

Ultra Low Current Consumption 300mA CMOS Voltage Regulator

INTRODUCTION

The FC6232 series are a group of positive voltage regulators manufactured by CMOS technologies with ultra low power consumption and low dropout voltage, which provide large output currents even when the difference of the input-output voltage is small. The FC6232 series can deliver 300mA output current and allow an input voltage as high as 8V. The series are very suitable for the battery-powered equipments, such as RF applications and other systems requiring a quiet voltage source.

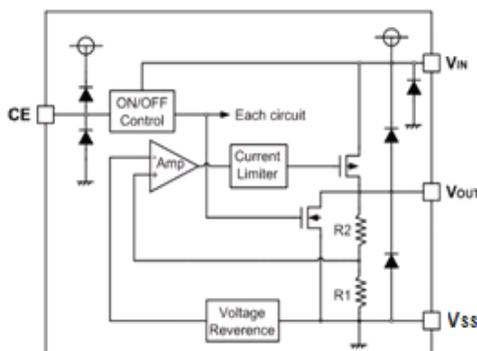
FEATURES

- Low Quiescent Current: 0.8 μ A
- Operating Voltage Range: 1.8V~8V
- Output Current: 300mA
- Low Dropout Voltage:
110mV@100mA($V_{OUT}=3.3V$)
- Output Voltage: 1.0~ 5.0V
- High Accuracy: $\pm 2\%/ \pm 1\%$ (Typ.)
- High Power Supply Rejection Ratio:
50dB@1kHz
- Low Output Noise:
27x V_{OUT} μ V_{RMS} (10Hz~100kHz)
- Excellent Line and Load Transient Response
- Built-in Current Limiter, Short-Circuit Protection

APPLICATIONS

- Portable consumer equipments
- Radio control systems
- Laptop, Palmtops and PDAs
- Wireless Communication Equipments
- Portable Audio Video Equipments
- Ultra Low Power Microcontroller

BLOCK DIAGRAM

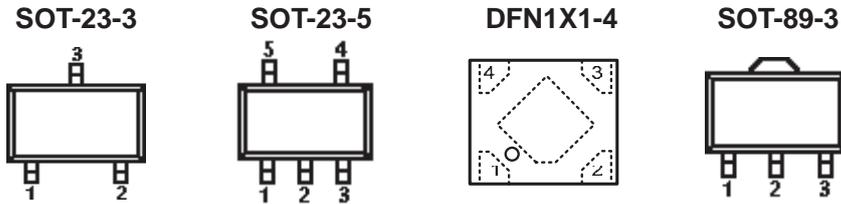


ORDER INFORMATION

FC6232①②③④⑤

DESIGNATOR	SYMBOL	DESCRIPTION
①	A	Standard
	B	High Active, pull-down resistor built in, with C _{OUT} discharge resistor
②③	Integer	Output Voltage e.g. 1.05V= ②③A1 e.g. 1.8V= ②:1③:8
④	F	Package:DFN1X1-4
	M/ MC/ MY	Package:SOT-23-3
	M	Package:SOT-23-5
	P/PT/PL	Package:SOT-89-3
⑤	-	2% Accuracy
	1	1% Accuracy

PIN CONFIGURATION



PIN NUMBER						PIN NAME	FUNCTION
SOT-23-3			SOT-89-3				
M	MC	MY	P	PT	PL		
1	3	3	1	2	2	V_{SS}	Ground
2	2	1	3	1	3	V_{OUT}	Output
3	1	2	2	3	1	V_{IN}	Power input

SOT-23-5

PIN NUMBER	SYMBOL	FUNCTION
1	V_{IN}	Power Input Pin
2	V_{SS}	Ground
3	CE	Chip Enable Pin
4	NC	No Connection
5	V_{OUT}	Output Pin

DFN1X1-4

PIN NUMBER	SYMBOL	FUNCTION
F		
1	V_{OUT}	Output Pin
2	V_{SS}	Ground
3	CE	Chip Enable Pin
4	V_{IN}	Power Input Pin

ABSOLUTE MAXIMUM RATINGS⁽¹⁾ ($T_a=25^\circ\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNITS
Input Voltage ⁽²⁾	V_{IN}	-0.3~9	V
Output Voltage ⁽²⁾	V_{OUT}	-0.3~ $V_{IN}+0.3$	V
Output Current	I_{OUT}	600	mA
Power Dissipation	SOT-23	0.4	W
	DFN1X1-4	0.4	W
	SOT-89	0.6	W
Operating Junction Temperature Range	T_j	-40~125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40~125	$^\circ\text{C}$
Lead Temperature(Soldering, 10 sec)	T_{solder}	260	$^\circ\text{C}$



FC6232

Note:

(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) All voltages are with respect to network ground terminal.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	MIN.	NOM.	MAX.	UNITS
Supply voltage at V_{IN}	1.8		8	V
Operating junction temperature range, T_j	-40		125	°C
Operating free air temperature range, T_A	-40		85	°C

ELECTRICAL CHARACTERISTICS

($V_{IN}=V_{OUT}+1V$, $C_{IN}=C_{OUT}=1\mu F$, $T_a=25^\circ C$, unless otherwise specified)

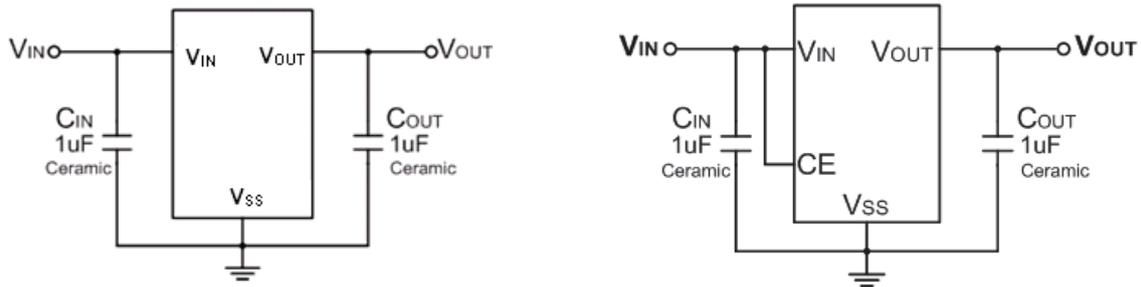
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP. ⁽³⁾	MAX.	UNITS	
Input Voltage	V_{IN}		1.8	—	8	V	
Output Voltage Range	V_{OUT}		1.0	—	5	V	
DC Output Accuracy		$I_{OUT}=1mA$	-2	—	2	%	
			-1	—	1	%	
Dropout Voltage	$V_{dif}^{(4)}$	$I_{OUT}=100mA, V_{OUT}=3.3V$	—	110	—	mV	
Supply Current	I_{SS}	$I_{OUT}=0$	$1.2V \leq V_{OUT} \leq 3.3V$	—	0.8	1.3	μA
			$3.3V < V_{OUT} \leq 5.0V$	—	1.0	1.5	μA
Standby Current	I_{STBY}	$CE = V_{SS}$			0.1	μA	
Line Regulation	$\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta V_{IN}}$	$I_{OUT}=10mA$ $V_{OUT}+1V \leq V_{IN} \leq 8V$	—	0.05	0.3	%/V	
Load Regulation	ΔV_{OUT}	$V_{IN} = V_{OUT} + 1V$, $1mA \leq I_{OUT} \leq 100mA$	—	10	—	mV	
Temperature Coefficient	$\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta T_A}$	$I_{OUT}=10mA$, $-40^\circ C < T_A < 125^\circ C$		100		ppm	
Output Current Limit	I_{LIM}	$V_{OUT} = 0.5 \times V_{OUT(Normal)}$, $V_{IN} = 5V$	550	700	850	mA	
Short Current	I_{SHORT}	$V_{OUT} = V_{SS}$	—	20	—	mA	
Power Supply Rejection Ratio	PSRR	$I_{OUT}=50mA$	100Hz	—	70	—	dB
			1kHz	—	50	—	
			10kHz	—	40	—	
			100kHz	—	35	—	
Output Noise Voltage	V_{ON}	BW=10Hz to 100kHz	—	$27 \times V_{OUT}$	—	μV_{RMS}	
CE "High" Voltage	$V_{CE} "H"$		1.5		V_{IN}	V	
CE "Low" Voltage	$V_{CE} "L"$				0.3	V	
C_{OUT} Auto-Discharge Resistance	$R_{DISCHRG}$	$V_{IN}=5V, V_{OUT}=3.0V$, $V_{CE}=V_{SS}$		200		Ω	

Note:

(3) Typical numbers are at 25°C and represent the most likely norm.

(4) V_{dif} : The Difference Of Output Voltage And Input Voltage When Input Voltage Is Decreased Gradually Till Output Voltage Equals To 98% Of V_{OUT} (E).

TYPICAL APPLICATION CIRCUIT



APPLICATION INFORMATION

Selection of Input/ Output Capacitors

In general, all the capacitors need to be low leakage. Any leakage the capacitors have will reduce efficiency, increase the quiescent current.

A recent trend in the design of portable devices has been to use ceramic capacitors to filter DC-DC converter inputs. Ceramic capacitors are often chosen because of their small size, low equivalent series resistance (ESR) and high RMS current capability. Also, recently, designers have been looking to ceramic capacitors due to shortages of tantalum capacitors.

Unfortunately, using ceramic capacitors for input filtering can cause problems. Applying a voltage step to a ceramic capacitor causes a large current surge that stores energy in the inductances of the power leads. A large voltage spike is created when the stored energy is transferred from these inductances into the ceramic capacitor. These voltage spikes can easily be twice the amplitude of the input voltage step.

Many types of capacitors can be used for input bypassing, however, caution must be exercised when using multilayer ceramic capacitors (MLCC). Because of the self-resonant and high Q characteristics of some types of ceramic capacitors, high voltage transients can be generated under some start-up conditions, such as connecting the LDO input to a live power source. Adding a 3Ω resistor in series with an X5R ceramic capacitor will minimize start-up voltage transients.

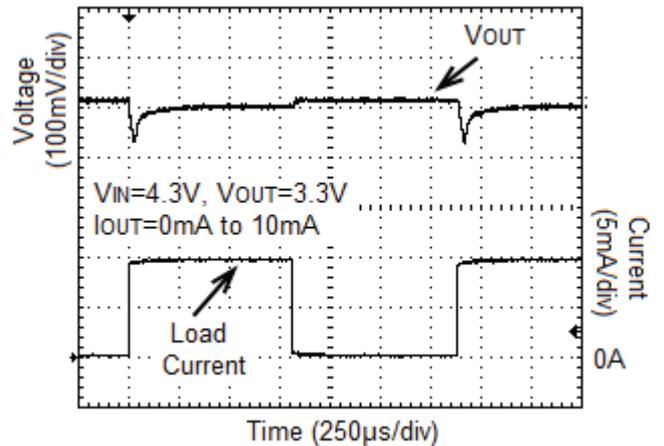
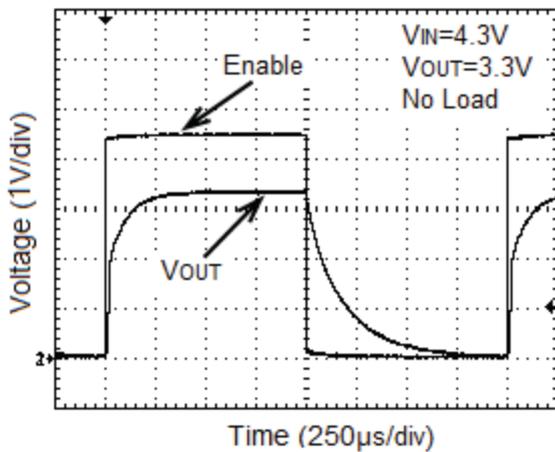
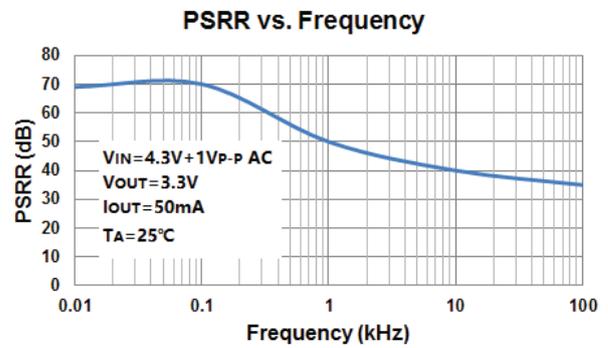
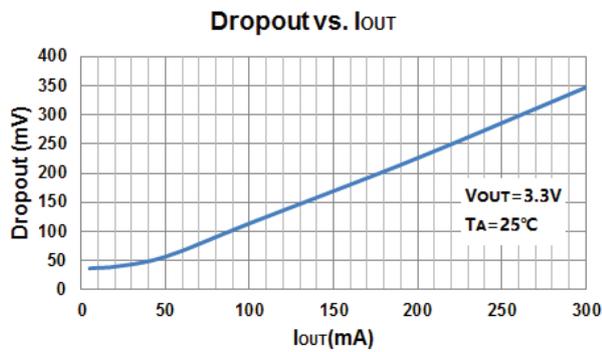
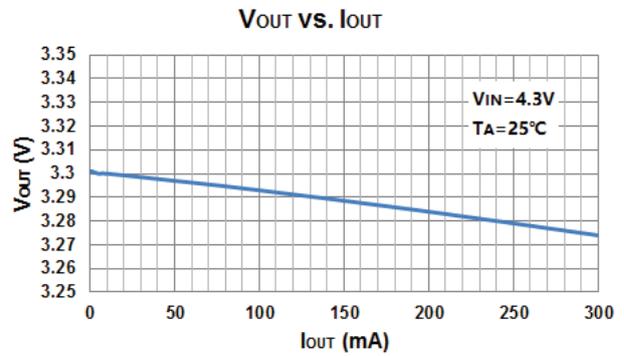
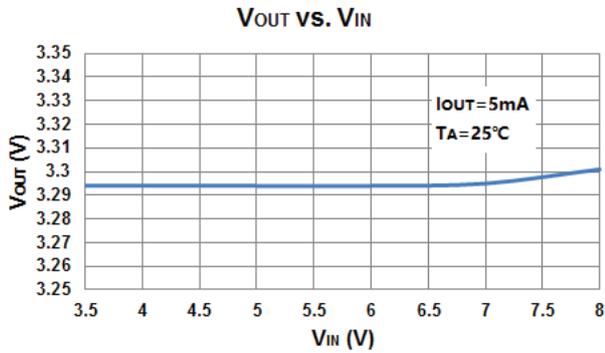
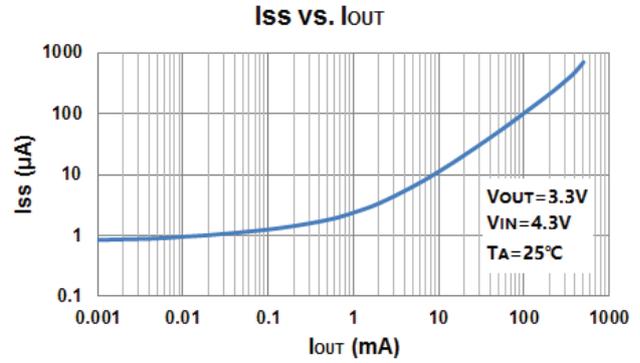
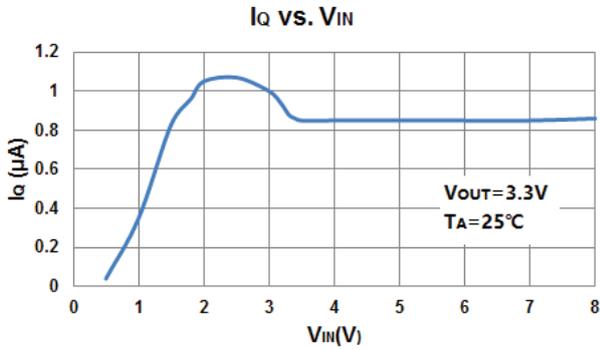
The LDO also requires an output capacitor for loop stability. Connect a 1μF tantalum capacitor from OUT to GND close to the pins. For improved transient response, this output capacitor may be ceramic.



FC6232

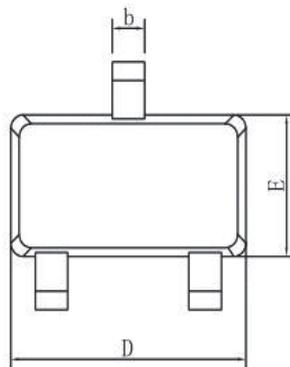
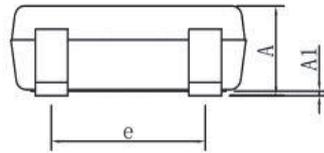
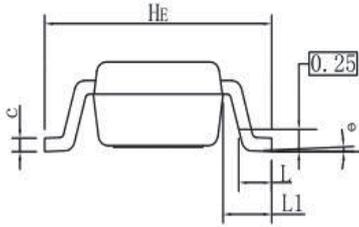
TYPICAL PERFORMANCE CHARACTERISTICS

($V_{IN}=V_{OUT}+1V$, $C_{IN}=C_{OUT}=1\mu F$, $T_A=25^\circ C$, unless otherwise specified)



■ PACKAGING INFORMATION

● SOT-23-3 PACKAGE OUTLINE DIMENSIONS

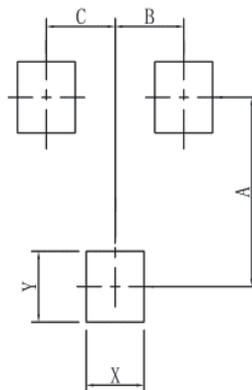


DIM	MIN	NOR	MAX
A	0.90	1.00	1.10
A1	0.01	0.06	0.10
b	0.30	0.40	0.50
c	0.10	0.17	0.20
D	2.80	2.90	3.00
E	1.50	1.60	1.70
e	1.80	1.90	2.00
L	0.20	0.40	0.60
L1	0.60REF		
HE	2.60	2.80	3.00
θ	0°	-	10°
All Dimensions in mm			

GENERAL NOTES

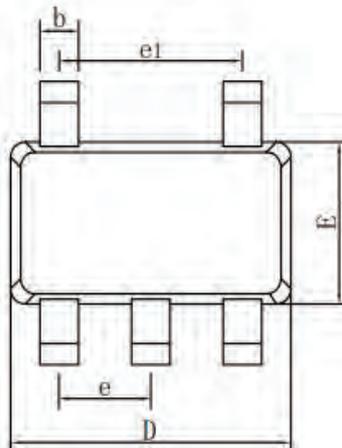
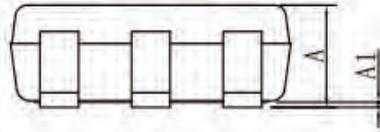
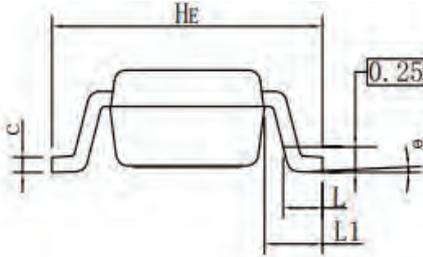
- 1.Top package surface finish Ra0.4±0.2um
- 2.Bottom package surface finish Ra0.7±0.2um
- 3.Side package surface finish Ra0.4±0.2um

SOLDERING FOOTPRINT



DIM	(mm)
X	0.80
Y	0.90
A	2.40
B	0.95
C	0.95

● SOT-23-5 PACKAGE OUTLINE DIMENSIONS

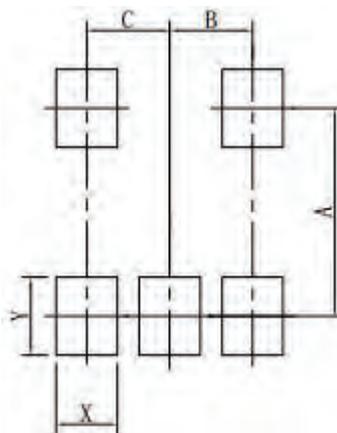


DIM	MIN	NOR	MAX
A	0.90	1.00	1.10
A1	0.01	0.06	0.10
b	0.30	0.40	0.50
c	0.10	0.17	0.20
D	2.80	2.90	3.00
E	1.50	1.60	1.70
e	0.85	0.95	1.05
e1	1.80	1.90	2.00
L	0.20	0.40	0.60
L1	0.60REF		
He	2.60	2.80	3.00
θ	0°	-	10°

GENERAL NOTES

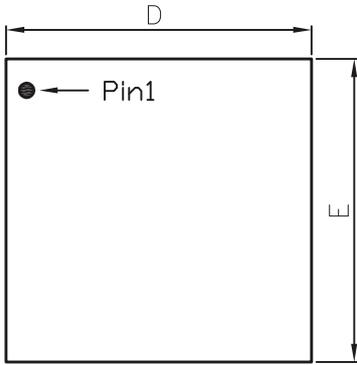
- 1.Top package surface finish Ra0.4±0.2um
- 2.Bottom package surface finish Ra0.7±0.2um
- 3.Side package surface finish Ra0.4±0.2um

SOLDERING FOOTPRINT

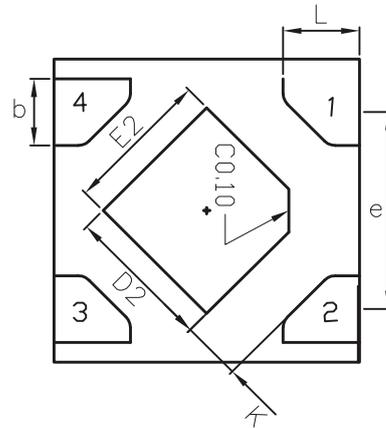


DIM	(mm)
X	0.70
Y	0.90
A	2.40
B	0.95
C	0.95

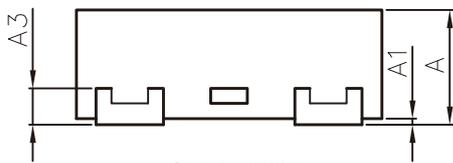
● DFNXX1-4 PACKAGE OUTLINE DIMENSIONS



TOP VIEW



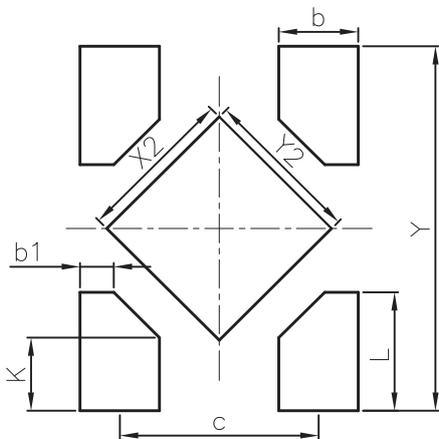
BOTTOM VIEW



SIDE VIEW

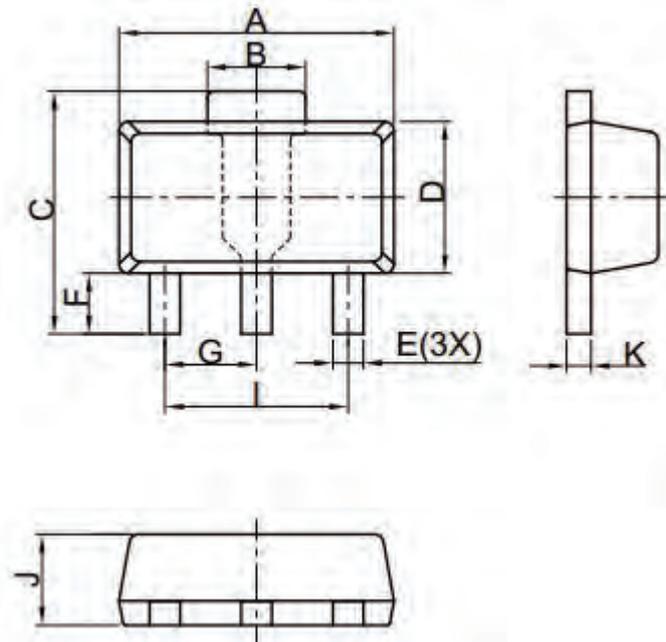
DFN1010			
DIM	MIN	NOR	MAX
A	0.34	0.37	0.40
A1	0.01	0.02	0.05
b	0.17	0.22	0.25
L	0.20	0.25	0.30
D	0.95	1.00	1.05
E	0.95	1.00	1.05
D2	0.43	0.48	0.53
E2	0.43	0.48	0.53
e	0.65		
A3	0.127REF.		
K	0.15	-	-
All Dimensions in mm			

Suggested Pad layout



DFN1010	
DIM	(mm)
X2	0.52
Y2	0.52
L	0.39
Y	1.20
K	0.24
b	0.26
c	0.65
b1	0.11

● SOT-89-3 PACKAGE OUTLINE DIMENSIONS

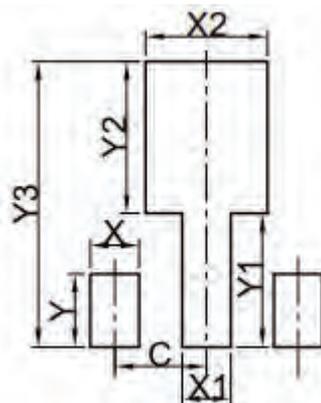


DIM	MIN	NOR	MAX
A	4.40	4.50	4.60
B	1.40	1.60	1.80
C	3.90	4.00	4.25
D		2.50	2.60
E		0.50	0.58
F	0.90	1.00	1.20
G	1.50 BSC		
I	3.00 BSC		
J	1.40	1.50	1.60
K	0.34	0.40	0.50
All Dimensions in mm			

GENERAL NOTES

1. Top package surface finish Ra0.4±0.2um
2. Bottom package surface finish Ra0.7±0.2um
3. Side package surface finish Ra0.4±0.2um
4. Protrusion or Gate Burrs shall not exceed 0.10mm per side.

SOLDERING FOOTPRINT



DIM	(mm)
X	0.80
Y	1.20
X1	0.80
Y1	2.20
X2	2.00
Y2	2.50
C	1.50
Y3	4.70



FC6232

■ ORDER INFORMATION APPENDIX

Device ⁽⁵⁾	Package	Output Voltage ⁽⁶⁾	Marking ⁽⁷⁾ ⁽⁸⁾	Shipping
FC232AxxM	SOT- 23- 3	1.0V~ 5.0V	4AX	3K/ Reel
FC6232AxxMC	SOT- 23- 3	1.0V~ 5.0V	4CX	3K/ Reel
FC6232AxxMY	SOT- 23- 3	1.0V~ 5.0V	4YX	3K/ Reel
FC6232BxxM	SOT- 23- 5	1.0V~ 5.0V	4BX	3K/ Reel
FC6232AxxP	SOT- 89- 3	1.0V~ 5.0V	4DX	1K/ Reel
FC6232AxxPT	SOT- 89- 3	1.0V~ 5.0V	4TX	1K/ Reel
FC6232AxxPL	SOT- 89- 3	1.0V~ 5.0V	4LX	1K/ Reel
FC6232BxxF	DFN1X1- 4	1.0V~ 5.0V	MX	10K/ Reel

(8) : "xx" represents output voltageeg"18" express that the output voltage is 1.8V

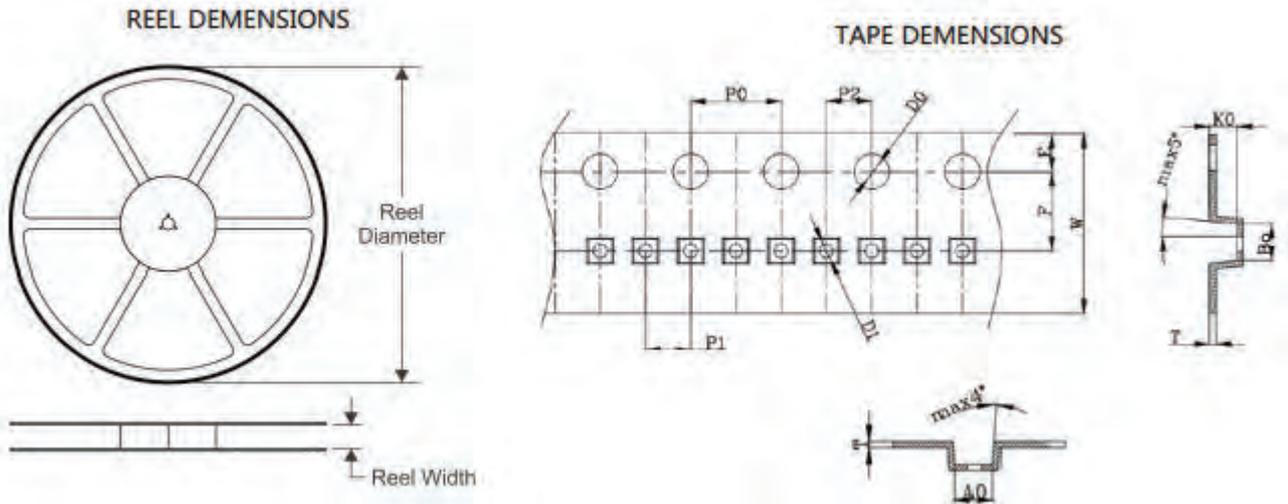
(9) : Output voltage variesfrom 1.0V to 5.0V, 0.1V an interval

(10): The last letter "X" changes along with the output voltage, as figure below

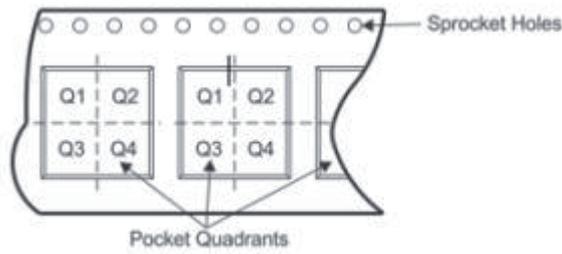
(11): There are additional marking, which relates to the date code

Voltage	....	1.0	1.2	1.5	1.8	2.5	2.7	2.8	3.0	3.3	3.6	4.0	4.2	5.0	....
Symble	....	D	E	F	G	H	I	J	K	L	M	N	T	P	....

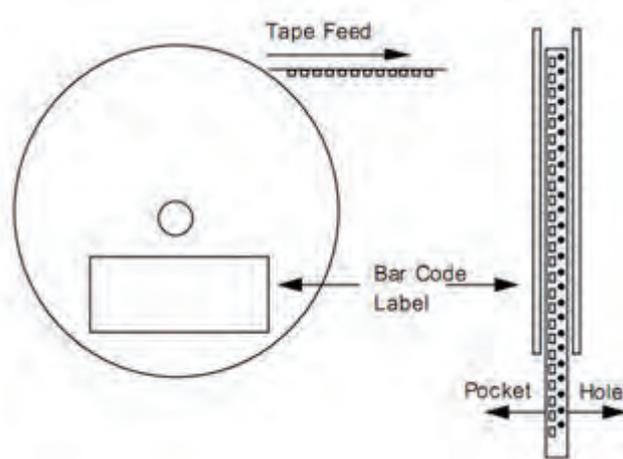
■ TAPE AND REEL INFORMATION



PIN ORIENTATION



ROLLING ORIENTATION





FC6232

Device	Package	Reel Diameter (mm)	Reel width (mm)	P0 (mm)	P1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	W (mm)	PIN1
FC6232AxxM	SOT-23-3	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.1±0.1	3.28±0.1	1.32±0.1	8.0±0.1	NA
FC6232AxxMC	SOT-23-3	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.1±0.1	3.28±0.1	1.32±0.1	8.0±0.1	NA
FC6232AxxMY	SOT-23-3	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.1±0.1	3.28±0.1	1.32±0.1	8.0±0.1	NA
FC6232BxxM	SOT-23-5	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.25±0.05	3.15±0.05	1.5±0.05	8.0±0.1	Q3
FC6232AxxP	SOT-89-3	178±1	13.0 ⁺¹ _{-0.5}	4.00±0.1	8.00±0.1	4.75±0.1	4.2±0.1	1.75±0.1	12.0 ^{+0.3} _{-0.1}	NA
FC6232AxxPT	SOT-89-3	178±1	13.0 ⁺¹ _{-0.5}	4.00±0.1	8.00±0.1	4.75±0.1	4.2±0.1	1.75±0.1	12.0 ^{+0.3} _{-0.1}	NA
FC6232AxxPL	SOT-89-3	178±1	13.0 ⁺¹ _{-0.5}	4.00±0.1	8.00±0.1	4.75±0.1	4.2±0.1	1.75±0.1	12.0 ^{+0.3} _{-0.1}	NA
FC6232BxxF	DFN1X1-4	178±1	9.6±1.2	4.00±0.1	2.00±0.05	1.16±0.05	1.16±0.05	0.5±0.05	8.0±0.1	Q3