

1 Background

During qualification, it was noticed that the voltage regulator N2 of type LM5010 sometimes suffers a defect even with a soft short circuit (with 10 Ohm load), but quite reliably with a hard short circuit at the "p24V".

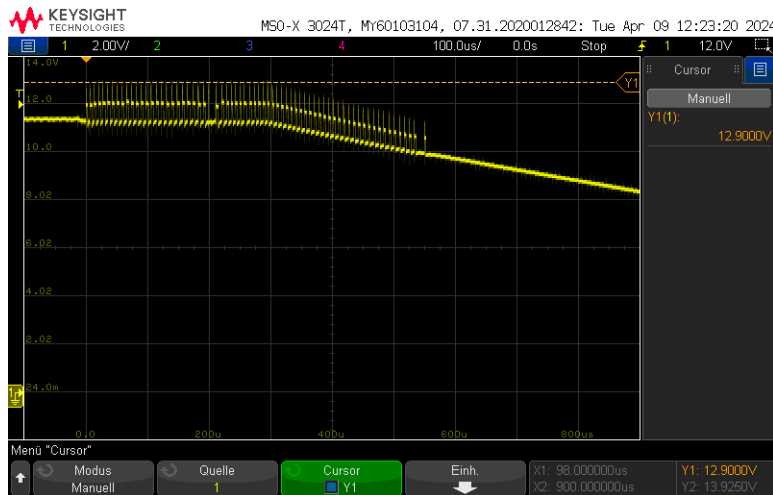
The regulator is damaged to such an extent that its internal control logic no longer functions correctly.

After the soft start phase, the regulator stops and stops clocking for a while. As a result, the 24V cannot be built up.

Note: The error could also be reproduced on an old HW stand (see 2.1).

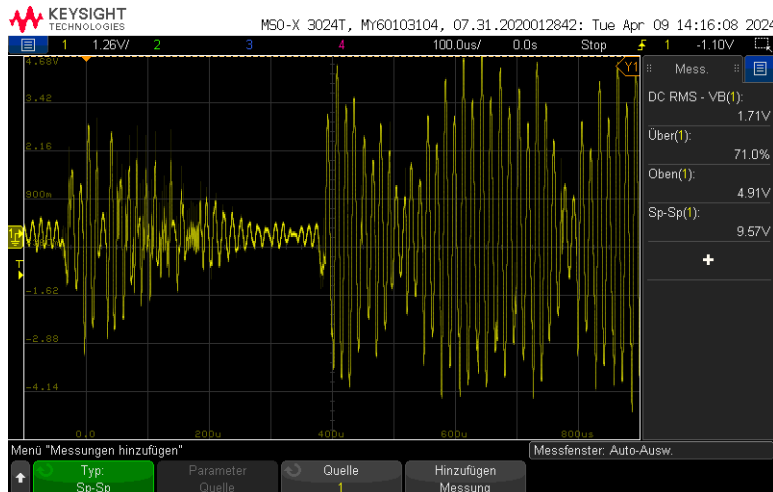
2 Measurements

2.1 Measurements on a module with an old HW version (predecessor module)



Scope_0: soft short circuit with 10 Ohm at "p24V_d", measuring point is mains "P192", BG supplied with 42Vdc (destruction of N2 (LM5010) in the course of the tests)

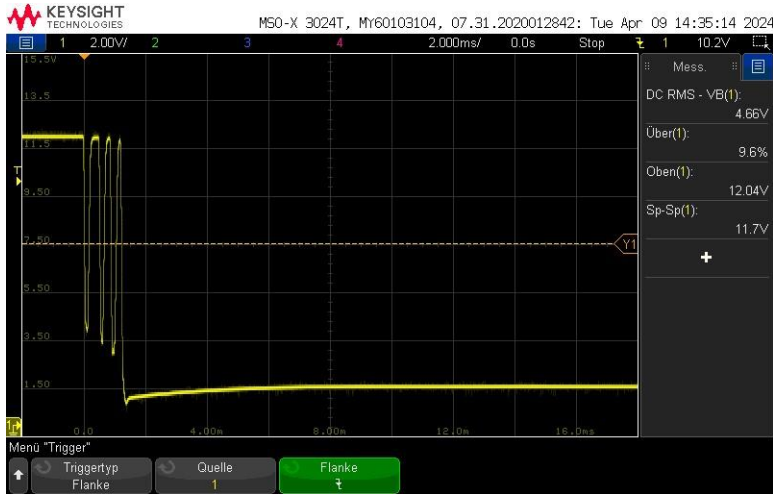
→ The voltage is borderline, as the VCC pin of the LM5010 can only withstand a maximum of 14V.



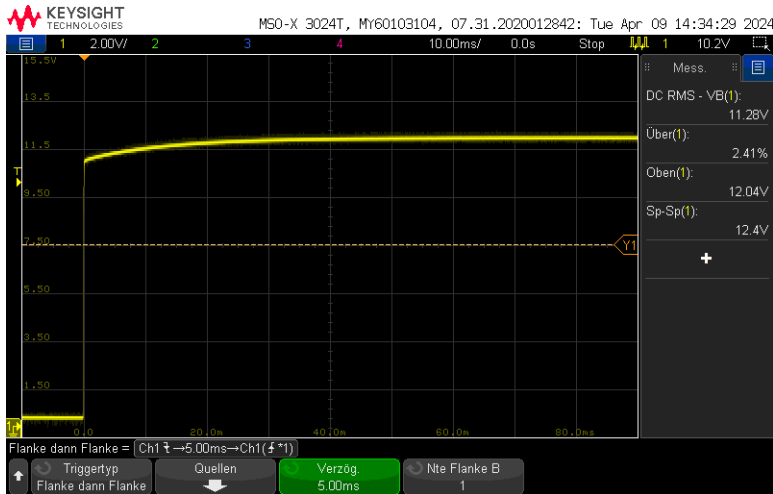
Scope_2: hard short circuit at "p24V_d", measuring point is mains "P188" - AC coupling, BG supplied with 48Vdc, diode V37 already removed (see chapter 3)

→ Very high voltage ripple caused by L23, which represents a series impedance for the voltage regulator N2 in the load case

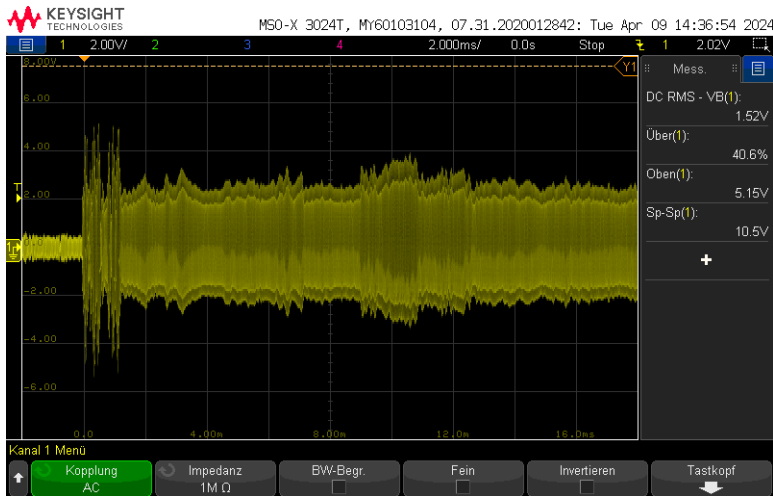
2.2 Measurements on an assembly with a new HW status (newly developed assembly)



Scope_5: hard short circuit at "p24V_d", measuring point is mains "p12V", BG supplied with 48Vdc, diode V37 already removed



Scope_5: Hard short circuit at "p24V_d" resolved, measuring point is mains "p12V", BG supplied with 48Vdc, diode V37 already removed



Scope_7: Hard short circuit at "p24V_d", measuring point is the "P188" network - AC coupling, BG supplied with 48Vdc, diode V37 already removed

Probable cause and recommended action

The most likely cause of the defect on IC N2 is that small voltage overshoots occur on the connected voltage regulator N1 during certain load jumps and changes. This in turn supplies the VCC pin of N2 via diode V37.

As the static voltage including diode drop of approx. 11.5V is already quite close to the limit of 14V, it does not take much more to cause damage due to overvoltage. In the event of a short circuit, other factors such as GND potential shifts may also play a negative role.

The customer had another failure even after removing diode V37.