STM6321/6322
STM6821/6822/6823/6824/6825

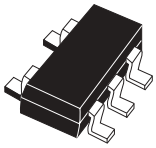
5-Pin Supervisor with Watchdog Timer and Push-button Reset

PRELIMINARY DATA

FEATURES SUMMARY

- PRECISION V_{CC} MONITORING OF 5V, 3.3V, 3V, OR 2.5V POWER SUPPLIES
  - STM6xxxL
  - STM6xxxM
  - STM6xxxT
  - STM6xxxS
  - STM6xxxR
  - STM6xxxZ
- $\overline{RST}$ OUTPUTS (ACTIVE-LOW, PUSH-PULL OR OPEN DRAIN)
- RST OUTPUTS (ACTIVE-HIGH, PUSH-PULL)
- 200ms (TYP) t_{rec}
- WATCHDOG TIMER - 1.6sec (TYP)
- MANUAL RESET INPUT ($\overline{MR}$)
- LOW SUPPLY CURRENT - 3µA (TYP)
- GUARANTEED $\overline{RST}$ (RST) ASSERTION DOWN TO V_{CC} = 1.0V
- OPERATING TEMPERATURE:
  –40°C to 85°C (Industrial Grade)

Figure 1. Package



SOT23-5 (WY)

Table 1. Device Options

Part Number	Watchdog Input	Manual Reset Input	Reset Output		
			Active-Low (Push-pull)	Active-High (Push-pull)	Active-Low (Open Drain)
STM6321	✔			✔	✔
STM6322		✔		✔	✔
STM6821	✔	✔		✔	
STM6822	✔	✔			✔
STM6823	✔	✔	✔		
STM6824	✔		✔	✔	
STM6825		✔	✔	✔	

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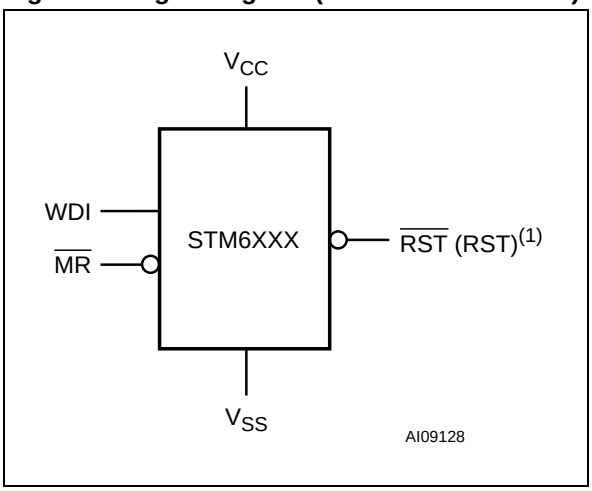
SUMMARY DESCRIPTION

The STM6xxx Supervisors are self-contained devices which provide microprocessor supervisory functions. A precision voltage reference and comparator monitors the V_{CC} input for an out-of-tolerance condition. When an invalid V_{CC} condition occurs, the reset output ($\overline{RST}$) is forced low (or high in the case of RST). These devices also offer a watchdog timer (except for STM6322/6825) and/or a push-button ($\overline{MR}$) reset input.

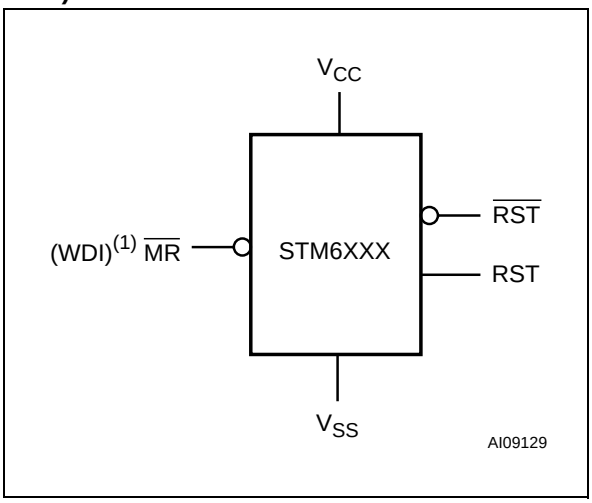
These devices are available in a standard 5-pin SOT23 package.

Figure 2. Logic Diagram (STM6821/6822/6823)



Note: 1. For STM6821 only.

Figure 3. Logic Diagram (STM6321/6322/6824/6825)

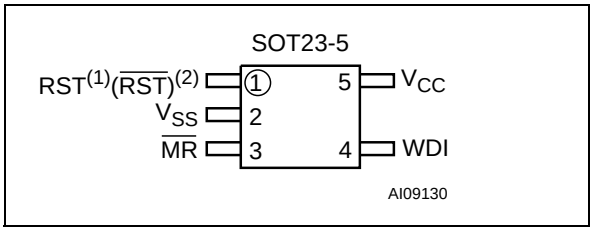


Note: 1. For STM6321/6824

Table 2. Signal Names

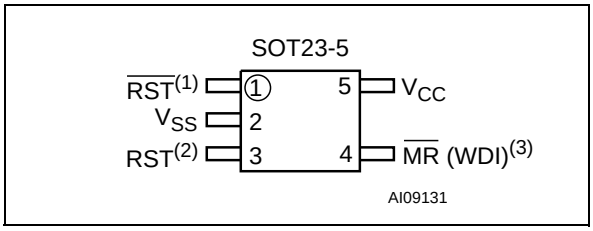
$\overline{MR}$	Push-button Reset Input
WDI	Watchdog Input
$\overline{RST}$	Active-Low Reset Output
RST	Active-High Reset Output
V_{CC}	Supply Voltage
V_{SS}	Ground

Figure 4. STM6821/6822/6823 SOT23-5 Connections



Note: 1. Push-pull only.
2. Open Drain for STM6822.

Figure 5. STM6321/6322/6824/6825 SOT23-5 Connections



Note: 1. Open Drain for STM6321/6322.
2. Push-pull only.
3. For STM6321/6824

Pin Descriptions

Active-Low, Push-pull Reset Output ($\overline{RST}$) - STM6822/6823/6824/6825. Pulses low when triggered, and stays low whenever V_{CC} is below the reset threshold or when $\overline{MR}$ is a logic low. It remains low for t_{rec} after either V_{CC} rises above the reset threshold, the watchdog triggers a reset, or $\overline{MR}$ goes from low to high.

Active-Low, Open Drain Reset Output ($\overline{RST}$) - STM6321/6322/6822. Pulses low when triggered, and stays low whenever V_{CC} is below the reset threshold or when $\overline{MR}$ is a logic low. It remains low for t_{rec} after either V_{CC} rises above the reset threshold, the watchdog triggers a reset, or $\overline{MR}$ goes from low to high. Connect a pull-up resistor to supply voltage.

Push-button Reset Input ($\overline{MR}$). A logic low on $\overline{MR}$ asserts the reset output. Reset remains asserted as long as $\overline{MR}$ is low and for t_{rec} after $\overline{MR}$ returns high. This active-low input has an internal 52kΩ pull-up. It can be driven from a TTL or CMOS logic line, or shorted to ground with a switch. Leave open if unused.

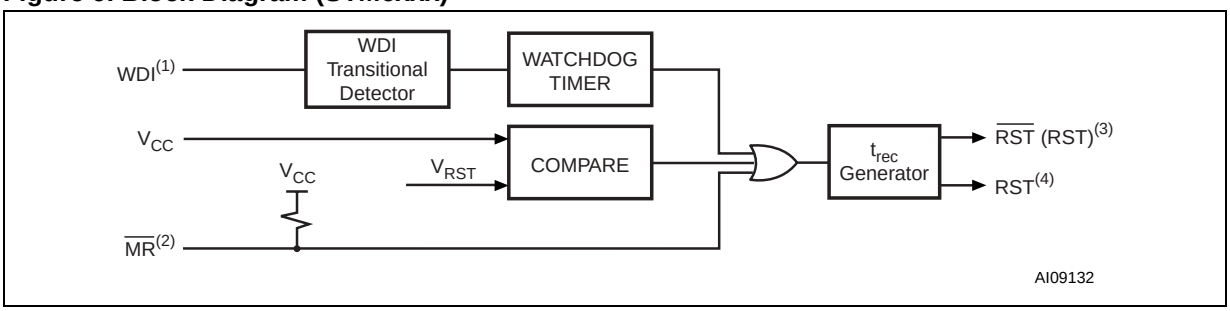
Watchdog Input (WDI). If WDI remains high or low for at least 1.6sec, the internal watchdog timer expires and reset is asserted. The internal watchdog timer clears while reset is asserted or when WDI sees a rising or falling edge. The watchdog function **CAN** be disabled if WDI is left unconnected or is connected to a tri-state buffer output.

Active-High Reset Output. Active-high, push-pull reset output; inverse of $\overline{RST}$.

Table 3. Pin Functions

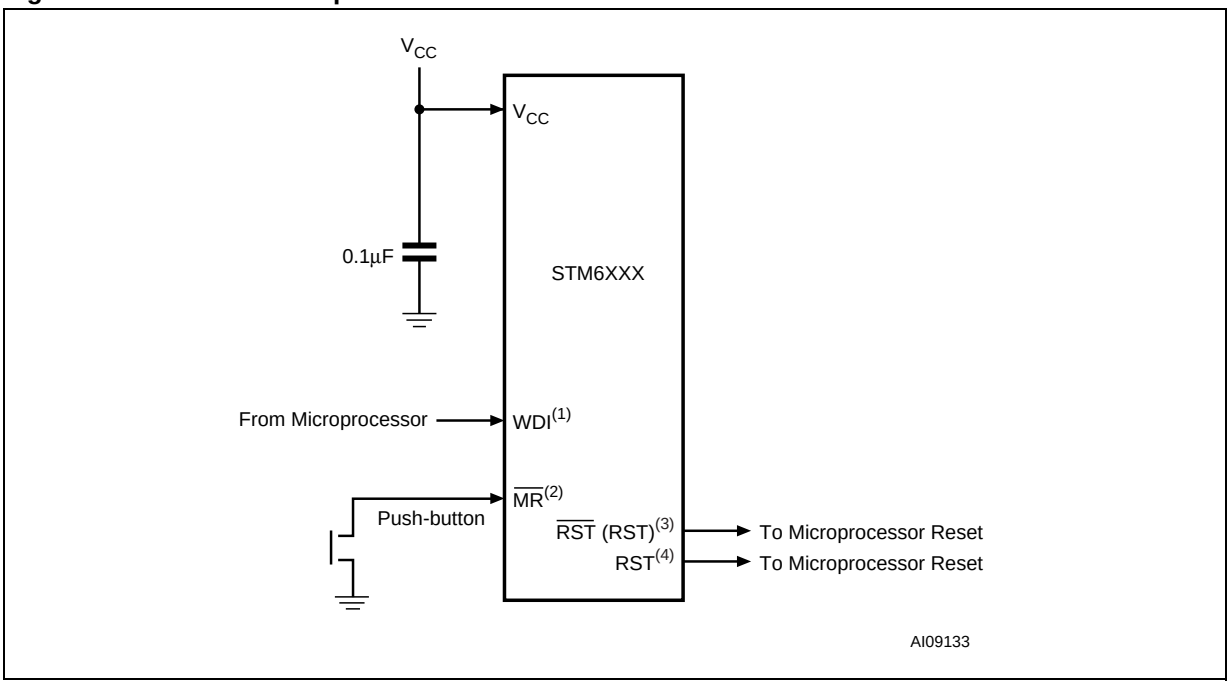
Pin				Name	Function
STM6822 STM6823	STM6821	STM6321 STM6824	STM6322 STM6825		
1	–	1	1	$\overline{RST}$	Active-Low Reset Output
3	3	–	4	$\overline{MR}$	Push-button Reset Input
4	4	4	–	WDI	Watchdog Input
–	1	3	3	RST	Active-High Reset Output
5	5	5	5	V_{CC}	Supply Voltage
2	2	2	2	V_{SS}	Ground

Figure 6. Block Diagram (STM6xxx)



Note: 1. For STM6321/6821/6822/6823/6824
2. For STM6322/6821/6822/6823/6825
3. For STM6821/ (RST output only)
4. For STM6321/6322/6824/6825 (both RST and $\overline{RST}$ outputs)

Figure 7. Hardware Hookup



Note: 1. For STM6321/6821/6822/6823/6824
2. For STM6322/6821/6822/6823/6825
3. For STM6821/ (RST output only)
4. For STM6321/6322/6824/6825 (both RST and $\overline{RST}$ outputs)

OPERATION

Reset Output

The STM6xxx Supervisor asserts a reset signal to the MCU whenever V_{CC} goes below the reset threshold (V_{RST}), a watchdog time-out occurs, or when the Push-button Reset Input ($\overline{MR}$) is taken low. Reset is guaranteed valid for $V_{CC} < V_{RST}$ down to V_{CC} =1V for T_A = 0°C to 85°C.

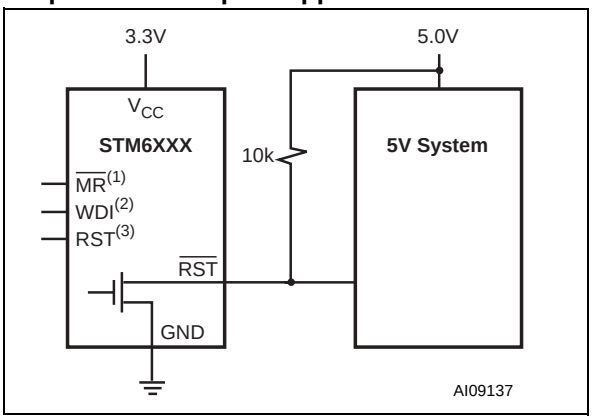
During power-up, once V_{CC} exceeds the reset threshold an internal timer keeps reset low for the reset time-out period, t_{rec}. After this interval reset is de-asserted.

Each time $\overline{RST}$ is asserted, it stays low for at least the reset time-out period (t_{rec}). Any time V_{CC} goes below the reset threshold the internal timer clears. The reset timer starts when V_{CC} returns above the reset threshold.

Open Drain $\overline{RST}$ Output

The STM6321/6322/6822 have an active-low, open drain reset output. This output structure will sink current when $\overline{RST}$ is asserted. Connect a pull-up resistor from $\overline{RST}$ to any supply voltage up to 6V (see Figure 8.). 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 10kΩ pull-up resistor is sufficient in most applications.

Figure 8. STM6321/6322/6822 Open Drain $\overline{RST}$ Output with Multiple Supplies



Note: 1. STM6322/6822
2. STM6321/6822
3. STM6321/6322

Push-button Reset Input (STM6322/6821/6822/6823/6825)

A logic low on $\overline{MR}$ asserts reset. Reset remains asserted while $\overline{MR}$ is low, and for t_{rec} (see Figure 22., page 15) after it returns high. The $\overline{MR}$ input has an internal 52kΩ pull-up resistor, allowing it to be left open if not used. This input can be driven with TTL/CMOS-logic levels or with open-drain/collector outputs. Connect a normally open momentary switch from $\overline{MR}$ to GND to create a manual reset function; external debounce circuitry is not required. If $\overline{MR}$ is driven from long cables or the device is used in a noisy environment, connect a 0.1µF capacitor from $\overline{MR}$ to GND to provide additional noise immunity. $\overline{MR}$ may float, or be tied to V_{CC} when not used.

Watchdog Input (STM6321/6821/6822/6823/6824)

The watchdog timer can be used to detect an out-of-control MCU. If the MCU does not toggle the Watchdog Input (WDI) within t_{WD} (1.6sec), the reset is asserted. The internal watchdog timer is cleared by either:

1. a reset pulse, or
2. by toggling WDI (high-to-low or low-to-high), which can detect pulses as short as 50ns.

The timer remains cleared and does not count for as long as reset is asserted. As soon as reset is released, the timer starts counting.

Note: The watchdog function may be disabled by floating WDI or tri-stating the driver connected to WDI. When tri-stated or disconnected, the maximum allowable leakage current is 10uA and the maximum allowable load capacitance is 200pF.

Applications Information

Watchdog Input Current. The WDI input is internally driven through a buffer and series resistor from the watchdog counter. For minimum watchdog input current (minimum overall power consumption), leave WDI low for the majority of the watchdog time-out period. When high, WDI can draw as much as 160µA. Pulsing WDI high at a low duty cycle will reduce the effect of the large input current. When WDI is left unconnected, the watchdog timer is serviced within the watchdog time-out period by a low-high-low pulse from the counter chain.

Ensuring a Valid Reset Output Down to V_{CC} = 0V. The STM6xxx Supervisors are guaranteed to operate properly down to V_{CC} = 1V. In applications that require valid reset levels down to V_{CC} = 0, a pull-down resistor to active-low outputs (push/pull only, see Figure 9.) and a pull-up resistor to active-high outputs (push/pull only, see Figure 10.) will ensure that the reset line is valid while the reset output can no longer sink or source current. This scheme does not work with the open drain outputs of the STM6321/6322/6822.

The resistor value used is not critical, but it must be large enough not to load the reset output when V_{CC} is above the reset threshold. For most applications, 100kΩ is adequate.

Interfacing to Microprocessors with Bi-directional Reset Pins

Microprocessors with bi-directional reset pins can contend with the STM6321/6322/6821/6822/6823/6824/6825 reset output. For example, if the reset output is driven high and the microprocessor wants to pull it low, signal contention will result. To prevent this from occurring, connect a 4.7kΩ resistor between the reset output and the microprocessor's reset I/O as in Figure 11..

Figure 9. Ensuring $\overline{RST}$ Valid to V_{CC} = 0, (Active-Low Push-pull Outputs)

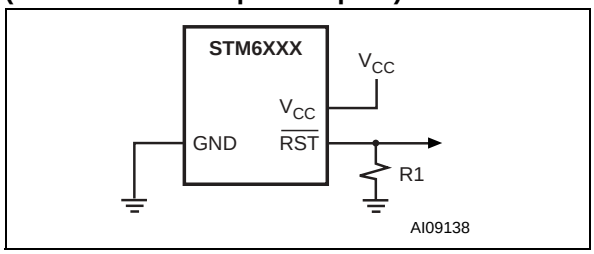
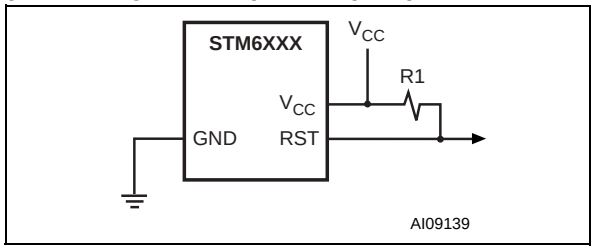
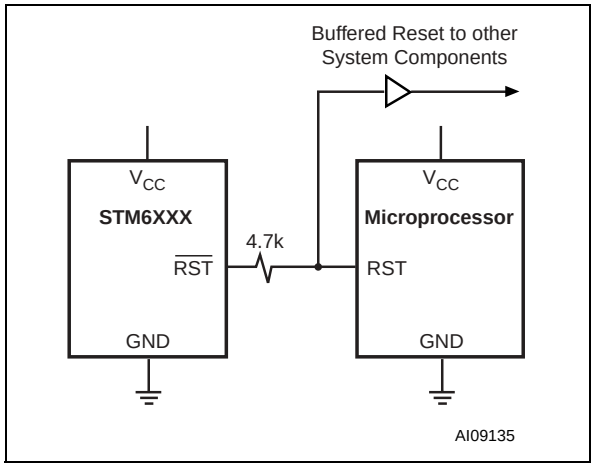


Figure 10. Ensuring RST Valid to V_{CC} = 0, (Active-High, Push-pull Outputs)



Note: This configuration does not work on open drain outputs of the STM6321/6322/6822.

Figure 11. Interfacing to Microprocessors with Bi-directional Reset I/O



TYPICAL OPERATING CHARACTERISTICS

Figure 12. V_{CC}-to-Reset Output Delay vs. Temperature

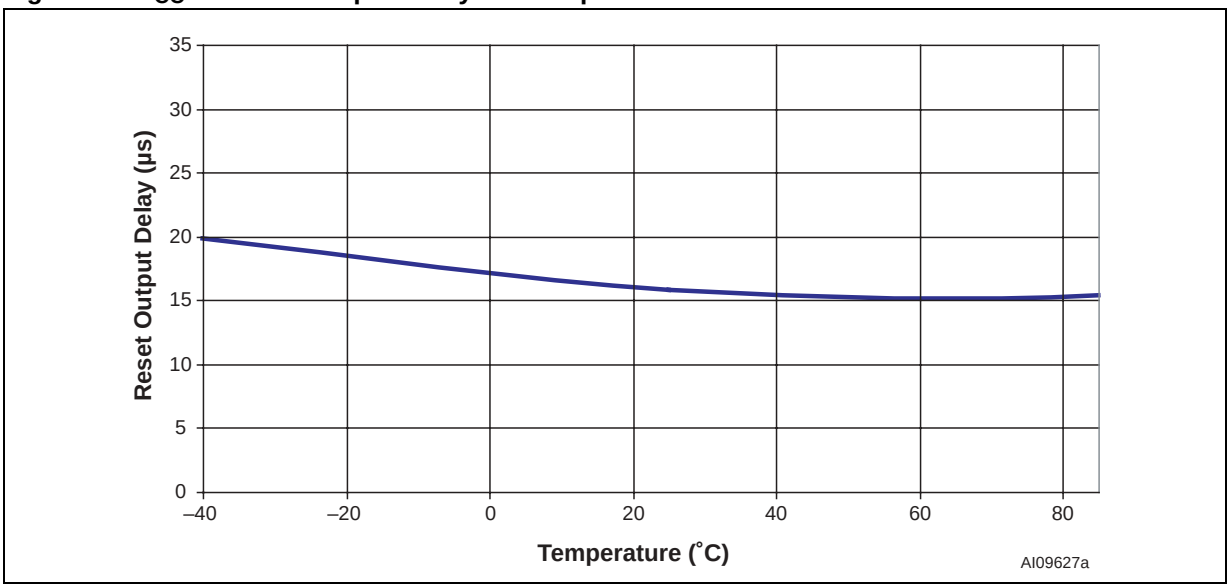


Figure 13. Supply Current vs. Temperature

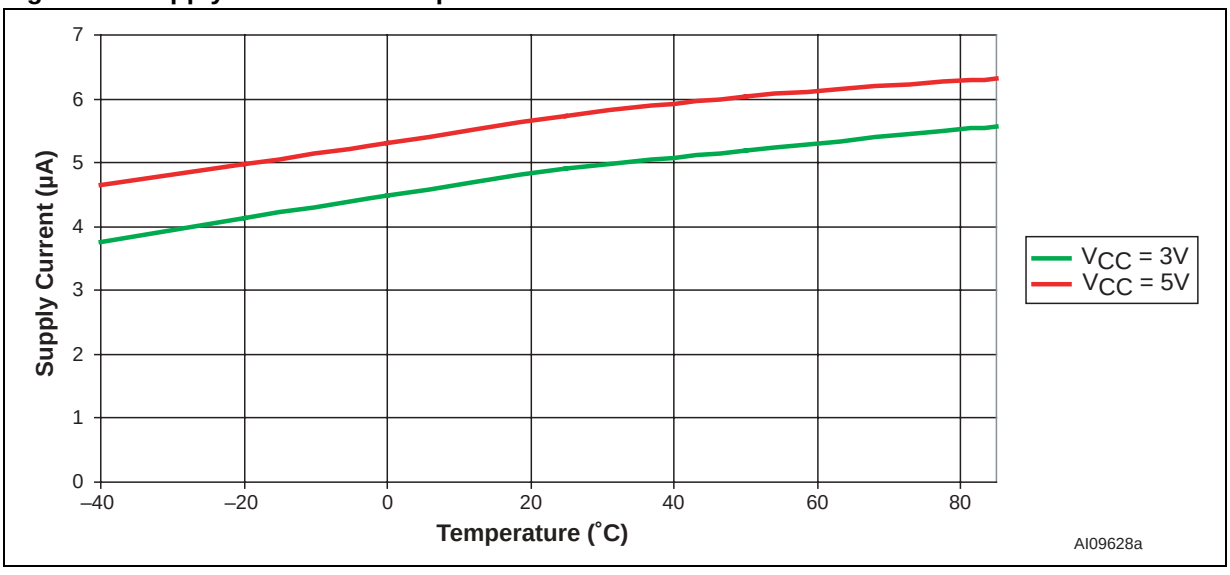


Figure 14. $\overline{MR}$-to-Reset Output Delay vs. Temperature

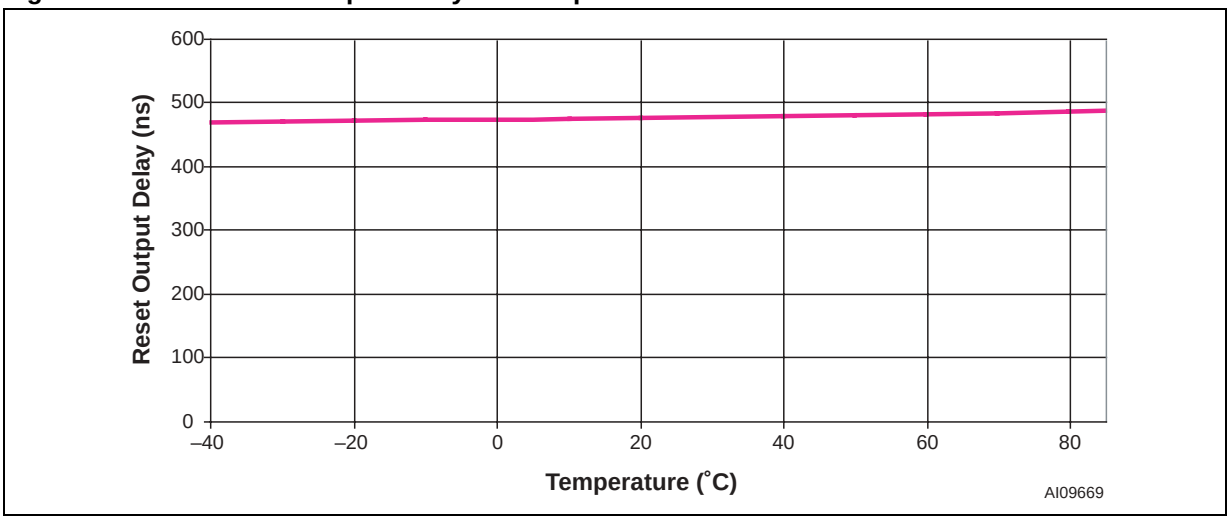


Figure 15. Normalized Power-up t_{rec} vs. Temperature

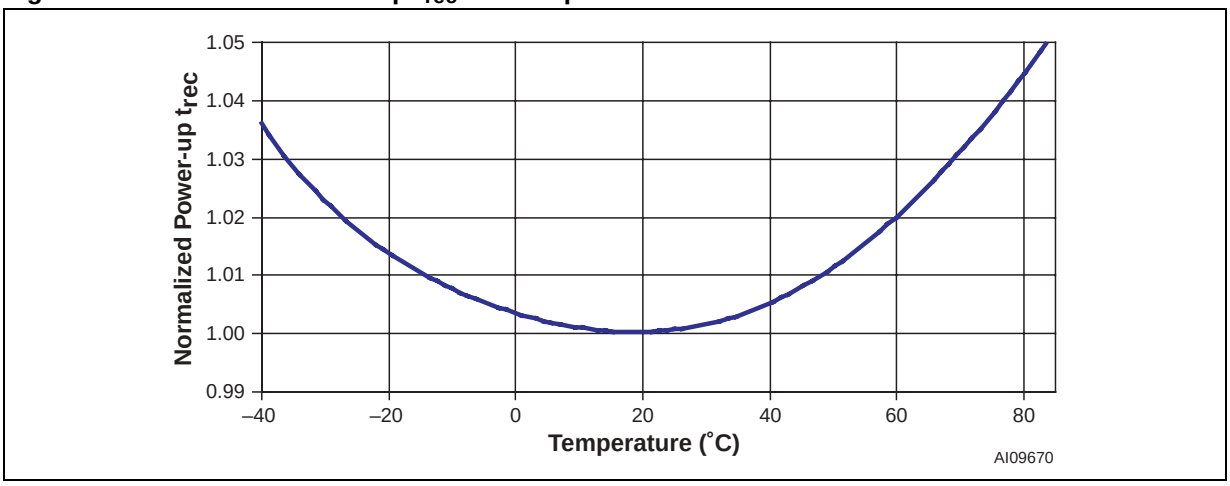


Figure 16. Normalized Reset Threshold Voltage vs. Temperature

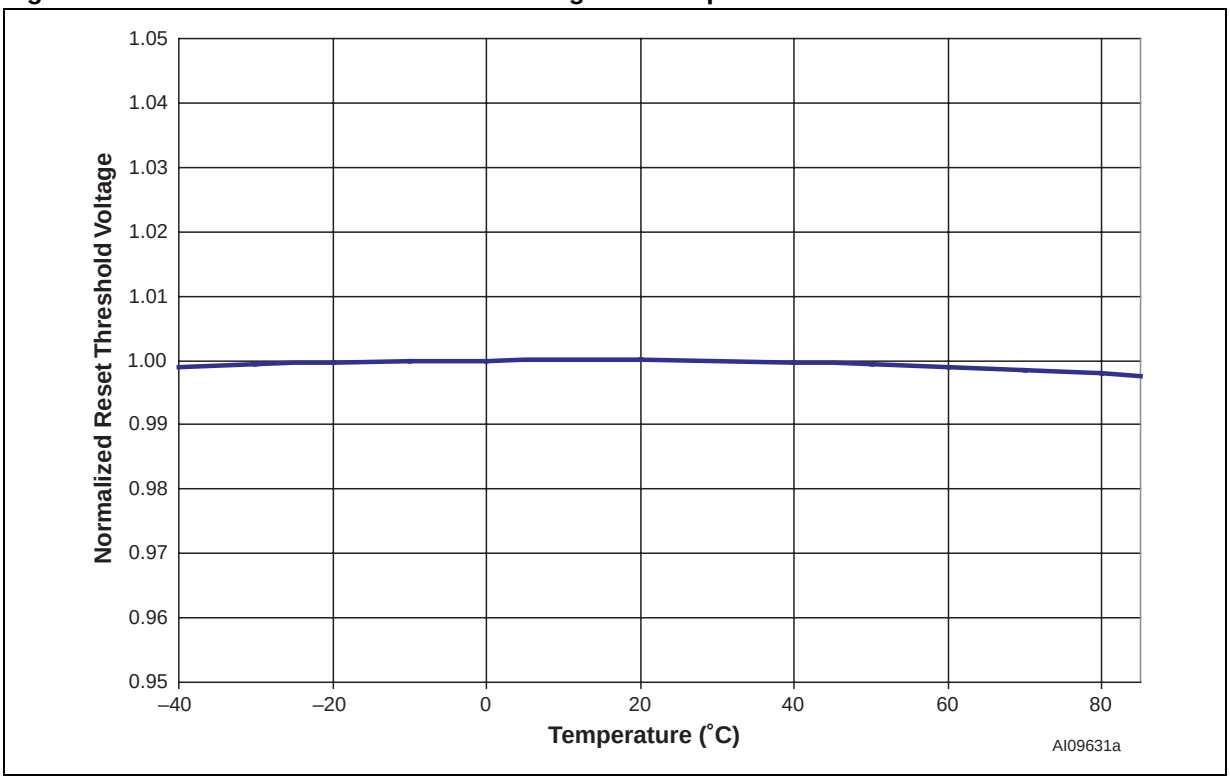


Figure 17. Normalized Power-up Watchdog Time-Out Period

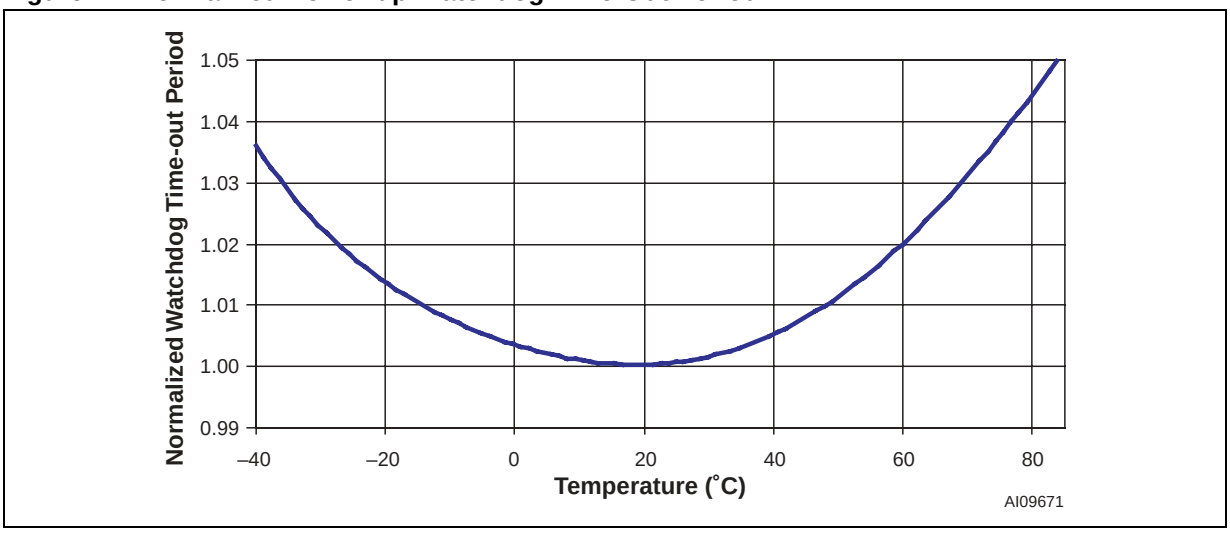


Figure 18. Voltage Output Low vs. I_{SINK}

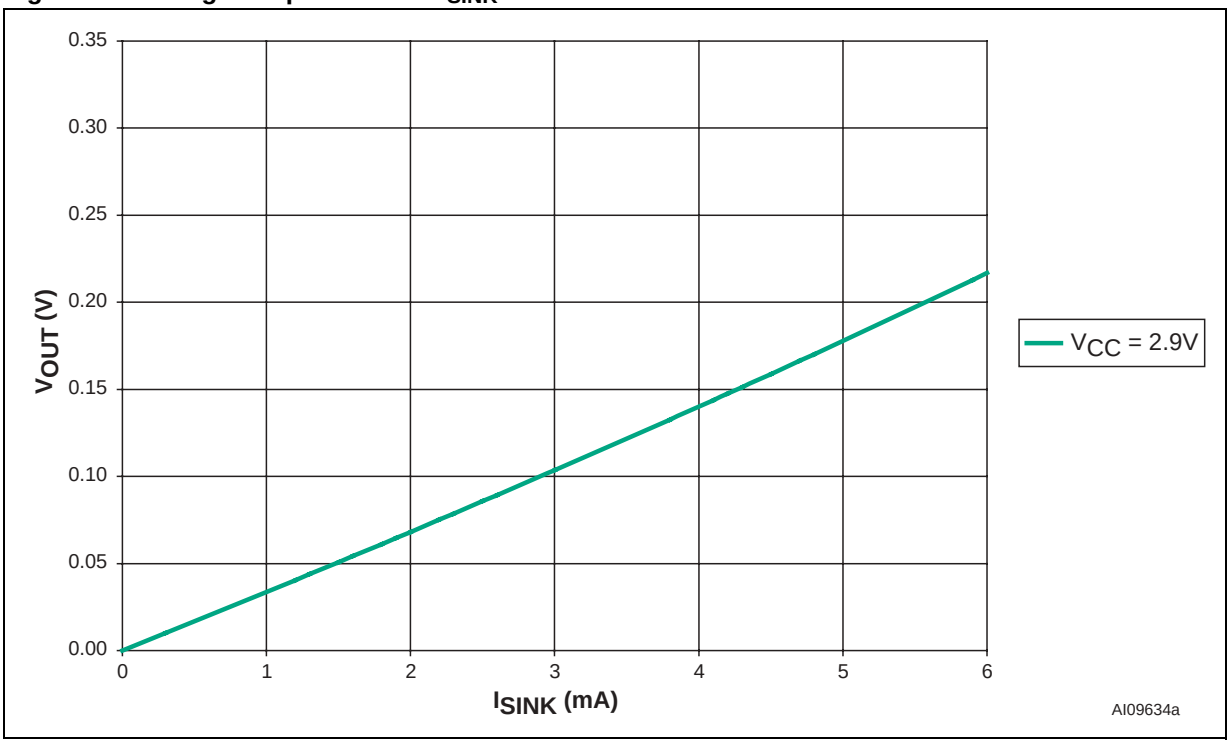


Figure 19. Voltage Output High vs. I_{SOURCE}

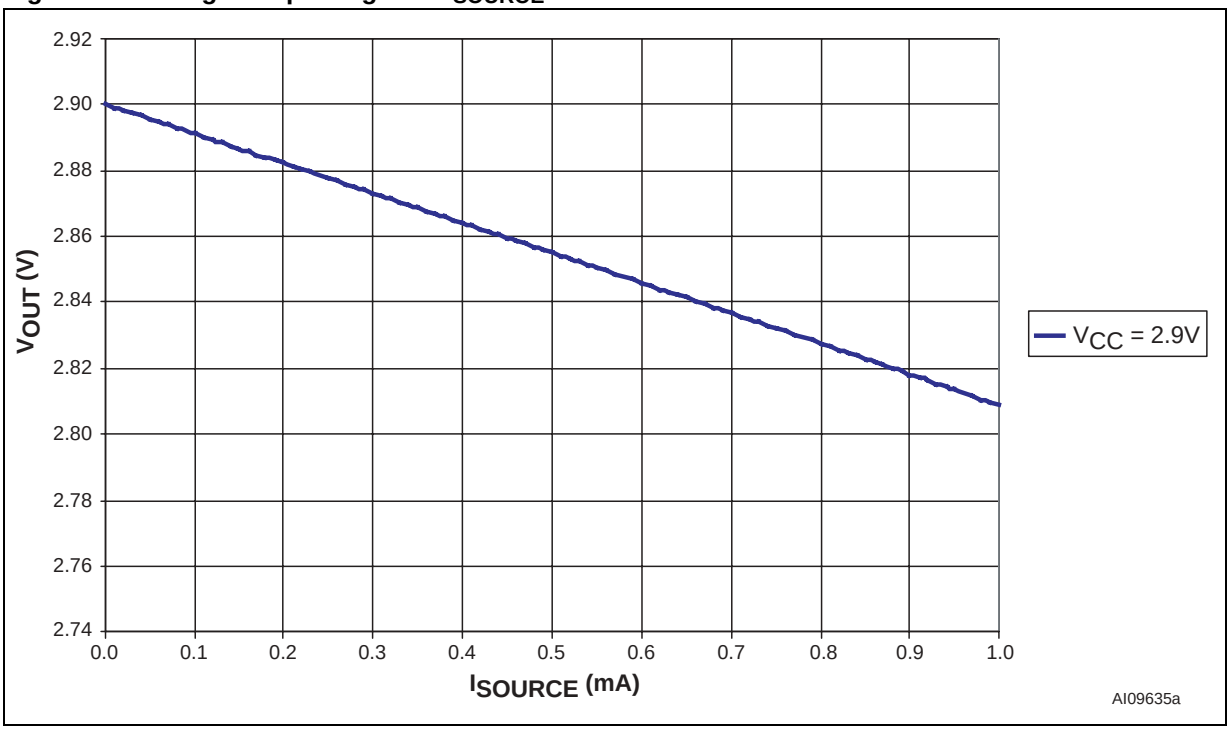
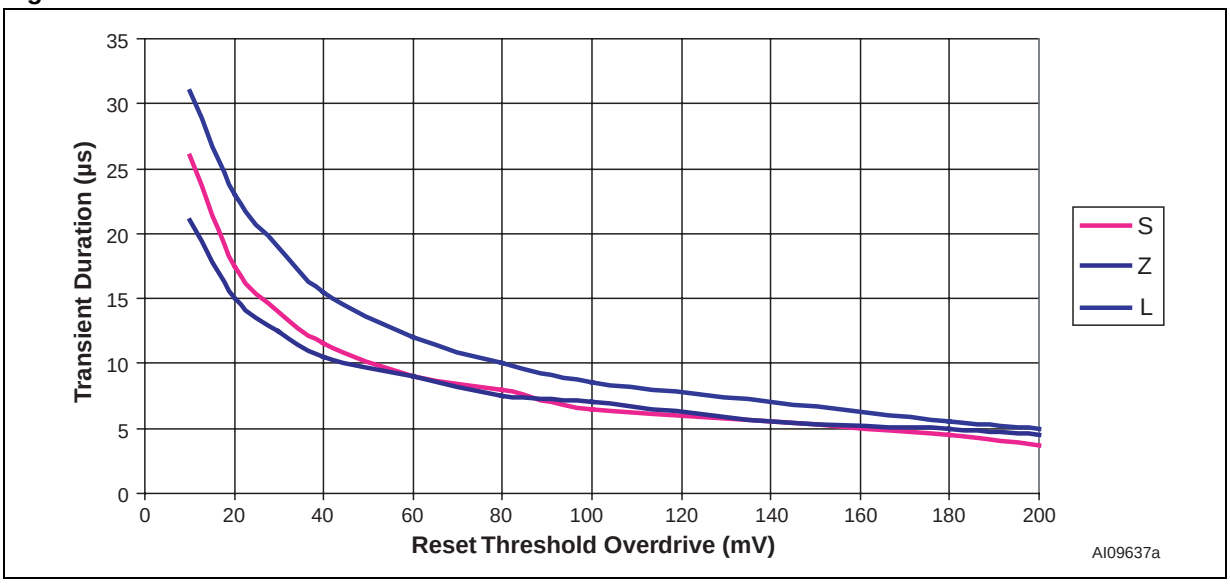


Figure 20. Maximum Transient Duration vs. Reset Threshold Overdrive



MAXIMUM RATING

Stressing the device above the rating listed in the Absolute Maximum Ratings" table 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 the Operating sections 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 4. 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

Note: 1. Reflow at peak temperature of 255°C to 260°C for < 30 seconds (total thermal budget not to exceed 180°C for between 90 to 150 seconds).

DC AND AC PARAMETERS

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

Table 5. Operating and AC Measurement Conditions

Parameter	STM6xxx	Unit
V_{CC} Supply Voltage	1.0 to 5.5	V
Ambient Operating Temperature (T_A)	–40 to 85	°C
Input Rise and Fall Times	≤ 5	ns
Input Pulse Voltages	0.2 to 0.8V_{CC}	V
Input and Output Timing Ref. Voltages	0.3 to 0.7V_{CC}	V

Figure 21. AC Testing Input/Output Waveforms

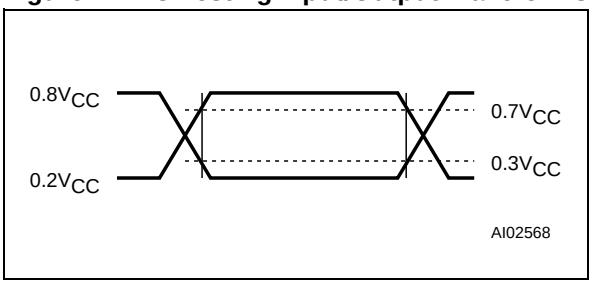
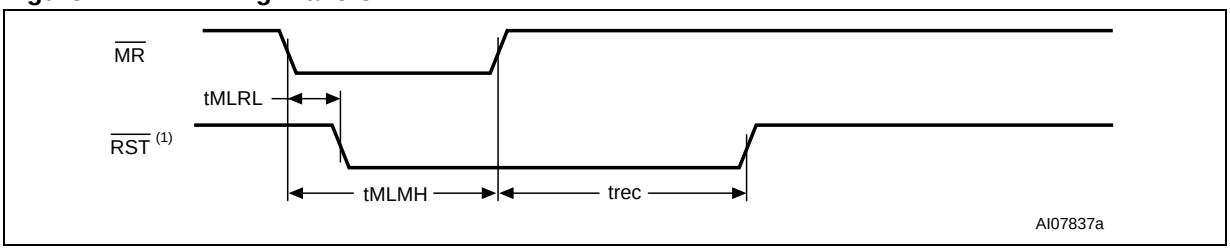


Figure 22. $\overline{MR}$ Timing Waveform



Note: 1. RST for STM6322/6821/6825.

Figure 23. Watchdog Timing

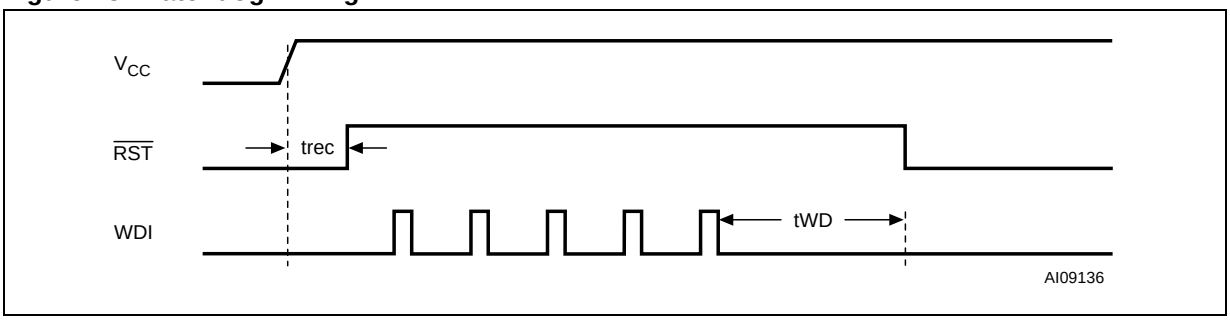


Table 6. DC and AC Characteristics

Sym	Alter-native	Description	Test Condition(1)	Min	Typ	Max	Unit
V_{CC}		Operating Voltage		1.2(2)		5.5	V
I_{CC}		V_{CC} Supply Current ($\overline{MR}$ and WDI unconnected)	T/S/R/Z (V_{CC} < 3.6V)		4	12	µA
			L/M (V_{CC} < 5.5V)		6	17	µA
		V_{CC} Supply Current ($\overline{MR}$ unconnected; STM6322/6825)	T/S/R/Z (V_{CC} < 3.6V)		3	8	µA
			L/M (V_{CC} < 5.5V)		3	12	µA
I_{LI}		Input Leakage Current	0V = V_{IN} = V_{CC}	–1		+1	µA
		Input Leakage Current (WDI)(3)	WDI = V_{CC}, time average		120	160	µA
			WDI = GND, time average	–20	–15		µA
I_{LO}		Open Drain Reset Output Leakage Current	V_{CC} > V_{RST}, Reset not asserted	–1		+1	µA
V_{IH}		Input High Voltage ($\overline{MR}$)	V_{RST} > 4.0V	2.0			V
			V_{RST} < 4.0V	0.7V_{CC}			V
V_{IH}		Input High Voltage (WDI)(4)	V_{RST} (max) < V_{CC} < 5.5V	0.7V_{CC}			V
V_{IL}		Input Low Voltage ($\overline{MR}$)	V_{RST} > 4.0V			0.8	V
			V_{RST} < 4.0V			0.3V_{CC}	V
V_{IL}		Input Low Voltage (WDI)(4)	V_{RST} (max) < V_{CC} < 5.5V			0.3V_{CC}	V
V_{OL}		Output Low Voltage ($\overline{RST}$; Push-pull or Open Drain)	V_{CC} ≥ 1.0V, I_{SINK} = 50µA, Reset asserted			0.3	V
			V_{CC} ≥ 1.2V, I_{SINK} = 100µA, Reset asserted			0.3	V
			V_{CC} ≥ 2.7V, I_{SINK} = 1.2mA, Reset asserted			0.3	V
			V_{CC} ≥ 4.5V, I_{SINK} = 3.2mA, Reset asserted			0.4	V
		Output Low Voltage (RST; Push-pull Only)	V_{CC} ≥ 2.7V, I_{SINK} = 1.2mA, Reset not asserted			0.3	V
			V_{CC} ≥ 4.5V, I_{SINK} = 3.2mA, Reset not asserted			0.4	V
V_{OH}		Output High Voltage ($\overline{RST}$)	V_{CC} ≥ 2.7V, I_{SOURCE} = 500µA, Reset not asserted	0.8V_{CC}			V
			V_{CC} ≥ 4.5V, I_{SOURCE} = 800µA , Reset not asserted	0.8V_{CC}			V
		Output High Voltage (RST)	V_{CC} ≥ 1.0V, I_{SOURCE} = 1µA, Reset asserted (0°C to 85°C)	0.8V_{CC}			V
			V_{CC} ≥ 1.5V, I_{SOURCE} = 100µA, Reset asserted	0.8V_{CC}			V
			V_{CC} ≥ 2.55V, I_{SOURCE} = 500µA, Reset asserted	0.8V_{CC}			V
			V_{CC} ≥ 4.25V, I_{SOURCE} = 800µA, Reset asserted	0.8V_{CC}			V

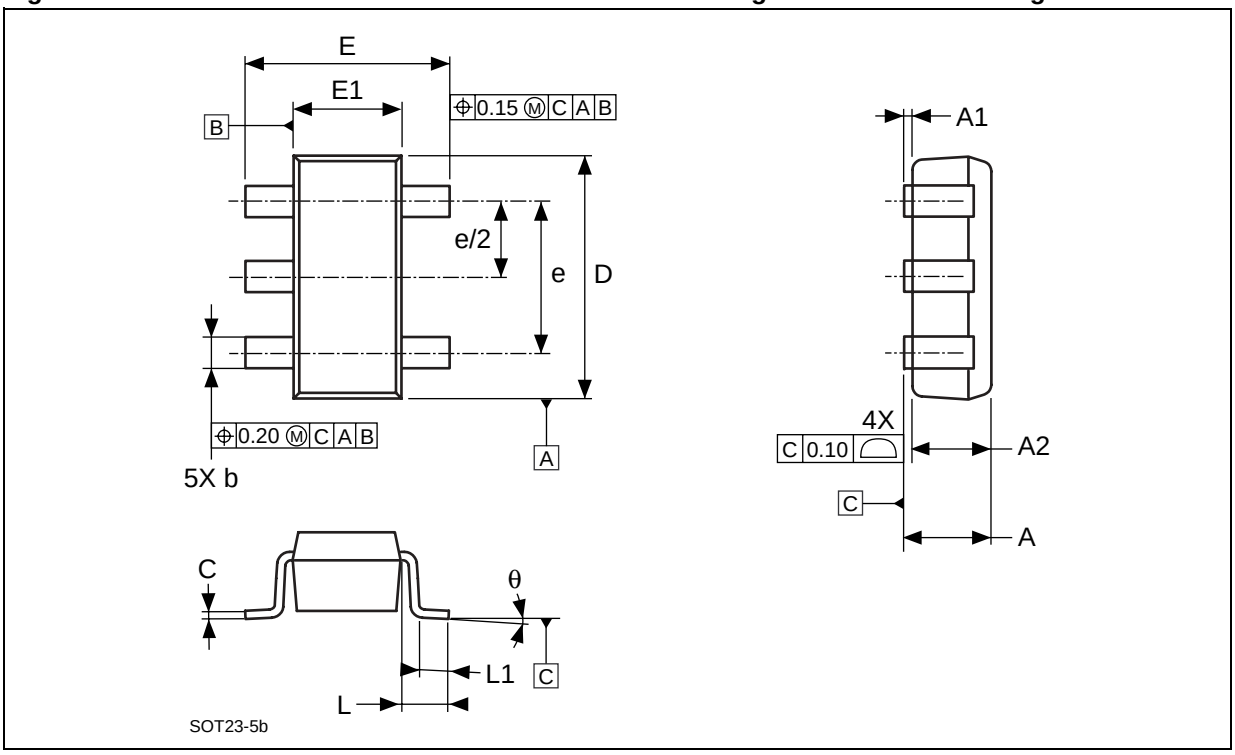
Sym	Alter-native	Description	Test Condition(1)		Min	Typ	Max	Unit
Reset Thresholds								
V_{RST}(5)		Reset Threshold	STM6xxxL	25°C	4.561	4.630	4.699	V
				–40 to 85°C	4.514		4.746	V
			STM6xxxM	25°C	4.314	4.390	4.446	V
				–40 to 85°C	4.270		4.490	V
			STM6xxxT	25°C	3.040	3.080	3.110	V
				–40 to 85°C	3.000		3.150	V
			STM6xxxS	25°C	2.890	2.930	2.960	V
				–40 to 85°C	2.857		3.000	V
			STM6xxxR	25°C	2.590	2.630	2.660	V
				–40 to 85°C	2.564		2.696	V
			STM6xxxZ(6)	25°C	2.280	2.320	2.350	V
				–40 to 85°C	2.250		2.380	V
		Reset Threshold Hysteresis	L/M versions			10		mV
			T/S/R/Z versions			5		mV
		V_{CC} to $\overline{RST}$ Delay ($V_{RST} - V_{CC}$ = 100mV, V_{CC} falling at 1mV/µs)				20		µs
t_{rec}		Reset Pulse Width			140	200	280	ms
		Reset Threshold Temperature Coefficient				40		ppm/°C
Push-button Reset Input								
t_{MLMH}	t_{MR}	$\overline{MR}$ Pulse Width			1			µs
t_{MLRL}	t_{MRD}	$\overline{MR}$ to $\overline{RST}$ Output Delay				500		ns
		$\overline{MR}$ Glitch Immunity				100		ns
		$\overline{MR}$ Pull-up Resistor			35	52	75	kΩ
Watchdog Timer								
t_{WD}		Watchdog Timeout Period			1.12	1.60	2.24	s
		WDI Pulse Width			50			ns

Note: 1. Valid for Ambient Operating Temperature: T_A = –40 to 85°C; V_{CC} = 4.5V to 5.5V for "L/M" versions; V_{CC} = 2.7V to 3.6V for "T/S/R" versions; and VCC = 2.1V to 2.75V for "Z" version (except where noted).

2. V_{CC} (min) = 1.0V for T_A = 0°C to +85°C.
3. WDI input is designed to be driven by a three-state output device. To float WDI, the "high-impedance mode" of the output device must have a maximum leakage current of 10µA and a maximum output capacitance of 200pF. The output device must also be able to source and sink at least 200µA when active.
4. WDI is internally serviced within the watchdog period if WDI is left unconnected.
5. The leakage current measured on the $\overline{RST}$ pin is tested with the reset asserted (output high impedance).
6. Contact local sales office for availability.

PACKAGE MECHANICAL

Figure 24. SOT23-5 – 5-lead Small Outline Transistor Package Mechanical Drawing



Note: Drawing is not to scale.

Table 7. SOT23-5 – 5-lead Small Outline Transistor Package Mechanical Data

Symb	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
E	2.80	2.60	3.00	0.110	0.102	0.118
E1	1.60	1.50	1.75	0.063	0.059	0.069
e	1.90	–	–	0.075	–	–
e/2	0.95	–	–	0.037	–	–
L	0.60	0.55	0.63	0.024	0.022	0.025
L1	0.35	0.10	0.60	0.014	0.004	0.024
α	–	0°	10°	–	0°	10°
N	5			5		

PART NUMBERING

Table 8. Ordering Information Scheme

Example: STM6xxx L M 6 E

Device Type

STM6xxx

Reset Threshold Voltage

L: V_{RST} = 4.514V to 4.746V

M: V_{RST} = 4.270V to 4.490V

T: V_{RST} = 3.000V to 3.150V

S: V_{RST} = 2.850V to 3.000V

R: V_{RST} = 2.564V to 2.696V

Z: V_{RST} = 2.250V to 2.380V(1)

Package

WY = SOT23-5

Temperature Range

6 = –40 to 85°C

Shipping Method

E = Tubes (Pb-Free - ECOPACK®)

F = Tape & Reel (Pb-Free - ECOPACK®)

Note: 1. Contact local sales office for availability.

For other options, or for more information on any aspect of this device, please contact the ST Sales Office nearest you.

Table 9. Marking Description

Part Number	Reset Threshold	Topside Marking(1)
STM6321	L: V_{RST} = 4.63V M: V_{RST} = 4.39V T: V_{RST} = 3.08V S: V_{RST} = 2.93V R: V_{RST} = 2.63V Z: V_{RST} = 2.32V	321X
STM6322		322X
STM6821		821X
STM6822		822X
STM6823		823X
STM6824		824X
STM6825		825X

Note: 1. Where “X” = L, M, T, S, R, or Z.

REVISION HISTORY

Table 10. Document Revision History

Date	Version	Revision Details
August 25, 2004	1.0	First Draft
15-Dec-04	2.0	Update characteristics (Figure 12, 13, 14; Table 6, 8)