

Vishay Siliconix

2 A, 1.2 V, Slew Rate Controlled Load Switch

DESCRIPTION

The SiP32411 is a slew rate controlled load switch that is designed for 1.1 V to 5.5 V operation.

The device guarantees low switch on-resistance at 1.2 V input. It features a controlled soft-on slew rate of typical 150 µs that limits the inrush current for designs of capacitive load or noise sensitive loads.

The device features a low voltage control logic interface (on/off interface) that can interface with low voltage digital control without extra level shifting circuit. It also integrates an output discharge switch that enables fast shutdown load discharge. When the switch is off, it provides the reverse blocking to prevent high current flowing into the power source.

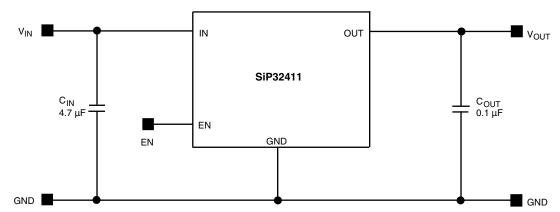
The SiP32411DN is in TDFN4 package of 1.2 mm by 1.6 mm. It supports over 2 A of continuous current. The SiP32411DR is in SC-70-6 package.

FEATURES

- 1.1 V to 5.5 V operation voltage range
- 62 m Ω typical from 2 V to 5 V for SiP32411DN
- 101 m Ω typical from 2 V to 5 V for SiP32411DR
- Low R_{ON} down to 1.2 V
- Slew rate controlled turn-on: 150 µs at 3.6 V
- Fast shutdown load discharge
- Low quiescent current
 < 1 μA when disabled
 6.7 μA at V_{IN} = 1.2 V
- Switch off reversed blocking
- Material categorization: for definitions of compliance please see <u>www.vishay.com/doc?99912</u>

APPLICATIONS

- · Cellular phones
- Portable media players
- Digital camera
- GPS
- Computers
- · Portable instruments and healthcare devices



TYPICAL APPLICATION CIRCUIT

Fig. 1 - SiP32411 Typical Application Circuit

ORDERING INFORMATION					
TEMPERATURE RANGE	PACKAGE	MARKING	PART NUMBER		
-40 °C to 85 °C	SC-70-6	MBxx	SiP32411DR-T1-GE3		
-40 0 10 85 0	TDFN4 1.2 mm x 1.6 mm	Ex	SiP32411DNP-T1-GE4		

Notes

x = lot code

• -GE3 and -GE4 denotes halogen-free and RoHS-compliant

1



ROHS COMPLIANT HALOGEN FREE Available www.vishay.com

SiP32411

Vishay Siliconix

ABSOLUTE MAXIMUM RATING	6		
PARAMETER	LIMIT	UNIT	
Supply input voltage (VIN)		-0.3 to 6	
Enable input voltage (V _{EN})		-0.3 to 6	V
Output voltage (V _{OUT})		-0.3 to V _{IN} +0.3	
Maximum continuous switch current (I _{max})	SC-70-6 package	1.8	
Maximum continuous switch current (I _{max.)}	TDFN4 1.2 mm x 1.6 mm	2.4	А
Maximum pulsed current (I _{DM}) V _{IN}	SC-70-6 package	2.2	A
(pulsed at 1 ms, 10 % duty cycle)	TDFN4 1.2 mm x 1.6 mm 3		
ESD rating (HBM)		4000	V
Junction temperature (T _J)		-40 to +125	°C
Thermal testeres $(0, \cdot)$ a	6 pin SC-70-6 ^b	240	°C/W
Thermal tesistance (θ_{JA}) ^a	4 pin TDFN4 1.2 mm x 1.6 mm ^c	170	C/W
Devuer discipution (D.) à	6 pin SC-70- 6 ^b	230	
Power dissipation (P _D) ^a	4 pin TDFN4 1.2 mm x 1.6 mm ^c	324	— mW

Notes

a. Device mounted with all leads and power pad soldered or welded to PC board, see PCB layout

b. Derate 4.5 mW/°C above $T_A = 70$ °C, see PCB layout

c. Derate 5.9 mW/°C above T_A = 70 °C, see PCB layout

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating/conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING RANGE				
PARAMETER	LIMIT	UNIT		
Input voltage range (V _{IN})	1.1 to 5.5	V		
Operating temperature range	-40 to 85	°C		



www.vishay.com

SiP32411

Vishay Siliconix

SPECIFICATIONS							
PARAMETER	SYMBOL	TEST CONDITIONS UNLESS SPECIFIED $V_{IN} = 5$, $T_A = -40 \degree C$ to 85 $\degree C$		LIMITS -40 °C TO 85 °C			UNIT
			pical values are at $T_A = 25$ °C)	MIN. ^a	TYP. ^b	MAX. a	
Operating voltage ^c	V _{IN}			1.5	-	5.5	V
			V _{IN} = 1.2 V, EN = active	-	6.7	14	
			V _{IN} = 1.8 V, EN = active	-	14	24	
Quiescent current			$V_{IN} = 2.5 V, EN = active$	-	25	40	
Quescent current	Ι _Q		V _{IN} = 3.6 V, EN = active	-	40	60	μA
			$V_{IN} = 4.3 V$, EN = active	-	52	75	
			$V_{IN} = 5 V$, EN = active	-	71	99	
Off supply current	I _{Q(off)}		EN = inactive, OUT = open	-	-	1	
Off switch current	I _{DS(off)}		EN = inactive, OUT = GND	-	-	1	
Reverse blocking current	I _{RB}	V _{OUT}	= 5 V, V_{IN} = 1.2 V, V_{EN} = inactive	-	-	10	
			$V_{IN} = 1.2 \text{ V}, I_L = 100 \text{ mA}, T_A = 25 ^\circ\text{C}$	-	105	125	
			V_{IN} = 1.8 V, I_L = 100 mA, T_A = 25 °C	-	101	120	
		SC-70-6	$V_{IN} = 2.5 \text{ V}, I_L = 100 \text{ mA}, T_A = 25 ^\circ\text{C}$	-	101	120	
		00100	$V_{IN} = 3.6 \text{ V}, I_L = 100 \text{ mA}, T_A = 25 ^\circ\text{C}$	-	101	120	
			V_{IN} = 4.3 V, I_L = 100 mA, T_A = 25 °C	-	101	120	
On-resistance	R _{DS(on)}		V_{IN} = 5 V, I_L = 100 mA, T_A = 25 °C	-	101	120 mΩ	
On-resistance	1 (01)	TDFN4 1.2 mm	$V_{IN} = 1.2 \text{ V}, I_L = 100 \text{ mA}, T_A = 25 ^\circ\text{C}$	-	66	76	-
			$V_{IN} = 1.8 \text{ V}, I_L = 100 \text{ mA}, T_A = 25 ^\circ\text{C}$	-	62	72	
			$V_{IN} = 2.5 \text{ V}, I_L = 100 \text{ mA}, T_A = 25 ^{\circ}\text{C}$	-	62	72	
		x 1.6 mm	$V_{IN} = 3.6 \text{ V}, I_L = 100 \text{ mA}, T_A = 25 ^\circ\text{C}$	-	62	72	
			V_{IN} = 4.3 V, I_L = 100 mA, T_A = 25 $^\circ C$ $-$	-	62	72	
			$V_{IN} = 5 \text{ V}, \text{ I}_{L} = 100 \text{ mA}, \text{ T}_{A} = 25 ^{\circ}\text{C}$	-	62	72	
On-resistance temperature	TC _{RDS}		SC-70-6 package	-	4300	-	ppm/°C
coefficient	103	TDI	FN4 1.2 mm x 1.6 mm package	-	3400	-	1-1
			V _{IN} = 1.2 V	-	-	0.3	_
			V _{IN} = 1.8 V	-	-	0.4 ^d	_
EN input low voltage c	VIL		V _{IN} = 2.5 V	-	-	0.5 ^d	
	12		V _{IN} = 3.6 V	-	-	0.6 ^d	_
			V _{IN} = 4.3 V	-	-	0.7 ^d	_
		V _{IN} = 5 V		-	-	0.8 ^d	v
		-	V _{IN} = 1.2 V	0.9 ^d	-	-	
			V _{IN} = 1.8 V	1.2 ^d	-	-	-
EN input high voltage ^c	V _{IH}		$V_{IN} = 2.5 V$	1.4 ^d	-	-	4
			V _{IN} = 3.6 V	1.6 ^d	-	-	_
			1.7 d	-	-	-	
EN Input looker -			$V_{\rm IN} = 5 V$	1.8	-	-	
EN Input leakage			$V_{EN} = 5.5 \text{ V}$	-1	-	1	μΑ
Output pull-down resistance	R _{PD}		EN = inactive, $T_A = 25 \text{ °C}$	-	217	280	Ω
Output turn-on delay time	t _{d(on)}			-	140	210	4
Output turn-on rise time	t _(on)	V _{IN} =	= 3.6 V, R_{load} = 10 Ω , T_A = 25 °C	80	150	220	μs
Output turn-off delay time	t _{d(off)}			-	0.27	1	

Notes

a. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum

b. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing

c. For V_{IN} outside this range consult typical EN threshold curve

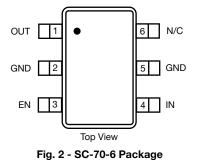
d. Not tested, guarantee by design

3

Document Number: 66710

Vishay Siliconix

PIN CONFIGURATION



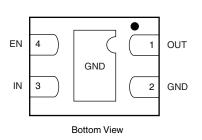


Fig. 3 - TDFN4 1.2 mm x 1.6 mm Package

PIN DE	SCRIPTIC	N	
PIN NU	IMBER	NAME	FUNCTION
SC-70-6	TDFN4	NAME	FONCTION
4	3	IN	This pin is the n-channel MOSFET drain connection. Bypass to ground through a 2.2 µF capacitor
2, 5	2	GND	Ground connection
3	4	EN	Enable input
1	1	OUT	This pin is the n-channel MOSFET source connection. Bypass to ground through a 0.1 µF capacitor

TYPICAL CHARACTERISTICS (internally regulated, 25 °C, unless otherwise noted)

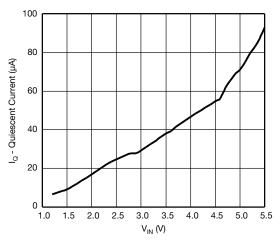


Fig. 4 - Quiescent Current vs. Input Voltage

V_{IN} (V)

Fig. 5 - Off Supply Current vs. Input Voltage

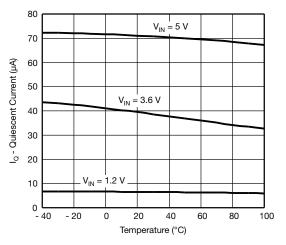


Fig. 6 - Quiescent Current vs. Temperature

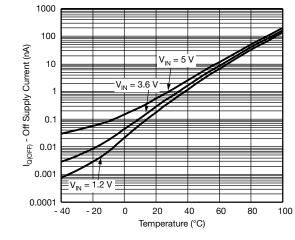


Fig. 7 - Off Supply Current vs. Temperature

S20-0532-Rev. G, 06-Jul-2020

1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5

0.9

0.8

0.7

0.6

0.5

0.4

0.3

0.2

0.1

0 L 1.0

I_{Q(OFF)} - Off Supply Current (nA)

4

Document Number: 66710

For technical questions, contact: <u>powerictechsupport@vishay.com</u> THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT <u>www.vishay.com/doc?91000</u>



TYPICAL CHARACTERISTICS (internally regulated, 25 °C, unless otherwise noted)

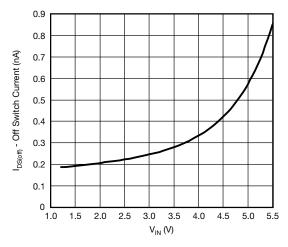


Fig. 8 - Off Switch Current vs. Input Voltage

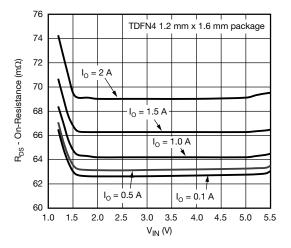


Fig. 9 - R_{DS(on)} vs. V_{IN} for TDFN4 package

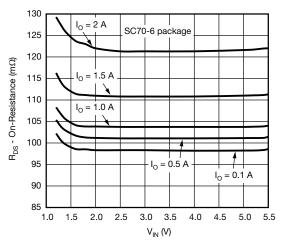


Fig. 10 - R_{DS(on)} vs. V_{IN} for SC-70-6 package

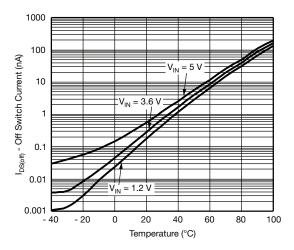


Fig. 11 - Off Switch Current vs. Temperature

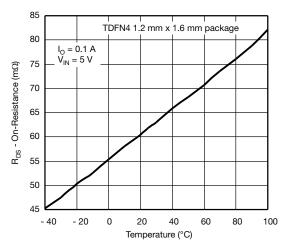


Fig. 12 - R_{DS(on}) vs. Temperature for TDFN4 package

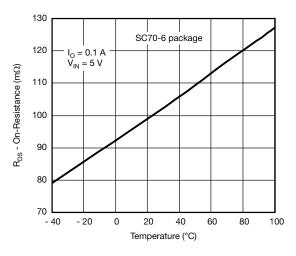


Fig. 13 - R_{DS(on)} vs. Temperature for SC-70-6 package

Document Number: 66710

For technical questions, contact: <u>powerictechsupport@vishay.com</u> THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT <u>www.vishay.com/doc?91000</u>





TYPICAL CHARACTERISTICS (internally regulated, 25 °C, unless otherwise noted)

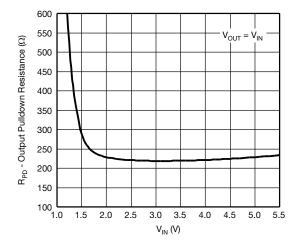


Fig. 14 - Output Pull Down vs. Input Voltage

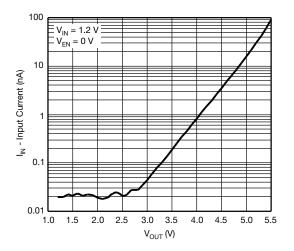


Fig. 15 - Reverse Blocking Current vs. Output Voltage

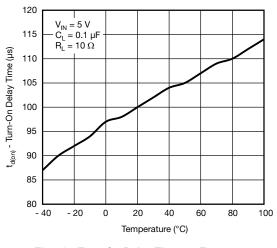


Fig. 16 - Turn-On Delay Time vs. Temperature

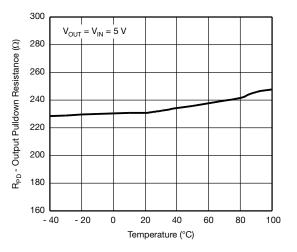


Fig. 17 - Output Pull Down vs. Temperature

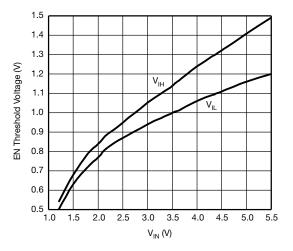


Fig. 18 - EN Threshold Voltage vs. Input Voltage

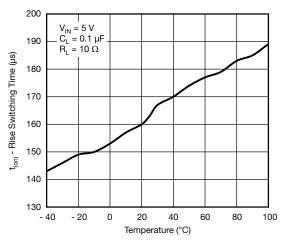


Fig. 19 - Rise Time vs. Temperature

S20-0532-Rev. G, 06-Jul-2020

6 questions, contact; powerictechsupport@y Document Number: 66710

For technical questions, contact: powerictechsupport@vishay.com THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000



TYPICAL CHARACTERISTICS (internally regulated, 25 °C, unless otherwise noted)

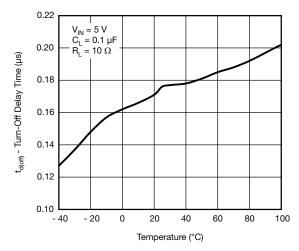


Fig. 20 - Turn-Off Delay Time vs. Temperature

TYPICAL WAVEFORMS

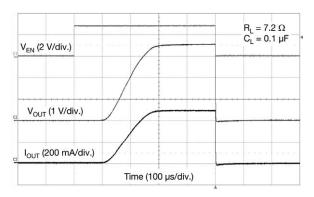


Fig. 21 - Switching (V_{IN} = 3.6 V)

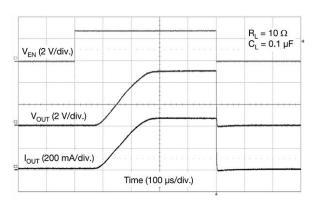


Fig. 22 - Switching (V_{IN} = 5 V)

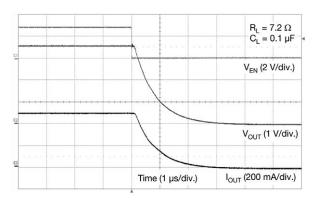


Fig. 23 - Turn-Off (V_{IN} = 3.6 V)

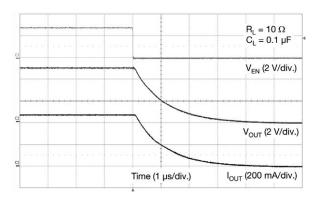
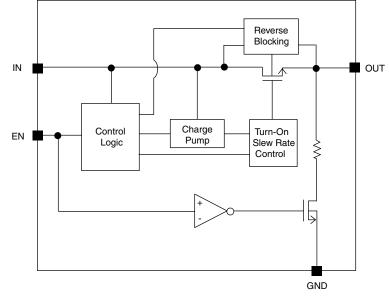


Fig. 24 - Turn-Off (V_{IN} = 5 V)



Vishay Siliconix

BLOCK DIAGRAM





PCB LAYOUT

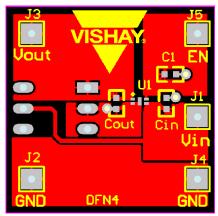


Fig. 26 - Top, PCB Layout for TDFN4 1.2 mm x 1.6 mm (board size: 1" x 1v)

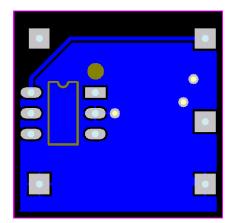


Fig. 27 - Bottom, PCB Layout for TDFN4 1.2 mm x 1.6 mm (board size: 1" x 1")

S20-0532-Rev. G, 06-Jul-2020

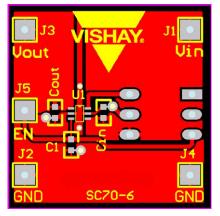


Fig. 28 - Top, PCB Layout for SC-70-6 (board size: 1" x 1")

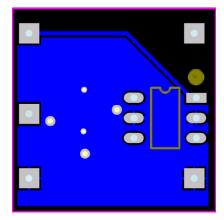


Fig. 29 - Bottom, PCB Layout for SC-70-6 (board size: 1" x 1")

Document Number: 66710

8 For technical questions, contact: <u>powerictechsupport@vishay.com</u>

THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000



DETAILED DESCRIPTION

SiP32411 is an n-channel power MOSFET designed as high side load switch with slew rate control to prevent in-rush current. Once enable the device charge pumps the gate of the power MOSFET to 5 V gate to source voltage while controlling the slew rate of the turn on time. The mostly constant gate to source voltage keeps the on resistance low through out the input voltage range. When disable, the output discharge circuit turns on to help pull the output voltage to ground more quickly. Also in disable mode, the reverse blocking circuit is activated to prevent current from going back to the input in case the output voltage is higher than the input voltage. Input voltage is needed for the reverse blocking circuit to work properly, it can be as low as $V_{\rm IN(min.)}$.

APPLICATION INFORMATION

Input Capacitor

While a bypass capacitor on the input is not required, a 2.2 μ F or larger capacitor for C_{IN} is recommended in almost all applications. The bypass capacitor should be placed as physically close as possible to the SiP32411 to be effective in minimizing transients on the input. Ceramic capacitors are recommended over tantalum because of their ability to withstand input current surges from low impedance sources such as batteries in portable devices.

Output Capacitor

A 0.1 μ F capacitor or larger across V_{OUT} and GND is recommended to insure proper slew operation. C_{OUT} may be increased without limit to accommodate any load transient condition with only minimal affect on the SiP32411 turn on slew rate time. There are no ESR or capacitor type requirement.

Enable

The EN pin is compatible with both TTL and CMOS logic voltage levels.

Protection Against Reverse Voltage Condition

The SiP32411 contains a reverse blocking circuitry to protect the current from going to the input from the output in case where the output voltage is higher than the input voltage when the main switch is off. A supply voltage as low as the minimum required input voltage is necessary for this circuitry to work properly.

Thermal Considerations

The SiP32411 is designed to maintain a constant output load current. Due to physical limitations of the layout and assembly of the device the maximum switch current is 1.8 A

for SC-70-6 package and 2.4 A for TDFN4 package, as stated in the absolute maximum ratings table. However, another limiting characteristic for the safe operating load current is the thermal power dissipation of the package. To obtain the highest power dissipation (and a thermal resistance of 240 °C/W for SC-70-6 and 170 °C/W for TDFN4) the power pad of the device should be connected to a heat sink on the printed circuit board.

The maximum power dissipation in any application is dependent on the maximum junction temperature, $T_{J(max.)} = 125$ °C, the junction-to-ambient thermal resistance for the TDFN4 1.2 mm x 1.6 mm package, $\theta_{J-A} = 170$ °C/W, and the ambient temperature, T_A , which may be formulaically expressed as:

P (max.) =
$$\frac{T_{J (max.)} - T_{A}}{\theta_{...A}} = \frac{125 - T_{A}}{170}$$

It then follows that, assuming an ambient temperature of 70 $^{\circ}$ C, the maximum power dissipation will be limited to about 324 mW.

So long as the load current is below the 2.4 A limit, the maximum continuous switch current becomes a function two things: the package power dissipation and the $R_{DS(on)}$ at the ambient temperature.

As an example let us calculate the worst case maximum load current at $T_A = 70$ °C. The worst case $R_{DS(on)}$ at 25 °C occurs at an input voltage of 1.2 V and is equal to 75 m Ω . The $R_{DS(on)}$ at 70 °C can be extrapolated from this data using the following formula

 $R_{DS(on)}$ (at 70 °C) = $R_{DS(on)}$ (at 25 °C) x (1 + $T_C x \Delta T$)

Where T_{C} is 3400 ppm/°C. Continuing with the calculation we have

 $\mathsf{R}_{\mathsf{DS(on)}}$ (at 70 °C) = 75 m Ω x (1 + 0.0034 x (70 °C - 25 °C)) = 86.5 m Ω

The maximum current limit is then determined by

$$I_{LOAD (max.)} < \sqrt{\frac{P (max.)}{R_{DS(on)}}}$$

which in case is 1.94 A. Under the stated input voltage condition, if the 1.94 A current limit is exceeded the internal die temperature will rise and eventually, possibly damage the device.



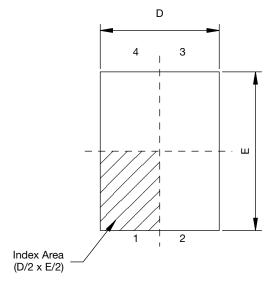
Vishay Siliconix

PRODUCT SUMMARY			
Part number	SiP32411	SiP32411	
Description	1.1 V to 5 V, 62 mΩ, 150 μs rise time, output discharge	1.1 V to 5 V, 101 m Ω , 150 μ s rise time output discharge	
Configuration	Single	Single	
Slew rate time (µs)	150	150	
On delay time (µs)	140	140	
Input voltage min. (V)	1.1	1.1	
Input voltage max. (V)	5.5	5.5	
On-resistance at input voltage min. (m Ω)	66	105	
On-resistance at input voltage max. (m Ω)	62	101	
Quiescent current at input voltage min. (µA)	6.7	6.7	
Quiescent current at input voltage max. (µA)	71	71	
Output discharge (yes / no)	Yes	Yes	
Reverse blocking (yes / no)	Yes	Yes	
Continuous current (A)	2.4	1.8	
Package type	TDFN4	SC-70-6	
Package size (W, L, H) (mm)	1.2 x 1.6 x 0.5	2.0 x 2.0 x 0.5	
Status code	2	2	
Product type	Slew rate	Slew rate	
Applications	Computers, consumer, industrial, healthcare, networking, portable	Computers, consumer, industrial, healthcare, networking, portable	

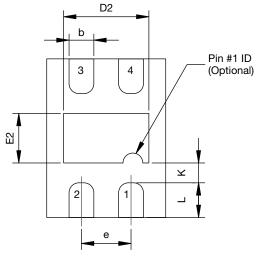
Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see <u>www.vishay.com/ppg?66710</u>.



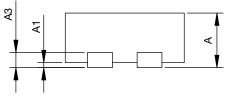
TDFN4 1.2 x 1.6 Case Outline



Top View



Bottom View



Side View

DIM.		MILLIMETERS		INCHES		
Dilvi.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
А	0.45	0.55	0.60	0.017	0.022	0.024
A1	0.00	-	0.05	0.00	-	0.002
A3	0.	15 REF. or 0.127 REF	. (1)		0.006 or 0.005 ⁽¹⁾	
b	0.20	0.25	0.30	0.008	0.010	0.012
D	1.15	1.20	1.25	0.045	0.047	0.049
D2	0.81	0.86	0.91	0.032	0.034	0.036
е		0.50 BSC		0.020		
E	1.55	1.60	1.65	0.061	0.063	0.065
E2	0.45	0.50	0.55	0.018	0.020	0.022
К		0.25 typ.			0.010 typ.	
L	0.25	0.30	0.35	0.010	0.012	0.014
L ECN: T16-0143-F DWG: 5995	0.25 Rev. C, 18-Apr-16	0.30	0.35	0.010	0.012	0.0

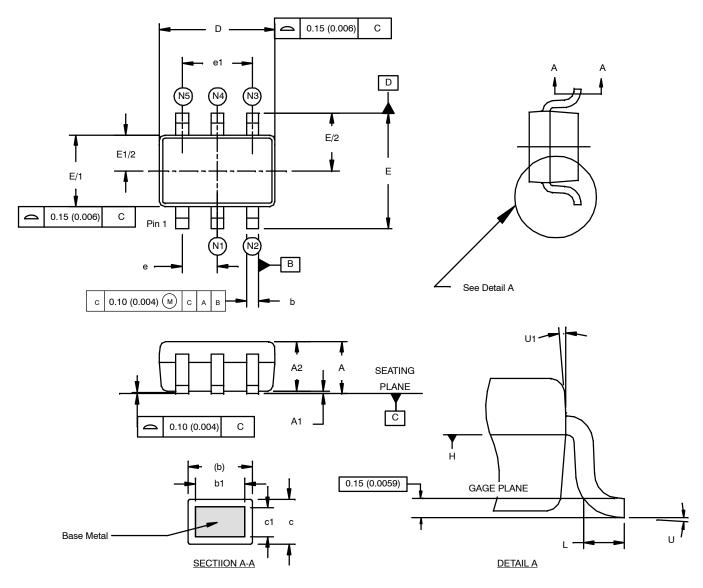
Note

⁽¹⁾ The dimension depends on the leadframe that assembly house used.

1



SC-70: 3/4/5/6-LEADS (PIC ONLY)



Pin	L	LEAD COUNT				
Code	3	4	5	6		
N1	-	-	2	2		
N2	2	2	3	3		
N3	-	3	4	4		
N4	3	-	-	5		
N5	-	4	5	6		

NOTES:

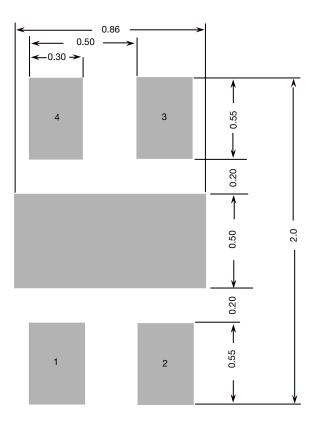
- 1. Dimensioning and tolerancing per ANSI Y14.5M-1994.
- 2. Controlling dimensions: millimeters converted to inch dimensions are not necessarily exact.
- Dimension "D" does not include mold flash, protrusion or gate burr. Mold flash, protrusion or gate burr shall not exceed 0.15 mm (0.006 inch) per side.
- 4. The package top shall be smaller than the package bottom. Dimension "D" and "E1" are determined at the outer most extremes of the plastic body exclusive of mold flash, tie bar burrs, gate burrs and interlead flash, but including any mismatch between the top and bottom of the plastic body.



	Μ	MILLIMETERS			INCHES		
Dim	Min	Nom	Max	Min	Nom	Max	
Α	0.80	-	1.10	0.031	-	0.043	
A1	0.00	-	0.10	0.000	-	0.004	
A2	0.80	0.90	1.00	0.031	0.035	0.040	
b	0.15	-	0.30	0.006	-	0.012	
b1	0.15	0.20	0.25	0.006	0.008	0.010	
С	0.08	-	0.25	0.003	-	0.010	
c1	0.08	0.13	0.20	0.003	0.005	0.008	
D	1.90	2.10	2.15	0.074	0.082	0.084	
Е	2.00	2.10	2.20	0.078	0.082	0.086	
E ₁	1.15	1.25	1.35	0.045	0.050	0.055	
е		0.65 BSC			0.0255 BSC		
e ₁		1.30 BSC			0.0512 BSC		
L	0.26	0.36	0.46	0.010	0.014	0.018	
U	0°	-	8°	0°	-	8 °	
U1	4°		10°	4°		10°	



RECOMMENDED MINIMUM PADS FOR TDFN4 1.2 x 1.6



Recommended Minimum Pads Dimensions in mm

Application Note 826

Vishay Siliconix



RECOMMENDED MINIMUM PADS FOR SC-70: 6-Lead



Recommended Minimum Pads Dimensions in Inches/(mm)

Return to Index



Vishay

Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

© 2025 VISHAY INTERTECHNOLOGY, INC. ALL RIGHTS RESERVED

Revision: 01-Jan-2025

1