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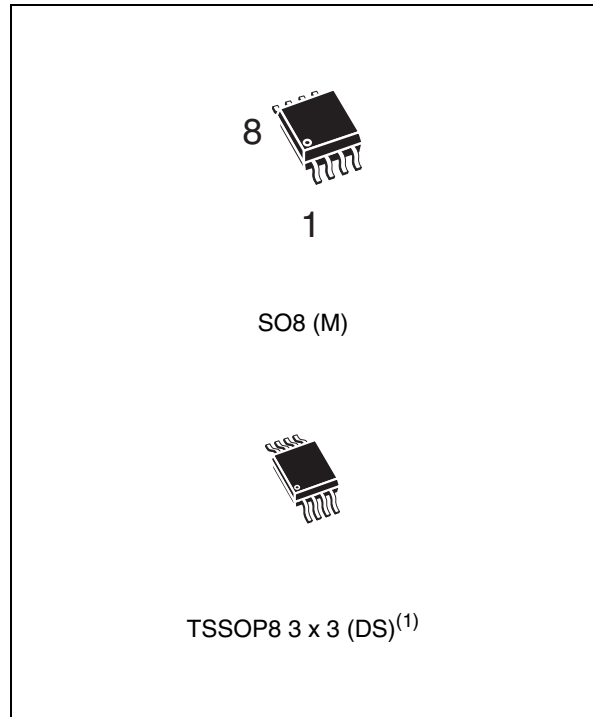


STM690A, STM692A, STM703 STM704, STM802, STM805, STM817/8/9

5 V supervisor with battery switchover

Features

- 5 V operating voltage
- NVRAM supervisor for external LPSRAM
- Chip-enable gating (STM818 only) for external LPSRAM (7 ns max prop delay)
- RST and $\overline{\text{RST}}$ outputs
- 200 ms (typ) t_{rec}
- Watchdog timer - 1.6 sec (typ)
- Automatic battery switchover
- Low battery supply current - 0.4 μA (typ)
- Power-fail comparator (PFI/ $\overline{\text{PFO}}$)
- Low supply current - 40 μA (typ)
- Guaranteed $\overline{\text{RST}}$ (RST) assertion down to $V_{\text{CC}} = 1.0 \text{ V}$
- Operating temperature:
-40 °C to +85 °C (industrial grade)
- RoHS compliance
 - Lead-free components are compliant with the RoHS directive



1. Contact local ST sales office for availability.

Table 1. Device summary

Part number	Watchdog input	Active-low RST ⁽¹⁾	Active-high RST	Manual reset input ⁽¹⁾	Battery switchover	Power-fail comparator	Chip-enable gating	Battery freshness seal
STM690A	✓	✓			✓	✓		
STM692A	✓	✓			✓	✓		
STM703		✓		✓	✓	✓		
STM704		✓		✓	✓	✓		
STM802L/M	✓	✓			✓	✓		
STM805L	✓		✓		✓	✓		
STM817L/M	✓	✓			✓	✓		✓
STM818L/M	✓	✓			✓		✓	✓
STM819L/M		✓		✓	✓	✓		✓

1. All $\overline{\text{RST}}$ and RST outputs are push-pull.

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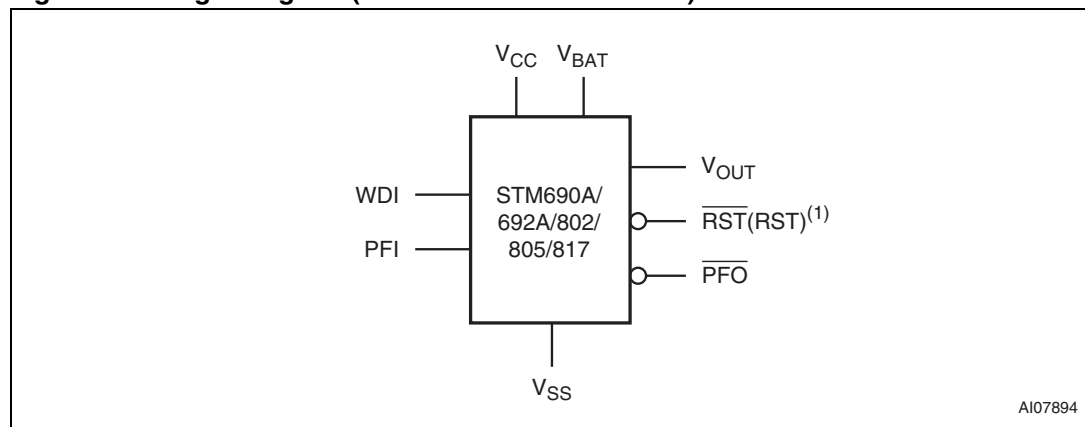
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1 Description

The STM690A/692A/703/704/802/805/817/818/819 supervisors are self-contained devices which provide microprocessor supervisory functions with the ability to non-volatize and write-protect external LPSRAM. 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 STM703/704/819) as well as a power-fail comparator (except for STM818) to provide the system with an early warning of impending power failure.

These devices are available in a standard 8-pin SOIC package or a space-saving 8-pin TSSOP package.

Figure 1. Logic diagram (STM690A/692/802/805/817)



1. For STM805, reset output is active-high.

Figure 2. Logic diagram (STM703/704/819)

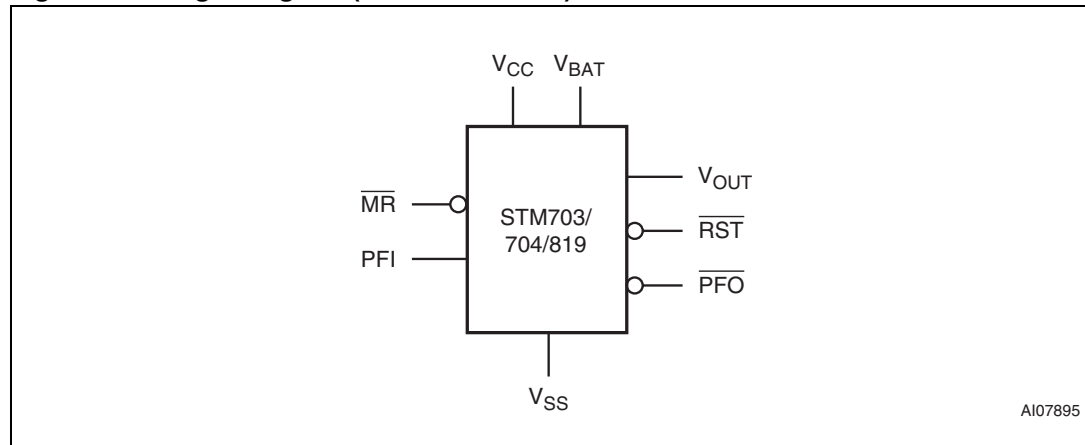


Figure 3. Logic diagram (STM818)

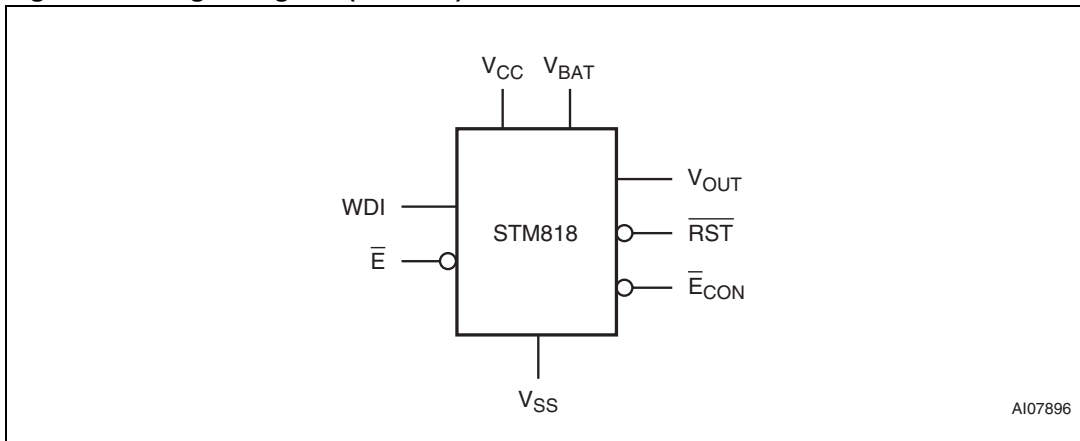
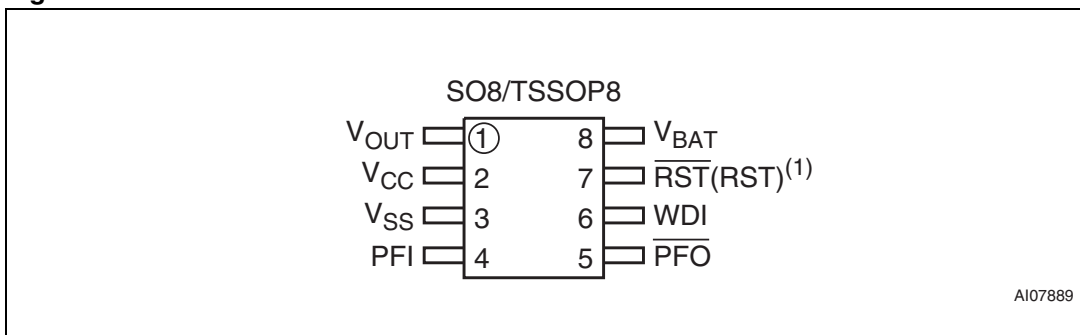


Table 2. Signal names

\overline{MR}	Push-button reset input
WDI	Watchdog input
\overline{RST}	Active-low reset output
RST	Active-high reset output
$\overline{E}^{(1)}$	Chip-enable input
$\overline{E}_{CON}^{(1)}$	Conditioned chip-enable output
V_{OUT}	Supply voltage output
V_{CC}	Supply voltage
V_{BAT}	Backup supply voltage
PFI	Power-fail input
\overline{PFO}	Power-fail output
V_{SS}	Ground

1. STM818

Figure 4. STM690A/692A/802/805/817 connections



1. For STM805, reset output is active-high.

Figure 5. STM703/704/819 connections

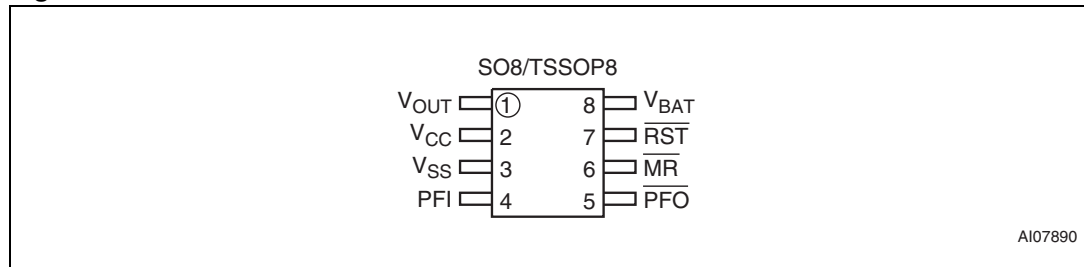
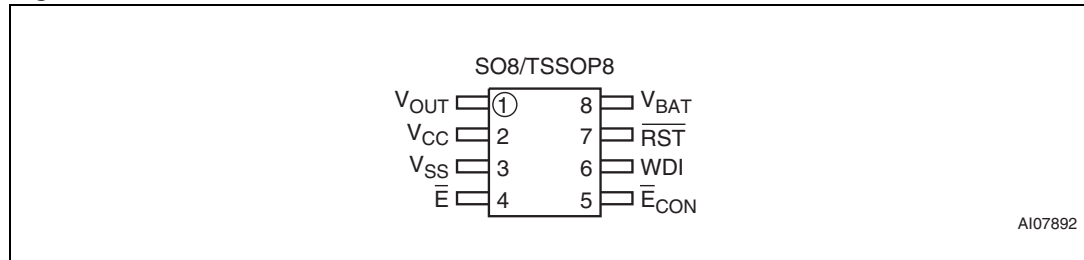


Figure 6. STM818 connections



1.1 Pin descriptions

1.1.1 $\overline{\text{MR}}$

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

1.1.2 WDI

If WDI remains high or low for 1.6 sec, the internal watchdog timer runs out and reset is triggered. The internal watchdog timer clears while reset is asserted or when WDI sees a rising or falling edge.

The watchdog function can be disabled by allowing the WDI pin to float.

1.1.3 $\overline{\text{RST}}$

Pulses low for t_{rec} when triggered, and stays low whenever V_{CC} is below the reset threshold or when $\overline{\text{MR}}$ 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 $\overline{\text{MR}}$ goes from low to high.

1.1.4 RST

Pulses high for t_{rec} when triggered, and stays high whenever V_{CC} is above the reset threshold or when $\overline{\text{MR}}$ is a logic high. It remains high for t_{rec} after either V_{CC} falls below the reset threshold, the watchdog triggers a reset, or $\overline{\text{MR}}$ goes from high to low.

1.1.5 V_{OUT}

When V_{CC} is above the switchover voltage (V_{SO}), V_{OUT} is connected to V_{CC} through a P-channel MOSFET switch. When V_{CC} falls below V_{SO} , V_{BAT} connects to V_{OUT} .

1.1.6 V_{BAT}

When V_{CC} falls below V_{SO} , V_{OUT} switches from V_{CC} to V_{BAT} . When V_{CC} rises above $V_{SO} +$ hysteresis, V_{OUT} reconnects to V_{CC} . V_{BAT} may exceed V_{CC} . Connect to V_{CC} if no battery is used.

1.1.7 \bar{E}

The input to the chip-enable gating circuit. Connect to ground if unused.

1.1.8 \bar{E}_{CON}

\bar{E}_{CON} goes low only when \bar{E} is low and reset is not asserted. If \bar{E}_{CON} is low when reset is asserted, \bar{E}_{CON} will remain low for 15 μ s or until \bar{E} goes high, whichever occurs first. In the disabled mode, \bar{E}_{CON} is pulled up to V_{OUT} .

1.1.9 PFI

When PFI is less than V_{PFI} or when V_{CC} falls below 2.4 V (or V_{SO}), \overline{PFO} goes low; otherwise, \overline{PFO} remains high. Connect to ground if unused.

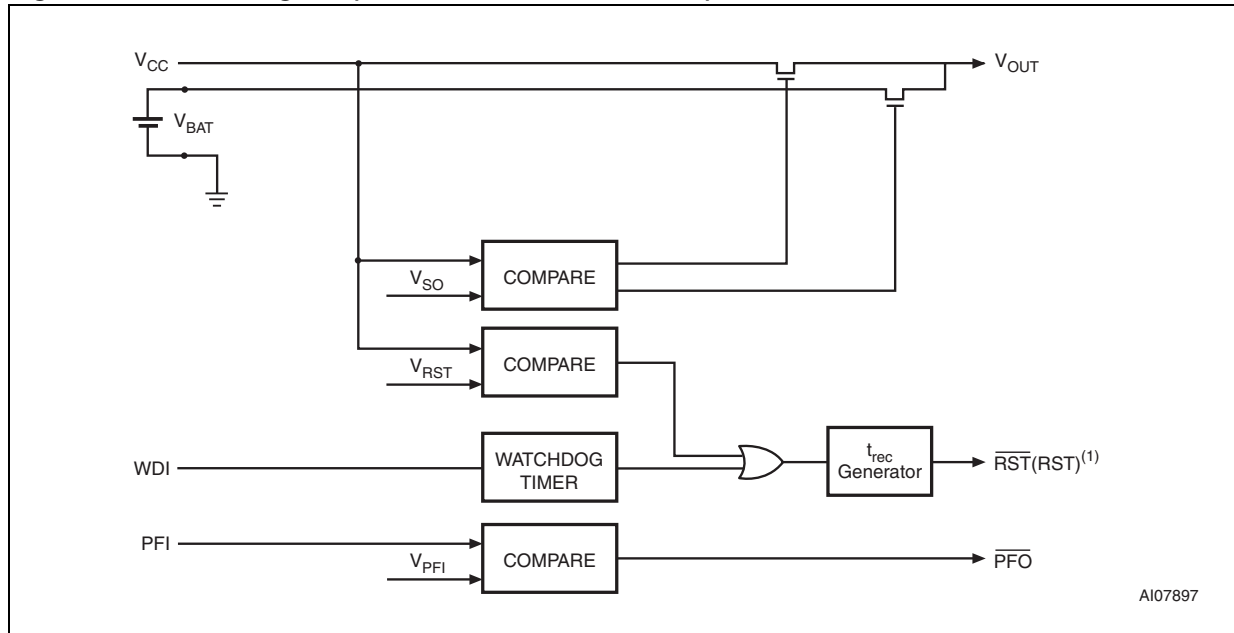
1.1.10 \overline{PFO}

When PFI is less than V_{PFI} , or V_{CC} falls below 2.4 V (or V_{SO}), \overline{PFO} goes low; otherwise, \overline{PFO} remains high. Leave open if unused. Output type is push-pull.

Table 3. Pin description

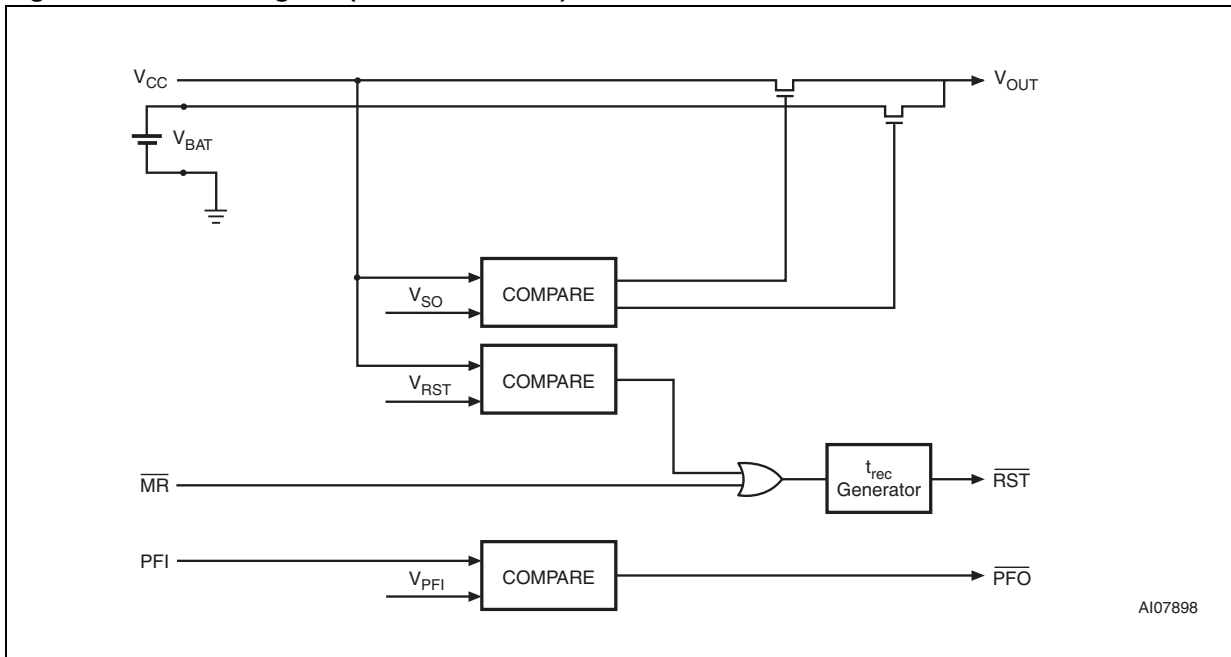
Pin				Name	Function
STM818	STM690A STM692A STM802 STM817	STM703 STM704 STM819	STM805		
-	-	6	-	\overline{MR}	Push-button reset input
6	6	-	6	WDI	Watchdog input
7	7	7	-	\overline{RST}	Active-low reset output
-	-	-	7	RST	Active-high reset output
1	1	1	1	V_{OUT}	Supply output for external LPSRAM
2	2	2	2	V_{CC}	Supply voltage
8	8	8	8	V_{BAT}	Backup battery input
4	-	-	-	\overline{E}	Chip-enable input
5	-	-	-	\overline{E}_{CON}	Conditioned chip-enable output
-	4	4	4	PFI	Power-fail input
-	5	5	5	\overline{PFO}	Power-fail output (push-pull)
3	3	3	3	V_{SS}	Ground

Figure 7. Block diagram (STM690A/692A/802/805/817)



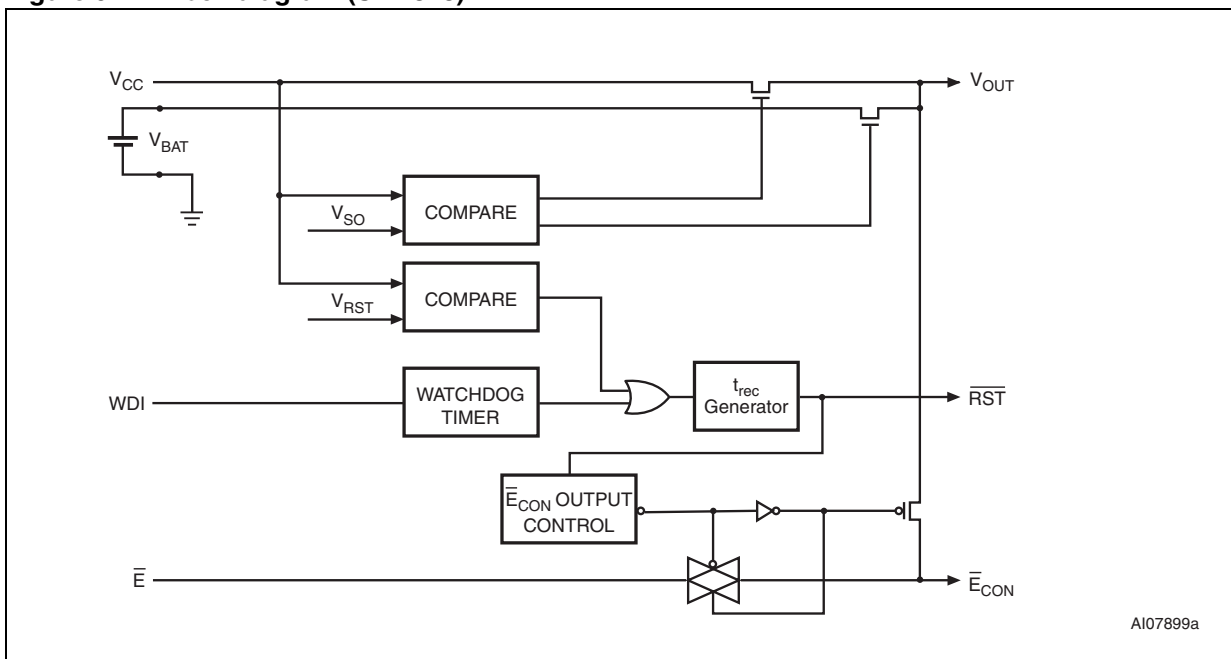
1. For STM805, reset output is active-high.

Figure 8. Block diagram (STM703/704/819)



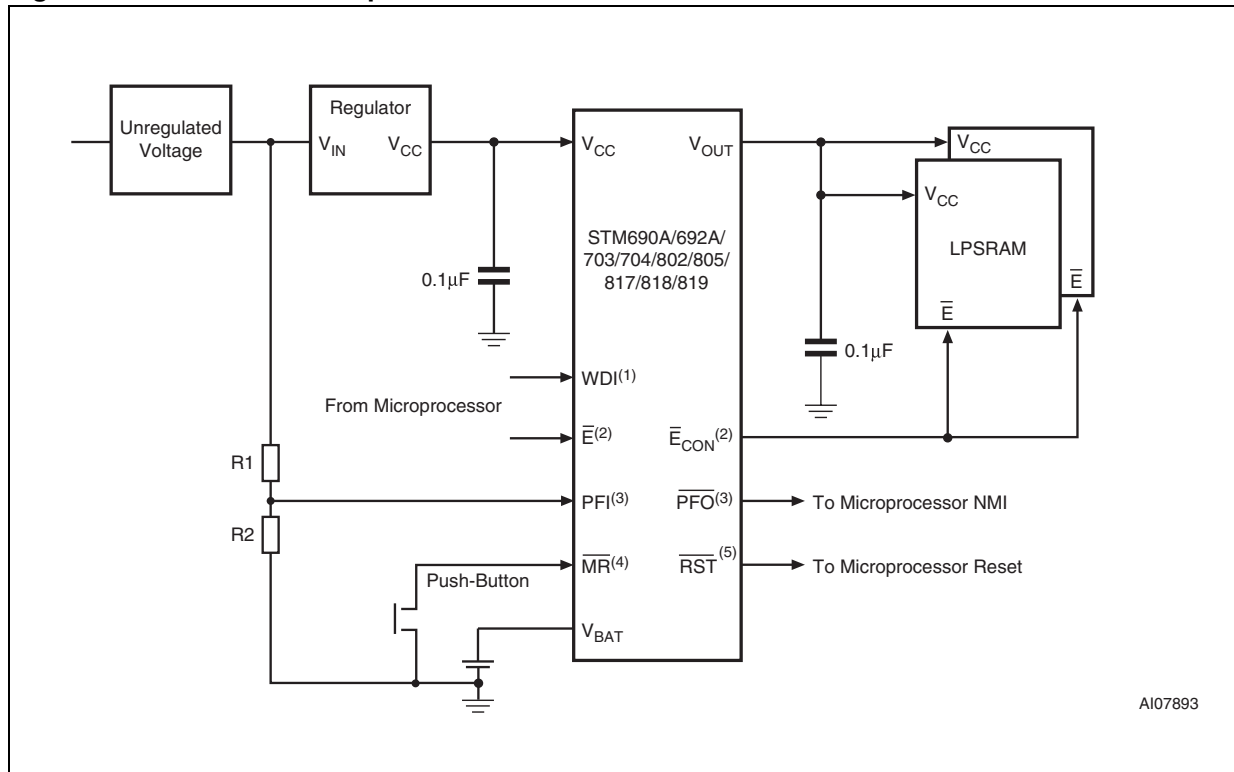
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Figure 9. Block diagram (STM818)



AI07899a

Figure 10. Hardware hookup



1. For STM690A/692A/802/805/817/818.
2. For STM818 only.
3. Not available on STM818.
4. For STM703/704/819.
5. Active high on STM805.

2 Operation

2.1 Reset output

The STM690A/692A/703/704/802/805/817/818/819 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. \overline{RST} is guaranteed to be a logic low (logic high for STM805) for $0V < V_{CC} < V_{RST}$ if V_{BAT} is greater than 1 V. Without a backup battery, \overline{RST} is guaranteed valid down to $V_{CC} = 1V$.

During power-up, once V_{CC} exceeds the reset threshold an internal timer keeps \overline{RST} low for the reset time-out period, t_{rec} . After this interval \overline{RST} returns high.

If V_{CC} drops below the reset threshold, \overline{RST} goes low. 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.

2.2 Push-button reset input (STM703/704/819)

A logic low on \overline{MR} asserts reset. Reset remains asserted while \overline{MR} is low, and for t_{rec} (see [Figure 41](#)) after it returns high. The \overline{MR} input has an internal 40 k Ω 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 0.1 μF capacitor from \overline{MR} to GND to provide additional noise immunity. \overline{MR} may float, or be tied to V_{CC} when not used.

2.3 Watchdog input (NOT available on STM703/704/819)

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} (1.6 sec typ), 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. If WDI is tied high or low, a reset pulse is triggered every 1.8 sec ($t_{WD} + t_{rec}$).

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 (see [Figure 42](#)).

- Note:*
- 1 *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 10 μA and the maximum allowable load capacitance is 200 pF.*
 - 2 *Input pulses less than 20 ns will be ignored.*

2.4 Backup battery switchover

In the event of a power failure, it may be necessary to preserve the contents of external SRAM through V_{OUT} . With a backup battery installed with voltage V_{BAT} , the devices automatically switch the SRAM to the backup supply when V_{CC} falls.

Note: When the battery is first connected without V_{CC} power applied, the device does not immediately provide backup battery voltage on V_{OUT} . Only after V_{CC} exceeds V_{RST} will the switchover operate as described below. This mode allows a battery to be attached during manufacturing but not used until after the system has been activated for the first time. As a result, no battery power is consumed by the device during storage and shipment. For the STM81x devices, the battery freshness seal can be initiated again by following the procedure outlined in [Section 2.12](#). If the backup battery is not used, connect both V_{BAT} and V_{OUT} to V_{CC} .

Whenever V_{CC} falls below the switchover voltage, V_{SO} , V_{OUT} is connected to V_{BAT} through a $100\ \Omega$ switch. V_{SO} is the lesser of V_{BAT} and V_{RST} . Choosing the lesser allows the device to be powered by V_{CC} for as long as possible before switching over thereby maximizing the battery life.

Assuming $V_{BAT} > 2.0\text{ V}$, switchover at V_{SO} ensures that battery backup mode is entered before V_{OUT} gets too close to the 2.0 V minimum required to reliably retain data in most external SRAMs. When V_{CC} recovers, hysteresis is used to avoid oscillation around the V_{SO} point. V_{OUT} is connected to V_{CC} through a $3\ \Omega$ PMOS power switch.

Note: The backup battery may be removed while V_{CC} is valid, assuming V_{BAT} is adequately decoupled ($0.1\ \mu\text{F typ}$), without danger of triggering a reset.

Table 4. I/O status in battery backup

V_{OUT}	Connected to V_{BAT} through internal switch
V_{CC}	Disconnected from V_{OUT}
PFI	Disabled
$\overline{\text{PFO}}$	Logic low
$\overline{\text{E}}$	High impedance
$\overline{\text{E}}_{\text{CON}}$	Logic high
WDI	Watchdog timer is disabled
$\overline{\text{MR}}$	Disabled
$\overline{\text{RST}}$	Logic low
RST	Logic high
V_{BAT}	Connected to V_{OUT}

2.5 Chip-enable gating (STM818 only)

Internal gating of the chip-enable (\bar{E}) signal prevents erroneous data from corrupting the external CMOS RAM in the event of an undervoltage condition. The STM818 uses a series transmission gate from \bar{E} to \bar{E}_{CON} (see [Figure 11](#)). During normal operation (reset not asserted), the \bar{E} transmission gate is enabled and passes all \bar{E} transitions. When reset is asserted, this path becomes disabled, preventing erroneous data from corrupting the CMOS RAM. The short propagation delay from \bar{E} to \bar{E}_{CON} enables the STM818 to be used with most μ Ps. If \bar{E} is low when reset asserts, \bar{E}_{CON} remains low for typically 15 μ s (or until \bar{E} goes high) to permit the current WRITE cycle to complete. Connect \bar{E} to V_{SS} if unused.

2.6 Chip-enable input (STM818 only)

The chip-enable transmission gate is disabled and \bar{E} is high impedance (disabled mode) while reset is asserted. During a power-down sequence when V_{CC} passes the reset threshold, the chip-enable transmission gate disables and \bar{E} immediately becomes high impedance if the voltage at \bar{E} is high. If \bar{E} is low when reset asserts, the chip-enable transmission gate will disable 15 μ s after reset asserts (see [Figure 12](#)). This permits the current WRITE cycle to complete during power-down.

Any time a reset is generated, the chip-enable transmission gate remains disabled and \bar{E} remains high impedance (regardless of \bar{E} activity) for the reset time-out period. When the chip-enable transmission gate is enabled, the impedance of \bar{E} appears as a 40 Ω resistor in series with the load at \bar{E}_{CON} . The propagation delay through the chip-enable transmission gate depends on V_{CC} , the source impedance of the drive connected to \bar{E} , and the loading on \bar{E}_{CON} . The chip-enable propagation delay is production tested from the 50% point on \bar{E} to the 50% point on \bar{E}_{CON} using a 50 Ω driver and a 50 pF load capacitance (see [Figure 39](#)). For minimum propagation delay, minimize the capacitive load at \bar{E}_{CON} and use a low-output impedance driver.

2.7 Chip-enable output (STM818 only)

When the chip-enable transmission gate is enabled, the impedance of \bar{E}_{CON} is equivalent to a 40 Ω resistor in series with the source driving \bar{E} . In the disabled mode, the transmission gate is off and an active pull-up connects \bar{E}_{CON} to V_{OUT} (see [Figure 11](#)). This pull-up turns off when the transmission gate is enabled.

Figure 11. Chip-enable gating

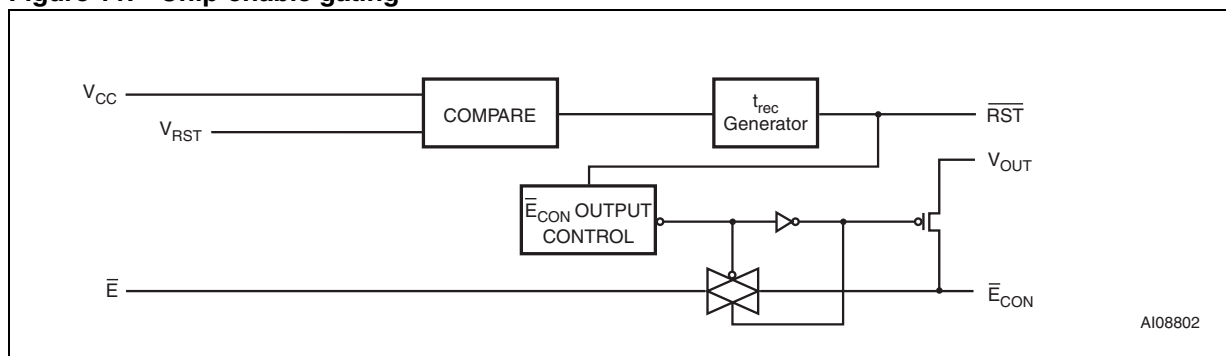
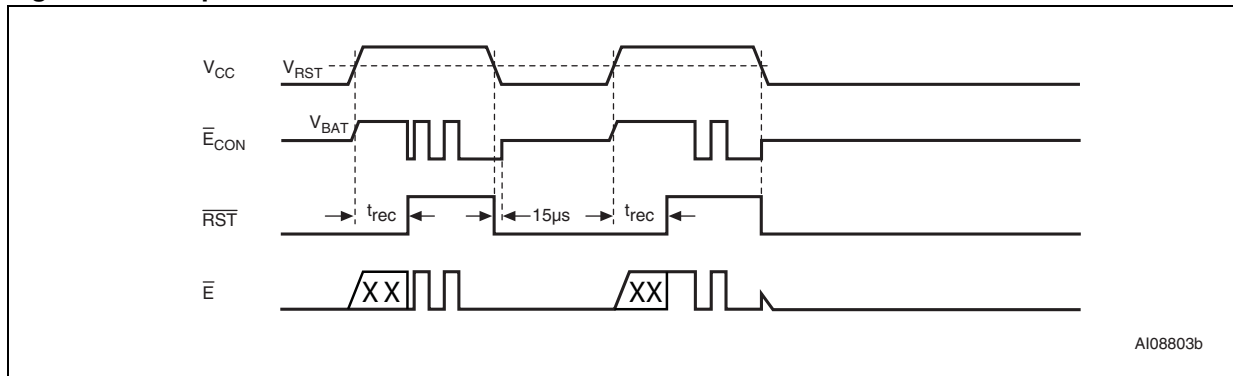


Figure 12. Chip-enable waveform



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2.8 Power-fail input/output (NOT available on STM818)

The Power-fail Input (PFI) is compared to an internal reference voltage (independent from the V_{RST} comparator). If PFI is less than the power-fail threshold (V_{PFI}), the Power-Fail Output (\overline{PFO}) will go low. This function is intended for use as an undervoltage detector to signal a failing power supply. Typically PFI is connected through an external voltage divider (see [Figure 12](#)) to either the unregulated DC input (if it is available) or the regulated output of the V_{CC} regulator. The voltage divider can be set up such that the voltage at PFI falls below V_{PFI} several milliseconds before the regulated V_{CC} input to the STM690A/692A/703/704/802/805/817/818/819 Supervisor or before the microprocessor drops below the minimum operating voltage. This provides several milliseconds of advanced warning that power is about to fail.

During battery backup, the power-fail comparator turns off and \overline{PFO} goes (or remains) low (see [Figure 13](#) below and [Figure 14](#)). This occurs after V_{CC} drops below 2.4 V (or V_{SO}). When power returns, \overline{PFO} is forced high (STM817/819 only), irrespective of V_{PFI} for the WRITE protect time (t_{rec}). At the end of this time, the power-fail comparator is enabled and \overline{PFO} follows PFI. If the comparator is unused, PFI should be connected to V_{SS} and \overline{PFO} left unconnected. \overline{PFO} may be connected to \overline{MR} on the STM703/704/818 so that a low voltage on PFI will generate a reset output.

2.9 Applications information

These supervisor circuits are not short-circuit protected. Shorting V_{OUT} to ground - excluding power-up transients such as charging a decoupling capacitor - destroys the device. Decouple both V_{CC} and V_{BAT} pins to ground by placing 0.1 µF capacitors as close to the device as possible.

Figure 13. Power-fail comparator waveform (STM817/818/819)

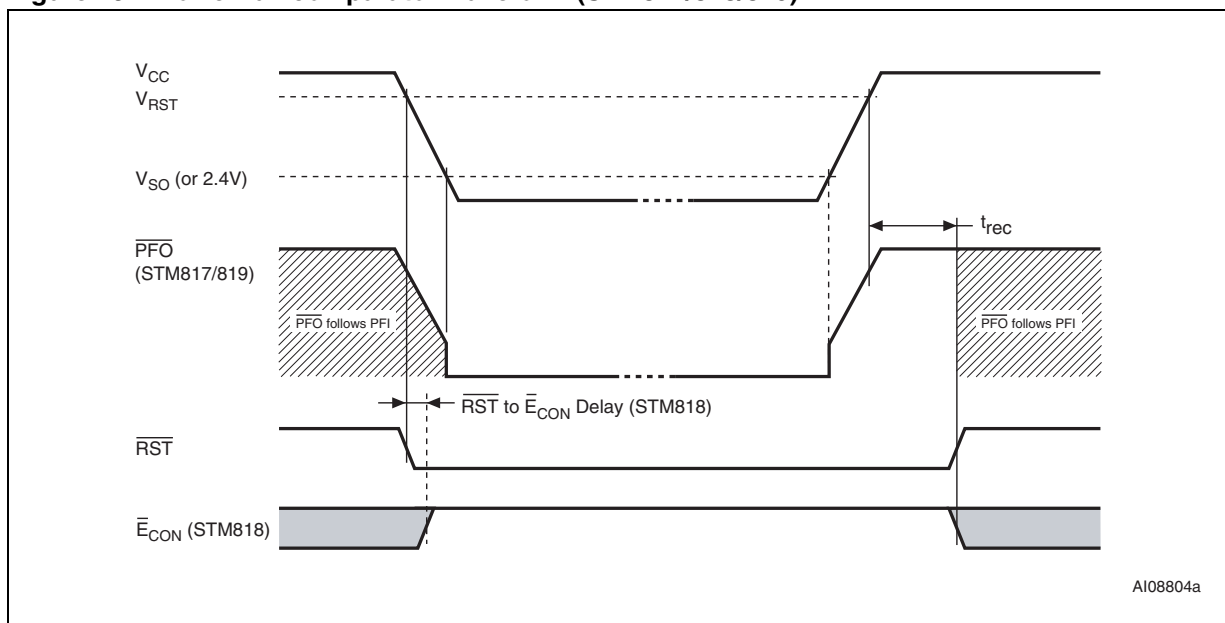
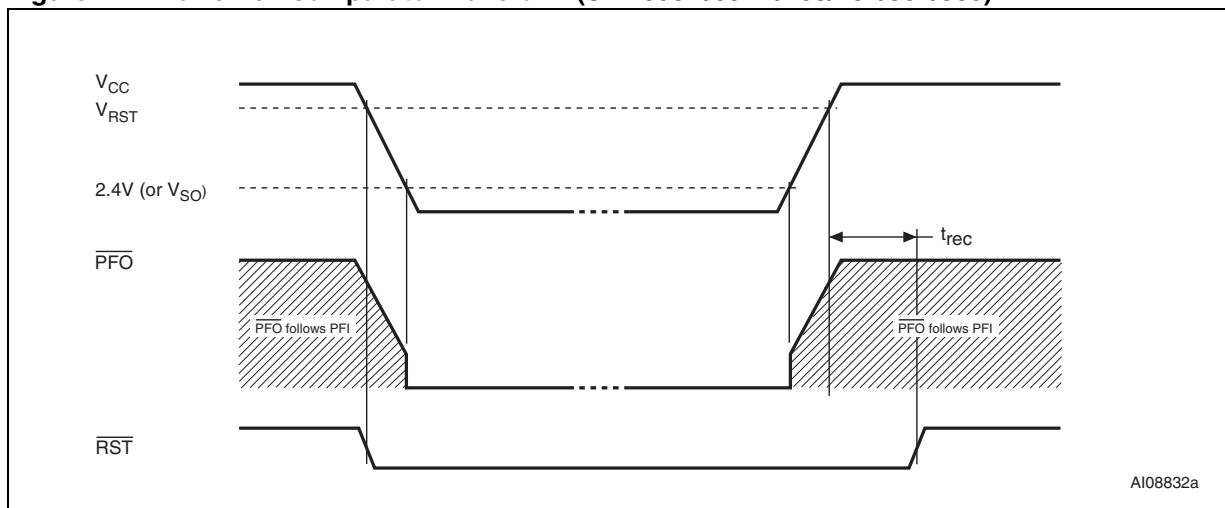


Figure 14. Power-fail comparator waveform (STM690A/692A/703/704/802/805)



2.10 Using a SuperCap™ as a backup power source

SuperCaps™ are capacitors with extremely high capacitance values (e.g., 0.47 F) for their size. [Figure 15](#) shows how to use a SuperCap as a backup power source. The SuperCap may be connected through a diode to the 5 V supply. Since V_{BAT} can exceed V_{CC} while V_{CC} is above the reset threshold, there are no special precautions for using these supervisors with a SuperCap.

2.11 Negative-going V_{CC} transients

The STM690A/692A/703/704/802/805/817/818/819 Supervisors are relatively immune to negative-going V_{CC} transients (glitches). [Figure 37](#) shows typical transient duration versus reset comparator overdrive (for which the STM690A/692A/703/704/802/805/817/818/819 will NOT generate a reset pulse). The graph was generated using a negative pulse applied to V_{CC} , starting at $V_{RST} + 0.3$ V and ending below the reset threshold by the magnitude indicated (comparator overdrive). The graph indicates the maximum pulse width a negative V_{CC} transient can have without causing a reset pulse. As the magnitude of the transient increases (further below the threshold), the maximum allowable pulse width decreases. Any combination of duration and overdrive which lies under the curve will NOT generate a reset signal. Typically, a V_{CC} transient that goes 100 mV below the reset threshold and lasts 40 μ s or less will not cause a reset pulse. A 0.1 μ F bypass capacitor mounted as close as possible to the V_{CC} pin provides additional transient immunity.

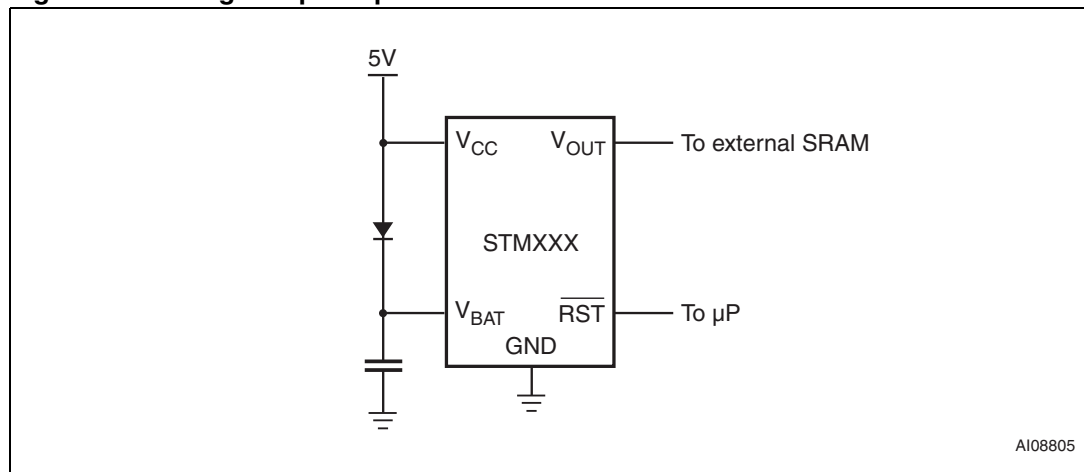
2.12 Battery freshness seal (STM817/818/819)

The battery freshness seal disconnects the backup battery from internal circuitry and V_{OUT} until it is needed. This allows an OEM to ensure that the backup battery connected to V_{BAT} will be fresh when the final product is put to use. To enable the freshness seal:

1. Connect a battery to V_{BAT}
2. Ground \overline{PFO}
3. Bring V_{CC} above the reset threshold and hold it there until reset is deasserted following the reset timeout period and
4. Bring V_{CC} down again (Figure 16)

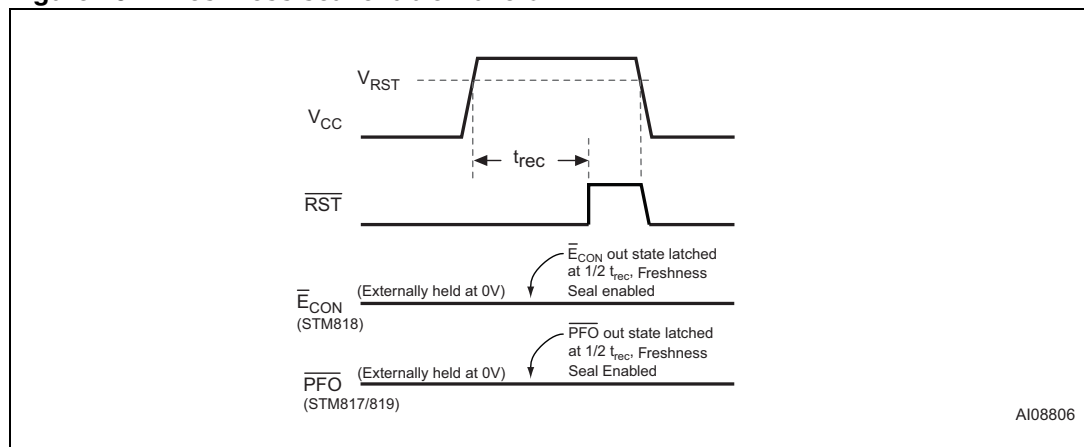
Use the same procedure for the STM818, but ground \overline{ECON} instead of \overline{PFO} . Once the battery freshness seal is enabled (disconnecting the backup battery from internal circuitry and anything connected to V_{OUT}), it remains enabled until V_{CC} is brought above V_{RST} .

Figure 15. Using a SuperCap™



AI08805

Figure 16. Freshness seal enable waveform



AI08806

3 Typical operating characteristics

Note: Typical values are at $T_A = 25\text{ }^\circ\text{C}$.

Figure 17. V_{CC} to V_{OUT} on-resistance vs. temperature

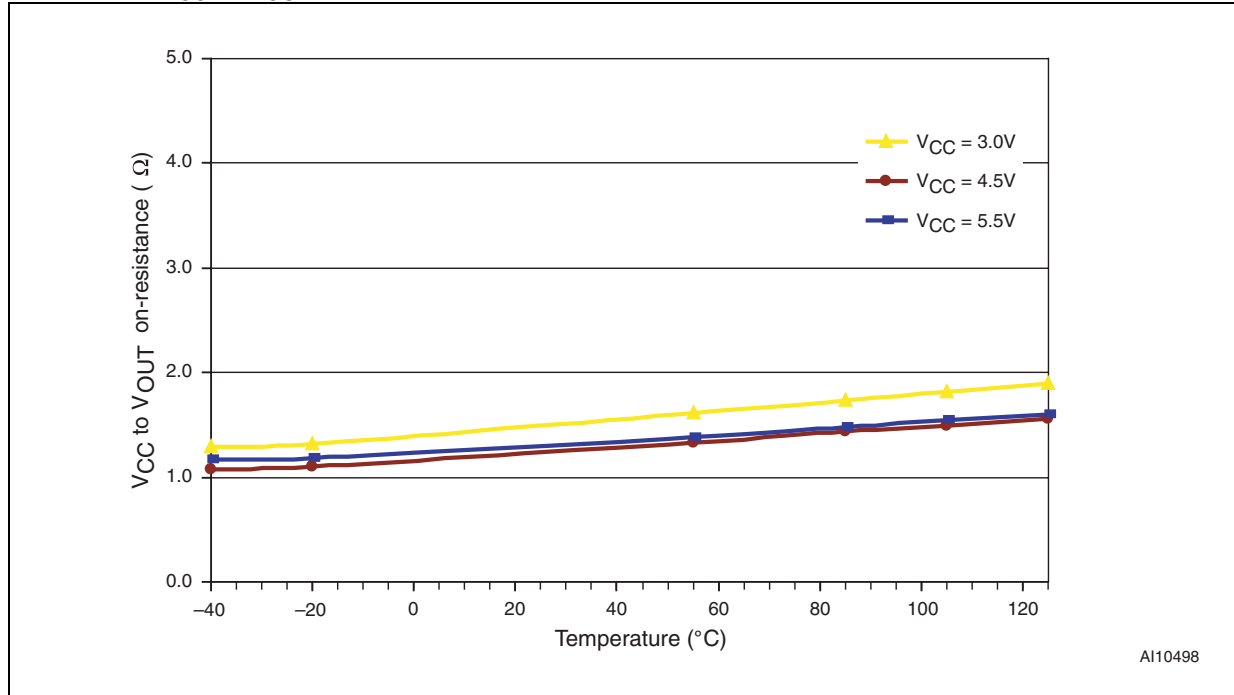


Figure 18. V_{BAT} to V_{OUT} on-resistance vs. temperature

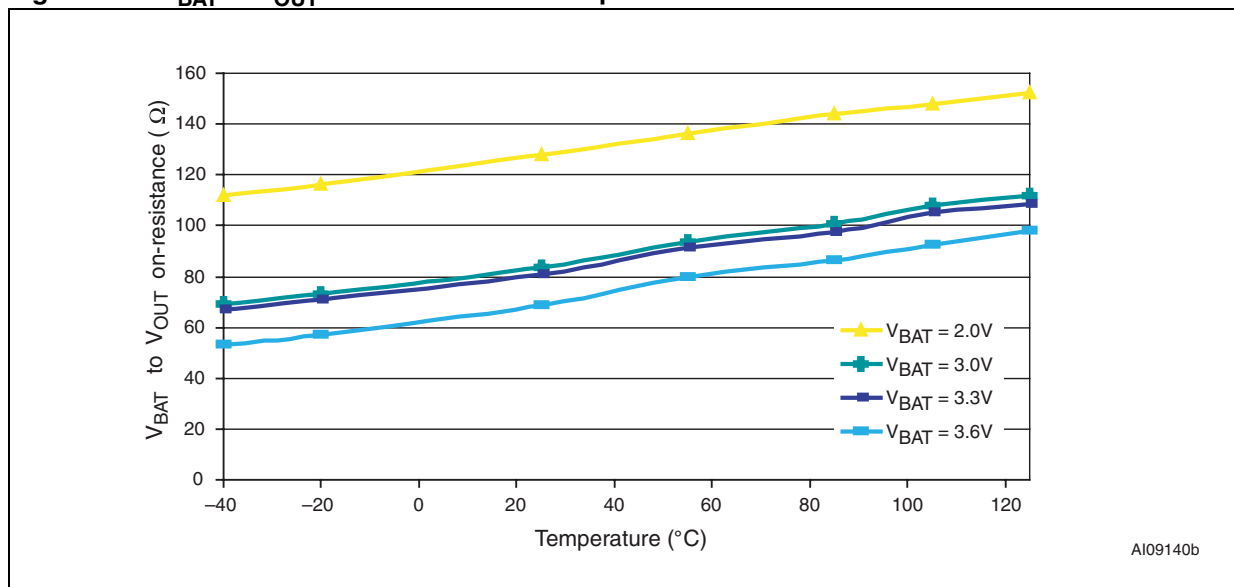


Figure 19. Supply current vs. temperature (no load)

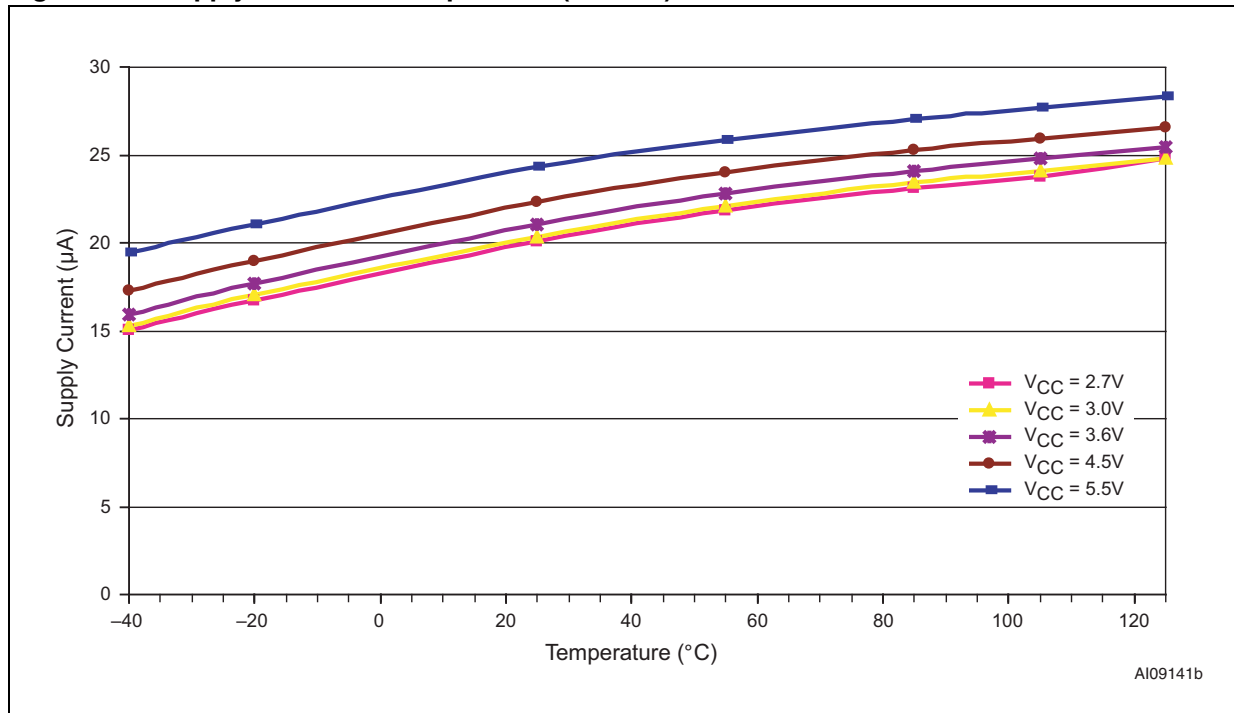


Figure 20. Battery current vs. temperature

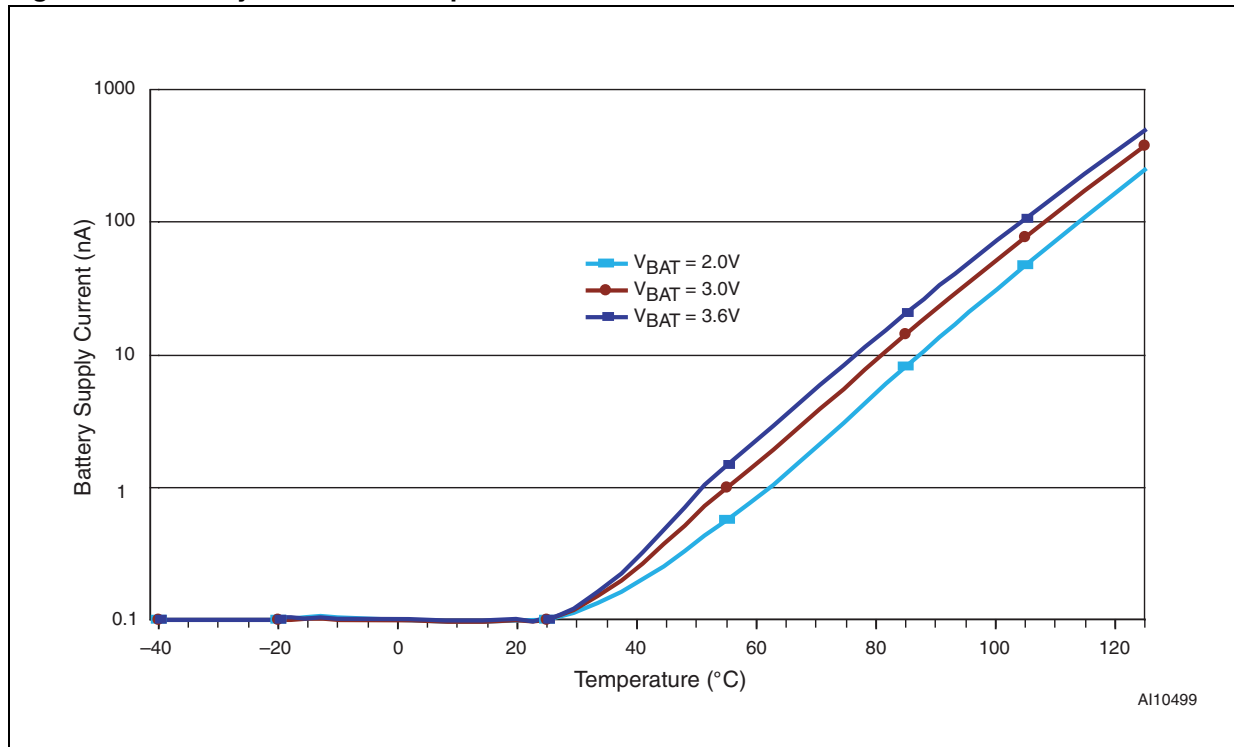


Figure 21. V_{PFI} threshold vs. temperature

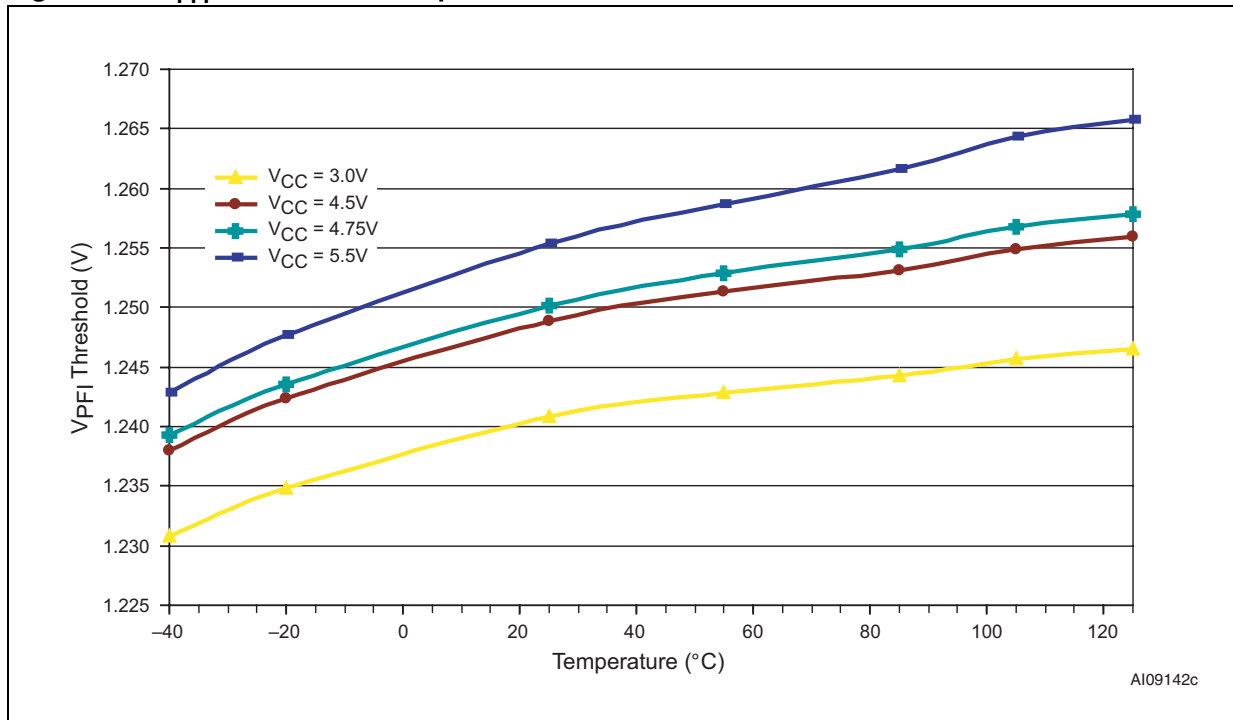


Figure 22. Reset comparator propagation delay vs. temperature (other than STM817/818/819)

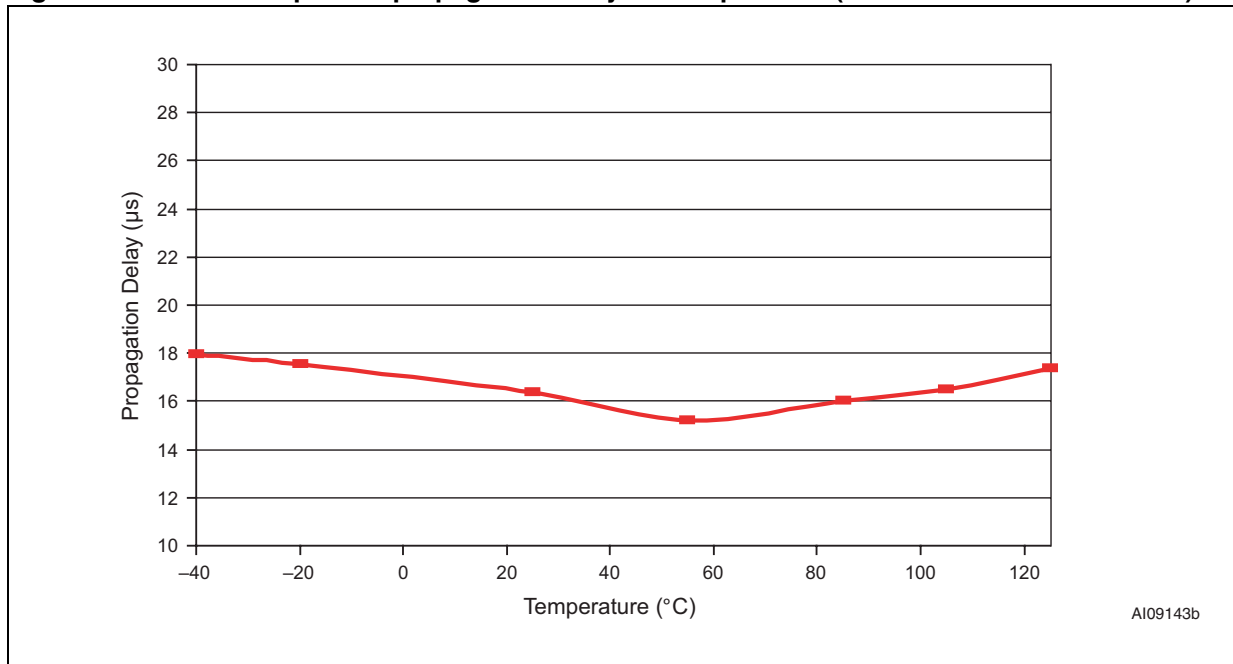


Figure 23. Reset comparator propagation delay vs. temperature ($V_{BAT} = 3.0\text{ V}$; STM817/818/819)

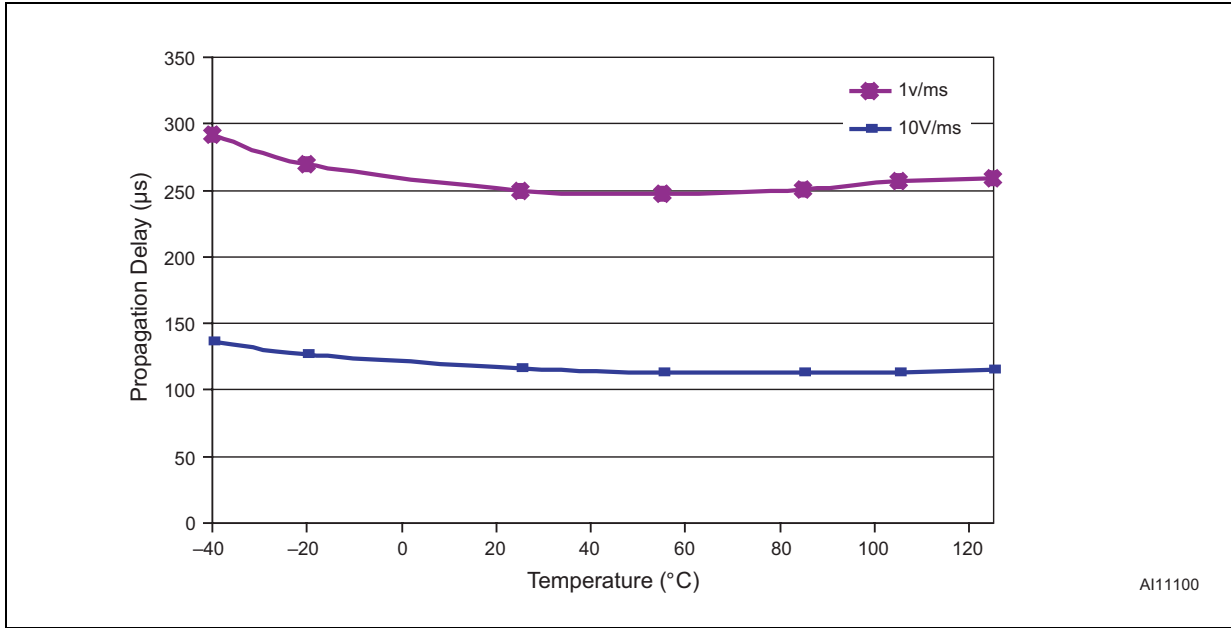


Figure 24. Power-up t_{REC} vs. temperature

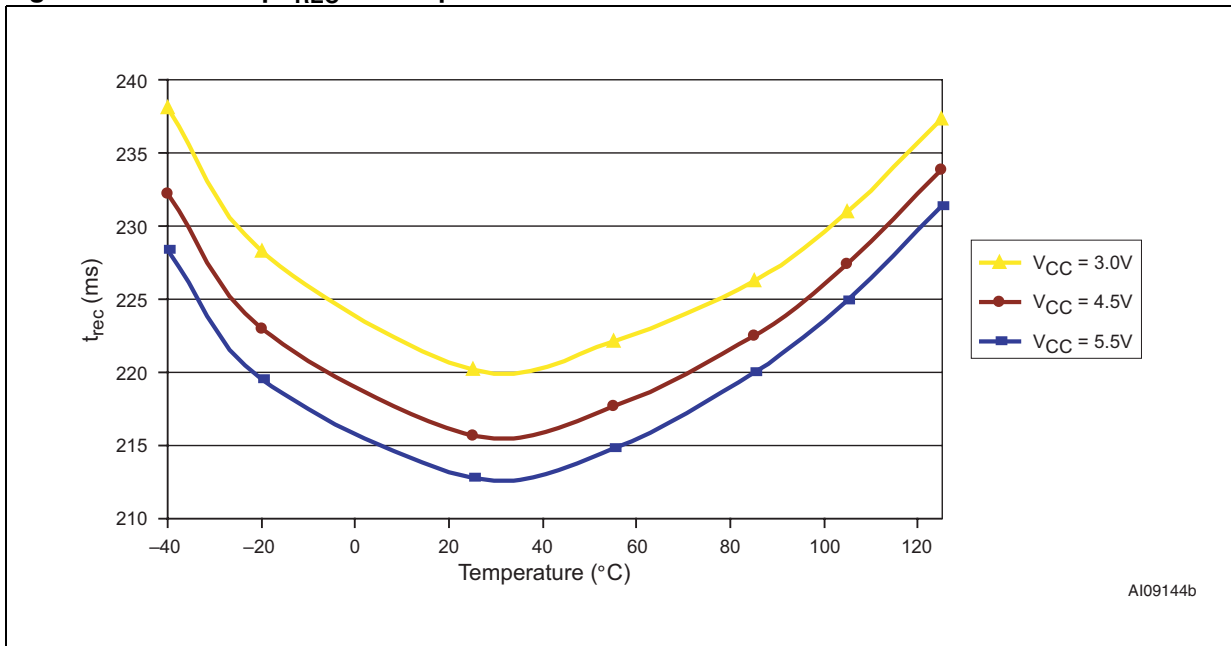


Figure 25. Normalized reset threshold vs. temperature

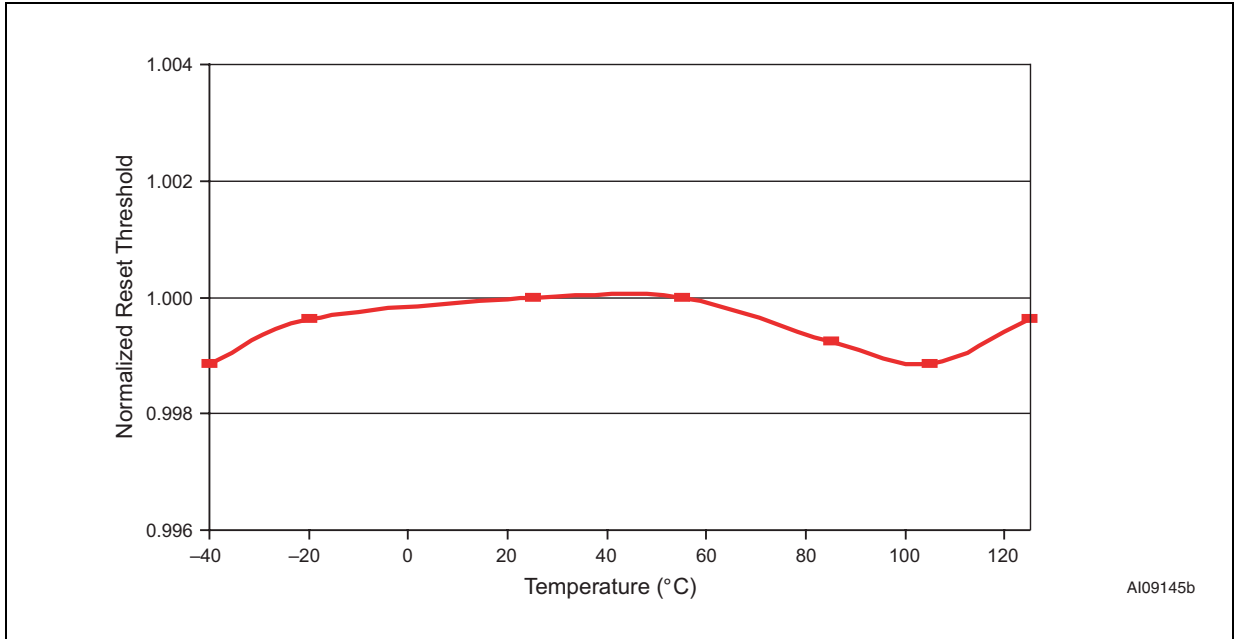


Figure 26. Watchdog time-out period vs. temperature

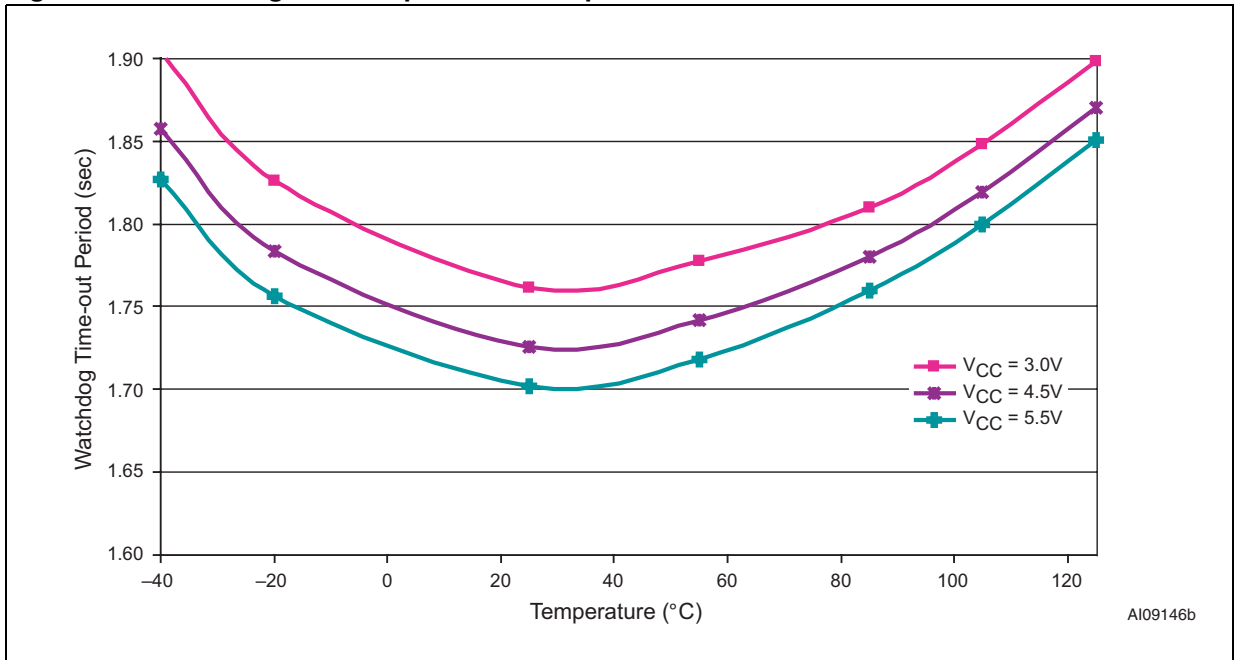


Figure 27. \bar{E} to \bar{E}_{CON} on-resistance vs. temperature

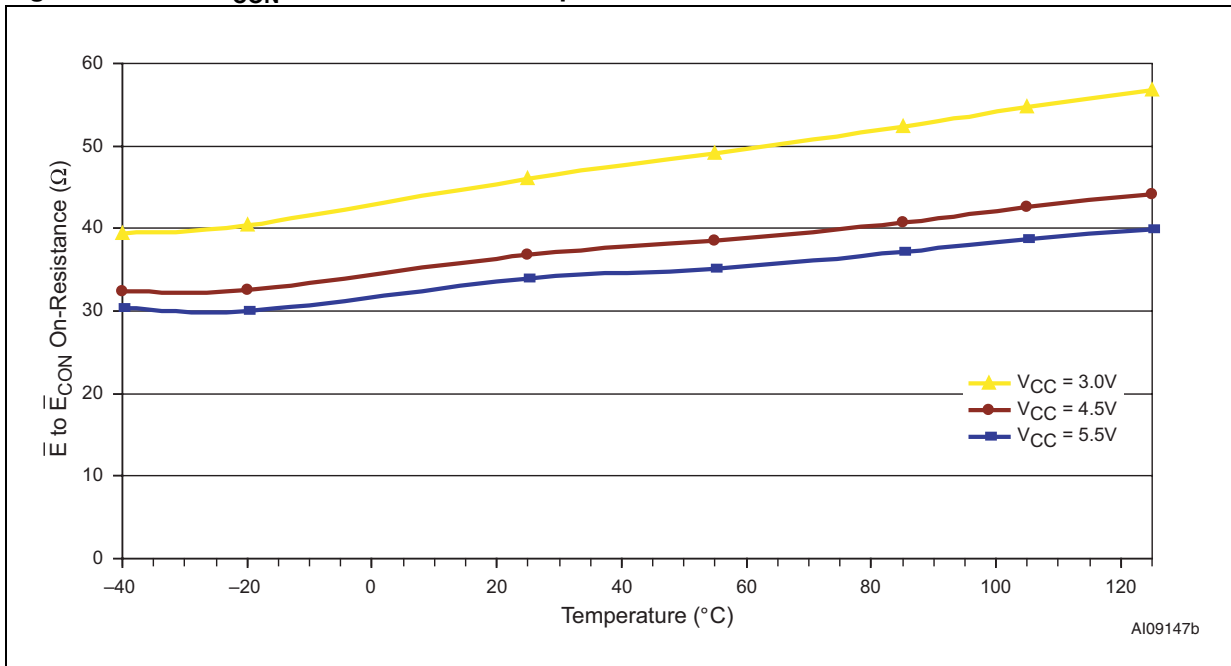


Figure 28. PFI to \overline{PFO} propagation delay vs. temperature

