FC61 Series Positive Voltage Detector

❖ Application

- Memory Battery Back-up Circuits
- Microprocessor Reset Circuitry
- Power Failure Detection
- Power-on Reset Circuit
- System Battery Life and Charge Voltage Monitor

❖ Features

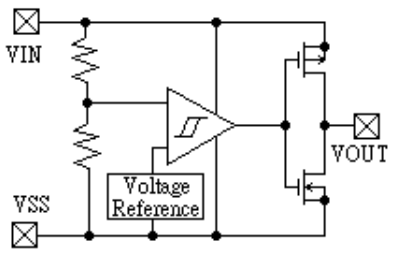
- CMOS Low Power Consumption : Typical 1.0uA at Vin=2.0V
- Selectable Detect Voltage : 1.1V to 7.0V in 0.1V increments
- Highly Accurate : Detect Voltage 1.1V to 1.9V ± 3%
  Detect Voltage 2.0V to 7.0V ± 2%
- Operating Voltage : 0.8V to 10.0V
- Package Available : SOT-23 (150mW), SOT-89 (500mW) & TO92 (300mW)

❖ General Description

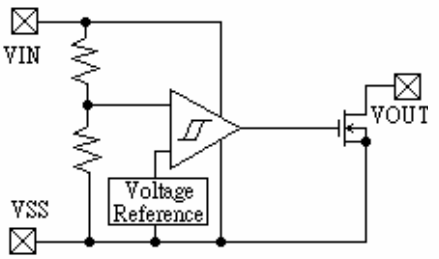
The FC61 is a group of high-precision and low-power voltage detectors.
The FC61 consists of a highly-accurate and low-power reference voltage source, a comparator, a hysteresis circuit, and an output driver. Detect voltage is very accurate and stable with N-channel open drain and CMOS, are available.

❖ Block Diagram

(1) CMOS Output



(2) N-Channel Open Drain Output



❖ Absolute Maximum Ratings

Parameter		Symbol	Ratings	Units
Input Voltage		V_{IN}	10	V
Output Current		I_{OUT}	50	mA
Output Voltage		V_{OUT}	V_{SS} - 0.3 ~ V_{IN} +0.3	V
Continuous Total Power Dissipation	SOT-23	P_d	150	mW
	SOT-89		500	
	TO-92		300	
Operating Ambient Temperature		T_{opr}	- 40 ~ +85	°C
Storage Temperature		T_{stg}	- 55 ~ +125	°C

❖ Electrical Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Detect Voltage	V_{DF}	V_{DF} = 1.1V to 1.9V	X0.97	V_{DF}	X1.03	V
		V_{DF} = 2.0V to 7.0V	X0.98	V_{DF}	X1.02	V
Hysteresis Range	V_{HYS}		X0.02	V_{DF} X0.05	X0.08	V
Supply Current	I_{SS}	V_{IN} = 1.0V V_{IN} = 2.0V V_{IN} = 3.0V V_{IN} = 4.0V V_{IN} = 5.0V		0.8 1.0 1.3 1.6 2.0	2.0 2.5 3.0 3.5 4.0	*uA*
Operating Voltage	V_{IN}	V_{DF} = 1.1 ~ 7.0V	0.8		10.0	V
Output Current	I_{OUT}	Nch V_{IN} = 0.5V V_{IN} = 1.0V V_{IN} = 2.0V V_{IN} = 3.0V V_{IN} = 4.0V V_{IN} = 5.0V		 1.0 3.0 5.0 11.0 13.0		*mA*
		Pch V_{DS} = 2.0V V_{IN} = 8.0V (CMOS Output)		-10.0		
Transient Delay Time ($V_{DR} \rightarrow V_{OUT}$ Inversion)	t_{DLY}	While V_{IN} changes from 0.6V to 10V			0.2	ms

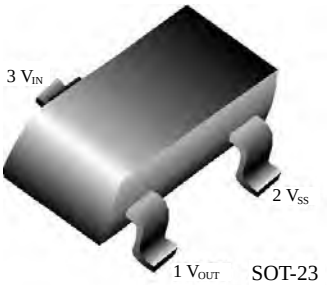
❖ Electrical Characteristics By Detector Threshold

Part Number	Standard Detector Accuracy	Detector Threshold V_{DF} (V)			Hysteresis Range V_{HYS} (V)		Supply Current I_{SS} (uA)		
		MIN.	TYP.	MAX.	MIN.	MAX.	Condition	TYP.	MAX.
FC61X113XX	3%	1.067	1.100	1.133	V_{DF} x 0.02	V_{DF} x 0.08	V_{IN} = 1.0V	0.8	2.0
FC61X123XX		1.164	1.200	1.236					
FC61X133XX		1.261	1.300	1.339					
FC61X143XX		1.358	1.400	1.442					
FC61X153XX		1.455	1.500	1.545					
FC61X163XX		1.552	1.600	1.648					
FC61X173XX		1.649	1.700	1.751					
FC61X183XX		1.746	1.800	1.854					
FC61X193XX		1.843	1.900	1.957					
FC61X202XX	2%	1.960	2.000	2.040			V_{IN} = 2.0V	1.0	2.5
FC61X212XX		2.058	2.100	2.142					
FC61X222XX		2.156	2.200	2.244					
FC61X232XX		2.254	2.300	2.346					
FC61X242XX		2.352	2.400	2.448					
FC61X252XX		2.450	2.500	2.550					
FC61X262XX		2.548	2.600	2.652					
FC61X272XX		2.646	2.700	2.754					
FC61X282XX		2.744	2.800	2.856					
FC61X292XX		2.842	2.900	2.958					
FC61X302XX		2.940	3.000	3.060			V_{IN} = 3.0V	1.3	3.0
FC61X312XX		3.038	3.100	3.162					
FC61X322XX		3.136	3.200	3.264					
FC61X332XX		3.234	3.300	3.366					
FC61X342XX		3.332	3.400	3.468					
FC61X352XX		3.430	3.500	3.570					
FC61X362XX		3.528	3.600	3.672					
FC61X372XX		3.626	3.700	3.774					
FC61X382XX		3.724	3.800	3.876					
FC61X392XX		3.822	3.900	3.978					
FC61X402XX		3.920	4.000	4.080			V_{IN} = 4.0V	1.6	3.5
FC61X412XX		4.018	4.100	4.182					
FC61X422XX		4.116	4.200	4.284					
FC61X432XX		4.214	4.300	4.386					
FC61X442XX		4.312	4.400	4.488					
FC61X452XX		4.410	4.500	4.590					
FC61X462XX		4.508	4.600	4.692					
FC61X472XX		4.606	4.700	4.794					
FC61X482XX		4.704	4.800	4.896					
FC61X492XX		4.802	4.900	4.998					
FC61X502XX		4.900	5.000	5.100			V_{IN} = 5.0V	2.0	4.0
FC61X512XX		4.998	5.100	5.202					
FC61X522XX		5.096	5.200	5.304					
FC61X532XX		5.194	5.300	5.406					
FC61X542XX		5.292	5.400	5.508					
FC61X552XX		5.390	5.500	5.610					
FC61X562XX		5.488	5.600	5.712					
FC61X572XX		5.586	5.700	5.814					
FC61X582XX		5.684	5.800	5.916					
FC61X592XX		5.782	5.900	6.018					
FC61X602XX		5.880	6.000	6.120					
FC61X702XX		6.860	7.000	7.210			V_{IN} = 6.0V	2.4	4.5

PartNumber	Operating Voltage V_N (V)		Pch Output Current Pch I_{OUT} (mA)		Nch Output Current Nch I_{OUT} (mA)		Transient Delay Time t_{DLY} (ms)
	MIN.	MAX.	Condition	TYP.	Condition	TYP.	MAX.
FC61X113XX	0.8V	10V	V_{DS} = 2.1V V_N = 8.0V	-10.0	V_{DS} = 0.5V V_{IN} = 1.0V	1.0	0.2
FC61X123XX							
FC61X133XX							
FC61X143XX							
FC61X153XX							
FC61X163XX							
FC61X173XX							
FC61X183XX							
FC61X193XX							
FC61X202XX							
FC61X212XX					V_{DS} = 0.5V V_{IN} = 2.0V	3.0	
FC61X222XX							
FC61X232XX							
FC61X242XX							
FC61X252XX							
FC61X262XX							
FC61X272XX							
FC61X282XX							
FC61X292XX							
FC61X302XX							
FC61X312XX					V_{DS} = 0.5V V_{IN} = 3.0V	5.0	
FC61X322XX							
FC61X332XX							
FC61X342XX							
FC61X352XX							
FC61X362XX							
FC61X372XX							
FC61X382XX							
FC61X392XX							
FC61X402XX							
FC61X412XX					V_{DS} = 0.5V V_{IN} = 4.0V	11.0	
FC61X422XX							
FC61X432XX							
FC61X442XX							
FC61X452XX							
FC61X462XX							
FC61X472XX							
FC61X482XX							
FC61X492XX							
FC61X502XX							
FC61X512XX					V_{DS} = 0.5V V_{IN} = 5.0V	13.0	
FC61X522XX							
FC61X532XX							
FC61X542XX							
FC61X552XX							
FC61X562XX							
FC61X572XX							
FC61X582XX							
FC61X592XX							
FC61X602XX							
FC61X702XX							

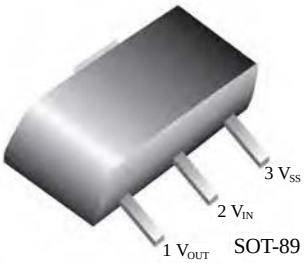
❖ Pin Configuration

SOT-23-3



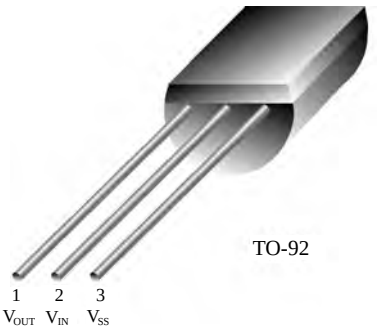
SOT-23

SOT-89-3



SOT-89

TO-92



TO-92

Package Pin Number			Pin Name	Function
SOT-23-3	SOT-89-3	TO-92		
1	1	1	VOUT	Supply Voltage Output
3	2	2	VIN	Supply Voltage Input
2	3	3	VSS	Ground

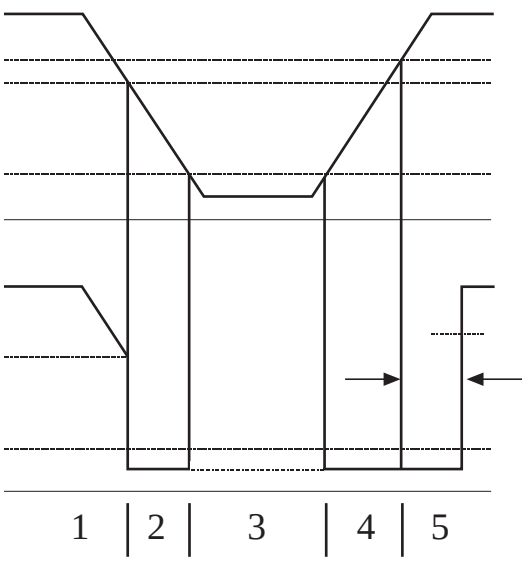
❖ Functional Description (Refers to CMOS Output)

1. Firstly, when a voltage, higher than the Release Voltage (V_{DR}) , is applied to the Voltage Input pin (V_{IN}), that voltage will gradually fall. When a voltage higher than the Detect Voltage (V_{DF}) is applied to the Input Voltage pin (V_{IN}), output at V_{OUT} will be equal to the input at the V_{IN} pin. High impedance exists on the Output pin (V_{OUT}) with the N-channel open drain configuration. If the pin is pulled-up. V_{OUT} will be identical to the pull-up voltage.
2. When the input Voltage (V_{IN}) falls below the Detect Voltage (V_{DF}) level, the Output Voltage (V_{OUT}) is equal to the Ground Voltage (V_{SS}) level (detect state). Also applicable to N-channel open drain configuration.
3. When the Input Voltage (V_{IN}) falls below the Minimum Operating Voltage (V_{MIN}) level, output becomes unstable. In the case of N-channel open drain configuration, as the output pin is generally pulled-up, the output will be equal to the pull-up voltage.
4. When the Input Voltage (V_{IN}) rises, output become stable once the voltage has exceeded V_{MIN}. The Output Voltage (V_{OUT}) will remain equal to the Ground Voltage (V_{SS}) level until the Input Voltage (V_{IN}) reaches the Detect Release Voltage (V_{DR}) level.
5. When the Input Voltage (V_{IN}) rises above the Detect Release Voltage (V_{DR}) level, output at the Output pin (V_{OUT}) is equal to V_{IN}. (High impedance exists with the N-channel open drain output configuration and V_{OUT} follows the pull-up voltage.)

Notes :

1. The difference between V_{DR} and V_{DF} represents the Hysteresis Range.
2. The Propagation Delay Time (t_{DLY}) represents the time it takes for the Input Voltage (V_{IN}) to appear at the Output pin (V_{OUT}), once the said voltage has exceeded the Release Voltage (V_{DR}) level.

❖ Timing Diagram



Input Voltage (V_{IN})
Detect Release Voltage(D_{DR})
Detect Voltage(V_{DF})

Minimum Operating Voltage (V_{OUT})
Ground Voltage (V_{SS})

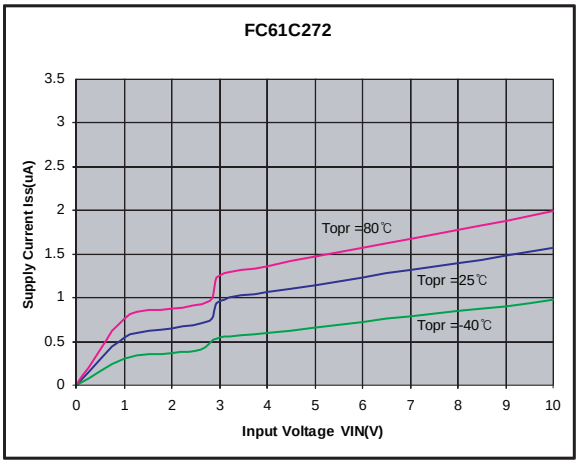
Output Voltage (V_{OUT})

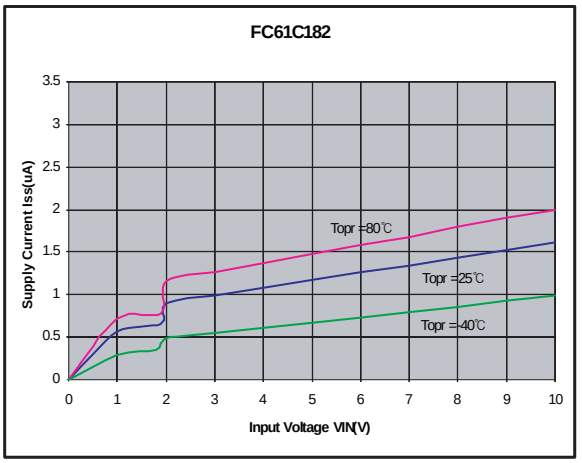
Propagation Delay Time (t_{DLY})

Ground Voltage (V_{SS})

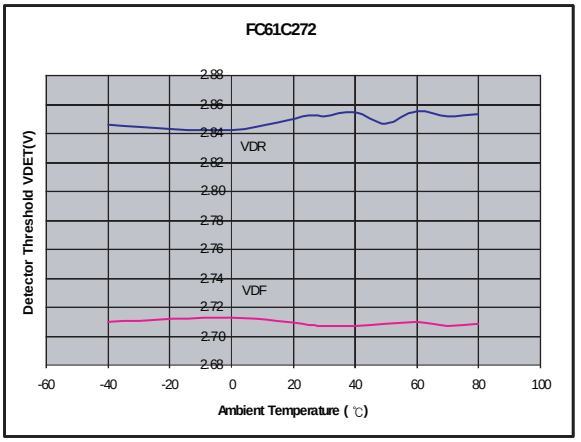
❖ Typical Performance Characteristics

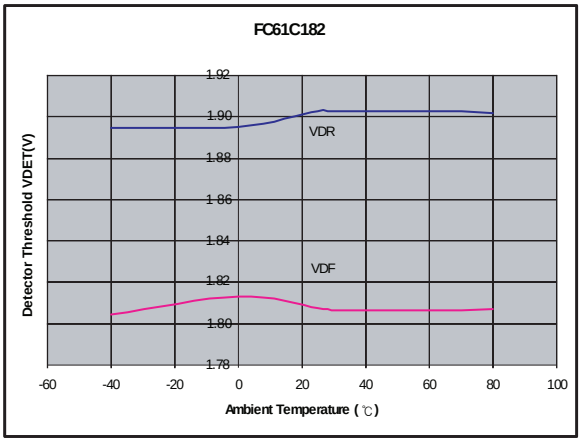
1) Supply Current vs. Input Voltage



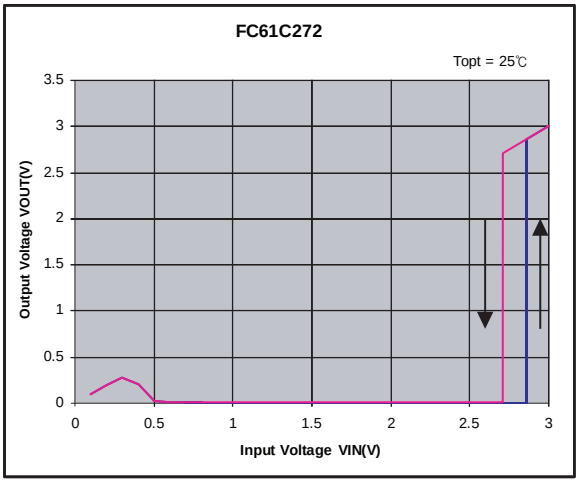


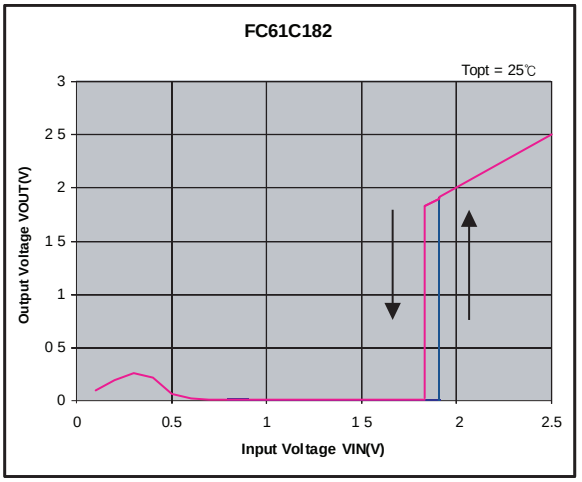
2) Detect, Release Voltage vs. Ambient Temperature



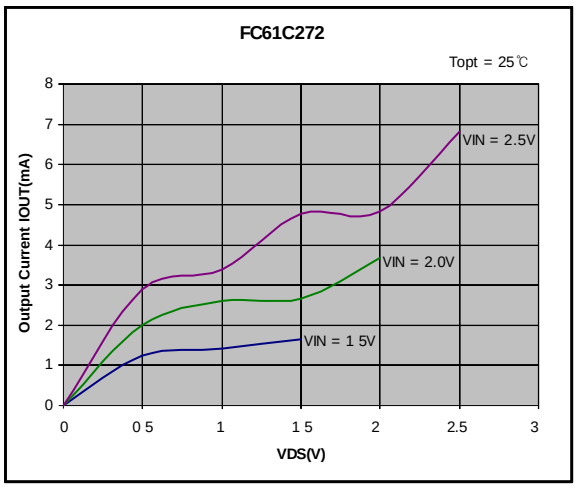


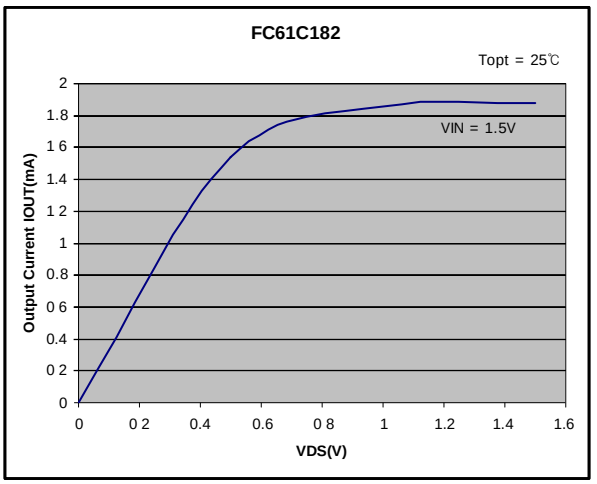
3) Output Voltage vs. Input Voltage



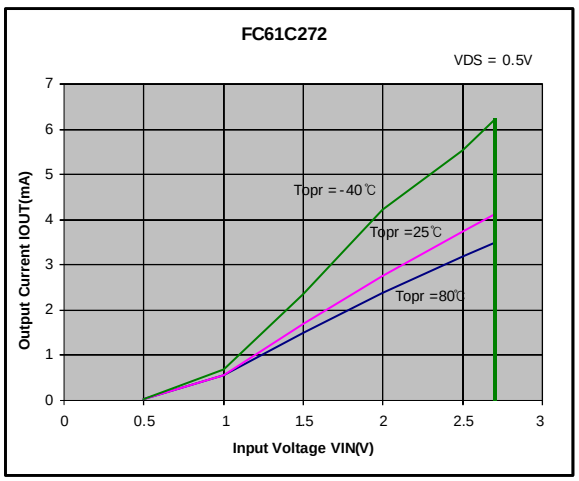


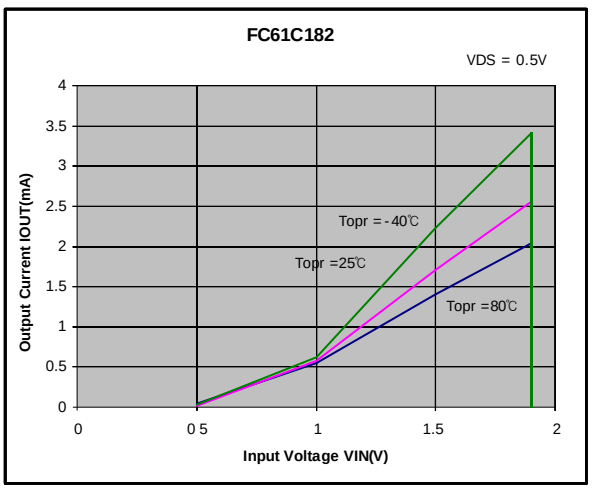
4) N-ch Driver Output Current vs. V_{DS}



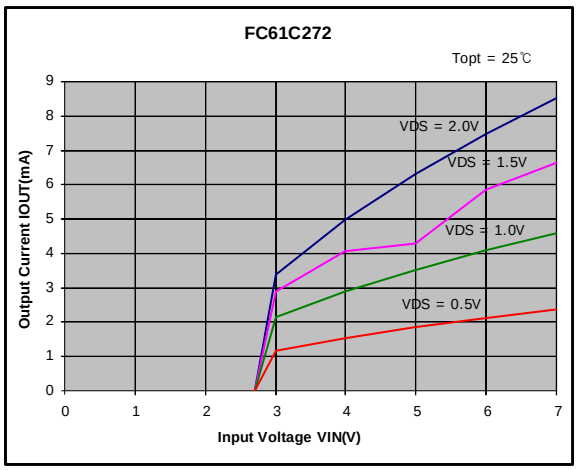


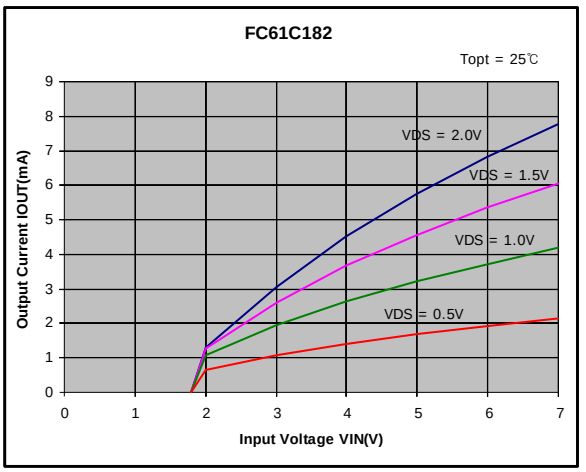
5) N-ch Driver Output Current vs. Input Voltage





6) P-ch Driver Output Current vs. Input Voltage





❖ Ordering Information

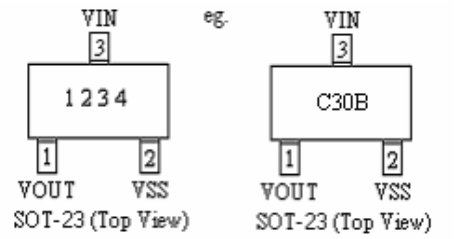
Designator	Description
a	Output Configuration C = CMOS Output N = N-Channel Output
b	Detect Voltage eg. 30=3.0V 50=5.0V
c	Detect Voltage Accuracy 2 = ±2.0% 3 = ±3.0%
d	Package Type M = SOT-23-3 P = SOT-89 T = TO-92
e	Device Orientation R = Embossed Tape (Orientation of Device : Right) L = Embossed Tape (Orientation of Device : Left) B = Bag (TO-92) H = Paper Tape (TO-92)
G	G = Lead Free Part

FC61xxxxxxG
a b c d e

❖ Marking

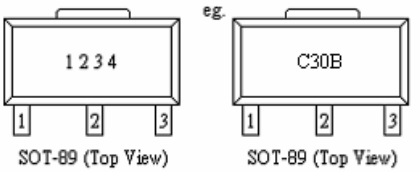
SOT-23-3 :

Designator	Description
1	Type C = Voltage Detector (CMOS Output) N = Voltage Detector (N-channel Output)
2,3	Output Voltage eg. 30 = 3.0V
4	Internal Code



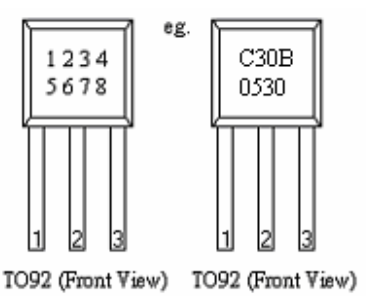
SOT-89-3 :

Designator	Description
1	Type C = Voltage Detector (CMOS Output) N = Voltage Detector (N-channel Output)
2,3	Output Voltage eg. 30 = 3.0V
4	Internal Code



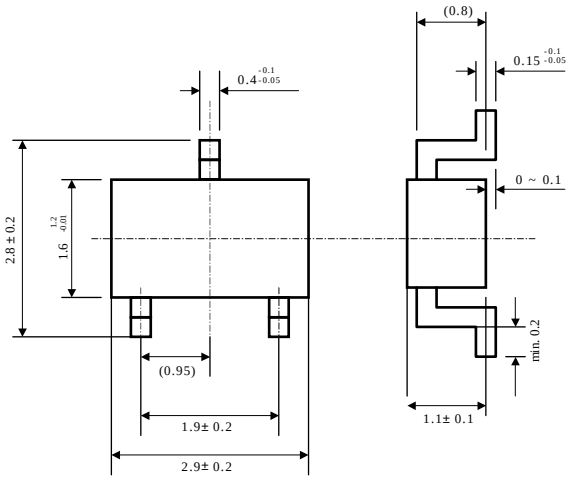
TO-92 :

Designator	Description
1	Type C = Voltage Detector (CMOS Output) N = Voltage Detector (N-channel Output)
2,3	Output Voltage eg. 30 = 3.0V
4	Internal code
5, 6	Year Code eg. 05 = Year 2005
7, 8	Week Code eg. 30 = Week 30

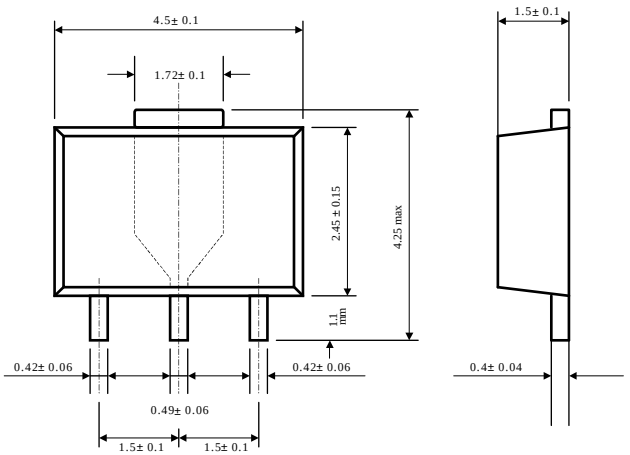


❖ Packaging Information

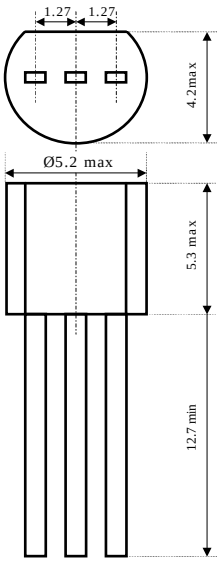
SOT- 23- 3:



SOT- 89- 3 :



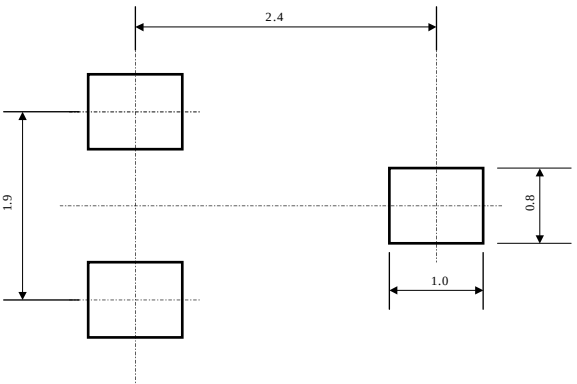
TO- 92 :



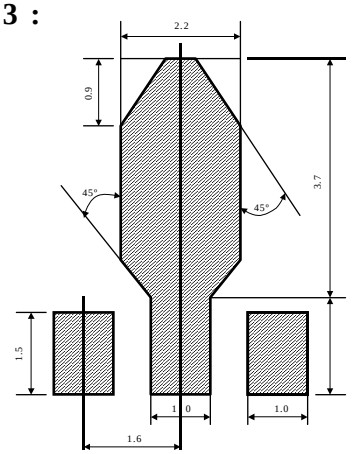
Units : mm

❖ Recommended Pattern Layout

SOT- 23- 3 :

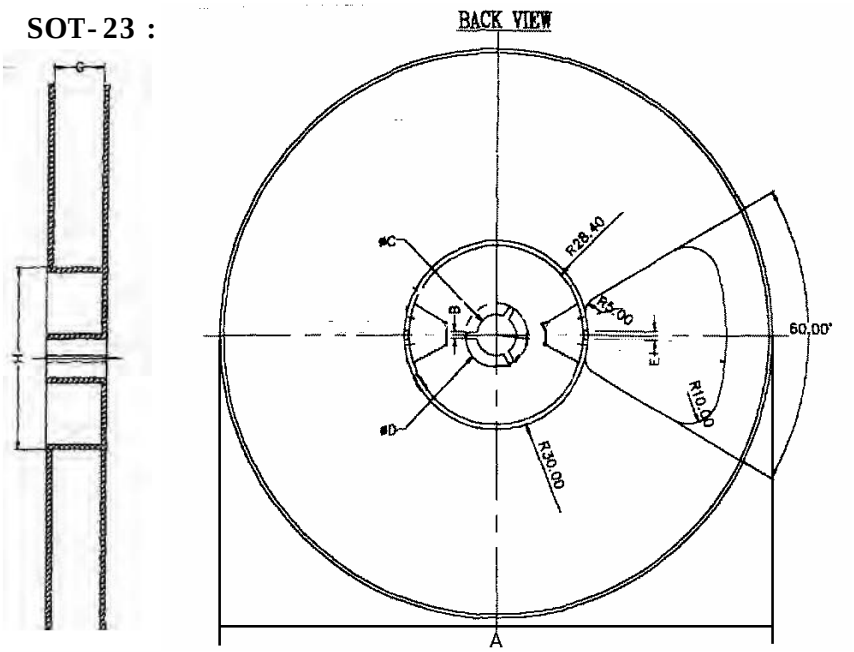


SOT- 89- 3 :



❖ Tape and Reel Information

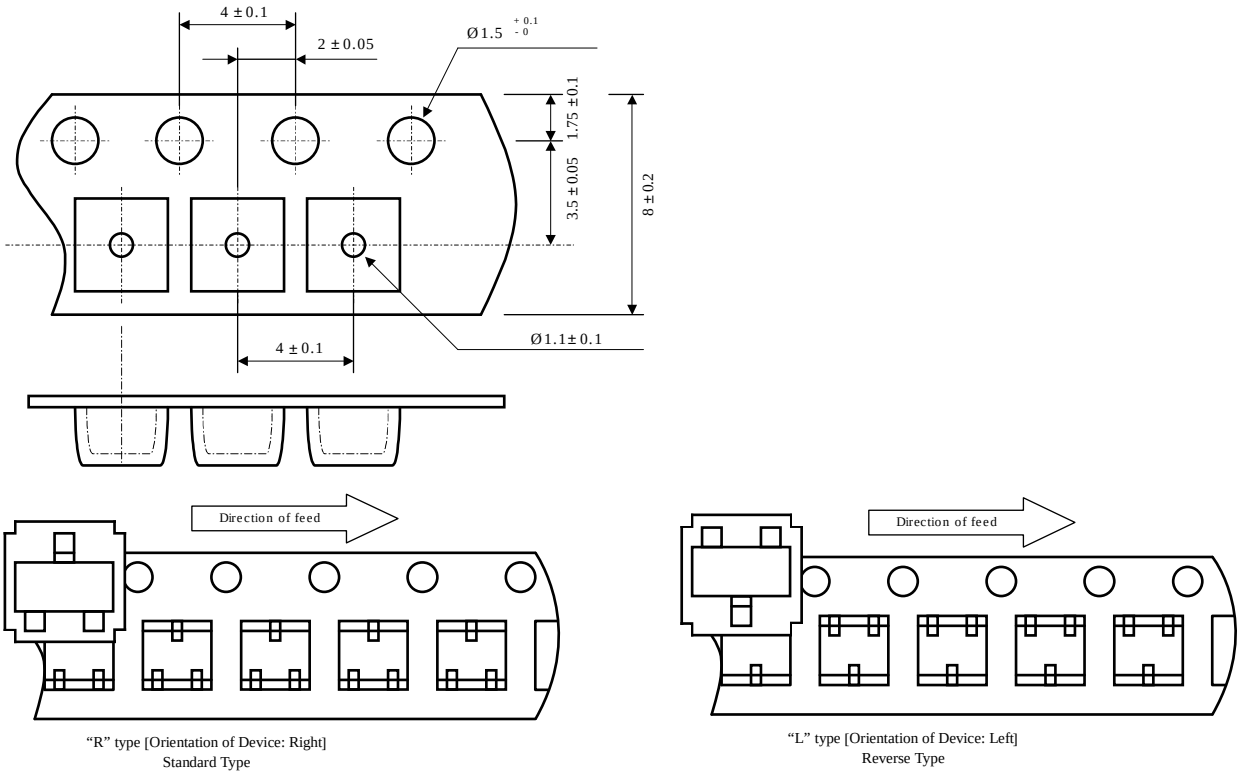
SOT-23 :



	SIZE (mm)
A	Ø178±0.8
B	2 ± 0.2
C	Ø13±0.2
D	Ø21±0.8
G	8 ± 0.5
H	Ø60

3,000 pcs / reel

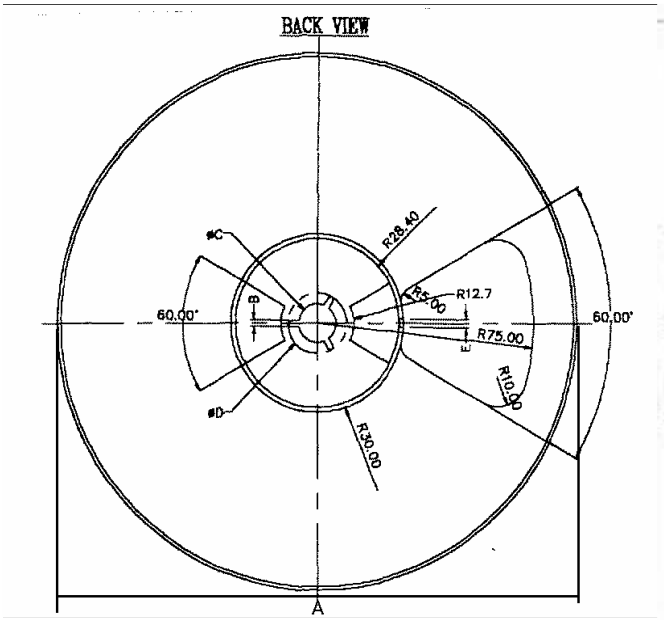
SOT-23 Taping Specifications :



"R" type [Orientation of Device: Right]
Standard Type

"L" type [Orientation of Device: Left]
Reverse Type

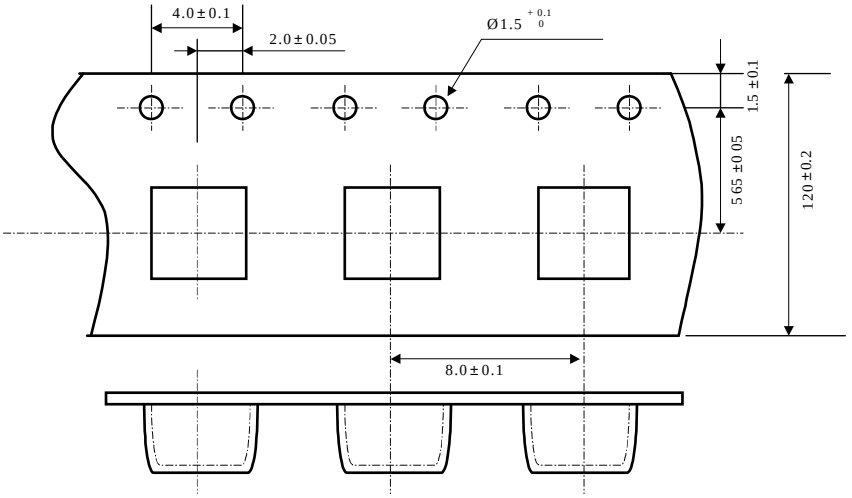
SOT-89 :

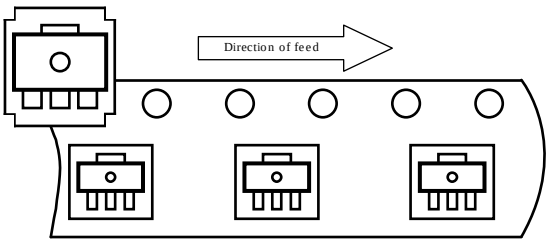


	SIZE (mm)
A	Ø178±0.8
B	2 ±0.2
C	Ø13±0.2
D	Ø21±0.8
G	12±0.5
H	Ø60

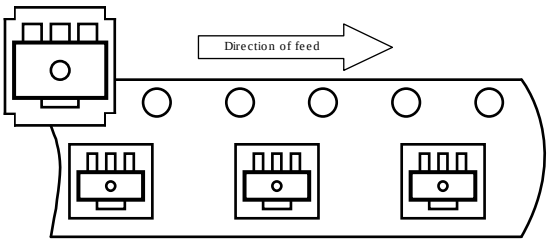
1,000 pcs / reel

SOT-89 Taping Specifications :



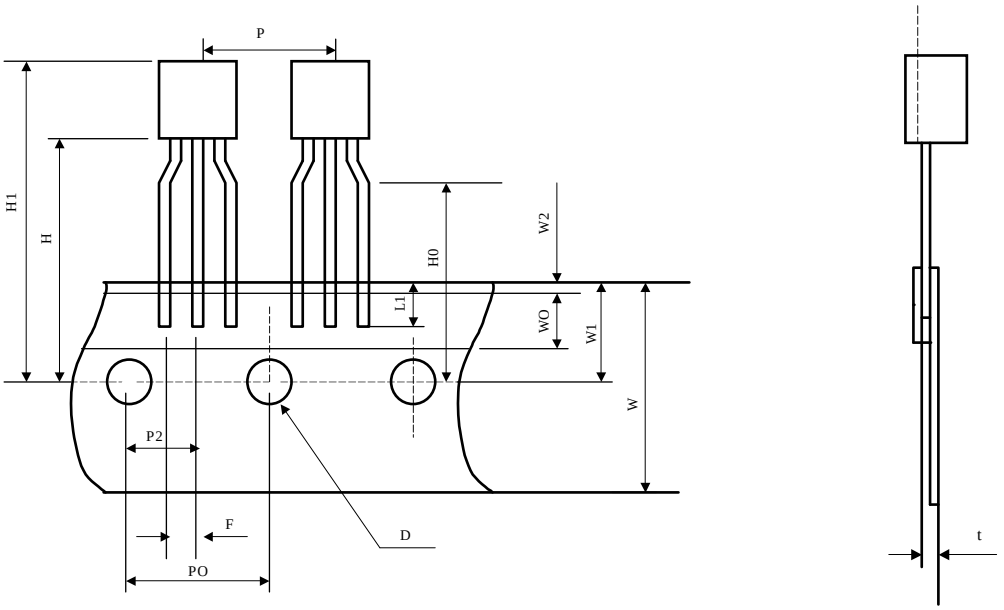


"R" type [Orientation of Device Right]
Standard Type



"L" type [Orientation of Device Left]
Reverse Type

TO-92 Taping Specifications :



	SIZE (mm)
P	12.7± 1.0
PO	12.7± 0.3
P2	6.35± 0.4
F	2.5 + 0.45 - 0.15
W	18.0± 1.0
WO	6.0± 0.3
W1	9.0± 0.5
W2	0.5 MAX
H	19.0± 0.5
H0	16.0± 0.5
H1	32.25 MAX
D	Ø4.0± 0.2
t	0.6± 0.2
L1	3.5 MIN

2,000 pcs / box