High-precision Low Voltage Detector

LR6301

LR6301 is a series of high precision voltage detector with ultra low current consumption (500nA typ. at Vdd=3.0V). It can work at very low voltage, which makes it perfect for system reset.

LR6301 is composed of high precision voltage reference, comparator, output driver and resistor array. Internally preset detect voltage has a low temperature drift and requires no external trimming.

Two type of output, CMOS and N-channel open-drain are available.

LR6301 is available in SOT-89-3,SOT-23-3 TO92, SOT23-5 packages which is Pb free.

Features:

- High-precision detection Voltage: ±2%
- Detection Voltage: 0.9V~6.0V (in 0.1V steps)
- Precise hysteresis: 4% typ.
- Operating Voltage range: 0.7V~10V
- Ultra-low current consumption: 500nA typ. (at V_{DD}=3.0V)
- Two Output forms : CMOS and N-channel open-drain
- Externally Programmable Time Delay Generator
- We declare that the material of product compliance with RoHS requirements.

Selection Guide:

LR6301-XX X XX

Package Type:
RM: SOT-23-3
RN: SOT-23-5
SM: SOT-89-3
T: TO-92
(Default、Pb Free)

Output Type:
N: Nch Open-drain
C: CMOS

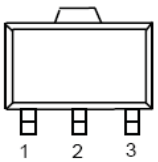
Detector Voltage:
09 0.9V
30 3.0V
50 5.0V
60 6.0V

Application:

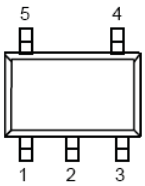
- Power monitor for portable equipment such as PDA,DSC,Mobile phone,Notebook,MP3
- CPU and Logic Circuit Reset
- Battery Checker
- Battery Back-up Circuit
- Power Failure Detector

Pin Assignment:

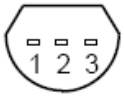
SOT-89-3
Top view



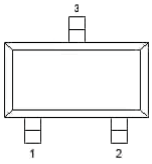
SOT-23-5
Top view



TO-92
Bottom view



SOT-23-3
Top view



Pin Description:

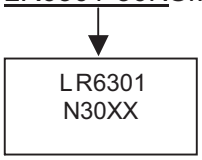
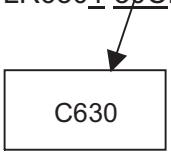
PIN Number				PIN Name	Function
SOT-89-3	TO-92	SOT-23-3	SOT-23-5		
1	3	1	1	VOUT	Voltage detection output Pin
2	1	3	2	VDD	Voltage input Pin
3	2	2	3	VSS	GND Pin
—	—	—	4	NC	No connection
—	—	—	5	CD	Externally Programmable Time Delay

Product Classification:

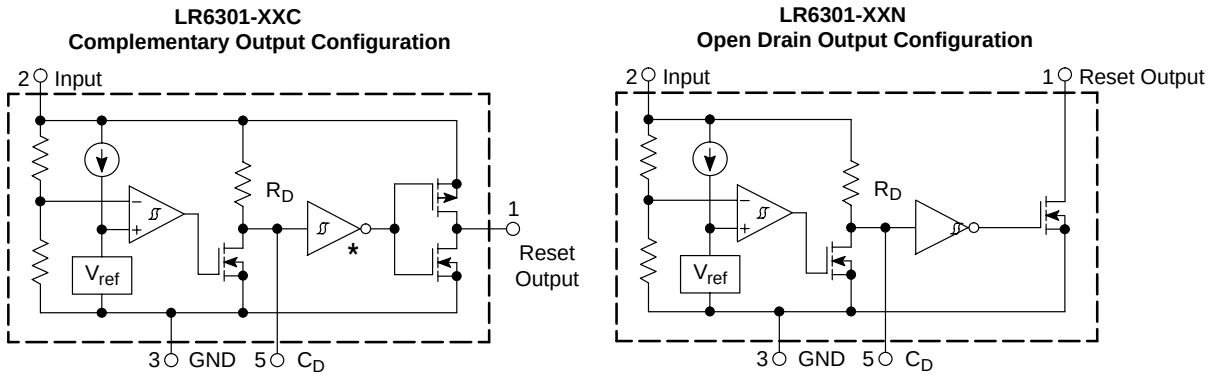
Product Name	Detector Voltage	Output Type	Package
LR6301-XXNRM	XX V	Nch Open-Drain	SOT-23-3
LR6301-XXNRN	XX V	Nch Open-Drain	SOT-23-5
LR6301-XXNSM	XX V	Nch Open-Drain	SOT-89-3
LR6301-XXNT	XX V	Nch Open-Drain	TO-92
LR6301-XXCRM	XX V	CMOS	SOT-23-3
LR6301-XXCRN	XX V	CMOS	SOT-23-5
LR6301-XXCSM	XX V	CMOS	SOT-89-3
LR6301-XXCT	XX V	CMOS	TO-92

Product Mark Information:

Product NO.	Mark
LR6301-09CSM	LR6301-09C
LR6301-20CT	LR6301-20C
LR6301-27CSM	LR6301-27C
LR6301-30CT	LR6301-30C
LR6301-09NRM	N609
LR6301-21NRN	N621
LR6301-27CRM	C627
LR6301-30CRM	C630

SOT-89-3 TO-92	SOT-23-5 SOT-23-3
Example： LR6301-30NSM  	Example： LR6301-30CRM 

Block diagram:



Absolute Maximum Ratings:

Input Voltage range ---------- -0.3V~12V
Output Voltage range ---------- -0.3V~12V
Maximum Output current---------- 70mA
Maximum power dissipation---------- 150mW
Ambient temperature---------- -40~+70°C
Storage temperature ---------- -40~125°C
Lead temperature and time---------- 260°C,10S

Recommended Work Conditions:

Item	Min	Recommended	Max	unit
Input Voltage range	0.7		10	V
Ambient temperature	-40	25	70	℃

Electrical Characteristics:

- LR6301-09C/NXX（0.9V） (Topt＝25℃,Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-VDET	Detector Threshold		0.882	0.9	0.918	V
VHYS	Detector Threshold Hysteresis		0.018	0.036	0.054	V
ISS	Current consumption	VDD=2.9V		0.5	1	uA
VDDH	Maximum operating voltage				10	V
VDDL	Minimum Operating voltage			0.5		V
IOUT	Output current	Nch VDS=0.05V，VDD=0.7V VDS=0.50V，VDD=0.8V	0.01 0.05	0.05 0.50		mA
		Pch VDS=-2.1V，VDD=4.50V	1.0	2.0		mA
TPLH	Output Delay Time				30	uS

- LR6301-27C/NXX（2.7V） (Topt＝25℃,Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-VDET	Detector Threshold		2.646	2.7	2.754	V
VHYS	Detector Threshold Hysteresis		0.054	0.108	0.162	V
ISS	Current consumption	VDD=4.7V		0.5	1	uA
VDDH	Maximum operating voltage				10	V
VDDL	Minimum Operating voltage			0.5		V
IOUT	Output current	Nch VDS=0.05V，VDD=0.70V	0.01	0.05		mA
		Pch VDS=-2.1V，VDD=4.50V	1.0	2.0		mA
TPLH	Output Delay Time				30	uS

- LR6301-30C/NXX（3.0V） (Topt＝25℃,Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-VDET	Detector Threshold		2.94	3.0	3.06	V
VHYS	Detector Threshold Hysteresis		0.060	0.12	0.18	V
ISS	Current consumption	VDD=5.0V		0.5	1	uA
VDDH	Maximum operating voltage				10	V
VDDL	Minimum Operating voltage			0.5		V
IOUT	Output current	Nch VDS=0.05V，VDD=0.7V	0.01	0.05		mA
		Pch VDS=-2.1V，VDD=4.50V	1.0	2.0		mA
TPLH	Output Delay Time				30	uS

- LR6301-34C/NXX（3.4V） (Topt＝25℃,Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V_{DET}	Detector Threshold		3.332	3.4	3.468	V
V_{HYS}	Detector Threshold Hysteresis		0.068	0.136	0.204	V
I_{SS}	Current consumption	V_{DD}=5.0V		0.5	1	uA
V_{DDH}	Maximum operating voltage				10	V
V_{DDL}	Minimum Operating voltage			0.5		V
I_{OUT}	Output current	Nch V_{DS}=0.05V，V_{DD}=0.7V	0.01	0.05		mA
		Pch V_{DS}=-2.1V，V_{DD}=4.50V	1.0	2.0		mA
T_{PLH}	Output Delay Time				30	uS

- LR6301-44C/NXX（4.4V） (Topt＝25℃,Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V_{DET}	Detector Threshold		4.312	4.4	4.488	V
V_{HYS}	Detector Threshold Hysteresis		0.088	0.176	0.264	V
I_{SS}	Current consumption	V_{DD}=6.4V		0.5	1	uA
V_{DDH}	Maximum operating voltage				10	V
V_{DDL}	Minimum Operating voltage			0.5		V
I_{OUT}	Output current	Nch V_{DS}=0.05V，V_{DD}=0.7V	0.01	0.05		mA
		Pch V_{DS}=-2.1V，V_{DD}=8.0V	1.5	3.0		mA
T_{PLH}	Output Delay Time				30	uS

Electrical Characteristics By Detector Threshold

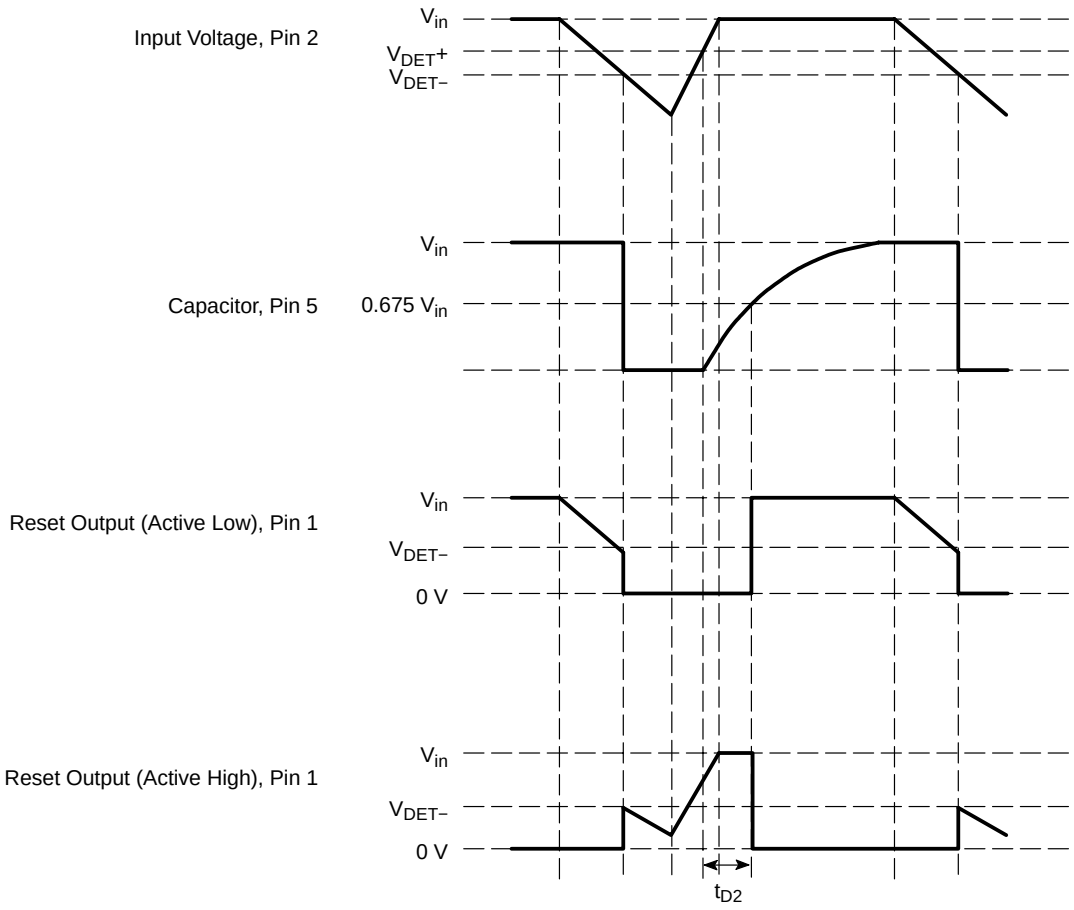
Part Number	Detector Threshold			Detector Threshold Hysteresis			Supply Current1			Supply Current2		
	-Vdet[V]			Vhys[V]			Iss1[uA]			Iss2[uA]		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Condition	Typ.	Max.	Condition	Typ.	Max.
LR6301-09XXX	0.882	0.900	0.918	0.018	0.036	0.054	Vdd= (-Vdet) +0.1V	0.5	1.0	Vdd= (-Vdet) +2V	1.0	1.5
LR6301-10XXX	0.980	1.000	1.020	0.020	0.040	0.060						
LR6301-11XXX	1.078	1.100	1.122	0.022	0.044	0.066						
LR6301-12XXX	1.176	1.200	1.224	0.024	0.048	0.072						
LR6301-13XXX	1.274	1.300	1.326	0.026	0.052	0.078						
LR6301-14XXX	1.372	1.400	1.428	0.028	0.056	0.084						
LR6301-15XXX	1.470	1.500	1.530	0.030	0.060	0.090						
LR6301-16XXX	1.568	1.600	1.632	0.032	0.064	0.096						
LR6301-17XXX	1.666	1.700	1.734	0.034	0.068	0.102						
LR6301-18XXX	1.764	1.800	1.836	0.036	0.072	0.108						
LR6301-19XXX	1.862	1.900	1.938	0.038	0.076	0.114						
LR6301-20XXX	1.960	2.000	2.040	0.040	0.080	0.120					0.5	1.0
LR6301-21XXX	2.058	2.100	2.142	0.042	0.084	0.126						
LR6301-22XXX	2.156	2.200	2.244	0.044	0.088	0.132						
LR6301-23XXX	2.254	2.300	2.346	0.046	0.092	0.138						
LR6301-24XXX	2.352	2.400	2.448	0.048	0.096	0.144						
LR6301-25XXX	2.450	2.500	2.550	0.050	0.100	0.150						
LR6301-26XXX	2.548	2.600	2.652	0.052	0.104	0.156						
LR6301-27XXX	2.646	2.700	2.754	0.054	0.108	0.162						
LR6301-28XXX	2.744	2.800	2.856	0.056	0.112	0.168						
LR6301-29XXX	2.842	2.900	2.958	0.058	0.116	0.174						
LR6301-30XXX	2.940	3.000	3.060	0.060	0.120	0.180						
LR6301-31XXX	3.038	3.100	3.162	0.062	0.124	0.186						
LR6301-32XXX	3.136	3.200	3.264	0.064	0.128	0.192						
LR6301-33XXX	3.234	3.300	3.366	0.066	0.132	0.198						
LR6301-34XXX	3.332	3.400	3.468	0.068	0.136	0.204						
LR6301-35XXX	3.430	3.500	3.570	0.070	0.140	0.210						
LR6301-36XXX	3.528	3.600	3.672	0.072	0.144	0.216						
LR6301-37XXX	3.626	3.700	3.774	0.074	0.148	0.222						
LR6301-38XXX	3.724	3.800	3.876	0.076	0.152	0.228						
LR6301-39XXX	3.822	3.900	3.978	0.078	0.156	0.234						
LR6301-40XXX	3.920	4.000	4.080	0.080	0.160	0.240						
LR6301-41XXX	4.018	4.100	4.182	0.082	0.164	0.246						
LR6301-42XXX	4.116	4.200	4.284	0.084	0.168	0.252						
LR6301-43XXX	4.214	4.300	4.386	0.086	0.172	0.258						
LR6301-44XXX	4.312	4.400	4.488	0.088	0.176	0.264						
LR6301-45XXX	4.410	4.500	4.590	0.090	0.180	0.270						
LR6301-46XXX	4.508	4.600	4.692	0.092	0.184	0.276						
LR6301-47XXX	4.606	4.700	4.794	0.094	0.188	0.282						
LR6301-48XXX	4.704	4.800	4.896	0.096	0.192	0.288						
LR6301-49XXX	4.802	4.900	4.998	0.098	0.196	0.294						
LR6301-50XXX	4.900	5.000	5.100	0.100	0.200	0.300						
LR6301-51XXX	4.998	5.100	5.202	0.102	0.204	0.306						
LR6301-52XXX	5.096	5.200	5.304	0.104	0.208	0.312						
LR6301-53XXX	5.194	5.300	5.406	0.106	0.212	0.318						
LR6301-54XXX	5.292	5.400	5.508	0.108	0.216	0.324						
LR6301-55XXX	5.390	5.500	5.610	0.110	0.220	0.330						
LR6301-56XXX	5.488	5.600	5.712	0.112	0.224	0.336						
LR6301-57XXX	5.586	5.700	5.814	0.114	0.228	0.342						
LR6301-58XXX	5.684	5.800	5.916	0.116	0.232	0.348						
LR6301-59XXX	5.782	5.900	6.018	0.118	0.236	0.354						
LR6301-60XXX	5.880	6.000	6.120	0.120	0.240	0.360						

Output Current1			Output Current2				Output Delay Time	Minimum Operating Voltage		Detector Threshold Temperature Coefficient	
Iout1[mA]			Iout2[mA]				T_{PLH}[us]	V_{DDL}[V]		Δ-V_{DET}/ΔTppm/°C	
Condition	Min.	Typ.	Condition		Min.	Typ.	Max.	Typ.	Max.	Condition	Typ.
NCH, V_{DS}=0.05V, V_{DD}=0.7V	0.01	0.05	NCH, V_{DS}=0.5V	Vdd=0.85V	0.1	0.5	20	0.5	0.7	-40°C≤ Topt ≤85°C	±100
				Vdd=1.0V	0.2	1.0					
				V_{DD}=1.5V	1.0	2.0					

OPERATING DESCRIPTION FOR DELAY CD

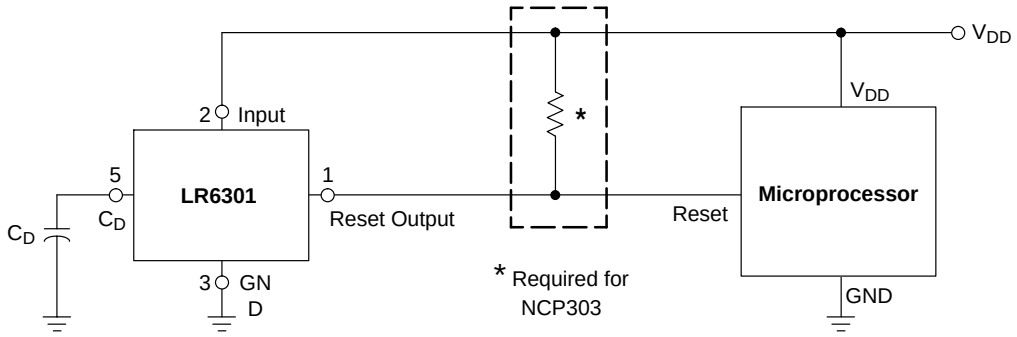
The LR6301 with SOT23-5 series devices consist of precision voltage detector that drives a time delay generator. Figures 37 and 38 show a timing diagram and a typical application. Initially consider that input voltage V_{in} is at a nominal level and it is greater than the voltage detector upper threshold (V_{DET+}). The voltage at Pin 5 and capacitor C_D will be at the same level as V_{in}, and the reset output (Pin 1) will be in the high state for active low devices, or in the low state for active high devices. If there is a power interruption and V_{in} becomes significantly deficient, it will fall below the lower detector threshold (V_{DET-}) and the external time delay capacitor C_D will be immediately discharged by an internal N−Channel MOSFET that connects to Pin 5. This sequence of events causes the Reset output to be in the low state for active low devices, or in the high state for active high devices. After completion of the power interruption, V_{in} will again return to its nominal level and become greater than the V_{DET+}. The voltage detector will turn off the N−Channel MOSFET and allow pullup resistor R_D to charge external capacitor C_D, thus creating a programmable delay for releasing the reset signal. When the voltage at Pin 5 exceeds the inverter/buffer threshold, typically 0.675 V_{in}, the reset output will revert back to its original state. The voltage detector and inverter/buffer have built-in hysteresis to prevent erratic reset operation.

Although these device series are specifically designed for use as reset controllers in portable microprocessor based systems, they offer a cost−effective solution in numerous applications where precise voltage monitoring and time delay are required.

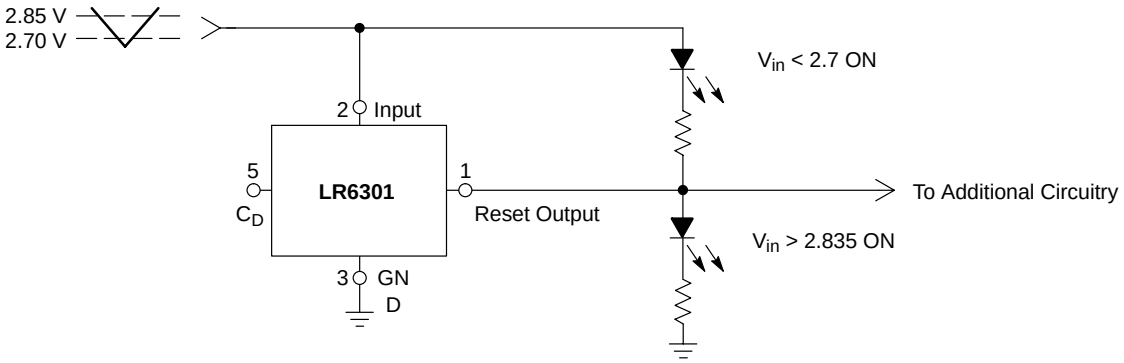


Timing Waveforms

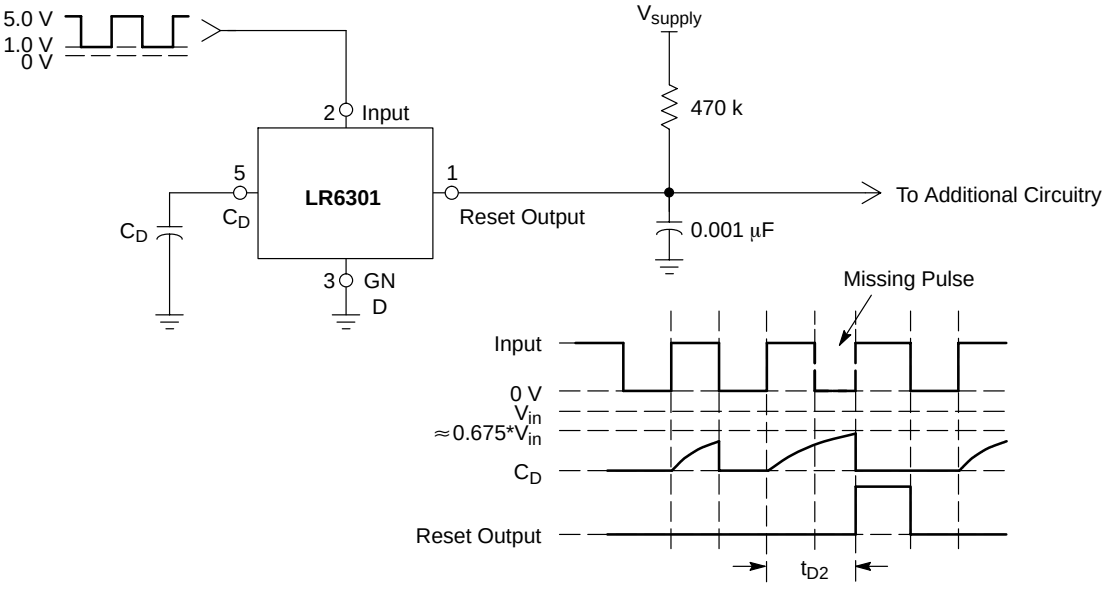
APPLICATION CIRCUIT INFORMATION



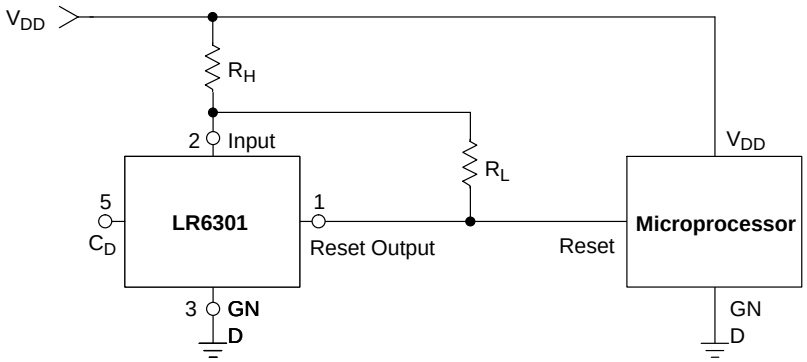
Microprocessor Reset Circuit



Battery Charge Indicator



Missing Pulse Detector or Frequency Detector



Microprocessor Reset Circuit with Additional Hysteresis

Comparator hysteresis can be increased with the addition of resistor R_H. The hysteresis equations have been simplified and do not account for the change of input current I_{in} as V_{in} crosses the comparator threshold. The internal resistance, R_{in} is simply calculated using I_{in} = 0.26 µA at 2.6 V.

V_{in} Decreasing:

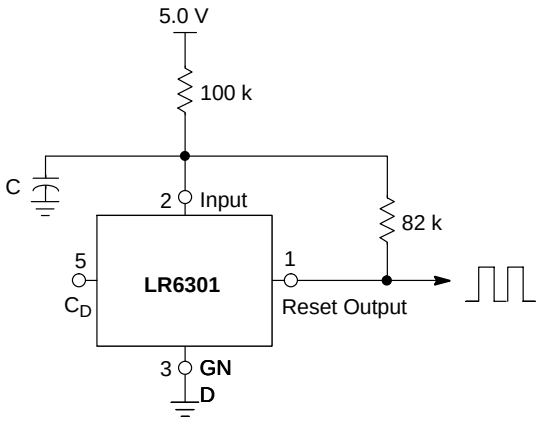
$$V_{th} = \left(\frac{R_H}{R_{in}} + 1\right)(V_{DET-})$$

V_{in} Increasing:

$$V_{th} = \left(\frac{R_H}{R_{in} \parallel R_L} + 1\right)(V_{DET-} + V_{HYS})$$

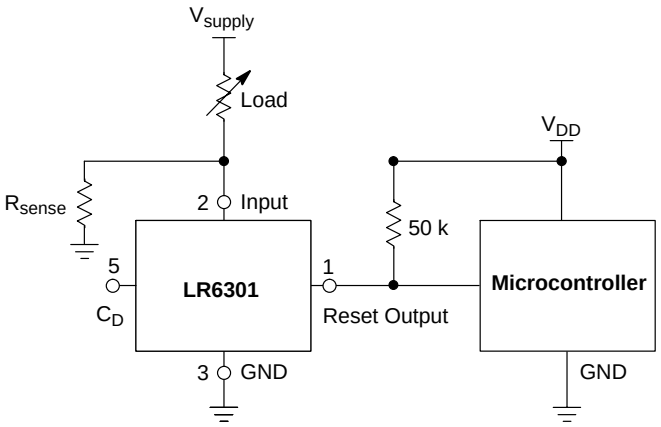
$V_{HYS} = V_{in}$ Increasing − V_{in} Decreasing

Test Data				
V_{th} Decreasing (V)	**V_{th} Increasing (V)**	**V_{HYS} (V)**	**R_H (Ω)**	**R_L (kΩ)**
2.70	2.84	0.135	0	–
2.70	2.87	0.17	100	10
2.70	2.88	0.19	100	6.8
2.70	2.91	0.21	100	4.3
2.70	2.90	0.20	220	10
2.70	2.94	0.24	220	6.8
2.70	2.98	0.28	220	4.3
2.70	2.70	0.27	470	10
2.70	3.04	0.34	470	6.8
2.70	3.15	0.35	470	4.3



Test Data		
C (µF)	**f_{OSC} (kHz)**	**I_Q (µA)**
0.01	2590	21.77
0.1	490	21.97
1.0	52	22.07

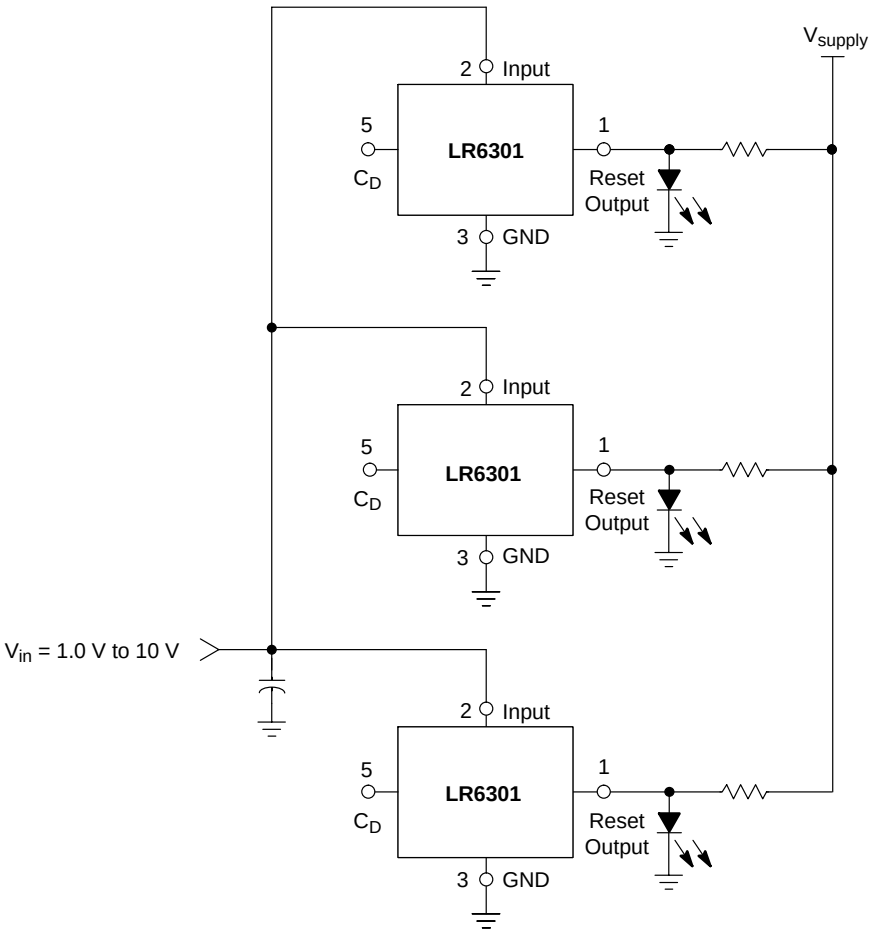
Simple Clock Oscillator



This circuit monitors the current at the load. As current flows through the load, a voltage drop with respect to ground appears across R_{sense} where $V_{sense} = I_{load} * R_{sense}$. The following conditions apply:

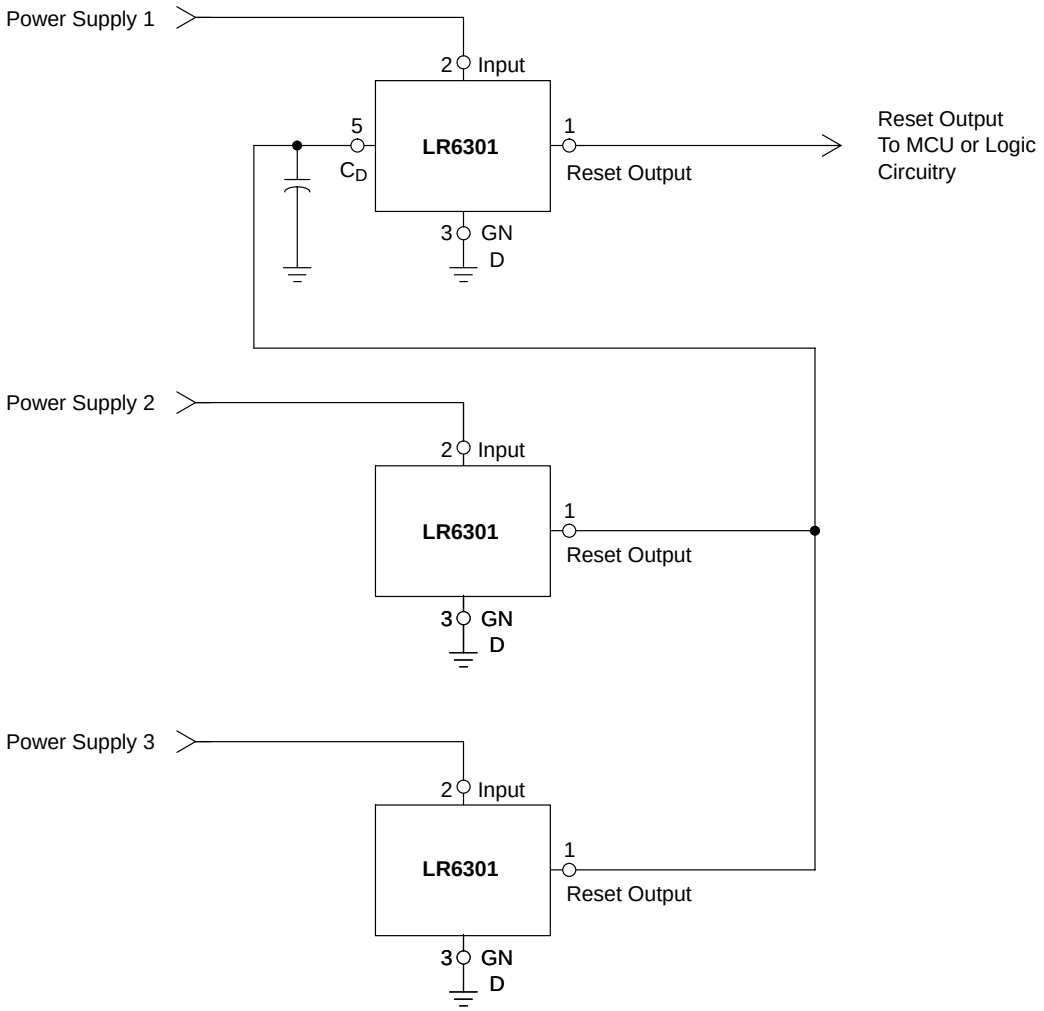
If:	Then:
$I_{Load} < V_{DET-}/R_{sense}$	Reset Output = 0 V
$I_{Load} \geq (V_{DET-}+V_{HYS})/R_{sense}$	Reset Output = V_{DD}

Microcontroller Systems Load Sensing



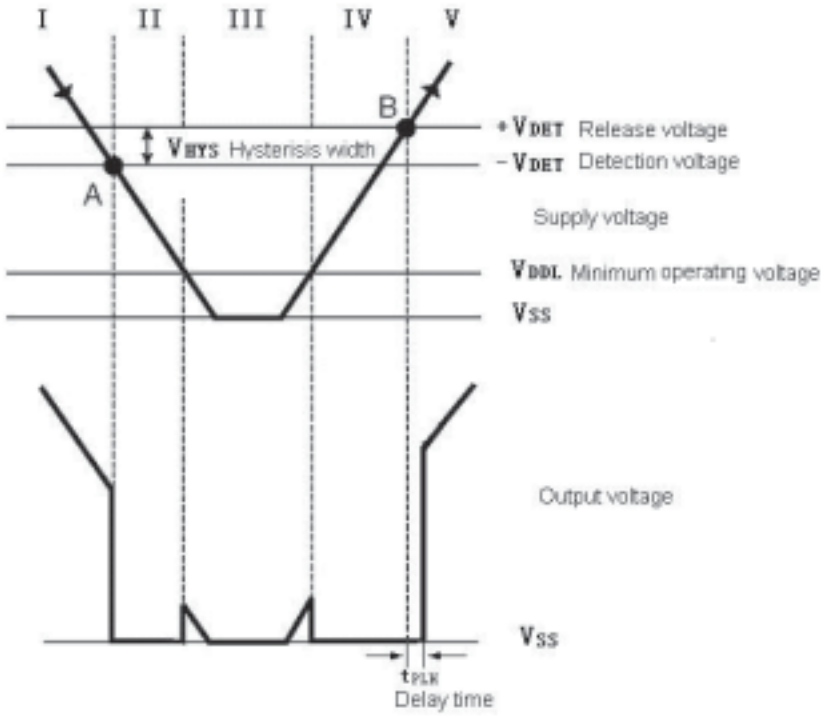
A simple voltage monitor can be constructed by connecting several voltage detectors as shown above. Each LED will sequentially turn on when the respective voltage detector threshold (V_{DET-} +V_{HYS}) is exceeded. Note that detector thresholds (V_{DET-}) that range from 0.9 V to 4.9 V in 100 mV steps can be manufactured.

LED Bar Graph Voltage Monitor



For monitoring power supplies with a time delay reset, only a single LR6301 with delay capacitor is required.

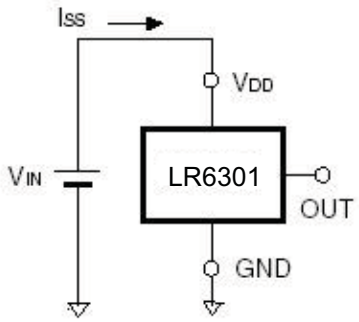
Multiple Power Supply Undervoltage Supervision with Time Delay Reset



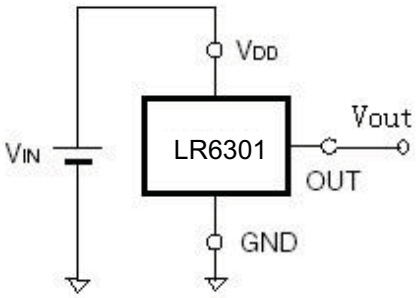
No.	Operation status	Output status
I	V_{DD}>-V_{DET}	Output voltage is equal to the supply voltage
II	V_{DD} drops below - V_{DET}	Output voltage equals to GND level
III	V_{DD} drops further below V_{DDL}	Output voltage is undefined
IV	V_{DD} rises above V_{DDL}	Output voltage equals to GND level
V	V_{DD} rises above + V_{DET}	Output voltage equals to supply voltage，V_{HYS}=(+ V_{DET})-(- V_{DET})

Test circuits：

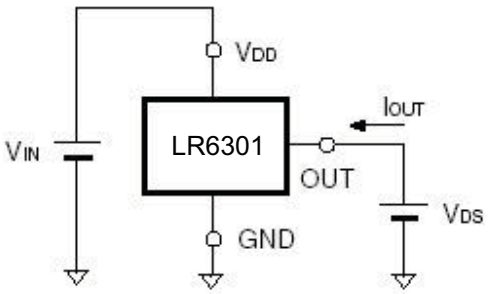
（1）Supply current test circuit



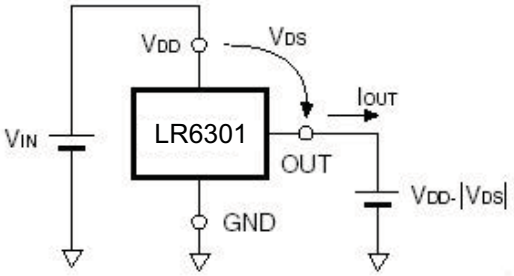
（2）Detector threshold test circuit



（3）NCH Drive Output Current Test Circuit



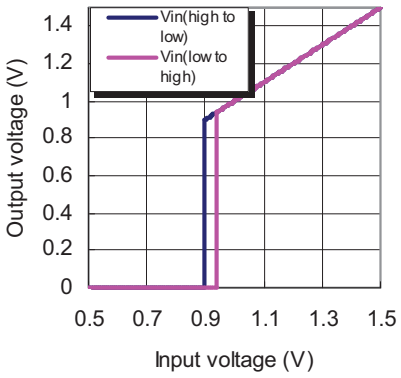
（4）PCH Drive Output Current Test Circuit



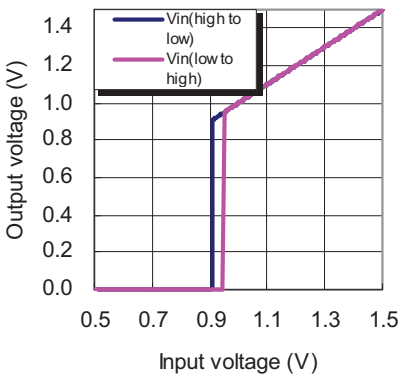
Typical Performance Characteristics：

1) Output voltage VS. Input voltage

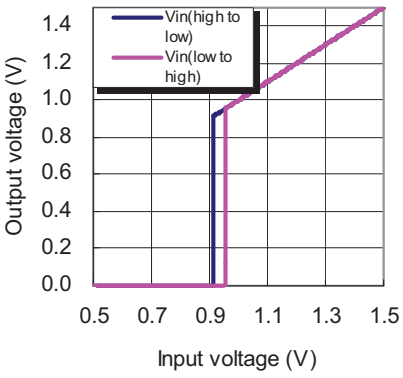
Detector threshold= 0.9V (-40°C)



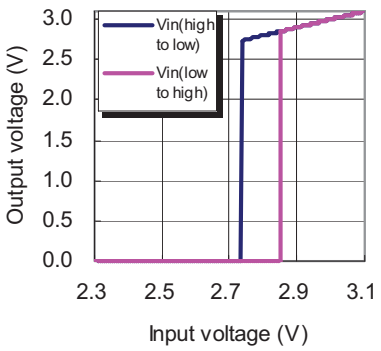
Detector threshold= 0.9V (25°C)



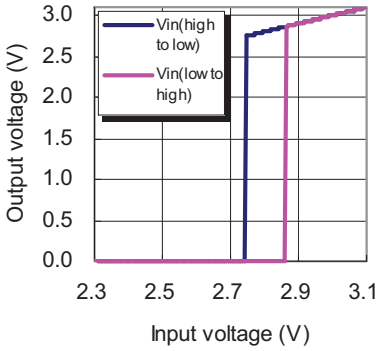
Detector threshold= 0.9V (70°C)



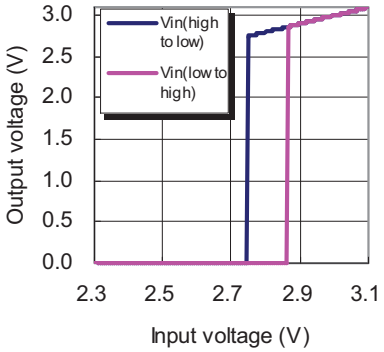
Detector threshold=2.7V（-40°C）



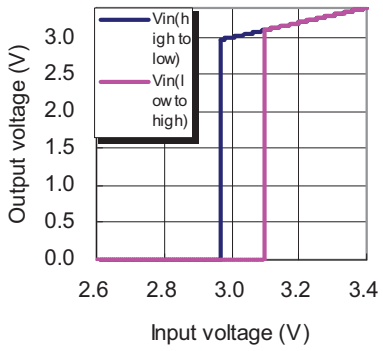
Detector threshold=2.7V（25°C）



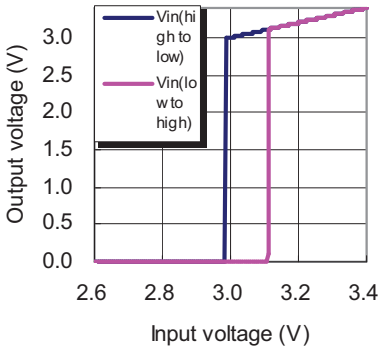
Detector threshold=2.7V（70°C）



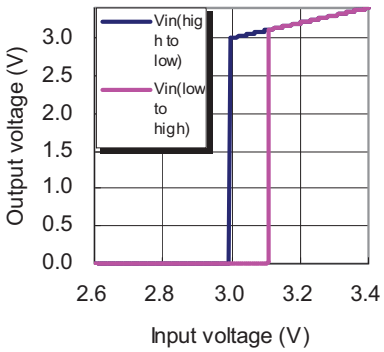
Detector threshold=3.0V（-40°C）



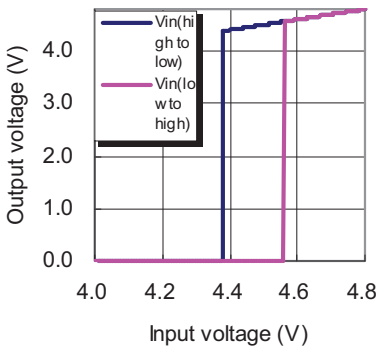
Detector threshold=3.0V（25°C）



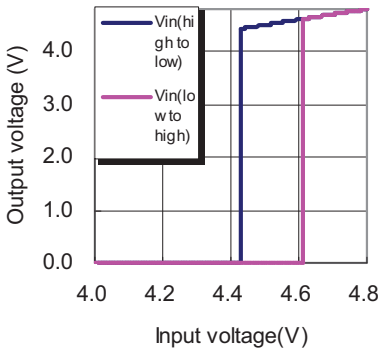
Detector threshold=3.0V（70°C）



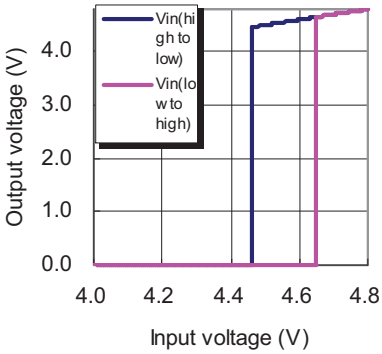
Detector threshold=4.4V（-40°C）



Detector threshold=4.4V（25°C）

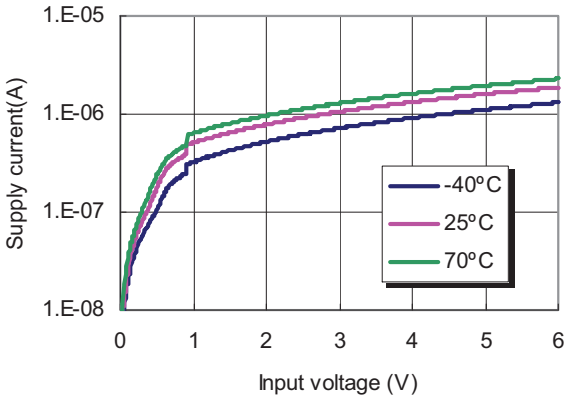


Detector threshold=4.4V（70°C）

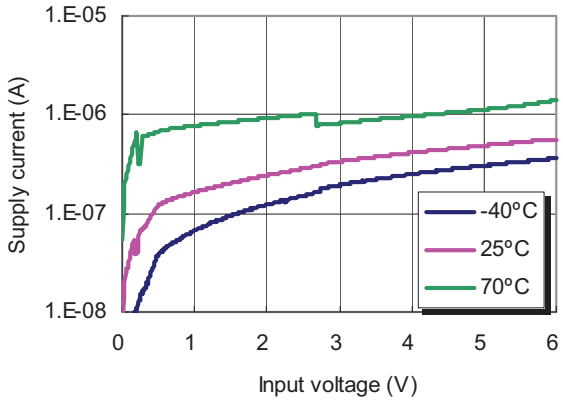


2) Supply current VS. Input voltage

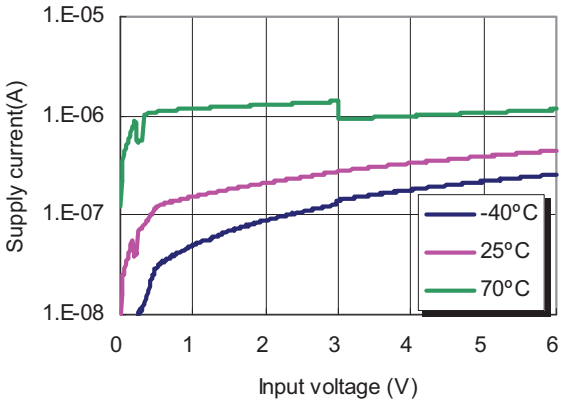
Detector threshold= 0.9V



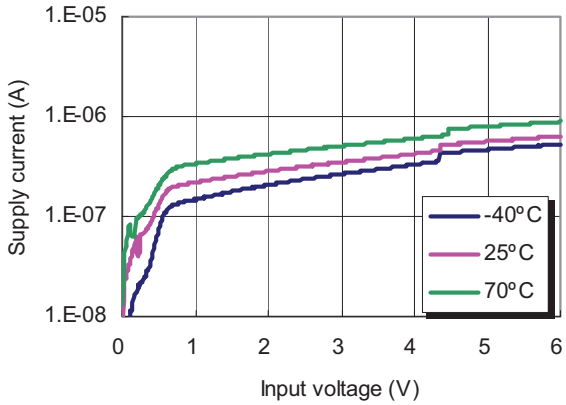
Detector threshold=2.7V



Detector threshold=3.0V

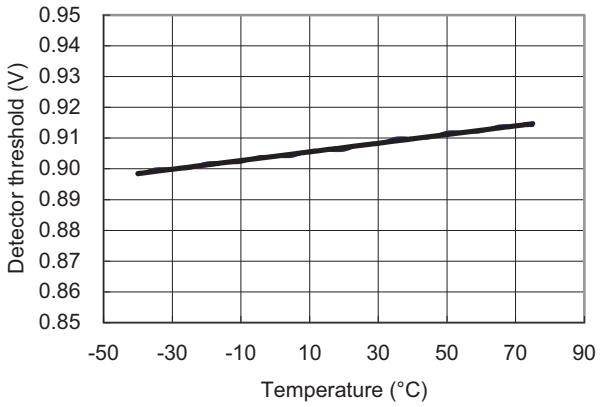


Detector threshold=4.4V

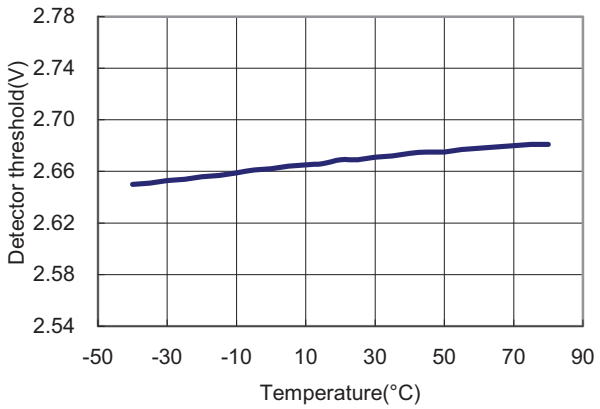


3) Detector Threshold Hysteresis VS. Temperature

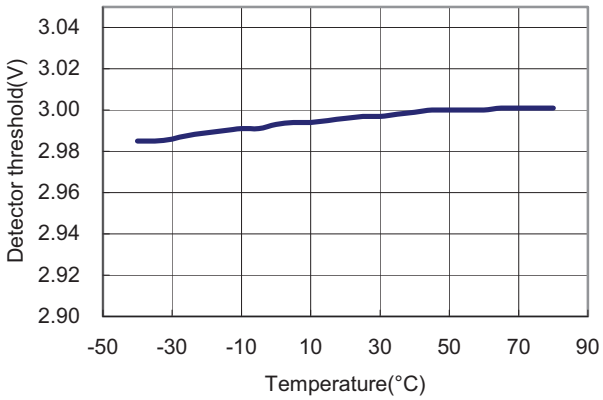
Detector threshold= 0.9V



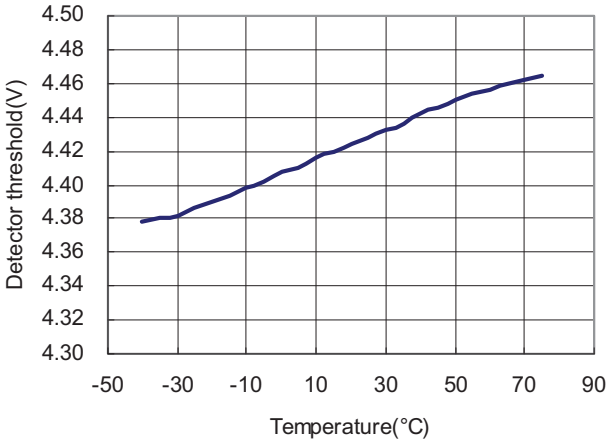
Detector threshold=2.7V



Detector threshold=3.0V

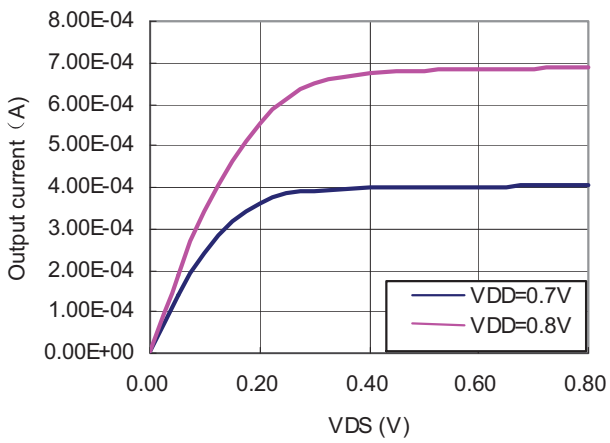


Detector threshold=4.4V

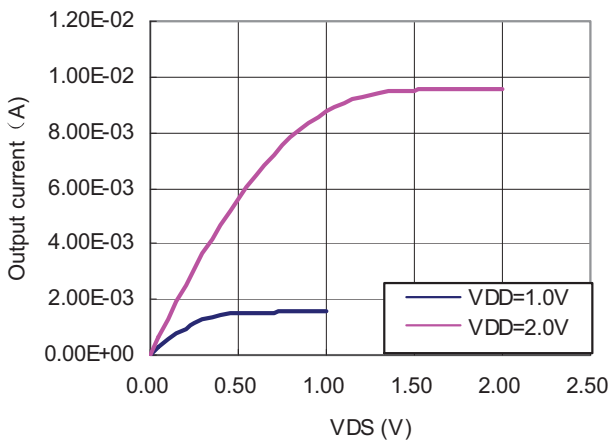


4）Nch Driver Output Current VS. V_{DS}

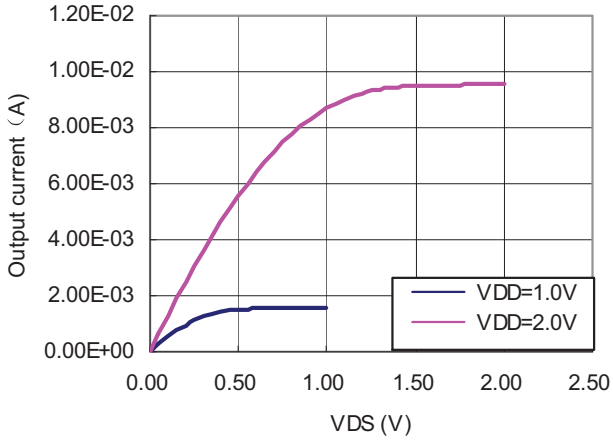
LR6301-09CXX



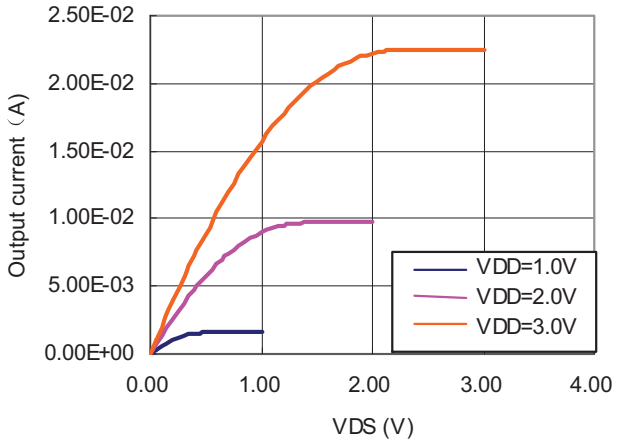
LR6301-27CXX



LR6301-30CXX

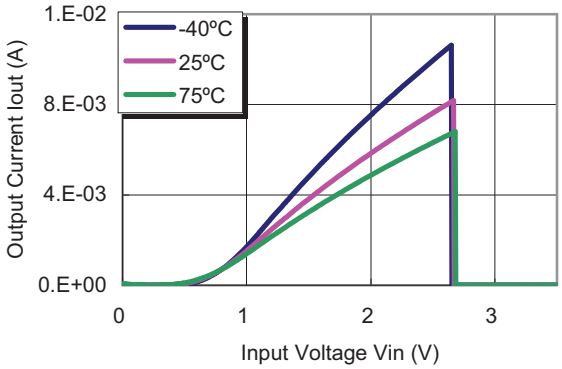


LR6301-44CXX

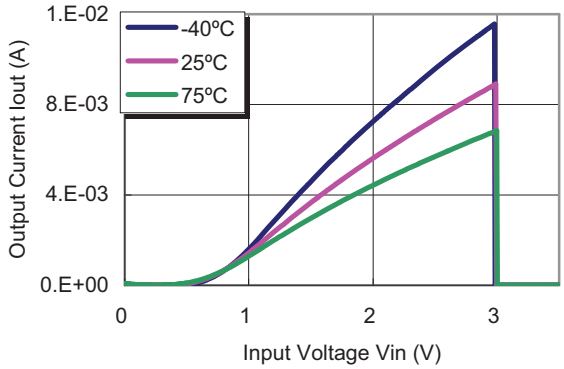


5）NCH Driver Output Current vs. Input Voltage

Detector threshold=2.7V

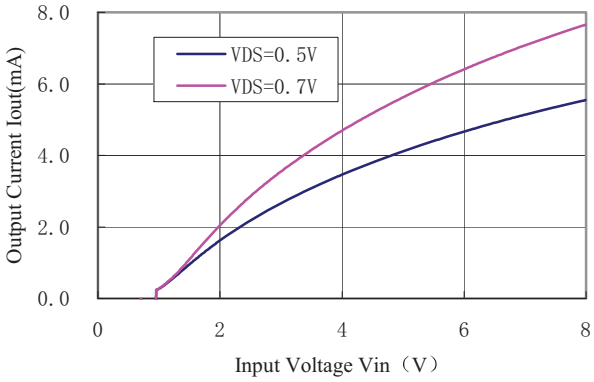


Detector threshold=3.0V

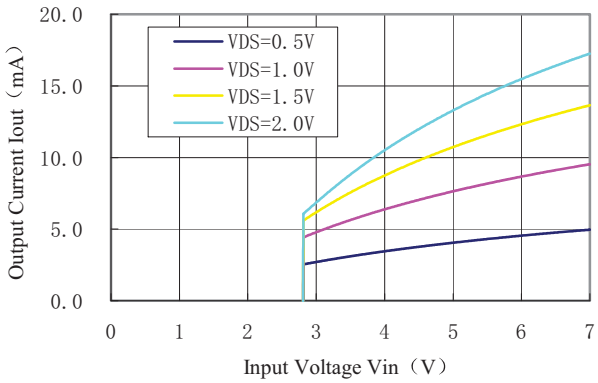


6）PCH Driver Output Current vs. Input Current

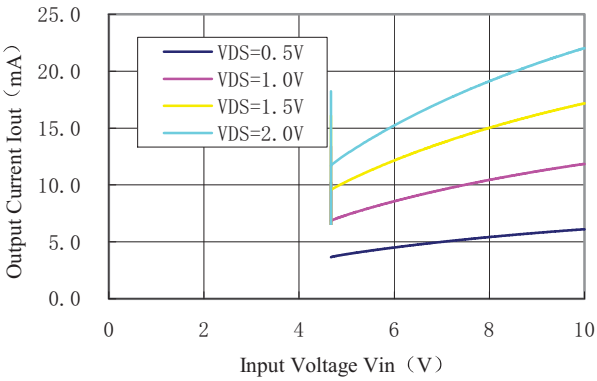
Detector threshold=0. 9V



Detector threshold=2. 7V

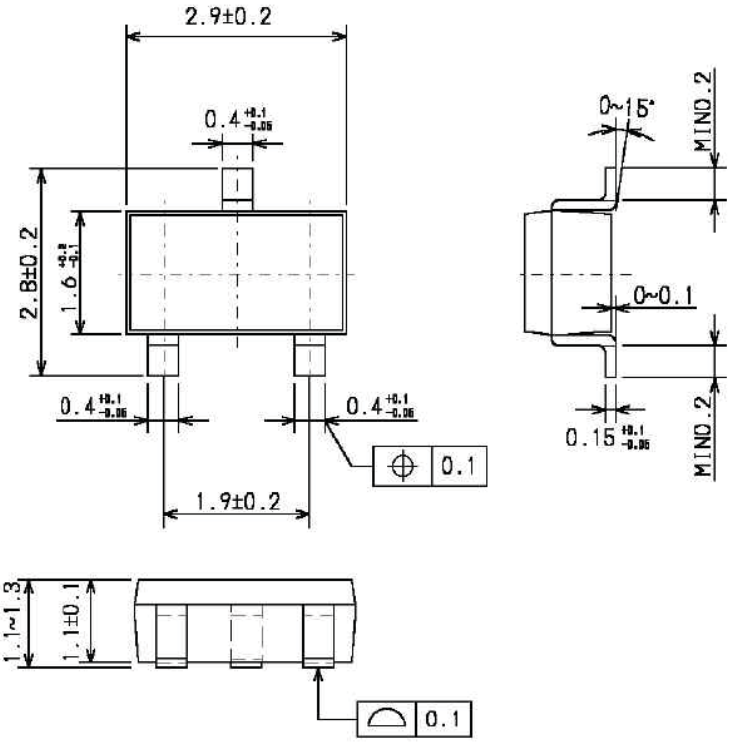


Detector threshold=4. 4V

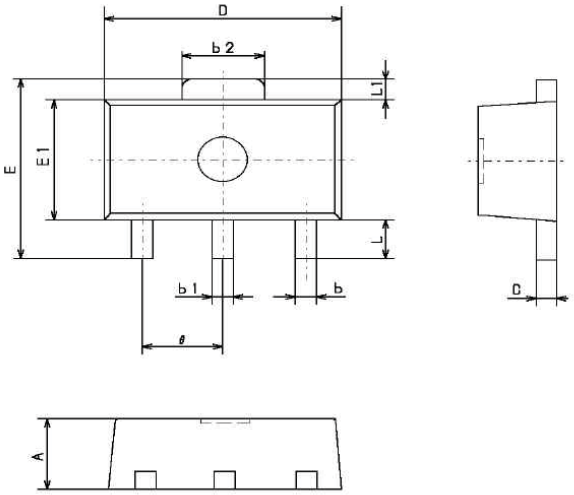


PACKAGING INFORMATION

- **SOT-23**

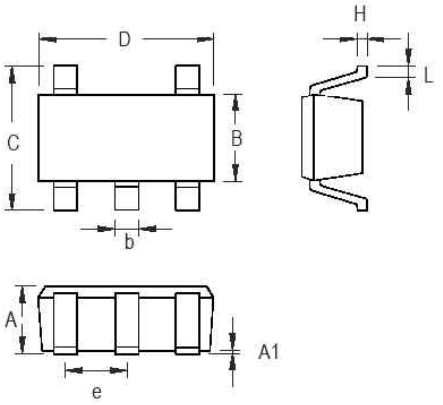


- **SOT-89**



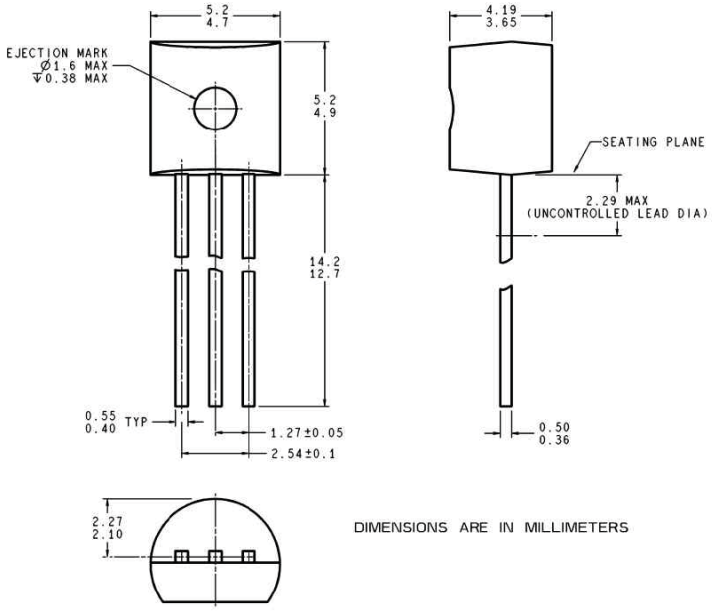
Symbols	Dimensions in millimeters		
	Min	Nom	Max
A	1.40	1.50	1.60
b	0.36	0.42	0.48
b1	0.41	0.47	0.53
b2	1.40	1.60	1.75
C	0.38	0.40	0.43
D	4.40	4.50	4.60
E	—	—	4.25
E1	2.40	2.50	2.60
θ	1.40	1.50	1.60
L	1.80	—	—
L1	—	0.40	—

● **SOT- 23- 5**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.035	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.356	0.559	0.014	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

● **TO92**



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