

## Power CMOS Drivers With Voltage Tripler

### Features:

- Power Driver With On-Board Voltage Booster
- Low  $I_{DD}$ : < 4 mA
- Small Package: 8-Pin PDIP
- Undervoltage Circuitry
- Fast Rise/Fall Time: <40 ns @1000 pF
- Below-Rail Input Protection

### Applications:

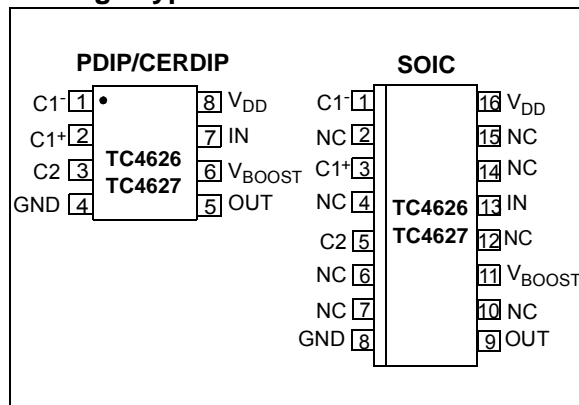
- Raises 5V to drive higher –  $V_{gs}$  (ON) MOSFETs
- Eliminates one system power supply

### General Description:

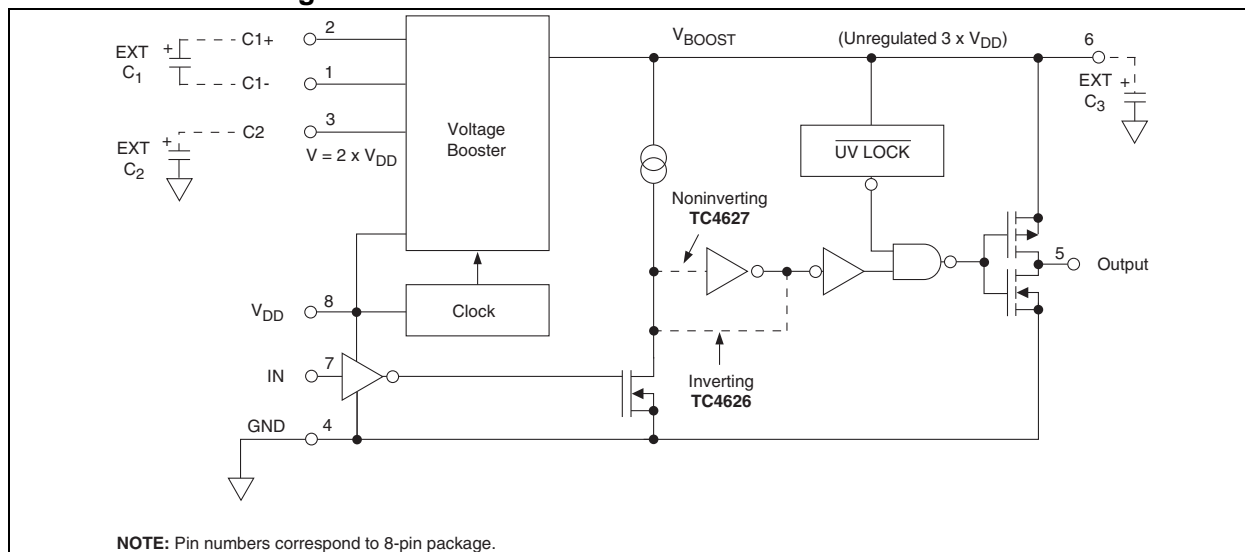
The TC4626/TC4627 are single CMOS high-speed drivers with an on-board voltage boost circuit. These parts work with an input supply voltage from 4 to 6 volts. The internal voltage booster will produce a  $V_{BOOST}$  potential up to 12 volts above  $V_{IN}$ . This  $V_{BOOST}$  is not regulated, so its voltage is dependent on the input  $V_{DD}$  voltage and output drive loading requirements. An internal undervoltage lockout circuit keeps the output in a low state when  $V_{BOOST}$  drops below 7.8 volts. Output is enabled when  $V_{BOOST}$  is above 11.3 volts.

**Note:** Check the Microchip web site for available package types and package information.

### Package Type



### Functional Block Diagram



# TC4626/TC4627

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

Supply Voltage .....	6.2V
Input Voltage, Any Terminal .....	$V_S + 0.3V$ to $GND - 0.3V$
Package Power Dissipation ( $T_A \leq 70^\circ C$ )	
PDIP .....	730 mW
CERDIP .....	800 mW
SOIC .....	760 mW
Derating Factor      PDIP .....	5.6 mW/°C Above 36°C
CERDIP .....	6.0 mW/°C
Operating Temperature Range (Ambient)	
C Version .....	0°C to +70°C
E Version .....	-40°C to +85°C
M Version .....	-55°C to +125°C
Storage Temperature Range .....	-65°C to +150°C

† **Notice:** 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 operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

## TC4626/TC4627 ELECTRICAL SPECIFICATIONS

Electrical Characteristics: $T_A = +25^\circ C$ , $V_{DD} = 5V$ , $C_1 = C_2 = C_3 = 10\mu F$ unless otherwise noted.						
Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
<b>Input</b>						
Logic '1', High Input Voltage	$V_{IH}$	2.4	—	—	V	
Logic '0', Low Input Voltage	$V_{IL}$	—	—	0.8	V	
Input Current	$I_{IN}$	-1	—	+1	$\mu A$	$0V \leq V_{IN} \leq V_{DRIVE}$
<b>Output</b>						
High Output Voltage	$V_{OH}$	$V_{BOOST} - 0.025$	—	—	V	
Low Output Voltage	$V_{OL}$	—	—	0.025	V	
Output Resistance, High	$R_O$	—	10	15	$\Omega$	$I_{OUT} = 10\text{ mA}$ , $V_{DD} = 5V$
Output Resistance, Low	$R_O$	—	8	10	$\Omega$	$I_{OUT} = 10\text{ mA}$ , $V_{DD} = 5V$
Peak Output Current	$I_{PK}$	—	1.5	—	A	
<b>Switching Time</b>						
Rise Time	$t_R$	—	33	40	ns	Figure 3-1, Figure 3-2
Fall Time	$t_F$	—	27	35	ns	Figure 3-1, Figure 3-2
Delay Time	$t_{D1}$	—	35	45	ns	Figure 3-1, Figure 3-2
Delay Time	$t_{D2}$	—	45	55	ns	Figure 3-1, Figure 3-2
Maximum Switching Frequency	$F_{MAX}$	1.0	—	—	MHz	$V_{DD} = 5V$ , $V_{BOOST} > 8.5V$ , Figure 3-1
<b>Voltage Booster</b>						
Voltage Tripler Output Source Resistance	$R_3$	—	300	400	$\Omega$	$I_L = 10\text{ mA}$ , $V_{DD} = 5V$
Voltage Doubler Output Source Resistance	$R_2$	—	120	200	$\Omega$	
Oscillator Frequency	$F_{OSC}$	12	—	28	kHz	
Oscillator Amplitude Measured at C1-	$V_{OSC}$	4.5	—	10	V	$R_{LOAD} = 10\text{ k}\Omega$
Undervoltage Threshold	$UV @ V_{BOOST}$	7.0	7.8	8.5	V	
Start-Up Voltage	$V_{START} @ V_{BOOST}$	10.5	11.3	12	V	

## TC4626/TC4627 ELECTRICAL SPECIFICATIONS (CONTINUED)

Electrical Characteristics: $T_A = +25^\circ\text{C}$ , $V_{DD} = 5\text{V}$ , $C_1 = C_2 = C_3 = 10\mu\text{F}$ unless otherwise noted.						
Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
@ $V_{DD} = 5\text{V}$	$V_{\text{BOOST}}$	14.6	—	—	V	No Load
<b>Power Supply</b>						
Power Supply Current	$I_{DD}$	—	—	2.5	mA	$V_{\text{IN}} = \text{Low or High}$
Supply Voltage	$V_{DD}$	4.0	—	6.0	V	
<b>Input</b>						
Logic 1, High Input Voltage	$V_{\text{IH}}$	2.4	—	—	V	
Logic 0, Low Input Voltage	$V_{\text{IL}}$	—	—	0.8	V	
Input Current	$I_{\text{IN}}$	-10	—	1	$\mu\text{A}$	$0\text{V} \leq V_{\text{IN}} \leq V_{\text{BOOST}}$
<b>Output</b>						
High Output Voltage	$V_{\text{OH}}$	$V_{\text{DRIVE}} - 0.025$	—	—	V	
Low Output Voltage	$V_{\text{OL}}$	—	—	0.025	V	
Output Resistance, High	$R_{\text{O}}$	—	15 15	20 25	$\Omega$	$I_{\text{OUT}} = 10\text{ mA}$ , $V_{DD} = 5\text{V}$ C & E Version ( $T_A = +70^\circ\text{C}$ or $+85^\circ\text{C}$ ) M Version ( $T_A = +125^\circ\text{C}$ )
Output Resistance, Low	$R_{\text{O}}$	—	10 10	13 15	$\Omega$	$I_{\text{OUT}} = 10\text{ mA}$ , $V_{DD} = 5\text{V}$ C & E Version ( $T_A = +70^\circ\text{C}$ or $+85^\circ\text{C}$ ) M Version ( $T_A = +125^\circ\text{C}$ )
Peak Output Current	$I_{\text{PK}}$	—	1.5	—	A	
<b>Switching Time</b>						
Rise Time	$t_{\text{R}}$	—	—	55	ns	<a href="#">Figure 3-1</a> , <a href="#">Figure 3-2</a>
Fall Time	$t_{\text{F}}$	—	—	50	ns	<a href="#">Figure 3-1</a> , <a href="#">Figure 3-2</a>
Delay Time	$t_{\text{D1}}$	—	—	60	ns	<a href="#">Figure 3-1</a> , <a href="#">Figure 3-2</a>
Delay Time	$t_{\text{D2}}$	—	—	70	ns	<a href="#">Figure 3-1</a> , <a href="#">Figure 3-2</a>
Maximum Switching Frequency	$F_{\text{MAX}}$	750	—	—	kHz	$V_{DD} = 5\text{V}$ , $V_{\text{BOOST}} > 8.5\text{V}$ , <a href="#">Figure 3-1</a>
<b>Voltage Booster</b>						
Voltage Boost Output Source Resistance	$R_3$	—	400	500	$\Omega$	$I_{\text{L}} = 10\text{ mA}$ , $V_{DD} = 5\text{V}$
Voltage Doubler Output Source Resistance	$R_2$	—	170	300	$\Omega$	
Oscillator Frequency	$F_{\text{OSC}}$	5	—	50	kHz	
Oscillator Amplitude Measured at C1-	$V_{\text{OSC}}$	4.5	—	10	V	$R_{\text{LOAD}} = 10\text{ k}\Omega$
Undervoltage Threshold	$\text{UV @ } V_{\text{BOOST}}$	7.0	7.8	8.5	V	
Start-Up Voltage	$V_{\text{START @ } V_{\text{BOOST}}}$	10.5	11.3	12	V	
@ $V_{DD} = 5\text{V}$	$V_{\text{BOOST}}$	14.6	—	—	V	No Load
<b>Power Supply</b>						
Power Supply Current	$I_{DD}$	—	—	4	mA	$V_{\text{IN}} = \text{Low or High}$
Supply Voltage	$V_{DD}$	4.0	—	6.0	V	

# TC4626/TC4627

---

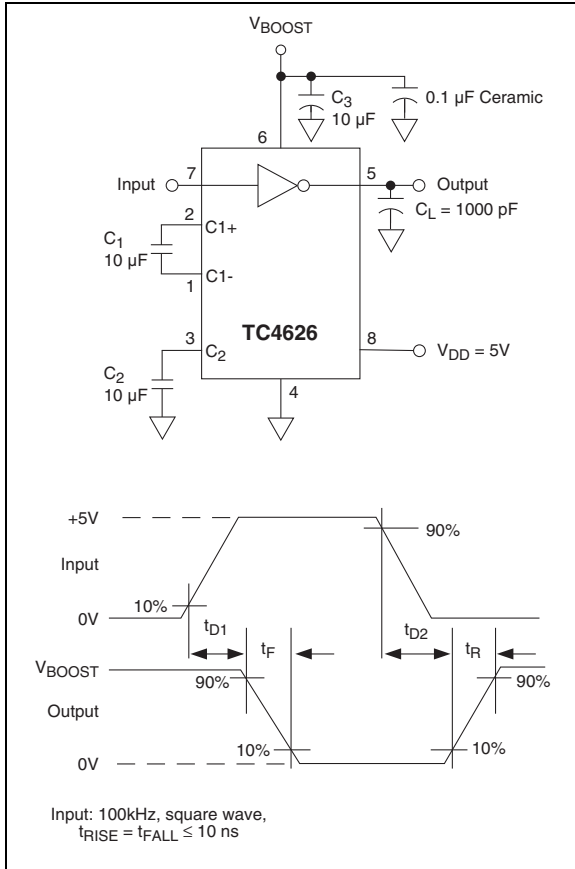
## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 2-1](#).

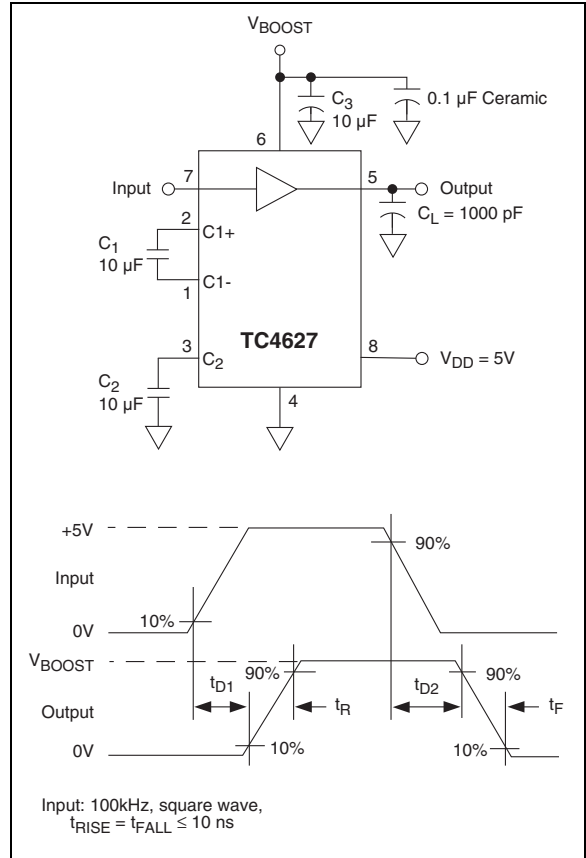
**TABLE 2-1: PIN FUNCTION TABLE**

Pin No. (8-Pin PDIP, CERDIP)	Pin No. (16-Pin SOIC Wide)	Symbol	Description
1	1	C1-	See <b>Section 3.1 “Booster Function”</b> for description
2	3	C1+	See <b>Section 3.1 “Booster Function”</b> for description
3	5	C2	See <b>Section 3.1 “Booster Function”</b> for description
4	8	GND	Ground.
5	9	OUT	Output
6	11	V <sub>BOOST</sub>	See <b>Section 3.1 “Booster Function”</b> for description
7	13	IN	Control Input
8	16	V <sub>DD</sub>	Supply Input
—	2, 4, 6, 7, 10, 12, 14, 15	NC	Not connected.

## 3.0 APPLICATIONS INFORMATION



**FIGURE 3-1:** Inverting Driver Switching Time.

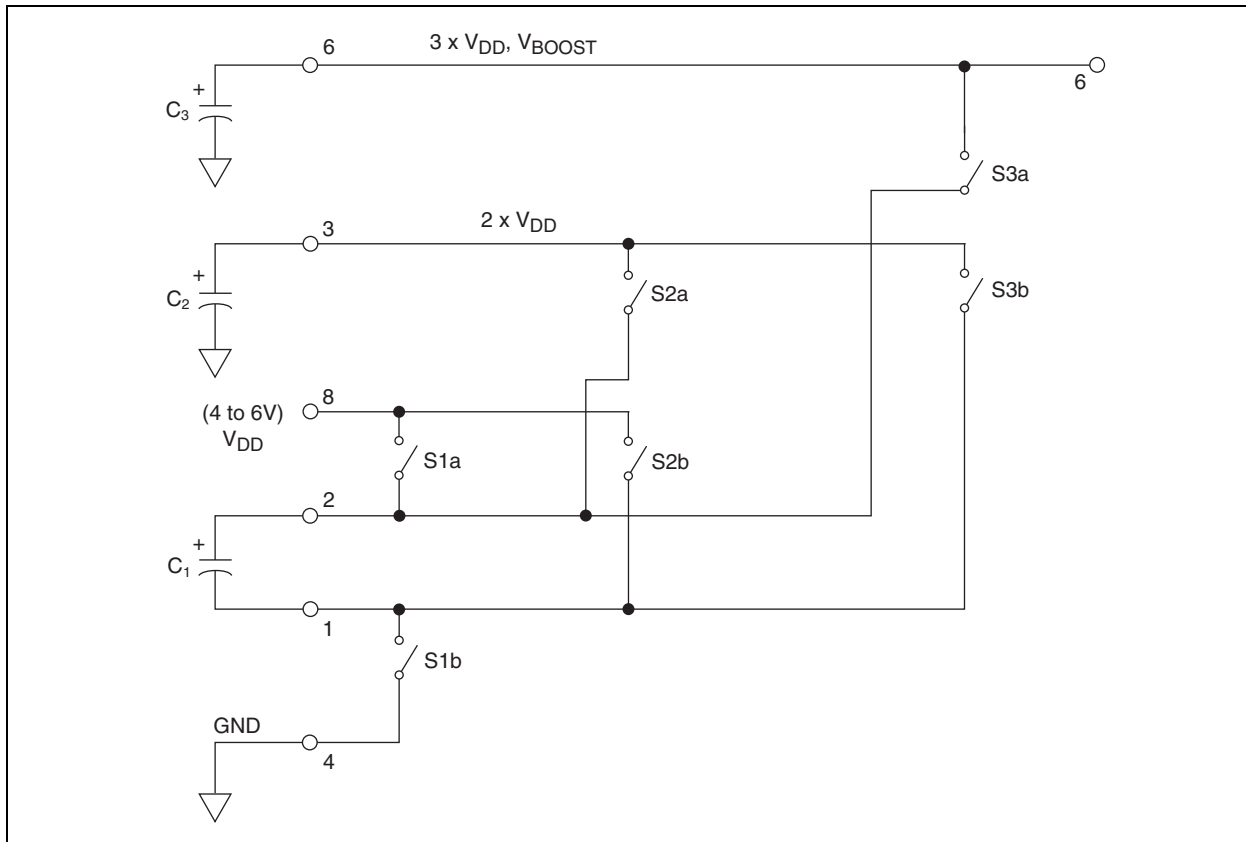


**FIGURE 3-2:** Noninverting Driver Switching Time.

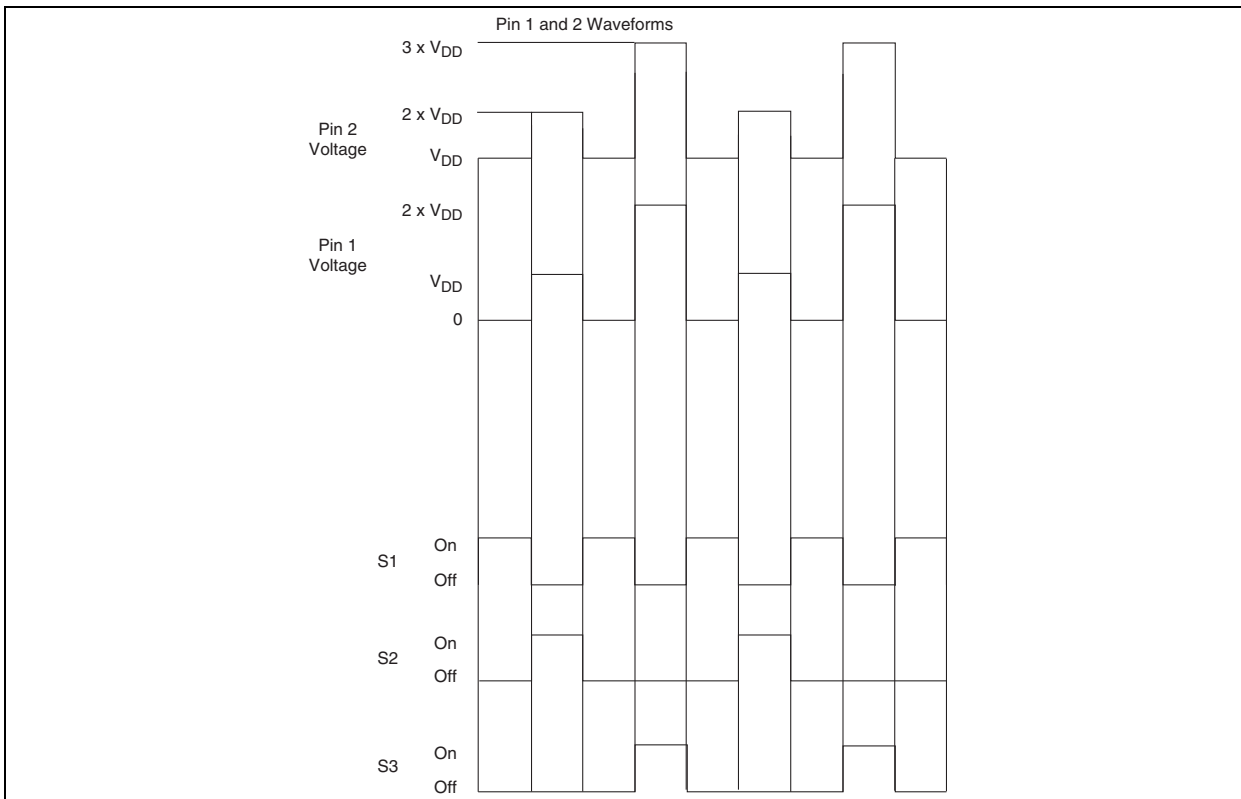
# TC4626/TC4627

## 3.1 BOOSTER FUNCTION

The voltage booster is an unregulated voltage tripler circuit. The tripler consists of three sets of internal switches and three external capacitors. S1a and S1b charge capacitor C1 to  $V_{DD}$  potential. S2a and S2b add C1 potential to  $V_{DD}$  input to charge C2 to  $2 \times V_{DD}$ . S3a and S3b add C1 potential to C2 to charge C3 to  $3 \times V_{DD}$ . The position of the switches is controlled by the internal four-phase clock.



**FIGURE 3-3:** Voltage Booster.

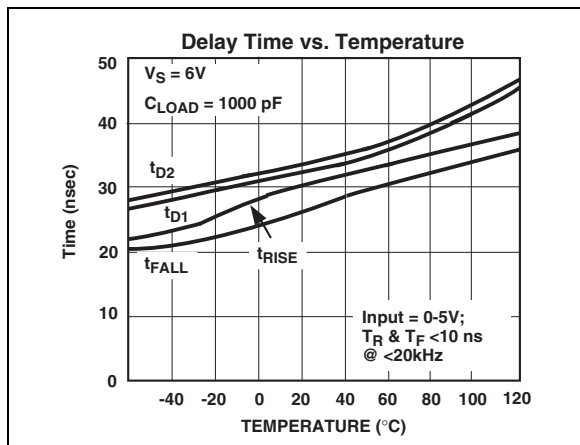
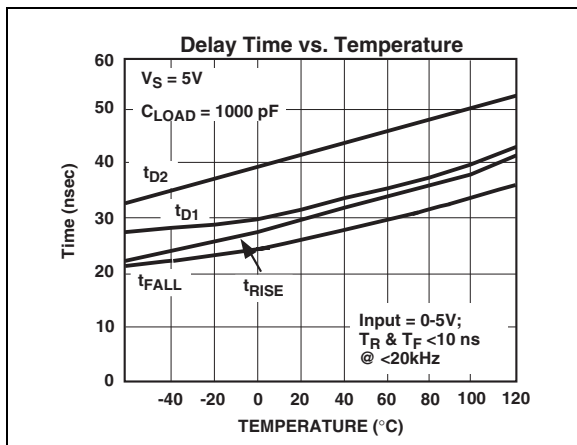
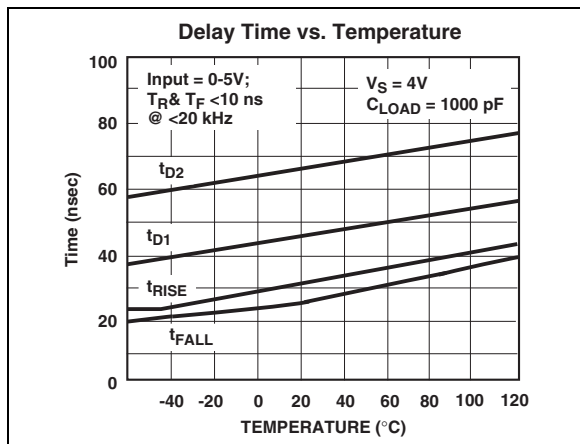
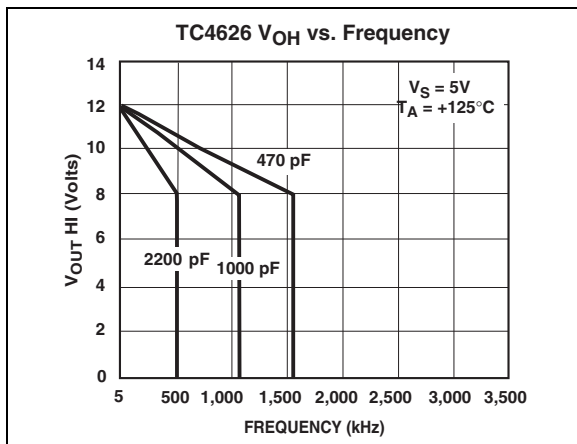
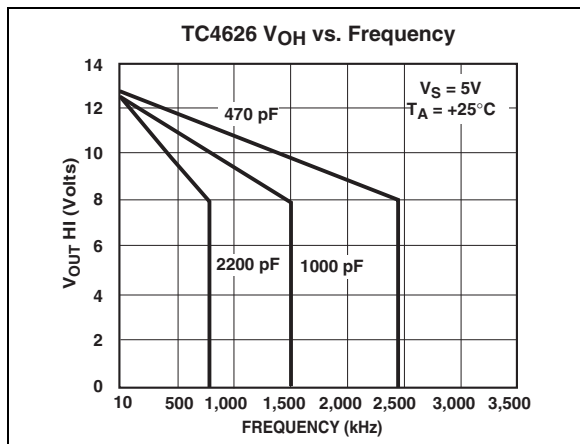
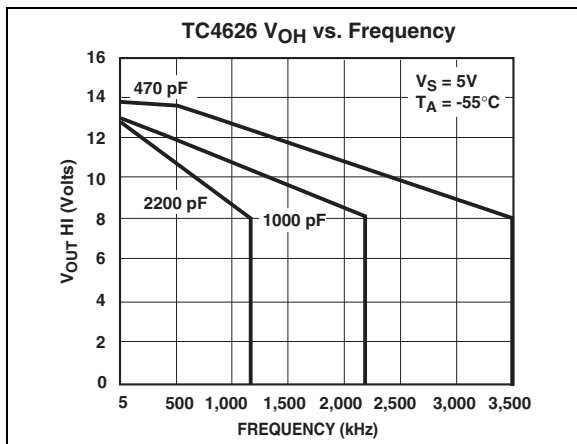


**FIGURE 3-4:** Position of Switches.

# TC4626/TC4627

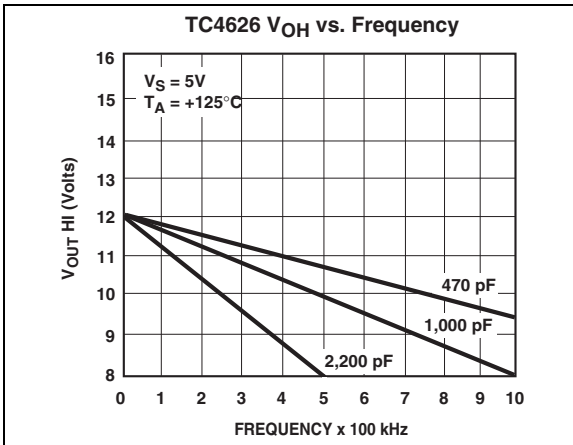
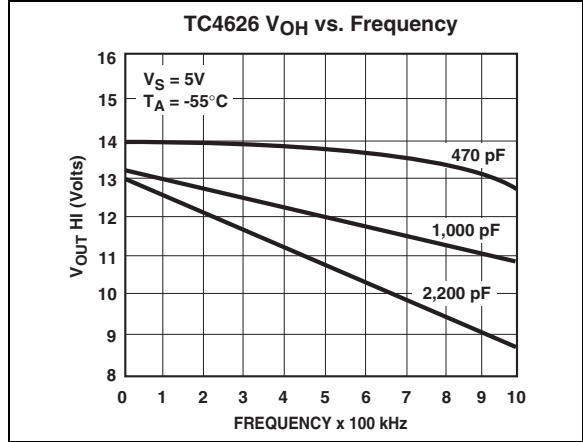
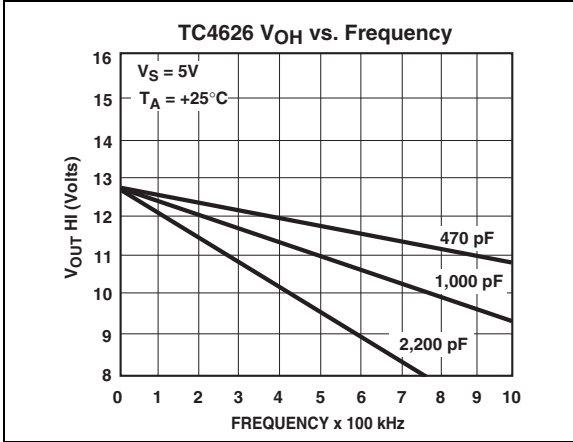
## 4.0 TYPICAL CHARACTERISTICS

**Note:** The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.





# TC4626/TC4627

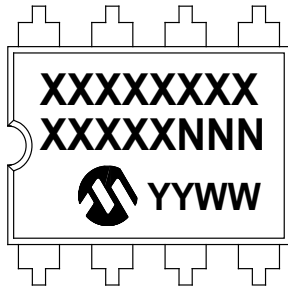


# TC4626/TC4627

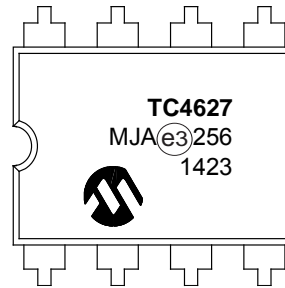
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

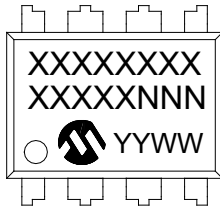
#### 8-Lead CERDIP (.300") (TC4627 Only)



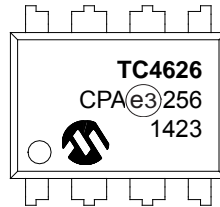
#### Example



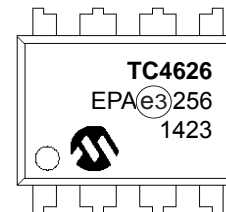
#### 8-Lead PDIP (300 mil)



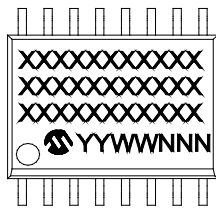
#### Example



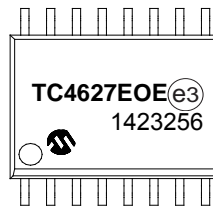
OR



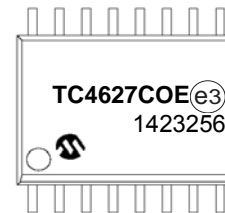
#### 16-Lead SOIC (7.50 mm)



#### Example



OR

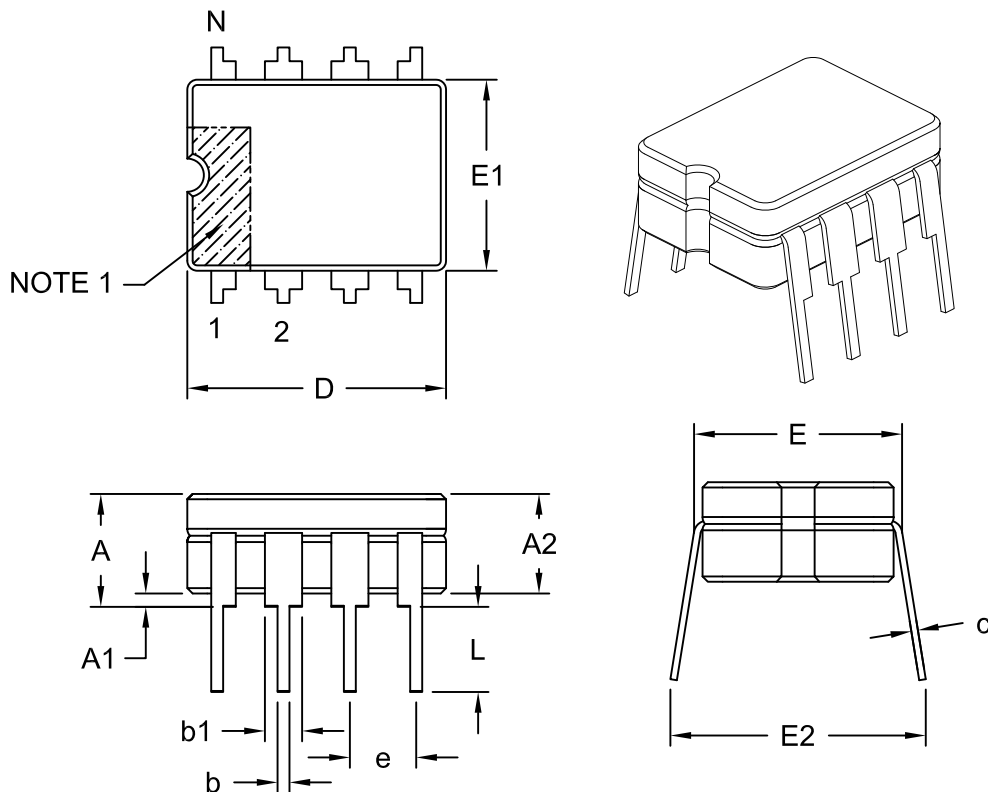


<b>Legend:</b>	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

## 8-Lead Ceramic Dual In-Line (JA) ~ .300" Body [CERDIP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



		Units	INCHES		
Dimension Limits			MIN	NOM	MAX
Number of Pins	N		8		
Pitch	e		.100 BSC		
Top to Seating Plane	A	-	-	-	.200
Base to Seating Plane §	A1	.015	-	-	-
Ceramic Package Height	A2	.140	-	-	.175
Shoulder to Shoulder Width	E	.290	-	-	.320
Ceramic Pkg. Width	E1	.230	.248	-	.300
Overall Length	D	.370	.380	-	.400
Tip to Seating Plane	L	.125	-	-	.200
Lead Thickness	c	.008	-	-	.015
Upper Lead Width	b1	.045	-	-	.065
Lower Lead Width	b	.015	-	-	.023
Overall Row Spacing	E2	.314	-	-	.410

**Notes:**

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensioning and tolerancing per ASME Y14.5M

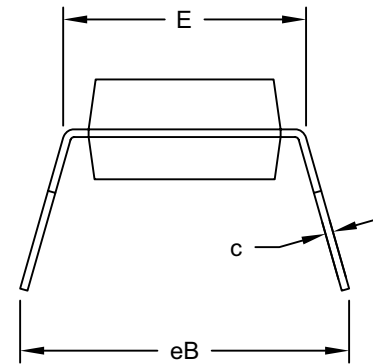
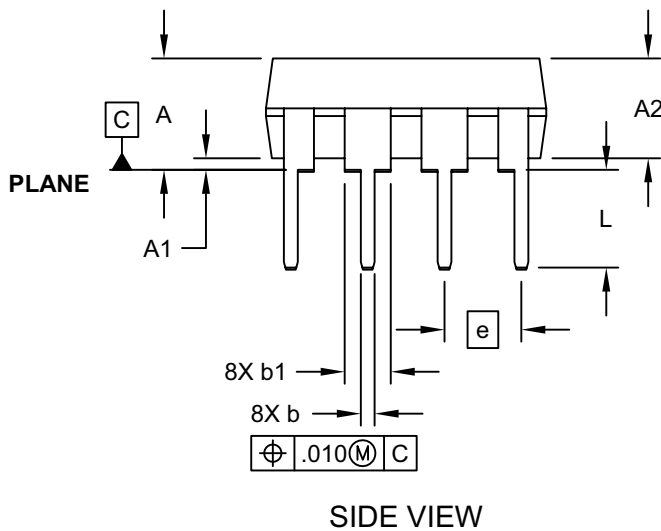
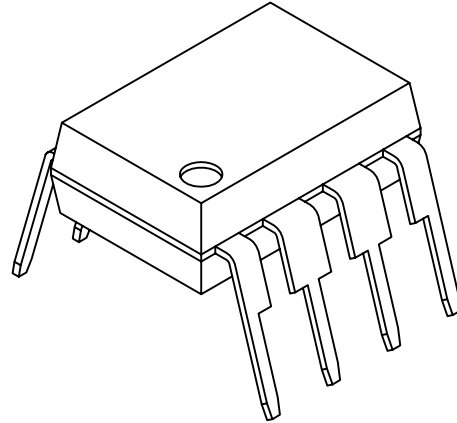
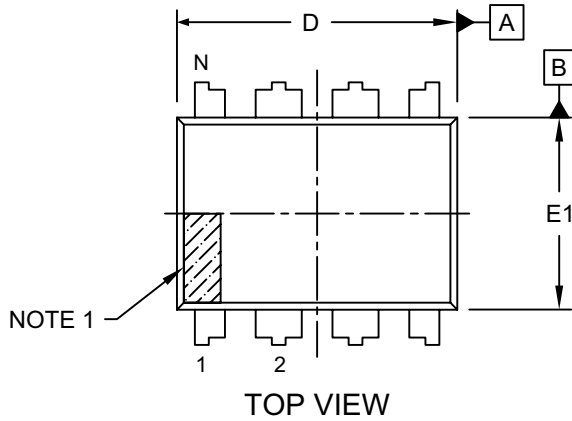
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-001C

# TC4626/TC4627

## 8-Lead Plastic Dual In-Line (PA) - 300 mil Body [PDIP]

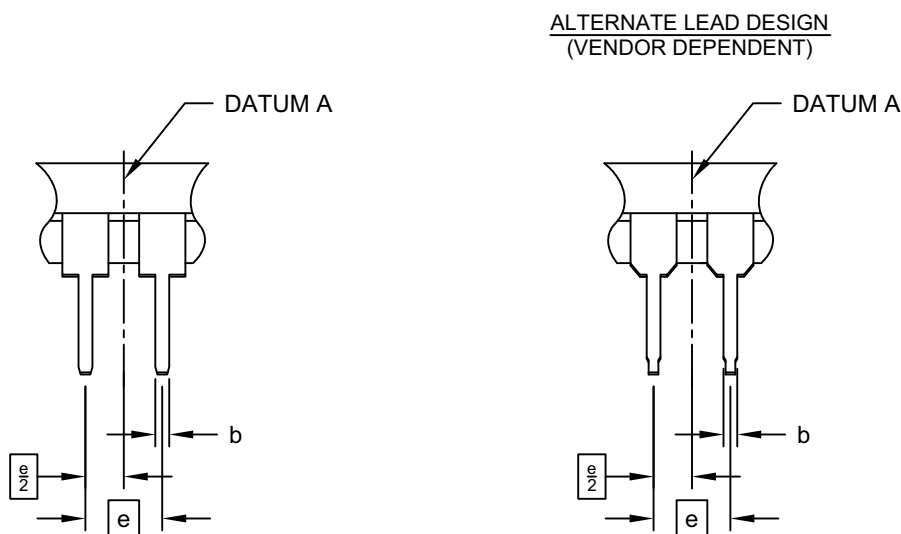
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packageing>



Microchip Technology Drawing No. C04-018D Sheet 1 of 2

## 8-Lead Plastic Dual In-Line (PA) - 300 mil Body [PDIP]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	INCHES		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	.100 BSC		
Top to Seating Plane	A	-	-	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	-	-
Shoulder to Shoulder Width	E	.290	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.348	.365	.400
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.040	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing	§ eB	-	-	.430

**Notes:**

- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
- Dimensioning and tolerancing per ASME Y14.5M

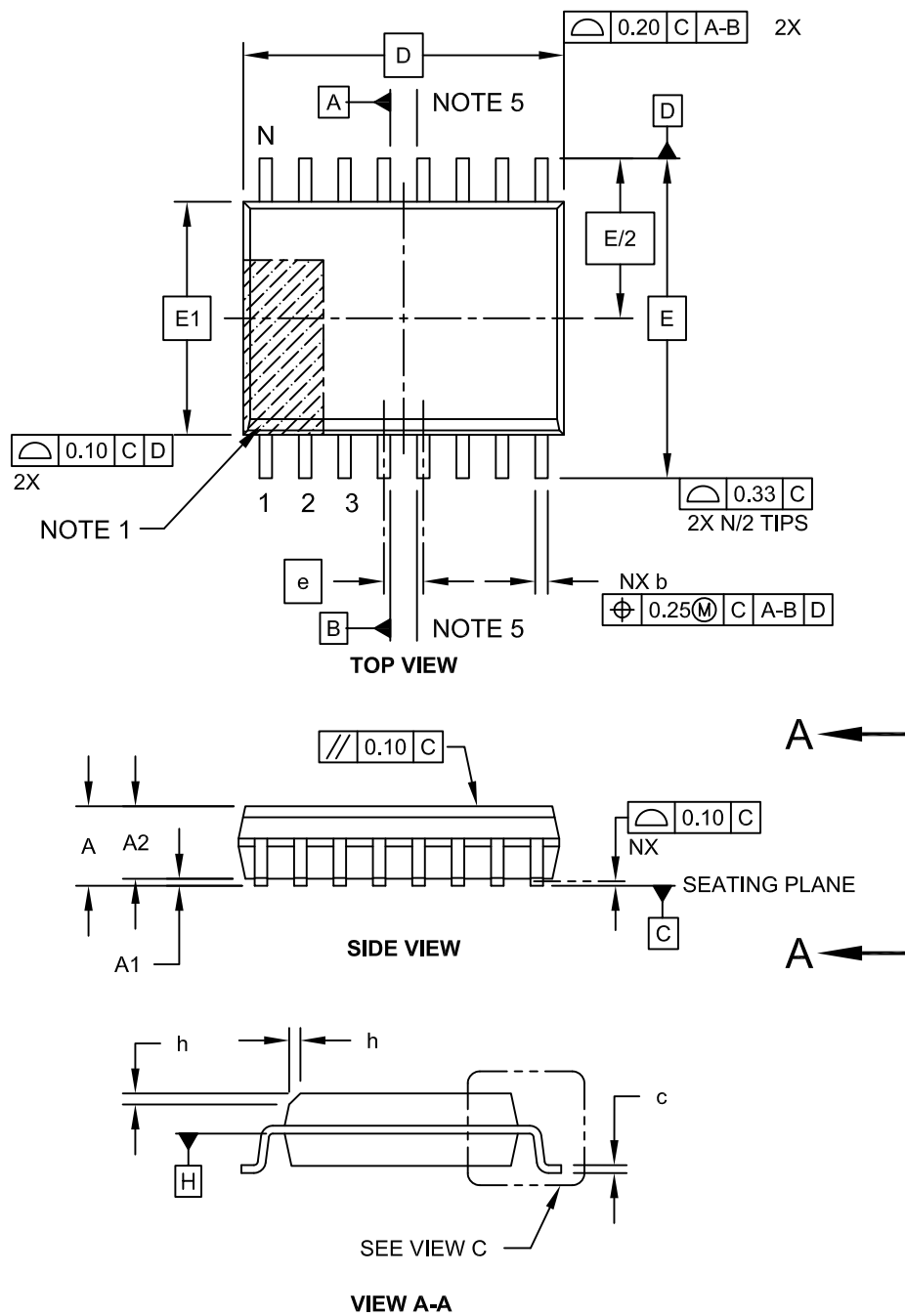
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-018D Sheet 2 of 2

# TC4626/TC4627

## 16-Lead Plastic Small Outline (OE) - Wide, 7.50 mm Body [SOIC]

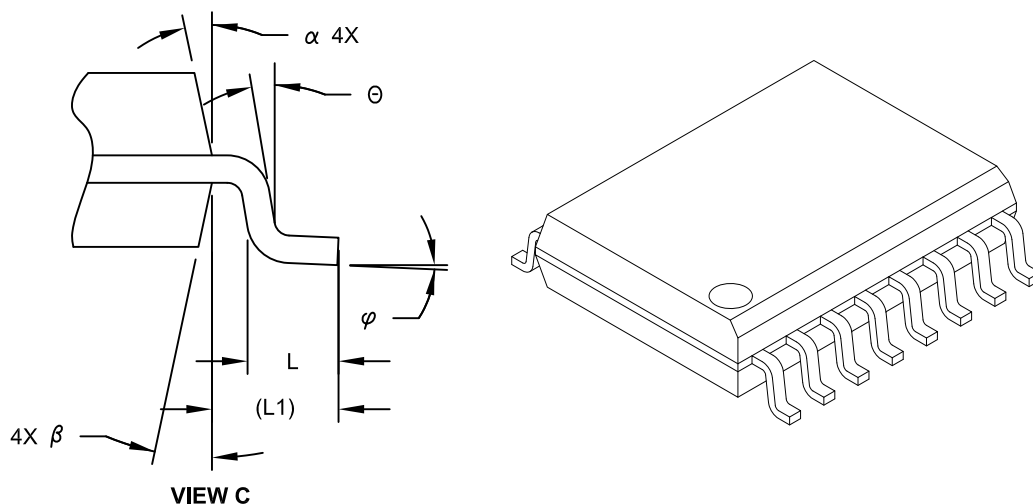
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing C04-102C Sheet 1 of 2

## 16-Lead Plastic Small Outline (OE) - Wide, 7.50 mm Body [SOIC]

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	16		
Pitch	e	1.27 BSC		
Overall Height	A	-	-	2.65
Molded Package Thickness	A2	2.05	-	-
Standoff §	A1	0.10	-	0.30
Overall Width	E	10.30 BSC		
Molded Package Width	E1	7.50 BSC		
Overall Length	D	10.30 BSC		
Chamfer (Optional)	h	0.25	-	0.75
Foot Length	L	0.40	-	1.27
Footprint	L1	1.40 REF		
Lead Angle	θ	0°	-	-
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.20	-	0.33
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

**Notes:**

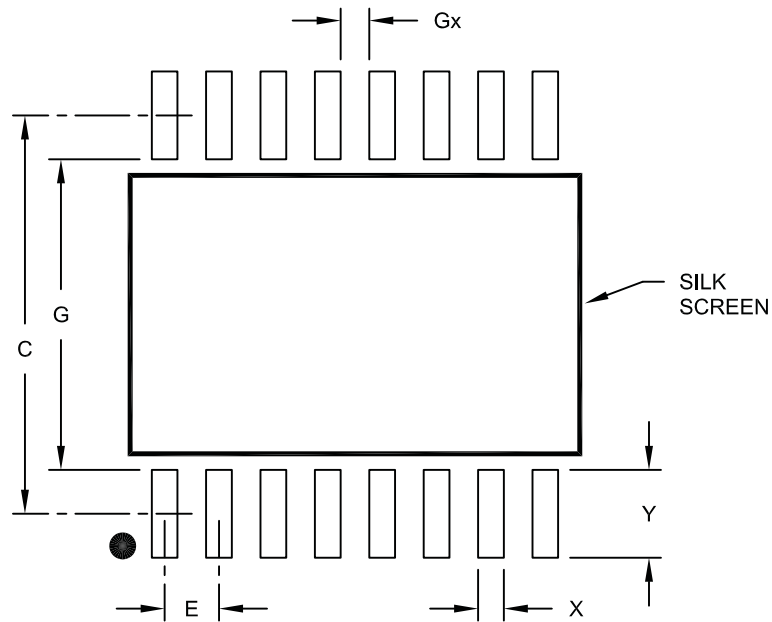
- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimension D does not include mold flash, protrusions or gate burrs, which shall not exceed 0.15 mm per end. Dimension E1 does not include interlead flash or protrusion, which shall not exceed 0.25 mm per side.
- Dimensioning and tolerancing per ASME Y14.5M  
 BSC: Basic Dimension. Theoretically exact value shown without tolerances.  
 REF: Reference Dimension, usually without tolerance, for information purposes only.
- Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-102C Sheet 2 of 2

# TC4626/TC4627

## 16-Lead Plastic Small Outline (OE) – Wide, 7.50 mm Body [SOIC] Land Pattern

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		9.30	
Contact Pad Width	X			0.60
Contact Pad Length	Y			2.05
Distance Between Pads	Gx	0.67		
Distance Between Pads	G	7.25		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2102A



## APPENDIX A: REVISION HISTORY

### Revision D (July 2014)

The following is the list of modifications:

- Restructured [Table 2-1](#) for readability purposes.
- Updated package specification drawings in [Section 5.0, Packaging Information](#) to match all views available.
- Added new [Product Identification System](#).

### Revision C (December 2012)

Added a note to each package outline drawing.

# TC4626/TC4627

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	-	<u>X</u>	<u>/XX</u>
Device		Temperature Range	Package
<b>Device:</b>	TC4626:	Single CMOS High-Speed Driver, Inverting	
	TC4627:	Single CMOS High-Speed Driver, Non-Inverting	
<b>Temperature Range:</b>	C =	0°C to +70°C	
	E =	-40°C to +85°C	
<b>Package:</b>	JA =	8-Lead Ceramic Dual In-Line, 300" Body (CERDIP) (TC4627 only)	
	OE =	16-Lead Plastic Small Outline, Wide, 7.50 mm Body (SOIC)	
	PA =	8-Lead Plastic Dual In-Line, 300 mil Body (PDIP)	

**Examples:**

a) TC4626CPA: High-Speed Inverting Single CMOS Driver, 0°C to +70°C.

b) TC4626EPA: High-Speed Inverting Single CMOS Driver, -40°C to +85°C.

---

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable.”

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

---

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

**Trademarks**

The Microchip name and logo, the Microchip logo, dsPIC, FlashFlex, flexPWR, JukeBlox, KEELOQ, KEELOQ logo, Klear, LANCheck, MediaLB, MOST, MOST logo, MPLAB, OptoLyzer, PIC, PICSTART, PIC<sup>32</sup> logo, RightTouch, SpyNIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

The Embedded Control Solutions Company and mTouch are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, ECAN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, KlearNet, KlearNet logo, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, RightTouch logo, REAL ICE, SQI, Serial Quad I/O, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademarks of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2001-2014, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

ISBN: 978-1-63276-380-8

**QUALITY MANAGEMENT SYSTEM**  
**CERTIFIED BY DNV**  
**== ISO/TS 16949 ==**

*Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC<sup>®</sup> MCUs and dsPIC<sup>®</sup> DSCs, KEELOQ<sup>®</sup> code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*



# MICROCHIP

## 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:  
<http://www.microchip.com/support>  
Web Address:  
[www.microchip.com](http://www.microchip.com)

**Atlanta**  
Duluth, GA  
Tel: 678-957-9614  
Fax: 678-957-1455

**Austin, TX**  
Tel: 512-257-3370

**Boston**  
Westborough, MA  
Tel: 774-760-0087  
Fax: 774-760-0088

**Chicago**  
Itasca, IL  
Tel: 630-285-0071  
Fax: 630-285-0075

**Cleveland**  
Independence, OH  
Tel: 216-447-0464  
Fax: 216-447-0643

**Dallas**  
Addison, TX  
Tel: 972-818-7423  
Fax: 972-818-2924

**Detroit**  
Novi, MI  
Tel: 248-848-4000

**Houston, TX**  
Tel: 281-894-5983

**Indianapolis**  
Noblesville, IN  
Tel: 317-773-8323  
Fax: 317-773-5453

**Los Angeles**  
Mission Viejo, CA  
Tel: 949-462-9523  
Fax: 949-462-9608

**New York, NY**  
Tel: 631-435-6000

**San Jose, CA**  
Tel: 408-735-9110

**Canada - Toronto**  
Tel: 905-673-0699  
Fax: 905-673-6509

### ASIA/PACIFIC

**Asia Pacific Office**  
Suites 3707-14, 37th Floor  
Tower 6, The Gateway  
Harbour City, Kowloon  
Hong Kong  
Tel: 852-2943-5100  
Fax: 852-2401-3431

**Australia - Sydney**  
Tel: 61-2-9868-6733  
Fax: 61-2-9868-6755

**China - Beijing**  
Tel: 86-10-8569-7000  
Fax: 86-10-8528-2104

**China - Chengdu**  
Tel: 86-28-8665-5511  
Fax: 86-28-8665-7889

**China - Chongqing**  
Tel: 86-23-8980-9588  
Fax: 86-23-8980-9500

**China - Hangzhou**  
Tel: 86-571-8792-8115  
Fax: 86-571-8792-8116

**China - Hong Kong SAR**  
Tel: 852-2943-5100  
Fax: 852-2401-3431

**China - Nanjing**  
Tel: 86-25-8473-2460  
Fax: 86-25-8473-2470

**China - Qingdao**  
Tel: 86-532-8502-7355  
Fax: 86-532-8502-7205

**China - Shanghai**  
Tel: 86-21-5407-5533  
Fax: 86-21-5407-5066

**China - Shenyang**  
Tel: 86-24-2334-2829  
Fax: 86-24-2334-2393

**China - Shenzhen**  
Tel: 86-755-8864-2200  
Fax: 86-755-8203-1760

**China - Wuhan**  
Tel: 86-27-5980-5300  
Fax: 86-27-5980-5118

**China - Xian**  
Tel: 86-29-8833-7252  
Fax: 86-29-8833-7256

**China - Xiamen**  
Tel: 86-592-2388138  
Fax: 86-592-2388130

**China - Zhuhai**  
Tel: 86-756-3210040  
Fax: 86-756-3210049

### ASIA/PACIFIC

**India - Bangalore**  
Tel: 91-80-3090-4444  
Fax: 91-80-3090-4123

**India - New Delhi**  
Tel: 91-11-4160-8631  
Fax: 91-11-4160-8632

**India - Pune**  
Tel: 91-20-3019-1500

**Japan - Osaka**  
Tel: 81-6-6152-7160  
Fax: 81-6-6152-9310

**Japan - Tokyo**  
Tel: 81-3-6880-3770  
Fax: 81-3-6880-3771

**Korea - Daegu**  
Tel: 82-53-744-4301  
Fax: 82-53-744-4302

**Korea - Seoul**  
Tel: 82-2-554-7200  
Fax: 82-2-558-5932 or  
82-2-558-5934

**Malaysia - Kuala Lumpur**  
Tel: 60-3-6201-9857  
Fax: 60-3-6201-9859

**Malaysia - Penang**  
Tel: 60-4-227-8870  
Fax: 60-4-227-4068

**Philippines - Manila**  
Tel: 63-2-634-9065  
Fax: 63-2-634-9069

**Singapore**  
Tel: 65-6334-8870  
Fax: 65-6334-8850

**Taiwan - Hsin Chu**  
Tel: 886-3-5778-366  
Fax: 886-3-5770-955

**Taiwan - Kaohsiung**  
Tel: 886-7-213-7830

**Taiwan - Taipei**  
Tel: 886-2-2508-8600  
Fax: 886-2-2508-0102

**Thailand - Bangkok**  
Tel: 66-2-694-1351  
Fax: 66-2-694-1350

### EUROPE

**Austria - Wels**  
Tel: 43-7242-2244-39  
Fax: 43-7242-2244-393

**Denmark - Copenhagen**  
Tel: 45-4450-2828  
Fax: 45-4485-2829

**France - Paris**  
Tel: 33-1-69-53-63-20  
Fax: 33-1-69-30-90-79

**Germany - Dusseldorf**  
Tel: 49-2129-3766400

**Germany - Munich**  
Tel: 49-89-627-144-0  
Fax: 49-89-627-144-44

**Germany - Pforzheim**  
Tel: 49-7231-424750

**Italy - Milan**  
Tel: 39-0331-742611  
Fax: 39-0331-466781

**Italy - Venice**  
Tel: 39-049-7625286

**Netherlands - Drunen**  
Tel: 31-416-690399  
Fax: 31-416-690340

**Poland - Warsaw**  
Tel: 48-22-3325737

**Spain - Madrid**  
Tel: 34-91-708-08-90  
Fax: 34-91-708-08-91

**Sweden - Stockholm**  
Tel: 46-8-5090-4654

**UK - Wokingham**  
Tel: 44-118-921-5800  
Fax: 44-118-921-5820

03/25/14