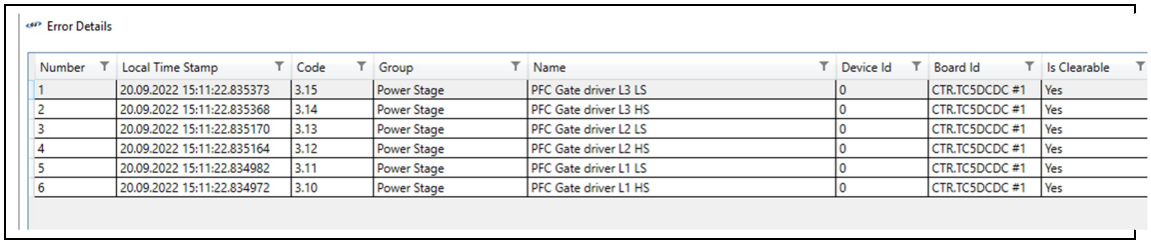
Problem with flyback driver PFC at low temperatures

Version	Datum	Was	Autor
V00	19.09.2022	creation	Stefan Baebler

Reason for measurement

- During temperature tests with the new Infineon modules (FF17MR12W1M1HP_B11) in the complete unit, all desat errors were always triggered at an ambient temperature of 0°C and a time of 15-20min.



Error Details

Number	Local Time Stamp	Code	Group	Name	Device Id	Board Id	Is Clearable
1	20.09.2022 15:11:22.835373	3.15	Power Stage	PFC Gate driver L3 LS	0	CTR.TC5DCDC #1	Yes
2	20.09.2022 15:11:22.835368	3.14	Power Stage	PFC Gate driver L3 HS	0	CTR.TC5DCDC #1	Yes
3	20.09.2022 15:11:22.835170	3.13	Power Stage	PFC Gate driver L2 LS	0	CTR.TC5DCDC #1	Yes
4	20.09.2022 15:11:22.835164	3.12	Power Stage	PFC Gate driver L2 HS	0	CTR.TC5DCDC #1	Yes
5	20.09.2022 15:11:22.834982	3.11	Power Stage	PFC Gate driver L1 LS	0	CTR.TC5DCDC #1	Yes
6	20.09.2022 15:11:22.834972	3.10	Power Stage	PFC Gate driver L1 HS	0	CTR.TC5DCDC #1	Yes

Measurement object

- G5.SRC.18.500.108 (2235GV545 Prototyp mit SiC Infineon FF17)
- PFC SNr. 223447 463 (verbaute PFC mit Fehlerhaftem Flyback Treiber)
- PWR.TC5PFC(FF17) B-101057 V00 2221 8588.2 0168
- PFC SNr. 221031 041 (PFC mit Flyback Treiber aus Brokerware)

Result

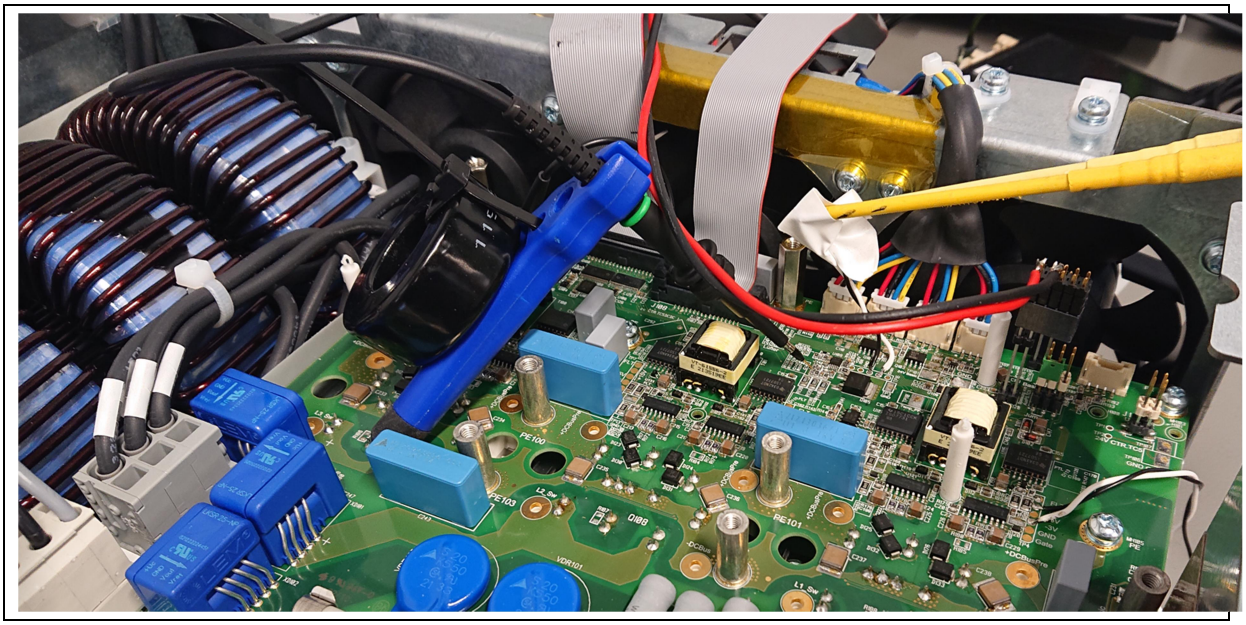
The conclusion:

- The flyback driver LM5022MM has internal problems with low temperatures.

Table of contents

1 Measurement setup and test specimen 3
1.1 Measuring instruments used 3
2 Measured values / results 3

1 Measurement setup and test specimen



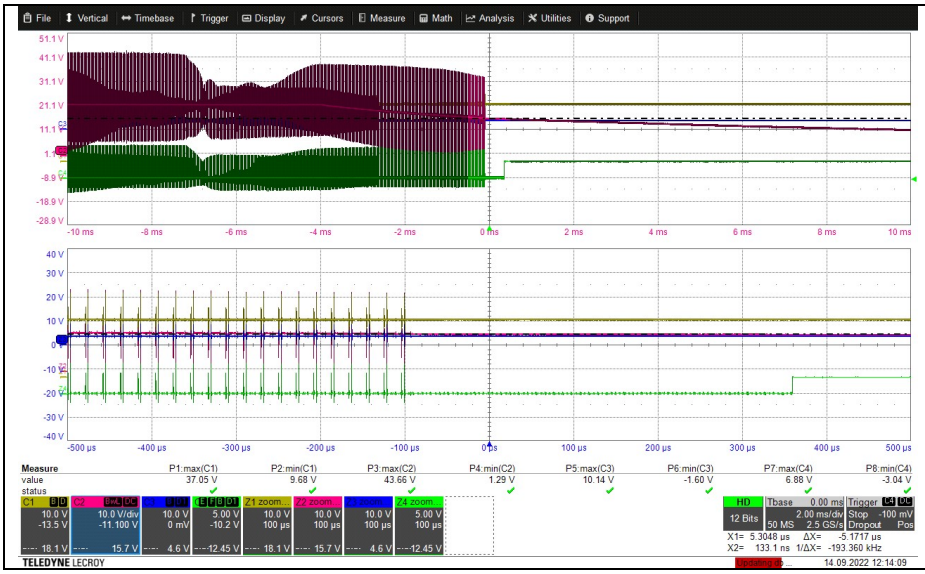
1.1 Measuring instruments used

Oszilloskop HDO6034A-MS // KO30-01

- Diff.-Probe HVD3106 // KO62-01
- Diff.-Probe HVD3106 // KO62-03
- Diff. Probe TT-SI 9001 // KO52-06
- Diff. Probe TT-SI 9001 // KO52-07

2 Measured values / results

First, the different supplies were checked.



Messung Speisungen PFC

Ch1: 24V Basic (HVD 3106 KO62-01)

Ch2: Gate Speisung L1 LS (18V/-3V) (HVD3106 KO62-03)

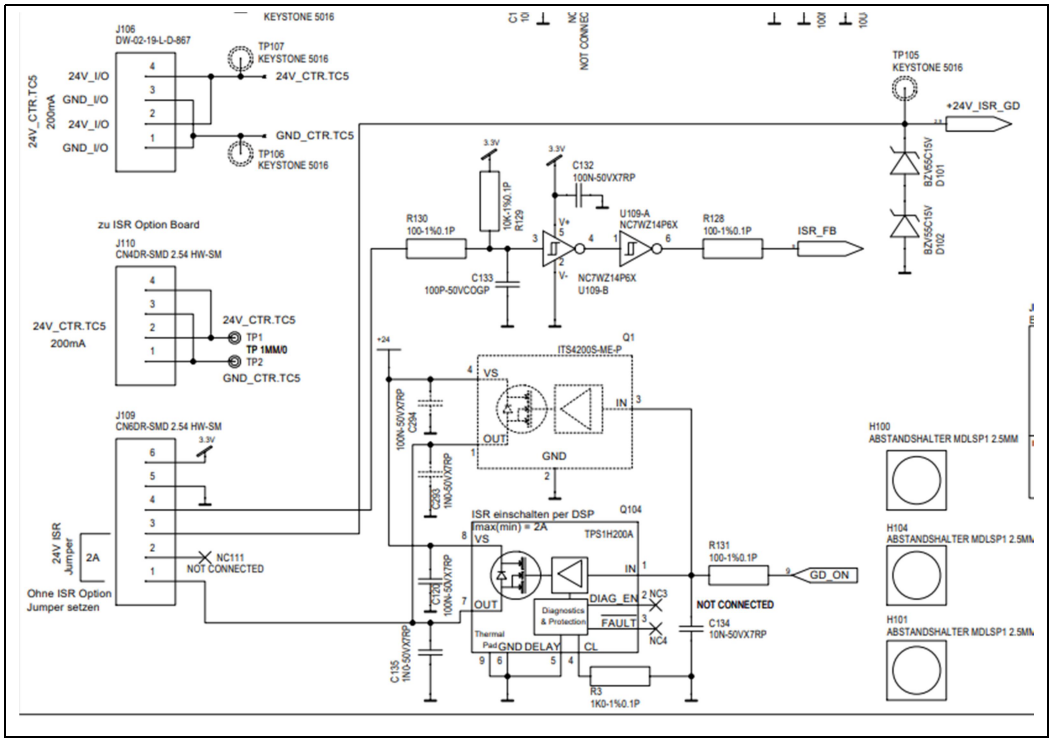
Ch3: 3.3V Speisung (SI9001 KO52-06)

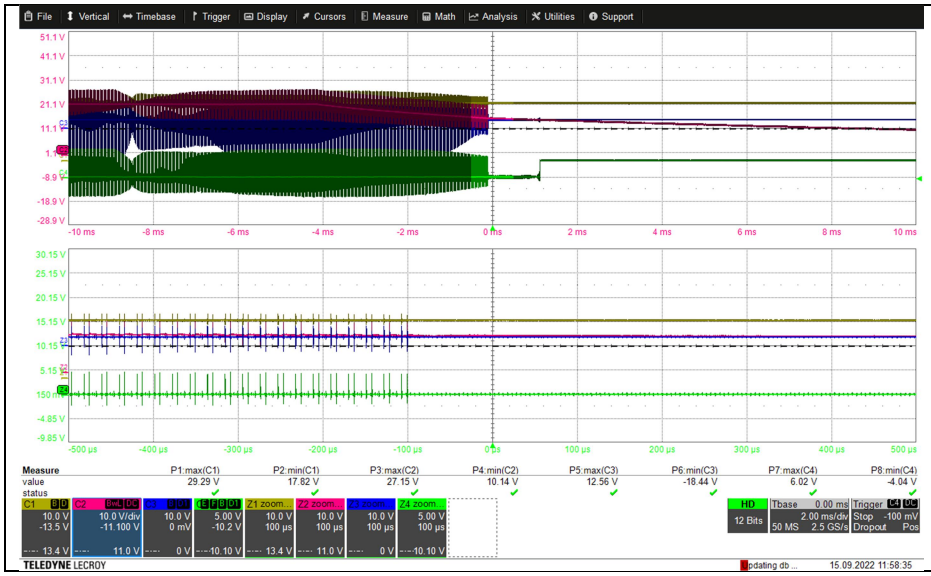
Ch4: BINCI_ImmediateError (SI9001 KO52-07)

A lot of noises because the test leads were relatively long.

From the measurement it can be seen that the gate supply starts to drop at a certain point. At 12.7V (15.7V -3V) the voltage drops below the UVLO threshold of the driver and the desat triggers. In order to measure the signal BINCI_ImmediateError at the DSP debug I/O of the CTR.DCDC, the firmware version V1.5.0.29 was loaded onto the DUT.

Therefore, the source of the error may still be in the flyback circuit or in the 24 ISR GD path.





Measurement supplies/signals PFC

Ch1: 24V ISR_GD (HVD3106 KO62-01)

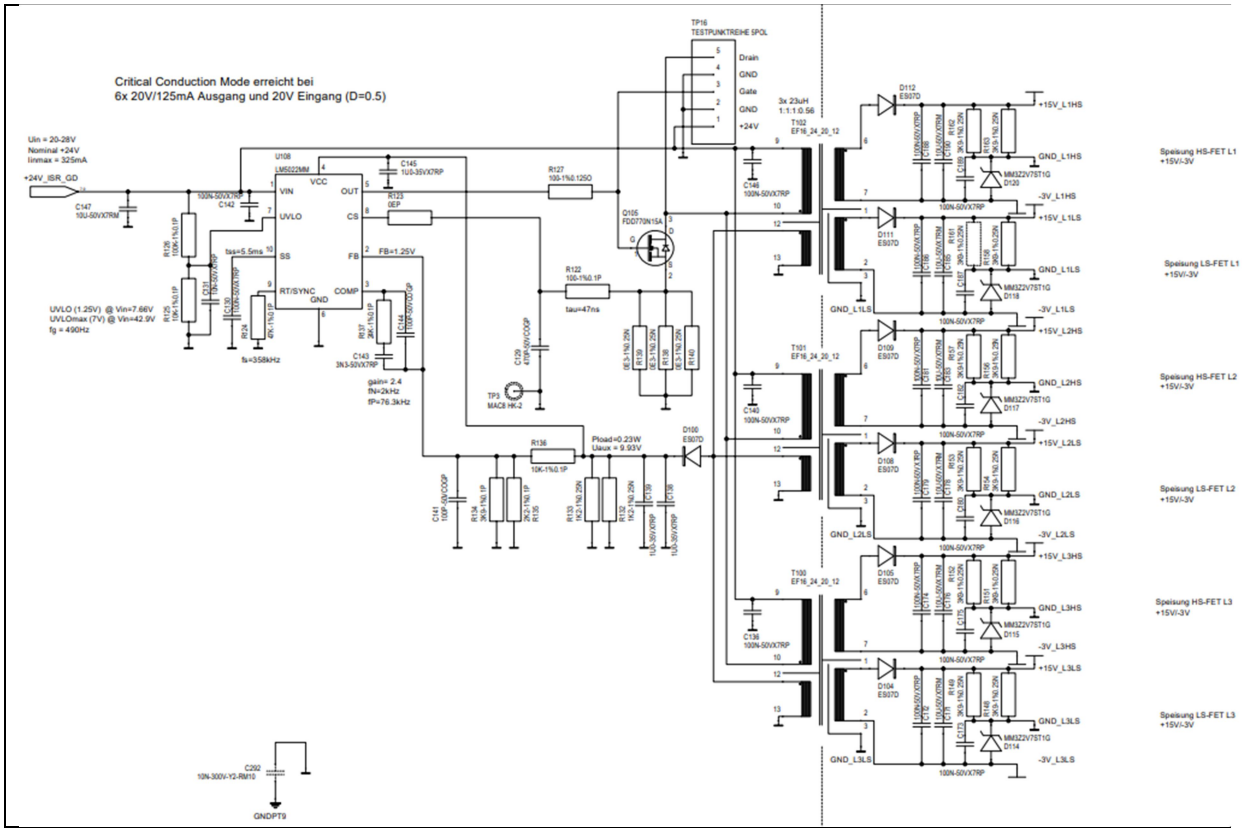
Ch2: Gate supply L1 LS (18V/-3V) (HVD3106 KO62-03)

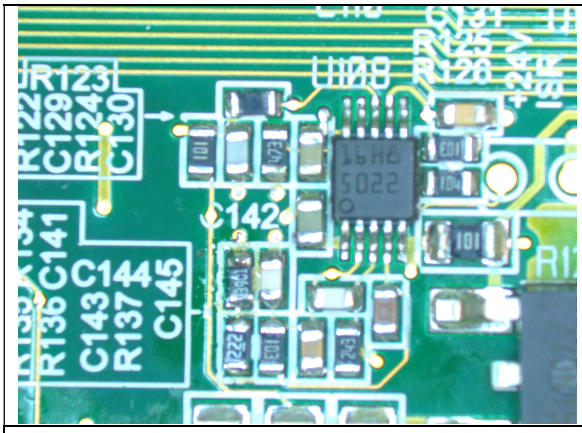
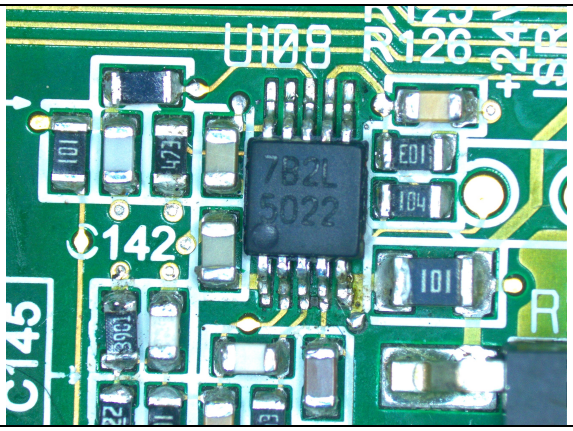
Ch3: Signal GD_ON (SI9001 KO52-06)

Ch4: BINCI_ImmediateError (SI9001 KO52-07)

A lot of noises because the test leads were relatively long.

The 24V ISR_GD looks good, so the problem can only be with the flyback circuit.



	
Installed driver LM5022MM (Faulty driver) Datecode:16H8	New driver LM5022MM Datecode:7B2L

In order to be able to reset the fault externally, the PFC was removed and the flyback driver LM5022MM was cooled with cold spray. The driver is approved for a temperature of up to -40°C. Therefore, it should not be a problem if the driver is cooled with the cold spray (can cool down to -45°C, but was only used intermittently). The error can also be triggered in this way.

Measurement Flybackdriver LM5022MM

Ch1: U Feedback at C139 (PP023)

Ch2: Gate supply L1 LS (18V/-3V) (HVD3106 KO62-01)

Ch3: Gate supply L1 LS (18V/-3V) (SI9001 KO52-07)

The measurement shows that the driver starts to shorten the duty cycle at a certain temperature. As a result, the voltage at the output starts to drop until the UVLO threshold of the gate drivers is undershot and they switch off. It is not possible to say what internally in the driver cannot cope with the low temperatures.
The faulty driver was also desoldered and tested on another print and the same errors occurred.