Reset generator parameters and their meaning

A reset generator has to deliver a reset signal whenever the power supply of a microcontroller (in the following abreviated with ’MCU’) falls out of the regular operating voltage. During reset all internal states of the MCU are forced to an initial state that allows restarting the MCU in a well defined way.

Reset trip point

The lowest supply voltage at which the MCU operates corretly is the lowest permissible threshold the reset generator has to trigger at when the supply goes down.

For better explaination see the following figure.

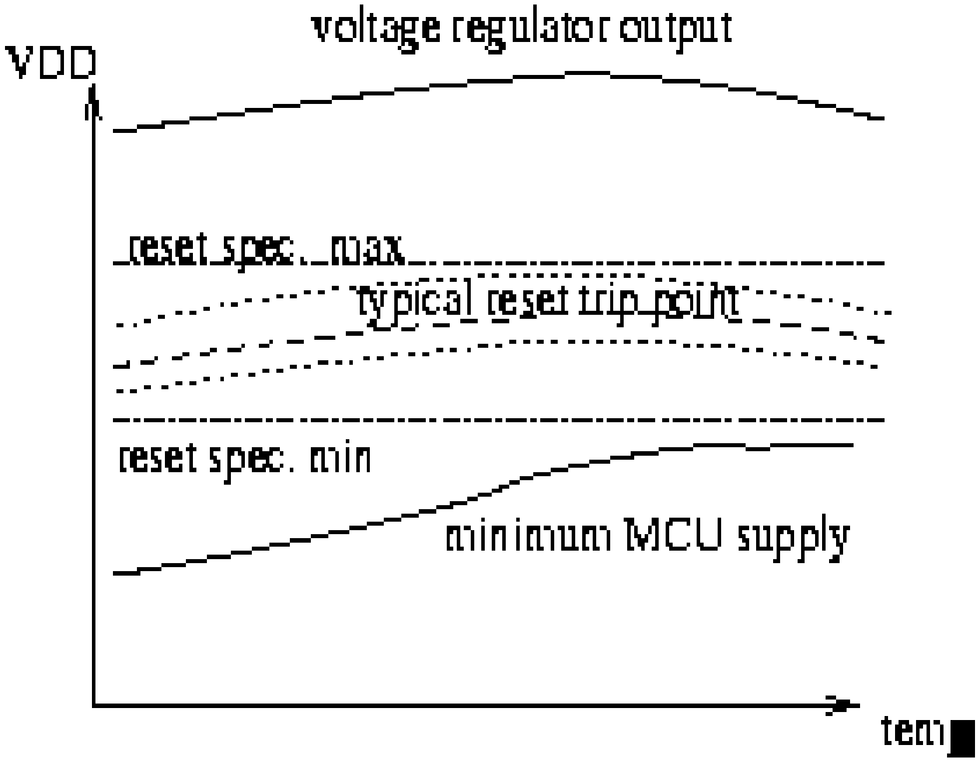

Fig. 1 Reset trip point.

The lowest curve describes the minimum supply voltage the MCU needs with respect to temperature.

The reset trip point (dashed) must be above this minimum supply voltage the MCU requires.

Since the reset trip point always has some spread even the worst cases (dotted) must be above the MCU requirement and the upper spread below the true output voltage of the regulator. (upmost solid curve).

Specifying a polygon shaped curve is very inconveniant. Therefore the specified thresholds (dash−dotted) usually define a temperature independent range (between the dash−dotted lines). The actual reset trip point (including the spread curves) is inside this range.

Reset release

Reset release is the threshold the reset generator deasserts the reset signal. The functional minimum requirement is that the reset release threshold is between the reset trip point and the actual output voltage of the regulator. Please see figure 2.

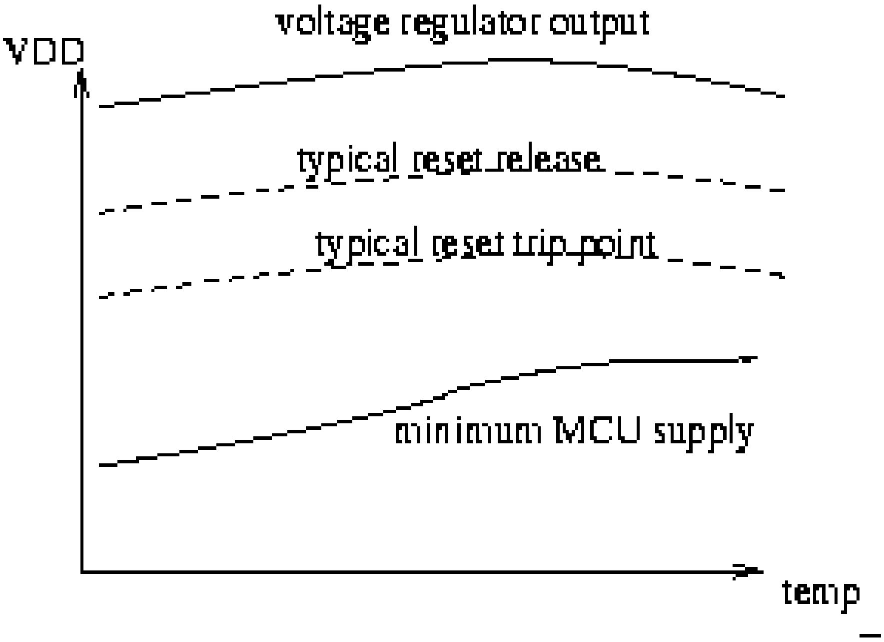

Fig. 2: Reset trip point and reset release point

The distance between the reset trip point and the reset release threshold is the hysteresis of the reset generator. The hysteresis (distance between both curves) is required to prevent toggling between reset and not reset or even worse undefined logic output voltages when the supply voltage exactly hits the threshold.

Overlap of specified reset trip and reset release thresholds

Adding the spreads makes the drawing a bit more tricky. The reset trip point range overlaps the reset release range!

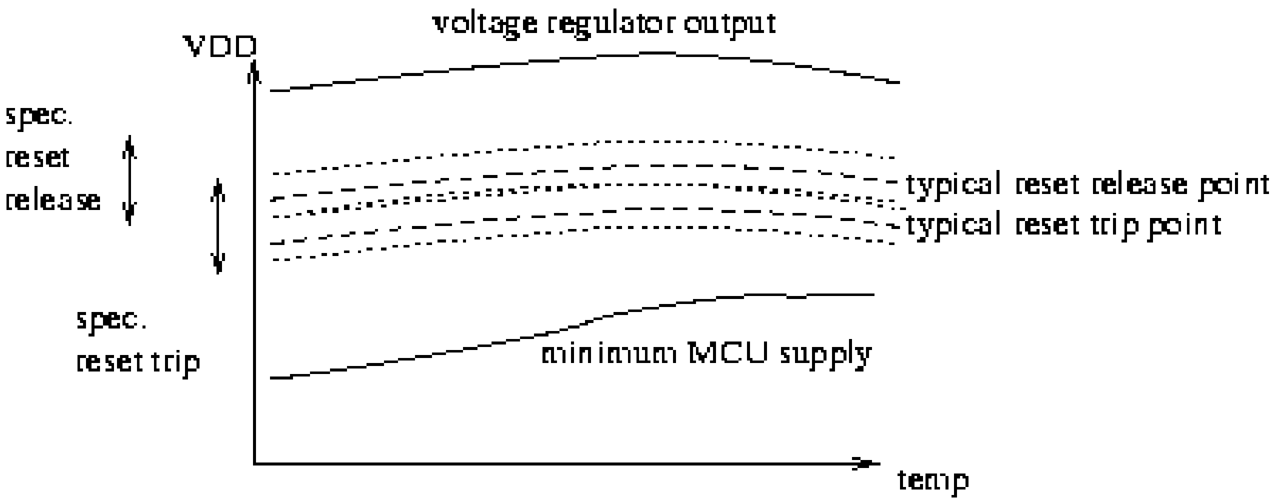

Fig. 3: Including spread reset trip range and reset release range overlap.

Overlapping specified reset trip range and reset release range are represented by the double ended arrows left of the y−axis. This overlapping representation is permissible provided a hysteresis exists (In other words: when the trip point spread is high, the reset release point must be high too. Both thresholds must track).

Usually both thresholds are derived from the same voltage divider and use the same voltage reference generator. So tracking of both thresholds is given by the design. Nevertheless the presence of a hysteresis must be verified by testing. (remember to implement a testmode overriding timers to test hysteresis!)

The following figure shows the resulting specified reset thresholds and the regulator output voltage including spread

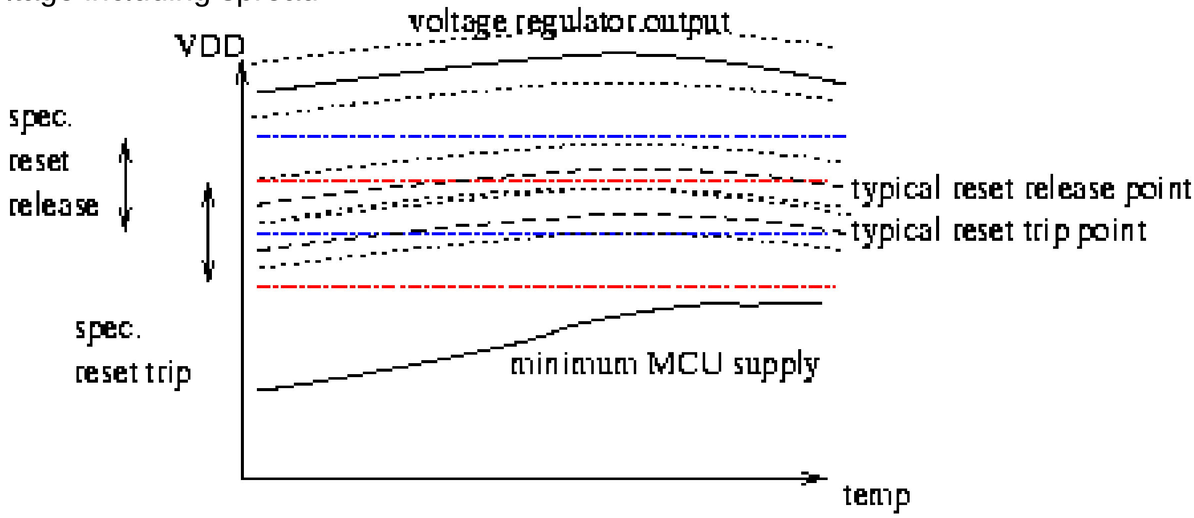

Fig. 4: specified reset trip point range (red limits), reset release (blue limits) and regulator output voltage including spread (dotted curves paralell to the nominal output voltage).

Reset release margin

In figure 4 we are facing the next specification problem. The low spread limit of the voltage regulator output voltage almost touches the upper limit (upper blue dash−dotted line) of the reset release specification. There is no more room left for a reasonable specification of the lowest regulator output voltage using a horizontal line.

In reality the problem only is present at some points (temperatures) where the true reset release threshold including spread does not really require the whole tolerance allowed by the blue limit lines defined in the specification.

To allow touching or overlapping low limits of the voltage regulator specification and high limits of the reset release threshold the parameter reset release headroom is introduced. This parameter more or less describes the closest distance of the upper spread of the reset release threshold and the lower spread of the voltage regulator.
(The approach is similar to specifiying a camparator hysteresis although the release threshold range and the trip threshold range overlap.)

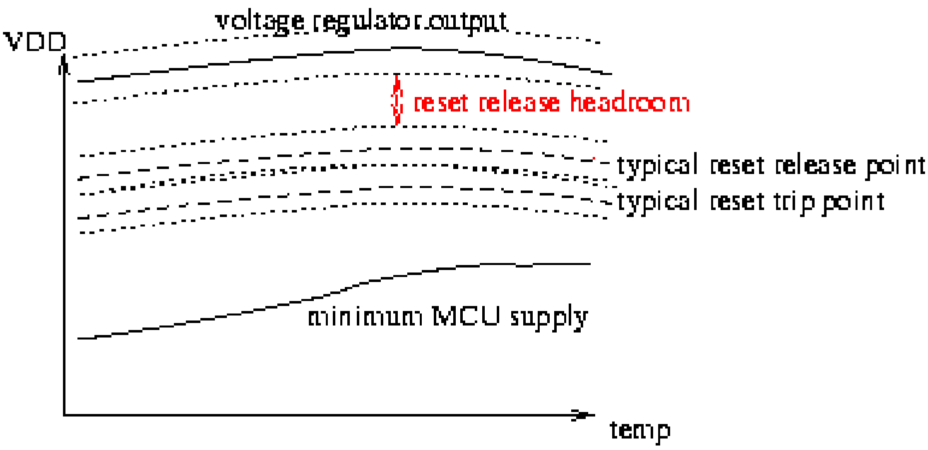

Fig. 5 reset release headroom.

How to check a reset generator specification for plausibility

To verify plausibility of a reset generator specification follow these steps:

1. Are there overlapping ranges (reset trip point range, reset release range, regulator output voltage range)?
2. If reset trip range and reset release range overlap:
   2.1. Is there a hysteresis specified?
   2.2. Is the typical hysteresis consistent with (or less than) the distance between typical values of reset trip point and reset release point?
   2.3. From application point of view a maximum value of the hysteresis is not needed as long as the reset release threshold is below the regulator output voltage minimum value.
   2.4. If 2.3 is not fullfilled and no maximum hysteresis is given a reset release headroom must be specified.
   2.5. Is threre a reasonable minimum hysteresis specified (If the design is allowed to consume sufficient current to support highly accurat circuits the minimum hysteresis should be about 60% of the typical hysteresis. In low cost designs and even worse in low current consumption designs the number of branches with current flow must be minimized. There the hysteresis can only be generated by ΔVbe or ΔVth circuits. The temperature coefficient requires a minimum hysteresis between 20% and 50% of the typical value!)? Expect between 20% and 60% of the nominal hysteresis. Everything better causes unnecessary costs.
3. If reset release and voltage regulator output voltage tolerances overlap each other a reset release headroom must be given.
4. Reset release headroom must be less than the distance between the typical output voltage and typical reset release threshold. Choosing a reset release headroom slightly below the distance of the low spread of the voltage regulator and the high spread of the reset release threshold is suggested.

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Dec. 2004