400mA PCI LDO

FEATURES

- Glitch-Free Transition Between Input Sources
- Automatic Input Source Selection
- External PMOS Bypass Switch Control
- Built-In 5V Detector
- 1% Regulated Output Voltage Accuracy
- 400mA Load Current Capability
- Kelvin Sense Input
- Low Ground Current, Independent of Load

APPLICATIONS

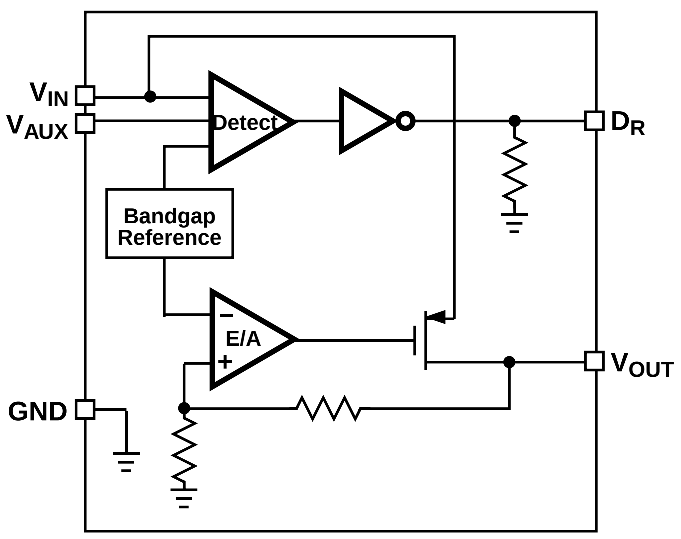
- PCMCIA
- PCI
- Network Interface Cards (NICs)
- Cardbus™ Technology
- Desktop Computers

GENERAL DESCRIPTION

The TC1267 is an application-specific, low dropout regulator (LDO) specifically intended for use in PCI peripheral card applications complying with PCI Power Management (PCI 2.0). It provides an uninterrupted, 3.3V output voltage when the main (5V) or auxiliary (3.3V) input voltage supplies are present.

The TC1267 consists of an LDO, a voltage threshold detector, external switchover logic and gate drive circuitry. It functions as a conventional LDO as long as the voltage on the main supply input (V_{IN}) is above the lower threshold (3.90V typ). Should the voltage on V_{IN} fall below the lower threshold the LDO is disabled, and an external P-channel MOSFET is automatically turned on, connecting the auxiliary supply input to V_{OUT}, and ensuring an uninterrupted 3.3V output. The main supply is automatically selected if both the main and auxiliary input supplies are present, and transition from one input supply to the other is guaranteed glitch-free. High integration, automatic secondary supply switchover, Kelvin sensing, and small size make the TC1267 the optimum LDO for PCI 2.0 applications.

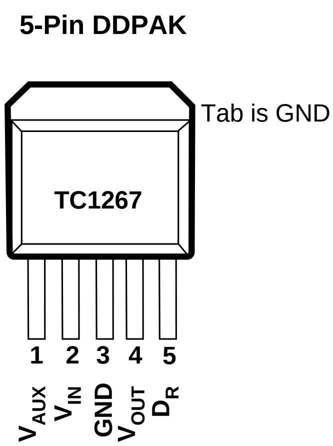
FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part No.	Package	Temperature Range
TC1267VET	5-Pin DDPAK	–5°C to +95°C

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

Input Supply Voltage (V_{IN}) .... –0.5V to + 7V (Max)
Auxiliary Supply Voltage (V_{AUX}) .... –0.5V to + 7V (Max)
LDO Output Current (I_{OUT}) 400mA
Operating Temperature Range (T_A) .... –5°C to +70°C
Storage Temperature Range (T_{STG}) ...... –65°C to +150°C
Lead Temperature (Soldering, 10 Sec) .... 300 °C
Thermal Impedance Junction-to-Ambient (θ_{JA}) ... 27°C/W for DDPAK
ESD Rating .... 2 KV

Static-sensitive device. Unused devices must be stored in conductive material. Protect devices from static discharge and static fields. Stresses above 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 above those indicated in the operational sections of the specifications is not implied. Exposure to Absolute Maximum Rating Conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS: T_A = +25°C, V_{IN} = 5V, V_{AUX} = 3.3V, I_{OUT} = 0.1mA, C_{OUT} = 4.7µF, unless otherwise specified. Values in **BOLD** apply over full operating temperature range.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Supply Voltage	V_{AUX} = 0V	**4.4**	**5.0**	**5.5**	V
I_{GND}	GROUND Current	V_{AUX} = 0V, (Note 6)	—	230	**450**	µA
		V_{AUX} = 3.3V, (Note 6)	—	260	**500**	
I_{VIN}	Reverse Leakage from V_{AUX}	V_{AUX} = 3.6V, V_{IN} = 0V, I_{OUT} = 0 mA	—	–0.1	**–1.0**	µA
V_{AUX}	Supply Voltage		**3.0**	**3.3**	**3.6**	V
$I_{Q(AUX)}$	Quiescent Current	V_{IN} = 0V, I_{OUT} = 0 mA	—	50	70	µA
			—	—	**100**	
		V_{IN} = 5V, I_{OUT} = 0 mA	—	60	80	
			—	—	**120**	
I_{VAUX}	Reverse Leakage from V_{IN}	V_{IN} = 5.5V, V_{AUX} = 0V, I_{OUT} = 0 mA	—	–0.1	**–1.0**	µA
$V_{TH(LO)}$	5V Detector Low Threshold Voltage	V_{IN} Falling (Notes 2, 3)	—	3.90	—	V
			3.75	—	**4.05**	
V_{HYST}	5V Detector Hysteresis Voltage	(Notes 2, 3)	—	260	—	mV
			200		**300**	
$V_{TH(HI)}$	5V Detector High Threshold Voltage	V_{IN} Rising (Notes 2, 3)	—	4.15	**—**	V
			4.0	—	**4.30**	
V_{OUT}	LDO Output Voltage	I_{OUT} = 20 mA	—	3.300	—	V
		4.4V ≤ V_{IN} ≤ 5.5V, 0 mA ≤ I_O ≤ 400mA	**3.201**	—	**3.366**	
		3.75V ≤ V_{IN} ≤ 4.3V, 0 mA ≤ I_{OUT} ≤ 400mA (Note 4)	**3.000**	—	—	
I_{OUT}	Output Current		400	—	—	mA
$REG_{(LINE)}$	Line Regulation	V_{IN} = 4.3V to 5.5V	—	0.05	—	%
			–0.5	—	**+0.5**	
$REG_{(LOAD)}$	Load Regulation	I_{OUT} = 0.1 mA to 400mA	—	–0.1	—	%
			–1.5	—	**+0.5**	

ELECTRICAL CHARACTERISTICS: T_A = +25°C, V_{IN} = 5V, V_{AUX} = 3.3V, I_{OUT} = 0.1mA, C_{OUT} = 4.7µF, unless otherwise specified. Values in **BOLD** apply over full operating temperature range.

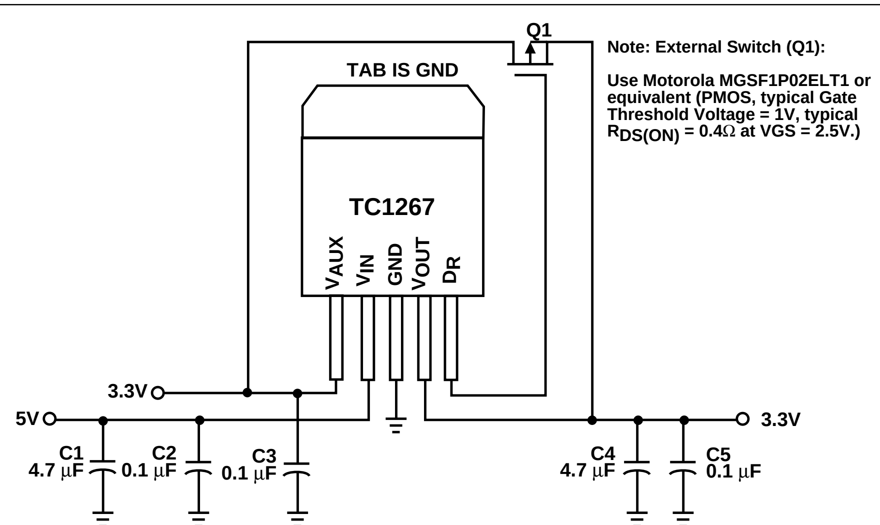
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{DR}	Drive Voltage	4.3V ≤ V_{IN} ≤ 5.5V, I_{DR}=200µA	V_{IN} – 0.2	V_{IN} – 0.1	—	V
			V_{IN} – 0.3	—	—	
		V_{IN} < $V_{TH(LO)}$, I_{DR} = 200µA	—	35	150	mV
			—	—	**200**	
$I_{DR(PK)}$	Peak Drive Current	Sinking: V_{IN} = 3.75V, V_{DR} = 1V;	7	—	—	mA
		Sourcing: V_{IN} = 4.3V, V_{IN}–V_{DR} = 2V	**6**	—	—	
t_{DH}	Drive High Delay (Notes 1,5)	C_{DR} = 1.2 nF, V_{IN} ramping up, measured from V_{IN} = $V_{TH(HI)}$ to V_{DR} = 2V	—	4	—	µsec
			—	—	**8**	
t_{DL}	Drive Low Delay (Notes 1,5)	C_{DR} = 1.2 nF, V_{IN} ramping down, measured from V_{IN} = $V_{TH(LO)}$ to V_{DR} = 2V	—	0.6	1.5	µsec
			—	—	**3.0**	

NOTES: 1. Guaranteed by design.
2. See 5V Detect Thresholds on page 4.
3. Recommended source impedance for 5V supply; ≤ 0.25Ω. This will ensure that I_{OUT} x R_{SOURCE} < V_{HYST}, thus avoiding D_R toggling during 5V detect threshold transitions.
4. In application circuit below.
5. See timing diagram on page 4.
6. Ground current is independent of I_{LOAD}.

PIN DESCRIPTION

Pin Number	Name	Description
1	V_{IN}	Main Input Supply for the TC1267, nominally 5V.
2	NC	Not connected.
3	V_{AUX}	Auxiliary Input Supply, nominally 3.3V.
4	GND	Logic and power ground.
5	NC	Not connected.
6	SENSE	Sense Pin for V_{OUT}. Connect to V_{OUT} at the load to minimize voltage drop across PCB traces.
7	V_{OUT}	LDO 3.3V output.
8	D_R	Driver output for external P-channel MOSFET pass element.

APPLICATION CIRCUIT



Thermal Considerations

Thermal Shutdown

Integrated thermal protection circuitry shuts the regulator off when die temperature exceeds 160°C. The regulator remains off until the die temperature drops to approximately 150°C.

Power Dissipation

The amount of power the regulator dissipates is primarily a function of input and output voltage, and output current. The following equation is used to calculate worst case *actual* power dissipation:

$$P_D \approx (V_{INMAX} - V_{OUTMIN})I_{LOADMAX}$$

Where:
- P_D = worst case actual power dissipation
- V_{INMAX} = maximum voltage on V_{IN}
- V_{OUTMIN} = minimum regulator output voltage
- $I_{LOADMAX}$ = maximum output (load) current

Equation 1.

The maximum *allowable* power dissipation (Equation 2) is a function of the maximum ambient temperature (T_{AMAX}), the maximum allowable die temperature (95°C) and the thermal resistance from junction-to-air (θ_{JA}).

$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}}$$

Where all terms are previously defined.

Equation 2.

Table 1. Thermal Resistance Guidelines for TC1267 in 5-Pin DDPAK

Copper Area (Topside)*	Copper Area (Backside)	Board Area	Thermal Resistance (θ_{JA})
2500 sq mm	2500 sq mm	2500 sq mm	25°C/W
1000 sq mm	2500 sq mm	2500 sq mm	27°C/W
125 sq mm	2500 sq mm	2500 sq mm	35°C/W

NOTES: *Tab of device attached to topside copper

Equation 1 can be used in conjunction with Equation 2 to ensure regulator thermal operation is within limits. For example:

GIVEN:
- V_{INMAX} = 5V ± 5%
- V_{OUTMIN} = 3.217
- $I_{LOADMAX}$ = 400mA
- T_{JAMAX} = 95°C
- T_{AMAX} = 70°C
- θ_{JA} = 27°C/W (DDPAK mounted on 1000 sq mm topside copper area)

FIND:
1. Actual power dissipation
2. Maximum allowable dissipation

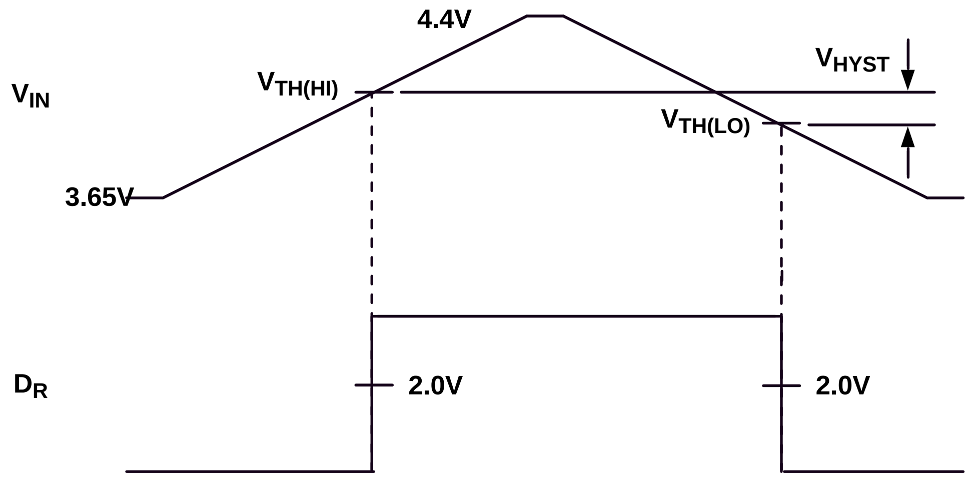
Actual power dissipation:

$$P_D \approx (V_{INMAX} - V_{OUTMIN})I_{LOADMAX}$$
$$= (5.25V - 3.217V)\ 400mA$$
$$= \underline{813\ mW}$$

Maximum allowable power dissipation:

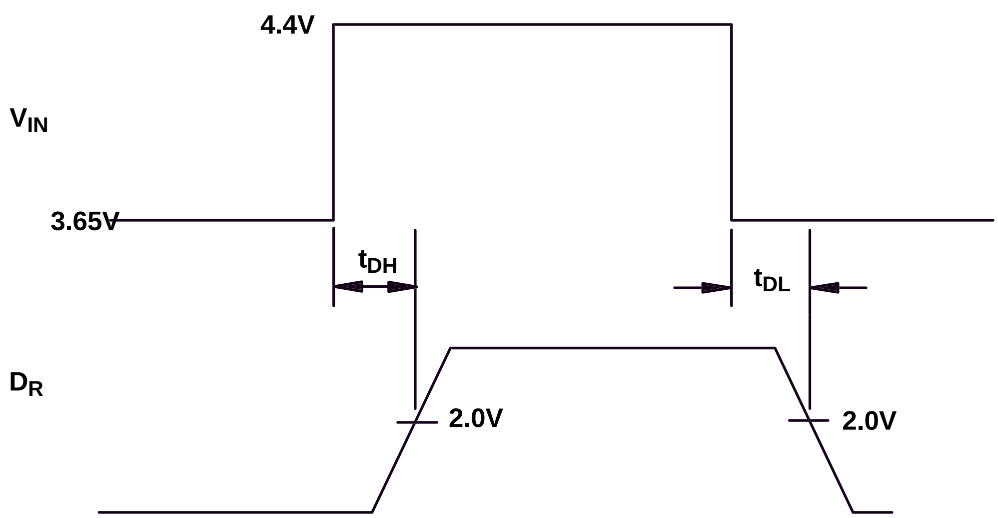
$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}}$$
$$= \frac{(95°C - 70°C)}{27°C/W}$$
$$= \underline{926\ mW}$$

In this example, the TC1267 dissipates a maximum of only 813 mW; below the allowable limit of 926 mW.



Note: V_{IN} rise and fall times (10% to 90%) to be ≥ 100 µsec.

Figure 1. 5V Detect Threshold



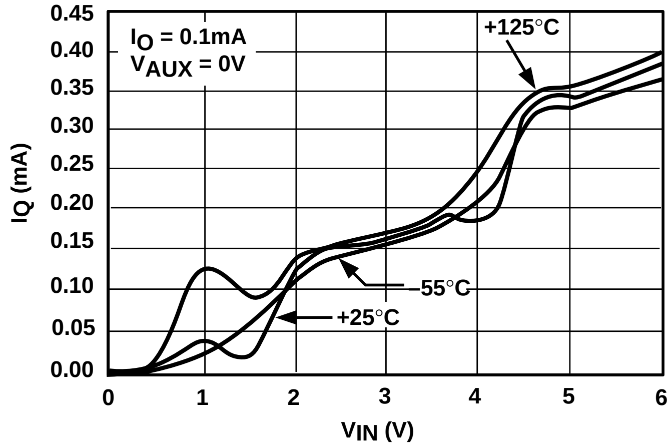
Note: V_{IN} rise and fall times (10% to 90%) to be ≤ 0.1 µsec.

Figure 2. Timing Diagram

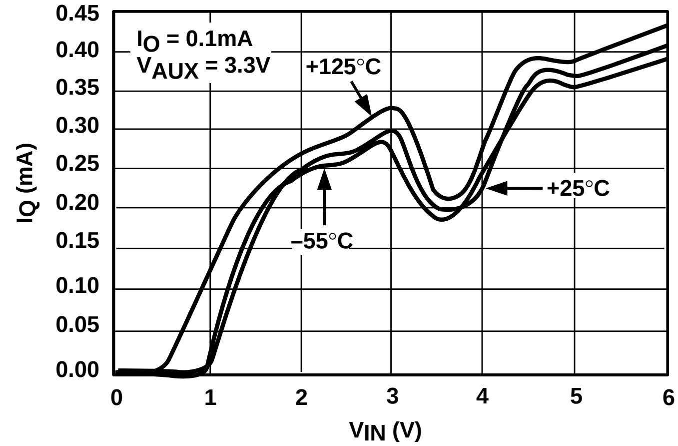
TC1267

TYPICAL CHARACTERISTICS

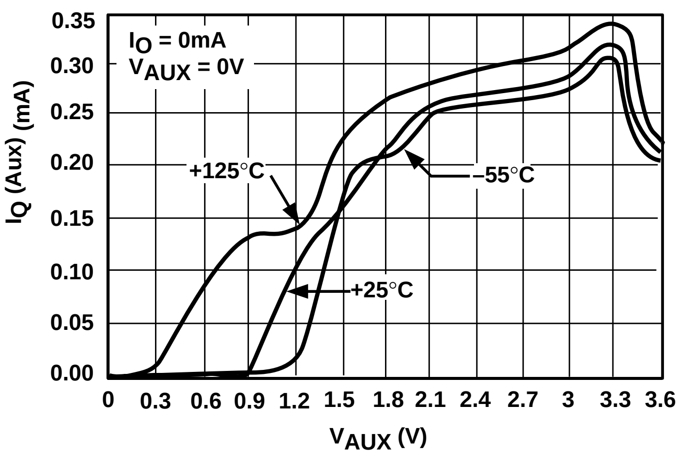
I_Q vs. V_{IN} AT
Junction Temperatures –55, 25, 125°C



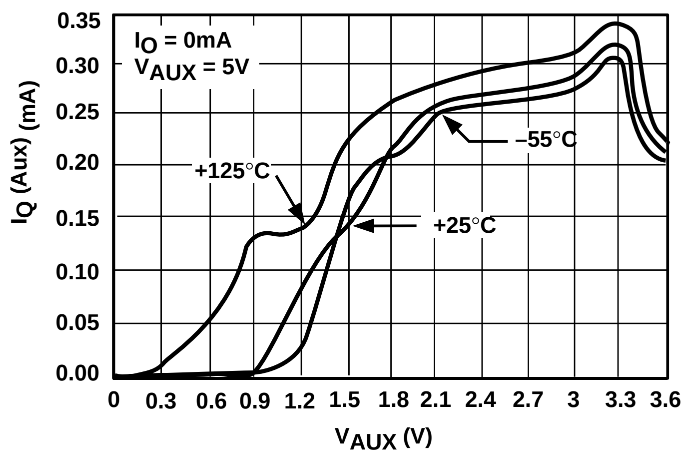
I_Q vs. V_{IN} AT
Junction Temperatures –55, 25, 125°C



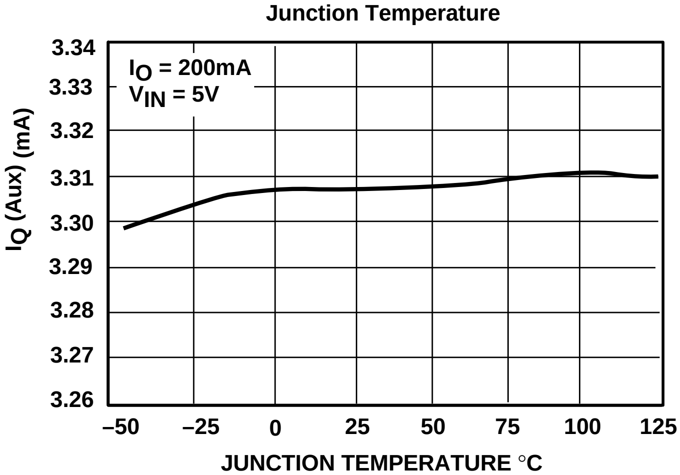
I_Q (Aux) vs. V_{AUX} AT
Junction Temperatures –55, 25, 125°C



I_Q (Aux) vs. V_{AUX} AT
Junction Temperatures –55, 25, 125°C

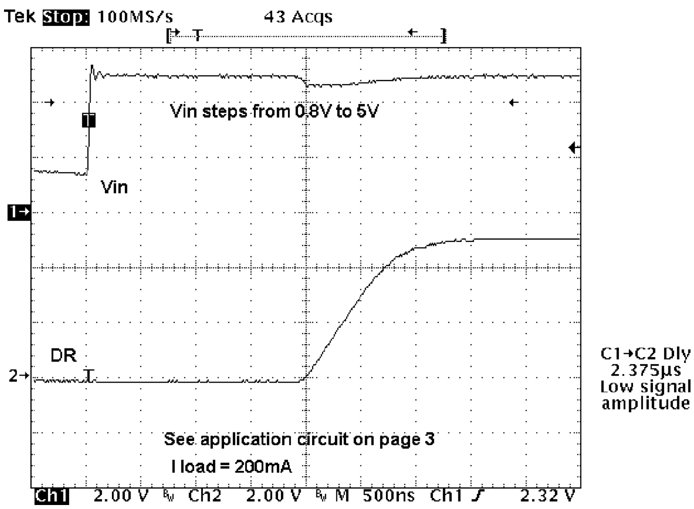


LDO Output Voltage vs.
Junction Temperature



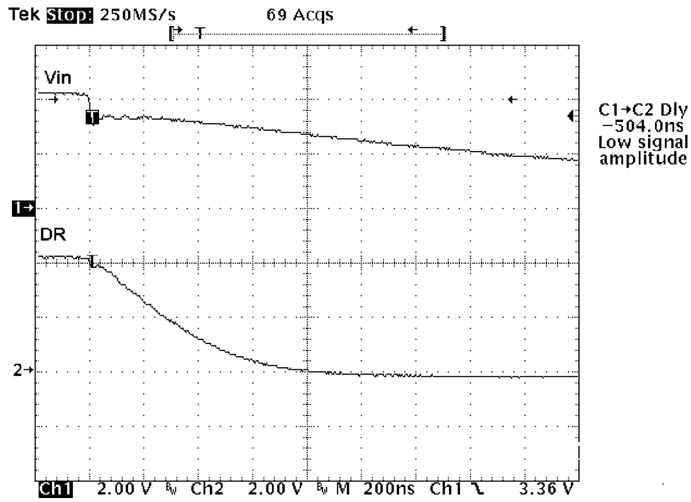
TYPICAL CHARACTERISTICS (CONT.)

Drive High Delay



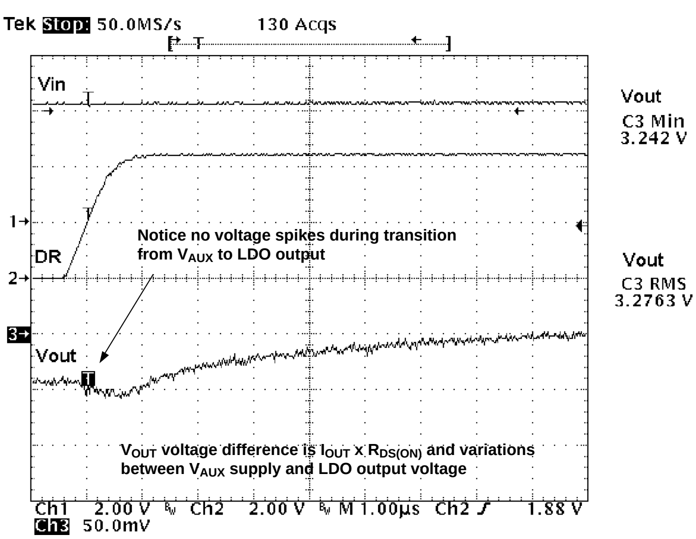
Trace 1: V_{IN} stepping for 0.8V to 5V
Trace 2: D_R going high at V_{TH}(Hi)
TdH = < 4µS

Drive Low Delay



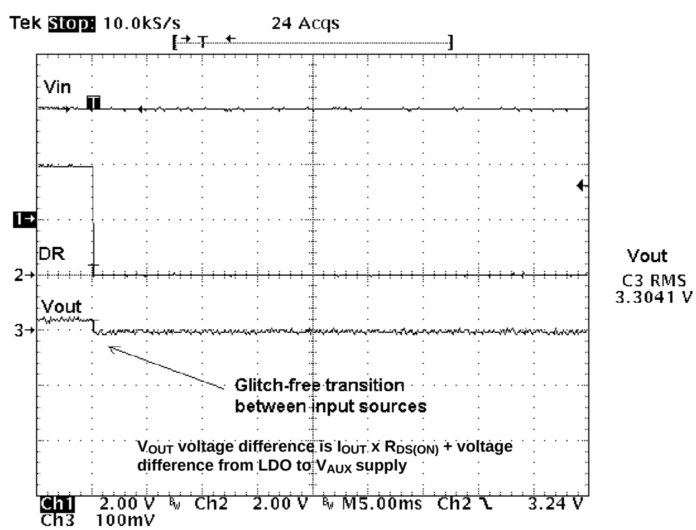
Trace 1: V_{IN} stepping for 5.5V to 0V
Trace 2: D_R going low
TDL = < 600nS

V_O (min) with V_{IN} Rising



Trace 1: V_{IN} – 3A charging a 1500µF capacitor
Trace 2: D_R going high at $V_{TH\ (HI)}$
Trace 3: V_{OUT}, offset 3.3V. V_{OUT} (min) = 3.24V
I_{LOAD} = 200µA

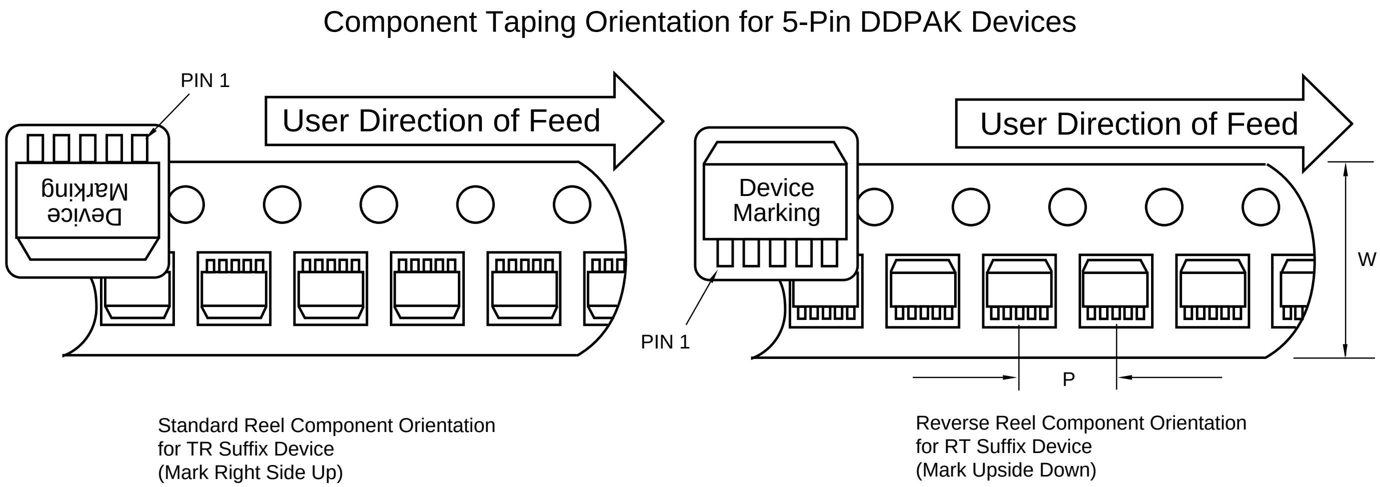
V_O (min) with V_{IN} Falling



Trace 1: Vin – discharging a 1500µF capacitor
Trace 2: D_R going low at $V_{TH\ (LO)}$
Trace 3: V_{OUT}, offset 3.3V. V_{OUT} (min) = 3.14V
I_{LOAD} = 200µA

TC1267

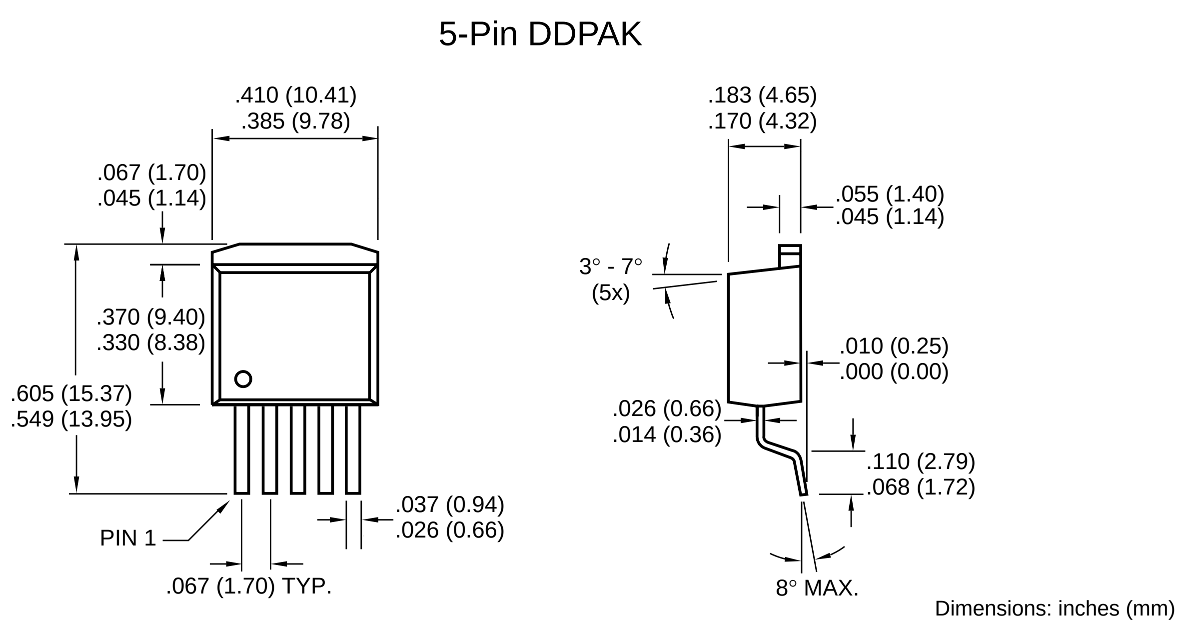
TAPING FORM



Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
5-Pin DDPAK	24 mm	16 mm	750	13 in

PACKAGE DIMENSIONS



WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200 Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: http://www.microchip.com

Rocky Mountain
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-7456

Atlanta
500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770-640-0034 Fax: 770-640-0307

Austin
Analog Product Sales
8303 MoPac Expressway North
Suite A-201
Austin, TX 78759
Tel: 512-345-2030 Fax: 512-345-6085

Boston
2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Boston
Analog Product Sales
Unit A-8-1 Millbrook Tarry Condominium
97 Lowell Road
Concord, MA 01742
Tel: 978-371-6400 Fax: 978-371-0050

Chicago
333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas
4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Dayton
Two Prestige Place, Suite 130
Miamisburg, OH 45342
Tel: 937-291-1654 Fax: 937-291-9175

Detroit
Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Los Angeles
18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

Mountain View
Analog Product Sales
1300 Terra Bella Avenue
Mountain View, CA 94043-1836
Tel: 650-968-9241 Fax: 650-967-1590

New York
150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose
Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto
6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

China - Beijing
Microchip Technology Beijing Office
Unit 915
New China Hong Kong Manhattan Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Shanghai
Microchip Technology Shanghai Office
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

Hong Kong
Microchip Asia Pacific
RM 2101, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India
Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, OíShaugnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan
Microchip Technology Intl. Inc.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471- 6166 Fax: 81-45-471-6122

Korea
Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea
Tel: 82-2-554-7200 Fax: 82-2-558-5934

ASIA/PACIFIC (continued)

Singapore
Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-334-8870 Fax: 65-334-8850

Taiwan
Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Australia
Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

Denmark
Microchip Technology Denmark ApS
Regus Business Centre
Lautrup hoj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France
Arizona Microchip Technology SARL
Parc díActivite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - ler Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany
Arizona Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Germany
Analog Product Sales
Lochhamer Strasse 13
D-82152 Martinsried, Germany
Tel: 49-89-895650-0 Fax: 49-89-895650-22

Italy
Arizona Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom
Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

01/09/01