

## High Current, High Speed LDO Regulators, Voltage Detector Function

## ■ GENERAL DESCRIPTION

The XC6413/XC6414 series are highly precise, low noise, positive voltage LDO regulators with voltage detector manufactured using CMOS processes which features high ripple rejection and low dropout. The series is composed of a voltage reference, an error amplifier, a current limiter and a phase compensation circuit plus a driver transistor. Detect voltage is selectable in 0.1V increments within a range of 0.9V ~ 6.0V and VR output voltage is selectable within a range of 0.9V ~ 5.5V. The series is also compatible with low ESR ceramic capacitors which give added output stability. This stability can be maintained even during load fluctuations due to the excellent transient response of the series. The current limiter's foldback circuit operates as a short-circuit protection as well as the output current limiter for the output pin. The series provides optional user selection for a variety of circuit applications such as detector monitoring, detector output logic, CE and EN pin input logic, internal pull-up/down resistors. The XC6413/XC6414FY type can delay the detector output. Delay time can be controlled by the use of an external capacitor (semi-custom).

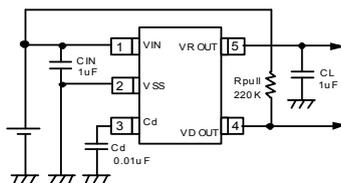
## ■ APPLICATIONS

- Smart phones / Mobile phones
- Digital still cameras / Camcorders
- Portable games
- Digital audio equipment
- Reference voltage sources
- Multi-function power supplies

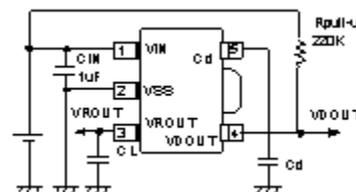
## ■ FEATURES

Maximum Output Current	: 300mA (380mA limit) ( $1.8 \leq V_{R\text{OUT}} \leq 5.5\text{V}$ ) [XC6413] 500mA (600mA limit) ( $2.5\text{V} \leq V_{R\text{OUT}} \leq 5.5\text{V}$ ) [XC6414]
Dropout Voltage	: 200mV @ $I_{R\text{OUT}}=100\text{mA}$
Operating Voltage Range	: 2.0V ~ 10.0V
VR Output Voltage Range	: 0.9V ~ 5.5V (0.1V increments)
Detect Voltage Range	: 0.9V ~ 6.0V (0.1V increments, $\pm 2\%$ ) More than 2.0V ( $V_{\text{IN}}$ sensing)
VR Output Voltage Accuracy	: $\pm 2\%$
Detect Voltage Accuracy	: $\pm 2\%$
VR.VD Temperature Coefficient	: $\pm 100\text{ppm}/^\circ\text{C}$ (TYP.)
Low Power Consumption	: 35 $\mu\text{A}$ (TYP.)
High Ripple Rejection	: 65dB @ 10kHz
Low ESR Capacitor	: Ceramic Capacitor Compatible
Operating Ambient Temperature	: $-40^\circ\text{C} \sim +85^\circ\text{C}$
Packages	: SOT-25, SOT-89-5, USP-6B
Environmentally Friendly	: EU RoHS Compliant, Pb Free

## ■ TYPICAL APPLICATION CIRCUITS



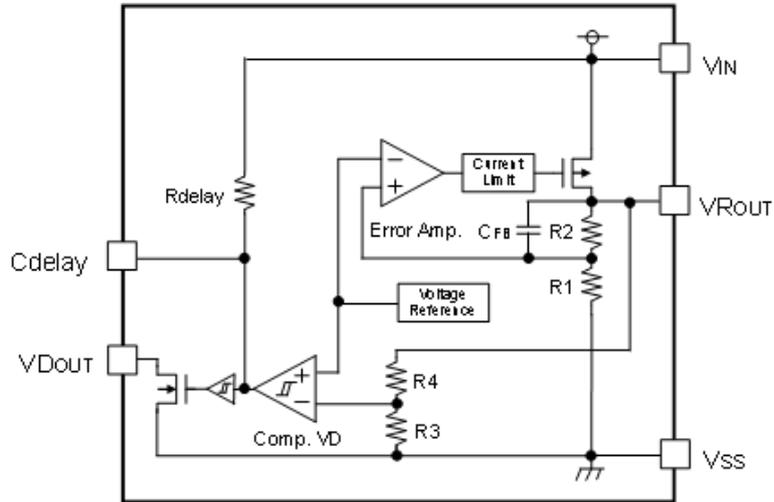
XC6413 Series  
Type FY



XC6414 Series  
Type FY

## ■ BLOCK DIAGRAM

XC6413/XC6414 Series Type FY



## ■ PRODUCT CLASSIFICATION

### ● Ordering Information

XC6413/XC6414①②③④⑤⑥-⑦<sup>(\*)</sup>

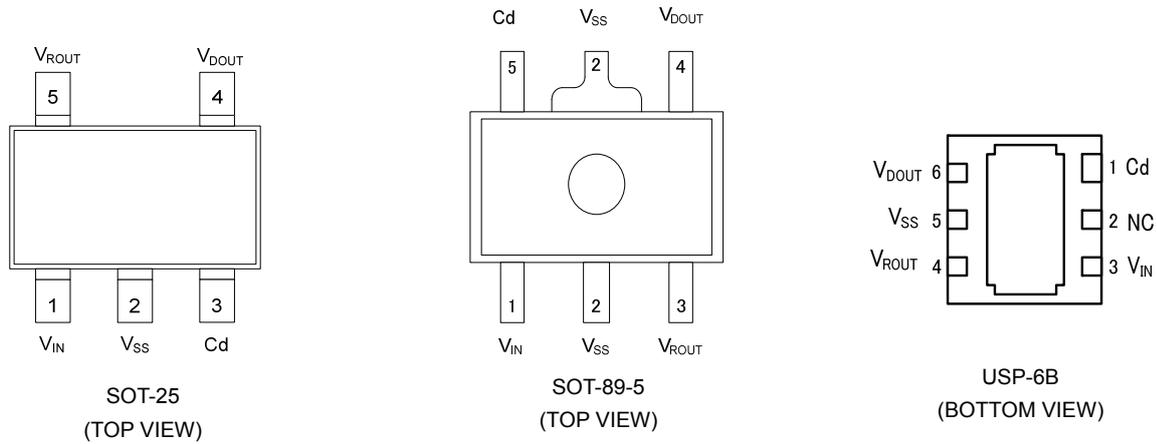
DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	Operational Function	F	Cd pin
②	Type of Regulator	Y	VD Sense pin : VR <sub>OUT</sub> , VD Output Logic : Detect L
③④	Output Voltage & Detect Voltage	-	Internally set sequential number relating to output voltage and detect voltage (refer to the chart below) VR setting output voltage range: 0.9V ~ 5.5V Detect voltage setting range: 0.9V ~ 6.0V 100mV increments are available
⑤⑥-⑦	Packages (Order Unit)	MR	SOT-25 (3,000pcs/Reel)
		MR-G	SOT-25 (3,000pcs/Reel)
		PR	SOT-89-5 (1,000pcs/Reel)
		PR-G	SOT-89-5 (1,000pcs/Reel)
		DR	USP-6B (3,000pcs/Reel)
		DR-G	USP-6B (3,000pcs/Reel))

(\*) The "-G" suffix denotes Halogen and Antimony free as well as being fully EU RoHS compliant.

PIN NUMBER: ③, ④ Types (80 ~ 99 : Standard voltage products)

③④	VR <sub>OUT</sub>	VD <sub>OUT</sub>	③④	VR <sub>OUT</sub>	VD <sub>OUT</sub>	③④	VR <sub>OUT</sub>	VD <sub>OUT</sub>	③④	VR <sub>OUT</sub>	VD <sub>OUT</sub>
01	3.2	2.5	11	4.0	3.6	80	1.8	1.6	90	1.3	2.0
02	-	-	12	3.1	2.8	81	2.8	3.1	91	1.5	2.0
03	4.5	3.0	13	5.0	4.2	82	1.8	2.0	92	-	-
04	2.5	1.7	14	3.3	2.4	83	2.5	2.8	93	-	-
05	5.0	4.5	15	3.5	3.8	84	2.85	3.2	94	-	-
06	3.3	3.0	16	-	-	85	3.0	3.3	95	-	-
07	2.8	2.2	17	-	-	86	3.5	3.8	96	-	-
08	5.0	4.6	18	-	-	87	3.0	4.2	97	-	-
09	5.0	5.0	19	-	-	88	3.3	4.0	98	-	-
10	3.3	2.7	20	-	-	89	-	-	99	-	-

## PIN CONFIGURATION



\*The dissipation pad for the USP-6B package should be solder-plated in recommended mount pattern and metal masking so as to enhance mounting strength and heat release. If the pad needs to be connected to other pins, it should be connected to the  $V_{SS}$  (No. 5) pin.

## PIN ASSIGNMENT

PIN NUMBER			PIN NAME	FUNCTIONS
SOT-25	SOT-89-5	USP-6B		
1	1	3	$V_{IN}$	Power Input
2	2	5	$V_{SS}$	Ground
3	5	1	$C_d$	Delay Capacitor Connection
4	4	6	$V_{DOUT}$	VD Output
5	3	4	$V_{ROUT}$	VR Output
—	—	2	NC	No connection

## ■ ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNIT
Input Voltage		$V_{IN}$	12.0	V
VR Output Current		$VR_{I_{OUT}}$	700 <sup>(*)</sup>	mA
VR Output Voltage		$VR_{OUT}$	$V_{SS} - 0.3 \sim V_{IN} + 0.3$	V
VD Output Current		$VD_{I_{OUT}}$	50	mA
VD Output Voltage		$VD_{OUT}$	$V_{SS} - 0.3 \sim 12.0$	V
$V_{CE} / V_{SEN} / Cd$ Voltage		$V_{CE} / V_{SEN} / Cd$	$V_{SS} - 0.3 \sim V_{IN} + 0.3$	V
Power Dissipation	SOT-25	Pd	250	mW
			600 (40mm x 40mm standard board) <sup>(*)</sup>	
	SOT-89-5		500	
			1750 (JEDEC board) <sup>(*)</sup>	
			USP-6B	
	1000 (40mm x 40mm standard board) <sup>(*)</sup>			
Operating Ambient Temperature		$T_{opr}$	- 40 ~ +85	°C
Storage Temperature		$T_{stg}$	- 55 ~ +125	°C

<sup>(\*)</sup> $VR_{I_{OUT}} \leq Pd / (V_{IN} - VR_{OUT})$

<sup>(\*)</sup>The power dissipation figure shown is PCB mounted. Please see the power dissipation page for the mounting condition.

# XC6413/XC6414 Series

## ELECTRICAL CHARACTERISTICS

XC6413/XC6414 Type FY

Ta=25°C

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT	
VR Output Voltage	$V_{ROUT(E)}$	$I_{ROUT}=30\text{mA}$	$\times 0.98$	$V_{ROUT(T)}$	$\times 1.02$	V	1	
VR Maximum Output Current (XC6413 Series)	$I_{ROUTMAX}$	$V_{IN}=V_{ROUT(T)}+1.0\text{V}$ When $V_{ROUT} \leq 2.1\text{V}$ , $V_{IN}=3.1\text{V}$	300	-	-	mA	1	
VR Maximum Output Current (XC6414 Series)	$I_{ROUTMAX}$	$V_{IN} = V_{ROUT(T)} + 2.0\text{V}$	500	-	-	mA	1	
$V_{ROUT} < 2.5\text{V}$		$V_{IN} = V_{ROUT(T)} + 2.0\text{V}$	400	-	-	mA	1	
VR Load Regulation	$\Delta V_{ROUT}$	$1\text{mA} \leq I_{ROUT} \leq 100\text{mA}$	-	15	50	mV	1	
Dropout Voltage (*4)	$V_{dif1}$	$I_{ROUT}=30\text{mA}$	E-1			mV	1	
	$V_{dif2}$	$I_{ROUT}=100\text{mA}$	E-2			mV	1	
Supply Current	$I_{DD}$	$V_{IN}=V_{ROUT(T)}+1.0\text{V}$ $V_{ROUT} \leq 0.90\text{V}$ , $V_{IN}=2.0\text{V}$	-	35	70	$\mu\text{A}$	2	
VR Line Regulation	$\frac{\Delta V_{ROUT}}{(\Delta V_{IN} \cdot V_{OUT})}$	$V_{ROUT(T)} + 1.0\text{V} \leq V_{IN} \leq 10.0\text{V}$ $V_{ROUT} \leq 0.90\text{V}$ , $V_{IN} \geq 2.0$ $I_{ROUT}=30\text{mA}$ $V_{ROUT(T)} \leq 1.75\text{V}$ , $I_{ROUT}=10\text{mA}$	-	0.01	0.20	% / V	1	
Input Voltage	$V_{IN}$		2.0	-	10.0	V	-	
VR Output Temperature Characteristics	$\frac{\Delta V_{ROUT}}{(\Delta T_{opr} \cdot V_{ROUT})}$	$I_{ROUT}=30\text{mA}$ $-40^\circ\text{C} \leq T_{opr} \leq 85^\circ\text{C}$	-	$\pm 100$	-	ppm / °C	1	
VR Ripple Rejection Rate	PSRR	$V_{IN}=[V_{ROUT(T)}+1.0\text{V}]+0.5\text{Vp-pAC}$ When $V_{ROUT(T)} \leq 1.25\text{V}$ → $V_{IN}=2.25\text{V}+0.5\text{Vp-pAC}$ $I_{ROUT}=50\text{mA}$ , $f=10\text{kHz}$	-	65	-	dB	3	
VR Current Limit (XC6413 Series)	$I_{RLIM}$	$V_{IN}=V_{ROUT(T)}+1.0\text{V}$ When $V_{ROUT} \leq 2.1\text{V}$ , $V_{IN}=3.1\text{V}$	300	380	-	mA	1	
$V_{ROUT} < 1.8\text{V}$			-	380	-	mA	1	
VR Current Limit (XC6414 Series)	$I_{RLIM}$	$V_{IN}=V_{ROUT(T)}+2.0\text{V}$	500	600	-	mA	1	
$V_{ROUT} < 2.5\text{V}$			-	600	-	mA	1	
VR Short Circuit Current (XC6413 Series)	$I_{RSHORT}$	$V_{IN}=V_{ROUT(T)}+1.0\text{V}$ When $V_{ROUT(T)} \leq 2.1\text{V}$ , $V_{IN}=3.1\text{V}$	-	30	-	mA	1	
VR Short Circuit Current (XC6414 Series)	$I_{RSHORT}$	$V_{IN}=V_{ROUT(T)}+2.0\text{V}$ When $V_{ROUT(T)} \leq 1.5\text{V}$ , $V_{IN}=3.1\text{V}$	-	30	-	mA	1	
VD Detect Voltage	$V_{DF(E)}$		$\times 0.98$	$V_{DF(T)}$	$\times 1.02$	V	4	
VD Hysteresis Range	$V_{HYS}$		$V_{DF(T)} \times 0.02$	$V_{DF(T)} \times 0.05$	$V_{DF(T)} \times 0.08$	V	4	
VD Output Current	$I_{DOUT}$	$V_{DOUT} = 0.5\text{V}$	$V_{IN} = 2.0\text{V}$	2.0	5.0	-	mA	5
			$V_{IN} = 3.0\text{V}$	4.0	7.5	-		
			$V_{IN} = 4.0\text{V}$	5.0	9.5	-		
			$V_{IN} = 5.0\text{V}$	6.0	10.5	-		
			$V_{IN} = 6.0\text{V}$	6.5	11.5	-		
			$V_{IN} = 7.0\text{V}$	7.0	12.5	-		
			$V_{IN} = 8.0\text{V}$	7.5	13.5	-		
			$V_{IN} = 9.0\text{V}$	8.0	14.5	-		
$V_{IN} = 10.0\text{V}$	8.5	14.5	-					
VD Detect Voltage Temperature Characteristics	$\frac{\Delta V_{DF}}{(\Delta T_{opr} \cdot V_{DF})}$	$-40^\circ\text{C} \leq T_{opr} \leq 85^\circ\text{C}$	-	$\pm 100$	-	ppm / °C	4	
Delay Resistance	Delay	$V_{IN}=7.0\text{V}$ , $C_d=0\text{V}$ Delay Resistance=7.0V/Delay Current	1.0	2.0	2.5	MΩ	6	

### NOTE

- \*1 Unless otherwise stated,  $V_{IN}=V_{ROUT(T)}+1.0\text{V}$ .  $V_{ROUT} \leq 0.9\text{V}$ :  $V_{IN}=2.0\text{V}$
- \*2  $V_{ROUT(T)}$ : Nominal VR output voltage
- \*3  $V_{OUT(E)}$ : Effective VR output voltage  
(ie. the VR output voltage when " $V_{ROUT(T)}+1.0\text{V}$ " is provided at the  $V_{IN}$  pin while maintaining a certain  $I_{ROUT}$  value).
- \*4  $V_{dif} = \{V_{IN1}^{(*)} - V_{ROUT1}^{(*)}\}$
- \*5  $V_{ROUT}$ : A voltage equal to 98% of the VR output voltage whenever a stabilized ( $V_{ROUT(T)}+1.0\text{V}$ ) is input with each  $I_{ROUT}$ .
- \*6  $V_{IN1}$ : the input voltage when  $V_{OUT1}$ , which appears as Input voltage is gradually decreased.

## ELECTRICAL CHARACTERISTICS

### ●VR Dropout Voltage

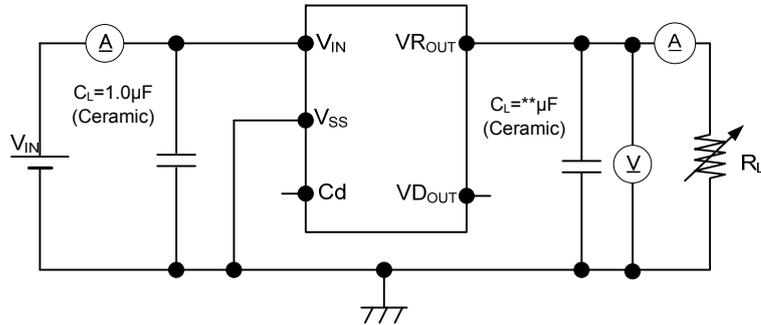
XC6413/XC6414 Type FY

SYMBOL PARAMETER NOMINAL DETECT VOLTAGE OUTPUT VOLTAGE	E-0		E-1		E-2	
	OUTPUT VOLTAGE DETECT VOLTAGE		DROPOUT VOLTAGE 1 (mV) (I <sub>OUT</sub> =30mA)		DROPOUT VOLTAGE 2 (mV) (I <sub>OUT</sub> =100mA)	
	(V)		Ta=25°C		Ta=25°C	
	V <sub>ROUT(T)</sub> V <sub>DF(T)</sub>	V <sub>ROUT</sub> / V <sub>DF</sub>		V <sub>dif1</sub>	V <sub>dif1</sub>	V <sub>dif2</sub>
	MIN.	MAX.	TYP.	MAX.	TYP.	MAX.
0.90	0.870	0.930	1050	1100	1150	1200
1.00	0.970	1.030	1000	1100	1050	1200
1.10	1.070	1.130	900	1000	950	1100
1.20	1.170	1.230	800	900	850	1000
1.30	1.270	1.330	700	800	750	900
1.40	1.370	1.430	600	700	650	800
1.50	1.470	1.530	500	600	550	700
1.60	1.568	1.632	400	500	500	600
1.70	1.666	1.734	300	400	400	500
1.80	1.764	1.836	200	300	300	400
1.90	1.862	1.938	120	150	280	380
2.00	1.960	2.040	80	120	240	350
2.10	2.058	2.142	80	120	240	330
2.20	2.156	2.244	80	120	240	330
2.30	2.254	2.346	80	120	240	310
2.40	2.352	2.448	80	120	240	310
2.50	2.450	2.550	70	100	220	290
2.60	2.548	2.652	70	100	220	290
2.70	2.646	2.754	70	100	220	290
2.80	2.744	2.856	70	100	220	270
2.90	2.842	2.958	70	100	220	270
3.00	2.940	3.060	60	90	200	270
3.10	3.038	3.162	60	90	200	250
3.20	3.136	3.264	60	90	200	250
3.30	3.234	3.366	60	90	200	250
3.40	3.332	3.468	60	90	200	250
3.50	3.430	3.570	60	90	200	250
3.60	3.528	3.672	60	90	200	250
3.70	3.626	3.774	60	90	200	250
3.80	3.724	3.876	60	90	200	250
3.90	3.822	3.978	60	90	200	250
4.00	3.920	4.080	60	80	180	230
4.10	4.018	4.182	60	80	180	230
4.20	4.116	4.284	60	80	180	230
4.30	4.214	4.386	60	80	180	230
4.40	4.312	4.488	60	80	180	230
4.50	4.410	4.590	60	80	180	230
4.60	4.508	4.692	60	80	180	230
4.70	4.606	4.794	60	80	180	230
4.80	4.704	4.896	60	80	180	230
4.90	4.802	4.998	60	80	180	230
5.00	4.900	5.100	50	70	160	210
5.10	4.998	5.202	50	70	160	210
5.20	5.096	5.304	50	70	160	210
5.30	5.194	5.406	50	70	160	210
5.40	5.292	5.508	50	70	160	210
5.50	5.390	5.610	50	70	160	210
5.60	5.488	5.712	-	-	-	-
5.70	5.586	5.814	-	-	-	-
5.80	5.684	5.916	-	-	-	-
5.90	5.782	6.018	-	-	-	-
6.00	5.880	6.120	-	-	-	-

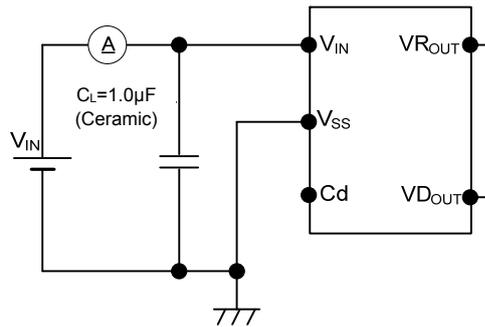
## TEST CIRCUITS

XC6413/XC6414 Type FY

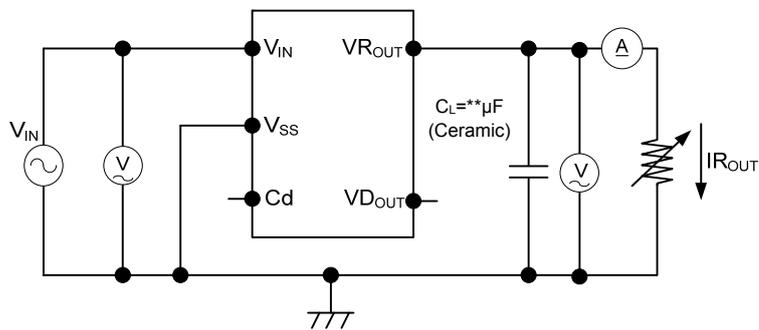
### ● Circuit 1



### ● Circuit 2



### ● Circuit 3

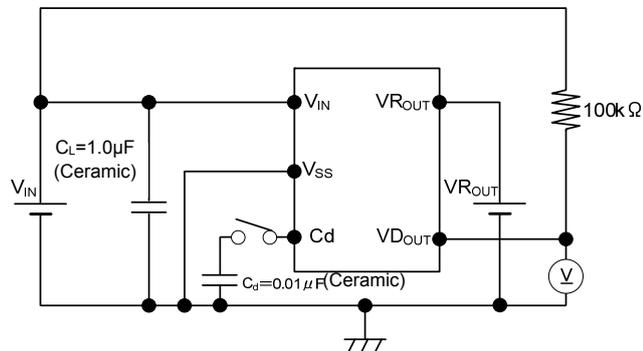




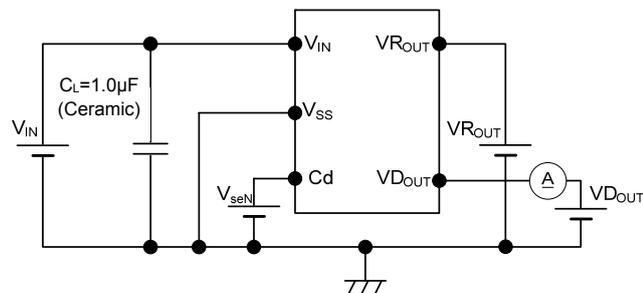
## TEST CIRCUITS (Continued)

XC6413/XC6414 Type FY

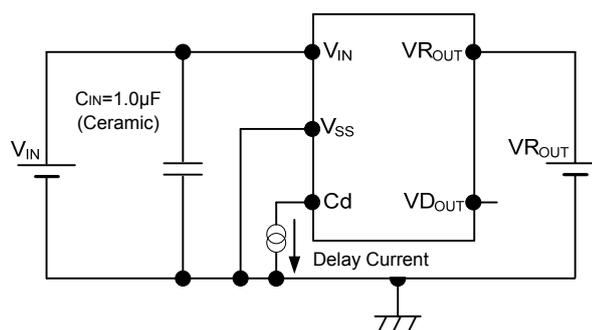
● Circuit 4



● Circuit 5



● Circuit 6



\*Output Capacitor Corresponding Chart

VR <sub>OUT</sub>	C <sub>L</sub>
0.9 ~ 1.2V	More than 4.7 μF
1.3 ~ 1.7V	More than 2.2 μF
1.8 ~ 5.5V	More than 1.0 μF

## OPERATIONAL EXPLANATION

### <Output Voltage Regulator Control>

The voltage, divided by resistors R1 & R2 which are connected to the V<sub>ROUT</sub> pin is compared with the internal reference voltage by the error amplifier. The P-channel MOSFET, which is connected to the V<sub>ROUT</sub> pin, is then driven by the subsequent output signal.

The output voltage at the V<sub>ROUT</sub> pin is controlled & stabilized by negative feedback.

The current limit circuit and short circuit protection operate in relation to the level of output current.

### <Detector Function with the XC6413/XC6414 Series>

The series' detector function monitors the voltage divided by resistors R3 & R4 which are connected to the V<sub>ROUT</sub> pin, as well as monitoring the voltage of the internal reference voltage source via the comparator.

The V<sub>DSEN</sub> pin has options (please refer to the Selection Guide, item 4). A 'Low' signal level can be output from the V<sub>DOUT</sub> pin when the VD pin voltage level goes below the detect voltage. As V<sub>DOUT</sub> is an open-drain N-channel output, a pull-up resistor of about 220kΩ is needed to achieve a voltage output. Because of hysteresis at the detector function, output at the V<sub>DOUT</sub> pin will invert when the detect voltage level increases above the release voltage (105% of the detect voltage).

By connecting the C<sub>delay</sub> pin to a capacitor (Cd), the XC6413/XC6414F series can apply a delay time to V<sub>DOUT</sub> voltage when releasing voltage.

The delay time can be calculated from the internal resistance, R<sub>delay</sub> (2MΩ, TYP., fixed) and the value of Cd as per the following equation.

$$\text{Delay Time} = C_{\text{delay}} \times R_{\text{delay}} \times 0.7$$

● R<sub>delay</sub>: 1.0 ~ 3.5MΩ, TYP:2.0MΩ

Cd	DELAY TIME (TYP.)	DELAY TIME
0.01 μF	14.0msec	7.00 ~ 24.5msec
0.022 μF	30.8msec	15.4 ~ 53.9msec
0.047 μF	65.8msec	32.90 ~ 115.15msec
0.10 μF	140msec	70.0 ~ 245msec
0.22 μF	308msec	154 ~ 539msec
0.47 μF	658msec	329.0 ~ 1151.5msec
1.0 μF	1400msec	700.0 ~ 2450msec

### <Low ESR Capacitors>

With the XC6413/XC6414 series regulator, a stable output voltage is achievable even if low ESR capacitors are used, as a phase compensation circuit is built-in to the regulator. In order to ensure the effectiveness of the phase compensation, we suggest that an output capacitor (C<sub>L</sub>) be connected as close as possible, between the output pin (V<sub>ROUT</sub>) and the V<sub>SS</sub> pin. Please use an output capacitor (C<sub>L</sub>) with a capacitance, based on the chart below.

We also suggest an input capacitor (C<sub>IN</sub>) of 1 μF : this should be connected between V<sub>IN</sub> and V<sub>SS</sub> in order to stabilize input power source.

### ● Output Capacitor Corresponding Chart

V <sub>ROUT</sub>	C <sub>L</sub>
0.9 ~ 1.2V	More than 4.7 μF
1.3 ~ 1.7V	More than 2.2 μF
1.8 ~ 5.5V	More than 1.0 μF

### <Current Limiter, Short-Circuit Protection>

The XC6413/XC6414 series regulator offers a combination of current limit and circuit protection by means of a built-in fixed current limiter circuit and a foldback circuit. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, the output voltage drops further and output current decreases. When the output pin is shorted, a current of about 50mA flows.

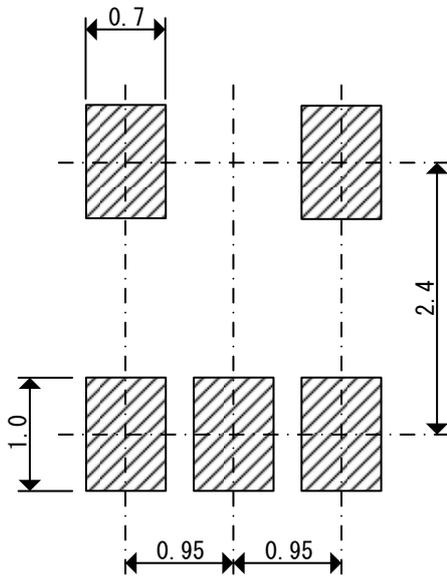
## ■ NOTES ON USE

1. Please use this IC within the stated absolute maximum ratings. The IC is liable to malfunction should the ratings be exceeded.
2. Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current. Please strengthen  $V_{IN}$  and  $V_{SS}$  wiring in particular.
3. Please wire the input capacitor ( $C_{IN}$ ) and the output capacitor ( $C_L$ ) as close to the IC as possible.  
Should rapid input fluctuation or load fluctuation occur, please increase the capacitor value such as  $C_{IN}$  or  $C_L$  to stabilize the operation.
4. Torex places an importance on improving our products and its reliability.  
However, by any possibility, we would request user fail-safe design and post-aging treatment on system or equipment.

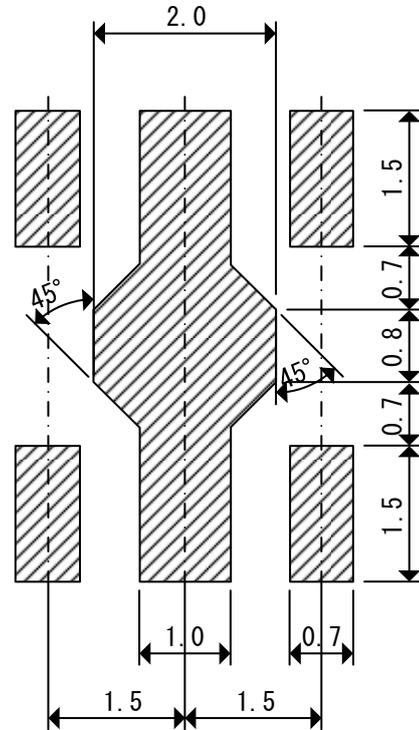


■ PACKAGING INFORMATION(Continued)

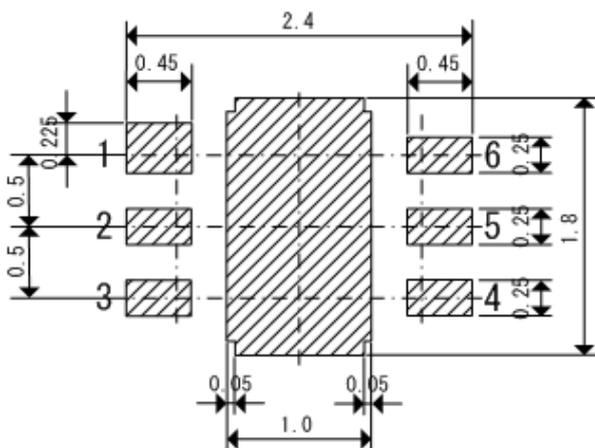
● SOT-25 Reference Pattern Layout



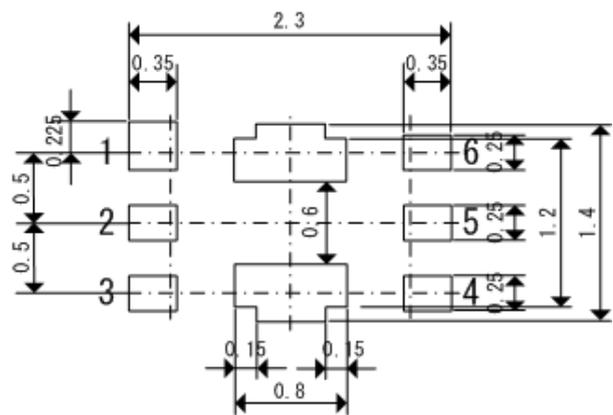
● SOT-89-5 Reference Pattern Layout



● USP-6B Reference Pattern Layout



● USP-6B Reference Metal Mask Design



## PACKAGING INFORMATION(Continued)

### SOT-25 Power Dissipation (40mm x 40mm Standard board)

Power dissipation data for the SOT-25 is shown in this page.

The value of power dissipation varies with the mount board conditions.

Please use this data as the reference data taken in the following condition.

#### 1. Measurement Condition

Condition: Mount on a board

Ambient: Natural convection

Soldering: Lead (Pb) free

Board: Dimensions 40 x 40 mm  
(1600 mm<sup>2</sup> in one side)

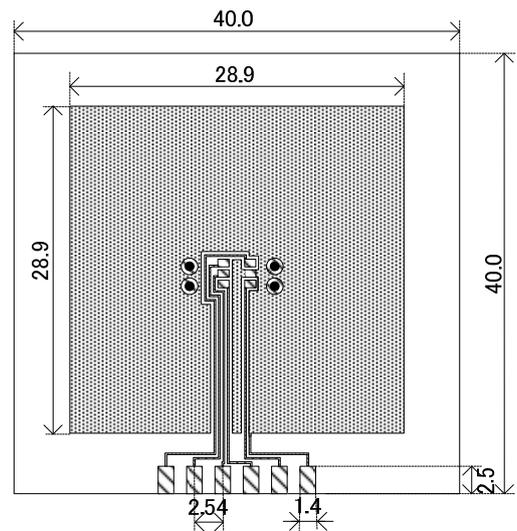
Copper (Cu) traces occupy 50% of the board  
area in top and back faces

Package heat-sink is tied to the copper traces  
(Board of SOT-26 is used.)

Material: Glass Epoxy (FR-4)

Thickness: 1.6mm

Through-hole: 4 x 0.8 Diameter

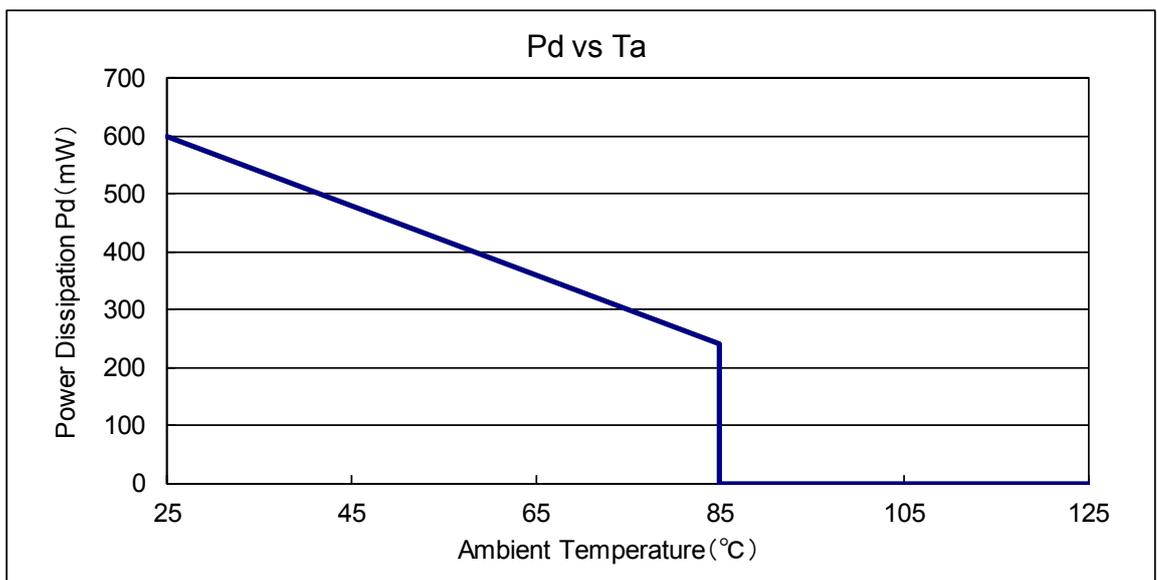


Evaluation Board (Unit: mm)

#### 2. Power Dissipation vs. Ambient Temperature

Board Mount ( $T_j$  max = 125°C)

Ambient Temperature (°C)	Power Dissipation Pd (mW)	Thermal Resistance (°C/W)
25	600	166.67
85	240	



## ■ PACKAGING INFORMATION(Continued)

### ● USP-6B Power Dissipation (40mm x 40mm Standard board)

Power dissipation data for the USP-6B is shown in this page.

The value of power dissipation varies with the mount board conditions.

Please use this data as the reference data taken in the following condition.

#### 1. Measurement Condition

Condition: Mount on a board

Ambient: Natural convection

Soldering: Lead (Pb) free

Board: Dimensions 40 x 40 mm  
(1600 mm<sup>2</sup> in one side)

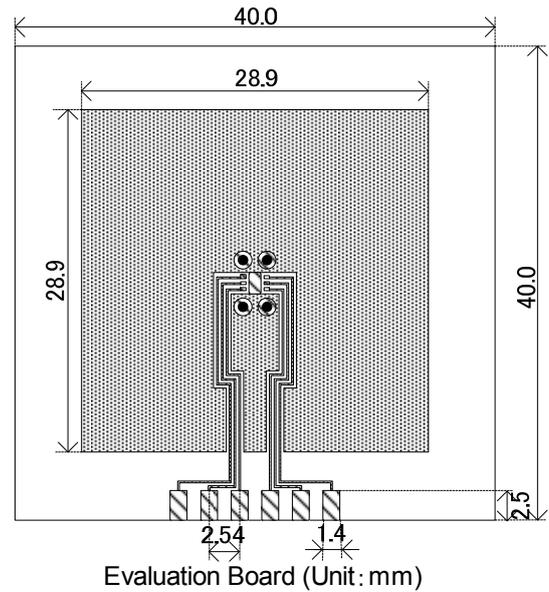
Copper (Cu) traces occupy 50% of the board  
area in top and back faces

Package heat-sink is tied to the copper traces

Material: Glass Epoxy (FR-4)

Thickness: 1.6mm

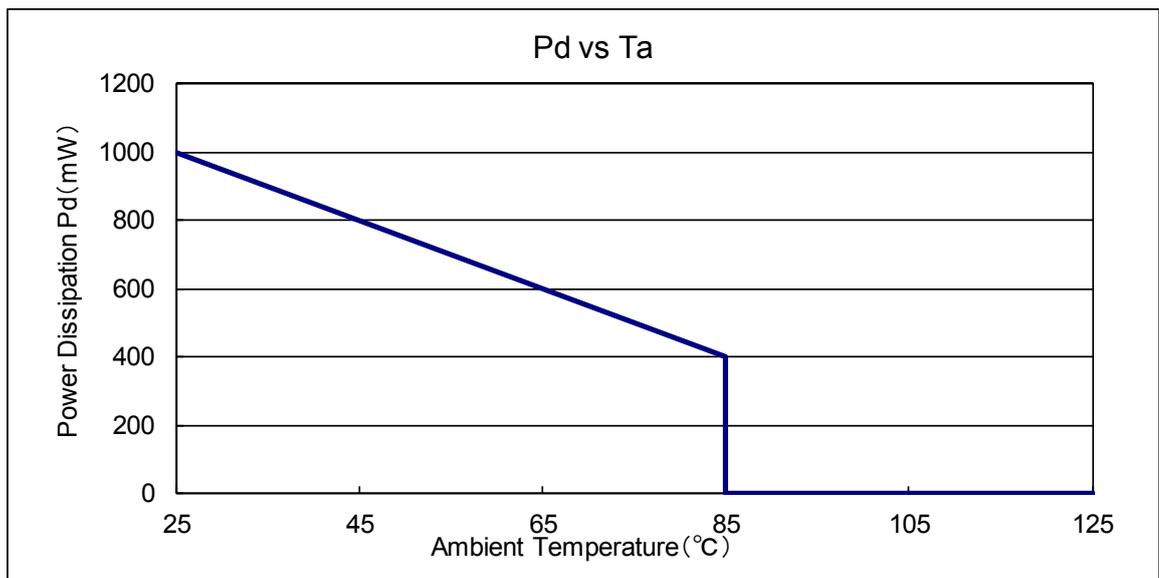
Through-hole: 4 x 0.8 Diameter



#### 2. Power Dissipation vs. Ambient Temperature

Board Mount ( $T_j \text{ max} = 125^\circ\text{C}$ )

Ambient Temperature ( $^\circ\text{C}$ )	Power Dissipation Pd (mW)	Thermal Resistance ( $^\circ\text{C}/\text{W}$ )
25	1000	100.00
85	400	



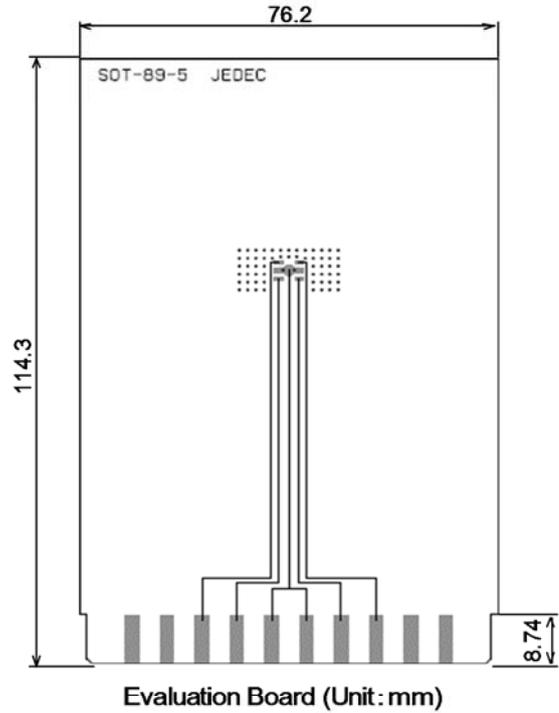
## PACKAGING INFORMATION(Continued)

### SOT-89-5 Power Dissipation (JEDEC)

Power dissipation data for the SOT-89-5 is shown in this page.  
 The value of power dissipation varies with the mount board conditions.  
 Please use this data as one of reference data taken in the described condition.

#### 1. Measurement Condition (Reference data)

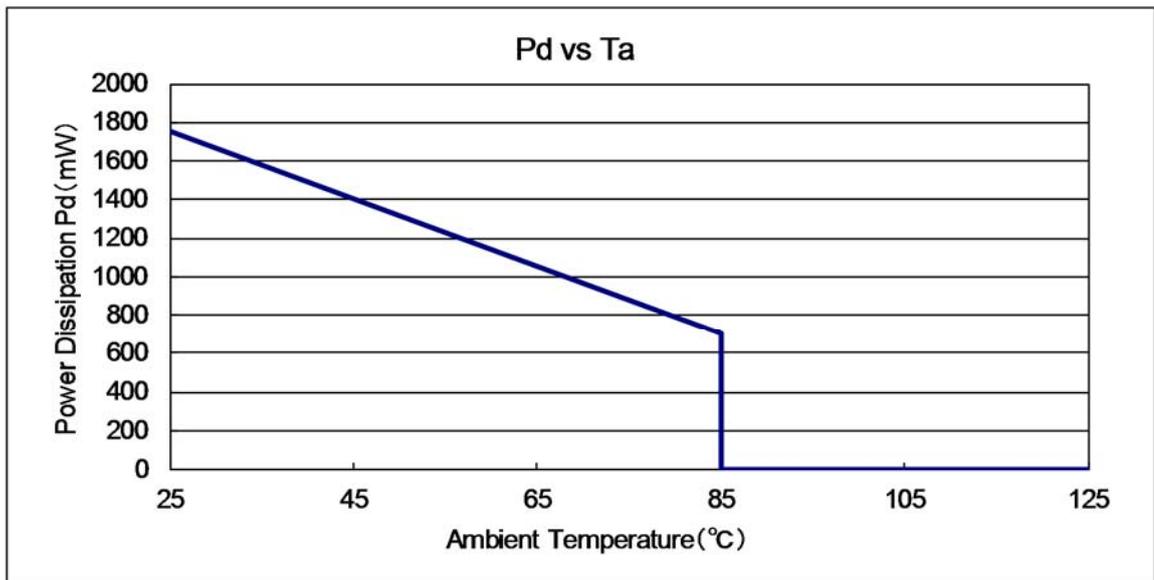
- Condition : Mount on a board
- Ambient : Natural convection
- Soldering : Lead (Pb) free
- Board : The board using 4 copper layer.  
 (76.2mm×114.3mm· · · Area: about 8700mm<sup>2</sup>)
- 1st layer : No copper foil (Signal layer)
- 2nd layer : 70mm×70mm\_Connected to heat-sink.
- 3rd layer : 70mm×70mm\_Connected to heat-sink.
- 4th layer : No copper foil (Signal layer)
- Material : Glass Epoxy (FR-4)
- Thickness : 1.6mm
- Through-hole : φ0.2mm x 60pcs



#### 2. Power Dissipation vs. Ambient Temperature

Board Mount (T<sub>j</sub> max = 125°C)

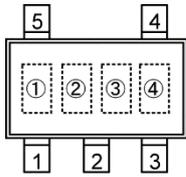
Ambient Temperature (°C)	Power Dissipation Pd (mW)	Thermal Resistance (°C/W)
25	1750	57.14
85	700	



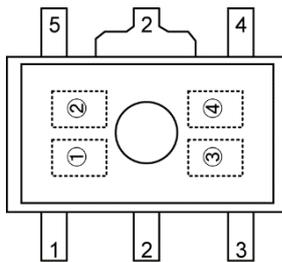


## MARKING RULE

● SOT-25, SOT-89-5



SOT-25  
(TOP VIEW)



SOT-89-5  
(TOP VIEW)

① represents product series

MARK	PRODUCT SERIES
<u>D</u>	XC6413xxxxxx
<u>E</u>	XC6414xxxxxx

②③ represents internal sequential number

01~09, 10~99, A0~A9, B0~B9, Z9~

(G, I, J, O, Q, W excepted)

The two digits show a combination of “Operational Function”, “Type of Regulator” and “Output Voltage & Detect Voltage”.

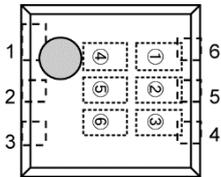
The same digits are used between the type of packages.

④ represents production lot number

0~9, A~Z repeated. (G, I, J, O, Q, W excluded.)

## MARKING RULE (Continued)

### ● USP-6B



USP-6B  
(TOP VIEW)

① represents product series

MARK	PRODUCT SERIES
6	XC6413xxxxxx
7	XC6414xxxxxx

② represents optional functions

MARK	OPTIONAL FUNCTION	PRODUCT SERIES
F	Cd Pin	XC6413/XC6414Fxxxxx

③ represents product type

MARK	EN/CE FUNCTION	VD SENSE PIN	VD OUTPUT LOGIC	PRODUCT SERIES
Y	Nonfunctional	$V_{ROUT}/V_{SEN}$	Detect L	XC6413/XC6414xYxxxx

④,⑤ represents output voltage

ex.)

MARK		OUTPUT VOLTAGE		PRODUCT SERIES
④	⑤	$V_{ROUT}(V)$	$V_{DOUT}(V)$	
0	1	3.2	2.5	XC6413/XC6414xx01xx

⑥ represents production lot number

0 to 9, A to Z repeated (G, I, J, O, Q, W excluded)

Note: No character inversion used.

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