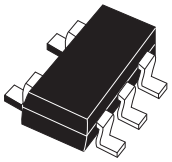
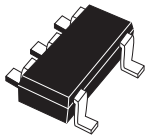
STWD100

Watchdog timer circuit

Datasheet - production data



SOT23-5 (WY)



SC70-5,
SOT323-5 (W8)

Applications

- Telecommunications
- Alarm systems
- Industrial equipment
- Networking
- Medical equipment
- UPS (uninterruptible power supply)

Features

- Current consumption 13 µA typ.
- Available watchdog timeout periods are 3.4 ms, 6.3 ms, 102 ms and 1.6 s
- Chip enable input
- Open drain or push-pull $\overline{WDO}$ output
- Operating temperature range: –40 to +125 °C
- Package SOT23-5, SC70-5 (SOT323-5)
- ESD performance
  - HBM: 2000 V
  - RCDM: 1000 V

Table 1. Device summary

Order code	Temperature range	Package	Packing	Topside marking
STWD100NWWY3F	-40/+125 °C	SOT23-5L	Tape and reel	WNW
STWD100YNWWY3F(1)	-40/+125 °C	SOT23-5L (automotive grade)	Tape and reel	WYNW
STWD100NYWY3F	-40/+125 °C	SOT23-5L	Tape and reel	WNY
STWD100YNYWY3F(1)	-40/+125 °C	SOT23-5L (automotive grade)	Tape and reel	WYNY
STWD100NPWY3F	-40/+125 °C	SOT23-5L	Tape and reel	WNP
STWD100YNPWY3F(1)	-40/+125 °C	SOT23-5L (automotive grade)	Tape and reel	WYNP
STWD100PYW83F	-40/+125 °C	SOT323-5L	Tape and reel	WPY

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q002 or equivalent

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1 Description

The STWD100 watchdog timer circuits are self-contained devices which prevent system failures that are caused by certain types of hardware errors (non-responding peripherals, bus contention, etc.) or software errors (bad code jump, code stuck in loop, etc.).

The STWD100 watchdog timer has an input, WDI, and an output, $\overline{WDO}$. The input is used to clear the internal watchdog timer periodically within the specified timeout period, t_{wd}. While the system is operating correctly, it periodically toggles the watchdog input, WDI. If the system fails, the watchdog timer is not reset, a system alert is generated and the watchdog output, $\overline{WDO}$, is asserted.

The STWD100 circuit also has an enable pin, $\overline{EN}$, which can enable or disable the watchdog functionality. The $\overline{EN}$ pin is connected to the internal pull-down resistor. The device is enabled if the $\overline{EN}$ pin is left floating.

Figure 1. SOT23-5 and SC70-5 (SOT323-5) package connections

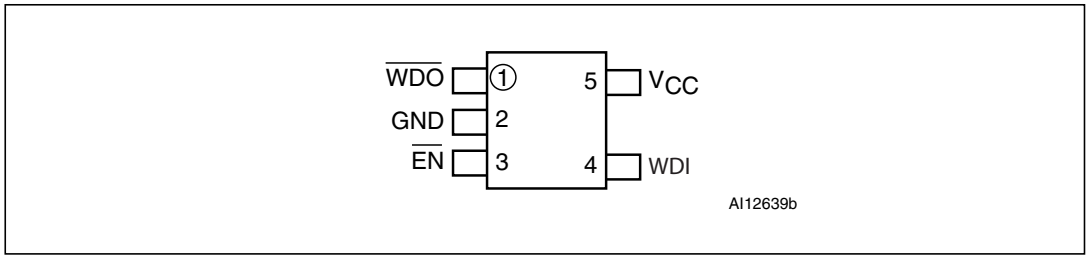
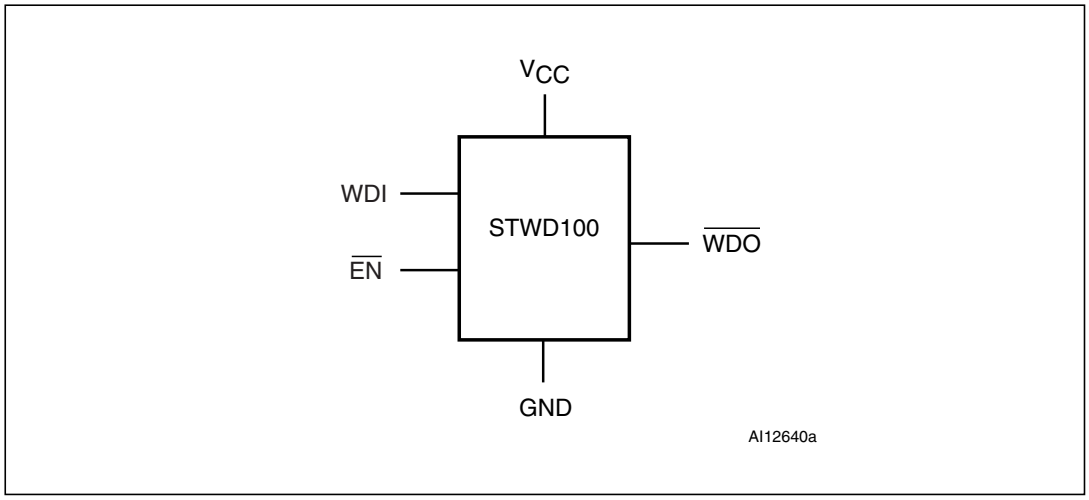


Table 2. SOT23-5 and SC70-5 (SOT323-5) pin description

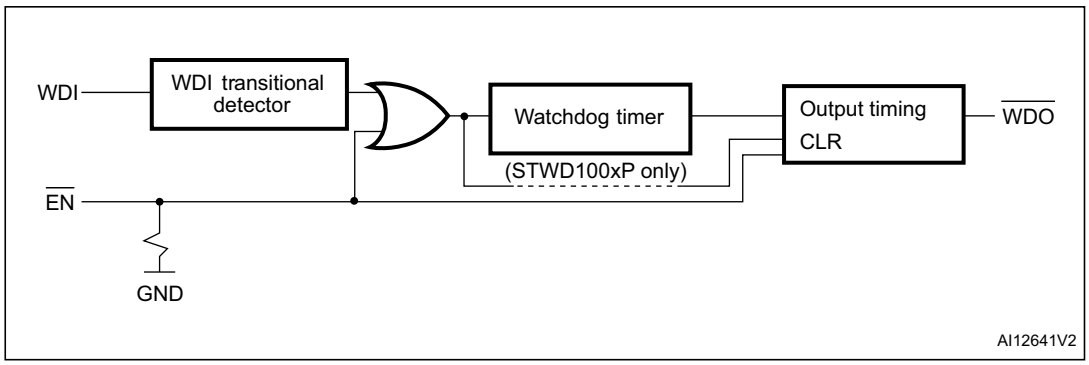
Pin number	Name	Description
1	$\overline{WDO}$	Watchdog output
2	GND	Ground
3	$\overline{EN}$	Enable pin
4	WDI	Watchdog input
5	V_{CC}	Supply voltage

Figure 2. Logic diagram



Note: $\overline{WDO}$ output is available in open drain or push-pull configuration.

Figure 3. Block diagram



Note: Positive pulse on enable pin $\overline{EN}$ longer than 1 µs resets the watchdog timer.

2 Operation

The STWD100 device is used to detect an out-of-control MCU. The user has to ensure watchdog reset within the watchdog timeout period, otherwise the watchdog output is asserted and MCU is restarted. The STWD100 can be also enabled or disabled by the chip enable pin.

2.1 Watchdog input (WDI)

The WDI input has to be toggled within the watchdog timeout period, t_{WD}, otherwise the watchdog output, $\overline{WDO}$, is asserted. The internal watchdog timer, which counts the t_{WD} period, is cleared either:

1. by a transition on watchdog output, $\overline{WDO}$ (see *Figure 8 on page 12*) or
2. by a pulse on enable pin, $\overline{EN}$ (see *Figure 10 on page 14*) or
3. by toggling WDI input (low-to-high on all versions and high-to-low on STWD100xW, STWD100xX and STWD100xY only).

The pulses on WDI input with a duration of at least 1 µs are detected and glitches shorter than 100 ns are ignored.

If WDI is permanently tied high or low and $\overline{EN}$ is tied low, the $\overline{WDO}$ toggles every 3.4 ms (t_{WD}) on STWD100xP and every t_{WD} and t_{PW} on STWD100xW, STWD100xX and STWD100xY (see *Figure 8 on page 12*).

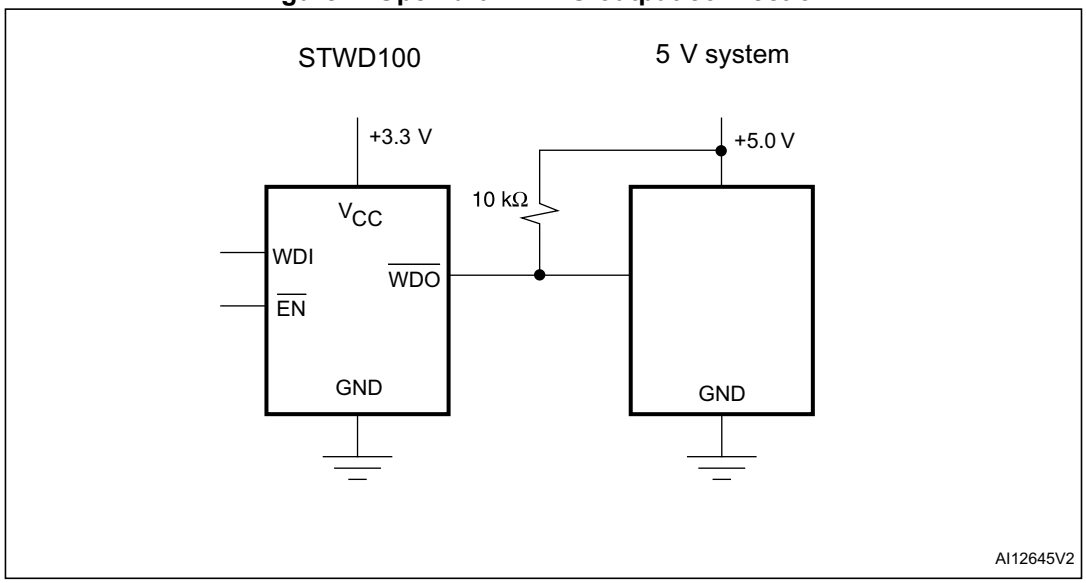
2.2 Watchdog output ($\overline{WDO}$)

When the V_{CC} exceeds the timer startup voltage V_{START} after power-up, the internal watchdog timer starts counting. If the timer is not cleared within the t_{WD}, the $\overline{WDO}$ will go low (see *Figure 6*).

After exceeding the t_{WD}, the $\overline{WDO}$ is asserted for t_{PW} on STWD100xW, STWD100xX and STWD100xY regardless of possible WDI transitions (see *Figure 9 on page 13*). On STWD100xP $\overline{WDO}$ is asserted for a minimum of 10 µs and a maximum of t_{WD} after exceeding the t_{WD} period (see *Figure 8 on page 12* and *Figure 9 on page 13*).

The STWD100 has an active low open drain or push-pull output. An external pull-up resistor connected to any supply voltage up to 6 V is required in case of open drain $\overline{WDO}$ output (see *Figure 4*). Select a resistor value large enough to register a logic low, and small enough to register a logic high while supplying all input current and leakage paths connected to the reset output line. A 10 kΩ pull-up resistor is sufficient in most applications.

Figure 4. Open drain $\overline{\text{WDO}}$ output connection



2.3 Chip enable input ($\overline{\text{EN}}$)

All states mentioned in *Section 2.1: Watchdog input (WDI)* and *Section 2.2: Watchdog output (WDO)* are valid under the condition that $\overline{\text{EN}}$ is in logical low state.

The behavior of $\overline{\text{EN}}$ is common to all versions (i.e. STWD100xP, STWD100xW, STWD100xX and STWD100xY).

If the $\overline{\text{EN}}$ goes high after power-up in less than t_{WD} from the moment that V_{CC} exceeds the timer startup voltage, V_{START}, the $\overline{\text{WDO}}$ will stay high for the same time period as $\overline{\text{EN}}$, plus t_{WD} (see *Figure 10 on page 14*).

If the $\overline{\text{EN}}$ goes high anytime during normal operation, the $\overline{\text{WDO}}$ will go high as well, but the minimum possible $\overline{\text{WDO}}$ pulse width is 10 µs (see *Figure 10 on page 14*).

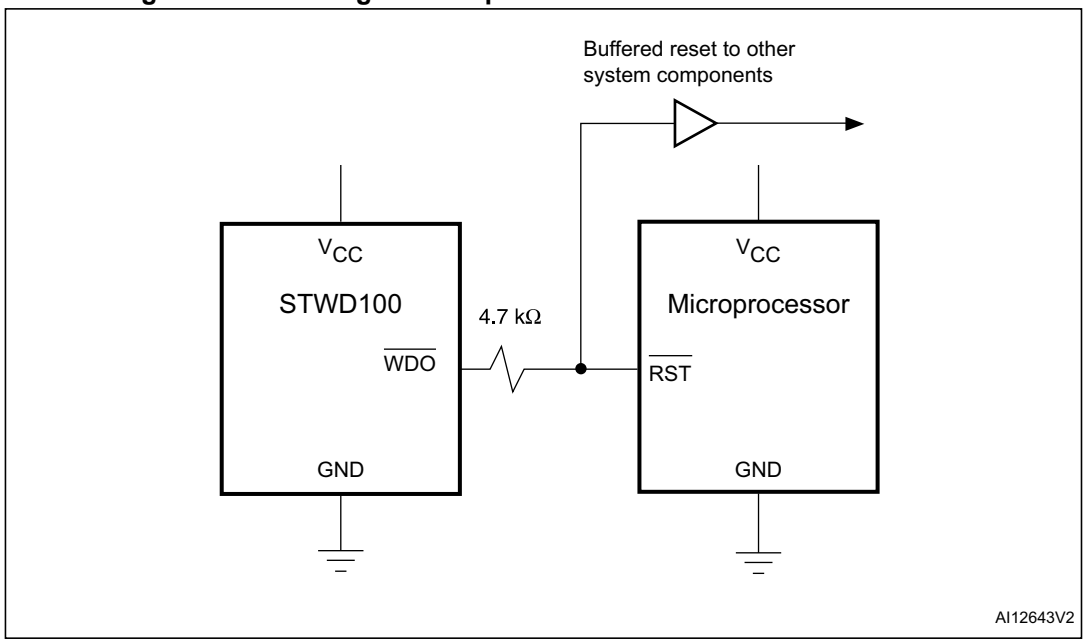
The pulses on the $\overline{\text{EN}}$ pin with a duration of at least 1 µs are detected and glitches shorter than 100 ns are ignored.

2.4 Applications information

Interfacing to microprocessors with bidirectional reset pins

Microprocessors with bidirectional reset pins can contend with the STWD100 watchdog output, $\overline{\text{WDO}}$. For example, if the $\overline{\text{WDO}}$ output is driven high and the micro wants to pull it low, signal contention will result. To prevent this from occurring, connect a 4.7 kΩ resistor between the $\overline{\text{WDO}}$ output and the microprocessors reset I/O as in *Figure 5*.

Figure 5. Interfacing to microprocessors with bidirectional reset I/O



3 Watchdog timing

Figure 6. Power-up

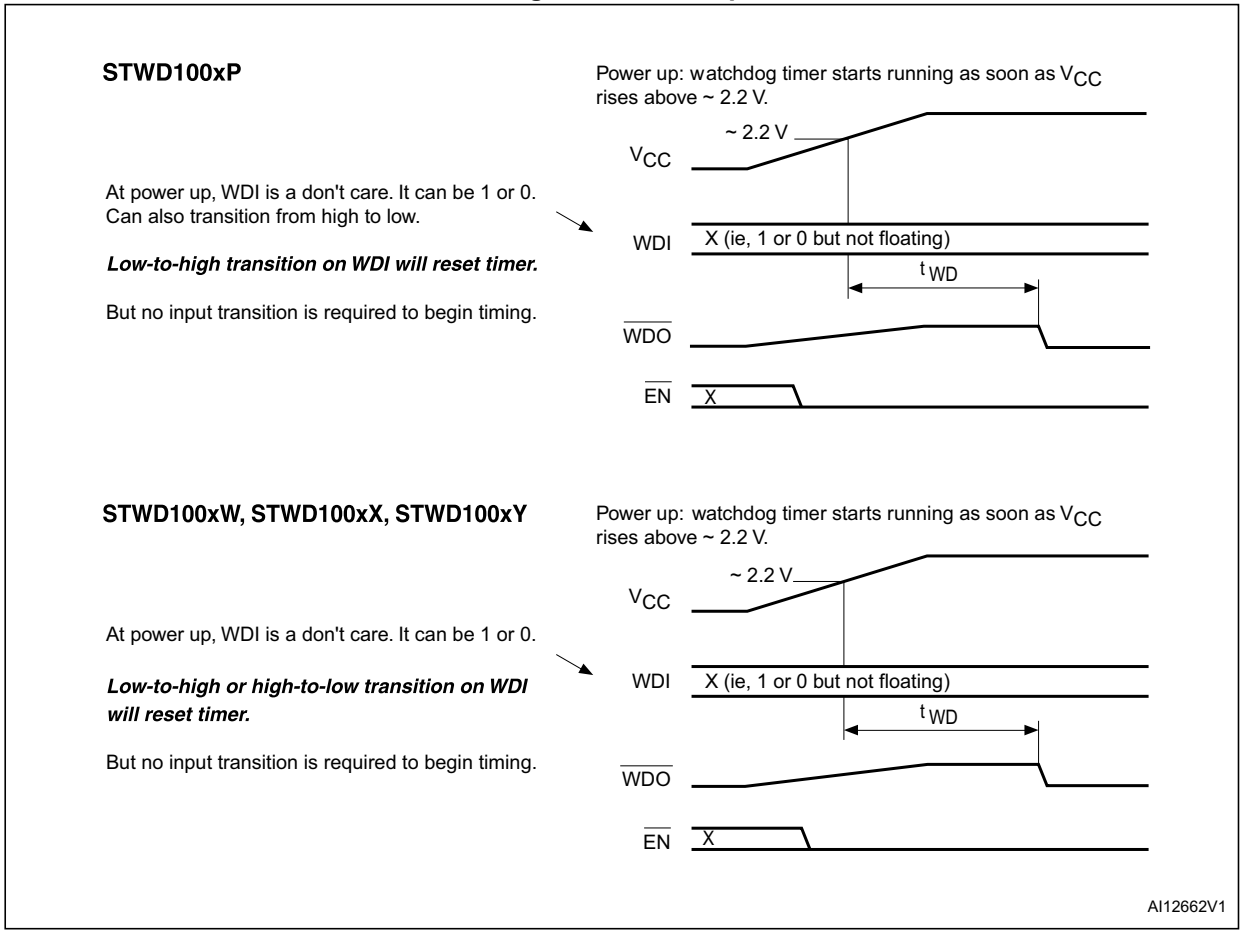


Figure 7. Normal triggering

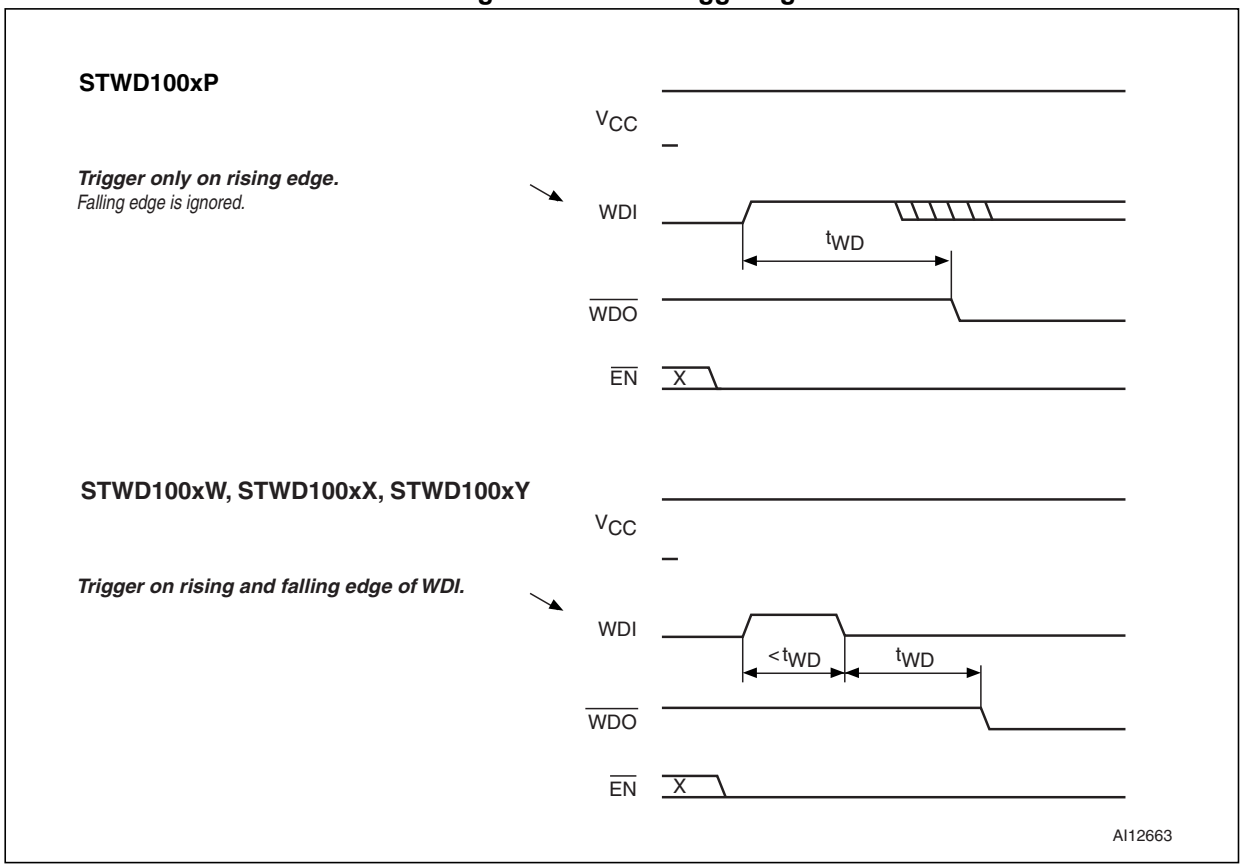


Figure 8. Timeout without re-trigger

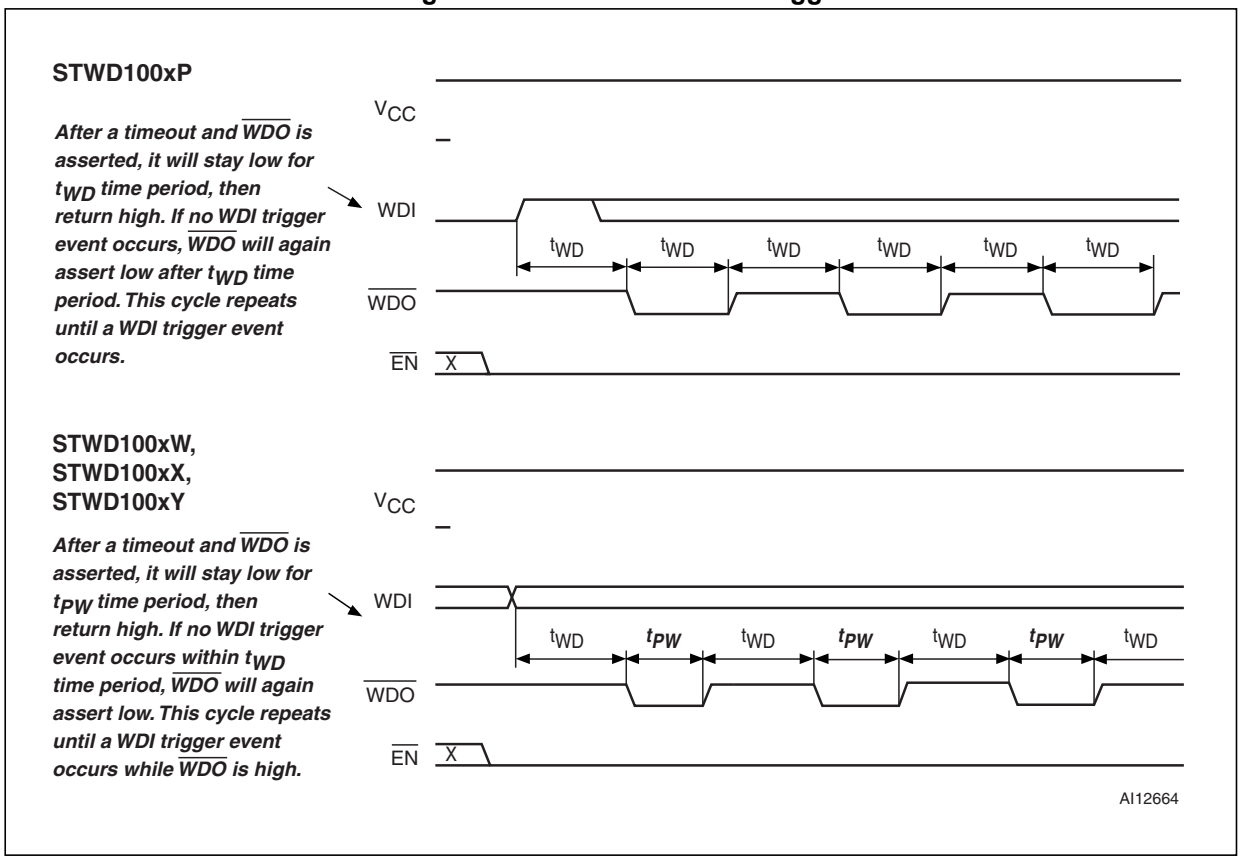
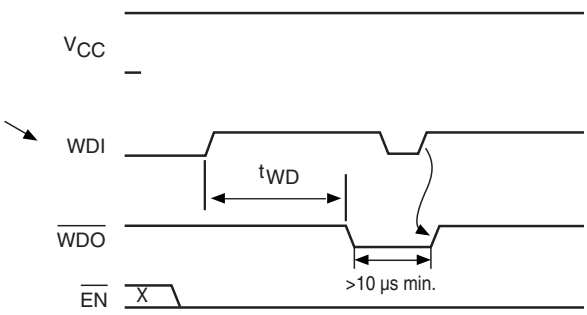


Figure 9. Trigger after timeout

STWD100xP

If a WDI trigger occurs after the $\overline{WDO}$ output has asserted, the output will de-assert, but with a pulse width of at least 10 µs (min).



STWD100xW, STWD100xX, STWD100xY

If a WDI trigger occurs after the $\overline{WDO}$ output has asserted, it is ignored, and the output remains asserted for the specified time, t_{PW}.

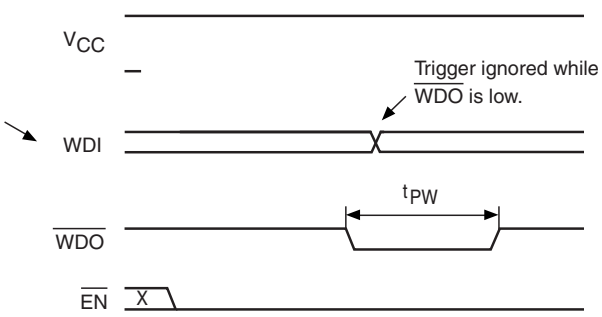


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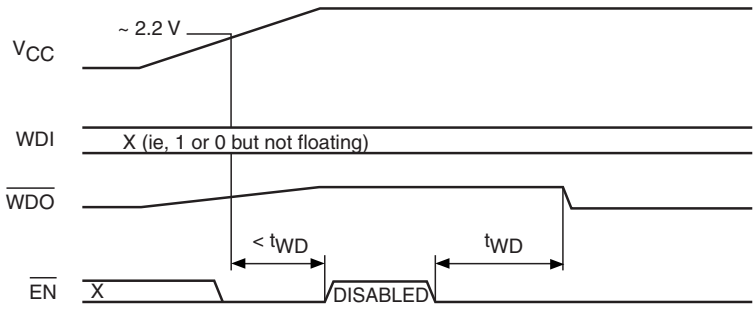
Figure 10. Enable pin, $\overline{EN}$, triggering

STWD100xx

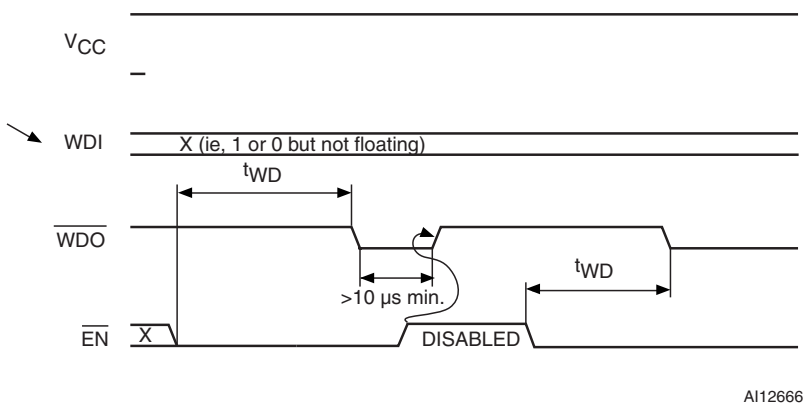
Whenever $\overline{EN}$ is high, all timing is reset, and the part is disabled.

Timing commences from 0 when $\overline{EN}$ goes low.



STWD100xx

If $\overline{EN}$ goes high while $\overline{WDO}$ is asserted, $\overline{WDO}$ will de-assert but only after the nominal minimum pulse width of 10 µs has elapsed.



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4 Maximum ratings

Stressing the device above the rating listed in *Table 3* may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in *Table 4* of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE program and other relevant quality documents.

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
T_{STG}	Storage temperature (V_{CC} off)	–55 to 150	°C
T_{SLD}(1)	Lead solder temperature for 10 seconds	260	°C
V_{IO}	Input or output voltage	–0.3 to V_{CC} +0.3	V
V_{CC}	Supply voltage	–0.3 to 7.0	V
I_O	Output current	20	mA
P_D	Power dissipation	320	mW

1. Reflow at peak temperature of 260 °C (total thermal budget not to exceed 245 °C for greater than 30 seconds).

5 DC and AC parameters

This section summarizes the operating measurement conditions, and the DC and AC characteristics of the device. The parameters in *Table 5* that follows, are derived from tests performed under the measurement conditions summarized in *Table 4*. Designers should check that the operating conditions in their circuit match the operating conditions when relying on the quoted parameters.

Table 4. Operating and AC measurement conditions

Parameter	Value	Unit
V_{CC} supply voltage	2.7 to 5.5	V
Ambient operating temperature (T_A)	–40 to 125	°C
Input rise and fall times	≤ 5	ns
Input pulse voltages	0.2 to 0.8 V_{CC}	V
Input and output timing ref. voltages	0.3 to 0.7 V_{CC}	V

Table 5. DC and AC characteristics

Symbol	Description	Test condition(1)	Min.	Typ.	Max.	Unit
V_{CC}	Operating voltage		2.7	5	5.5	V
I_{CC}	V_{CC} supply current			13	26	µA
I_{LO}	Open drain output leakage current	From output to the GND or V_{CC}	–1		+1	µA
	Input leakage current (WDI)		–1		+1	µA
V_{IH}	Input high voltage (WDI, $\overline{EN}$)		0.7 V_{CC}			V
V_{IL}	Input low voltage (WDI, $\overline{EN}$)				0.3 V_{CC}	V
V_{OL}	Output low voltage ($\overline{WDO}$)	$V_{CC} \geq 2.7$ V, I_{SINK} = 1.2 mA			0.3	V
		$V_{CC} \geq 4.5$ V, I_{SINK} = 3.2 mA			0.4	V
V_{OH}	Output high voltage ($\overline{WDO}$) (push-pull only)	$V_{CC} \geq 2.7$ V, I_{SOURCE} = 500 µA	0.8 V_{CC}			V
		$V_{CC} \geq 4.5$ V, I_{SOURCE} = 800 µA	0.8 V_{CC}			V
Enable pin ($\overline{EN}$)						
	$\overline{EN}$ input pulse width		1			µs
	$\overline{EN}$ glitch rejection			100		ns
	$\overline{EN}$-to-$\overline{WDO}$ delay(2)			200		ns
	$\overline{EN}$ pull-down resistance		32	63	100	kΩ
Watchdog timer						
V_{START}	Timer startup voltage		1.9	2.2	2.7	V
t_{WD}	Watchdog timeout period	STWD100xP	2.3	3.4	4.6	ms
		STWD100xW	4.3	6.3	8.6	ms
		STWD100YxW	5.1	6.3	8.6	ms
		STWD100xX	71	102	142	ms
		STWD100xY	1.12	1.6	2.24	s
t_{PW}	Watchdog active time		140	210	280	ms
	WDI-to-$\overline{WDO}$ delay(3)			150		ns
	WDI pulse width		1			µs
	WDI glitch rejection			100		ns

1. Valid for ambient operating temperature: T_A = –40 to 125 °C; V_{CC} = 2.7 V to 5.5 V except where noted.
2. $\overline{WDO}$ will assert for minimum of 10 µs even if $\overline{EN}$ transitions high.
3. $\overline{WDO}$ will assert for minimum of 10 µs regardless of transition on WDI (valid for STWD100xP only).

6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

The maximum ratings related to soldering conditions are also marked on the inner box label.

Figure 11. SOT23-5 - 5-lead small outline transistor package outline

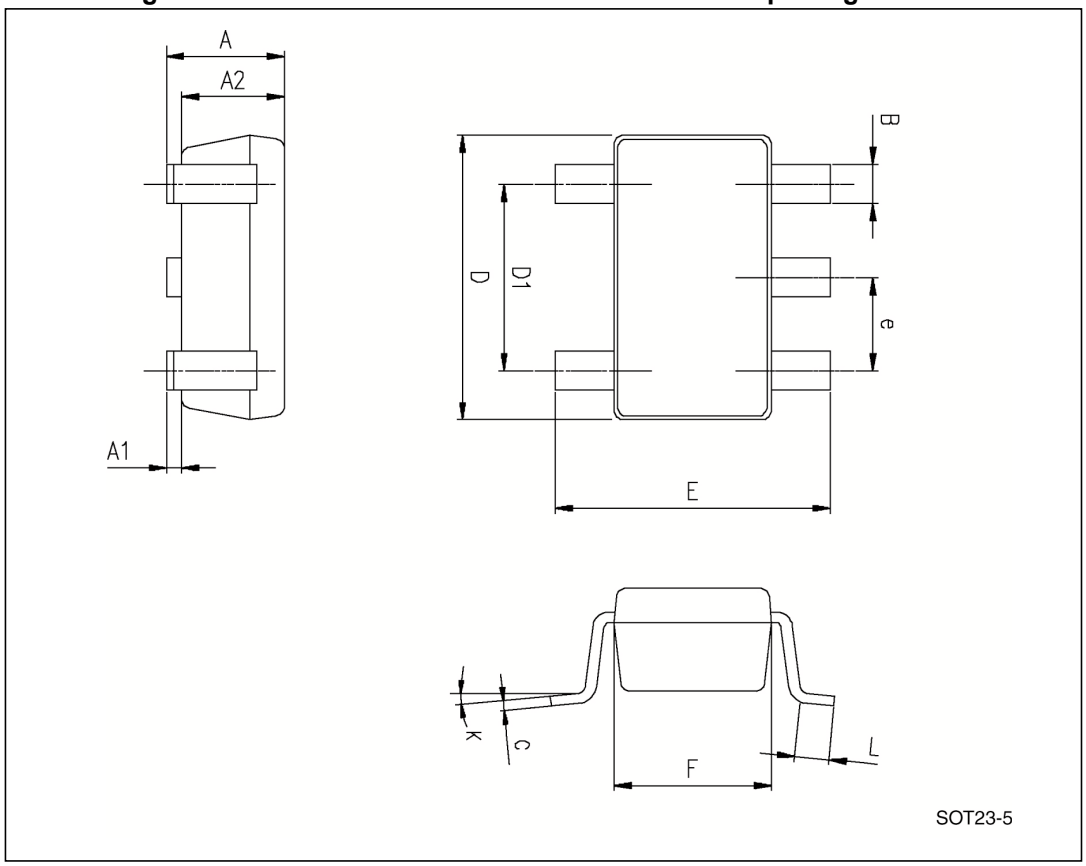

Table 6. SOT23-5 - 5-lead small outline transistor package mechanical data

Symbol	Dimensions					
	mm			inches		
	Typ.	Min.	Max.	Typ.	Min.	Max.
A	1.20	0.90	1.45	0.047	0.035	0.057
A1			0.15			0.006
A2	1.05	0.90	1.30	0.041	0.035	0.051
B	0.40	0.35	0.50	0.016	0.014	0.020
C	0.15	0.09	0.20	0.006	0.004	0.008
D	2.90	2.80	3.00	0.114	0.110	0.118
D1	1.90			0.075		
E	2.80	2.60	3.00	0.110	0.102	0.118
e	0.95			0.037		
F	1.60	1.50	1.75	0.063	0.059	0.069
K		0°	10°		0°	10°
L	0.35	0.10	0.60	0.014	0.004	0.024

Figure 12. SC70 (SOT323-5) - 5-lead small outline transistor package outline

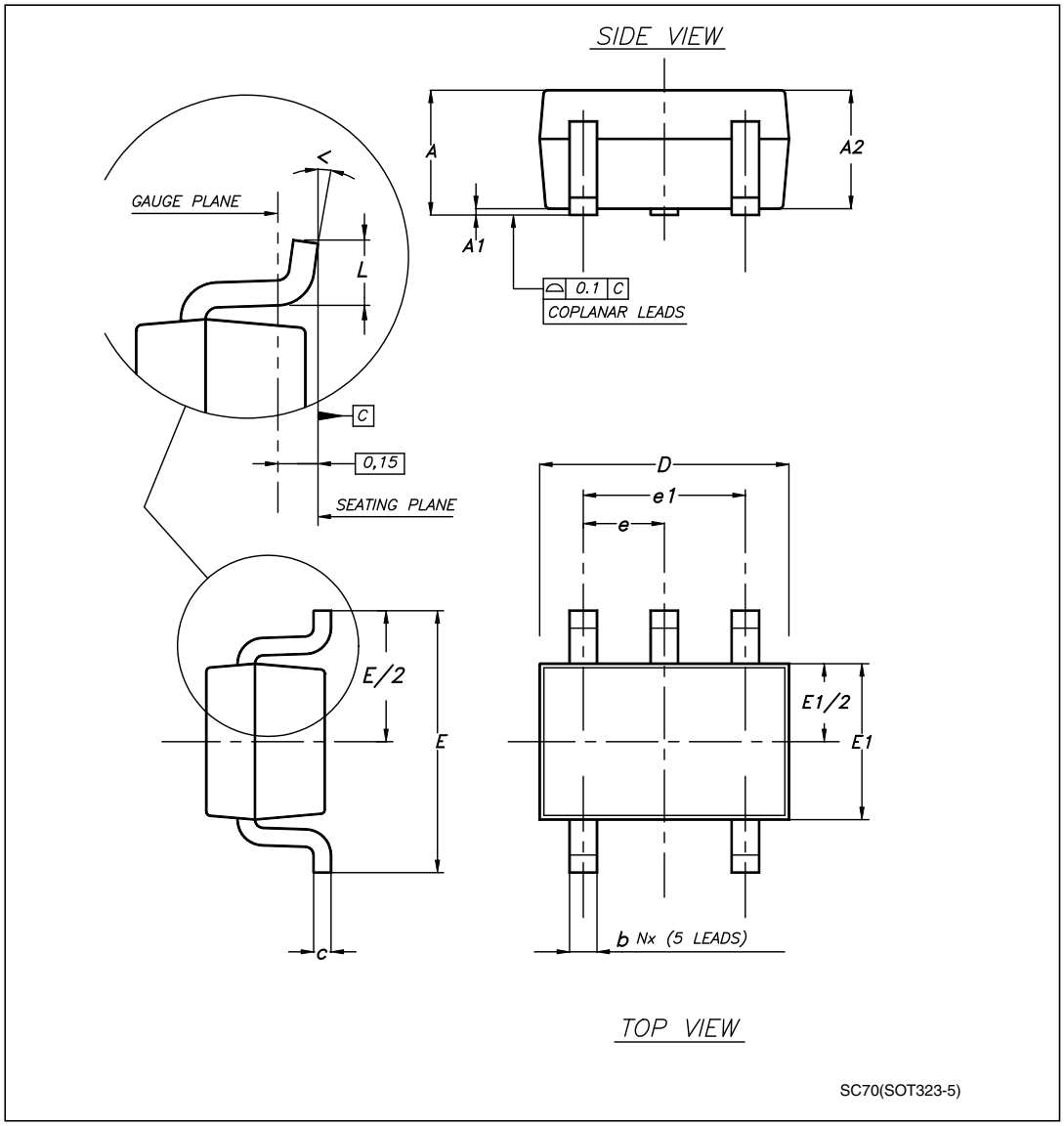

Table 7. SC70 (SOT323-5) – 5-lead small outline transistor package mechanical data

Symbol	Dimensions					
	mm			inches		
	Typ.	Min.	Max.	Typ.	Min.	Max.
A		0.80	1.10		0.031	0.043
A1		0.00	0.10		0.000	0.004
A2	0.90	0.80	1.00	0.035	0.031	0.039
b		0.15	0.30		0.006	0.012
c		0.10	0.22		0.004	0.009
D	2.00	1.80	2.20	0.079	0.071	0.087
E	2.10	1.80	2.40	0.083	0.071	0.094
E1	1.25	1.15	1.35	0.049	0.045	0.053
e	0.65			0.026		
e1	1.30			0.051		
L	0.36	0.26	0.46	0.014	0.010	0.018
<	–	0°	8°	–	0°	8°
N	5			5		

7 Part numbering

Table 8. Ordering information scheme

Example: **STWD100 Y N P WY 3 F**

Device type

STWD100

Device grade

Y: automotive grade

Output type

N: open drain (active low)

P: push-pull (active low)

Device version

P: t_{WD} = 3.4 ms, t_{PW} = t_{WD} = 3.4 ms

W: t_{WD} = 6.3 ms, t_{PW} = 210 ms

X: t_{WD} = 102 ms, t_{PW} = 210 ms

Y: t_{WD} = 1.6 s, t_{PW} = 210 ms

Package

WY: SOT23-5

W8: SC70-5 (SOT323-5)

Temperature range

3: –40 to +125 °C

Shipping method

F: ECOPACK® package, tape and reel

Note: Please check device version availability on www.st.com.
Please contact local ST sales office for new device version request.

8 Package marking information

Table 9. Device versions with marking descriptions

Part number	Watchdog timing period		Output configuration	Topside marking	Bottomside marking(1)
	t_{wd}	t_{pw}			
STWD100NPxxxx	3.4 ms	3.4 ms	Open drain	WNP	PYWW
STWD100NWxxxx	6.3 ms	210 ms	Open drain	WNW	PYWW
STWD100NXxxxx	102 ms	210 ms	Open drain	WNX	PYWW
STWD100NYxxxx	1.6 s	210 ms	Open drain	WNY	PYWW
STWD100PWxxxx	6.3 ms	210 ms	Push-pull	WPW	PYWW
STWD100PXxxxx	102 ms	210 ms	Push-pull	WPX	PYWW
STWD100PYxxxx	1.6 s	210 ms	Push-pull	WPY	PYWW

1. Description: P = assembly plant code, Y = assembly year (0 to 9), WW = assembly work week (01 to 52).

9 Revision history

Table 10. Document revision history

Date	Revision	Changes
08-Nov-2007	1	Initial release.
23-Jan-2008	2	Updated cover page and *Table 5*; document status upgraded to full datasheet.
28-Jan-2008	3	Updated cover page.
17-Mar-2008	4	Updated cover page, *Figure 4*, *7*, *9*, and *Table 5*, *9*.
31-Jul-2008	5	Updated *Features* on cover page and *Table 5*.
05-Mar-2012	6	Added product maturity information and section *Applications*, updated *Section 1*, *Section 2.4*, *Section 4*, *Section 5*, *Section 7* and *Section 8*, ECOPACK® text, minor text corrections throughout document.
26-Oct-2012	7	Updated *Features* (added ESD information). Added *Table 1: Device summary*. Updated *Table 8* (added automotive grade version to the device type). Minor corrections throughout document.
11-Mar-2014	8	Updated *Table 1: Device summary* and *Table 8: Ordering information scheme* Added STWD100YxW and values to t_{WD} in *Table 5: DC and AC characteristics*

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