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*

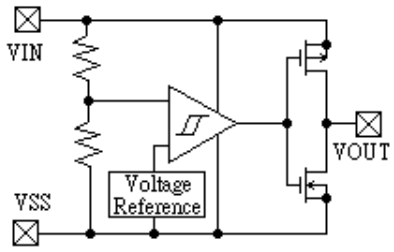
- CMOS Low Power Consumption : Typical 1.0uA at Vin=2.0V
- Selectable Detect Voltage : 1.1V to 7.0V in 0.1V increments
- Highly Accurate : Detect Voltage 1.1V to 1.9V ±3%
  Detect Voltage 2.0V to 7.0V ±2%
- Operating Voltage : 0.8V to 10.0V
- Package Available : SOT23 (150mW), SOT89 (500mW) & TO92 (300mW)

❖ *General Description*

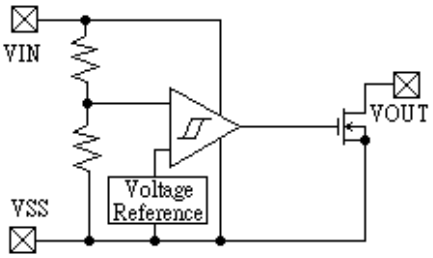
The ML61 is a group of high-precision and low-power voltage detectors.
The ML61 consists of a highly-accurate and low-power reference voltage source, a comparator, a hysteresis circuit, and an output driver. Detect voltage is very accurate and stable with N-channel open drain and CMOS, are available.

❖ *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 ~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 to 1.9V	X*0.97*	V_{DF}	X*1.03*	*V*
		V_{DF} = 2.0V to 7.0V	X*0.98*	V_{DF}	X*1.02*	*V*
Hysteresis Range	V_{HYS}	V_{DF} = 1.1V to 2.9V	X*0.04*	V_{DF} X*0.05*	X*0.06*	*V*
		V_{DF} = 3.0V to 7.0V	X*0.015*	V_{DF} X*0.025*	X*0.035*	*V*
Supply Current	I_{SS}	V_{IN} = *1.0V*		*0.8*	*2.0*	*uA*
		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} = *1.1~7.0V*	*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		*-10.0*		
		(CMOS Output)				
Transient Delay Time (V_{DR} -> V_{OUT} *Inversion)*	t_{DLY}	*While V_{IN} changes from 0.6V to 10V*			*0.2*	*ms*

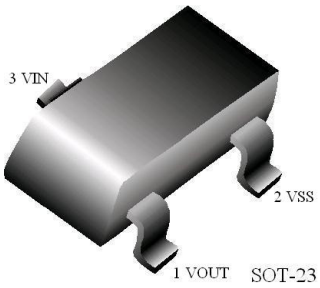
❖ *Electrical Characteristics By Detector Threshold*

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.
ML61X113XX	3%	1.067	1.100	1.133	V_{DF} x 0.04	V_{DF} x 0.06	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_{DF} x 0.015	V_{DF} x 0.035	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					
ML61X702XX		6.860	7.000	7.210			V_{IN} = 6.0V	2.4	4.5

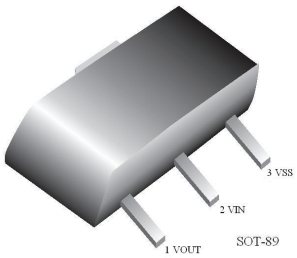
Part Number	Operating Voltage		Pch Output Current		Nch Output Current		Transient Delay Time
	V_{IN} (V)		Pch I_{OUT} (mA)		Nch I_{OUT} (mA)		t_{DLY} (ms)
	MIN.	MAX.	Condition	TYP.	Condition	TYP.	MAX.
ML61X113XX	0.8V	10V	V_{DS} = 2.1V V_{IN} = 8.0V	-10.0	V_{DS} = 0.5V V_{IN} = 1.0V	1.0	0.2
ML61X123XX							
ML61X133XX							
ML61X143XX							
ML61X153XX							
ML61X163XX							
ML61X173XX							
ML61X183XX							
ML61X193XX							
ML61X202XX							
ML61X212XX					V_{DS} = 0.5V V_{IN} = 2.0V	3.0	
ML61X222XX							
ML61X232XX							
ML61X242XX							
ML61X252XX							
ML61X262XX							
ML61X272XX							
ML61X282XX							
ML61X292XX							
ML61X302XX							
ML61X312XX					V_{DS} = 0.5V V_{IN} = 3.0V	5.0	
ML61X322XX							
ML61X332XX							
ML61X342XX							
ML61X352XX							
ML61X362XX							
ML61X372XX							
ML61X382XX							
ML61X392XX							
ML61X402XX							
ML61X412XX					V_{DS} = 0.5V V_{IN} = 4.0V	11.0	
ML61X422XX							
ML61X432XX							
ML61X442XX							
ML61X452XX							
ML61X462XX							
ML61X472XX							
ML61X482XX							
ML61X492XX							
ML61X502XX							
ML61X512XX					V_{DS} = 0.5V V_{IN} = 5.0V	13.0	
ML61X522XX							
ML61X532XX							
ML61X542XX							
ML61X552XX							
ML61X562XX							
ML61X572XX							
ML61X582XX							
ML61X592XX							
ML61X602XX							
ML61X702XX							

❖ *Pin Configuration*

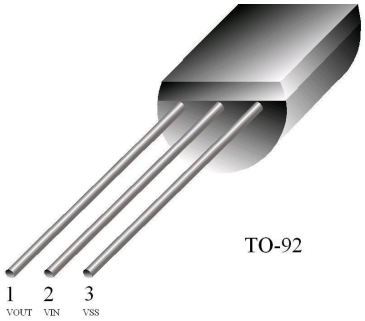
SOT-23-3



SOT-89-3

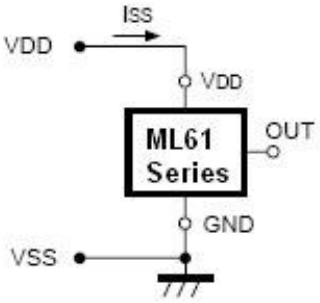


TO-92

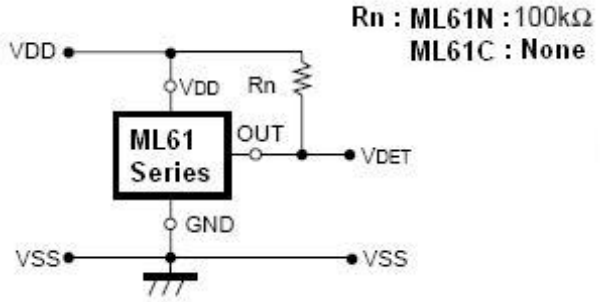


Package Pin Number			Pin Name	Function
SOT-23-3	SOT-89-3	TO-92		
1	1	1	VOUT	Supply Voltage Output
3	2	2	VIN	Supply Voltage Input
2	3	3	VSS	Ground

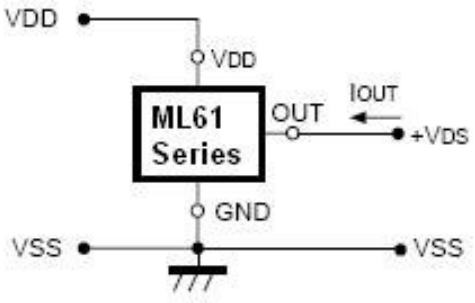
❖ *Test Circuits*



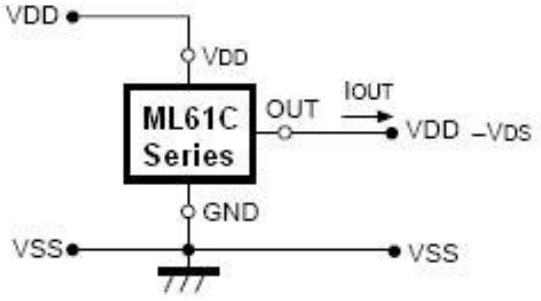
Supply Current Test Circuit



Detector Threshold Test Circuit



Nch Driver Output Current Test Circuit



Pch Driver Output Current Test Circuit

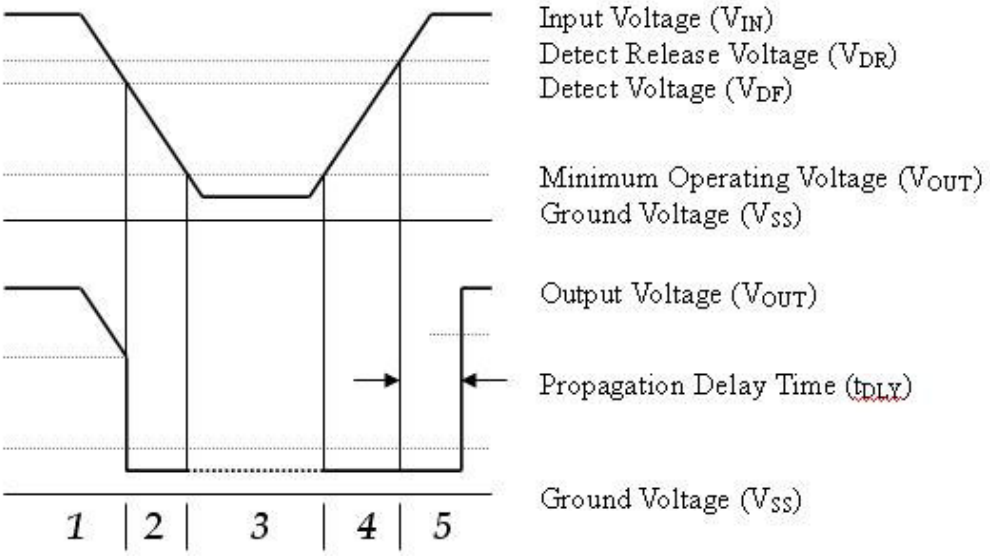
❖ *Functional Description (Refers to CMOS Output)*

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 :

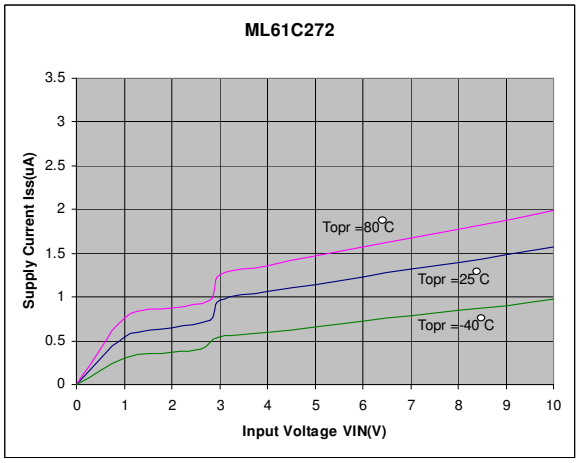
1. **The difference between V_{DR} and V_{DF} represents the Hysteresis Range.**
2. **The Propagation Delay Time (t_{DLY}) represents the time it takes for the Input Voltage (V_{IN}) to appear at the Output pin (V_{OUT}), once the said voltage has exceeded the Release Voltage (V_{DR}) level.**

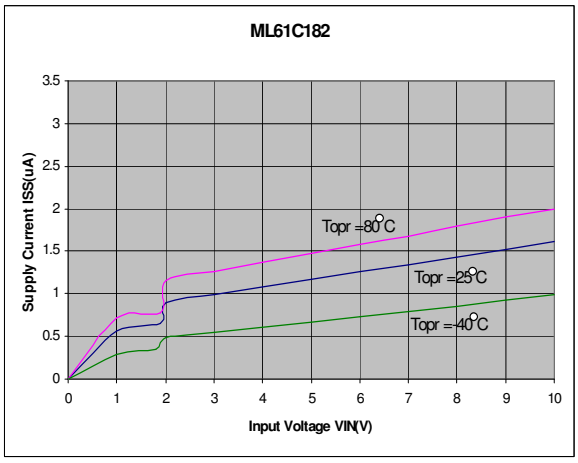
❖ *Timing Diagram*



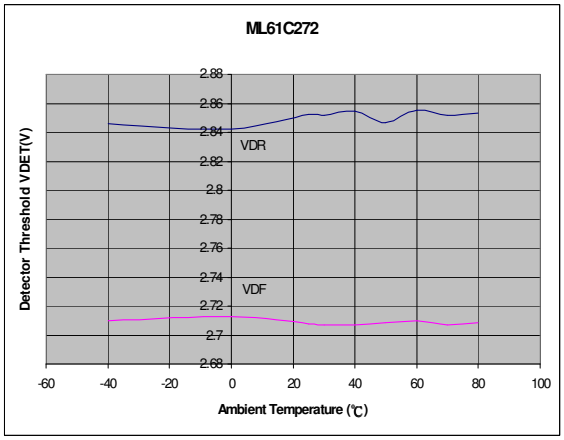
❖ *Typical Performance Characteristics*

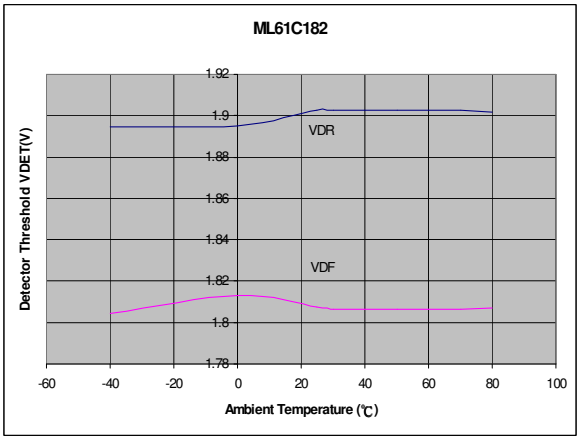
1) Supply Current vs. Input Voltage



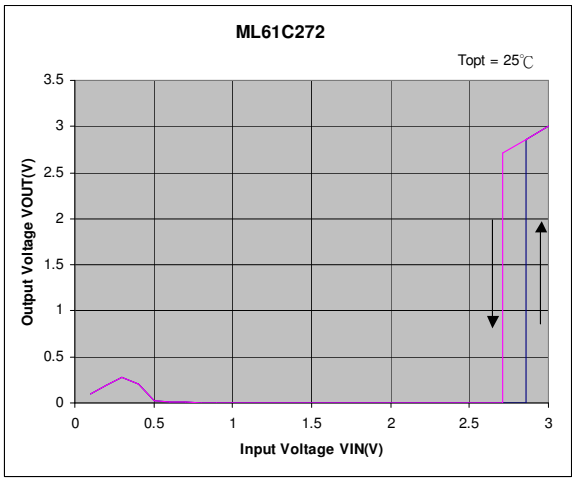


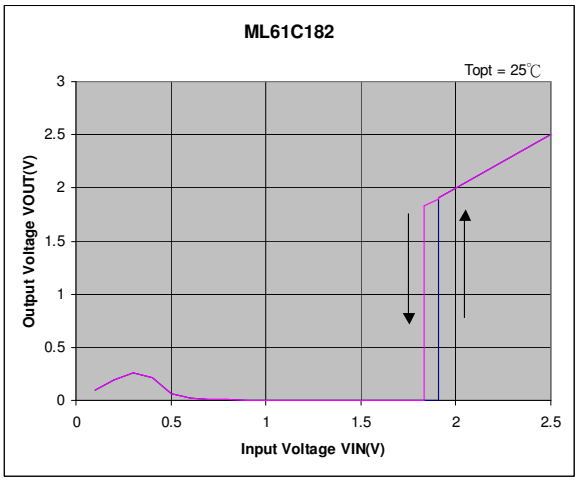
2) Detect, Release Voltage vs. Ambient Temperature



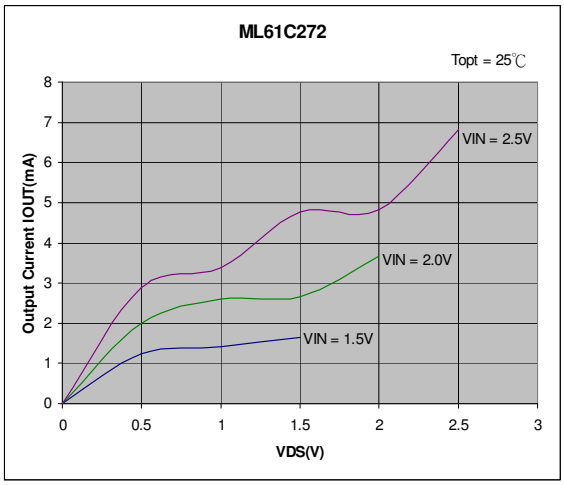


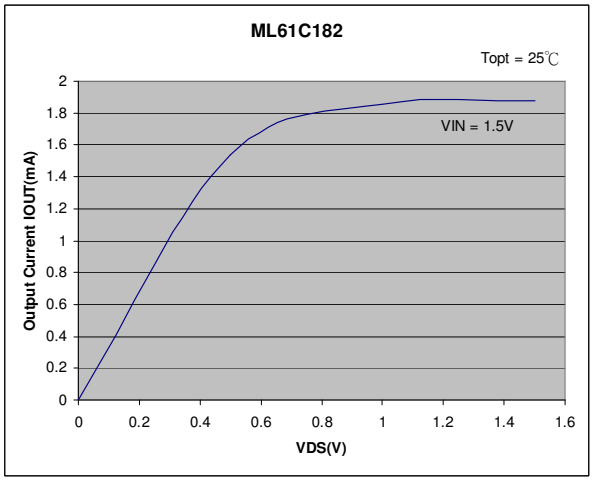
3) Output Voltage vs. Input Voltage



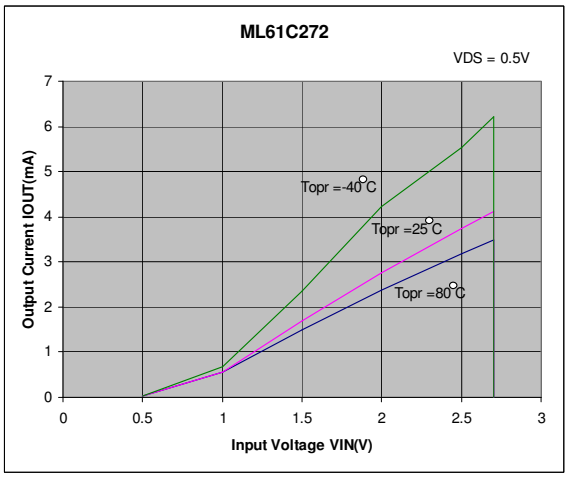


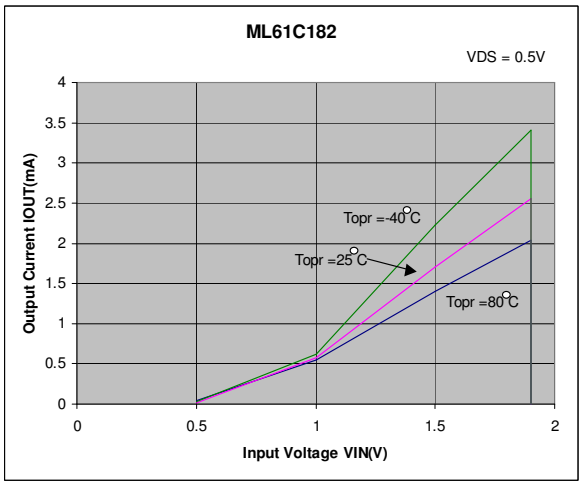
4) N-ch Driver Output Current vs. V_{DS}



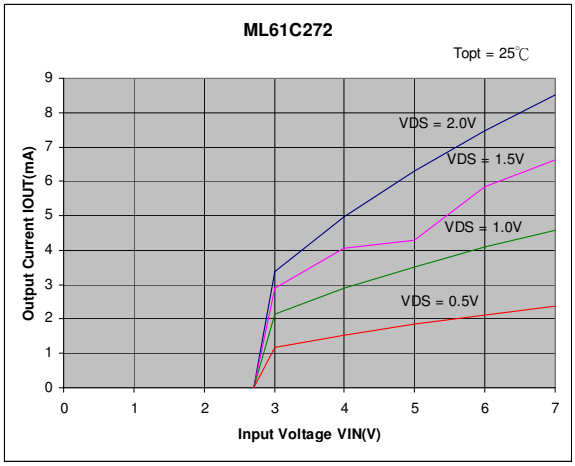


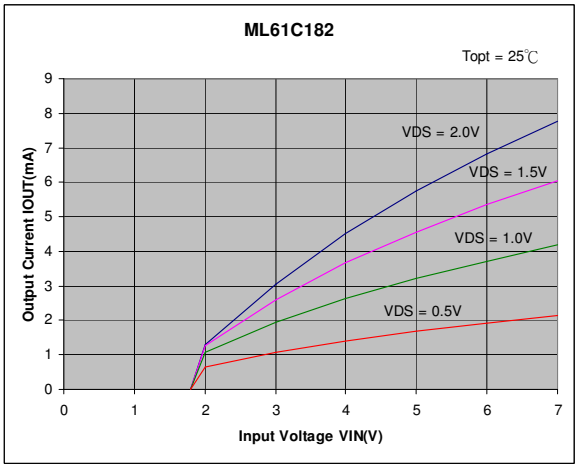
5) N-ch Driver Output Current vs. Input Voltage





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 = ±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)
f	G = ROHS Part GG = Green Part

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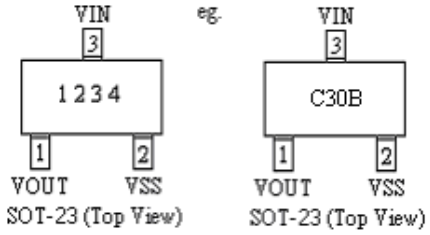
❖ *Marking*

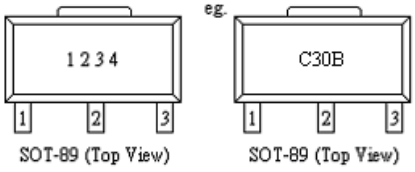
SOT-23-3 :

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**



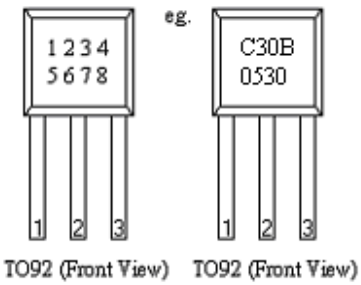
SOT-89-3 :

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**



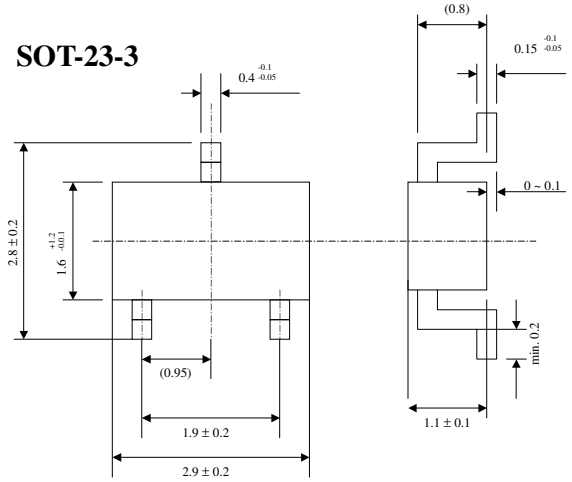
TO-92 :

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

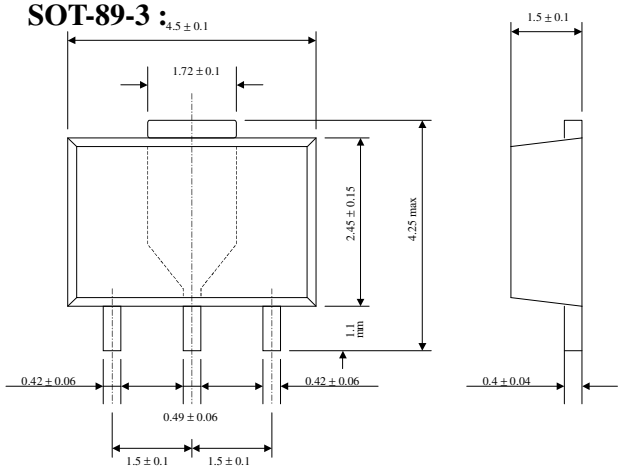


❖ *Packaging Information*

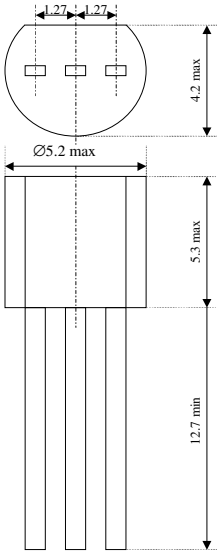
SOT-23-3



SOT-89-3 :



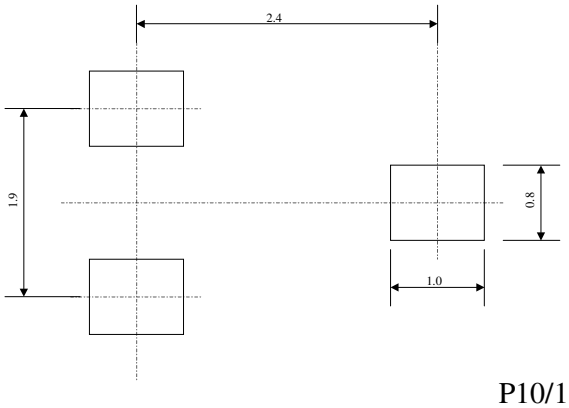
TO-92 :



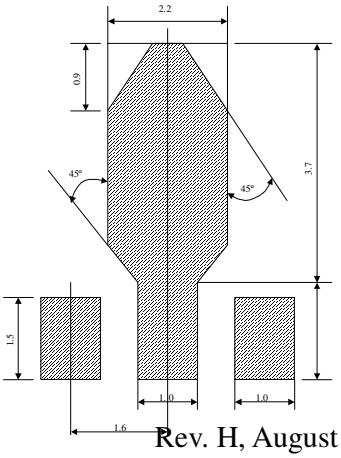
Units : mm

❖ *Recommended Pattern Layout*

SOT-23-3 :

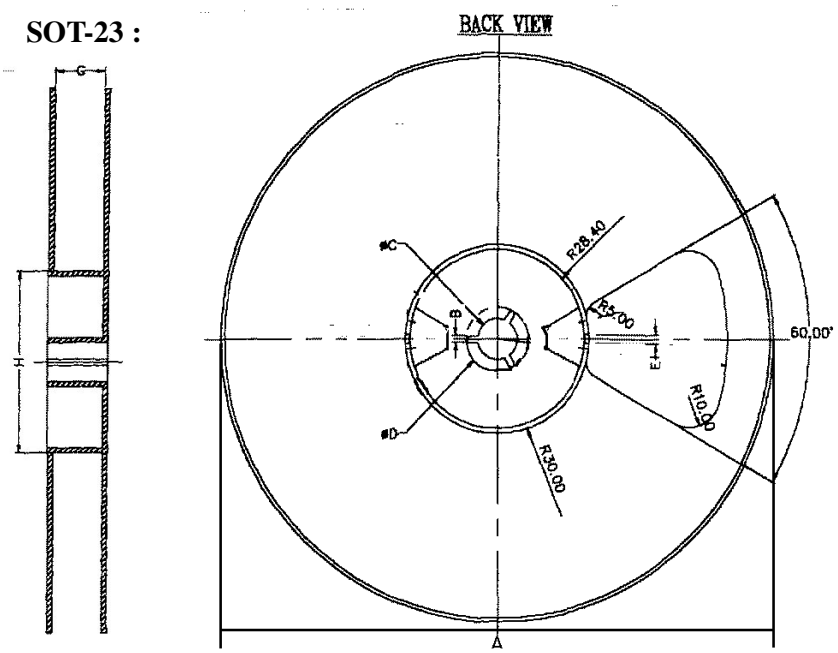


SOT-89-3 :



❖ *Tape and Reel Information*

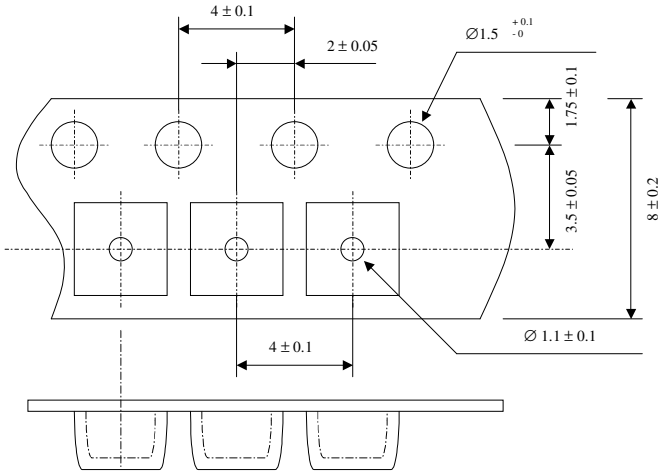
SOT-23 :

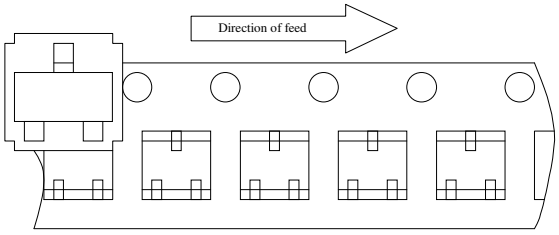


	SIZE (mm)
A	∅ 178 ± 0.8
B	2 ± 0.2
C	∅ 13 ± 0.2
D	∅ 21 ± 0.8
G	8 ± 0.5
H	∅ 60

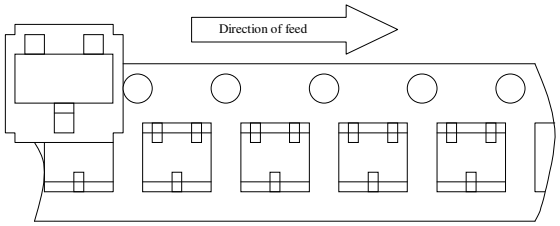
3,000 pcs / reel

SOT-23 Taping Specifications :



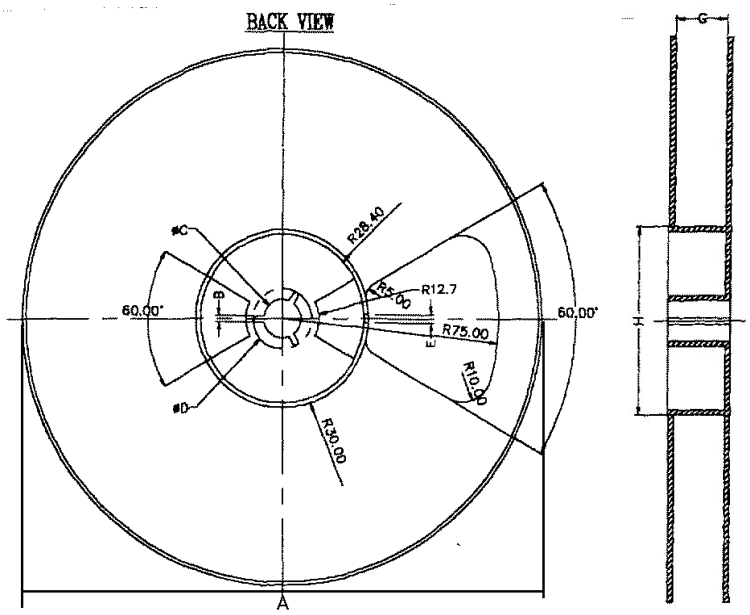


"R" type [Orientation of Device: Right]
Standard Type



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

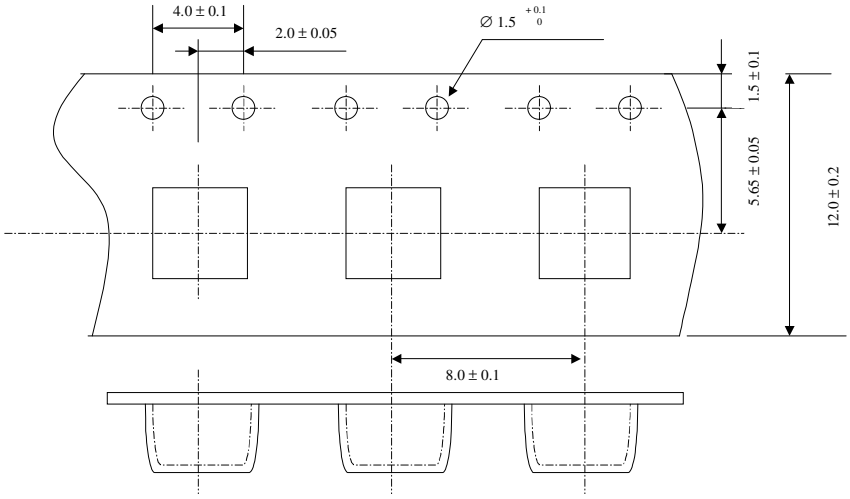
SOT-89 :

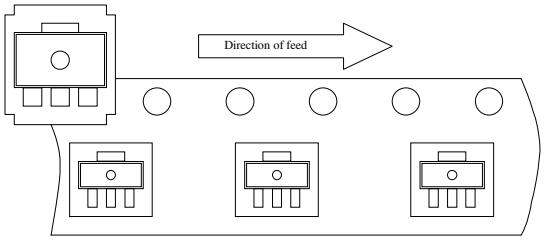


	SIZE (mm)
A	∅ 178 ± 0.8
B	2 ± 0.2
C	∅ 13 ± 0.2
D	∅ 21 ± 0.8
G	12 ± 0.5
H	∅ 60

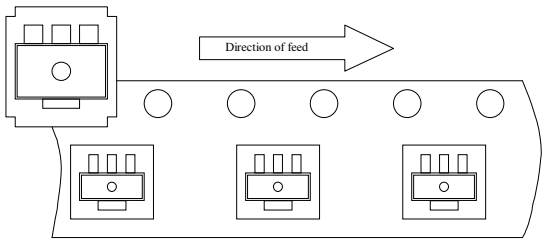
1,000 pcs / reel

SOT-89 Taping Specifications :



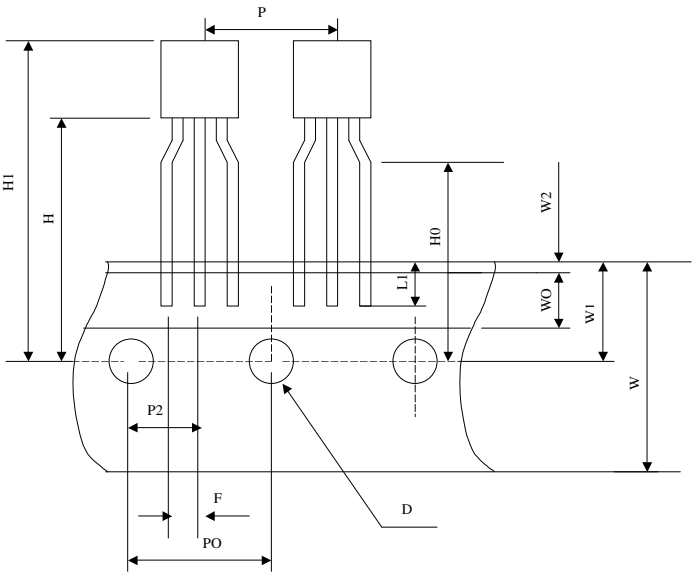


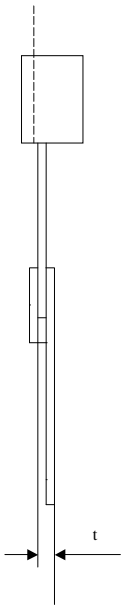
"R" type [Orientation of Device: Right]
Standard Type



"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	∅ 4.0 ± 0.2
t	0.6 ± 0.2
L1	3.5 MIN

2,000 pcs / box