Overview - DRV8305

Device number：	DRV8305
PVDD:	12V
PCBA:	Cusomer develop, based on previous TLE9XX platform
MOS key parameters	

Product Summary

Parameter	Value	Unit
V_{DS}	40	V
$V_{GS(th)\_Typ}$	2.8	V
I_D (@ V_{GS} = 10V) (1)	400	A
$R_{DS(ON)\_Typ}$ (@ V_{GS} = 10V)	0.56	mΩ

SWITCHING PARAMETERS (5)						
Total Gate Charge (@ V_{GS} = 10V)	Q_g	V_{GS} = 0 to 10V V_{DS} = 20V, I_D = 20A		107		nC
Total Gate Charge (@ V_{GS} = 6.0V)	Q_g			68		nC
Gate Source Charge	Q_{gs}			31		nC
Gate Drain Charge	Q_{gd}			27		nC
Turn-On DelayTime	$t_{D(on)}$	V_{GS} = 10V, V_{DS} = 20V R_L = 1.0Ω, R_{GEN} = 3Ω		21		ns
Turn-On Rise Time	t_r			35		ns
Turn-Off DelayTime	$t_{D(off)}$			64		ns
Turn-Off Fall Time	t_f			35		ns
Body Diode Reverse Recovery Time	t_{rr}	I_F = 20A, dI_F/dt = 100A/µs		87		ns
Body Diode Reverse Recovery Charge	Q_{rr}	I_F = 20A, dI_F/dt = 100A/µs		169		nC

Refert to TI paper, Forum posts, 8305 datasheet
[Paper]Understanding Smart Gate Drive
[Paper] ...

Good practice： Trise (nS)/Tfall = 100ns/200ns
Qgd (nC) 27/ Trise (nS) = IDRIVEP 125mA
Qgd (nC) 27/ Tfall (nS) = IDRIVEP 250mA

hsGateDriveControl =

.IDRIVEP_HS =125mA,
.IDRIVEN_HS = 250mA,
.TDRIVEN = 1780ns,

lsGateDriveControl =

.IDRIVEP_HS =125mA,
.IDRIVEN_HS = 250mA,
.TDRIVEN = 1780ns,

gateDriveControl =

.TVDS = VdsSenseDeglitch_7000ns,
.TVDS = VdsSenseDeglitch_3500ns,
.TBLANK = VdsSenseBlanking_7000ns,
.DEAD_TIME = DeadTime_880ns,
.PWM_MODE = PwmMode6IndependentInputs,
.COMM_OPTION = RectificationControlActiveFreewheeling,

.icOperation =

.SetChargePumpUndervoltageThresholdLevel_4600mv,
.CLR_FLTS = NormalOperation,
.SLEEP = DeviceAwake,
.WD_EN = WatchdogDisabled,
.DIS_SNS_OCP = SnsOvercurrentProtectionFaultAndReportingEnable,
.WD_DLY = WatchdogDelay_20ms,
.EN_SNS_CLAMP = SenseAmplifierClampDisabled,
.DIS_GDRV_FAULT = GateDriverFaultEnabled,
.DIS_PVDD_UVLO2 = PvddUvlo2FaultAndReportingEnabled,

.shuntAmplifierControl =

.GAIN_CS1 = CurrentShuntAmplifierGain_10V_V,
.GAIN_CS2 = CurrentShuntAmplifierGain_10V_V,
.GAIN_CS3 = CurrentShuntAmplifierGain_10V_V,
.CS_BLANK = CurrentShuntAmplifierBlankingTime_0ns,
.DC_CAL_CH1 = CurrentShuntAmplifierNormal,
.DC_CAL_CH2 = CurrentShuntAmplifierNormal,
.DC_CAL_CH3 = CurrentShuntAmplifierNormal,

①DeadTime=1760ns

②Tblank=7000ns

③TDeglitch=7000ns

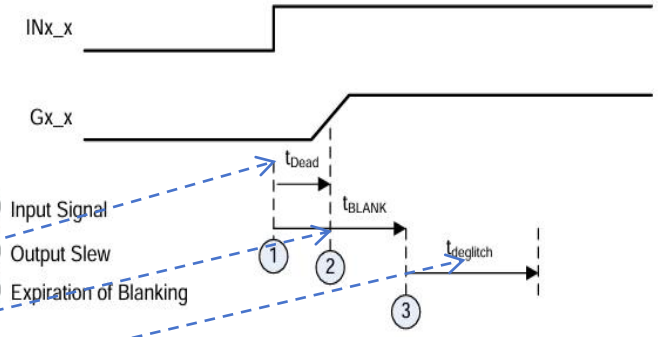


Figure 13. V_{DS} Deglitch and Blank Diagram

.voltageRegulatorControl =

.VREG_UV_LEVEL = VregUndervoltageSetPoint_0_7,
.DIS_VREG_PWRGD = VregUndervoltageFaultAndReportingEnabled,
.SLEEP_DLY = DelayToPowerDownVregAfterSleep_10us,
.RSVD1 = 0,
.VREF_SCALE = VregScalingK2,
.RSVD2 = 0,

.vdsSenseControl =

.VDS_MODE = VdsModeLatchedShutdownWhenOvercurrentDetected,
.VDS_LEVEL = VdsComparatorThreshold_2131mv,

VDS current = 2131mv/$R_{DS(on)}$ 0.56mΩ = 3805A

Problems happened

Running conditons：

- ✓ 6PWM input
- ✓ 2x2x2 invert in pairs
- ✓ continuous fixed PWM duty value
- ✓ without FOC
- ✓ without motor

MCU Freq.	100	MHZ
MCU period	10	ns
PWM Freq.	20000	Hz
PWM Period	0.05	ms
PWM count	5000	ticks
PWM duty	50% or 100%	
PWM rise/fall	Central aligned	
PWM dead time	1000	ns

input PWM duty 50% ➡ **no output, but 3 Lower OCP [refer to pictures below (1)-(5)]**

ReadOnlyRegisterafterPWMDrv	0x700047A4
ReadOnlyRegisterafterPWMDrv[0]	0000 0100 0010 0000
ReadOnlyRegisterafterPWMDrv[1]	0000 0010 1010 0000

7.6.1.1 Warning and Watchdog Reset (Address = 0x1)

Table 10. Warning and Watchdog Reset Register Description

BIT	R/W	NAME	DEFAULT	DESCRIPTION
10	R	FAULT	0x0	Fault indication
9	R	RSVD	0x0	-
8	R	TEMP_FLAG4	0x0	Temperature flag setting for approximately 175°C
7	R	PVDD_UVFL	0x0	PVDD undervoltage flag warning
6	R	PVDD_OVFL	0x0	PVDD overvoltage flag warning
5	R	VDS_STATUS	0x0	Real time OR of all VDS overcurrent monitors
4	R	VCHP_UVFL	0x0	Charge pump undervoltage flag warning
3	R	TEMP_FLAG1	0x0	Temperature flag setting for approximately 105°C
2	R	TEMP_FLAG2	0x0	Temperature flag setting for approximately 125°C
1	R	TEMP_FLAG3	0x0	Temperature flag setting for approximately 135°C
0	R	OTW	0x0	Overtemperature warning

7.6.1.2 OV/VDS Faults (Address = 0x2)

Table 11. OV/VDS Faults Register Description

BIT	R/W	NAME	DEFAULT	DESCRIPTION
10	R	VDS_HA	0x0	VDS overcurrent fault for high-side MOSFET A
9	R	VDS_LA	0x0	VDS overcurrent fault for low-side MOSFET A
8	R	VDS_HB	0x0	VDS overcurrent fault for high-side MOSFET B
7	R	VDS_LB	0x0	VDS overcurrent fault for low-side MOSFET B
6	R	VDS_HC	0x0	VDS overcurrent fault for high-side MOSFET C
5	R	VDS_LC	0x0	VDS overcurrent fault for low-side MOSFET C
4:3	R	RSVD	0x0	-
2	R	SNS_C_OCP	0x0	Sense C overcurrent fault
1	R	SNS_B_OCP	0x0	Sense B overcurrent fault
0	R	SNS_A_OCP	0x0	Sense A overcurrent fault

input PWM duty 100% ➡ **no output but charge bump, VCHP, PVDD UV**

ReadOnlyRegisterafterPWMDrv[0]	0000 0100 1001 0000
ReadOnlyRegisterafterPWMDrv[1]	0000 0000 0000 0000
ReadOnlyRegisterafterPWMDrv[2]	0000 0000 0000 0100

7.6.1.1 Warning and Watchdog Reset (Address = 0x1)

Table 10. Warning and Watchdog Reset Register Description

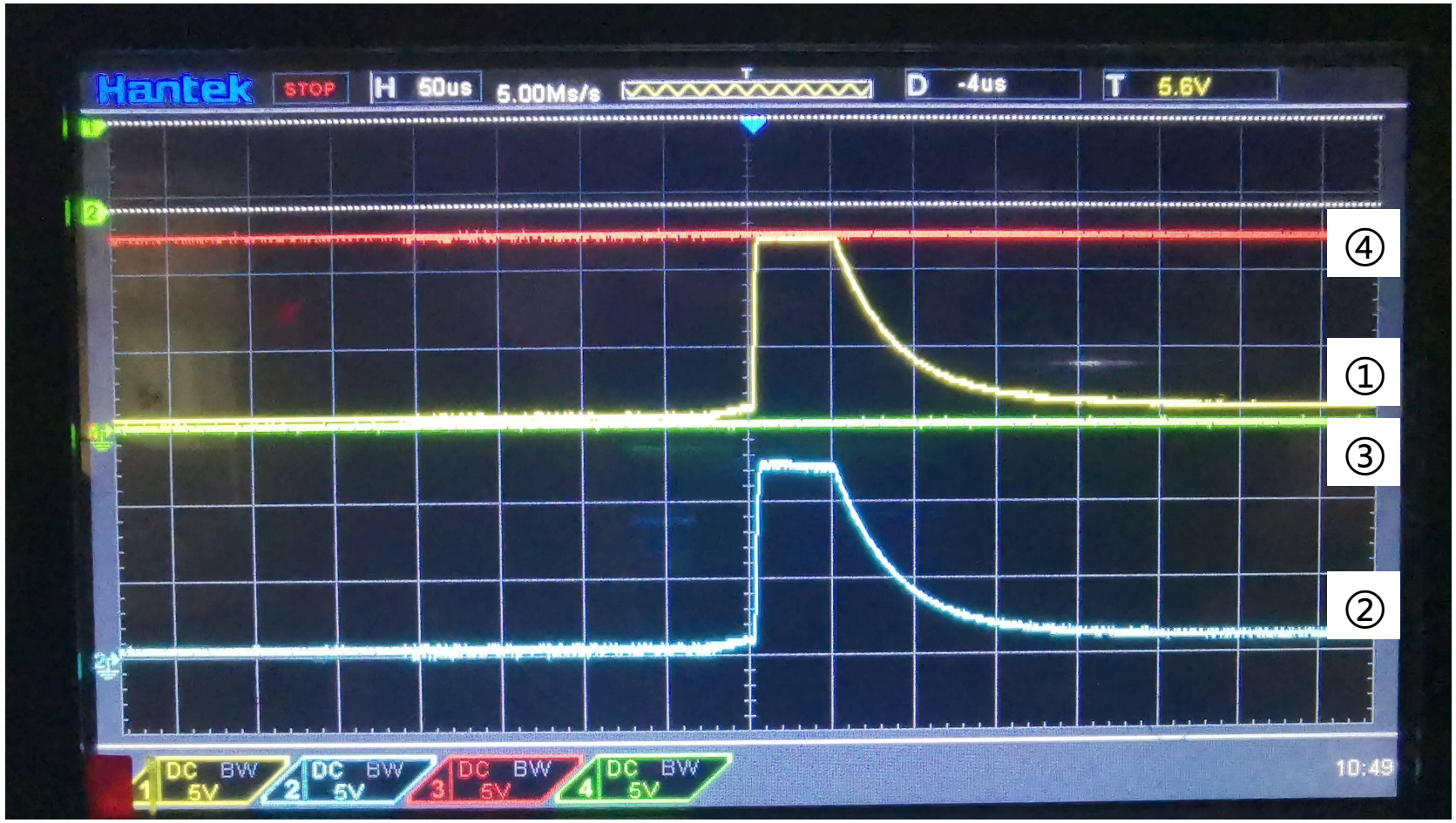
BIT	R/W	NAME	DEFAULT	DESCRIPTION
10	R	FAULT	0x0	Fault indication
9	R	RSVD	0x0	-
8	R	TEMP_FLAG4	0x0	Temperature flag setting for approximately 175°C
7	R	PVDD_UVFL	0x0	PVDD undervoltage flag warning
6	R	PVDD_OVFL	0x0	PVDD overvoltage flag warning
5	R	VDS_STATUS	0x0	Real time OR of all VDS overcurrent monitors
4	R	VCHP_UVFL	0x0	Charge pump undervoltage flag warning
3	R	TEMP_FLAG1	0x0	Temperature flag setting for approximately 105°C
2	R	TEMP_FLAG2	0x0	Temperature flag setting for approximately 125°C
1	R	TEMP_FLAG3	0x0	Temperature flag setting for approximately 135°C
0	R	OTW	0x0	Overtemperature warning

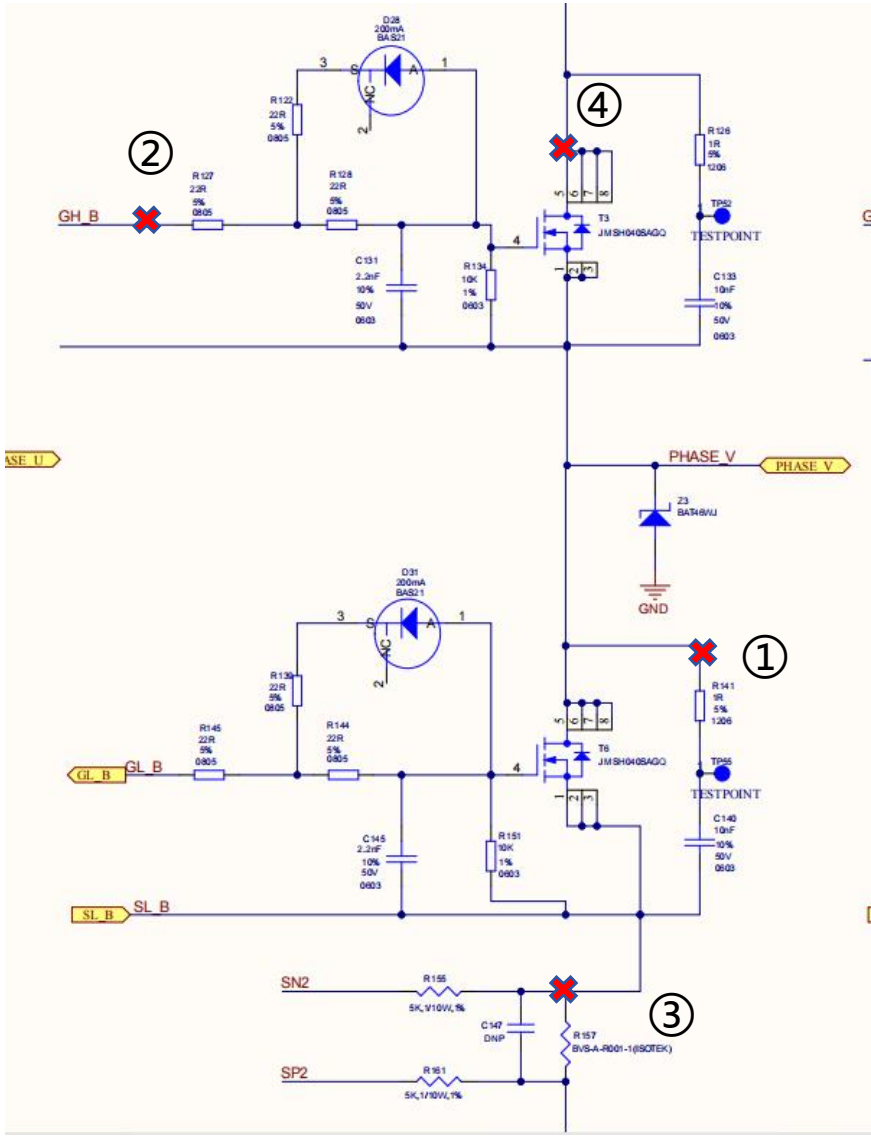
7.6.1.3 IC Faults (Address = 0x3)

Table 12. IC Faults Register Description

BIT	R/W	NAME	DEFAULT	DESCRIPTION
10	R	PVDD_UVLO2	0x0	PVDD undervoltage 2 fault
9	R	WD_FAULT	0x0	Watchdog fault
8	R	OTSD	0x0	Overtemperature fault
7	R	RSVD	0x0	-
6	R	VREG_UV	0x0	VREG undervoltage fault
5	R	AVDD_UVLO	0x0	AVDD undervoltage fault
4	R	VCP_LSD_UVLO2	0x0	Low-side gate supply fault
3	R	RSVD	0x0	-
2	R	VCPH_UVLO2	0x0	High-side charge pump undervoltage 2 fault
1	R	VCPH_OVLO	0x0	High-side charge pump overvoltage fault
0	R	VCPH_OVLO_ABS	0x0	High-side charge pump overvoltage ABS fault

(1) SHx/GHxS/ LBx/V_D @ Lower OCP





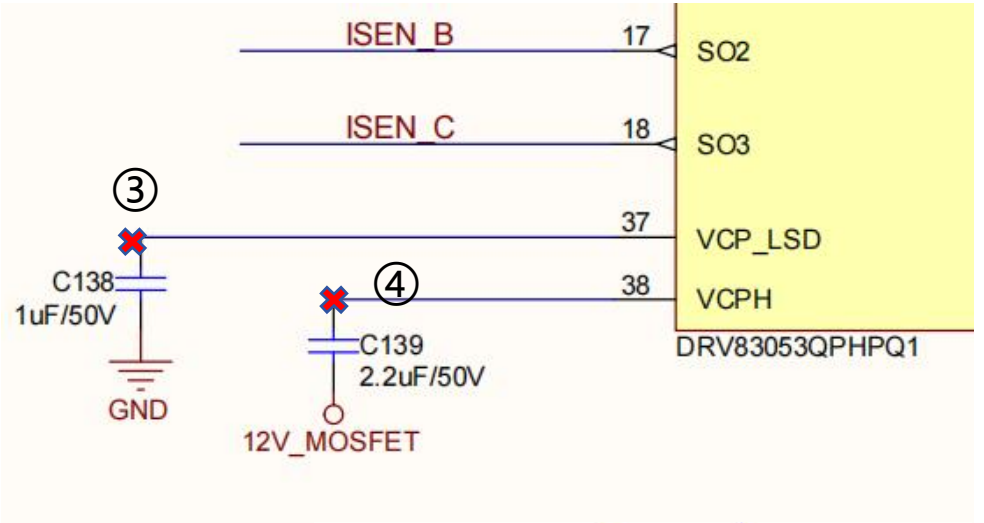
①CH1_Yellow SHx (@R141)
<0V - 12V>

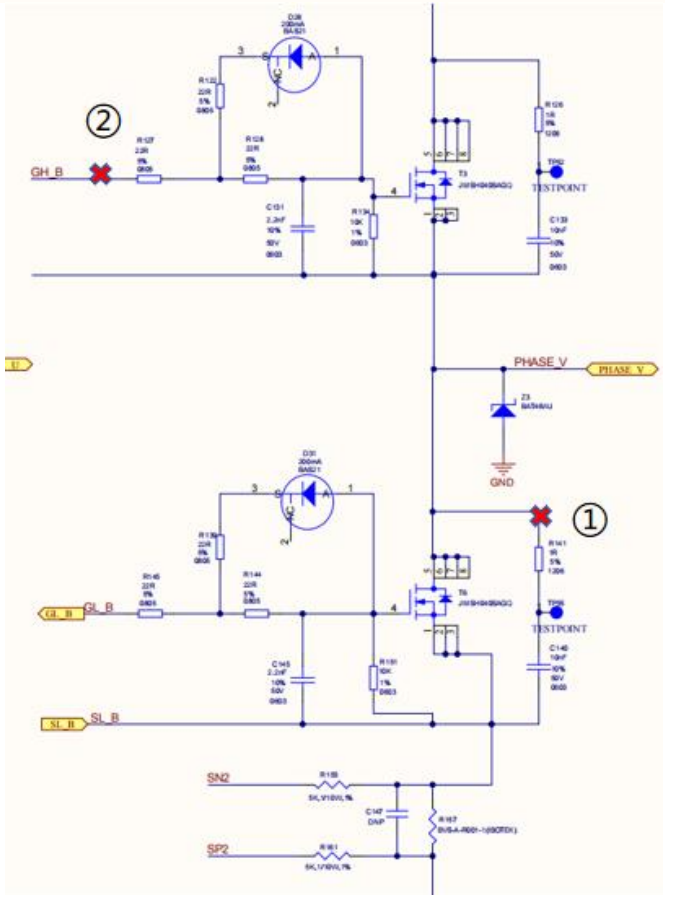
③CH3_Red SLBx (@R157)
<0V>

②CH2_Blue GHx (@R127)
<0V - 12V>

④CH4_Green V_D =PVDD (@MOS_D)
<12V>

(2) SHx/GHxS/VCP_LSD/VCPH @ Lower OCP





①CH1_Yellow SHx (@R141)
<0V - 12V>

③CH3_Red VCP_LSD (@C138)
<10V-12V>

②CH2_Blue GHx (@R127)
<0V - 12V>

④CH4_Green VCPH (@C139)
<12V-20V>

(3) SHx/GHxS/INHx/INLx @ Lower OCP

Item	value	unit
MCU Freq.	100	MHZ
MCU period	10	ns
PWM Freq.	20000	Hz
PWM Period	0.05	ms
PWM count	5000	ticks
PWM duty	50%	2500
PWM rise/fall	central align	
PWM dead time	1000	ns

- 6PWM input
- invert in pairs
- continuous fixed vduty value
- without FOC
- without motor

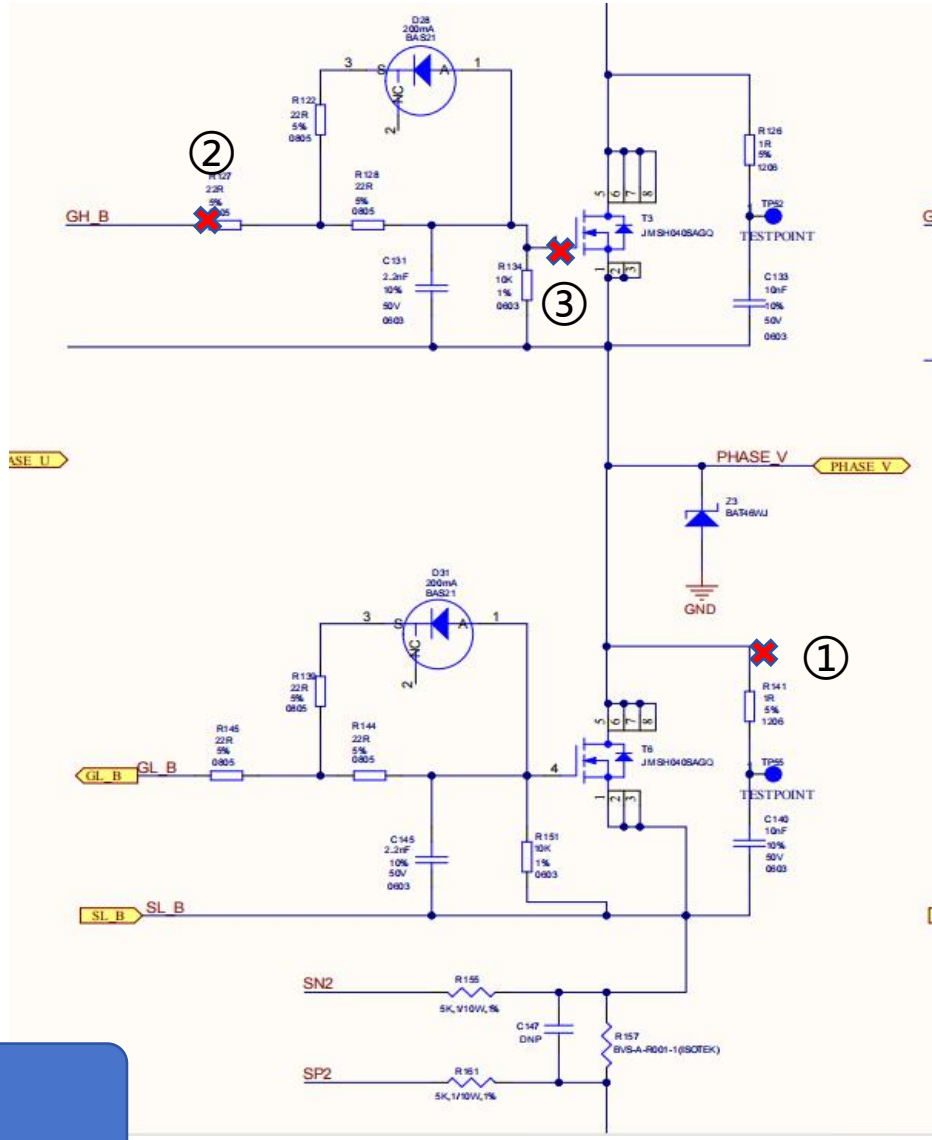
①CH1_Yellow SHx （R141）

③CH3_Red INHx PWM input

②CH2_Blue GHx上管栅极(R127)

④CH4_Green INLx PWM input

(4) SHx/GHxS/Vg @ Lower OCP



①CH1_Yellow SHx （@R141）
<0V - 12V>

②CH2_Blue GHx (@R127)
<0V - 12V>

③CH3_Red SLBx （@R157）
<0-9V>？？

(5) SHx/GHxS/nFault/PWRGD @ Lower OCP

①CH1_Yellow SHx （@R141）
<0V - 12V>

③CH3_ Red PWRGD （@R120）
<1.7V-4V>

②CH2_Blue GHx (@R127)
<0V - 12V>

④CH4_Green nFault （@R136）
<0.6V-4V>