2.2V Voltage Detector

Features

- Low detectable voltage 2.2V
- Low power consumption
- Low temperature coefficient
- Built-in high-stability reference source
- Built-in hysteresis characteristic
- TO-92 and SOT-89 package

Applications

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

General Description

The HT7022A is a three-terminal low power voltage detector implemented in CMOS technology. It detects a particular fixed voltage 2.2V. The voltage detector consists of a high-precision and low power consumption standard voltage source, a comparator, hysteresis circuit, and an output driver. CMOS technology ensures low power consumption.

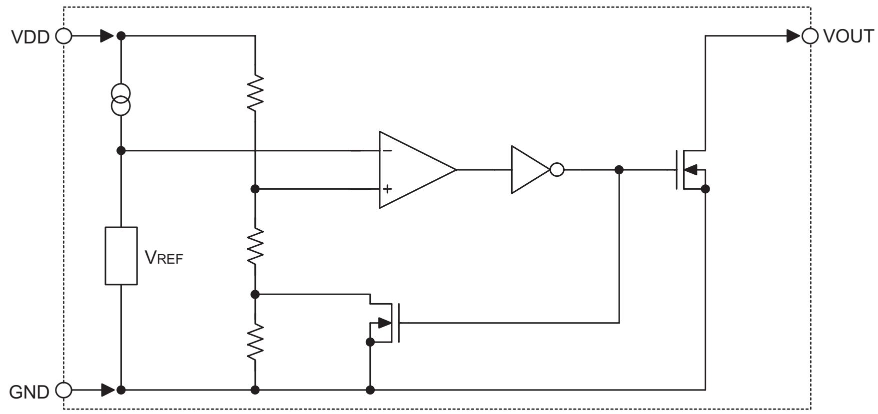
Although designed primarily as fixed voltage detectors, these devices can be used with external components to detect user specified threshold voltages (NMOS open drain type only).

Output Type Selection Table

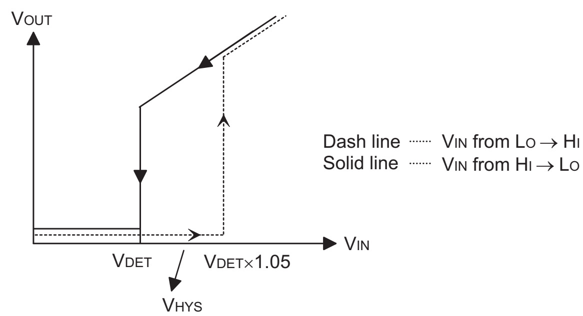
Type \ V_{OUT} \ V_{DD}	$V_{DD}>V_{DET}(+)$	$V_{DD}\leq V_{DET}(-)$
A	Hi-Z	VSS

Block Diagram

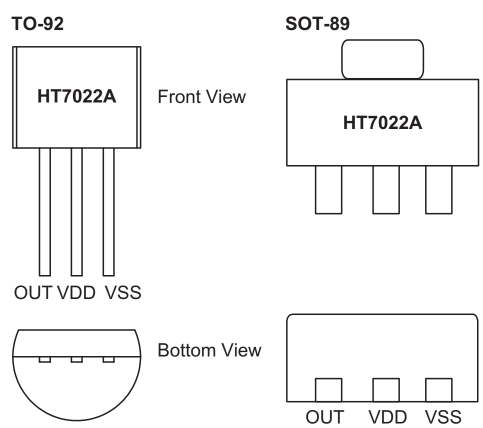
N Channel Open Drain Output (Normal Open; Active Low)



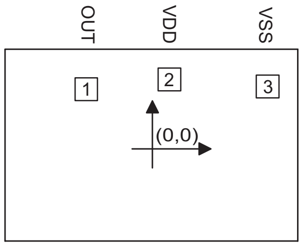
A Type



Pin Assignment



Pad Assignment



Chip size: 2032 × 1321 (μm)^2

* The IC substrate should be connected to VDD in the PCB layout artwork.

Pad Coordinates

Unit: μm

Pad No.	X	Y
1	–434.34	394.97
2	120.65	461.01
3	774.70	412.75

Absolute Maximum Ratings

Supply Voltage .... V_{SS}–0.3V to V_{SS}+13V

Output Current 50mA

Power Consumption 200mW

Output Voltage .... V_{SS}–0.3V to V_{DD}+0.3V

Storage Temperature .... –50°C to 125°C

Operating Temperature .... –40°C to 85°C

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.

Electrical Characteristics

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DET}	Hi→Lo Detectable Voltage	—	—	2.09	2.2	2.31	V
	Lo→Hi Detectable Voltage	—	—	2.132	2.31	2.541	V
V_{HYS}	Hysteresis Width	—	—	0.02V_{DET}	0.05V_{DET}	0.1V_{DET}	V
I_{DD}	Operating Current	3.2V	No load	—	1.8	4	μA
V_{DD}	Operating Voltage	—	—	1.6	—	12	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°C<Ta<70°C	—	±0.9	—	mV/°C

Functional Description

The HT7022A is a voltage detector equipped with a high stability voltage reference which is connected to the negative input of a comparator — denoted as V_{REF} in the following figure for NMOS output voltage detector.

When the voltage drop to the positive input of the comparator (i,e,V_B) is higher than V_{REF}, VOUT goes high, M1 turns off, and V_B is expressed as $V_{BH}=V_{DD} \times (R_B+R_C) / (R_A+R_B+R_C)$. If V_{DD} is decreased so that V_B falls to a value less than V_{REF}, the comparator output inverts from high to low, V_{OUT} goes low, V_C is high, M1 turns on, RC is bypassed, and V_B becomes: $V_{BL}=V_{DD}\times R_B / (R_A+R_B)$, which is less than V_{BH}. By so doing, the comparator output will stay low to prevent the circuit from oscillating when $V_B \approx V_{REF}$.

If V_{DD} falls below the minimum operating voltage, the output becomes undefined. When VDD goes from low to $V_{DD} \times R_B / (R_A+R_B) > V_{REF}$, the comparator output and V_{OUT} goes high.

The detectable voltage is defined as:

$$V_{DET}(-) = \frac{R_A + R_B + R_C}{R_B + R_C} \times V_{REF}$$

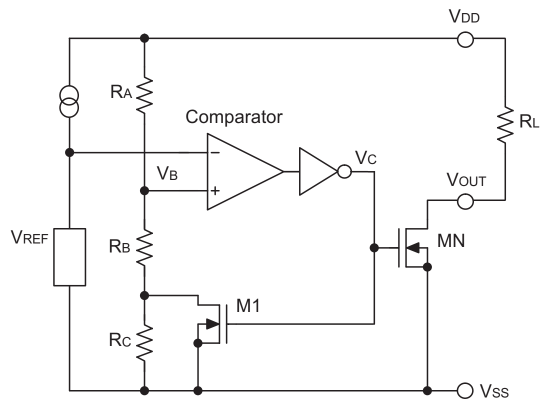
The release voltage is defined as:

$$V_{DET}(+) = \frac{R_A + R_B}{R_B} \times V_{REF}$$

The hysteresis width is:

$$V_{HYS} = V_{DET}(+) - V_{DET}(-)$$

The figure demonstrates the NMOS output type with positive output polarity (V_{OUT} is normally open, active low).



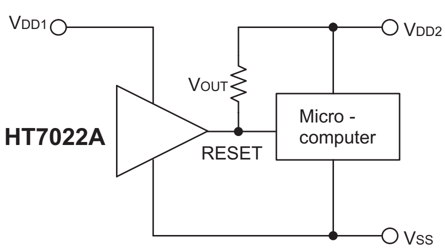
NMOS Output Voltage Detector

Application Circuits

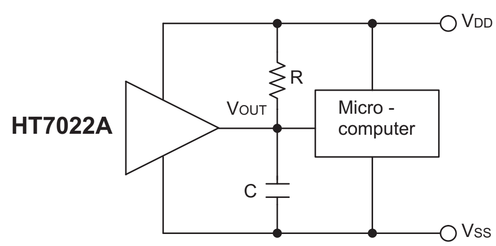
Microcomputer Reset Circuit

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

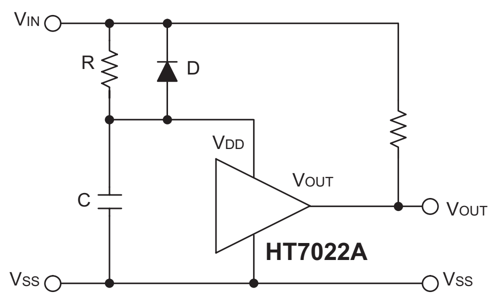


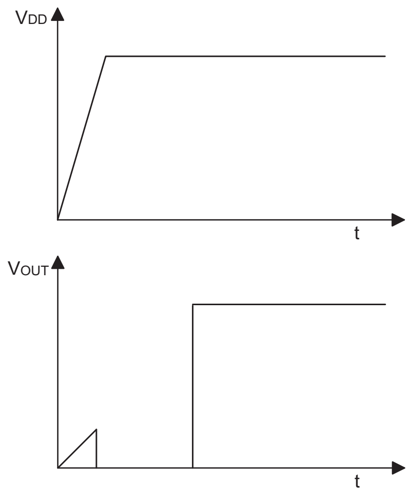
- NMOS open drain output application with R-C delay



Power-on Reset Circuit

With several external components, the HT7022A can be used to perform a power-on reset function as shown:

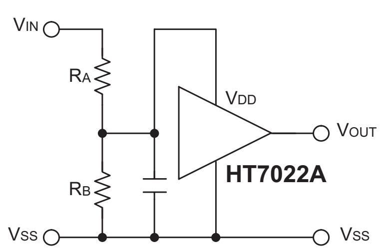




Change of Detectable Voltage

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.

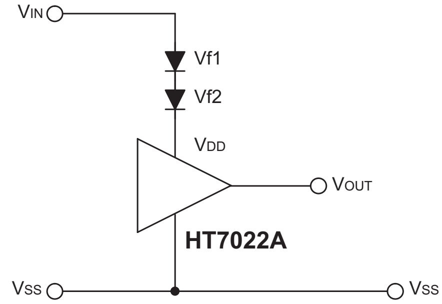
- Varying the detectable voltage with a resistance divider



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

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

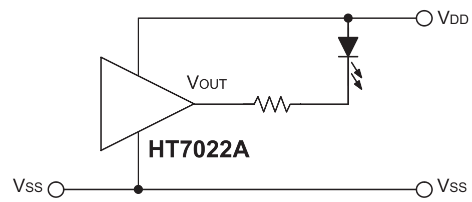
- Varying the detectable voltage with a diode



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

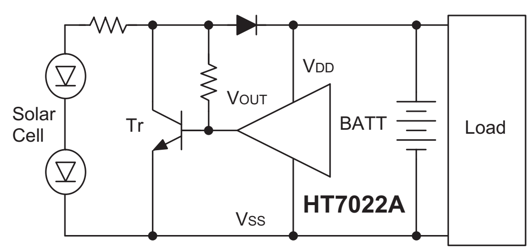
Malfunction Analysis

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



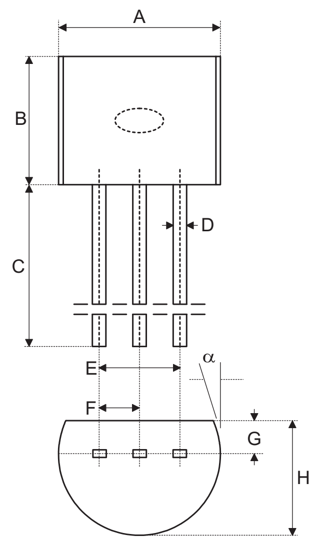
Charge Monitoring Circuit

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 on to bypass the charge current, protecting the battery from overcharging.



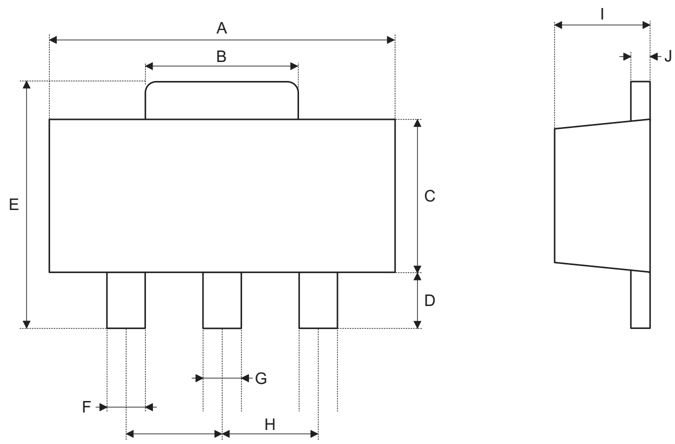
Package Information

3-pin TO-92 Outline Dimensions



Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	170	—	200
B	170	—	200
C	500	—	—
D	11	—	20
E	90	—	110
F	45	—	55
G	45	—	65
H	130	—	160
I	8	—	18
α	4°	—	6°

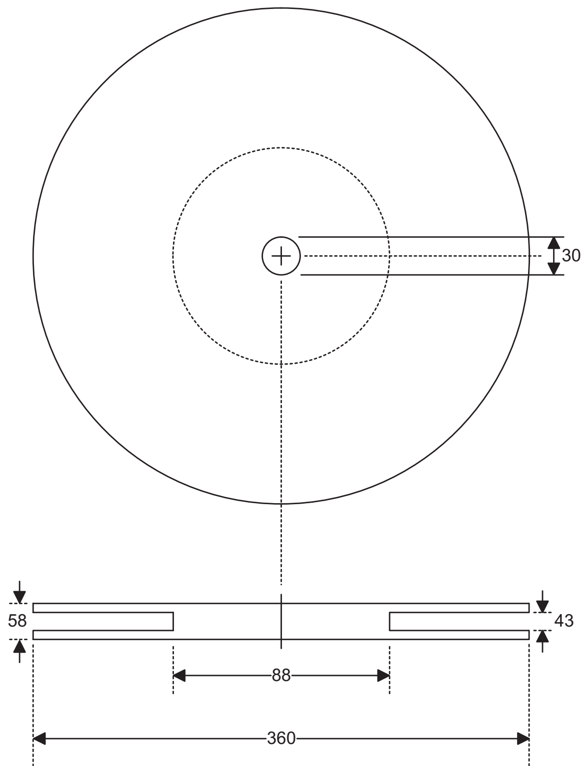
3-pin SOT-89 Outline Dimensions

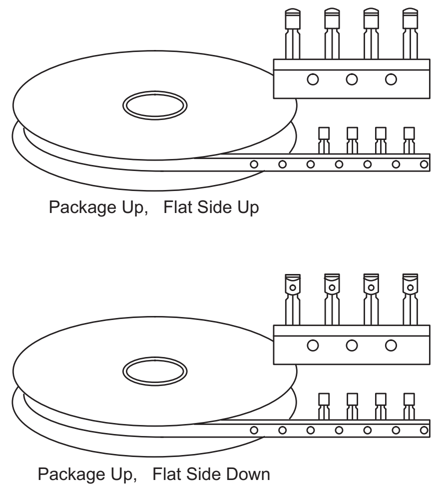


Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	173	—	181
B	64	—	72
C	90	—	102
D	35	—	47
E	155	—	167
F	14	—	19
G	17	—	22
H	—	59	—
I	55	—	63
J	14	—	17

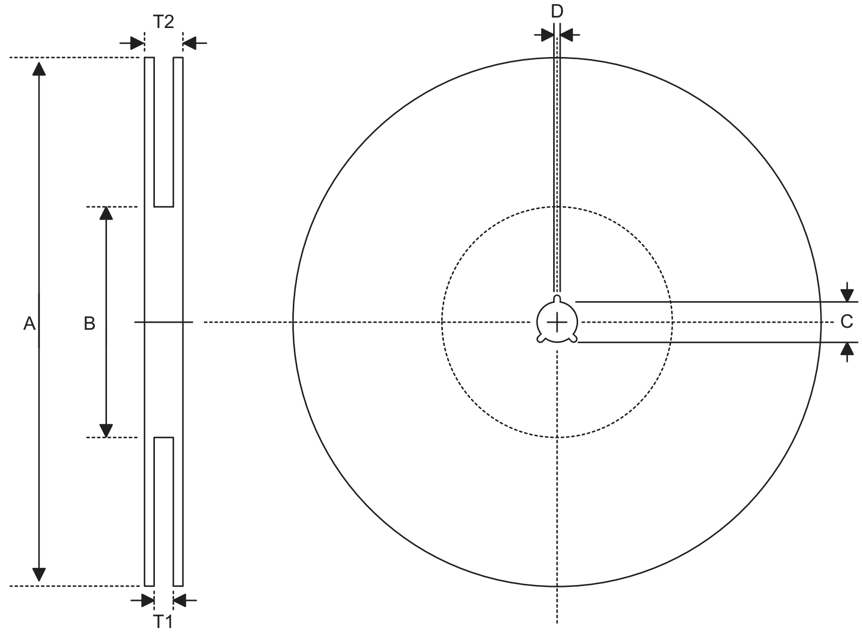
Product Tape and Reel Specifications

TO-92 Reel Dimensions (Unit: mm)





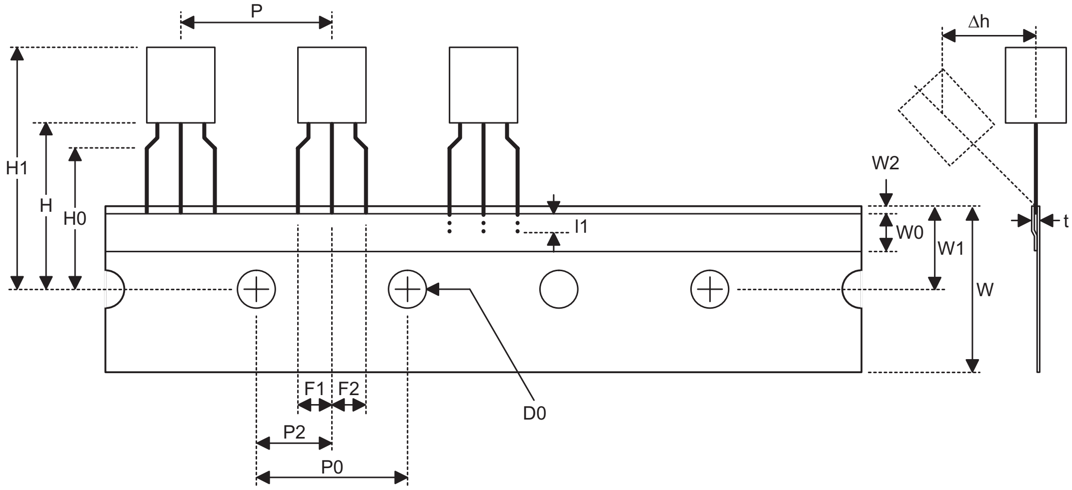
SOT-89 Reel Dimensions



SOT-89

Symbol	Description	Dimensions in mm
A	Reel Outer Diameter	180±1.0
B	Reel Inner Diameter	62±1.5
C	Spindle Hole Diameter	12.75+0.15
D	Key Slit Width	1.9±0.15
T1	Space Between Flange	12.4+0.2
T2	Reel Thickness	17−0.4

TO-92 Carrier Tape Dimensions



TO-92

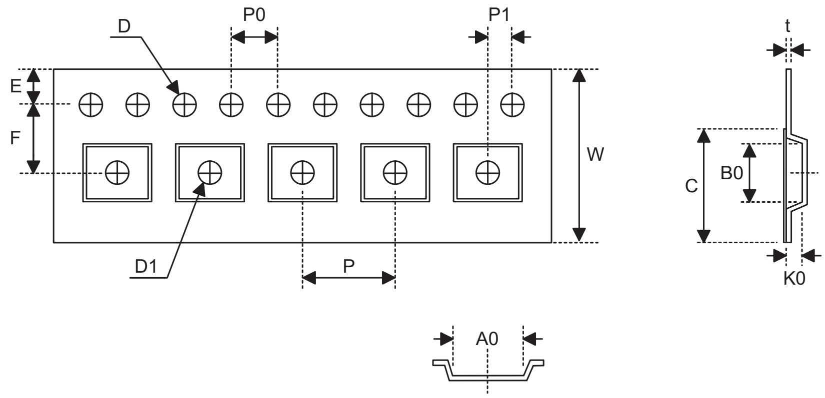
Symbol	Description	Dimensions in mm
I1	Taped Lead Length	(2.5)
P	Component Pitch	12.7±1.0
P_0	Perforation Pitch	12.7±0.3
P_2	Component to Perforation (Length Direction)	6.35±0.4
F_1	Lead Spread	2.5+0.4 −0.1
F_2	Lead Spread	2.5+0.4 −0.1
Δh	Component Alignment	0±0.1
W	Carrier Tape Width	18.0+1.0 −0.5
W_0	Hold-down Tape Width	6.0±0.5
W_1	Perforation Position	9.0±0.5
W_2	Hold-down Tape Position	(0.5)
H_0	Lead Clinch Height	16.0±0.5
H_1	Component Height	Less than 24.7
D_0	Perforation Diameter	4.0±0.2
t	Taped Lead Thickness	0.7±0.2
H	Component Base Height	19.0±0.5

Note: Thickness less than 0.38±0.05mm~0.5mm

P0 Accumulated pitch tolerance: ±1mm/20pitches.

( ) Bracketed figures are for consultation only

SOT-89 Carrier Tape Dimensions



SOT-89

Symbol	Description	Dimensions in mm
W	Carrier Tape Width	12.0+0.3 −0.1
P	Cavity Pitch	8.0±0.1
E	Perforation Position	1.75±0.1
F	Cavity to Perforation (Width Direction)	5.5±0.05
D	Perforation Diameter	1.5+0.1
D1	Cavity Hole Diameter	1.5+0.1
P0	Perforation Pitch	4.0±0.1
P1	Cavity to Perforation (Length Direction)	2.0±0.10
A0	Cavity Length	4.8±0.1
B0	Cavity Width	4.5±0.1
K0	Cavity Depth	1.8±0.1
t	Carrier Tape Thickness	0.30±0.013
C	Cover Tape Width	9.3

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