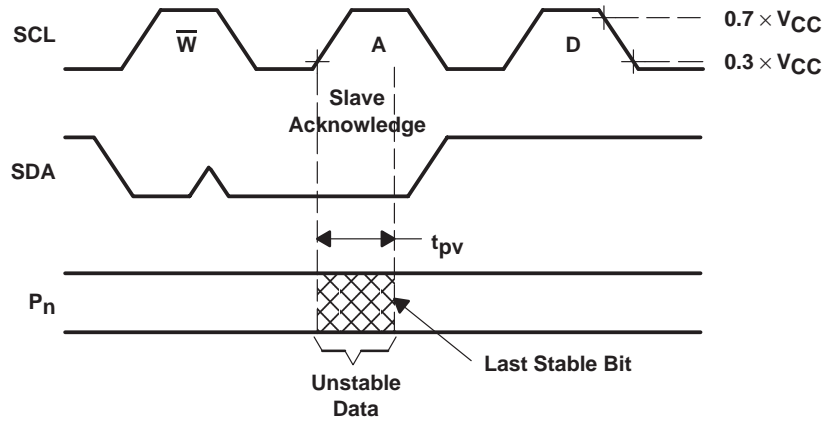


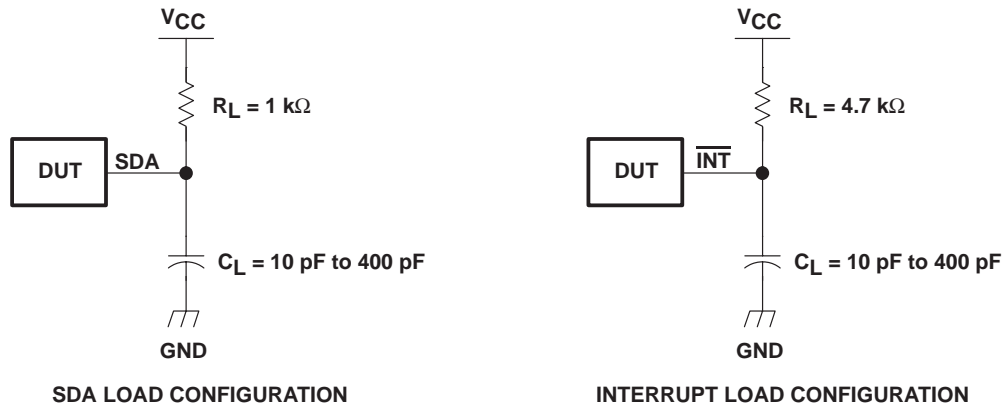
Figure 2. Interrupt-Timing Waveforms



### PARAMETER MEASUREMENT INFORMATION



**Figure 3. Write-Mode Timing**



**Figure 4. Load Circuits**

## 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>
PCF8574DGVR	ACTIVE	TVSOP	DGV	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
PCF8574DW	ACTIVE	SOIC	DW	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
PCF8574DWR	ACTIVE	SOIC	DW	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
PCF8574N	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
PCF8574PW	ACTIVE	TSSOP	PW	20	70	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
PCF8574PWR	ACTIVE	TSSOP	PW	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM
PCF8574RGYR	ACTIVE	QFN	RGY	20	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR

<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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

**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.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

<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.

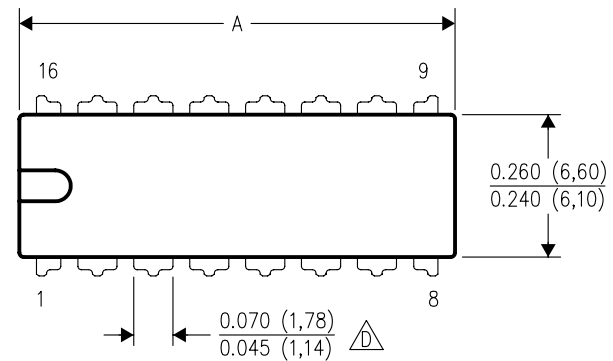
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## MECHANICAL DATA

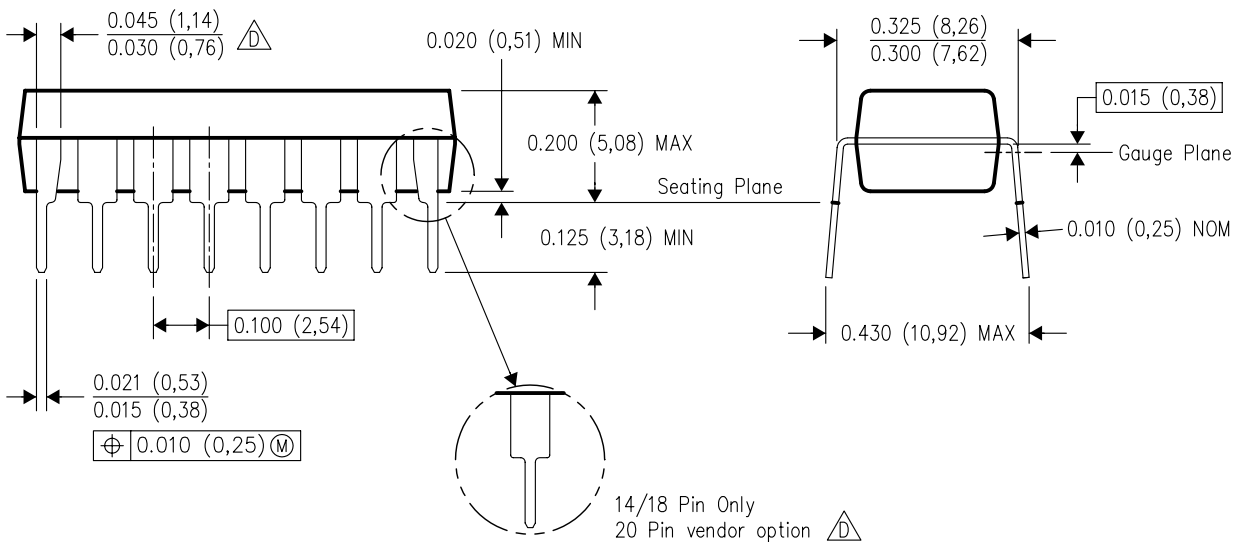
N (R-PDIP-T\*\*)

16 PINS SHOWN

# PLASTIC DUAL-IN-LINE PACKAGE





DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
-  The 20 pin end lead shoulder width is a vendor option, either half or full width.

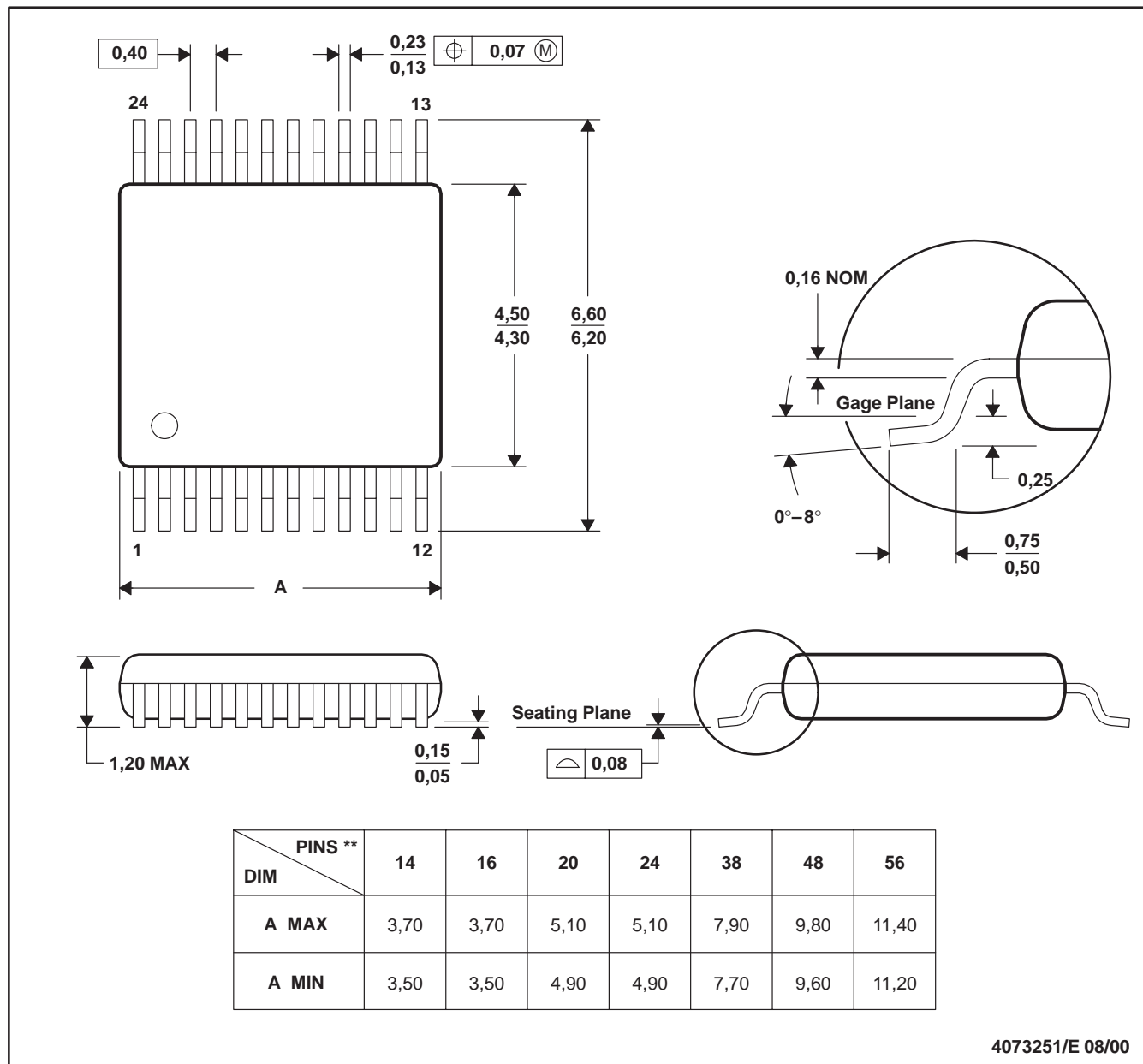
# MECHANICAL DATA

MPDS006C – FEBRUARY 1996 – REVISED AUGUST 2000

DGV (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN

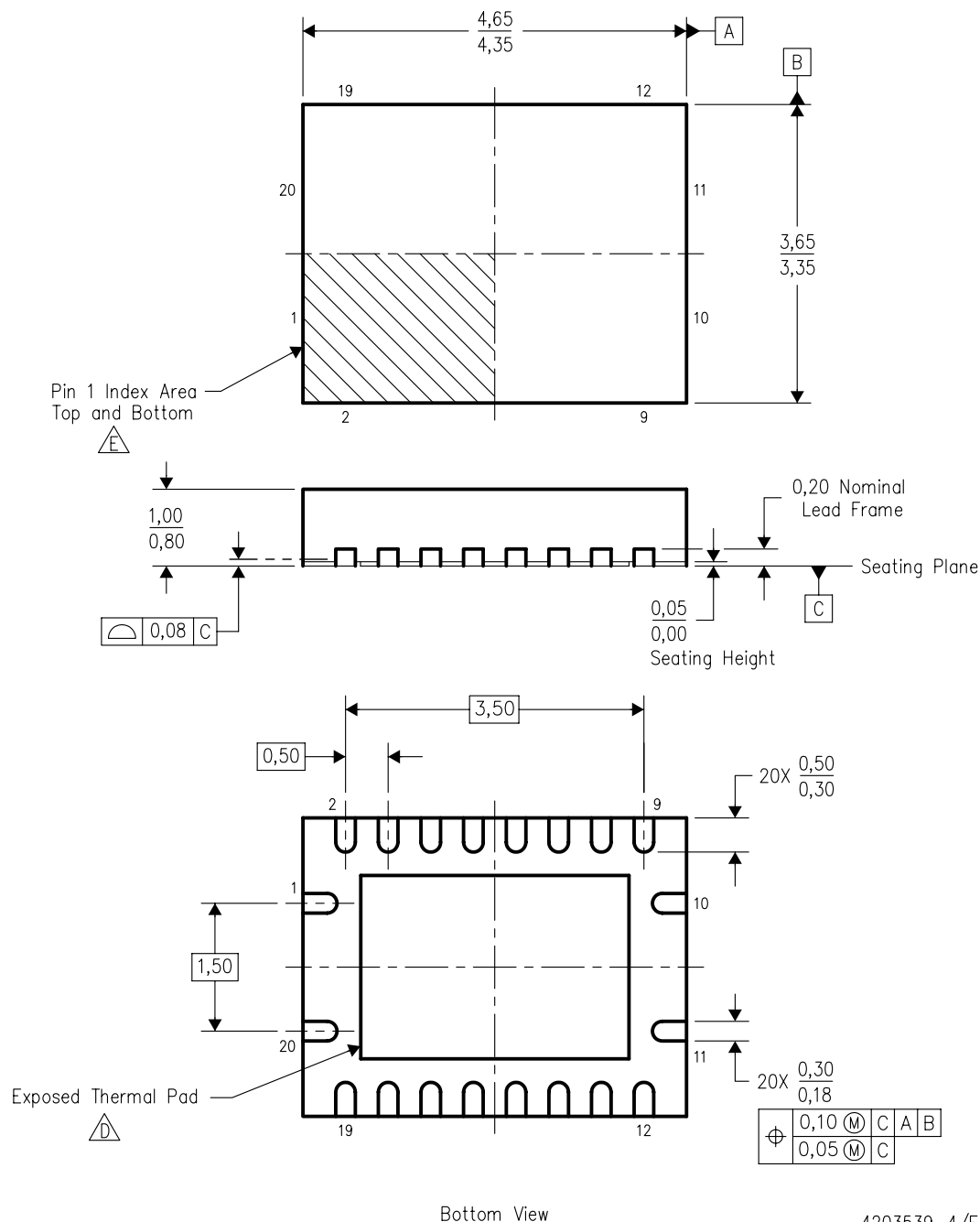


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194



## MECHANICAL DATA

## RGY (R-PQFP-N20)

## PLASTIC QUAD FLATPACK



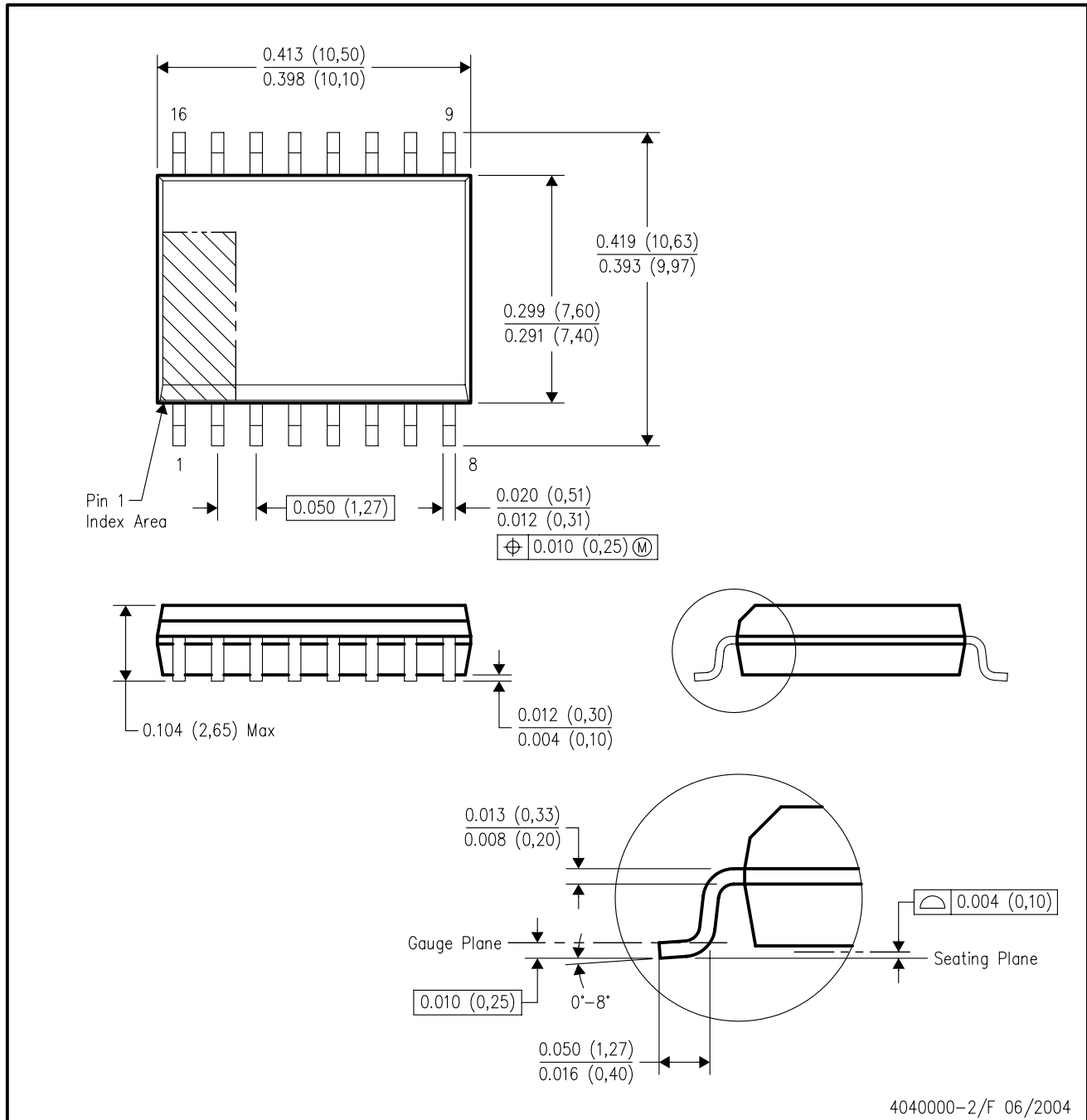
4203539-4/F 02/2005

- 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. QFN (Quad Flatpack No-Lead) package configuration.
  -  D. The package thermal pad must be soldered to the board for thermal and mechanical performance. See the Product Data Sheet for details regarding the exposed thermal pad dimensions.
  -  E. Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
  - F. Package complies to JEDEC MO-241 variation BC.

# MECHANICAL DATA

DW (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



# MECHANICAL DATA

MTSS001C – JANUARY 1995 – REVISED FEBRUARY 1999

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



PINS **	8	14	16	20	24	28
DIM						
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064/F 01/97

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
  - D. 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 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.

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.

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

### Products

Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</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>

### Applications

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265