3.3 V 2:1 400 MHz Bus Switch

Features

- Supply Voltage: 2.3 V to 3.6 V
- 5-V Tolerant I/Os With Device Power Up or Power Down
- Device Isolation During Power Off
- Low ON-State Resistance:
  typical 4 Ω at V_{CC} = 3 V
- Bandwidth: 400 MHz
- Break-Before-Make Switching
- Operation Temperature Range: –40°C to 125°C

Applications

- SPI Routing
- Server
- Video Signal Routing
- Computer

Description

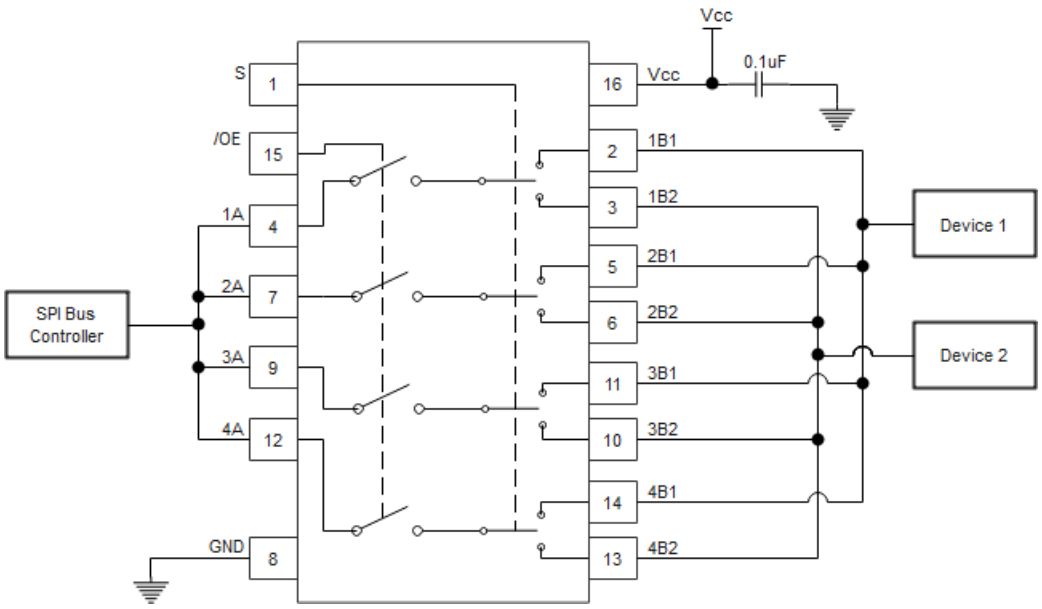
The TPW3257 device is a high-bandwidth bus switch utilizing a charge pump to provide a low and flat ON-state resistance.

The TPW3257 can be used to multiplex and de-multiplex up to 4 channels simultaneously in a 2:1 configuration. The /OE and S pins are used to control the chip from the bus controller.

The device has isolation during power off even when the signal exit on switch pin.

The V_{CC} operating range is from 2.3 V to 3.6 V and the switch pins support 0 V to 5 V signal levels.

Typical Application Circuit



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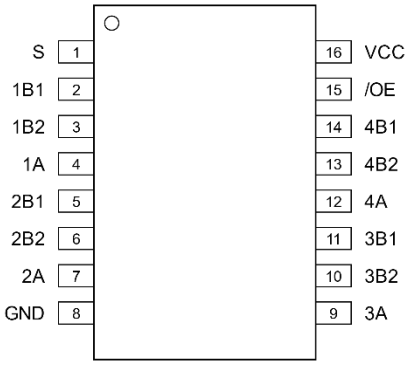
Revision History

Date	Revision	Notes
2021-09-20	Rev.A.0	Initial version

Pin Configuration and Functions

16-Pin SOP/QSOP/TSSOP



Pin Functions

Pin No.	Pin Name	Input / Output	Description
1	S	Input	Select Pin
2	1B1	Input / Output	Channel 1 I/O 1
3	1B2	Input / Output	Channel 1 I/O 2
4	1A	Input / Output	Channel 1 I/O common
5	2B1	Input / Output	Channel 2 I/O 1
6	2B2	Input / Output	Channel 2 I/O 2
7	2A	Input / Output	Channel 2 I/O common
8	GND		Ground
9	3A	Input / Output	Channel 3 I/O common
10	3B2	Input / Output	Channel 3 I/O 2
11	3B1	Input / Output	Channel 3 I/O 1
12	4A	Input / Output	Channel 4 I/O common
13	4B2	Input / Output	Channel 4 I/O 2
14	4B1	Input / Output	Channel 4 I/O 1
15	/OE	Input	Output Enable(Active Low)
16	V_{CC}		Power

Functional Table

/OE	S	INPUT/OUTPUT A	FUNCTION
L	L	B1	A port = B1 port
L	H	B2	A port = B2 port
H	X	Z	Disconnect

X = Don’t care

Specifications

Absolute Maximum Ratings

Parameter	Min	Max	Unit
Supply Voltage, V_{CC}	−0.5	4.6	V
Bus Switch Voltage	−0.5	7	V
Bus Switch Current	−100	100	mA
Bus Switch Diode Current		50	mA
Digital Input Voltage, /OE, S	−0.5	7	V
Digital Input Diode Current		50	mA
Maximum Junction Temperature		150	°C
Storage Temperature Range	−65	150	°C
Lead Temperature (Soldering, 10 sec)		260	°C

Note: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

ESD, Electrostatic Discharge Protection

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001(1)	2	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002(2)	1	kV

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	2.3		3.6	V
	Transition Rise and Fall Rate for Control Input			100	ns/V
	Switch I/O Port Voltage	0		5.5	V
	Operating Temperature Range	–40		125	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
16-Pin QSOP	100	50	°C/W

Electrical Characteristics

T_A = −40 to 125°C, all typical values are at T_A = 25°C, unless otherwise noted.

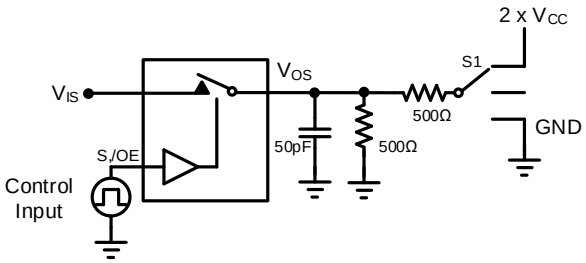
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
I_{CC}	Quiescent Supply Current	V_{CC} = 3.6 V, V_{IN} = 0 V or V_{CC}			1.5	mA
ΔI_{CC}	Increase in Supply Current	V_{CC} = 3.6 V, V_{IN} = 3.0 V			30	µA
Digital Input (V_{IN})						
V_{IH}	Input Voltage High	V_{CC} = 2.3 to 2.7 V	1.7		5.5	V
V_{IL}	Input Voltage Low	V_{CC} = 2.3 to 2.7 V			0.7	V
V_{IH}	Input Voltage High	V_{CC} = 2.7 to 3.6 V	2		5.5	V
V_{IL}	Input Voltage Low	V_{CC} = 2.7 to 3.6 V			0.8	V
I_{IN}	Control Input Leakage	V_{IN} = 0 V or V_{CC}			±1	µA
Analog Switch						
R_{ON}		V_{CC} = 2.3 V, I_{OUT} = 30 mA, V_{IS} = 0 V	4		8	Ω
		V_{CC} = 2.3 V, I_{OUT} = −15 mA, V_{IS} = 1.7 V	4		9	Ω
		V_{CC} = 3 V, I_{OUT} = 30 mA, V_{IS} = 0 V	4		6	Ω
		V_{CC} = 3 V, I_{OUT} = −15 mA, V_{IS} = 2.4 V	4		8	Ω
I_{OZ}	Switch OFF Leakage Current on Channel	V_{CC} = 3.6 V, V_{OS} = 0 to 5.5 V, V_{IS} = 0			±1	µA
I_{OFF}	Switch OFF Leakage Current on Common	V_{CC} floating, V_{OS} = 0 to 5.5 V, V_{IS} = 0			±1	µA

Electrical Characteristics (Continued)

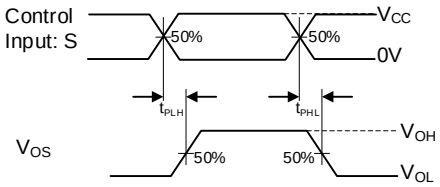
T_A = −40 to 125°C, all typical values are at T_A = 25°C, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic Characteristics , V_{CC} = 2.5 V						
t_{PD}		From A to B or B to A		0.2		ns
$t_{PD(S)}$		From S to A or B		5		ns
		From S to A or B, T_A = −40°C to 125°C		10		ns
t_{EN}		From /OE to A or B		5		ns
		From /OE to A or B, T_A = −40°C to 125°C		10		ns
t_{OFF}		From /OE to A or B		5		ns
		From /OE to A or B, T_A = −40°C to 125°C		10		ns
Dynamic Characteristics, V_{CC} = 3.3 V						
t_{PD}		From A to B or B to A		0.2		ns
$t_{PD(S)}$		From S to A or B		5		ns
		From S to A or B, T_A = −40°C to 125°C		8		
t_{EN}		From /OE to A or B		5		ns
		From /OE to A or B, T_A = −40°C to 125°C		8		
t_{OFF}		From /OE to A or B		5		ns
		From /OE to A or B, T_A = −40°C to 125°C		8		
BW	Bandwidth	R_L = 50 Ω, C_L = 5 pF		400		MHz
Capacitance						
C_{IN}	Control Input Capacitance	V_{CC} = 3.3 V		5		pF
$C_{IO(ON)}$	Switch On Capacitance	V_{CC} = 3.3 V		15		pF
$C_{IO(OFF)}$	Switch Off Capacitance	V_{CC} = 3.3 V		5		pF

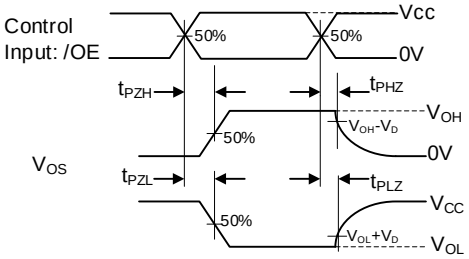
Test Circuit and Waveforms



Test	V_{CC}	S1	V_{IS}	C_L	V_D
$t_{PD(S)}$	2.5	Open	V_{CC} or GND	30pF	
	3.3	Open	V_{CC} or GND	50pF	
t_{PLZ}/t_{PZL}	2.5	2 × V_{CC}	GND	30pF	0.15V
	3.3	2 × V_{CC}	GND	50pF	0.3V
t_{PHZ}/t_{PZH}	2.5	GND	VCC	30pF	0.15V
	3.3	GND	VCC	50pF	0.3V



Test waveforms for $t_{PD(S)}$: t_{PLH} or t_{PHL}



Test waveforms for t_{EN} and t_{OFF}
t_{EN}: t_{PZH} or t_{PZL}, t_{OFF}: t_{PHZ} or t_{PLZ}

Typical Performance Characteristics

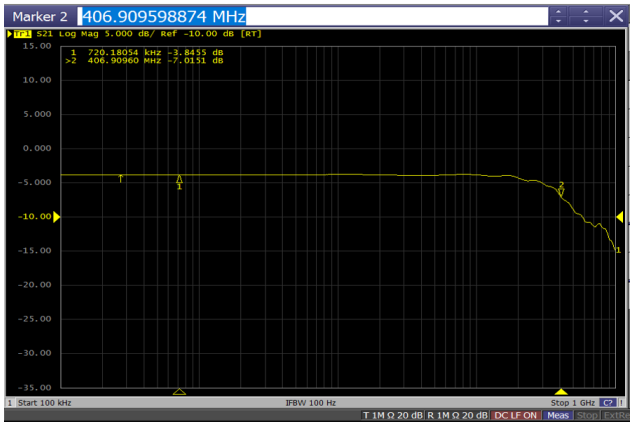


Figure 1 Bandwidth, V_{CC} = 3.3V

Detailed Description

Overview

The TPW3257 device is a high-bandwidth bus switch using a charge pump to provide higher voltage for internal circuit than input power voltage (V_{CC}). The design provides a low and flat ON-state resistance and low switch I/O capacitance, which allows for minimal propagation delay and supports high-bandwidth applications.

The TPW3257 device is organized as two 1-of-4 multiplexers/demultiplexers with single output-enable input (/OE) and single select input (S) control the data path of each multiplexer/demultiplexer. When /OE is low, the switch is enabled, and allows bidirectional data flow between A and B ports. When /OE is high, the switch is disabled, and a high-impedance state exists between the A and B ports.

Functional Block Diagram

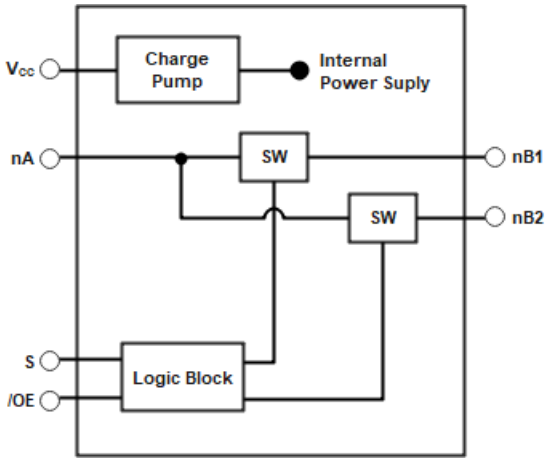


Figure 2 Functional Block Diagram

Feature Description

Over Power Rail Input for Switch

This device with internal charge pump has switching pass ability on data I/O ports for 0 V to 5 V switching with 3.3 V V_{CC} and 0 V to 3.3 V switching with 2.5 V V_{CC}.

Isolation during Power Off

The device has isolation during power off, the internal circuit prevents current flow when the device is powered down and the voltage still be applied at A, B ports or control inputs (S, /OE).

/OE should be tied to V_{CC} through a pullup resistor to ensure the high-impedance state during power up or power down.

Application and Implementation

NOTE

Information in the following applications sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

The TPW3257 device can be used to multiplex and demultiplex up to 4 channels simultaneously in a 2:1 configuration. The application shown here is a 4-bit bus being multiplexed between two devices. The control inputs (/OE and S) are used to control the device by the bus controller. If an application requires less than 4 channels, the unused channels of A port should tie to either high or low.

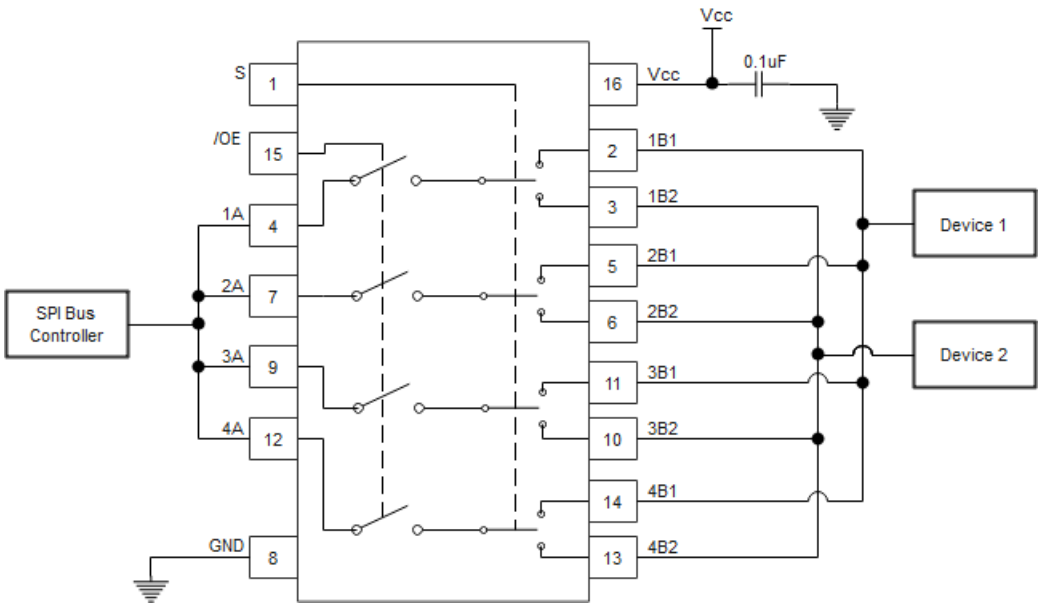
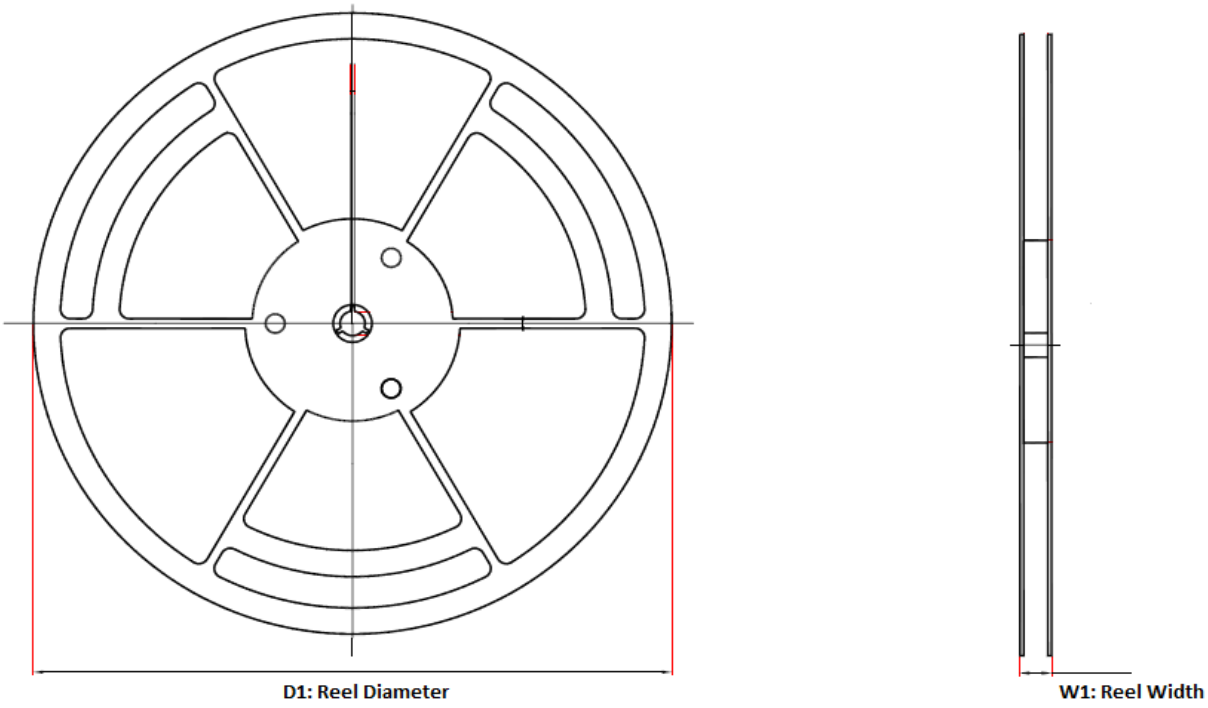


Figure 3 Typical Application

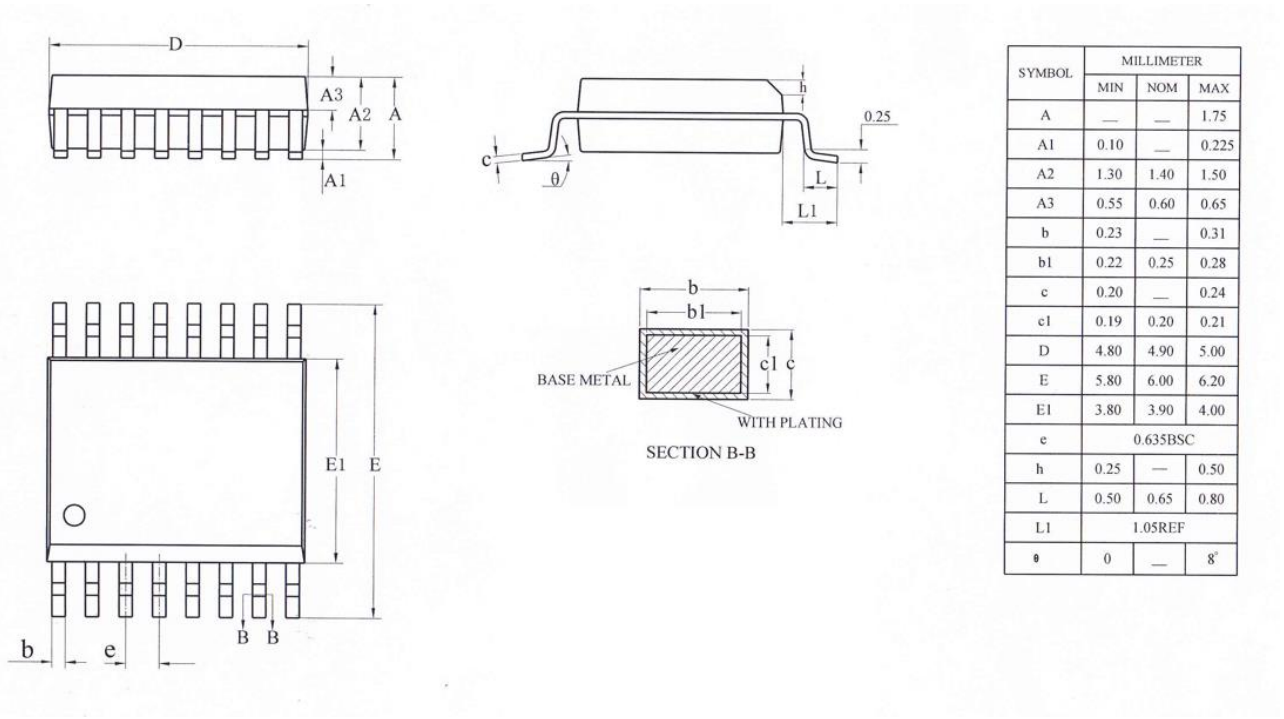
Tape and Reel Information



Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPW3257-SS3R	16-Pin QSOP	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1
TPW3257-SO3R	SOIC-16	330.0	21.6	6.7	10.4	2.1	8.0	16.0	Q1
TPW3257-TS3R	TSSOP-16	330.0	17.6	6.8	5.4	1.3	8.0	12.0	Q1

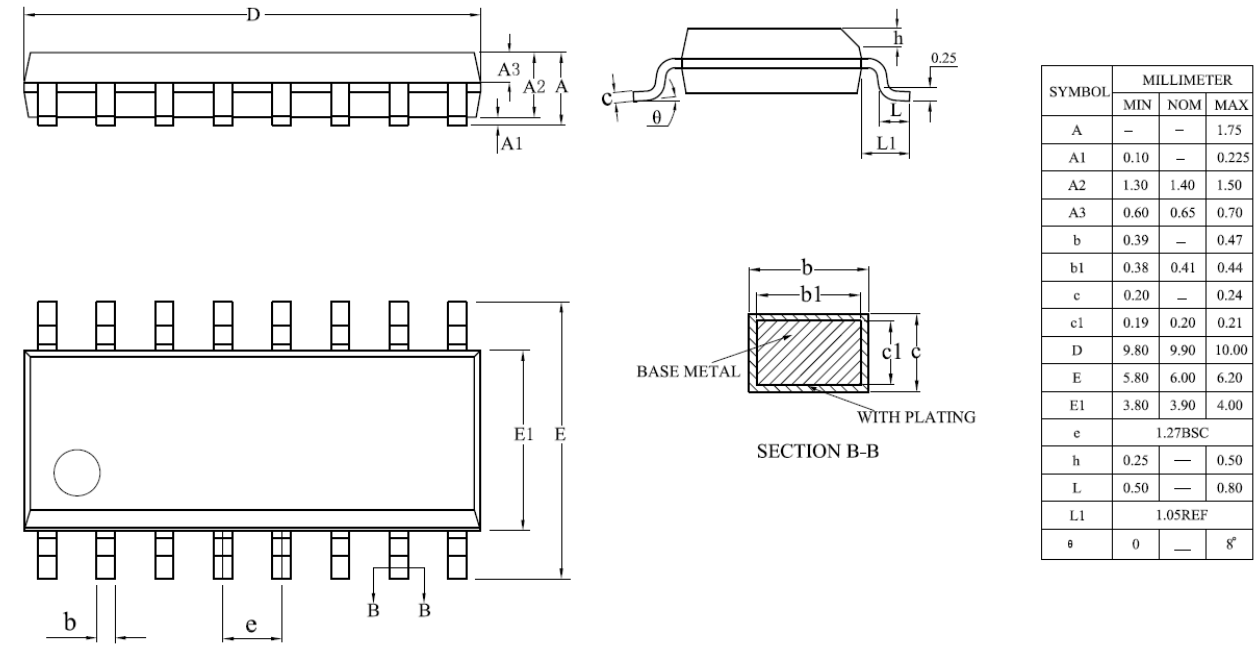
Package Outline Dimensions

QSOP-16



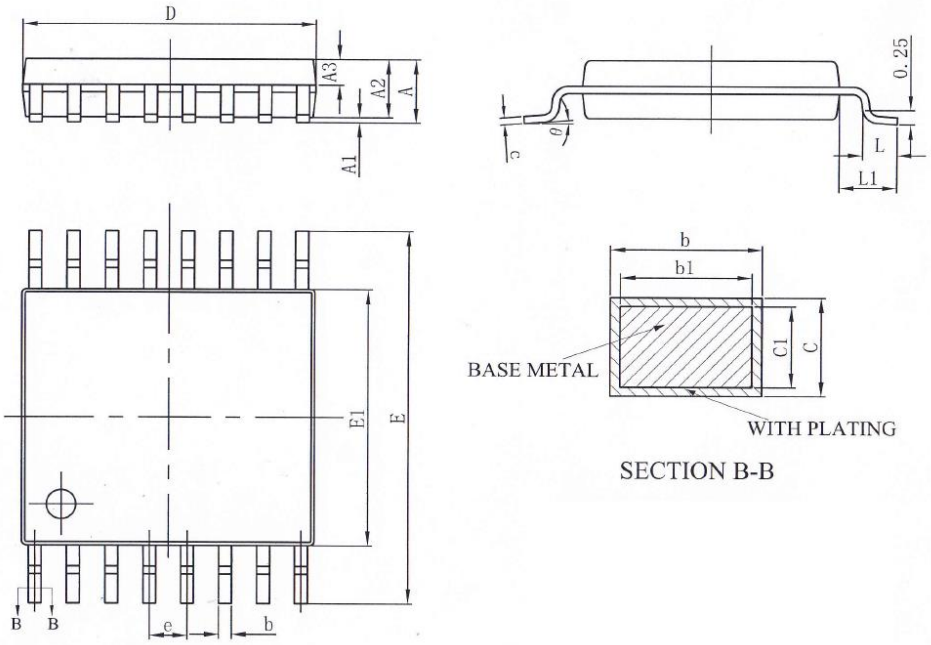
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.55	0.60	0.65
b	0.23	—	0.31
b1	0.22	0.25	0.28
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	0.635BSC		
h	0.25	—	0.50
L	0.50	0.65	0.80
L1	1.05REF		
θ	0	—	8°

SOIC-16



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	–	–	1.75
A1	0.10	–	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	–	0.47
b1	0.38	0.41	0.44
c	0.20	–	0.24
c1	0.19	0.20	0.21
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°

TSSOP-16



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	—	0.28
b1	0.19	0.22	0.25
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	4.90	5.00	5.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
θ	0	—	8°

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPW3257-SS3R	−40 to 125°C	16-Pin QSOP	W3257	3	Tape and Reel, 4000	Green
TPW3257-SO3R	−40 to 125°C	16-Pin SOIC	W3257	3	Tape and Reel, 2500	Green
TPW3257-TS3R	−40 to 125°C	16-Pin TSSOP	W3257	3	Tape and Reel, 3000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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