GTXU0101
Single-Bit Fixed Direction Voltage-Level Translator

1 Features

- Up to 200 Mbps support for 3.3 V to 5.0 V
- Schmitt-trigger inputs allows for noisy input
- High drive strength (up to 12 mA at 5 V)
- Low power consumption
- I_{off} supports partial-power-down mode operation
- Operating temperature from –40°C to +125°C
- Configurable dual-rail design allows each port to operate from 1.65 V to 5.5 V
- Inputs with integrated static pull-down resistors
- V_{CC} isolation and V_{CC} disconnect ($I_{off-float}$) feature
- Control logic (OE) with $V_{CC(MIN)}$ circuitry

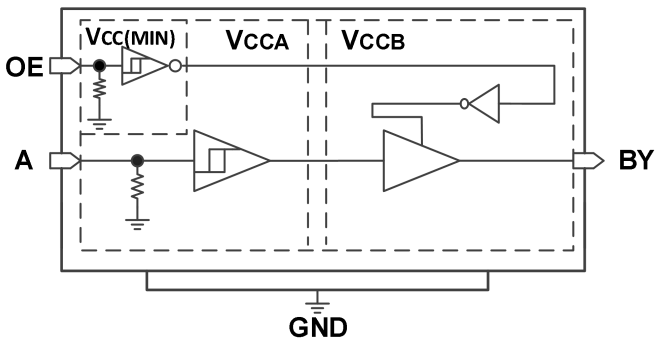
2 Application

- Eliminate slow or noisy input signals
- Driving indicator LEDS or buzzers
- General purpose I/O level shifting
- Push-pull level shifting
- Debouncing a mechanical switch

3 Description

GTXU0101 is a single-bit, dual-supply noninverting fixed direction voltage level translation device. A pin is referenced to V_{CCA} logic level, OE pin can be referenced to either V_{CCA} or V_{CCB} logic levels, and B pin is referenced to V_{CCB} logic level. The A port is able to accept input voltages ranging from 1.65 V to 5.5 V, while the B port can also accept input voltages from 1.65 V to 5.5 V. Fixed direction data transmission can occur from A to B or B to A when OE is set to high in reference to either supply. When OE is set to low, B pin is in the high-impedance state.

Circuit Diagram



Functional Block Diagram

4 Device Summary, Pin and Packages

Table 5-1. Device Summary(1)

Serial Name	Part Name	Package	Body Size (Nom)	Marking(2)	MSL(3)	Package Qty
GTXU0101	GTXU0101S6	SOT23-6	2.92mm×2.80mm	0101 XXXXX	3	Tape and Reel,3000
GTXU0101	GTXU0101U6	DFN1.45×1-6	1.45mm×1.00mm	0101 XXXXX	3	Tape and Reel,3000

(1) For all available packages, please contact product sales.

(2) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

(3) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

(4) "XXXXX" in Marking will be appeared as the batch code.

5 Device Summary, Pin and Packages(Continued)

Top View

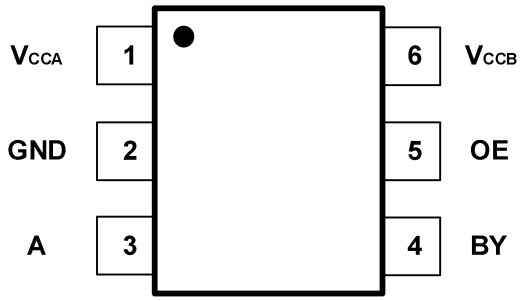


Fig.5-1. GTXU0101: S6 (SOT23-6) Package

Top View

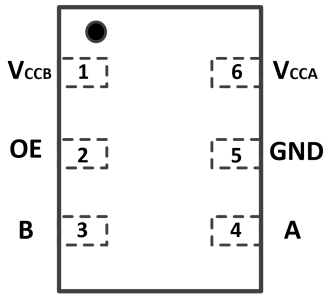


Fig.5-2. GTXU0101: U6 (DFN1.45×1.0-6) Package

Table 5-1 Pin Definition

Pin		I/O	Description
Name	S6		
A	3	I	Input A Referenced to V_{CCA}.
BY	4	O	Output BY. Referenced to V_{CCB}.
GND	2	-	Ground
OE	5	I	Output Enable. Pull to GND to place output in high-impedance mode. Pull to V_{CCA} or V_{CCB} to enable all outputs.
V_{CCA}	1	-	A-port supply voltage. 1.65 V ≤ V_{CCA} ≤ 5.5 V
V_{CCB}	6	-	B-port supply voltage. 1.65 V ≤ V_{CCB} ≤ 5.5 V

* It is suggested to leave the unconnected pins floating.

Table 5-2 Pin Definition

Pin		I/O	Description
Name	U6		
A	4	I	Input A Referenced to V_{CCA}.
BY	3	O	Output BY. Referenced to V_{CCB}.
GND	5	-	Ground
OE	2	I	Output Enable. Pull to GND to place output in high-impedance mode. Pull to V_{CCA} or V_{CCB} to enable all outputs.
V_{CCA}	6	-	A-port supply voltage. 1.65 V ≤ V_{CCA} ≤ 5.5 V
V_{CCB}	1	-	B-port supply voltage. 1.65 V ≤ V_{CCB} ≤ 5.5 V

6 Voltage, Temperature, ESD and Thermal Ratings

6.1 Absolute Maximum Ratings(1)

Parameters			Min.	Max.	Unit
V_{CC}	Supply voltage range		-0.5	6.5	V
V_I	Input voltage range(2)		-0.5	6.5	V
V_O	Voltage range applied to any output in the high-impedance or power-off state(2)		-0.5	6.5	V
V_O	Voltage range applied to any output in the high or low State(2)(3)		-0.5	V_{CC}+0.5	V
I_{IK}	Input clamp current	V_I < 0		-50	mA
I_{OK}	Output clamp current	V_O < 0		-50	mA
I_O	Continuous output current			±50	mA
	Continuous current through V_{CC} or GND			±100	mA
T_J	Junction temperature		-55	150	°C
T_{stg}	Storage temperature		-55	150	°C

(1) 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 under "Recommended Operating Conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.

(3) The output positive-voltage rating may be exceeded up to 6.5 V maximum if the output current rating is observed.

6.2 ESD Ratings

ESD			Value	Unit
V(ESD)	Electrostatic discharge	Human-Body Model (HBM)(1)	8 K	V
		Charged-Device Model (CDM)(2)	2 K	V

(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.

6 Voltage, Temperature, ESD and Thermal Ratings(Continued)

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted) (1) (2) (3)

Parameter	Conditions		Min	Max	Unit
V_{CCA}	Supply voltage A		1.65	5.5	V
V_{CCB}	Supply voltage B		1.65	5.5	V
I_{OH}	High-level output current	V_{CCO}=1.65 V		–4.5	mA
		V_{CCO}=2.3 V		–8	
		V_{CCO}=3 V		–10	
		V_{CCO}=4.5 V		–12	
I_{OL}	Low-level output current	V_{CCO}=1.65 V		4.5	mA
		V_{CCO}=2.3 V		8	
		V_{CCO}=3 V		10	
		V_{CCO}=4.5 V		12	
V_I	Input voltage(3)		0	5.5	V
V_O	Output voltage	Active State	0	V_{CCO}	V
		Tri-State	0	5.5	V
T_A	Operating free-air temperature		-40	125	°C

(1)V_{CCI} is the V_{CC} associated with the input port.

(2)V_{CCO} is the V_{CC} associated with the output port.

(3)All control inputs and data I/Os of this device have weak pulldowns to ensure the line is not floating when undefined external to the device. The input leakage from these weak pulldowns is defined by the I_I specification indicated under Electrical Characteristics.

7 Electrical Specifications

7.1 Electrical Characteristics

over operating free-air temperature range (unless otherwise noted)

Parameter		Test Conditions	V_{CCA}	V_{CCB}	Operating Free-air Temperature (TA)			Unit
					–40°C to 125°C			
					Min	Typ	Max	
VT+	Positive Going Input Threshold Voltage	Data Input (Referenced to V_{CCI})	1.65V	1.65V	0.88		1.19	V
			2.3V	2.3V	1.13		1.36	
			3V	3V	1.39		1.68	
			4.5V	4.5V	1.98		2.48	
			5.5V	5.5V	2.42		3.01	
		OE (Referenced to V_{CCA} or V_{CCB})	1.65V	1.65V	1		1.29	V
			2.3V	2.3V	1.26		1.69	
			3V	3V	1.52		2.03	
			4.5V	4.5V	2.16		2.78	
			5.5V	5.5V	2.63		3.33	
VT-	Negative Going Input Threshold Voltage	Data Input (Referenced to V_{CCI})	1.65V	1.65V	0.41		0.57	V
			2.3V	2.3V	0.59		0.83	
			3V	3V	0.88		1.1	
			4.5V	4.5V	1.4		1.73	
			5.5V	5.5V	1.74		2.15	
		OE (Referenced to V_{CCA} or V_{CCB})	1.65V	1.65V	0.44		0.63	V
			2.3V	2.3V	0.68		0.96	
			3V	3V	1.02		1.29	
			4.5V	4.5V	1.53		1.95	
			5.5V	5.5V	1.82		2.37	
ΔVT	Input Threshold Hysteresis (VT+ – VT-)	Data Input (Referenced to V_{CCI})	1.65V	1.65V	0.39		0.78	V
			2.3V	2.3V	0.43		0.75	
			3V	3V	0.45		0.66	
			4.5V	4.5V	0.53		0.79	
			5.5V	5.5V	0.62		0.93	
		OE (Referenced to V_{CCA} or V_{CCB})	1.65V	1.65V	0.44		0.85	V
			2.3V	2.3V	0.43		0.95	
			3V	3V	0.47		0.88	
			4.5V	4.5V	0.63		0.96	
			5.5V	5.5V	0.81		1.06	

7 Electrical Specifications(Continued)

over operating free-air temperature range (unless otherwise noted)

Parameter		Test Conditions	V_{CCA}	V_{CCB}	Operating Free-air Temperature (TA)			Unit
					–40°C to 125°C			
					Min	Typ	Max	
V_{OH}	High-Level Output Voltage	I_{OH}=-0.1mA	1.65V-5.5V	1.65V-5.5V	V_{CCO}-0.1			V
		I_{OH}=-4.5mA	1.65V	1.65V	1.41			
		I_{OH}=-8.0mA	2.3V	2.3V	2.15			
		I_{OH}=-10mA	3V	3V	2.85			
		I_{OH}=-12mA	4.5V	4.5V	4.35			
V_{OL}	Low-Level Output Voltage	I_{OL}=0.1mA	1.65V-5.5V	1.65V-5.5V			0.1	V
		I_{OL}=4.5mA	1.65V	1.65V			0.138	
		I_{OL}=8.0mA	2.3V	2.3V			0.182	
		I_{OL}=10mA	3V	3V			0.199	
		I_{OL}=8.0mA	4.5V	4.5V			0.143	
		I_{OL}=12mA	4.5V	4.5V			0.177	
I_I	Input Leakage Current	OE V_I=V_{CC} or GND	1.65V-5.5V	1.65V-5.5V	-0.1		2	μA
		Data Inputs(Ax,Bx) V_I=V_{CCI} or GND	1.65V-5.5V	1.65V-5.5V	-0.1		2	
I_{off}	Partial Power Down Current	A Port or B Port V_I or V_O=0 V - 5.5 V	0V	0V-5.5V	-2.5		2.5	μA
			0V-5.5V	0V	-2.5		2.5	
$I_{off\text{-}float}$	Floating Supply Partial Power Down Current	A Port or B Port V_I or V_O=GND	Floating	0V-5.5V	-2.5		2.5	μA
			0V-5.5V	Floating	-2.5		2.5	
I_{OZ}	Tri-State Output Current	A or B Port: V_I=V_{CCI} or GND V_O=V_{CCO} or GND OE=GND	1.65V-5.5V	1.65V-5.5V	-2.5		2.5	μA
I_{CCA}	V_{CCA} Supply Current	V_I=V_{CCI} or GND I_O=0	1.65V-5.5V	1.65V-5.5V			6	μA
			0V	5.5V	-1			
			5.5V	0V			3	
		V_I=GND I_O=0	5.5V	Floating			15	
I_{CCB}	V_{CCB} Supply Current	V_I=V_{CCI} or GND I_O=0	1.65V-5.5V	1.65V-5.5V			6	μA
			0V	5.5V			3	
			5.5V	0V	-1			
		V_I=GND I_O=0	5.5V	Floating			15	
I_{CCA} + I_{CCB}	Combined Supply Current	V_I=V_{CCI} or GND I_O=0	1.65V-5.5V	1.65V-5.5V			6	μA
C_i	Control Input Capacitance	V_I=3.3 V or GND	3.3V	3.3V		10.2		PF

7 Electrical Specifications(Continued)

over operating free-air temperature range (unless otherwise noted)

Parameter		Test Conditions	V_{CCA}	V_{CCB}	Operating Free-air Temperature (TA)	Unit
					25°C	
					Typ	
Cio	Data I/O Capacitance	OE=GND, VO= 1.65V DC +1 MHz -16 dBm Sine Wave	3.3V	3.3V	3.84	PF

7.2 Switching Characteristics: Tsk, Tmax

over operating free-air temperature range (unless otherwise noted)

Parameter	Test Conditions		V_{CCI}	V_{CCO}	Operating Free-air Temperature (TA)			Unit
					–40°C to 125°C			
					Min	Typ	Max	
TMAX - Maximum Data Rate	50% Duty Cycle Input One Channel Switching 20% of Pulse> 0.7*V_{CCO} 20% of Pulse< 0.3*V_{CCO}	Up Translation	3.0V-3.6V	4.5V-5.5V	200			Mbps
			1.65V-1.95V	4.5V-5.5V	150			
			1.65V-1.95V	3.0V-3.6V	100			
		Down Translation	4.5V-5.5V	3.0V-3.6V	125			
			4.5V-5.5V	1.65V-1.95V	50			
			3.0V-3.6V	1.65V-1.95V	50			
Tsk - Output Skew	Timing Skew Between Any Switching Outputs on The Rising or Falling Edge	Up Translation	3.0V-3.6V	4.5V-5.5V			3	ns
			1.65V-1.95V	4.5V-5.5V			10	
			1.65V-1.95V	3.0V-3.6V			8	
		Down Translation	4.5V-5.5V	3.0V-3.6V			3	
			4.5V-5.5V	1.65V-1.95V			10	
			3.0V-3.6V	1.65V-1.95V			8	

7.3 Switching Characteristics, V_{CCA}=1.8V±0.15V

over operating free-air temperature range (unless otherwise noted)

Parameter		From	To	Test Conditions	B-Port Supply Voltage (V_{CCB})				Unit
					1.8V±0.15V		5V±0.5V		
					Min	Max	Min	Max	
t_{pd}	Propagation Delay Time	A	B	–40°C to 125°C	13.3	22.3	7.6	10.3	ns
t_{dis}	Disable Time	OE	B	–40°C to 125°C	16.7	36.3	11.7	22.2	ns
t_{en}	Enable Time	OE	B	–40°C to 125°C	15.8	41.7	11.5	23.5	ns

7.4 Switching Characteristics, V_{CCA}=5V±0.5V

over operating free-air temperature range (unless otherwise noted)

Parameter		From	To	Test Conditions	B-Port Supply Voltage (V_{CCB})				Unit
					1.8V±0.15V		5V±0.5V		
					Min	Max	Min	Max	
t_{pd}	Propagation Delay Time	A	B	–40°C to 125°C	7	13.7	2.1	2.8	ns
t_{dis}	Disable Time	OE	B	–40°C to 125°C	10.8	36.6	4.5	7.3	ns
t_{en}	Enable Time	OE	B	–40°C to 125°C	10	42	2.5	3.3	ns

7.5 Operating Characteristics

Parameter		Test Conditions(25℃)	Supply Voltage (V_{CCB}=V_{CCA})				Unit
			1.8±0.15V	2.5±0.2V	3.3±0.3V	5V±0.5V	
			Typ	Typ	Typ	Typ	
C_{pdA}	A to B: Outputs Enabled	A Port CL=0, RL=Open f=10 MHz t_{rise}=t_{fall}=5 ns	0.5	0.9	1.5	3.6	PF
C_{pdB}	A to B: Outputs Enabled	B Port CL=0, RL=Open f=10 MHz t_{rise}=t_{fall}=5 ns	3.9	5.7	8.5	15.8	PF

8 Typical Characteristics

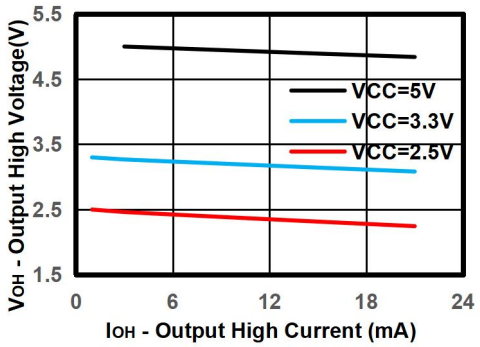


Fig.8-1. Typical (TA=25°C) Output High Voltage (V_{OH}) vs Source Current (I_{OH})

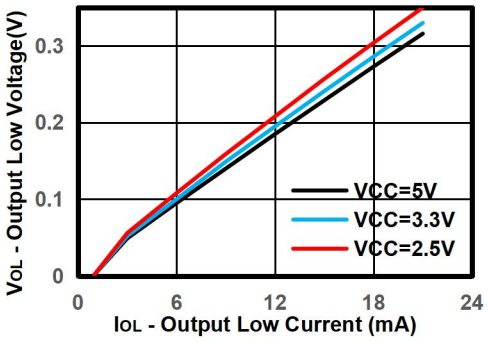


Fig.8-2. Typical (TA=25°C) Output Low Voltage (V_{OL}) vs Sink Current (I_{OL})

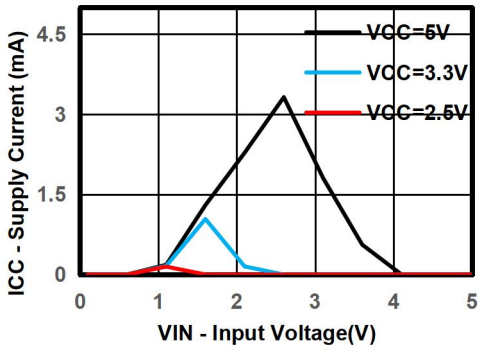
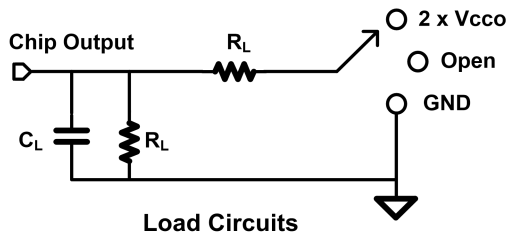


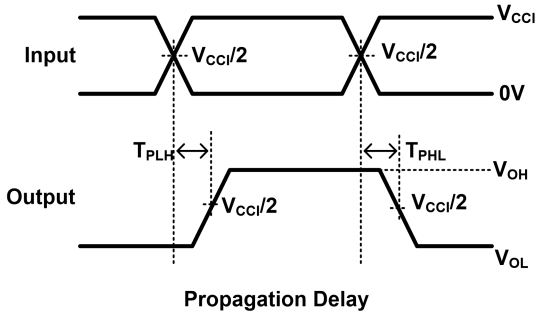
Fig.8-3. Typical (TA=25°C) Supply Current (I_{CC}) vs Input Voltage (V_{IN})

9 Parameter Measurement Information



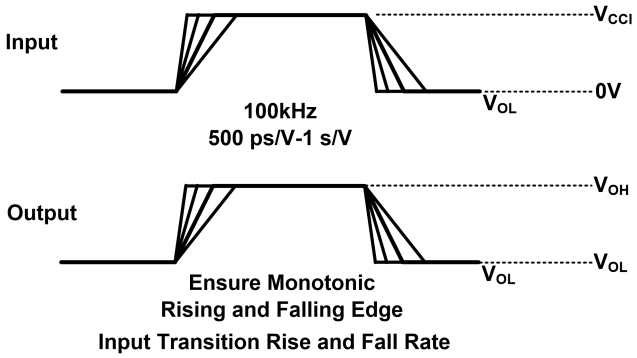
Load Circuits

Parameter	V_{CCO}	R_L	C_L	S1	VTP
T_{pd} Propagation delay time	1.65V-5.5V	10 kΩ	5 pF	Open	N/A
T_{en},T_{dis} Enable time, disable time	1.65V-2.7V	10 kΩ	5 pF	2 x V_{CCO}	0.15V
	3.0V-5.5V	10 kΩ	5 pF	2 x V_{CCO}	0.3V
T_{en},T_{dis} Enable time, disable time	1.65V-2.7V	10 kΩ	5 pF	GND	0.15V
	3.0V-5.5V	10 kΩ	5 pF	GND	0.3V



Propagation Delay

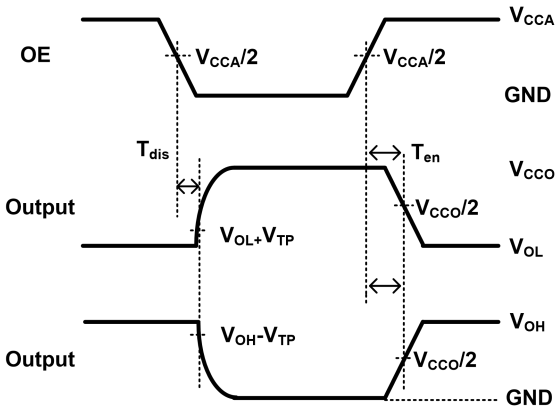
1. V_{CCI} is the supply pin associated with the input port.
2. V_{OH} and V_{OL} are typical output voltage levels that occur with specified R_L, C_L, and S_1.



Ensure Monotonic
Rising and Falling Edge
Input Transition Rise and Fall Rate

1. V_{CCI} is the supply pin associated with the input port.
2. V_{OH} and V_{OL} are typical output voltage levels that occur with specified R_L, C_L, and S_1.

9 Parameter Measurement Information(Continued)



Enable and Disable Times
Low-And High-Level Enabling

1. Output waveform on the condition that input is driven to a valid Logic Low.
2. Output waveform on the condition that input is driven to a valid Logic High.
3. V_{CCO} is the supply pin associated with the output port.
4. V_{OH} and V_{OL} are typical output voltage levels with specified R_L, C_L, and S1.

10 Detailed Description

The GTXU0101 is a single-bit translating transceiver that uses two individually configurable power-supply rails. The device is operational with V_{CCA} and V_{CCB} supplies as low as 1.65 V and as high as 5.5 V. Additionally, the device can be operated with V_{CCA}=V_{CCB}. The A port is designed to track V_{CCA}, and the B port is designed to track V_{CCB}.

The GTXU0101 device is designed for asynchronous communication between data buses, and transmits data with fixed direction from the A bus to the B bus on some channels and from the B bus to the A bus on the remaining channels. The output-enable input (OE) is used to disable the output so the buses are effectively isolated. The output-enable pin of the GTXU0101 (OE) can be referenced to either V_{CCA} or V_{CCB}. The OE pin can be left floating or externally pulled down to ground to ensure the high-impedance state of the level shifter outputs during power up or power down.

This device is fully specified for partial-power-down applications using the I_{off} current. The I_{off} protection circuitry ensures that no excessive current is drawn from or sourced into an input or output while the device is powered down.

Table. 10-1. Function table

Control Input	Port Status		Operation
OE	Input	Output	
H	L	L	Unidirectional non-inverting voltage translation
H	H	H	Unidirectional non-inverting voltage translation
L	X	Hi-z	Isolation

11 Application Note

The GTXU0101 device can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The GTXU0101 device is ideal for use in applications where a push-pull driver is connected to the data Input. The maximum data rate can be up to 200 Mbps when the device translates a signal from 3.3 V to 5.0 V.

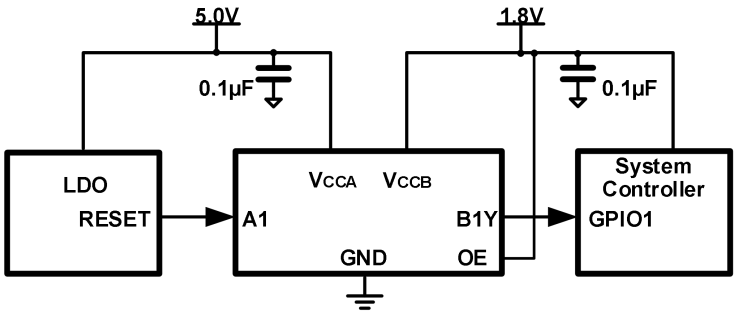
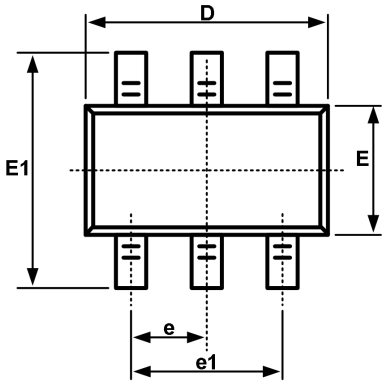
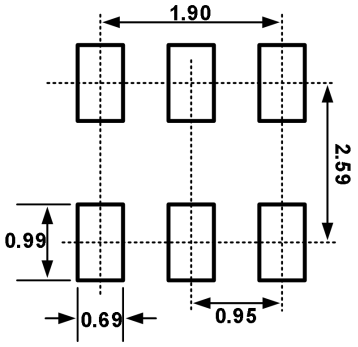


Fig.11-1. Typical Application Schematic

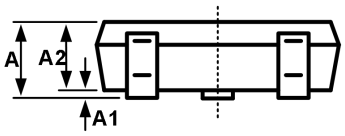
12 Package Outline Dimension

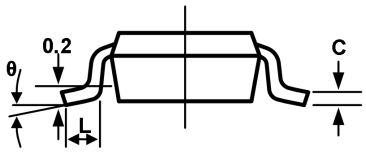
SOT23-6





Recommended Land Pattern (Unit: mm)

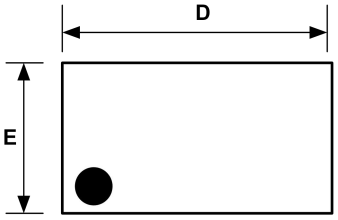




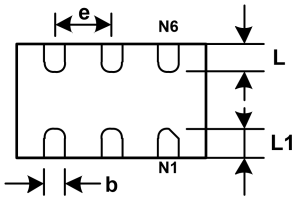
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

12 Package Outline Dimension(Continued)

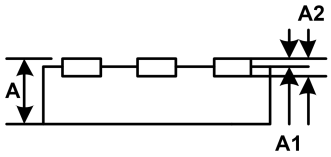
DFN1.45×1-6



TOP VIEW



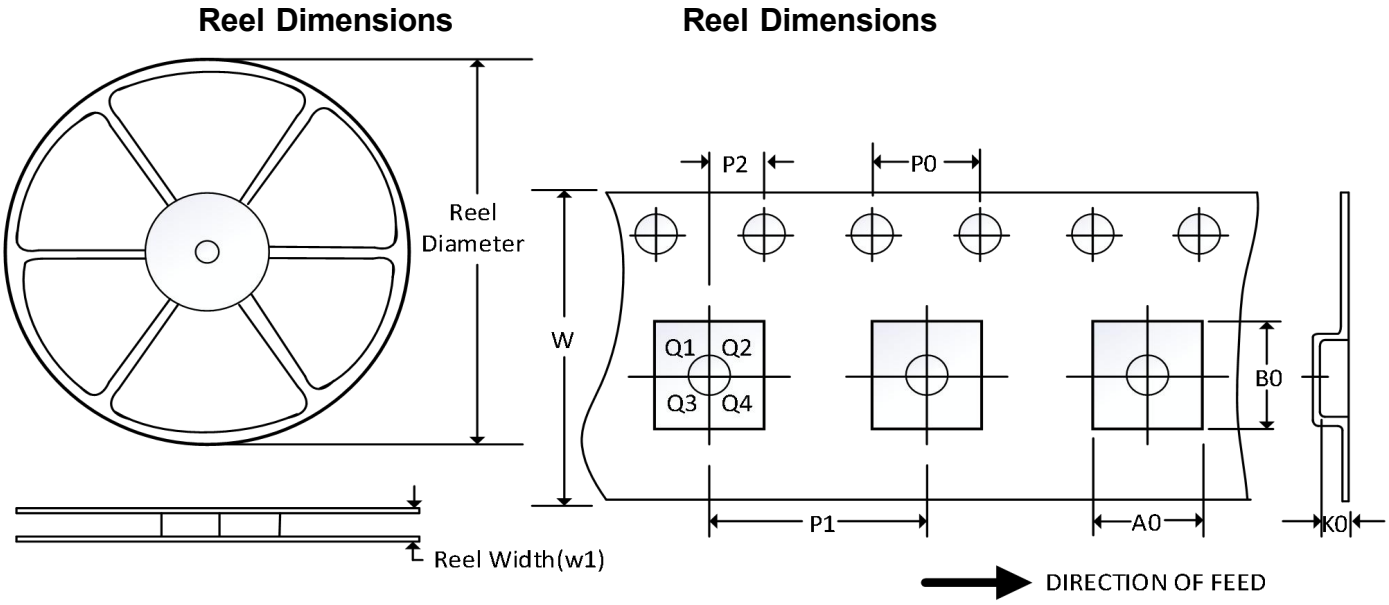
BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.500	0.600	0.020	0.024
A1	0.000	0.050	0.000	0.002
A2	0.150REF		0.006REF	
D	1.400	1.500	0.055	0.059
E	0.950	1.050	0.037	0.041
b	0.180	0.280	0.007	0.011
e	0.500BSC		0.020BSC	
L	0.250	0.450	0.010	0.018
L1	0.300	0.500	0.012	0.020

13 Tape and Reel Information



Note: The picture is only for reference. Please make the object as the standard.

Key Parameter List of Tape and Reel

Package Type	Reel Diameter	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 QµAdrant
SOT23-6	7''	9.5	3.17	3.23	1.37	4	4	2	8	Q3
DFN1.45×1.0-6	7''	9.5	1.2	1.65	0.7	4.0	4.0	2.0	8.0	Q1

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.