ADVANCED INFORMATION

VOLTAGE DETECTOR

FEATURES

- **Very Low Quiescent Current (1 μA)**
- **No External Components**
- **Built In Hysteresis (5% typ.)**
- **±2 % Voltage Detection Accuracy**
- **Miniature Package (SOT23-5)**

APPLICATIONS

- **Battery Powered Systems**
- **Wireless Telephones**
- **Pagers**
- **Personal Communications Equipment**
- **Personal Digital Assistants**

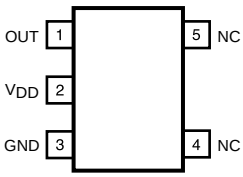
DESCRIPTION

The TK610xx family of voltage detectors is designed to provide accurate monitoring of the battery voltage. These low powered CMOS devices require no external components and are available in 0.1 V steps from 2.0 V to 5.0 V.

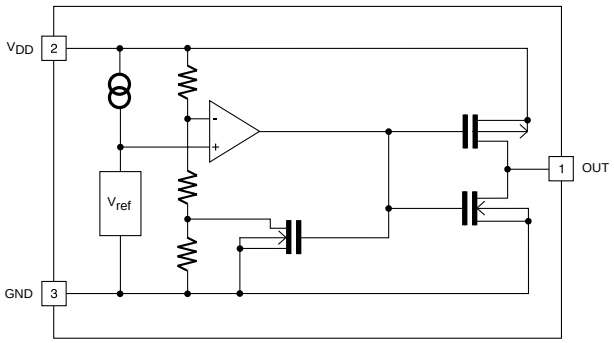
When the input voltage reaches the detection voltage, the output goes low. This detection voltage has a ±2 % accuracy and is set at the factory. When the input voltage goes high, the output will stay low until the voltage reaches the detection voltage plus hysteresis (+3 to +7 %).

The TK610xx is available in a miniature SOT23-5 surface mount package.

TK610xx



BLOCK DIAGRAM



ORDERING INFORMATION

TK610□□S □□

Voltage Code — Tape/Reel Code

VOLTAGE CODE *

23 = 2.3 V	36 = 3.6 V
25 = 2.5 V	40 = 4.0 V
27 = 2.7 V	41 = 4.1 V
30 = 3.0 V	42 = 4.2 V
33 = 3.3 V	45 = 4.5 V

* Consult factory for availability of other voltages

TAPE/REEL CODE
TL: Tape Left

ABSOLUTE MAXIMUM RATINGS

All Pins Except GND ..... 11 V
Power Dissipation (Note 4) ..... 400 mW
Storage Temperature Range ..... -40 to +125 °C
Operating Temperature Range .....-30 to +80 °C
Junction Temperature ..... 150 °C

TK610xx ELECTRICAL CHARACTERISTICS

T_A = 25 °C, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
V_{ERR}	Voltage Accuracy	Note 1	-2		+2	%
HYS	Hysteresis	Note 2	3	5	7	%
V_{DDH}	Maximum Operating Voltage		9			V
V_{DDL}	Lowest Operating Voltage				0.8	V
$\frac{\Delta V_{DET}}{V_{DET} * \Delta T}$	Detection Voltage Temperature Coefficient	-30 ° C ≤ top ≤ 80 ° C		±100		ppm/° C
t_{DR}	Rise Propagation Delay Time	Note 3		100		µsec
I_{SSL}	Supply Current (L)	V_{DD} = 1.0 V			1.0	µA
I_{SSM}	Supply Current (M)	V_{DD} = 5.0 V, 2.0 V ≤ Setting Voltage ≤ 5.0 V		1.0	2.0	µA
I_{SSH}	Supply Current (H)	V_{DD} = 7.0 V, 4.2 V ≤ Setting Voltage ≤ 5.0 V		1.5	3.0	µA
I_{ON1}	Output Current (N1) (Note 5)	V_{DS} = 0.05 V, V_{DD} = 0.8 V	0.01	0.05		mA
I_{ON2}	Output Current (N2) (Note 5)	V_{DS} = 0.5 V, V_{DD} = 1.5 V	2.0	4.0		mA
I_{OP1}	Output Current (P1) (Note 6)	V_{DS} = 2.1 V, V_{DD} = 4.5 V, 2.0 V ≤ Setting Voltage ≤ 4.1 V	2.0	4.0		mA
I_{OP1}	Output Current (P1) (Note 6)	V_{DS} = 2.1 V, V_{DD} = 7.0 V, 4.2 V ≤ Setting Voltage ≤ 5.0 V	6.0	8.0		mA

Note 1: V_{ERR} = 100 * (V_{DET} - Setting Voltage) / Setting Voltage expressed in %
Note 2: HYS = 100 * (V_{HYS} - V_{DET}) / V_{DET} expressed in %
Note 3: The applied voltage is a pulse of V_{LOW} = 0.8 V, V_{HIGH} = V_{DET} + 2 V
Note 4: Power dissipation is 400 mW when mounted as recommended. Derate at 3.2 mW/°C for operation above 25 °C.
Power dissipation is 200 mW in Free Air. Derate at 1.6 mW/°C for operation above 25 °C.
Note 5: Output sink current.
Note 6: Output source current.

TEST CIRCUIT

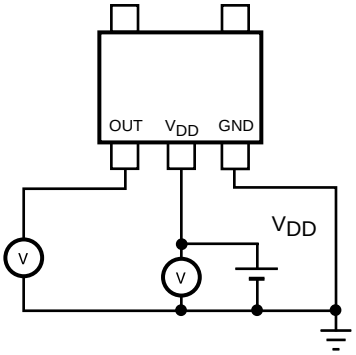


FIGURE 1: TEST CIRCUIT FOR V_{DET}, V_{HYS}, V_{DDH}, V_{DDL}, t_{DR}

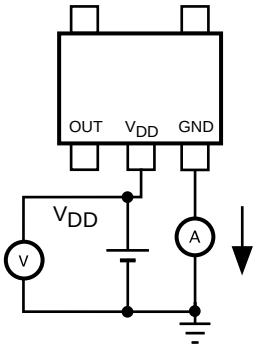


FIGURE 3: TEST CIRCUIT FOR I_{SS}

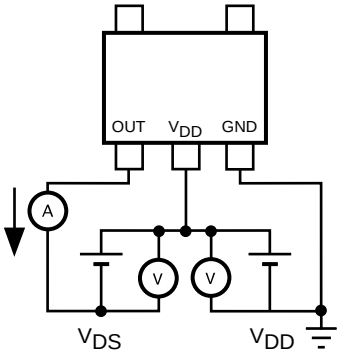


FIGURE 2: TEST CIRCUIT FOR I_{OP}

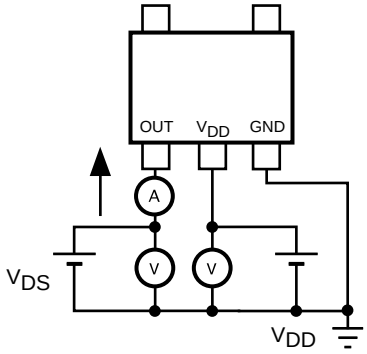
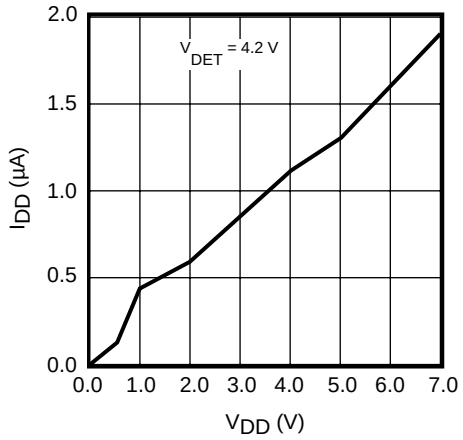


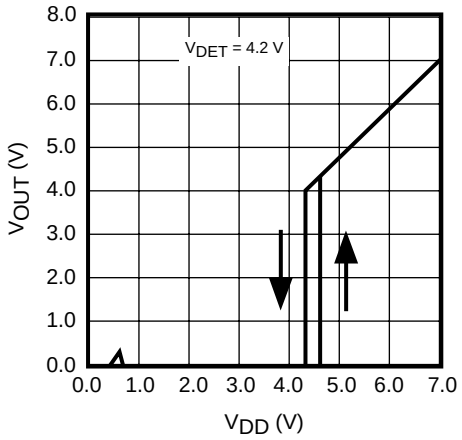
FIGURE 4: TEST CIRCUIT FOR I_{ON}

TYPICAL PERFORMANCE CHARACTERISTICS

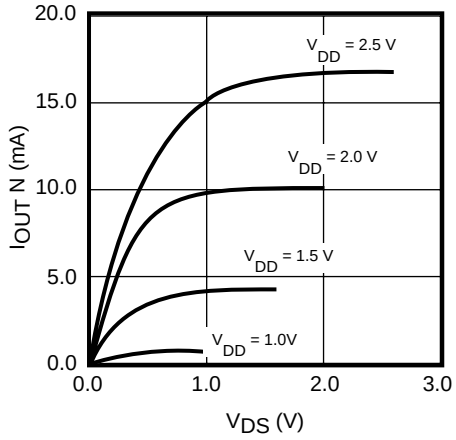
SUPPLY CURRENT vs. OPERATING VOLTAGE



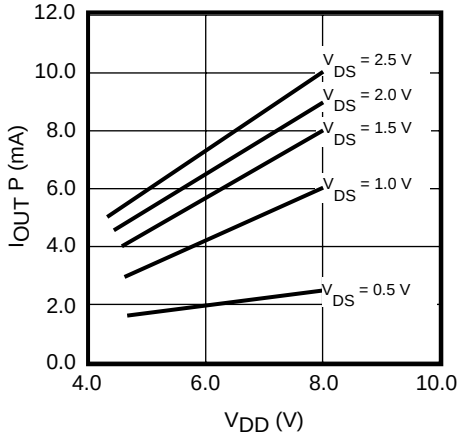
OUTPUT VOLTAGE vs. MAXIMUM OPERATING VOLTAGE



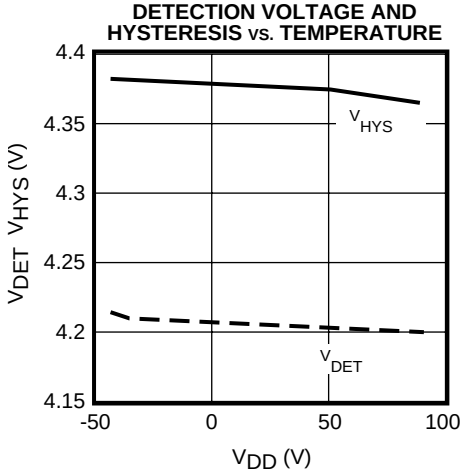
OUTPUT SINK CURRRENT vs. OUTPUT VOLTAGE



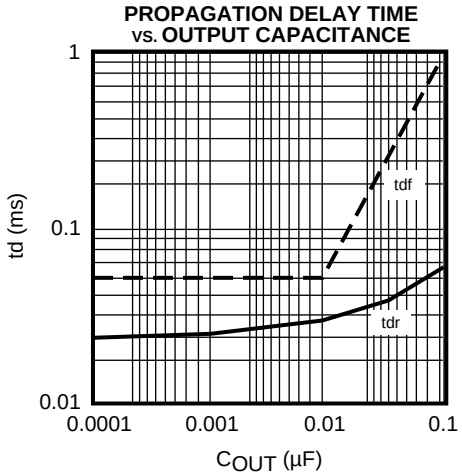
OUTPUT SOURCE CURRRENT vs. OPERATING VOLTAGE



DETECTION VOLTAGE AND HYSTERESIS vs. TEMPERATURE



PROPAGATION DELAY TIME vs. OUTPUT CAPACITANCE



DEFINITION AND EXPLANATION OF TECHNICAL TERMS

DETECTION VOLTAGE (V_{DET})

When V_{DD} goes below the detection voltage, the output goes low.

HYSTERESIS VOLTAGE (V_{HYS})

When V_{DD} goes above the sum of the detection voltage and the hysteresis voltage, the output goes high.

SUPPLY CURRENT (I_{SSL})

Supply current (V_{DD} = 1 V)

SUPPLY CURRENT (I_{SSM})

Supply current (V_{DD} = 5 V) 2.0 V ≤ setting voltage ≤ 4.1 V

SUPPLY CURRENT (I_{SSH})

Supply current (V_{DD} = 7 V) 4.2 ≤ setting voltage ≤ 5.0 V

OUTPUT CURRENT (I_{ON1})

Output sink current of output N channel FET
V_{DD} = 0.8 V, V_{DS} = 0.5 V

OUTPUT CURRENT (I_{ON2})

Output sink current of output N channel FET
V_{DD} = 1.5 V, V_{DS} = 0.5 V

OUTPUT CURRENT (I_{OP1})

Output source current of output P channel FET
V_{DD} = 4.5 V, V_{DS} = 2.1 V, 2.0 V ≤ setting voltage ≤ 4.1 V

VOLTAGE ACCURACY (V_{ERR})

Error ratio of set voltage
V_{ERR} = 100 * (V_{DET} - Setting Voltage)/ Setting Voltage expressed in %

HYSTERESIS (HYS)

Ratio of hysteresis voltage to detection voltage
HYS = 100 * (V_{HYS} - V_{DET}) / V_{DET} expressed in %

MAXIMUM OPERATING VOLTAGE (V_{DDH})

The maximum operating voltage.

LOWEST OPERATING VOLTAGE (V_{DDL})

Voltage when V_{DD} is reduced and output goes up from 0 V to 100 mV.

DETECTION VOLTAGE TEMPERATURE COEFFICIENT ($\Delta V_{DET} / V_{DET} * \Delta T$)

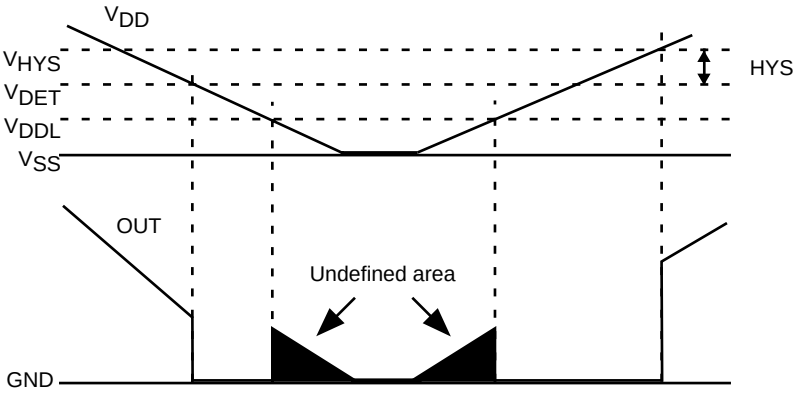
Temperature coefficient of detection voltage.

$$\frac{\Delta V_{DET}}{V_{DET} * \Delta T} = \frac{1000000 * (V_{DET}(T) - V_{DET}(25\ ^\circ C))}{V_{DET}(25\ ^\circ C) * (T - 25\ ^\circ C)}$$

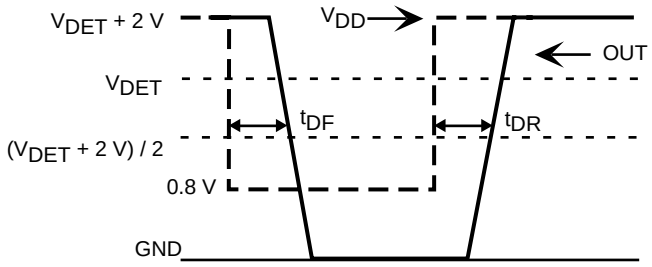
RISE PROPAGATION DELAY TIME (t_{DR})

The delay time for the output to reach (V_{DET} + 2.0 V) / 2 when V_{DD} goes from V_{LOW} = 0.8 V to V_{HIGH} = V_{DET} + 2.0 V

OUTPUT CHARACTERISTICS



OUTPUT vs. SUPPLY VOLTAGE

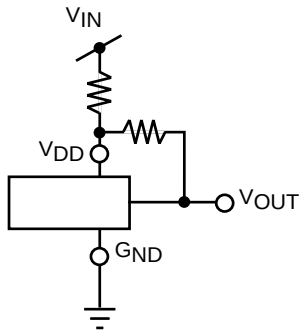


OUTPUT PROPAGATION DELAY

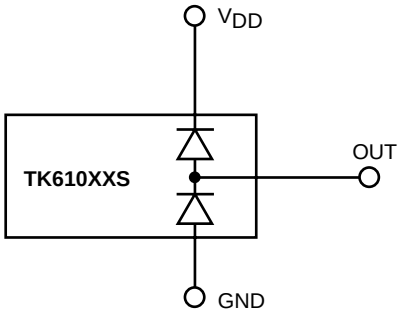
APPLICATION INFORMATION

CHANGING DETECTION VOLTAGE USING EXTERNAL RESISTORS

It is not recommended to set the detection voltage using external resistors (See figure below) as oscillations may occur.

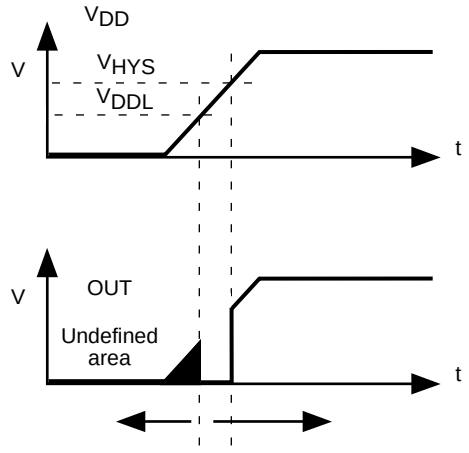


Note: For the TK610xx , there is an internal diode between GND and Output and another diode between Output and V_{DD}. Current will flow between these terminals if the diodes are forward biased. See the figure below for diode polarity.



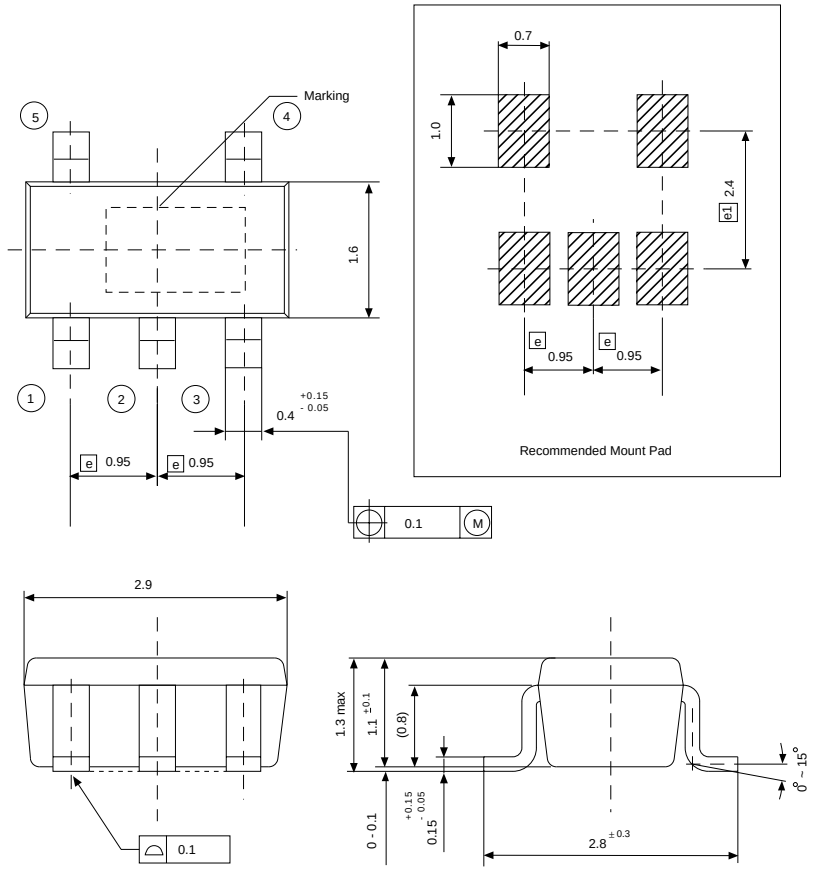
OUTPUT H CHARACTERISTICS FOR $V_{DD} < V_{DD1}$

The output voltage is not defined when $V_{DD} < V_{DDL}$.



PACKAGE OUTLINE

SOT23-5



Dimensions are shown in millimeters
Tolerance: x.x = ± 0.2 mm (unless otherwise specified)

Marking Information

	Marking
TK61023	23U
TK61025	25U
TK61027	27U
TK61030	30U
TK61033	33U
TK61036	36U
TK61040	40U
TK61041	41U
TK61042	42U
TK61045	45U

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