General Description

The TY70XXH series devices are a set of three terminal low power voltage detectors implemented in CMOS technology. Each voltage detector in the series detects a particular fixed voltage ranging from 2.2V to 7.0V. The voltage detectors consist of a high-precision and low power consumption standard voltage source as well as a comparator, hysteresis circuit, and an output driver. CMOS technology ensures low power consumption.

Although designed primarily as fixed voltage detectors, these devices can be used with external components to detect user specified threshold voltages.

Features

- Low power consumption
- Low temperature coefficient
- Built-in hysteresis characteristic
- High input voltage (up to 15V)
- Output voltage accuracy: tolerance ±2%
- TO92, SOT89 SOT23-3 and SOT23 package

Applications

- Battery checkers
- Level selectors
- Power failure detectors
- Microcomputer reset
- Battery memory backup
- Non-volatile RAM signal storage protectors

Selection Table

Part No	Detectable Voltage	Hysteresis Width	Tolerance	Package	Marking
TY7022HYxx	2.2V	0.11V	±2%	TO92 SOT89	70XXA-1(TO92) 70XXA-1(SOT89)
TY7024HYxx	2.4V	0.12V	±2%		
TY7027HYxx	2.7V	0.135V	±2%		
TY7030HYxx	3.0V	0.15V	±2%		
TY7033HYxx	3.3V	0.165V	±2%		
TY7036HYxx	3.6V	0.18V	±2%		
TY7039HYxx	3.9V	0.195V	±2%		
TY7040HYxx	4.0V	0.2V	±2%		
TY7044HYxx	4.4V	0.22V	±2%		
TY7050HYxx	5.0V	0.25V	±2%		
TY7070HYxx	7.0V	0.35V	±2%		

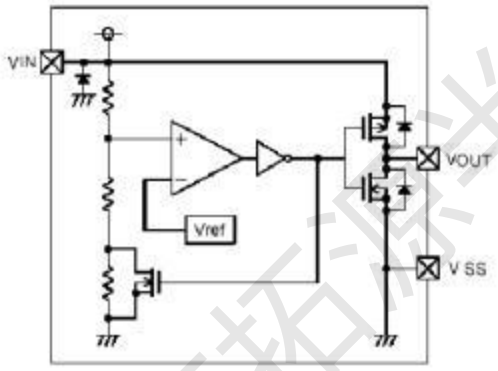
Order Information

TY70①②③④⑤⑥

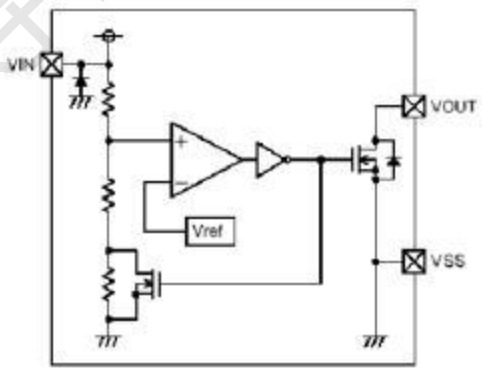
Designator	Symbol		Description
① ②	Integer		Output Voltage(2.2~7.0V)
③	H		Standard
④	Y	N	NMOS
		C	CMOS
⑤	T		Package:TO-92
	P		Package:SOT89
	M		Package:SOT23-3
	N		Package:SOT23
⑥	R		RoHS / Pb Free
	G		Halogen Free

Block Diagram

(1) CMOS Output

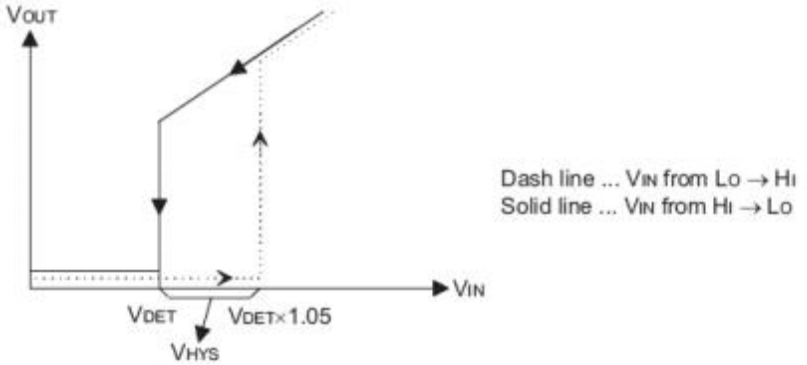


(2) N-ch Open Drain Output

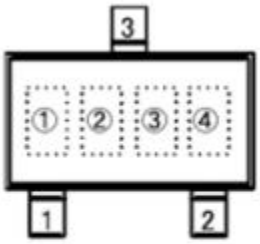


Output Table & Curve

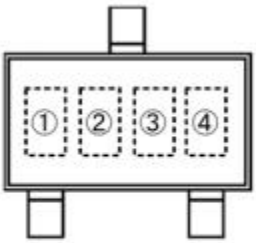
V_{DD}	$V_{DD}>V_{DET}(+)$	$V_{DD}\leqslant V_{DET}(-)$
V_{OUT}	Hi-Z	V_{SS}



Marking Rule



SOT23-3



SOT-23

① Represents integer of detect voltage and CMOS Output

MARK	CONFIGURATIONG	VOLTAGE(V)
A	CMOS	0.X
B	CMOS	1.X
C	CMOS	2.X
D	CMOS	3.X
E	CMOS	4.X
F	CMOS	5.X
H	CMOS	6.X

N-Channel Open Drain Output

MARK	CONFIGURATIONG	VOLTAGE(V)
K	N-ch	0.X
L	N-ch	1.X
M	N-ch	2.X
N	N-ch	3.X
P	N-ch	4.X
R	N-ch	5.X
S	N-ch	6.X

② Represents decimal number of detect voltage

MARK	VOLTAGE(V)	MARK	VOLTAGE(V)
0	X.0	5	X.5
1	X.1	6	X.6
2	X.2	7	X.7
3	X.3	8	X.8
4	X.4	9	X.9

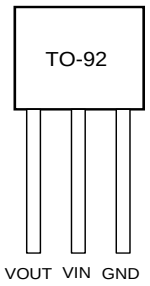
③ Represents accuracy

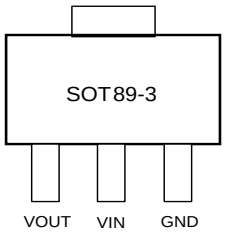
MARK	ACCURACY
3	2%
1	1%

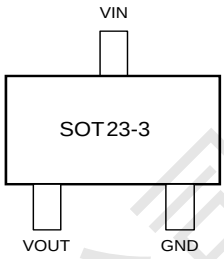
④ Represent production lot number

Y

Pin Assignment







Absolute Maximum Ratings

Supply Voltage .....-0.3V to16V
Storage Temperature .....-50℃ to 125℃
Operating Temperature .....-40℃ to 85℃

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

Thermal Information

Symbol	Parameter	Package	Max	Unit
θ_{JA}	Thermal Resistance (Junction to Ambient) (Assume no ambient airflow, no heat sink)	SOT23	500	℃/W
		SOT89	200	℃/W
		TO92	200	℃/W
P_D	Power Dissipation	SOT23	0.20	W
		SOT89	0.50	W
		TO92	0.50	W

Note: P_D is measured at Ta= 25℃

Electrical Characteristics

TY7022HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	2.156	2.200	2.244	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	0.5	1	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

TY7024HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	2.352	2.400	2.448	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	0.5	1	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

TY7027HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	2.646	2.700	2.754	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	0.5	1	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

Electrical Characteristics

TY7030HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	2.940	3.000	3.060	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	1.2	2.5	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

TY7033HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	3.234	3.300	3.366	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	1.2	2.5	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

TY7036HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	3.528	3.600	3.672	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	1.2	2.5	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

Electrical Characteristics

TY7039HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	3.822	3.900	3.978	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	1.2	2.5	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

TY7040HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	3.920	4.000	4.080	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	1.2	2.5	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

TY7044HYxx Ta=25℃

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	4.312	4.400	4.488	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	1.2	2.5	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

Electrical Characteristics

TY7050HYxx Ta=25℃

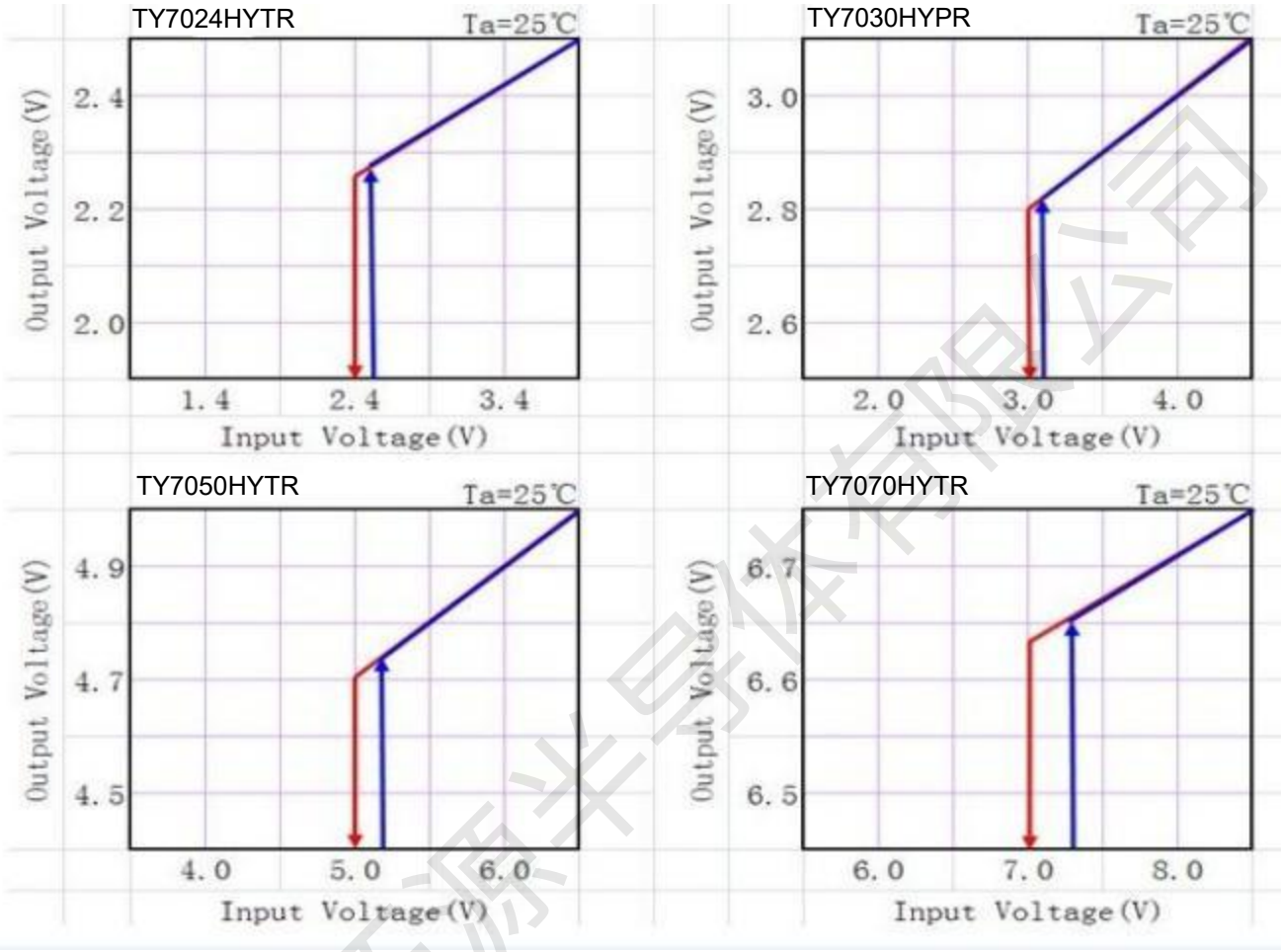
Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	4.900	5.000	5.100	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	1.2	2.5	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

TY7070HYxx Ta=25℃

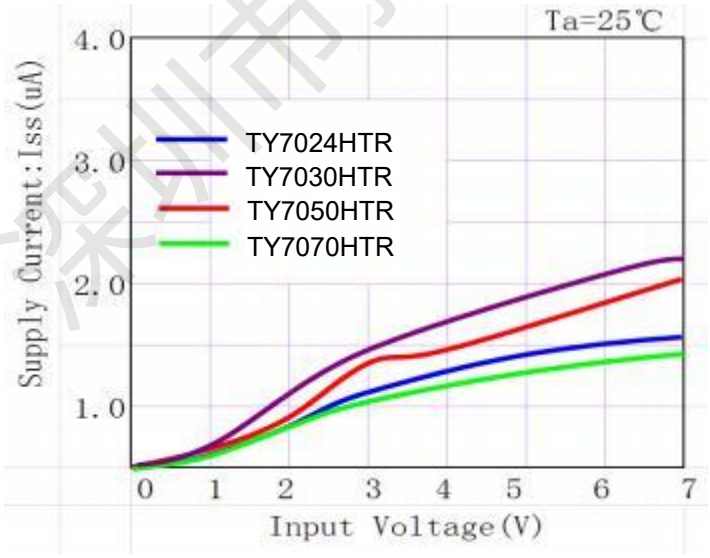
Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
		V_{DD}	Conditions				
V_{DET}	Detection Voltage	-	-	7.860	7.000	7.140	V
V_{HYS}	Hysteresis Width	-	-	0.02 V_{DET}	0.05 V_{DET}	0.1 V_{DET}	V
I_{DD}	Operating Current	8V	No Load	-	2	3	μA
V_{DD}	Operating Voltage	-	-	1.5	-	15	V
I_{OL}	Output Sink Current	2V	V_{OUT}=0.2V	1.2	2.5	-	mA
$\frac{\Delta V_{DET}}{\Delta T_a}$	Temperature Coefficient	-	0℃<Ta<70℃	-	±0.9	-	mV/℃

Typical Performance Characteristics

(1) Output Voltage vs Input voltage

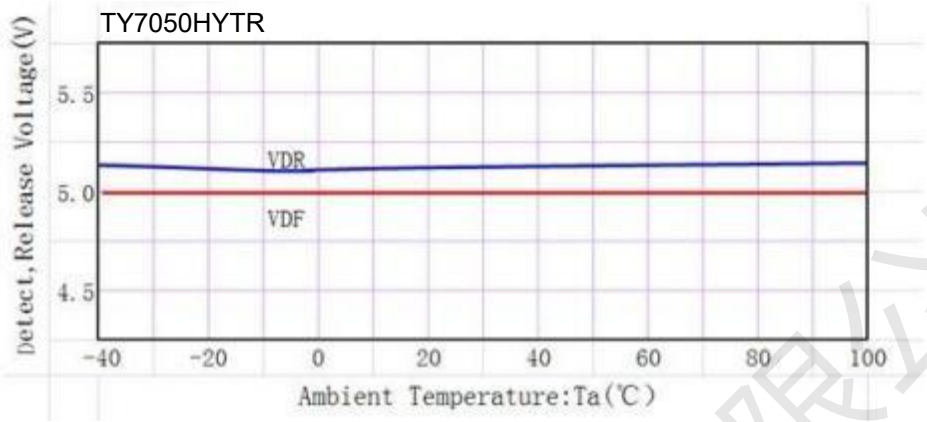


(2) Supply Current vs. Input Voltage



Typical Performance Characteristics

(3) Detect, Release Voltage vs. Ambient Temperature

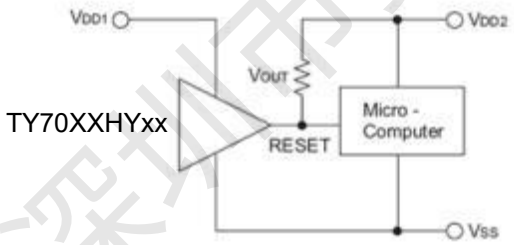


Application Circuits

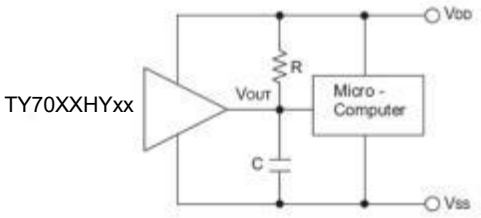
Microcomputer Reset Circuit

Normally a reset circuit is required to protect the microcomputer system from malfunctions due to power line interruptions. The following examples show how different output Configurations perform a reset function in various systems.

NMOS open drain output application for separate power supply

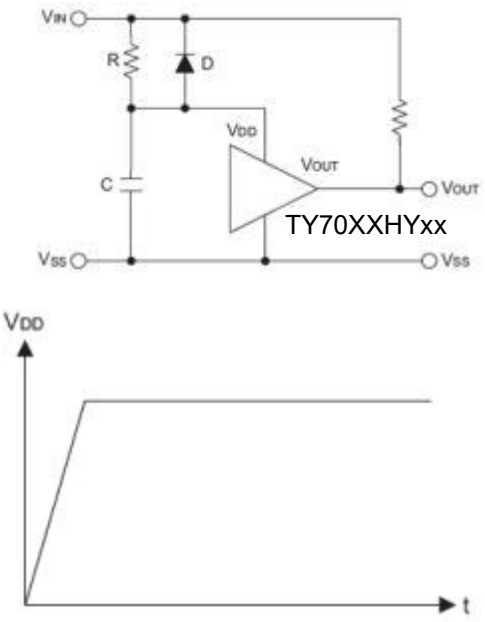


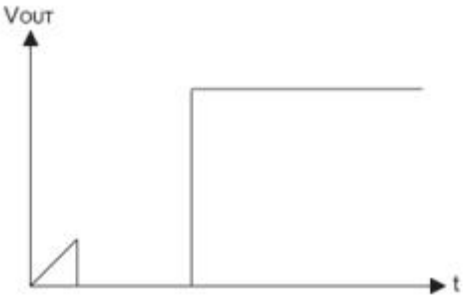
NMOS open drain output application with R-C delay



Power-on Reset Circuit

With several external components, the NMOS open drain type of the TY70XXH series can be used to perform a power-on reset function as shown:

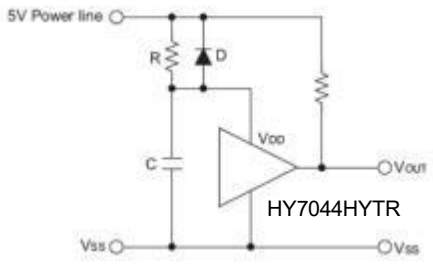




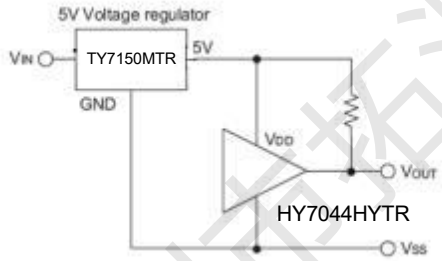
5V Power Line Monitoring Circuit

Generally, a minimum operating voltage of 4.5V is guaranteed in a 5V power line system. The TY7044HYTR is recommended for use as 5V power line monitoring circuit.

5V power line monitor with power-on reset



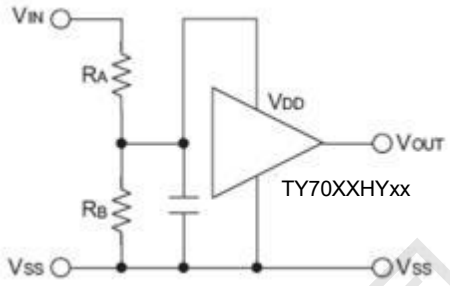
With 5V voltage regulator



Change of Detectable Voltage

If the required voltage is not found in the standard product selection table, it is possible to change it by using external resistance dividers or diodes.

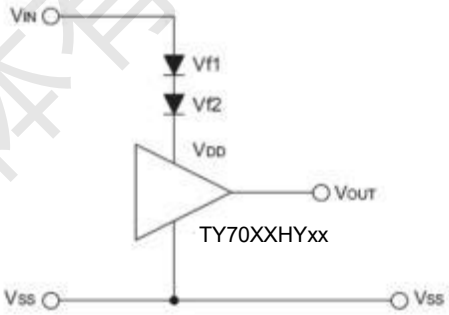
Varying the detectable voltage with a resistance divider



$$\text{Detectable voltage} = \frac{R_A + R_B}{R_B} \times V_{DET}$$

$$\text{Hysteresis width} = \frac{R_A + R_B}{R_B} \times V_{HYS}$$

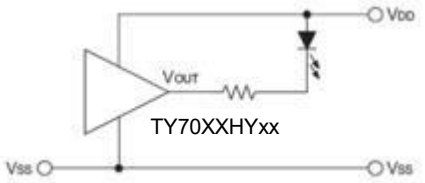
Varying the detectable voltage with a diode



$$\text{Detectable Voltage} = V_{f1} + V_{f2} + V_{DET}$$

Malfunction Analysis

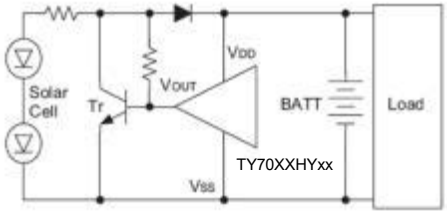
The following circuit demonstrates the way a circuit analyzes malfunctions by monitoring the variation or spike noise of power supply voltage.



Charge Monitoring Circuit

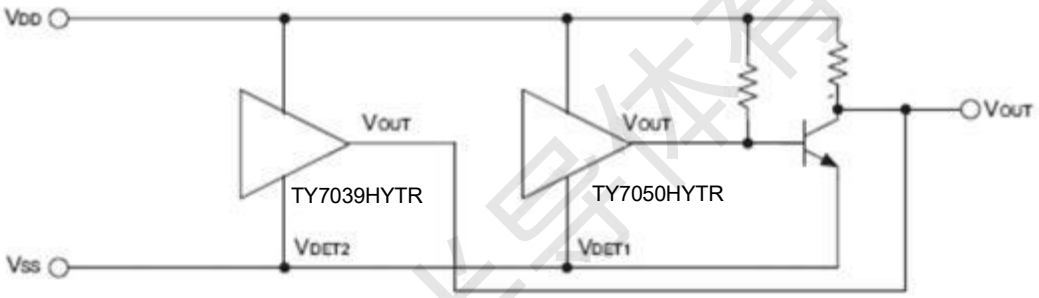
The following circuit shows a charged monitor for protection against battery deterioration by overcharging. When the voltage of the battery is higher than the set detectable voltage, the transistor turns onto bypass the charge

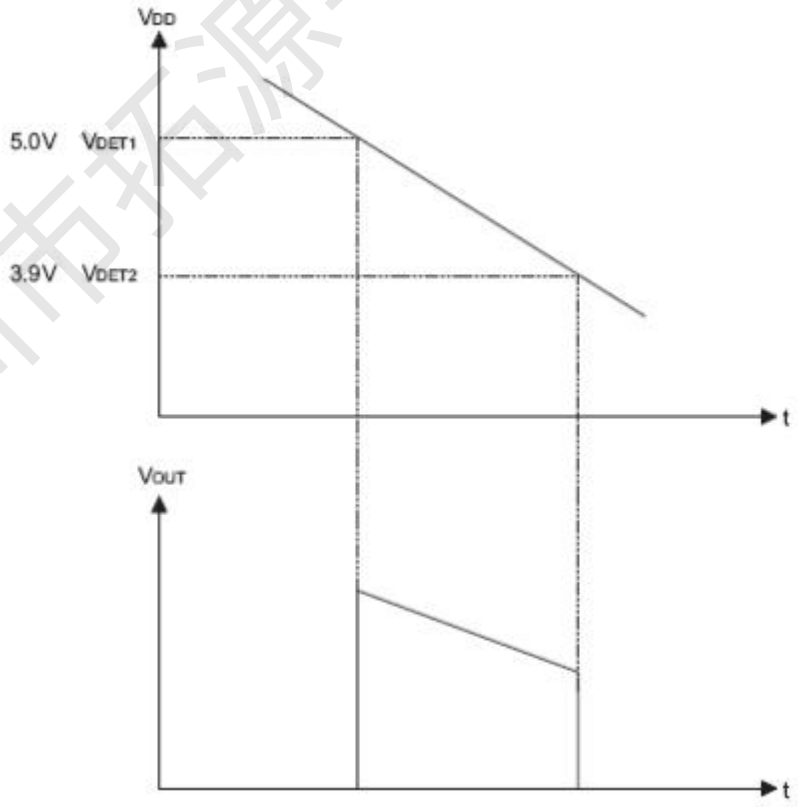
current, protecting the battery from overcharging.



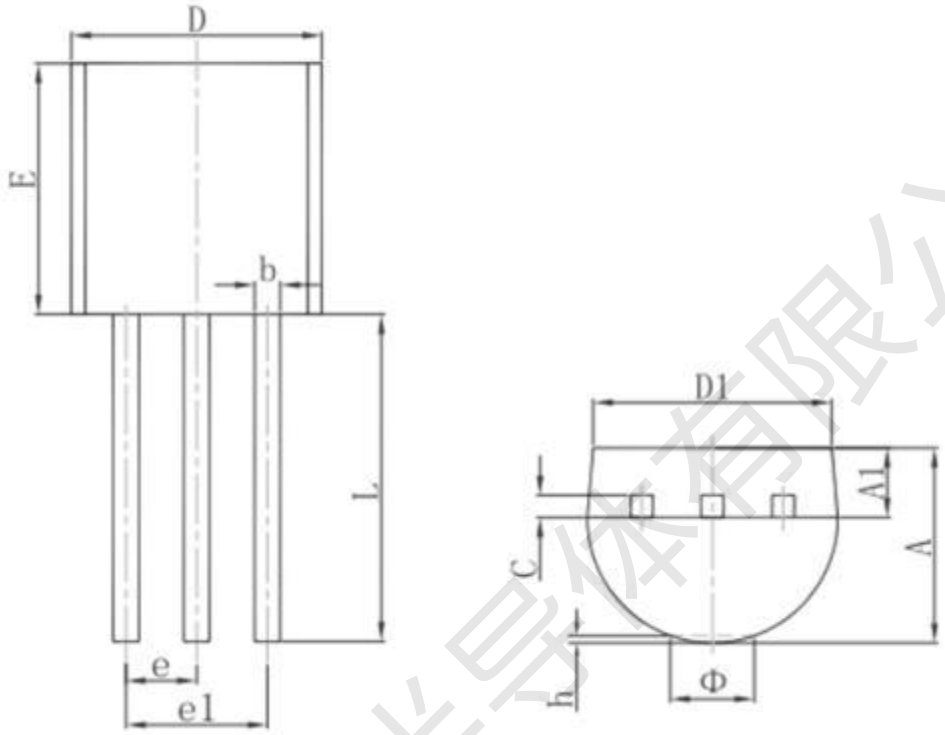
Level Selector

The following diagram illustrates a logic level selector.



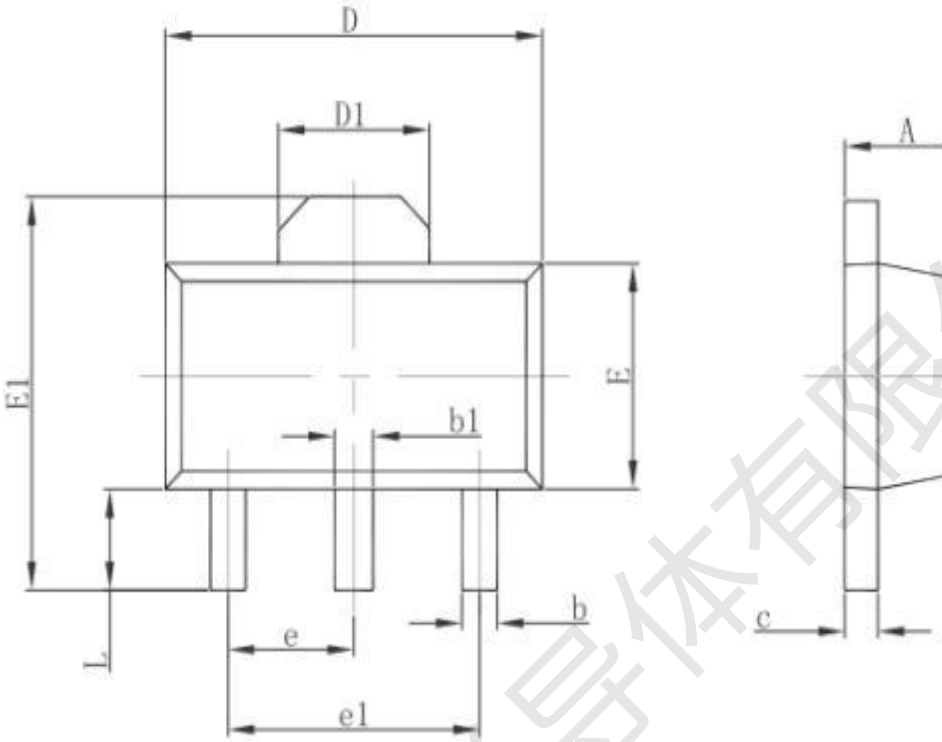


Package Information



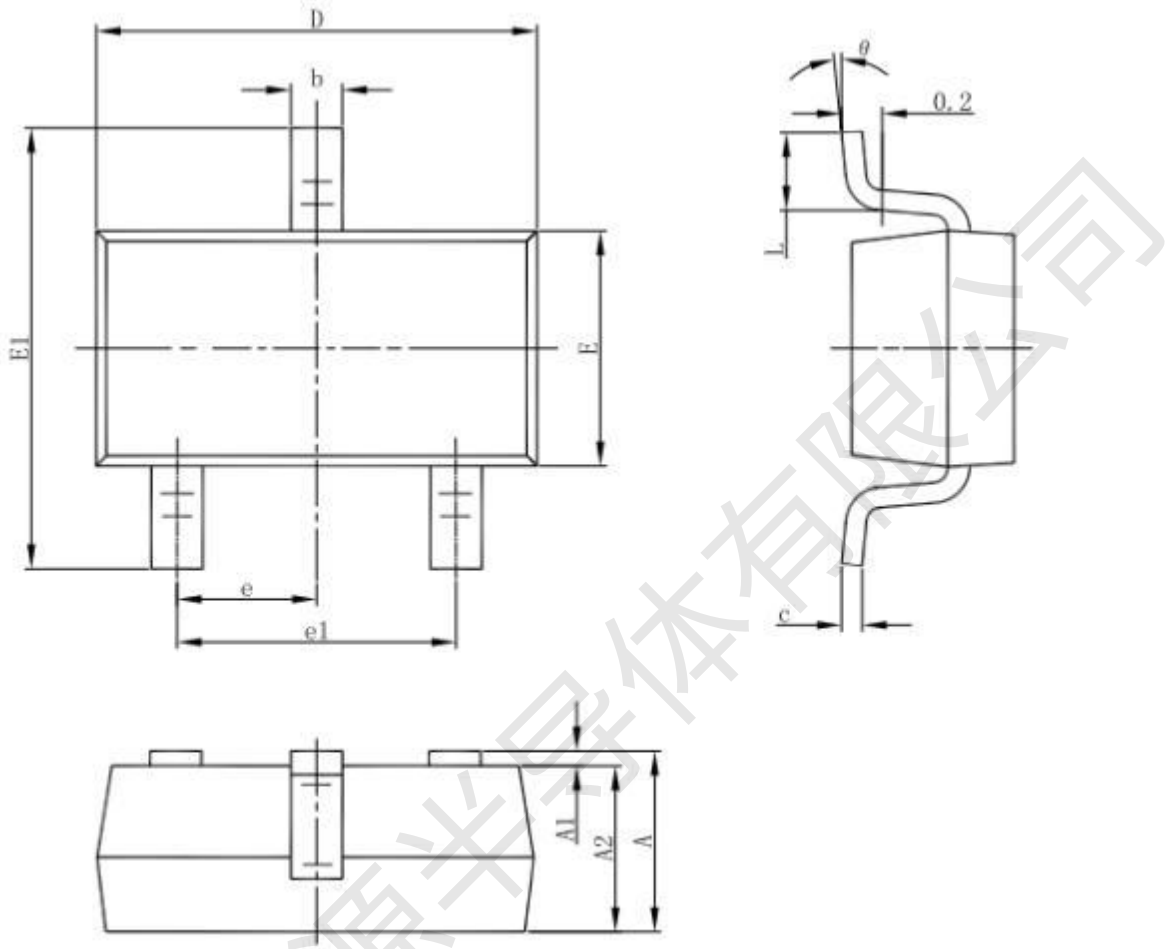
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.300	4.700	0.169	0.185
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP.		0.050 TYP.	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ		1.600		0.063
h	0.000	0.380	0.000	0.015

Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060 TYP.	
e1	3.000 TYP.		0.118 TYP.	
L	0.900	1.200	0.035	0.047

Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°