

ML61 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 $V_{IN}=2.0V$
- Selectable Detect Voltage : 1.1V to 6.0V in 0.1V increments
- Highly Accurate : Detect Voltage 1.1V to 1.9V $\pm 3\%$
Detect Voltage 2.0V to 6.0V $\pm 2\%$
- Operating Voltage : 0.8V to 10.0V
- Package Available : SOT23 (150mW), SOT89 (500mW) & TO92 (300mW)

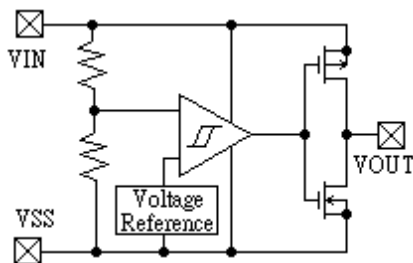
❖ General Description

The ML61 is a group of high-precision and low-power voltage detectors.

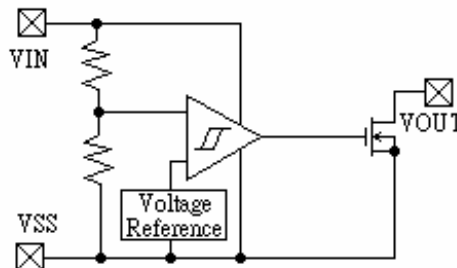
The ML61 consists of a highly-accurate and low-power reference voltage source, a comparator, a hysteresis circuit, and an output driver. Detect voltage is very accurate and stable with N-channel open drain and CMOS, are available.

❖ 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}	$V_{SS}-0.3 \sim V_{IN}+0.3$	V
Continuous Total Power Dissipation	SOT-23	P_d	150	mW
	SOT-89		500	
	TO-92		300	
Operating Ambient Temperature		T_{opr}	-40 ~ +70	°C
Storage Temperature		T_{stg}	-40 ~ +70	°C

❖ Electrical Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Detect Voltage	V_{DF}	$V_{DF} = 1.1V \text{ to } 1.9V$	X0.97	V_{DF}	X1.03	V
		$V_{DF} = 2.0V \text{ to } 6.0V$	X0.98	V_{DF}	X1.02	V
Hysteresis Range	V_{HYS}		X0.02	V_{DF} X0.05	X0.07	V
Supply Current	I_{SS}	$V_{IN} = 1.0V$		0.8	2.0	μA
		$V_{IN} = 2.0V$		1.0	2.5	
		$V_{IN} = 3.0V$		1.3	3.0	
		$V_{IN} = 4.0V$		1.6	3.5	
		$V_{IN} = 5.0V$		2.0	4.0	
Operating Voltage	V_{IN}	$V_{DF} = 1.1 \sim 6.0V$	0.8		10.0	V
Output Current	I_{OUT}	Nch $V_{DS} = 0.5V$				mA
		$V_{IN} = 1.0V$		1.0		
		$V_{IN} = 2.0V$		3.0		
		$V_{IN} = 3.0V$		5.0		
		$V_{IN} = 4.0V$		11.0		
		$V_{IN} = 5.0V$		13.0		
		Pch $V_{DS} = 2.1V$ $V_{IN} = 8.0V$ (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

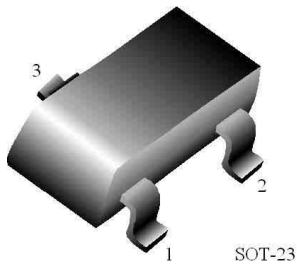
❖ Electrical Characteristics By Detector Threshold

Part Number	Standard Detector Accuracy	Detector Threshold			Hysteresis Range		Supply Current		
		V_{DF} (V)			V_{HYS} (V)		I_{SS} (uA)		
		MIN.	TYP.	MAX.	MIN.	MAX.	Condition	TYP.	MAX.
ML61X113XX	3%	1.067	1.100	1.133	$V_{DF} \times 0.02$	$V_{DF} \times 0.07$	$V_{IN} = 1.0V$	0.8	2.0
ML61X123XX		1.164	1.200	1.236					
ML61X133XX		1.261	1.300	1.339					
ML61X143XX		1.358	1.400	1.442					
ML61X153XX		1.455	1.500	1.545					
ML61X163XX		1.552	1.600	1.648					
ML61X173XX		1.649	1.700	1.751					
ML61X183XX		1.746	1.800	1.854					
ML61X193XX		1.843	1.900	1.957					
ML61X202XX	2%	1.960	2.000	2.040			$V_{IN} = 2.0V$	1.0	2.5
ML61X212XX		2.058	2.100	2.142					
ML61X222XX		2.156	2.200	2.244					
ML61X232XX		2.254	2.300	2.346					
ML61X242XX		2.352	2.400	2.448					
ML61X252XX		2.450	2.500	2.550					
ML61X262XX		2.548	2.600	2.652					
ML61X272XX		2.646	2.700	2.754					
ML61X282XX		2.744	2.800	2.856					
ML61X292XX		2.842	2.900	2.958					
ML61X302XX		2.940	3.000	3.060			$V_{IN} = 3.0V$	1.3	3.0
ML61X312XX		3.038	3.100	3.162					
ML61X322XX		3.136	3.200	3.264					
ML61X332XX		3.234	3.300	3.366					
ML61X342XX		3.332	3.400	3.468					
ML61X352XX		3.430	3.500	3.570					
ML61X362XX		3.528	3.600	3.672					
ML61X372XX		3.626	3.700	3.774					
ML61X382XX		3.724	3.800	3.876					
ML61X392XX		3.822	3.900	3.978					
ML61X402XX		3.920	4.000	4.080			$V_{IN} = 4.0V$	1.6	3.5
ML61X412XX		4.018	4.100	4.182					
ML61X422XX		4.116	4.200	4.284					
ML61X432XX		4.214	4.300	4.386					
ML61X442XX		4.312	4.400	4.488					
ML61X452XX		4.410	4.500	4.590					
ML61X462XX		4.508	4.600	4.692					
ML61X472XX		4.606	4.700	4.794					
ML61X482XX		4.704	4.800	4.896					
ML61X492XX		4.802	4.900	4.998					
ML61X502XX		4.900	5.000	5.100			$V_{IN} = 5.0V$	2.0	4.0
ML61X512XX		4.998	5.100	5.202					
ML61X522XX		5.096	5.200	5.304					
ML61X532XX		5.194	5.300	5.406					
ML61X542XX		5.292	5.400	5.508					
ML61X552XX		5.390	5.500	5.610					
ML61X562XX		5.488	5.600	5.712					
ML61X572XX		5.586	5.700	5.814					
ML61X582XX		5.684	5.800	5.916					
ML61X592XX		5.782	5.900	6.018					
ML61X602XX		5.880	6.000	6.120					

Part Number	Operating Voltage		Pch Output Current		Nch Output Current		Transient Delay Time
	V _{IN} (V)		Pch I _{OUT} (mA)		Nch I _{OUT} (mA)		t _{DLY} (ms)
	MIN.	MAX.	Condition	TYP.	Condition	TYP.	MAX.
ML61X113XX	0.8V	10V	V _{DS} = 2.1V V _{IN} = 8.0V	-10.0	V _{DS} = 0.5V V _{IN} = 1.0V	1.0	0.2
ML61X123XX							
ML61X133XX							
ML61X143XX							
ML61X153XX							
ML61X163XX							
ML61X173XX							
ML61X183XX							
ML61X193XX							
ML61X202XX							
ML61X212XX							
ML61X222XX							
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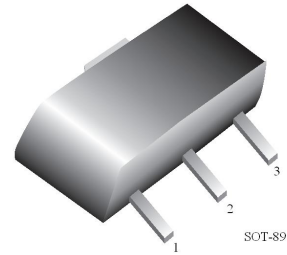
❖ *Pin Configuration*

SOT-23



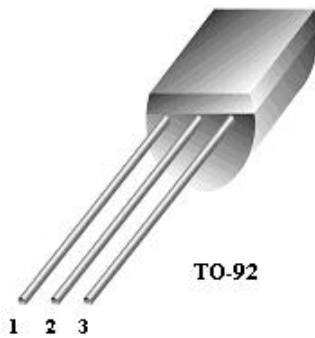
<i>Pin Number</i>	<i>Pin Name</i>	<i>Description</i>
<i>1</i>	<i>VOUT</i>	<i>Supply Voltage Output</i>
<i>2</i>	<i>VSS</i>	<i>Ground</i>
<i>3</i>	<i>VIN</i>	<i>Supply Voltage Input</i>

SOT-89



<i>Pin Number</i>	<i>Pin Name</i>	<i>Description</i>
<i>1</i>	<i>VOUT</i>	<i>Supply Voltage Output</i>
<i>2</i>	<i>VIN</i>	<i>Supply Voltage Input</i>
<i>3</i>	<i>VSS</i>	<i>Ground</i>

TO-92



<i>Pin Number</i>	<i>Pin Name</i>	<i>Description</i>
<i>1</i>	<i>VOUT</i>	<i>Supply Voltage Output</i>
<i>2</i>	<i>VIN</i>	<i>Supply Voltage Input</i>
<i>3</i>	<i>VSS</i>	<i>Ground</i>

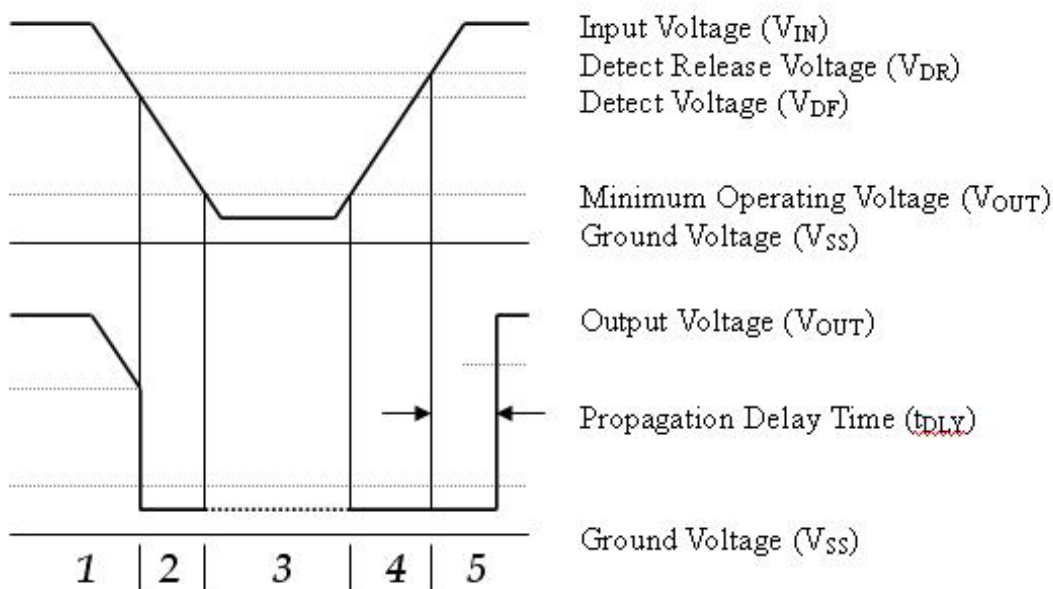
❖ Functional Description (Refers to CMOS Output)

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 :

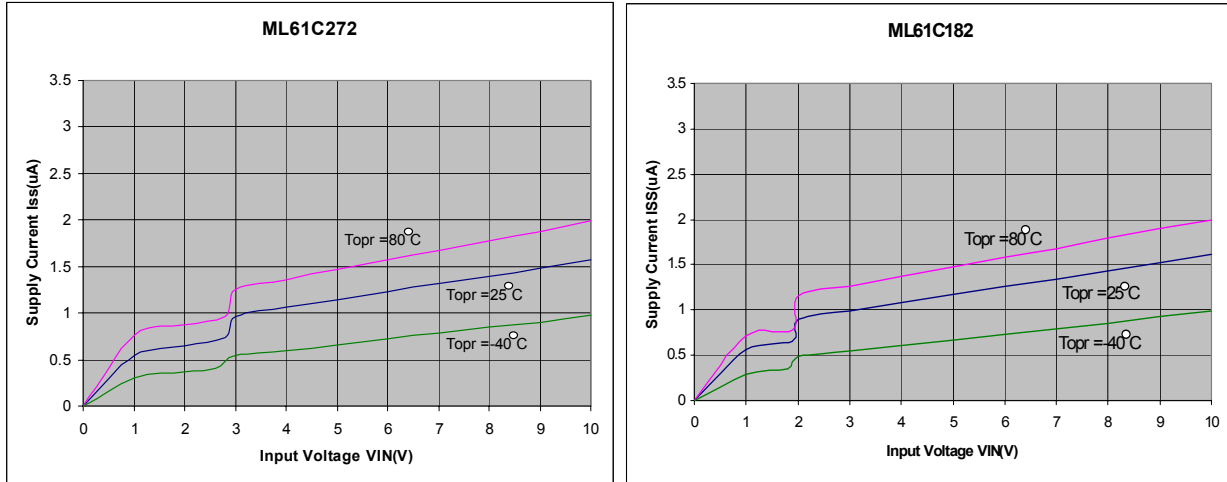
1. The difference between V_{DR} and V_{DF} represents the Hysteresis Range.
2. The Propagation Delay Time (t_{DLY}) represents the time it takes for the Input Voltage (V_{IN}) to appear at the Output pin (V_{OUT}), once the said voltage has exceeded the Release Voltage (V_{DR}) level.

❖ Timing Diagram

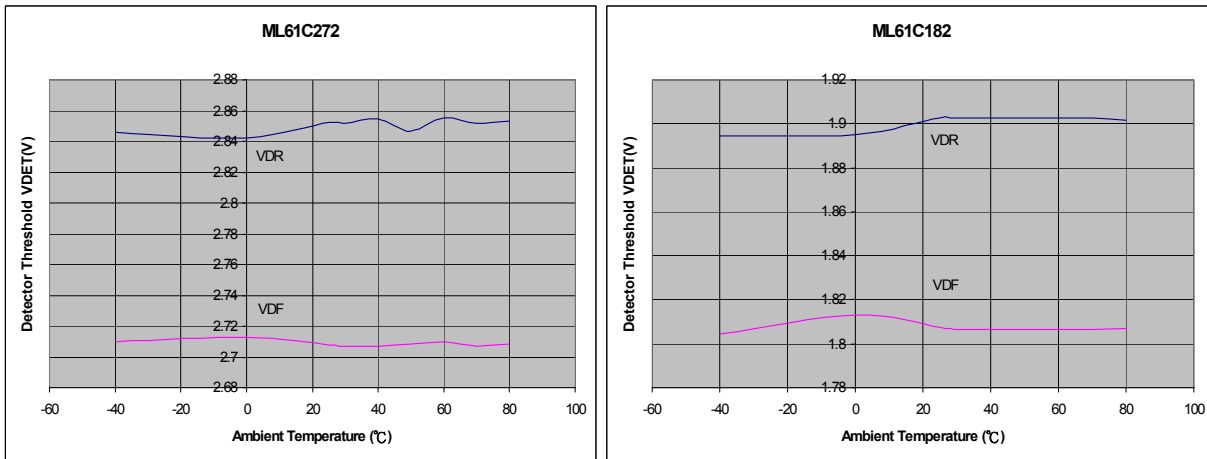


❖ Typical Performance Characteristics

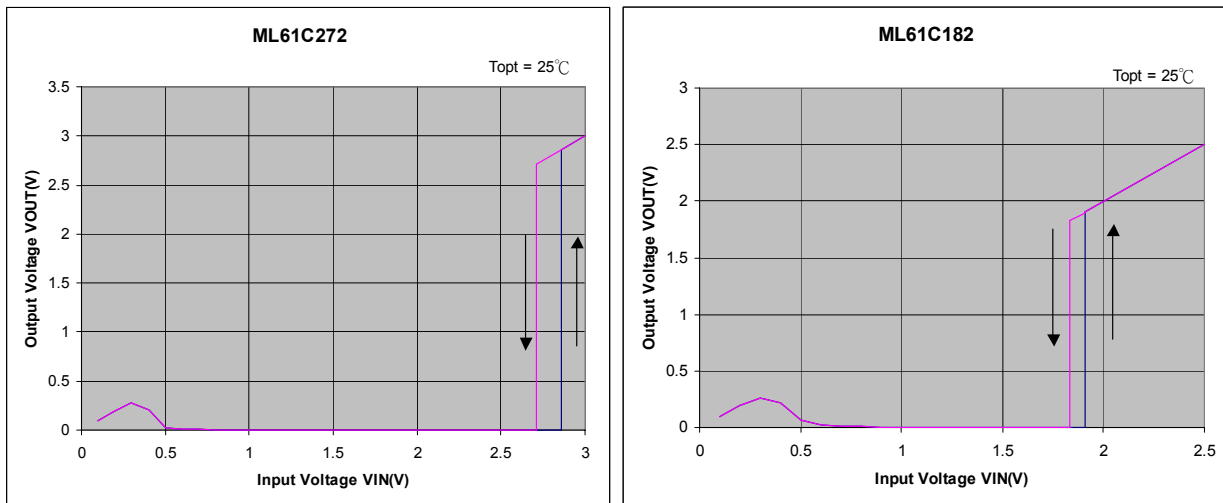
1) Supply Current vs. Input Voltage



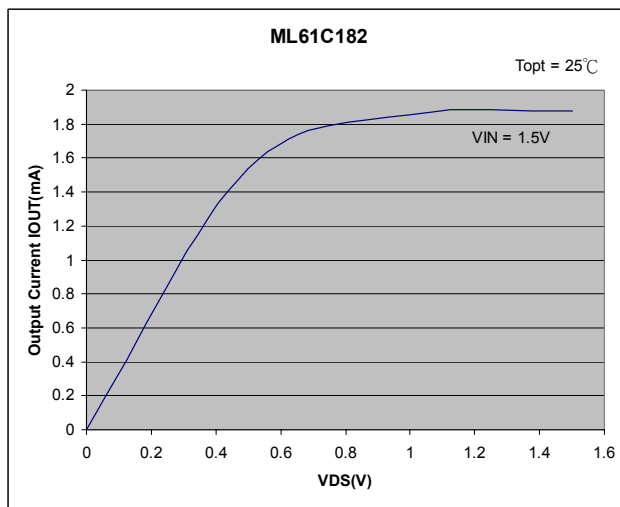
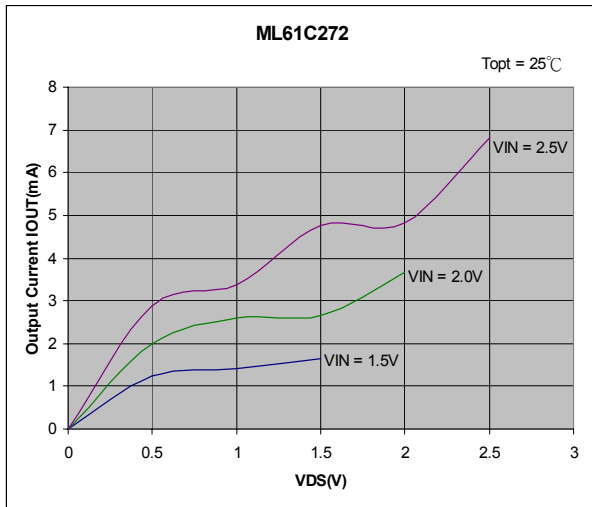
2) Detect, Release Voltage vs. Ambient Temperature



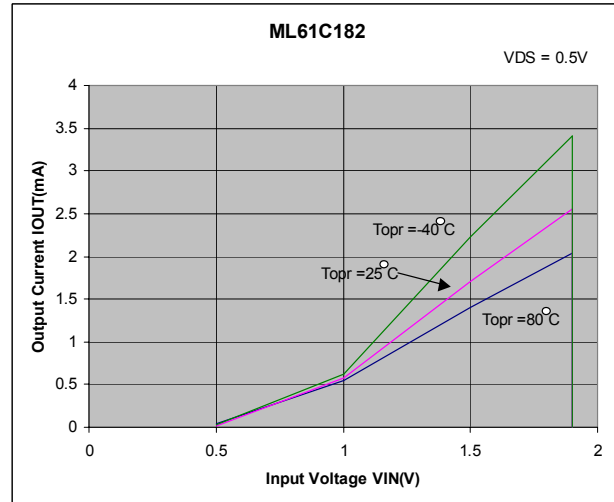
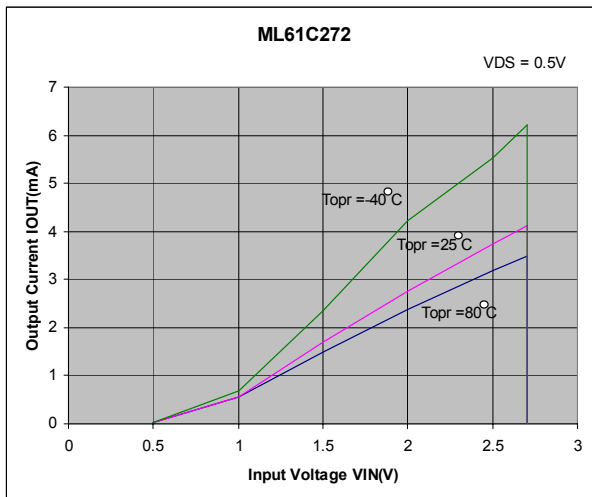
3) Output Voltage vs. Input Voltage



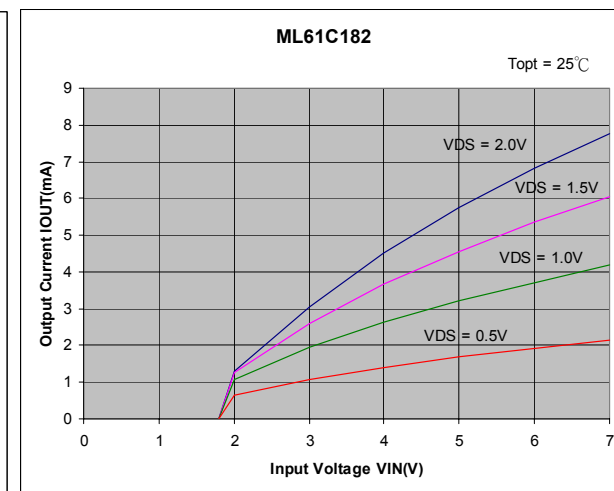
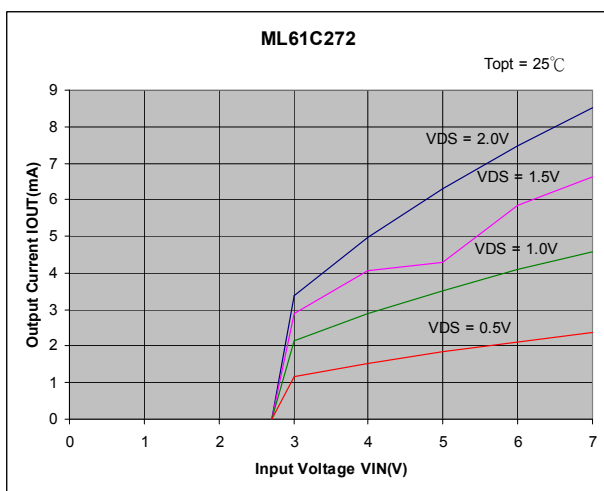
4) N-ch Driver Output Current vs. V_{DS}



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



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



❖ Ordering Information

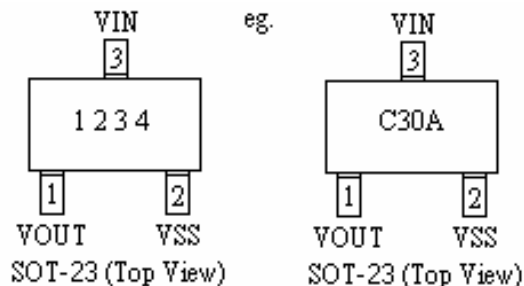
Designator	Description
a	Output Configuration C = CMOS Output N = N-Channel Output
b	Detect Voltage eg. 30=3.0V 50=5.0V
c	Detect Voltage Accuracy 2 = $\pm 2.0\%$ 3 = $\pm 3.0\%$
d	Package Type M = SOT-23 P = SOT-89 T = TO-92
e	Device Orientation R = Embossed Tape (Orientation of Device : Right) L = Embossed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

ML61xxxxxx
↑ ↑ ↑ ↑ ↑
a b c d e

❖ Marking

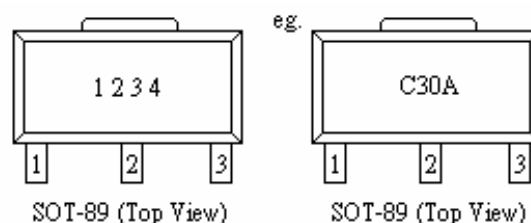
SOT-23 :

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



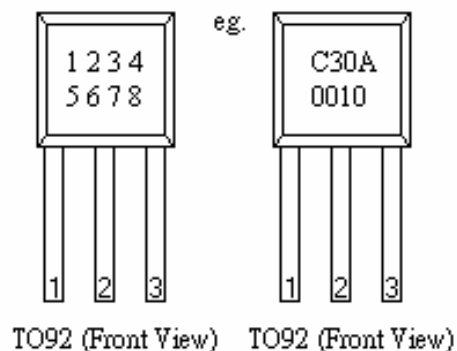
SOT-89 :

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

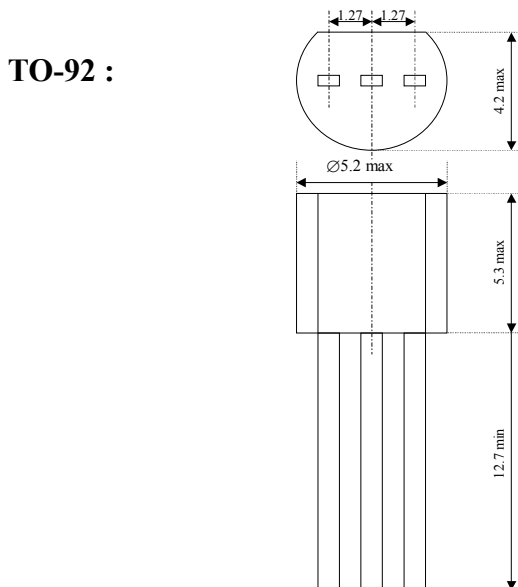
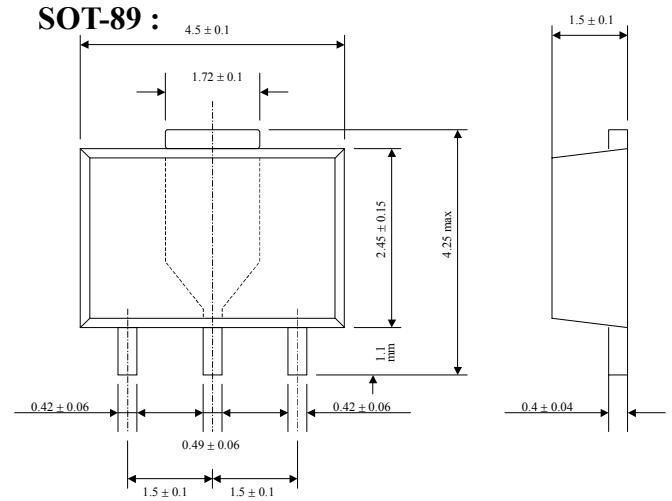
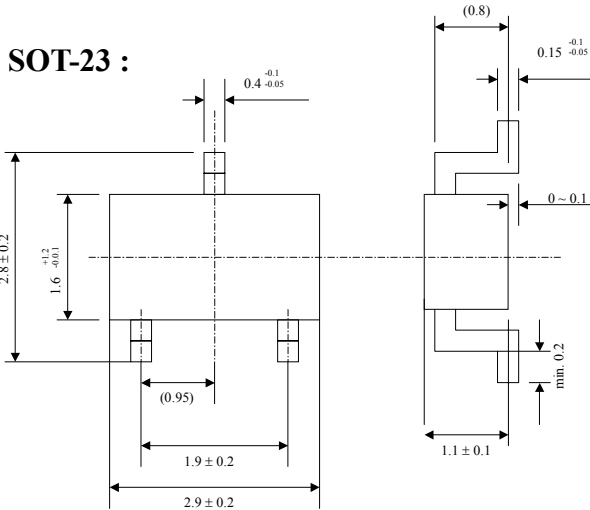


TO-92 :

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. 00 = Year 2000
7, 8	Week Code eg. 10 = Week 10



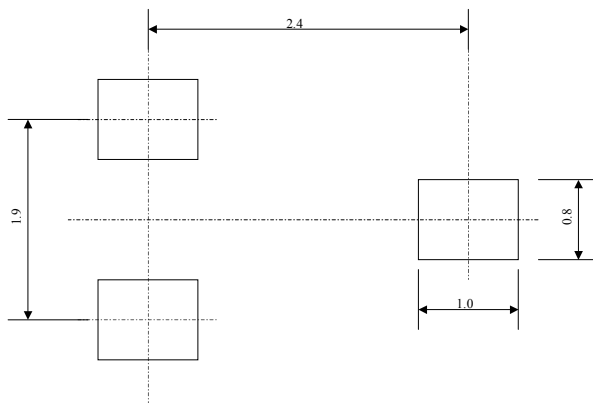
❖ Packaging Information



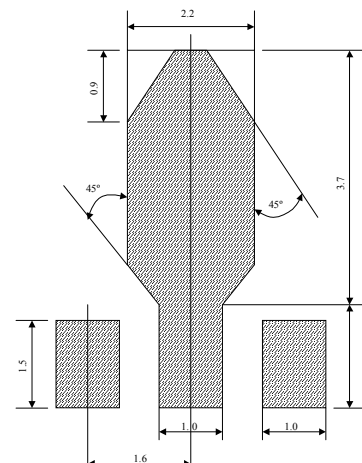
Units : mm

❖ Recommended Pattern Layout

SOT-23 :

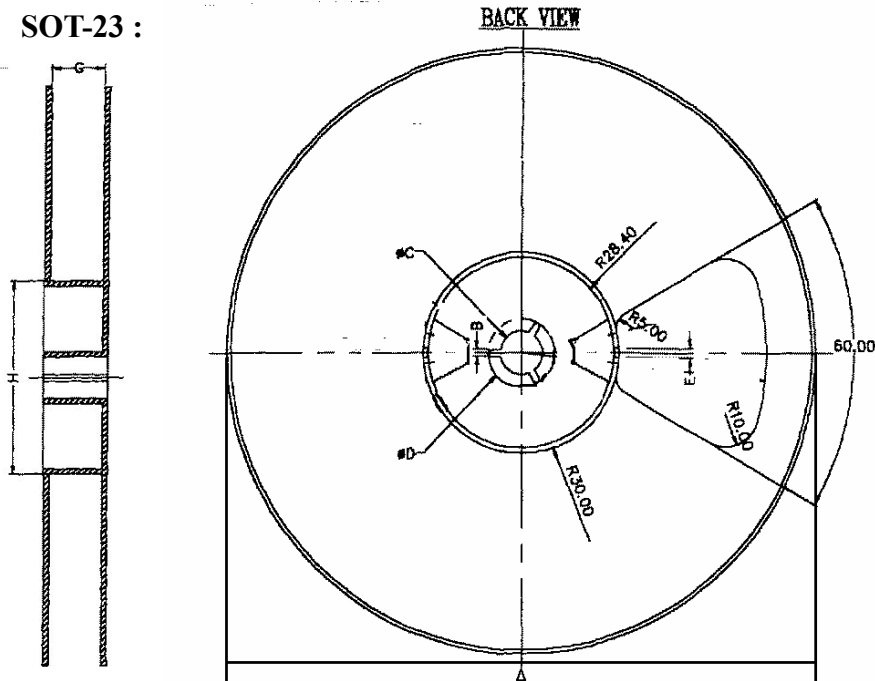


SOT-89



❖ Tape and Reel Information

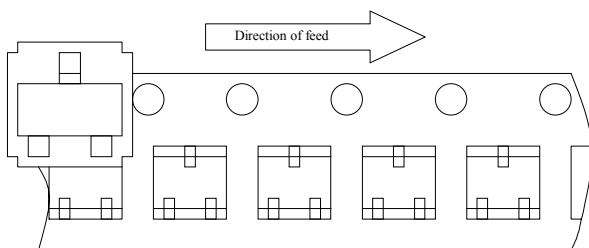
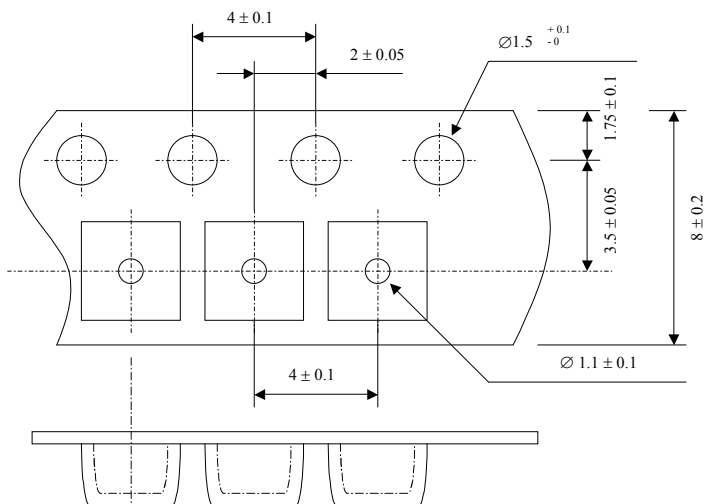
SOT-23 :



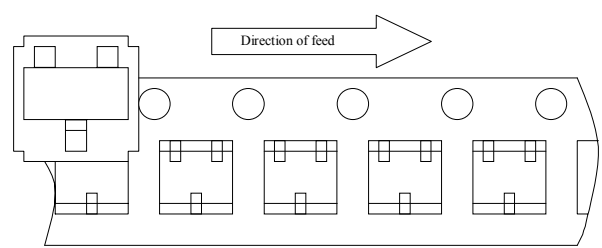
	SIZE (mm)
A	$\varnothing 178 \pm 0.8$
B	2 ± 0.2
C	$\varnothing 13 \pm 0.2$
D	$\varnothing 21 \pm 0.8$
G	8 ± 0.5
H	$\varnothing 60$

3,000 pcs / reel

SOT-23 Taping Specifications :

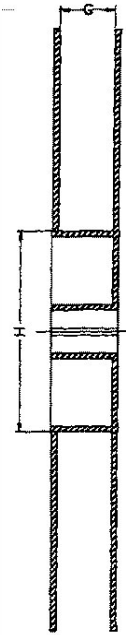
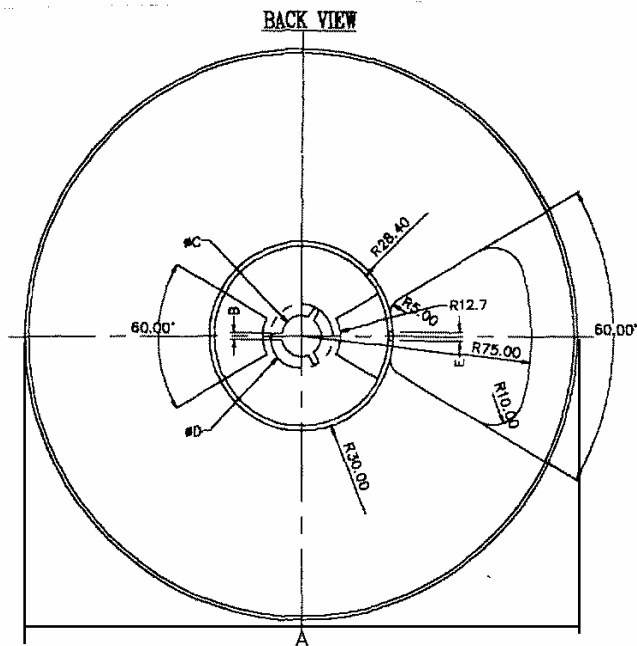


"R" type [Orientation of Device: Right]
Standard Type



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

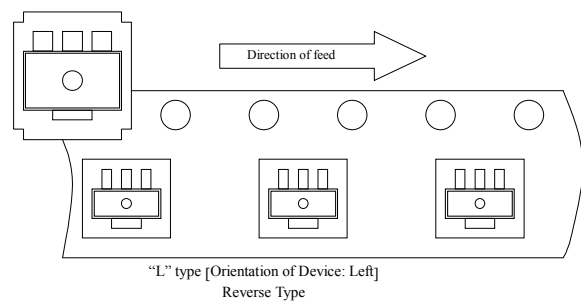
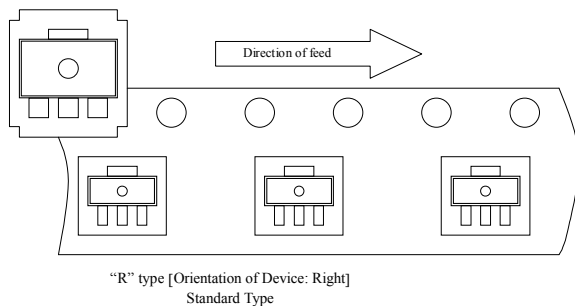
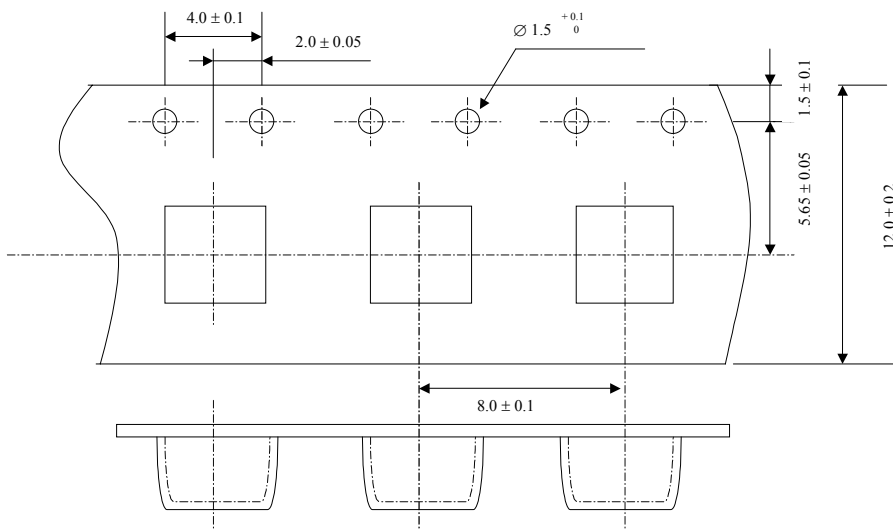
SOT-89 :



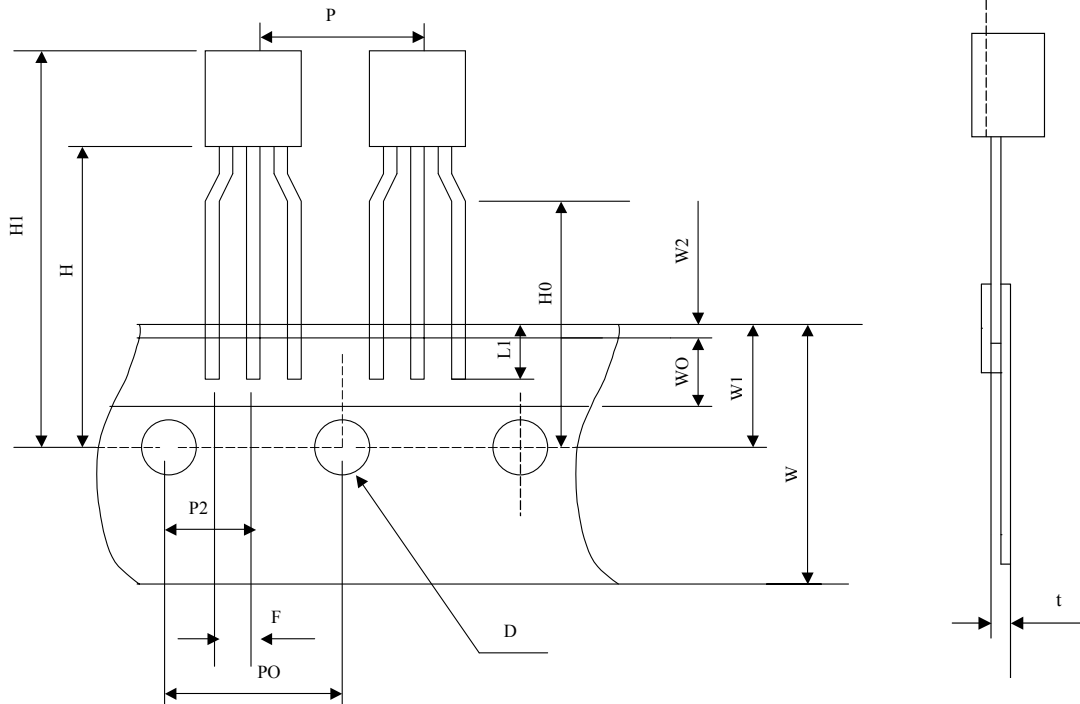
	SIZE (mm)
A	$\varnothing 178 \pm 0.8$
B	2 ± 0.2
C	$\varnothing 13 \pm 0.2$
D	$\varnothing 21 \pm 0.8$
G	12 ± 0.5
H	$\varnothing 60$

1,000 pcs / reel

SOT-89 Taping Specifications :



TO-92 Taping Specifications :



2,000 pcs / box

	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
W0	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	$\varnothing 4.0 \pm 0.2$
t	0.6 ± 0.2
L1	3.5 MIN

❖ *History of Revision*

REV	DESCRIPTION	DATE
	First Official Specification	20/3/02
A	Modify Max. Output Current & Add Table of Electrical characteristics by Detector Threshold.	3/4/02
B	Maximum Input Voltage increased to 12V, Hysteresis Range modified to 2% to 7% & Typical Performance Characteristics	31/10/02
C	Absolute Maximum Input Rating of Input Voltage reduced from 12V to 10V.	3/9/04

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