6V Over-Voltage and Over-Current Protection IC

DESCRIPTION

The MT7255 integrated load switch provides a robust input over-current protection to downstream circuit systems. The device comes with built-in over-voltage protection, internal soft-start. The switch's low $R_{DS(ON)}$ minimizes power loss of the system. In the event of input over voltage, MT7255 immediately turns off the switch to prevent downstream system from stress of excessive high voltage. Current limit level can be set with an external resistor. Internal soft-start ensures a smooth ramp up of output voltage and limits the input in-rush current. MT7255 is available in DFN2X2_8L or SOT23_3L package.

FEATURES

- Wide Input Voltage Range from 2.7V to 6V
  Surge Up to 28V
- 50mΩ Low $R_{DS(ON)}$ Protection Switch
- Built-in Over-Voltage Protection
- Discharge Output at OVP
- Internal Soft-Start
- Programmable Current Limit (DFN package Only)
  SOT23_3L: 3A; Peak Current 4A
  DFN2x2_8L: Programable up to 5A
- Hiccup Mode Protection for Over Load or Short Circuit
- Thermal Shutdown
- SOT23-3 or DFN2X2_8L Package
- Pb-Free ROHS compliant

APPLICATIONS

- Bluetooth Headsets
- HDD and SSD Drives
- Adapter Powered Devices
- Tablet PC
- PCI, PCIe Cards

TYPICAL APPLICATION

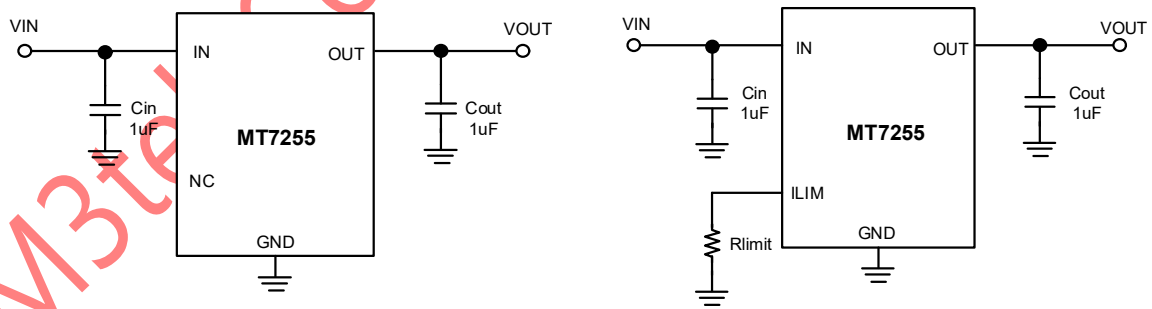


Figure1. Typical Application

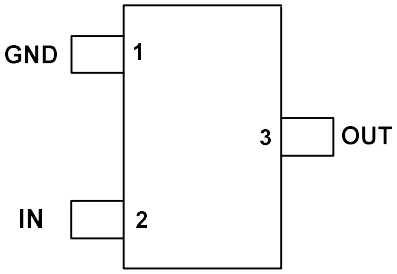
ORDERING INFORMATION

Part No.	Marking	Temp. Range	Package	MOQ
MT7255NSAR	7255 YWWxx	-40°C ~+85°C	SOT23-3	3000/Tape & Reel
MT7255NDAR	7255 YWxx	-40°C ~+85°C	DFN2x2_8L	3000/Tape & Reel

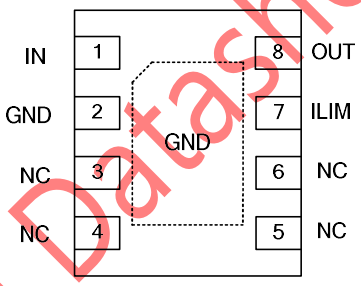
Note: Y: Year, WW: Week, xx: Manufacture Code

PIN CONFIGURATION

SOT23-3L TOP VIEW



DFN2X2_8L TOP VIEW



PIN DESCRIPTION

SOT233L	DFN2X2_8L	PIN NAME	DESCRIPTION
1	2	GND	Ground pin
2	1	IN	Input pin
3	8	OUT	Output pin. OUT is discharged to GND through an internal 80Ω resistor during OVP event.
-	7	ILIM	Current limit program pin. Program the current limit by connecting a resister to ground. This pin can't be short to ground.
-	3,4,5,6	NC	No Connection.

FUNCTIONAL BLOCK DIAGRAM

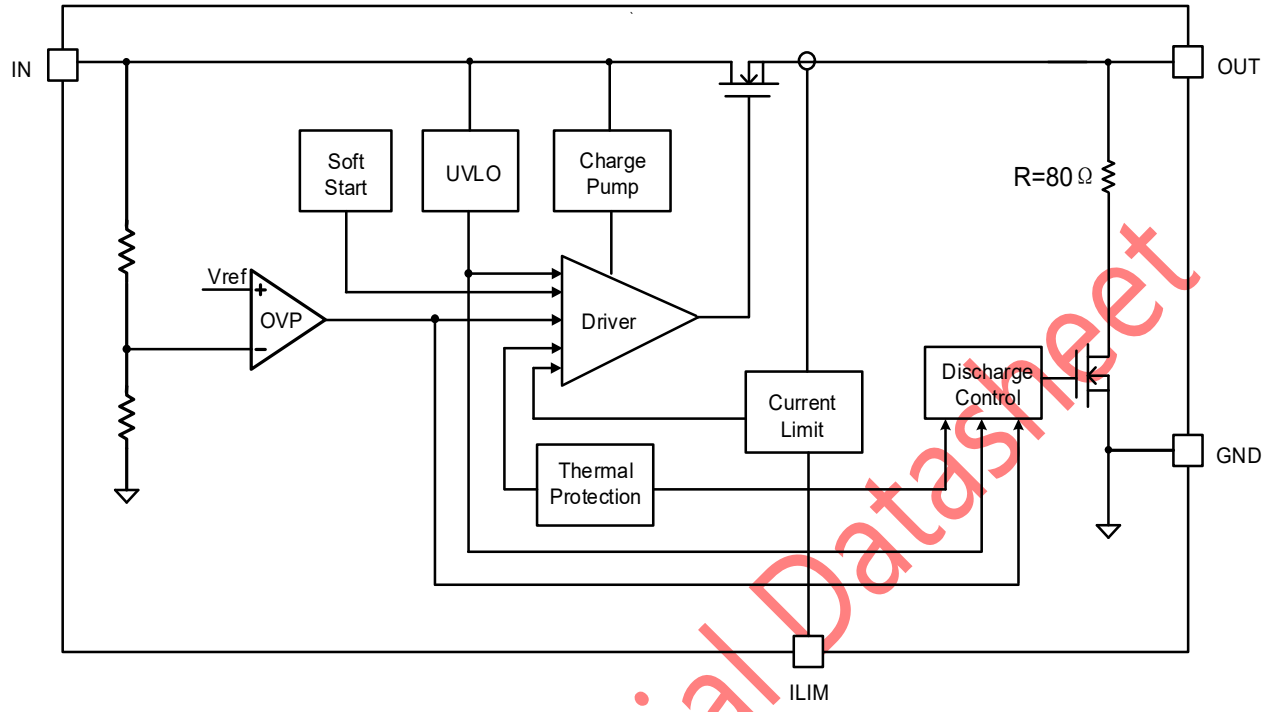


Figure2. MT7255 functional block diagram

Absolute Maximum Rating (Reference to GND) (Note1)

IN, OUT……..……..…….-0.3V to +30V
ILIM……..……..…….-0.3V to +6.5V
ESD ……..……..…….. Class 2

Junction Temperature Range ……..-40°C to +150°C
Storage Temperature Range …….. -65°C to +150°C
Lead Temperature (Soldering 10s) ……..…… 260°C

Recommend Operating Conditions (Note2)

Input Voltage (IN) ……..……+2.7V to +28V

Operating Temperature Range ..... -40°C to +85°C
Junction Temperature Range ..... +125°C

Thermal information (Note3, 4)

Maximum Power Dissipation (T_A=25°C)

SOT23_3L ……..……..……0.88W
DFN2x2_8L ……..……..……..1.52 W

SOT Thermal Resistance (θ_{JA}) ……..……..142°C/W
SOT Thermal Resistance (θ_{JC}) ……..……..74°C/W
DFN Thermal Resistance (θ_{JA}) ……..……..82°C/W
DFN Thermal Resistance (θ_{JC}) ……..……52°C/W

Note(1): Stress exceeding those listed “Absolute Maximum Ratings” may damage the device.
Note(2): The device is not guaranteed to function outside of the recommended operating conditions.
Note(3): Measured on JESD51-7, 4-Layer PCB.
Note(4): The maximum allowable power dissipation is a function of the maximum junction temperature T_{J_MAX}, the junction to ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_{D\_MAX}= (T_{J\_MAX}-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.

ELECTRICAL CHARACTERISTICS

T_A = +25°C, V_{IN}=5V, C_{IN}=1μF, unless otherwise specified

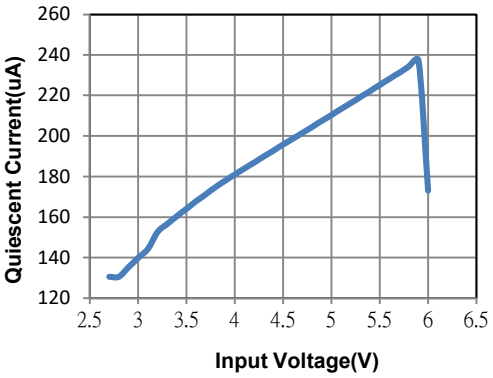
PARAMETER	Symbol	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage Range	V_{IN}		2.7		28	V
Quiescent Current	I_{BIAS}			200	260	μA
Input Under-voltage Threshold	V_{UV}			2.48		V
Input Under-voltage Hysteresis	V_{UVHYS}			180		mV
Input Over-voltage Threshold	V_{OV}			6.2		V
Input Over-voltage Hysteresis	V_{OV}			330		mV
Soft-start Slew Rate Time	T_{SS}			230		us
Current Limit	I_{LIMT}	R_{LIM}=500kΩ	1.35	1.5	1.65	A
		ILIM pin float		5		
Current Limit Setting Factor	K_{LIM}	I_{INLIM}=1A~5A	675	750	825	A*kΩ
OUT Discharging Resistance	R_{Disch}	V_{IN}=6.5V		80		Ω
Thermal Shutdown Temperature	T_{SD}			160		°C
Thermal Shutdown Hysteresis	T_{HYS}			40		°C

TYPICAL PERFORMANCE CHARACTERISTICS

C_{IN}=C_{OUT}=1uF, VIN=5V, TJ=+25°C, unless otherwise noted

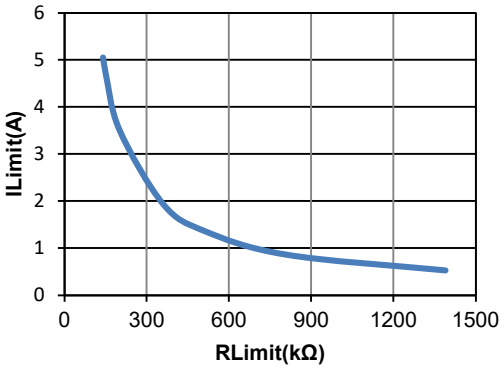
Quiescent Current vs. Input Voltage

(DFN2x2_8L)



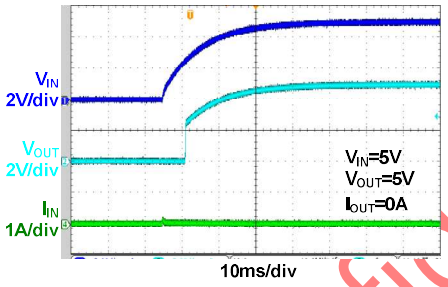
RLimit vs. Ilimit

(5Vin Application, DFN2x2_8L)



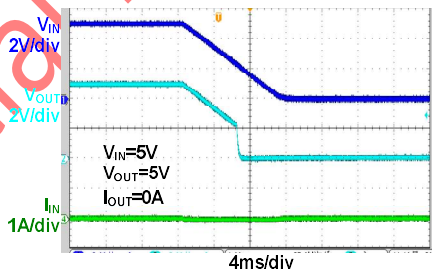
Vin On

(5Vin, I_O=0A)



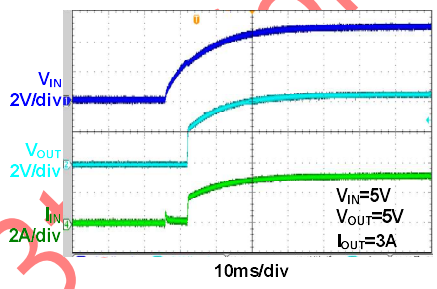
Vin Off

(5Vin, I_O=0A)



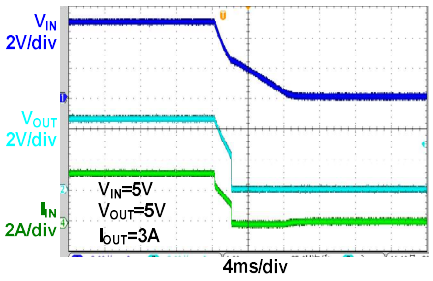
Vin On

(5Vin, I_O=3A)



Vin Off

(5Vin, I_O=3A)

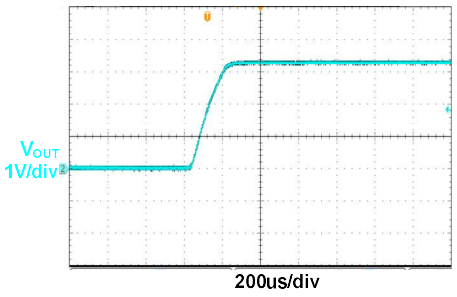


TYPICAL PERFORMANCE CHARACTERISTICS

C_{IN}=C_{OUT}=1uF, VIN=5V, TJ=+25°C, unless otherwise noted

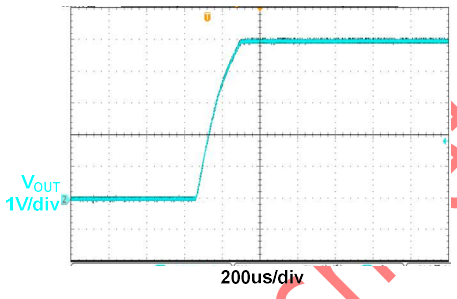
Soft Start

(3.3Vin, I_O=0A)



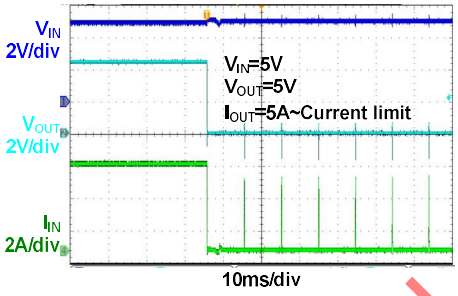
Soft Start

(5Vin, I_O=0A)



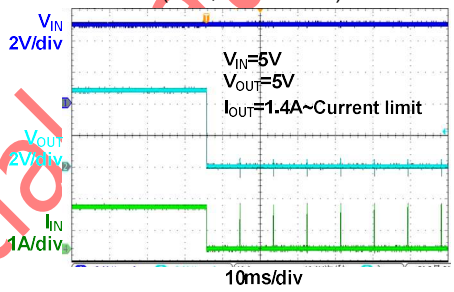
Current Limit

(5Vin, Rlimit=float)



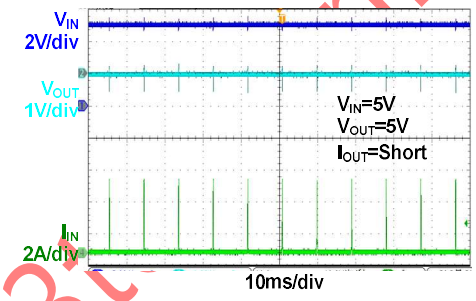
Current Limit

(5Vin, Rlimit=500k)



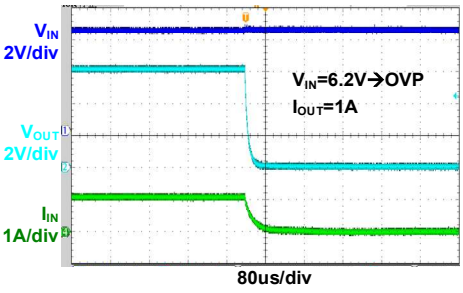
Short Protection

(5Vin, Rlimit=float)



Over Voltage Protection

(5Vin Application, I_O=1A)



OPERATION

The MT7255 is a fully integrated load switch with built-in over-voltage protection, internal soft-start and programmable current limit. When input voltage is within the valid range(2.7V~28V), the output pin OUT will ramp up with a fixed slew rate defined by internal soft-start. After OUT ramps up to input level, the internal load switch is fully turned on and ready to supply power to the system.

When power on, MT7255 continuously monitors the system load current through the switch. Once the load current reaches the current limit I_{LIMT} programmed by ILIMT pin, MT7255 will regulate the load current for 60us to prevent the load current from running away. After 60us, if the current limit condition sustains, MT7255 will turn off the load switch, wait for 8ms and then try to re-start. In the event of system short circuit failure, the load current could jump significantly higher than the current limit. Whenever the load current is 2A larger than the current limit level, MT7255 immediately turns off the load switch to prevent disastrous outcome, then also for 8ms before it tries to re-start.

MT7255 has an internal input OVP to protect the system from being stressed by excessive high voltage. Once it detects input voltage is higher than the built-in over-voltage threshold, MT7255 immediately turns off the load switch. The load switch will be automatically turned on once the input voltage falls within the valid range.

The MT7255 also has thermal shutdown protection, when device temperature (T_J) exceeds T_{SHDN}, typically 160°C, the thermal shutdown circuitry will shut down the internal MOSFET thereby disconnecting the load from the input supply. The MT7255 will remain off during a cooling period until device temperature falls below T_{SHDN} –40°C, after which it will attempt to restart.

Programmable Over-Current Protection

A programmable current limit level and short circuit current protection has been designed to prevent the load current overload the regulator. When the input current limit loop is engaged, input current will be automatically reduced to the pre-determined level which is set by ILIM pin, and regulate the load current for 60us, then enter hiccup mode waiting for 8ms to reduce power dissipation. When a short event happens, the short protection circuit will be triggered and turn off power switch quickly, MT7255 will restart after 8ms. The output can be shorted to ground indefinitely without damaging the part.

Input current limit can be programmed with below equation:

$$I_{INLIM} = \frac{750A * k\Omega}{R_{ILIM}}$$

Where R_{LIM} is the program resistor at the I_{LIM} pin.

Program Current Limit Resistance (kΩ)	750	375	250	187.5	150
Current Limit I_{INLIM}(A)	1	2	3	4	5

For the stable system operation, recommend to set the current limit level 1.2~1.5 times of the maximum system load current to avoid mis-triggering the current limit and causing system malfunctions.

Soft Start

When MT7255 is power on, VOUT will ramp up with a controlled rising time for minimizing inrush current.

Input and Output Capacitor Selection

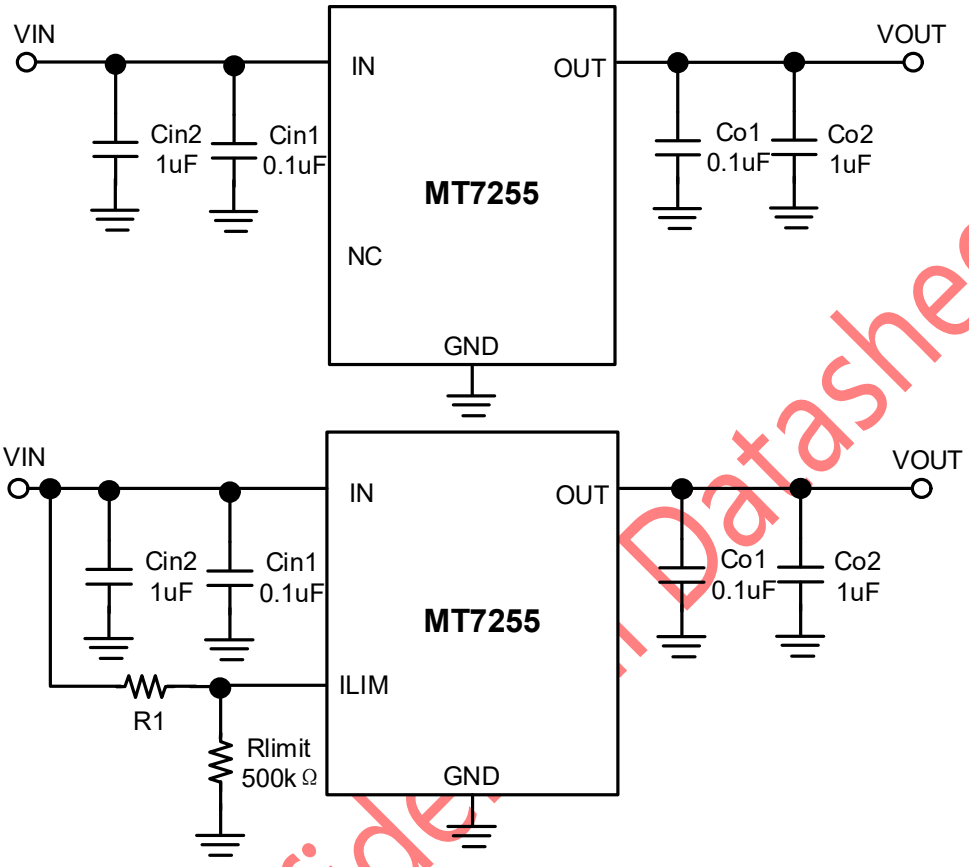
The MT7255 require ≥1uF input and output capacitor connected to GND. X7R type capacitors are recommended, but X5R and others may be used.

APPLICATION INFORMATION

PCB Layout Recommendation

- For all applications, a 0.1μF or greater ceramic decoupling capacitor is recommended between IN terminal and GND, and a 0.1μF or greater ceramic decoupling capacitor is recommended between OUT terminal and GDN. For hot-plug applications, where input power path inductance is negligible, this capacitor can be eliminated/minimized.
- The optimum placement of decoupling capacitor is closest to the IN and GND terminals of the device. Care must be taken to minimize the loop area formed by the bypass-capacitor connection, the IN terminal, and the GND terminal of the IC.
- High current carrying power path connections should be as short as possible and should be sized to carry at least twice the full-load current.
- The GND terminal must be tied to the PCB ground plane at the terminal of the IC. The PCB ground should be a copper plane or island on the board.
- Obtaining acceptable performance with alternate layout schemes is possible; however, this layout has been shown to produce good results and is intended as a guideline.

MT7255 Application Schematic

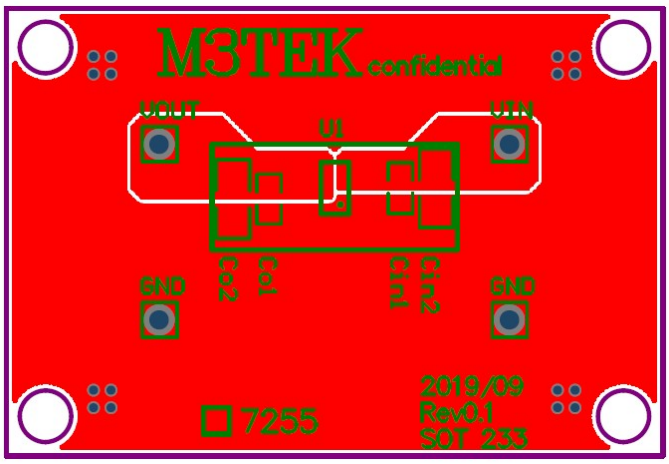


EVB BOM List

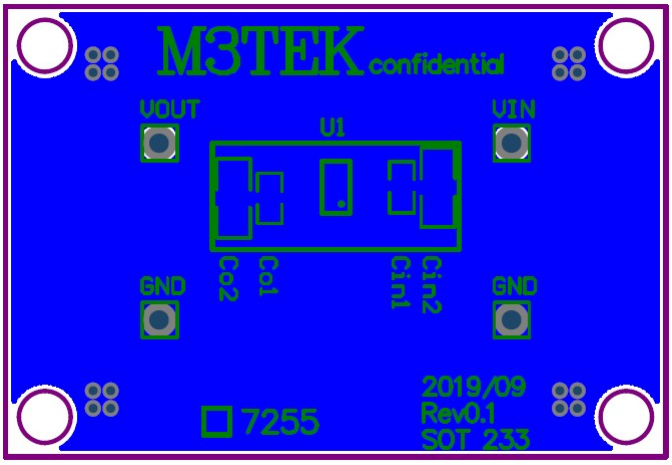
Qty	Ref	Value	Description	Package
2	C_{IN2}, C_{O2}	1μF	Ceramic Capacitor, 35V, X5R	0805
2	C_{IN1}, C_{O1}	0.1μF	Ceramic Capacitor, 35V, X5R	0603
1	Rlimit	500kOhm	Resistor, ±1%	0603
1	R1	NC	Resistor, ±1%	0603
1	U1	MT7255	Load Switch IC	SOT23-3 or DFN2x2_8L

EVB Layout

SOT23-3:

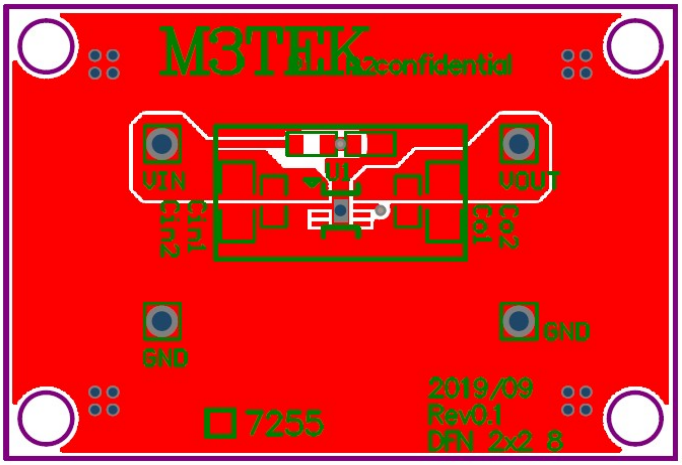


Top Layer

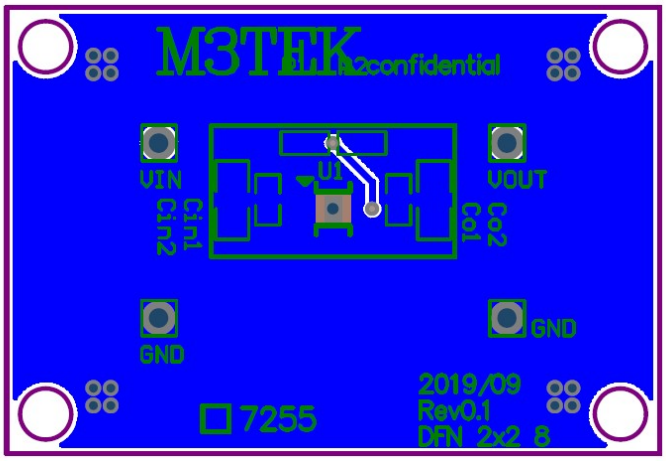


Bottom Layer

DFN2X2_8L:



Top Layer

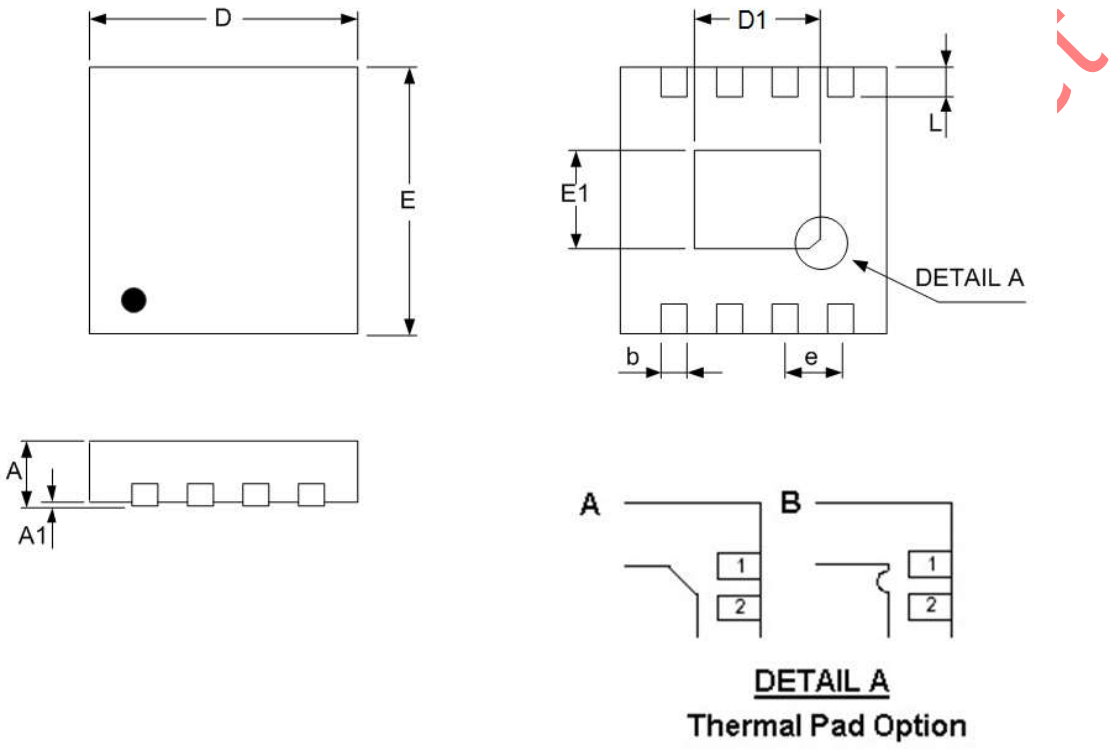


Bottom Layer

PACKAGING INFORMATION

DFN 8L 2x2mm Outline Dimensions

Unit: inches/mm

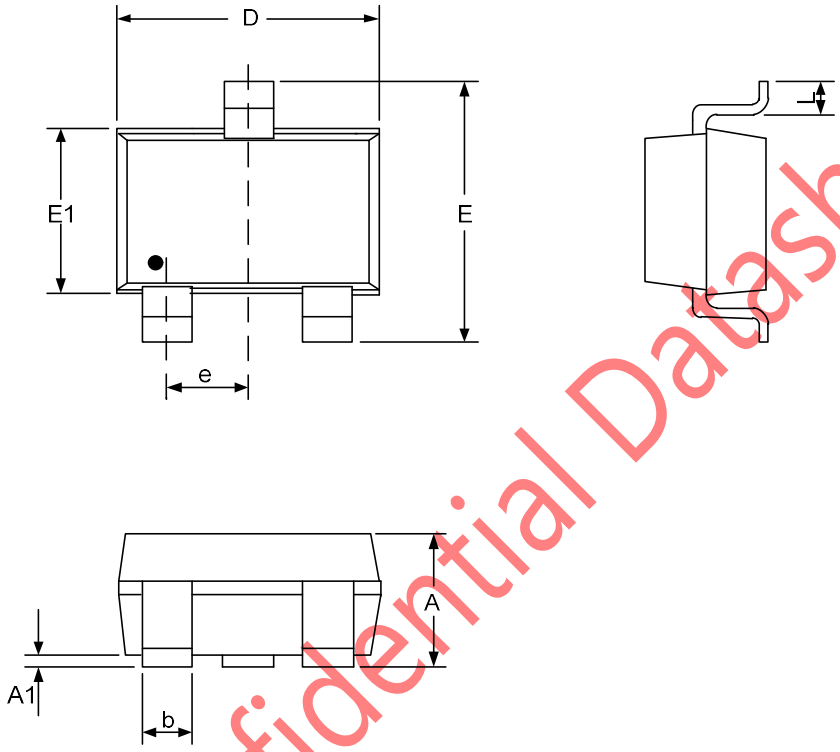


DETAIL A
Thermal Pad Option

SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	0.70	0.80	0.028	0.031
A1	0.00	0.05	0.000	0.002
b	0.18	0.30	0.007	0.012
D	1.90	2.10	0.075	0.083
D1	1.10	1.65	0.043	0.065
E	1.90	2.10	0.075	0.083
E1	0.50	1.10	0.020	0.043
e	0.50		0.020	
L	0.25	0.45	0.010	0.018

PACKAGING INFORMATION

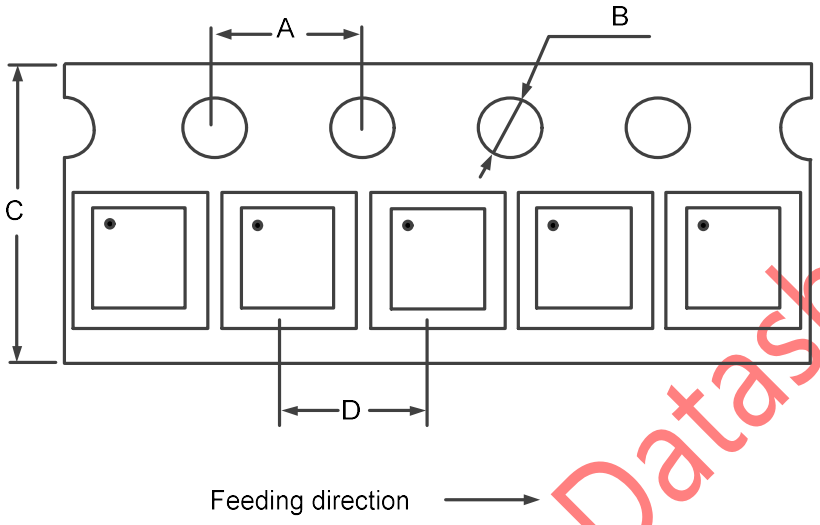
SOT 23 3L Package Outline Drawing



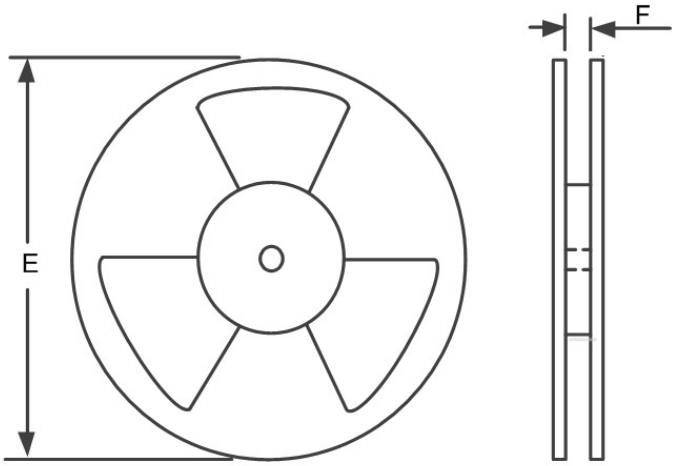
SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	1.45	-	0.057
A1	0.00	0.15	0.000	0.006
b	0.30	0.50	0.012	0.020
D	2.90		0.114	
E1	1.60		0.063	
e	0.95		0.037	
E	2.60	3.00	0.102	0.118
L	0.30	0.60	0.012	0.024

CARRIER TAPE & REEL DIMENSIONS

1. Orientation / Carrier Tape Information:



2. Reel Information:

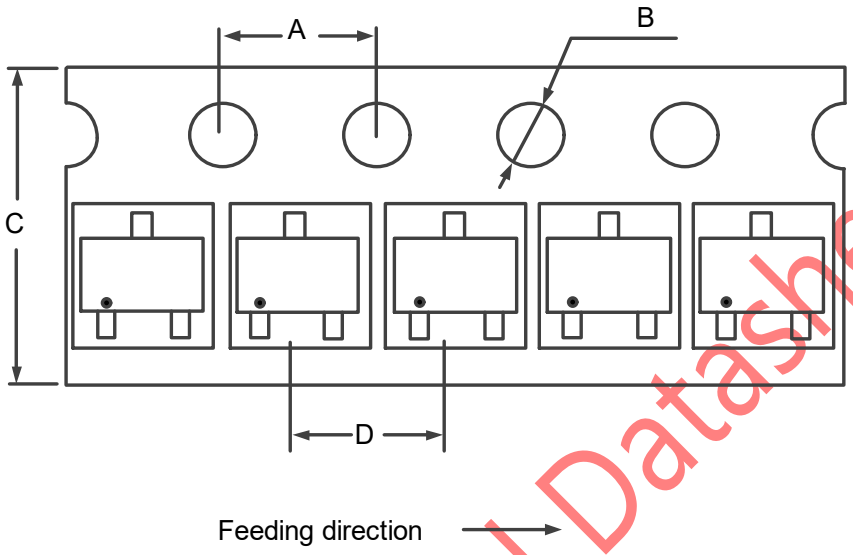


3. Dimension Details:

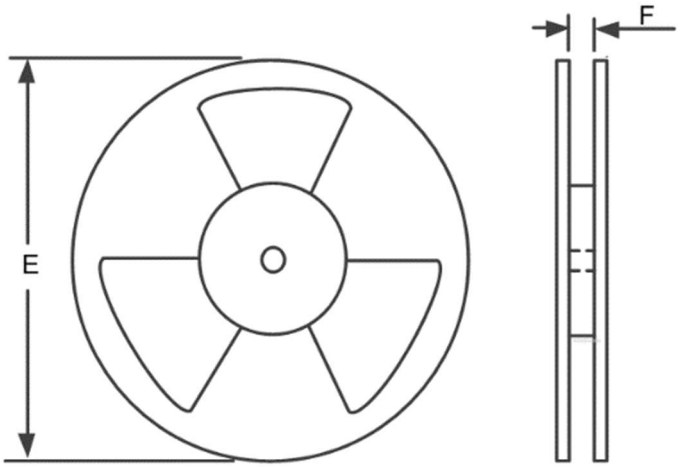
PKG Type	A	B	C	D	E	F	Q'ty/Reel
DFN2x2	4.0 mm	1.5 mm	8.0 mm	4.0 mm	7 inches	9.0 mm	3,000

CARRIER TAPE & REEL DIMENSIONS (Packing Spec SOT 23 3L)

1. Orientation / Carrier Tape Information:



2. Reel Information:



3. Dimension Details:

PKG Type	A	B	C	D	E	F	Q'ty/Reel
SOT23	4.0 mm	1.5 mm	8.0 mm	4.0 mm	7 inches	9.0 mm	3,000

REFLOW PROFILE

Classification Of IR Reflow Profile

Reflow Profile	Green Assembly
Average Ramp-Up Rate (Ts_{min} to Tp)	1~2℃/second, 3℃/second max.
Preheat & Soak -Temperature Min(Ts_{min}) -Temperature Max(Ts_{max}) -Time(ts_{min}totsts_{max})	 150℃ 200℃ 60~120 seconds
Time maintained above: -Temperature(T_L) -Time(t_L)	 217℃ 60~150 seconds
Peak Temperature(Tp)	See Classification Temp intable1
Time within 5℃of actual Peak Temperature(tp)	30 seconds max.
Ramp-Down Rate	6℃/second max.
Time 25℃ to Peak Temperature	8 minutes max.

* Tolerance for peak profile Temperature(T_p) is defined as a supplier minimum and a user maximum.
** Tolerance for time at peak profile temperature (t_p)is defined as a supplier minimum and a user maximum.

Table 1. Pb-freeProcess –Classification Temperatures (Tc)

Package Thickness	Volume mm^3 <350	Volume mm^3 350-2000	Volume mm^3 >2000
<1.6mm	260℃	260 ℃	260℃
1.6mm–2.5mm	260℃	250℃	245℃
2.5mm	250 ℃	245℃	245℃

Note: For all temperature information, please refer to topside of the package, measured on the package body surface.