JWH7103

Single Power Switch with Flag

Preliminary Specifications Subject to Change without Notice

DESCRIPTION

The JW®H7103 is a single channel current-limited power switch optimized for Universal Serial Bus (USB) and other hot-swap applications. The rise and fall times are controlled to minimize current overshoot or undershoot during switches on/off.

The device has fast short-circuited response time for improved overall system robustness. It provides a complete protection solution, such as reverse current blocking and limit, over-current protection, over-temperature protection and short-circuit protection, as well as controlled rise time and under-voltage lockout function. A 7.5ms de-glitch time on the open-drain flag output prevents false over-current reporting.

JWH7103 offers both DFN2X2-6 and SOT23-6 packages.

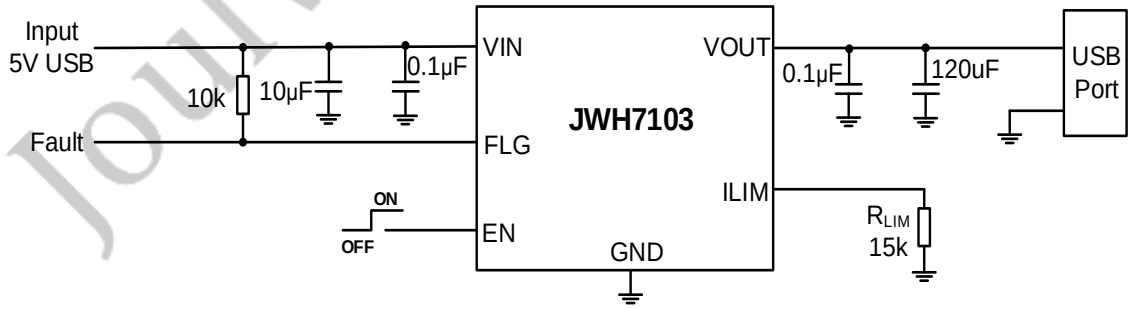
FEATURES

- Up to 1. 5A maximum load current
- ±9% accurate current limit@1.7A
- FLG: active low
- EN: active high
- Reverse current blocking during shutdown and reverse current limit during enable
- Constant-current during over-current
- Fast short-circuit response time: 2μs (typ.)
- Adjustable current limit 0.4A~1.7A
- Operating range: 2.7V - 5.5V
- Over-current protection, short-circuit Protection and thermal protection
- Fault report (FAULT) with de-glitch time
- ESD protection: 2kV HBM, 750V CDM
- Available in SOT23-6 and DFN2X2-6 packages

APPLICATIONS

- Set-Top Boxes
- LCD TVs & Monitors
- Residential Gateways
- Laptops, Desktops, Servers, E-books, Printers, Docking
- Stations, HUBs

TYPICAL APPLICATION



ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]
JWH7103SOTB#TRPBF	SOT23-6	JWGB□ YW□□□
JWH7103DFNB#TRPBF	DFN2x2-6	JWGC□ YW□□□

Notes:

1) JW□□ # TRPBF
- PB Free
- Tape and Reel(If" TR" is not shown, it means tube)
- Package Code
- Part No.

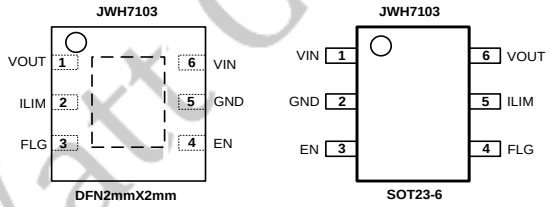
2) Line1: JW□□□
- Internal control code
- Product code
- Joulwatt LOGO

Line2: YW□□□
- Lot number
- Week code
- Year code

DEVICE[1)]	FEATURE	STATUS
JWH7103DFNB#TRPBF	DFN2x2-6	Available
JWH7103SOTB#TRPBF	SOT23-6	Available

PIN CONFIGURATION

TOP VIEW



ABSOLUTE MAXIMUM RATING[1)]

VIN PIN Voltage ..... -0.3V to 7V
VOUT PIN Voltage..... -0.3V to 7V
Other Pins Voltage..... -0.3V to 7V
Junction Temperature[2)] 150ºC
Lead Temperature 260ºC
Storage Temperature ..... -65ºC to +150ºC
ESD Susceptibility (Human Body Model) ..... ±2kV
ESD Susceptibility (Charged Device Model) ..... ±750V

RECOMMENDED OPERATING CONDITIONS[3)]

VIN PIN Voltage ..... 2.7V to 5.5V
VOUT PIN Voltage.....0V to (VIN+0.2V)
EN/$\overline{EN}$ PIN Voltage.....0V to 5.5V
High-Level Input Voltage on EN/$\overline{EN}$.....1.4V to VIN
Low-Level Input Voltage on EN/$\overline{EN}$.....0V to 0.5V
Operating Junction Temperature….....-40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{Jc}
DFN2X2-6	72	11.1ºC/W
SOT23-6	220	130ºC/W

Note：

1) Exceeding these ratings may damage the device. These stress ratings do not imply function operation of the device at any other conditions beyond those indicated under RECOMMENDED OPERATING CONDITIONS.

2) The JWH7103 includes thermal protection that is intended to protect the device in overload conditions. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.

3) The device is not guaranteed to function outside of its operating conditions.

4) Measured on JESD51-7, 4-layer PCB

ELECTRICAL CHARACTERISTICS

T_J=-40℃ to 125℃,Over recommended operating conditions, V_{IN} = 2.7V to 5.5V, V_{EN} = 0V or V_{EN} = V_{IN}, unless otherwise stated.

Item	Symbol	Condition[5]		Min.	Typ.	Max.	Units
Supply							
Input UVLO	V_{UVLO}	V_{IN} Rising			2.4	2.65	V
Input UVLO Hysteresis	ΔV_{UVLO}	V_{IN} Decreasing			50		mV
Input Shutdown Current	I_{SHDN}	V_{IN}= 5.5V, Disabled, V_{OUT} = Open T_J=-40°C to 105°C			0.1	1	μA
		V_{IN}= 5.5V, Disabled, V_{OUT} = Open, T_J=-40°C to 125°C			0.1	2.5	μA
Input Quiescent Current	I_Q	V_{IN}= 5.5V, Enabled, V_{OUT} = Open, R_{LIM}=20kΩ			130	165	μA
Power Switch							
Switch On Resistance	$R_{ds(ON)}$	SOT23-6	T_J = +25°C, V_{IN}= 5.0V, R_{LIM}=15k, Load=1A		40	48	mΩ
			T_J=-40°C to 125℃, V_{IN}= 5.0V, R_{LIM}=15k,Load=1A			60	mΩ
		DFN2X2-6	T_J = +25°C, V_{IN}= 5.0V, R_{LIM}=15k,Load=1A		40	48	mΩ
			T_J=-40°C to 125°C, V_{IN}= 5.0V, R_{LIM}=15k,Load=1A			60	mΩ
Output Turn-On Rise Time	t_R	V_{IN}= 5.5V, C_L = 1μF, R_{LOAD} = 100Ω. See Figure 1.			1.1	1.5	ms
		V_{IN}= 2.7V, C_L = 1μF, R_{LOAD} = 100Ω.			0.7	1	
Output Turn-Off Fall Time	t_F	V_{IN}= 5.5V, C_L = 1μF, R_{LOAD} = 100Ω. See Figure 1.		100		300	μs
		V_{IN}= 2.7V, C_L = 1μF, R_{LOAD} = 100Ω.		100		300	
Enable Pin							
Turn-On Time	t_{ON}	C_L = 1μF, R_L = 100Ω. See Figure 1.				3	ms
Turn-Off Time	t_{OFF}	C_L = 1μF, R_L = 100Ω. See Figure 1.				1	ms
EN High-Level Input Voltage	V_{EN_H}			1.4			V
EN Low-Level Input Voltage	V_{EN_L}					0.7	
Fault Flag							
FAULT Output Low Voltage	V_{OL}	I_{FAULT} = 1mA				180	mV

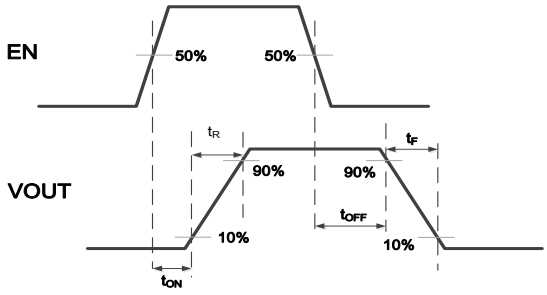
FAULT Blanking and Latch Off Time(Over-Current)	t_{Blank_OC}	Assertion or de-assertion due to over current		5	7.5	10	ms
FAULT Blanking and Latch Off Time(Reverse-Voltage)	t_{Blank_RV}	Assertion or de-assertion due to reverse voltage		2	4	6	ms
FAULT Off Current	I_{FOH}	V_{FAULT} = 6V				1	μA
Current Limit							
Current-Limit Threshold (maximum DC output current)	I_{LIMIT}	R_{LIM} = 15kΩ	-40°C ~+125°C	1547	1700	1853	mA
		R_{LIM} = 20kΩ	T_J=25°C	1179	1295	1411	
			-40°C ~+125°C	1164	1295	1426	
		R_{LIM} = 50kΩ	T_J=25°C	464	520	576	
			-40°C ~+125°C	449	520	591	
Short-Circuit Fold-back Current Limit	I_{SHORT}	VOUT Connected to GND			0.6		A
Short-Circuit Response Time[7]	t_{SHORT}	V_{IN}=5V, See Figure 2.			2		μs
Reverse Voltage Protection							
Reverse-Voltage Comparator Trip Point	V_{RVP}	V_{OUT}–V_{IN}		90	175	230	mV
Reverse Current Limit	I_{ROCP}	V_{OUT}–V_{IN}= 200mV			0.61		A
Time from reverse-voltage condition to MOSFET turn off	T_{RVP}			3	5	7	ms
Thermal Shutdown							
Thermal Shutdown Threshold[7]	T_{SHDN}	Enabled, R_{LOAD} = 1kΩ			160		°C
Thermal Shutdown Threshold under Current Limit[7]	T_{SHDN_OCP}	Enabled			130		°C
Thermal Shutdown Hysteresis[7]	T_{HYS}				30		°C

Note:

5) Pulse-testing techniques maintain junction temperature close to ambient temperature; thermal effects must be taken into account separately.

6) The discharge function is active when the device is disabled (when enable is de-asserted or during power-up power-down when VIN< VUVLO).The discharge function offers a resistive discharge path for the external storage capacitor for limited time.

7) Guaranteed by design



JWH7103 EN Active High

Figure 1 Voltage Waveforms

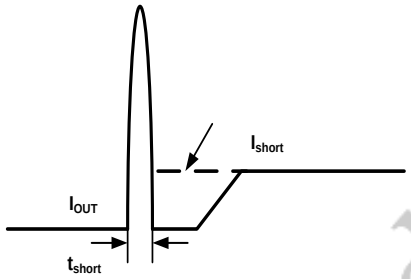
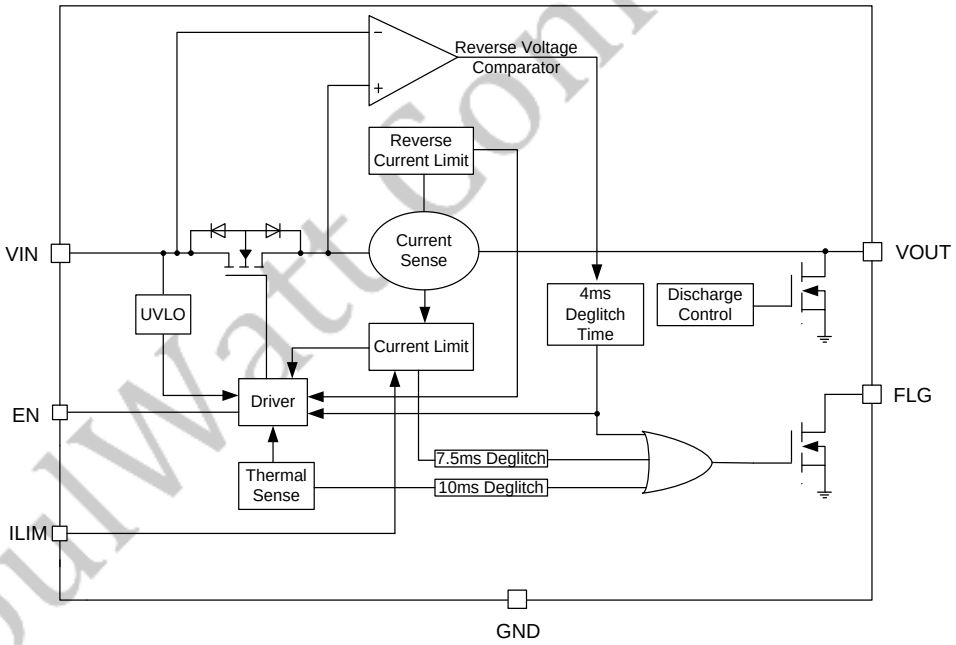


Figure 2 Response Time to Short Circuit Waveform

PIN DESCRIPTION

Pin		Name	Description
SOT23-6	DFN2X2-6		
6	1	VOUT	Output voltage
2	5	GND	Ground(0V)
4	3	FLG	Active-low open-drain output, asserted during over-current, over-temperature or reverse-voltage conditions
3	4	EN	logic high turns on power switch.
1	6	VIN	Input, connect a 10μF or greater ceramic capacitor from VIN to GND as close to IC as possible.
5	2	ILIM	Use external resistor to set current-limit threshold; Recommended 15kΩ≦R_{LIM}≦66.5kΩ.

BLOCK DIAGRAM



JWH7103 Block Diagram

FUNCTIONAL DESCRIPTION

The JWH7103 integrates high-side MOSFET optimized for Universal Serial Bus (USB) that requires protection functions. The MOSFET is driven with controlled gate voltage and slew-rate, which makes this USB device ideal for hot-swap or hot-plug applications.

FAULT Response

The Fault Flag function is realized by an open-drain circuit. The output goes active low for any of following faults: current limit threshold, short-circuit current limit, reverse voltage threshold, or thermal shutdown. In order to avoid the mis-trigger, a 7.5ms deglitch timer is inserted when an overcurrent or short circuit fault condition occurs. The FLG output remains low until over-current, short-circuit current limit, reverse current limit or over-temperature condition is removed.

Connecting a heavy capacitive load to the output of the device can cause a momentary over-current condition, which does not trigger the FAULT as long as the Fault condition lasts less than 7.5ms deglitch. This deglitch timer is also applied for over-current recovery and over-temperature recovery.

Power Supply Considerations

A local 10μF~22μF/0805/10V X7R or X5R ceramic capacitor between VIN and GND, close to the device, is requested if the input supply is located more than a few inches from the device. This local capacitor can absorb the spikes on VIN pin in transient events, such as hot-plug, short-circuit, reverse-blocking. For most of conditions, 10μF/0805/10V is highly recommended for good safety.

Additionally, bypassing the device output with a 0.1μF to 4.7μF ceramic capacitor improves the immunity of the device to short-circuit condition.

This capacitor also prevents output from going negative during turn-off due to parasitic inductance. If the negative kick is less than -1V, a Scotty diode in parallel with VOUT pin is recommended. Otherwise, the device may go malfunction.

Generic Hot-Plug Applications

In many applications it is common to remove modules or PC boards while the main unit is still operating. These are considered hot-plug applications. Such implementations require the control of current surges. The most effective way to control the current surge is to limit and slowly ramp the current and voltage being applied to the card, similar to the Soft Start in which a power supply normally turns on. Due to the controlled rising and falling times of the switch, these devices can be used to provide a softer start-up to devices being hot-plugged into a powered system.

The UVLO feature also ensures that the switch is off after the card has been removed, and that the switch is off during the next insertion.

Under-Voltage Lockout (UVLO)

Whenever the input voltage falls below UVLO threshold (TYP. 2.4V), the power switch is turned off. This facilitates the design of hot-insertion systems where it is not possible to turn off the power switch before input power is removed.

Over-Current and Short-Circuit Protection

An internal sensing FET is employed to sense over-current conditions. Unlike current-sense resistors, sensing FETs do not increase the series resistance of the current path. When an over-current condition is detected, the switch maintains a constant output current and reduces the output voltage accordingly. Current limit will fold back to 0.6A(TYP.) when Output voltage is lower than 0.4V. Complete shutdown occurs only if the fault stays long enough to activate

over-temperature protection.

Over-Current FAULT Signal

The FAULT signal will be asserted in response to OCP before the device reaches its current limit. The output current upon FAULT signal triggered will be lower than the limit value. To implement FAULT signal for precision system protection control, it is recommended to leave enough margin from maximum continuous operating current.

Over-Temperature Protection

Thermal protection prevents the IC from damage when the die temperature exceeds safe margins. This mainly occurs when heavy-overload or short-circuit faults occurs. IC implements a thermal sensing circuit to monitor the operating junction temperature. Once the die temperature rises to approximately +160°C (+130°C in case the part is under current limit), the thermal protection feature activates as follows: The internal thermal sense circuitry turns the power switch off and the FLG output is asserted, thus preventing the power switch from damage. Once the junction temperature drops to 130°C, the MOSFET restart to work.

Reverse-Current Protection

The USB specification does not allow an output device to source current back into the USB port. In a normal MOSFET switch, current will flow in reverse direction (from the output side to the input side) when the output side voltage is higher than the input side. A reverse over-current protection (ROCP) is implemented in the JWH7103 to limit reverse current. The ROCP circuit is activated when the output voltage is higher than the input voltage. After the reverse current circuit has tripped (reached the reverse current trip threshold), the current is clamped at this I_{ROCP} level. Once ROCP is activated, N-MOSFET will be turned off after 5ms. And also FLG pin pulls down after a de-glitch time of 4ms. Recovery from ROCP is automatic when the fault is removed. FLG pin pulls higher after 5ms de-glitch time.

Programming the Current-limit Threshold

The current limit can be set by connecting resistor from the current limit adjustable pin ILIM to ground. The required value of resistor R_{LIM} for current limit is calculated as follows:

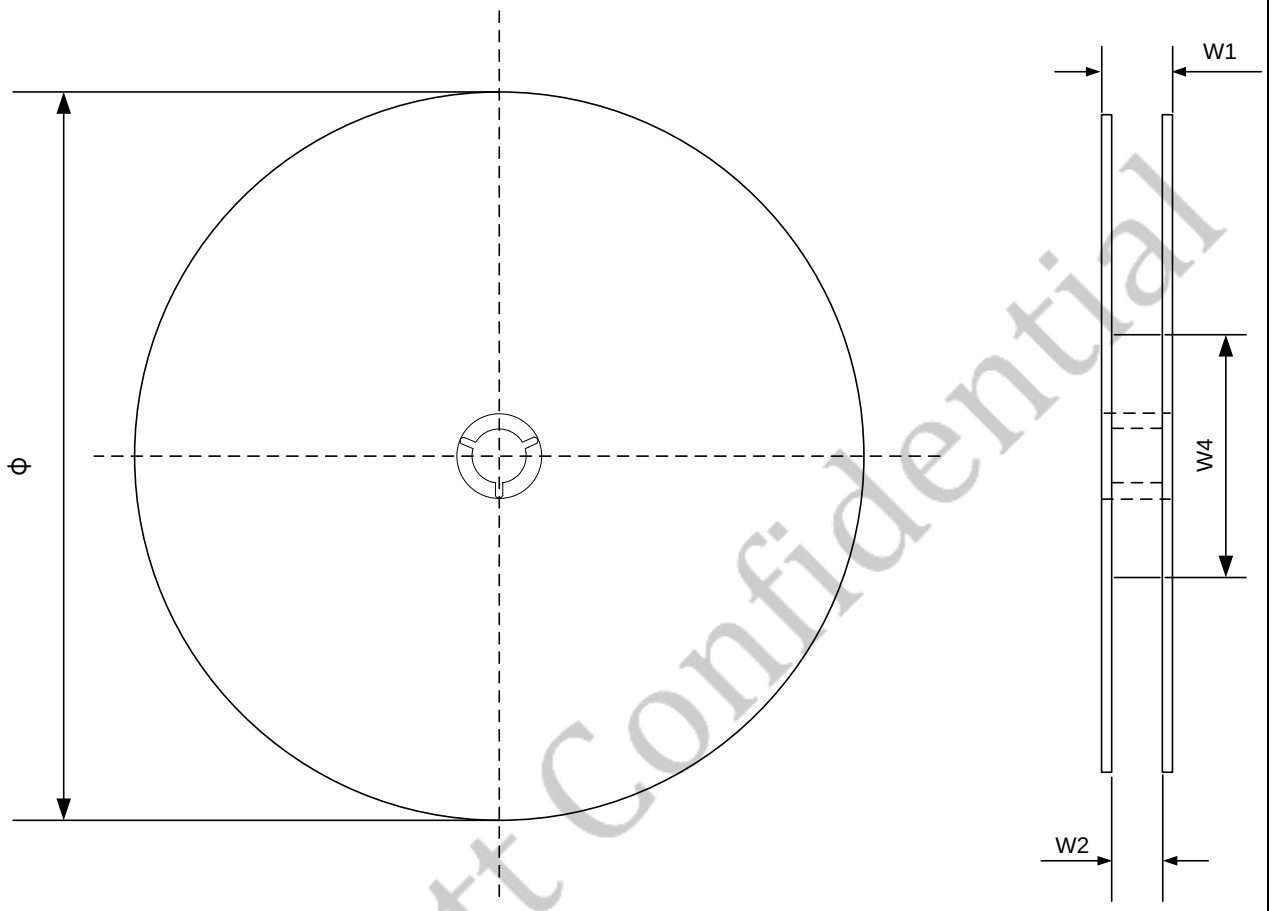
$$I_{LIM}(mA) = \frac{23950V}{R_{LIM}{}^{0.977}K\Omega}$$

Table1. Common R_{LIM} Resistor Selections

Desired Nominal Current Limit(mA)	Ideal Resistor(kΩ)	Closest 1% Resistor(kΩ)	Resistor Tolerance		Actual Limits		
			1% Low(kΩ)	1% High(kΩ)	I_{LIM} Min(mA)	I_{LIM} Typ (mA)	I_{LIM} Max(mA)
400	65.9	66.5	65.8	67.2	333.7	396.7	475.9
500	52.5	52.3	51.8	52.8	428.2	501.6	576.0
600	43.5	43.2	42.8	43.6	520.7	604.6	689.5
700	37.2	37.4	37.0	37.8	602.4	696.0	791.1
800	32.4	32.4	32.1	32.7	698.2	800.8	904.7
900	28.7	28.7	28.4	29.0	789.0	901.5	1015.6
1000	25.8	26.1	25.8	26.4	868.3	989.1	1111.9
1100	23.4	23.2	23.0	23.4	981.9	1109.7	1239.0
1200	21.4	21.5	21.3	21.7	1060.4	1195.4	1331.9
1300	19.7	19.6	19.4	19.8	1164.5	1308.5	1454.3
1400	18.3	18.2	18.0	18.4	1251.5	1406.7	1565.0
1500	17.0	16.9	16.7	17.1	1345.5	1512.4	1682.8
1600	16.0	15.8	15.6	16.0	1436.8	1615.2	1797.6
1700	15.0	15.0	14.9	15.2	1526.5	1699.3	1864.4

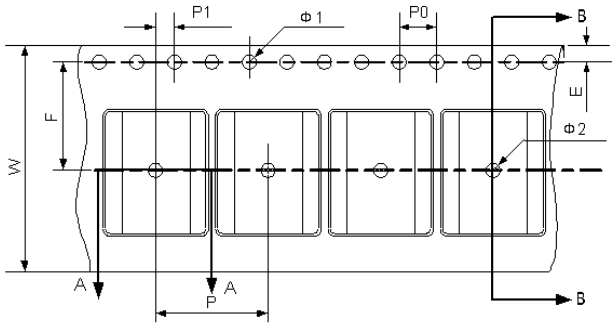
TAPE AND REEL INFORMATION

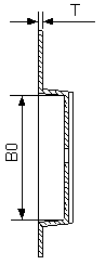
Reel UNIT: mm



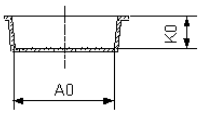
Package	Diameter Φ	Thickness W1	Width W2	W4
SOT23-6/DFN2x2-6	178±2	12.30±2	9.5±2	60±2

Carrier Tape UNIT: mm





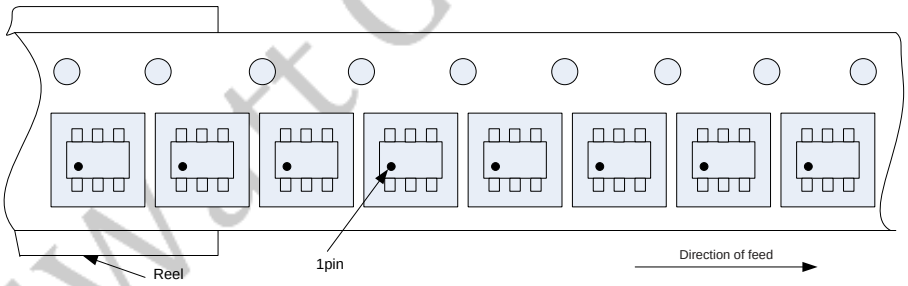
SECTION B-B



SECTION A-A

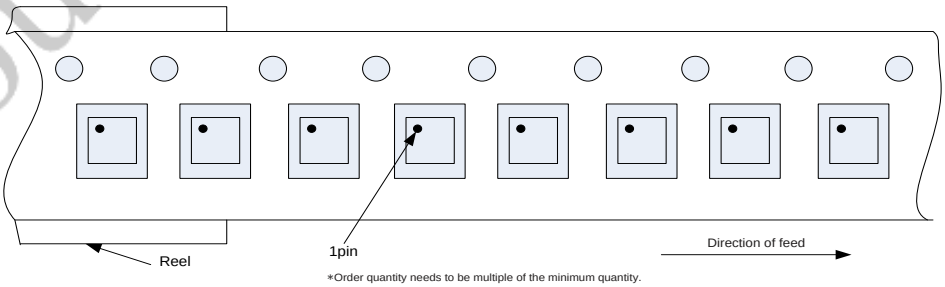
Package	P0	P1	P	A0	B0	W	T0	K0	Φ1	Φ2	E	F
SOT23-6	4.0±0.1	2.0±0.1	4.0±0.1	3.23±0.2	3.17±0.2	8.0±0.3	0.25±0.2	1.37±0.2	1.55±0.10	1.00min	1.75±0.1	3.50±0.1
DFN 2x2-6	4.00±0.10	2.00±0.10	4.00±0.10	2.30±0.20	2.30±0.20	8.00±0.30	0.25±0.20	1.10±0.35	1.50min	1.00min	1.75±0.10	3.50±0.10

SOT23-6:



*Order quantity needs to be multiple of the minimum quantity.

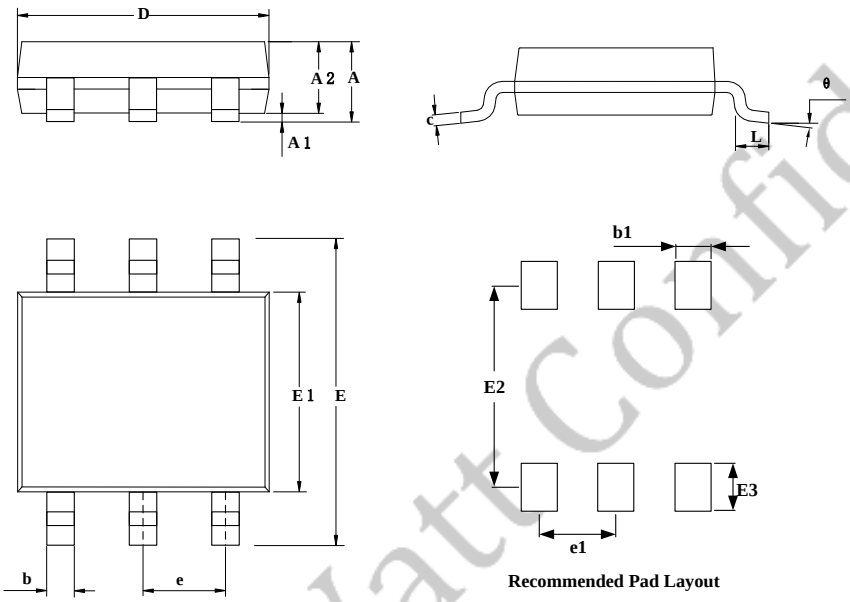
DFN2x2-6:



*Order quantity needs to be multiple of the minimum quantity.

PACKAGE OUTLINE

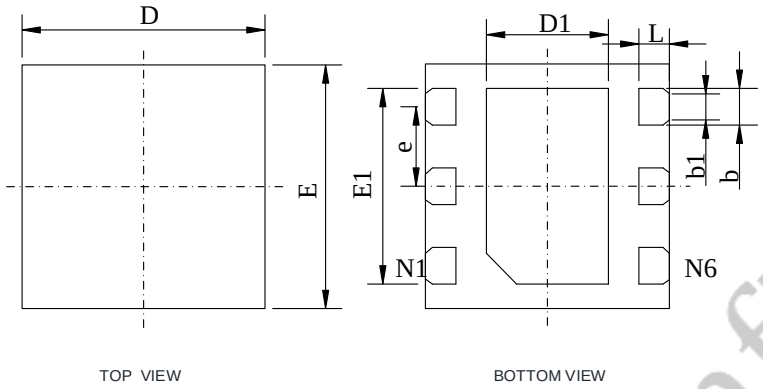
SOT23-6 UNIT: mm



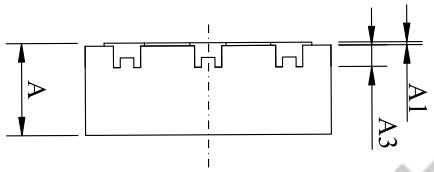
Recommended Pad Layout

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	1.05	1.15	1.25
A1	0	0.05	0.15
A2	0.95	1.10	1.20
b	0.20	0.40	0.60
b1		0.60	
c	0.05	—	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
E2		2.40	
E3		0.80	
e		0.95（BSC）	
e1		0.95（TYP）	
L	0.30	0.45	0.60
θ	0°	—	8°

DFN2X2-6 UNIT: mm



SYMBOL	MILLIMETER	
	MIN	MAX
A	0.700	0.800
A1	0.000	0.050
A3	0.203 REF	
b	0.250	0.350
b1	0.220 REF	
D	1.900	2.100
E	1.900	2.100
D1	0.900	1.100
E1	1.500	1.700
e	0.650 BSC	
L	0.174	0.326



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