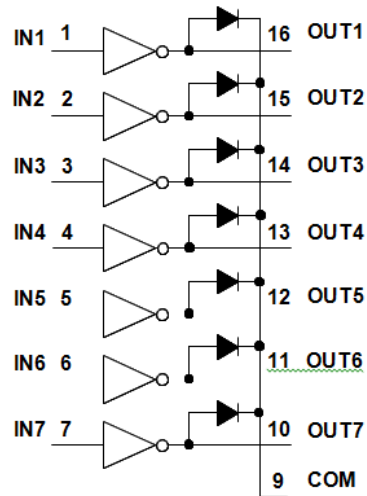
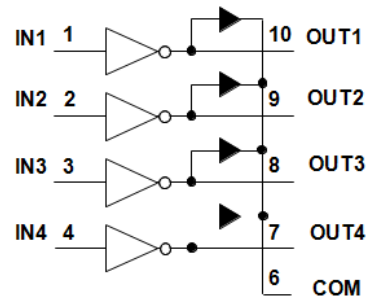


## Functional Diagram



ULN2003V12

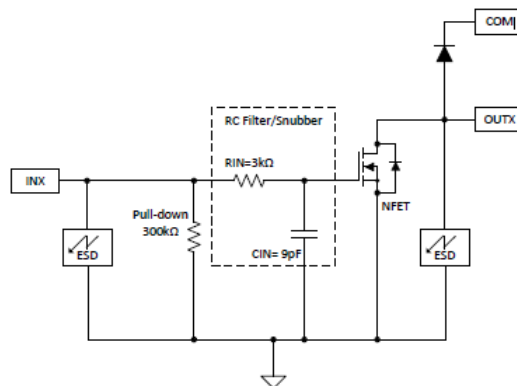


ULN2003F12

## Pin Descriptions

Pin Name	Package Number			Description
	SO16	TSSOP16	DFN3030-10	
IN1 ~ IN7	1~7	1~7	1~4	Logic Input Pins IN1 through IN7
GND	8	8	5	Ground Reference Pin
COM	9	9	6	Internal Free-Wheeling Diode Common Cathode Pin
OUT7 ~ OUT1	10~16	10~16	7~10	Channel Output Pins OUT7 through OUT1

## Functional Block Diagram (Single Channel)



**Absolute Maximum Ratings** (@  $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Symbol	Parameter	Rating		Unit
		Min	Max	
$V_{IN}$	Pin2 IN1~IN7 to GND Voltage	-0.3	5.5	V
$V_{OUT}$	Pins OUT1~OUT7 to GND Voltage	—	20	V
$V_{COM}$	Pin COM to GND Voltage	—	20	V
$I_{GND}$	Max GND-Pin Continuous Current ( $+100^\circ\text{C} < T_J < +125^\circ\text{C}$ )	—	700	mA
	Max GND-Pin Continuous Current ( $T_J < +100^\circ\text{C}$ )	—	1.0	A
$P_D$	Total Device Power Dissipation at $T_A = +85^\circ\text{C}$	16 Pin – SOIC	0.412	W
		16 Pin – TSSOP	0.277	W
		10 Pin – DFN3030	0.615	W
$\theta_{JA}$	Thermal Resistance Junction-to-Ambient (Note 6)	16 Pin – SOIC	97	$^\circ\text{C/W}$
		16 Pin – TSSOP	144	
		10 Pin – DFN3030	65	
$\theta_{JC}$	Thermal Resistance Junction-to-Case (Note 7)	16 Pin – SOIC	41	$^\circ\text{C/W}$
		16 Pin – TSSOP	61	
		10 Pin – DFN3030	17	
ESD	HBM	—	4	kV
	CDM	—	1	kV
$T_J$	Junction Temperature	-55	150	$^\circ\text{C}$
$T_{STG}$	Storage Temperature	-55	150	$^\circ\text{C}$

- Notes:
- Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only. 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.
  - All voltage values are with respect to the emitter/substrate terminal E, unless otherwise noted.
  - Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of  $+150^\circ\text{C}$  can affect reliability.
  - Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JC}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_C)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of  $+150^\circ\text{C}$  can affect reliability.

**Recommended Operating Conditions** (@  $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Symbol	Parameter	Min	Max	Unit
$V_{OUT}$	Channel Off-Stage Output Pull-Up Voltage	—	—	V
$V_{COM}$	COM Pin Voltage	—	—	V
$I_{OUT(ON)}$	Per Channel Continuous Sink Current	VINx = 3.3V	—	mA
		VINx = 5.0V	—	
$T_J$	Operating Junction Temperature	-40	—	$^\circ\text{C}$

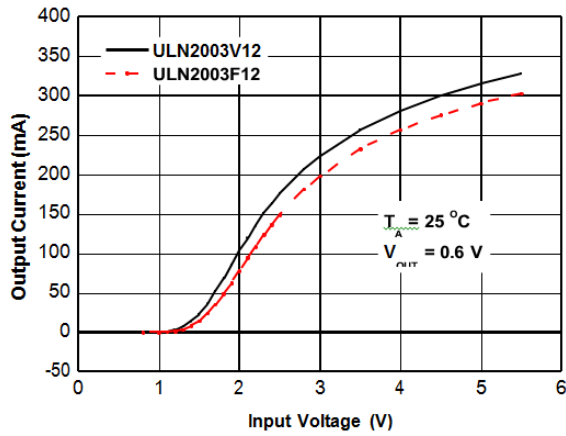
**Electrical Characteristics** (@  $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Specified over the recommended junction temperature range  $T_J = -40^\circ\text{C}$  to  $+125^\circ\text{C}$  and over recommended operating conditions unless otherwise noted. Typical values are at  $T_J = +25^\circ\text{C}$ .

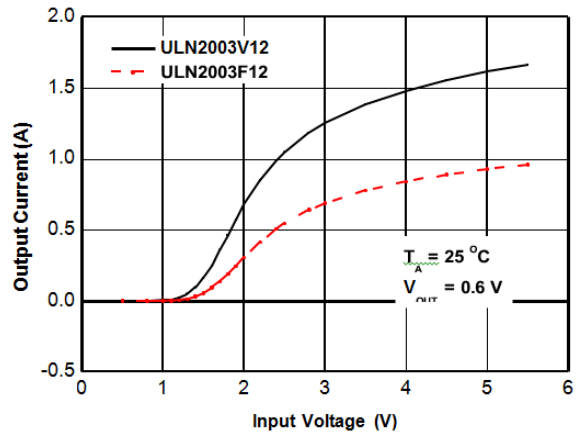
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>INPUTS IN1 THROUGH IN7 PARAMETERS</b>						
$V_{I(on)}$	IN1~IN7 logic high input voltage	$V_{CE} = 2\text{V}$ , $I_C = 300\text{mA}$	1.65	—	—	V
$V_{I(off)}$	IN1~IN7 logic low input voltage	$I_I = 250\mu\text{A}$ , $I_C = 100\text{mA}$	—	—	0.6	V
$I_{I(on)}$	IN1~IN7 ON state input current	$I_F = 350\text{mA}$	—	12	25	$\mu\text{A}$
$I_{I(off)}$	IN1~IN7 OFF state input leakage	—	—	—	250	nA
<b>OUTPUTS OUT1 THROUGH OUT7 PARAMETERS</b>						
$V_{OL(vce-sat)}$	OUT1~OUT7 low-level output voltage	$V_{INX} = 3.3\text{V}$ , $I_{OUTX} = 20\text{mA}$	—	0.12	0.15	V
		$V_{INX} = 3.3\text{V}$ , $I_{OUTX} = 100\text{mA}$	—	0.6	0.75	
		$V_{INX} = 5.0\text{V}$ , $I_{OUTX} = 20\text{mA}$	—	0.09	0.11	
		$V_{INX} = 5.0\text{V}$ , $I_{OUTX} = 140\text{mA}$	—	0.6	0.75	
$I_{OUT(on)}$	OUT1~OUT7 ON-state continuous current at $V_{OUTX} = 0.6\text{V}$	$V_{INX} = 3.3\text{V}$ , $V_{OUTX} = 0.6\text{V}$	80	100	—	V
		$V_{INX} = 5.0\text{V}$ , $V_{OUTX} = 0.6\text{V}$	80	140	—	A
$I_{OUT(off)}$	OUT1~OUT7 OFF-state leakage current	$V_{INX} = 0\text{V}$ , $V_{OUTX} = V_{COM} = 16\text{V}$	—	0.5	—	$\mu\text{A}$
<b>SWITCHING PARAMETERS</b>						
$t_{PHL}$	OUT1~OUT7 logic high propagation delay	$V_{INX} = 3.3\text{V}$ , $V_{pull-up} = 12\text{V}$ , $R_{pull-up} = 1\text{k}\Omega$	—	50	70	ns
$t_{PLH}$	OUT1~OUT7 logic low propagation delay	$V_{INX} = 3.3\text{V}$ , $V_{pull-up} = 12\text{V}$ , $R_{pull-up} = 1\text{k}\Omega$	—	121	140	ns
$t_{CHANNEL}$	Channel-to-channel delay	Over recommended operating conditions and with same test conditions on channels.	—	15	50	ns
$R_{PD}$	IN1~IN7 input pull-down resistance	—	210k	300k	390k	$\Omega$
$\zeta$	IN1~IN7 input filter time constant	—	—	9	—	ns
$C_{OUT}$	OUT1~OUT7 output capacitance	$V_{INX} = 3.3\text{V}$ , $V_{OUTX} = 0.4\text{V}$	—	15	—	pF
<b>FREE-WHEELING DIODE PARAMETERS</b>						
$V_F$	Forward voltage drop	$I_{F-peak} = 140\text{mA}$ , $V_F = V_{OUTX} - V_{COM}$	—	1.2	—	V
$I_{F-peak}$	Diode peak forward current	—	—	140	—	mA

## Performance Characteristics

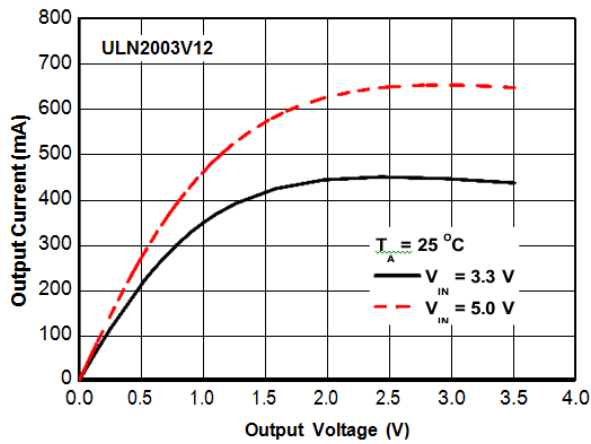
Output Current vs. Input Voltage (One Darlington)



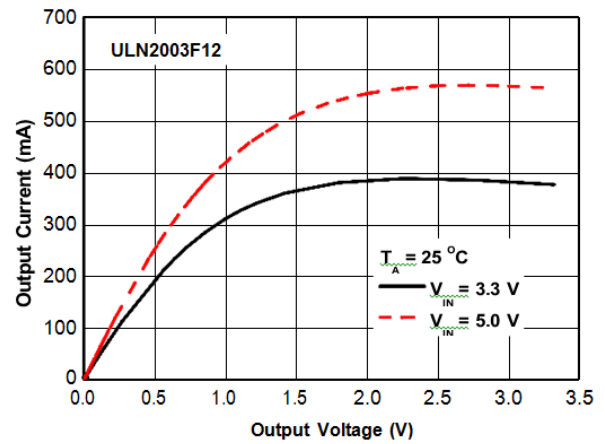
Output Current vs. Input Voltage (All Darlington in Parallel)



Output Current vs. Output Voltage

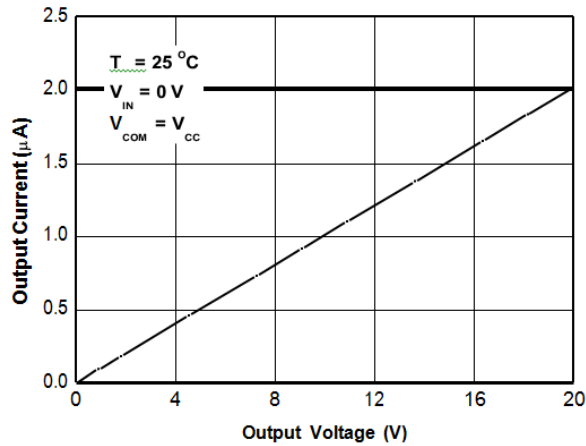


Output Current vs. Output Voltage

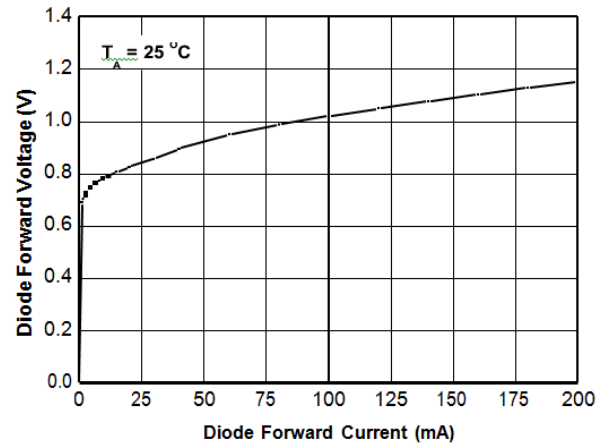


## Performance Characteristics (continued)

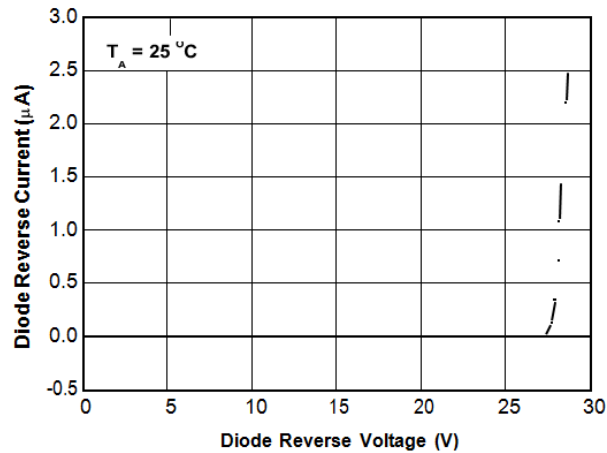
Output Current vs. Output Voltage



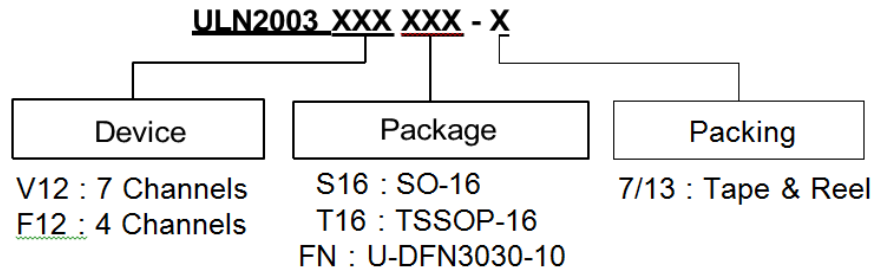
Diode Forward Voltage vs. Diode Forward Current



Diode Reverse Current vs. Diode Reverse Voltage



## Ordering Information

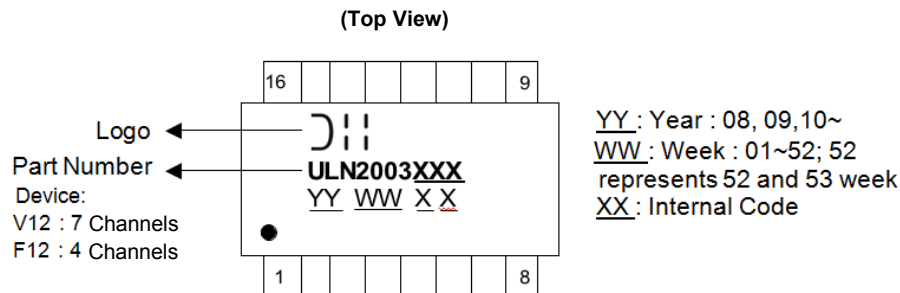


Device	Package Code	Packaging (Note 8)	7"/13" Tape and Reel	
			Quantity	Part Number Suffix
ULN2003V12S16-13	S16	SO-16	2,500/Tape & Reel	-13
ULN2003V12T16-13	T16	TSSOP-16	2,500/Tape & Reel	-13
ULN2003F12FN-7	FN	DFN3030-10	3,000/Tape & Reel	-7

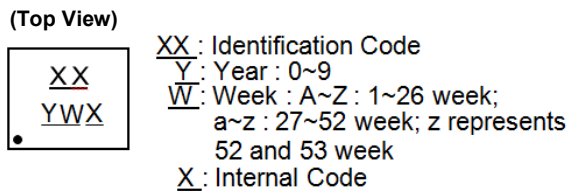
Note: 8. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

## Marking Information

### (1) SO-16 and TSSOP-16



### (2) DFN3030-10

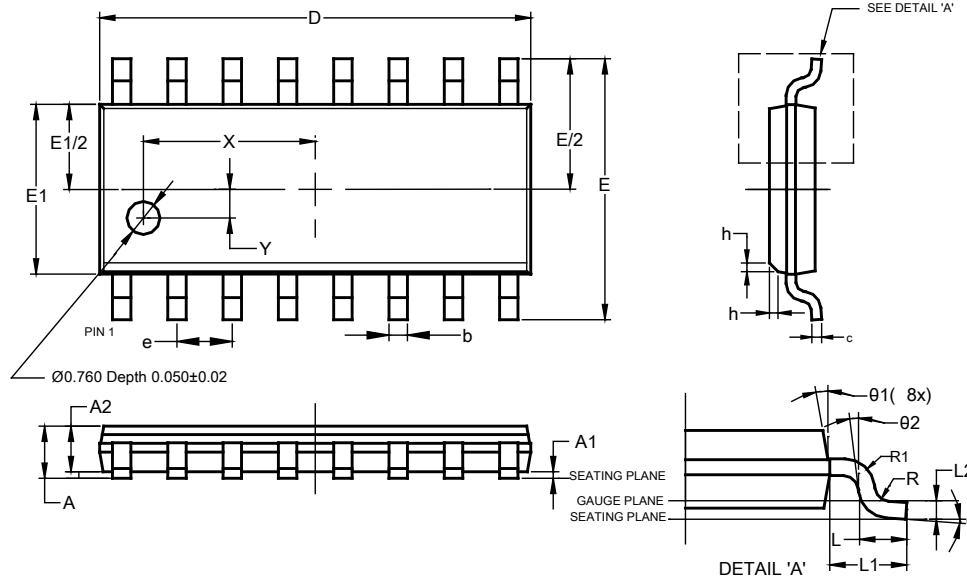


Part Number	Package	Identification Code
ULN2003F12FN-7	DFN3030-10	A3

## Package Outline Dimensions

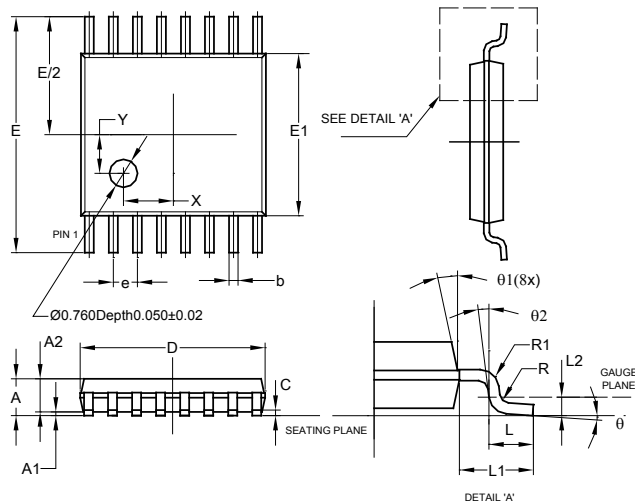
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### SO-16



SO-16			
Dim	Min	Max	Typ
A	--	1.260	--
A1	0.10	0.23	--
A2	1.02	--	--
b	0.31	0.51	--
c	0.10	0.25	--
D	9.80	10.00	--
E	5.90	6.10	--
E1	3.80	4.00	--
e	1.27 BSC		
h	0.15	0.25	0.20
L	0.40	1.27	--
L1	1.04 REF		
L2	0.25 BSC		
R	0.07	--	--
R1	0.07	--	--
X	3.945 REF		
Y	0.661 REF		
θ	0°	8°	--
θ1	5°	15°	--
θ2	0°	--	--
All Dimensions in mm			

### TSSOP-16

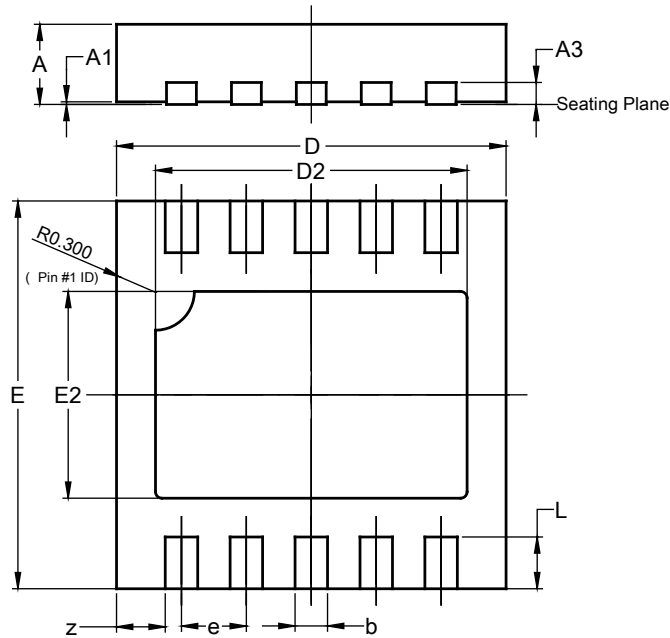


TSSOP-16			
Dim	Min	Max	Typ
A	-	1.08	-
A1	0.05	0.15	-
A2	0.80	0.93	-
b	0.19	0.30	-
c	0.09	0.20	-
D	4.90	5.10	-
E	6.40 BSC		
E1	4.30	4.50	-
e	0.65 BSC		
L	0.45	0.75	-
L1	1.00 REF		
L2	0.25 BSC		
R / R1	0.09	-	-
X	-	-	1.350
Y	-	-	1.050
θ	0°	8°	-
θ1	5°	15°	-
θ2	0°	-	-
All Dimensions in mm			

## Package Outline Dimensions (continued)

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

U-DFN3030-10

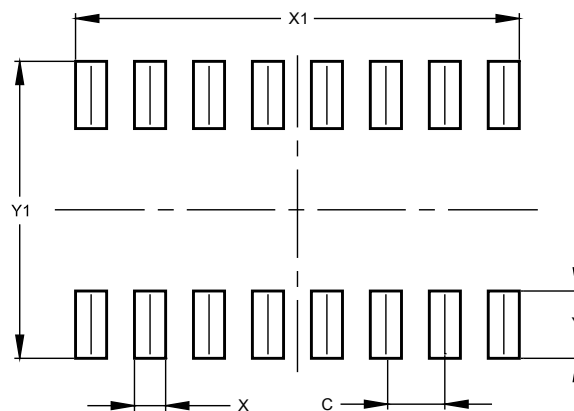


U-DFN3030-10			
Dim	Min	Max	Typ
A	0.57	0.63	0.60
A1	0.00	0.05	0.02
A3	—	—	0.15
b	0.20	0.30	0.25
D	2.90	3.10	3.00
D2	2.30	2.50	2.40
E	2.90	3.10	3.00
E2	1.50	1.70	1.60
e	—	—	0.50
L	0.25	0.55	0.40
z	—	—	0.375
All Dimensions in mm			

## Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

SO-16



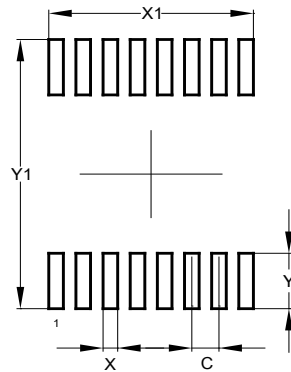
Dimensions	Value (in mm)
C	1.270
X	0.670
X1	9.560
Y	1.450
Y1	6.400



## Suggested Pad Layout (continued)

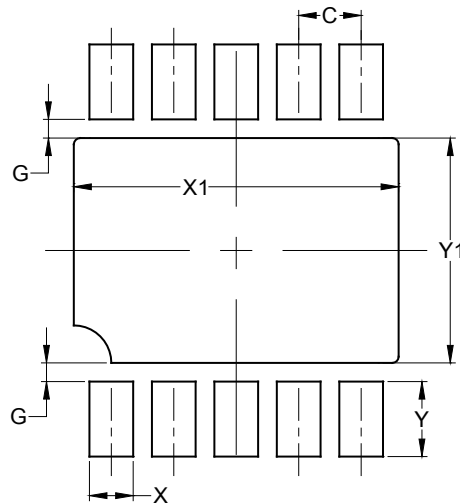
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### TSSOP-16



Dimensions	Value (in mm)
C	0.650
X	0.350
X1	4.900
Y	1.400
Y1	6.800

### U-DFN3030-10



Dimensions	Value (in mm)
C	0.50
G	0.15
X	0.35
X1	2.60
Y	0.60
Y1	1.80

## Mechanical Data

- Moisture Sensitivity: Level 3 per J-STD-020
- Terminals:
  - SO-16** and **TSSOP-16**: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 ③
  - DFN3030-10**: Finish NiPdAu over Copper Lead-Frame, Solderable per MIL-STD-202, Method 208 ③
- Weight:
  - SO-16**: 0.129 grams (Approximate)
  - TSSOP-16**: 0.055 grams (Approximate)
  - DFN3030-10**: 0.016 grams (Approximate)

**IMPORTANT NOTICE**

1. DIODES INCORPORATED AND ITS SUBSIDIARIES ("DIODES") MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).
2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes products. Diodes products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of the Diodes products for their intended applications, (c) ensuring their applications, which incorporate Diodes products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.
3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.
4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.
5. Diodes products are provided subject to Diodes' Standard Terms and Conditions of Sale (<https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/>) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
6. Diodes products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.
7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.
8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.

Copyright © 2021 Diodes Incorporated

[www.diodes.com](http://www.diodes.com)