MOTIX™ TLE9186 evaluation board

User guide

Z8F80781796

About this document

Scope and purpose

This user guide provides instructions for the MOTIX™ TLE9186 evaluation board, which is designed to evaluate hardware and software functionality of the MOTIX™ Bridge Driver TLE9186 and MOTIX™ SBC TLE9563. This user guide provides extensive information about the layout, jumper settings, interfaces and debug options of the board.

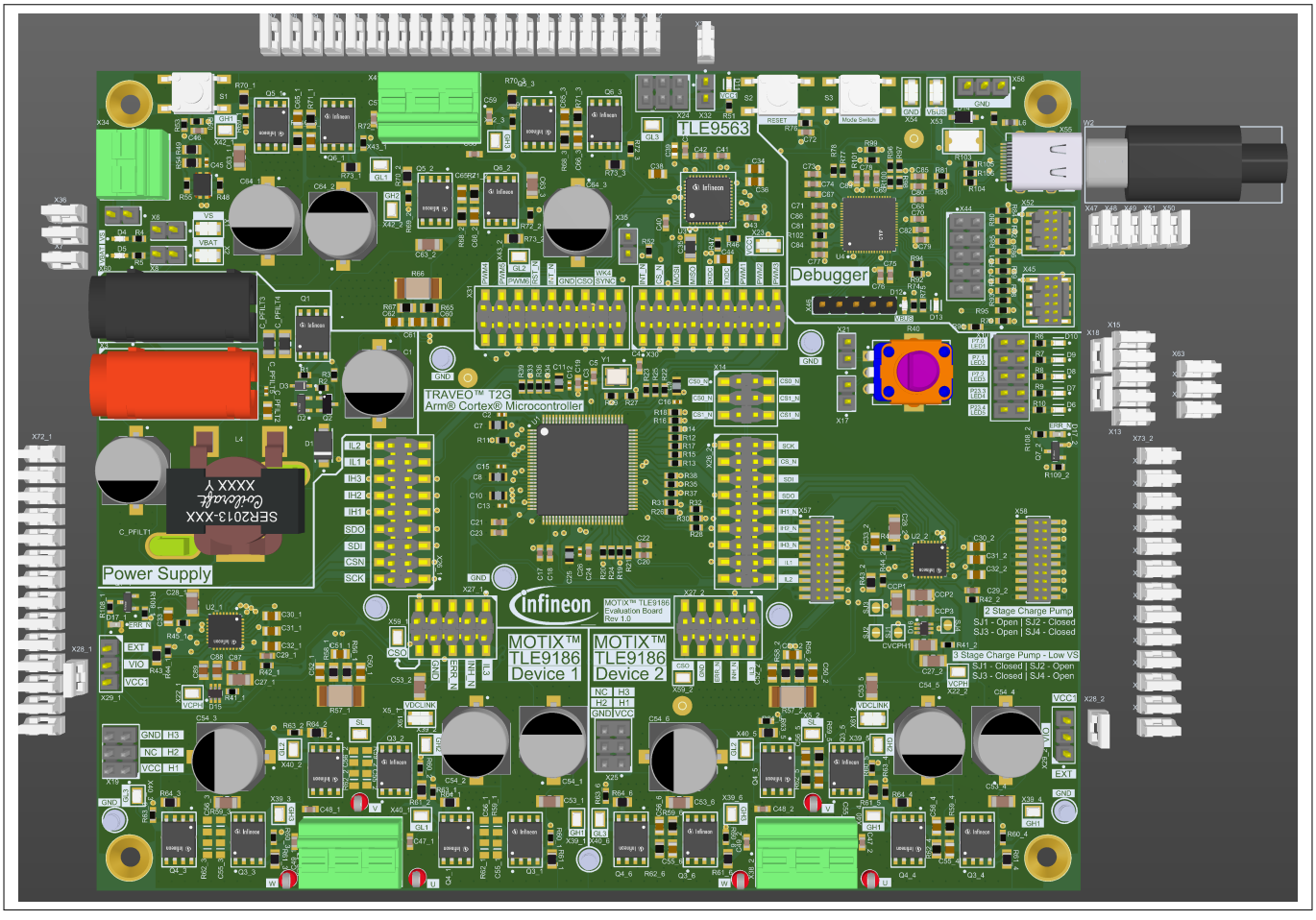

Figure 1 MOTIX™ TLE9186 gate driver IC for BLDC motors evaluation board

Intended audience

This document is intended for anyone using the MOTIX™ TLE9186 evaluation board.

***Note**: The printed circuit board (PCB) and auxiliary circuits are NOT optimized for final customer design.*

Important notice

“Evaluation Boards and Reference Boards” shall mean products embedded on a printed circuit board (PCB) for demonstration and/or evaluation purposes, which include, without limitation, demonstration, reference and evaluation boards, kits and design (collectively referred to as “Reference Board”).

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Safety precautions

Table 1	Safety precautions
	**Caution:** *The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.*
	**Caution:** *Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.*
	**Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*
	**Caution:** *A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.*
	**Caution:** *The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.*

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1 The board at a glance

This board is designed to provide a simple, easy-to-use tool to become familiar with MOTIX™ TLE9186 gate driver *integrated circuit (IC)* for *brushless direct current (BLDC)* motors by Infineon Technologies.

The evaluation board combines Infineon's TRAVEO™ CYT2B7 microcontroller with a MOTIX™ SBC TLE9563 and MOTIX™ Bridge Driver TLE9186. You can access every pin of the MOTIX™ Bridge TLE9186 and most of the pins through pin headers.

The power supply circuit can be powered by banana jacks and it is protected against reverse polarity of the input voltage supply. A battery *light-emitting diode (LED)* indicates that the board is connected to the battery supply correctly. The reverse polarity protection circuit secures the board from damage due to cross connection. The MOTIX™ SBC TLE9563 provides the logic power supply for the microcontroller and MOTIX™ Bridge TLE9186.

All the MOSFET half-bridges are placed on the board to drive BLDC motors. The board is ready to be connected to a car supply or similar and offers a USB-C port to use the on-board *serial wire debug (SWD)* debugger. The *controller area network (CAN)* interface is available at a push-in connector. You can operate the evaluation board with standard laboratory equipment.

1.1 Scope of supply

The scope of supply for the MOTIX™ TLE9186 evaluation board includes a *universal serial bus (USB)*-C cable to connect the board to a PC.

1.2 Block diagram

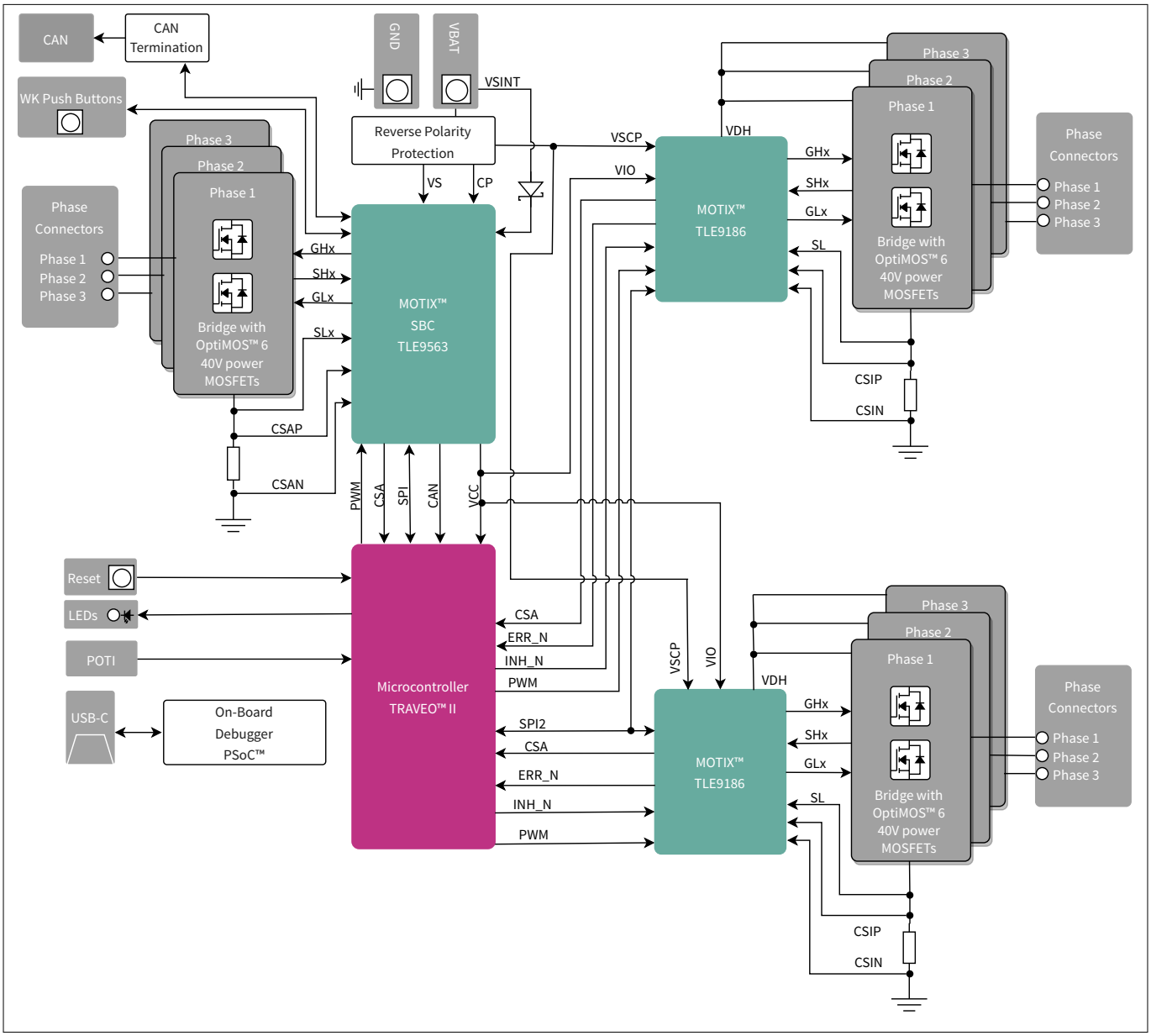

Figure 2 Block diagram

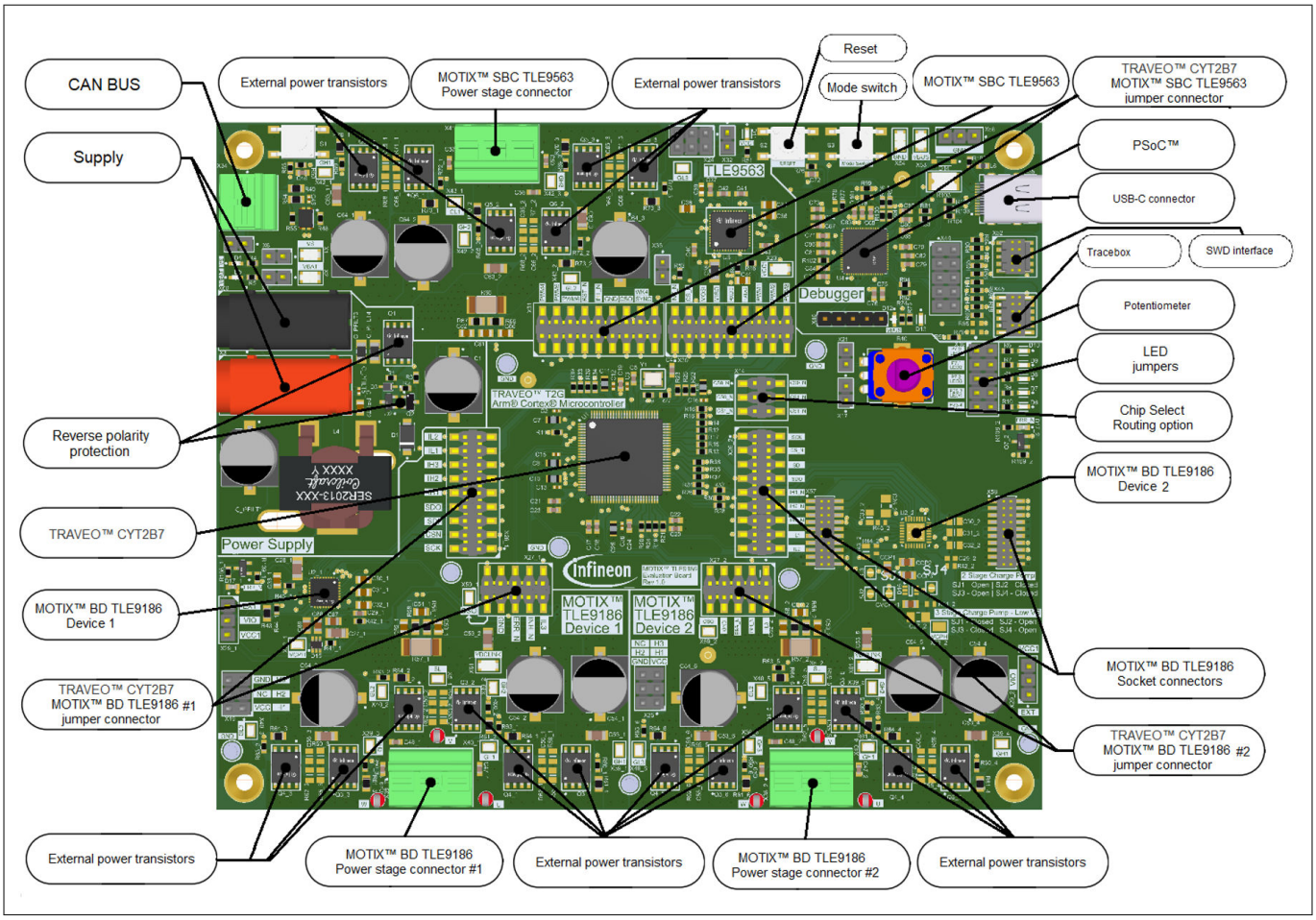

Figure 3 Board description

1.3 Main features

- Solder VQFN-32 pin package device (x2)
- Option to use socket VQFN-32 for debug purposes
- Option to control both MOTIX™ Bridge Driver TLE9186 together or independently
- TRAVEO™ CYT2B7 used as microcontroller
- On-board debugger for the microcontroller with *USB*-C connection
- Logic supply management with MOTIX™ SBC TLE9563
- Motor power stage and motor phase connector for MOTIX™ SBC TLE9563
- Supply voltage with reverse polarity protection
- Motor power stage and motor phase connector for both MOTIX™ BD TLE9186
- *general purpose input output (GPIO)* pin connector, *LED*s and pushbuttons available for the microcontroller
- Connectors available for Tracebox, *CAN*
- Potentiometer with analog input

1.4 Technical data

The table below specifies the technical data. The default assembly of banana plugs for battery supply and the motor phase connector limit the current capability for supply and motor phases.

Higher current capability can be reached by adjusting the battery and motor connectors.

1 The board at a glance

***Note**: If you are working with higher currents than the specified maximum ratings, you need to apply the relevant safety measures.*

Table 2 Technical data

Parameter	Value
Supply voltage	Typ. 12 V (max. 28 V)[1)]
Supply current	Max. 15 A[1)]
Pin ports	5 V
Board size	150 mm x 125 mm

1) Specified by design

2 System and functional description

2.1 Board information

2.1.1 Connectors

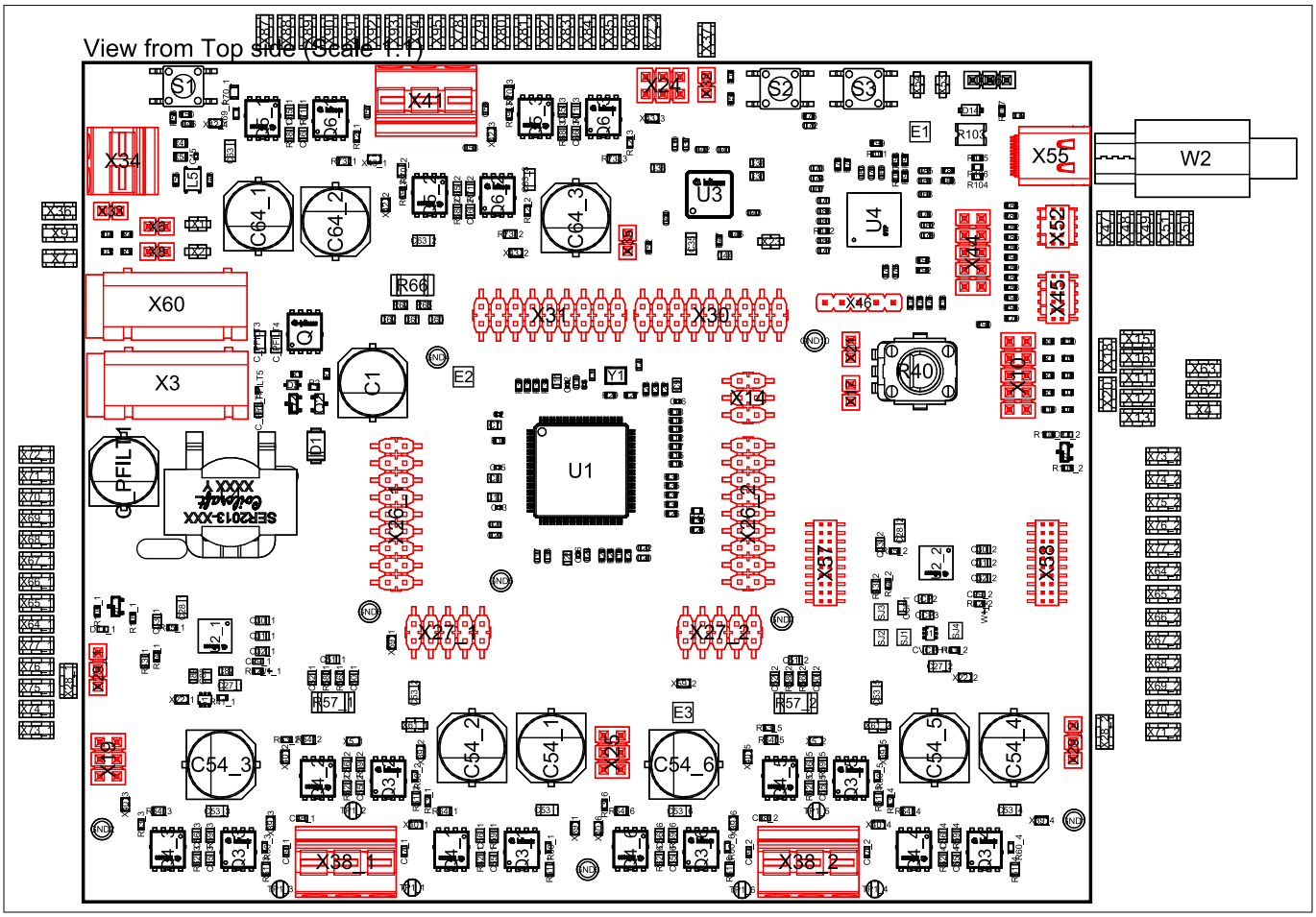

Figure 4 Connectors

Table 3 Connectors

Functionality	Designator	Description
$V_{BAT,}$ GND	X3,X60	Banana jacks for power supply (red) and ground (black)
LED indicator	X6	Jumper header for *voltage supply (VS)* indicator
LED indicator	X8	Jumper header for V_{BAT} supply indicator
LED indicator	X32	Jumper header for MOTIX™ SBC TLE9563 voltage regulator output indicator
SDM	X35	Jumper header for MOTIX™ SBC TLE9563 development mode
HALL sensor	X24	Hall sensor connector for MOTIX™ SBC TLE9563
Interface	X31,X32	Connector for MOTIX™ SBC TLE9563/TRAVEO™ CYT2B7 interface
W,V,U	X41	Push-in connector for MOTIX™ SBC TLE9563. For more information, refer to Motor power stage.

(table continues...)

Table 3 (continued) Connectors

Functionality	Designator	Description
CAN BUS	X34,X33	X34 push-in connector to connect *CAN* bus to the device. For jumper cables the pin header X33 can be used. For more information, refer to Debugging and virtual COM port.
VIO	X29(_1,_2)	Jumper header for MOTIX™ BD TLE9186 VIO supply. Set from VCC1 or supply externally.
HALL sensor	X19,X25	Hall sensor connector for MOTIX™ BD TLE9186
W,V,U	X36(_1,_2)	Push-in connector for MOTIX™ BD TLE9186. For more information, refer to Motor power stage.
Socket adapter	X57,X58	Connector for socket adapter for MOTIX™ BD TLE9186 (second device-only)
Interface	X26(_1,_2),X27(_1,_2)	Connector for MOTIX™ BD TLE9186/TRAVEO™ CYT2B7 interface
CSN selector	X14	Connector for controlling device addressability. Individual *chip select negated (CSN)* for each MOTIX™ BD TLE9186 device or shared CSN
LED indicator	X10	Jumper header for general purpose *LED* indicator. Connected to TRAVEO™ CYT2B7
Potentiometer	X17,X21	Jumper header for potentiometer connection. Port 8_1 from TRAVEO™ CYT2B7
USB-C	X55	USB-C connector header
SWD	X52	*SWD* connector header
Tracebox	X45	Tracebox connector header
Interface	X44	Connector for SWD/TRAVEO™ CYT2B7 interface
Interface	X46	PSoC™ 5LP Program/Debug connector

2.1.2 Test points

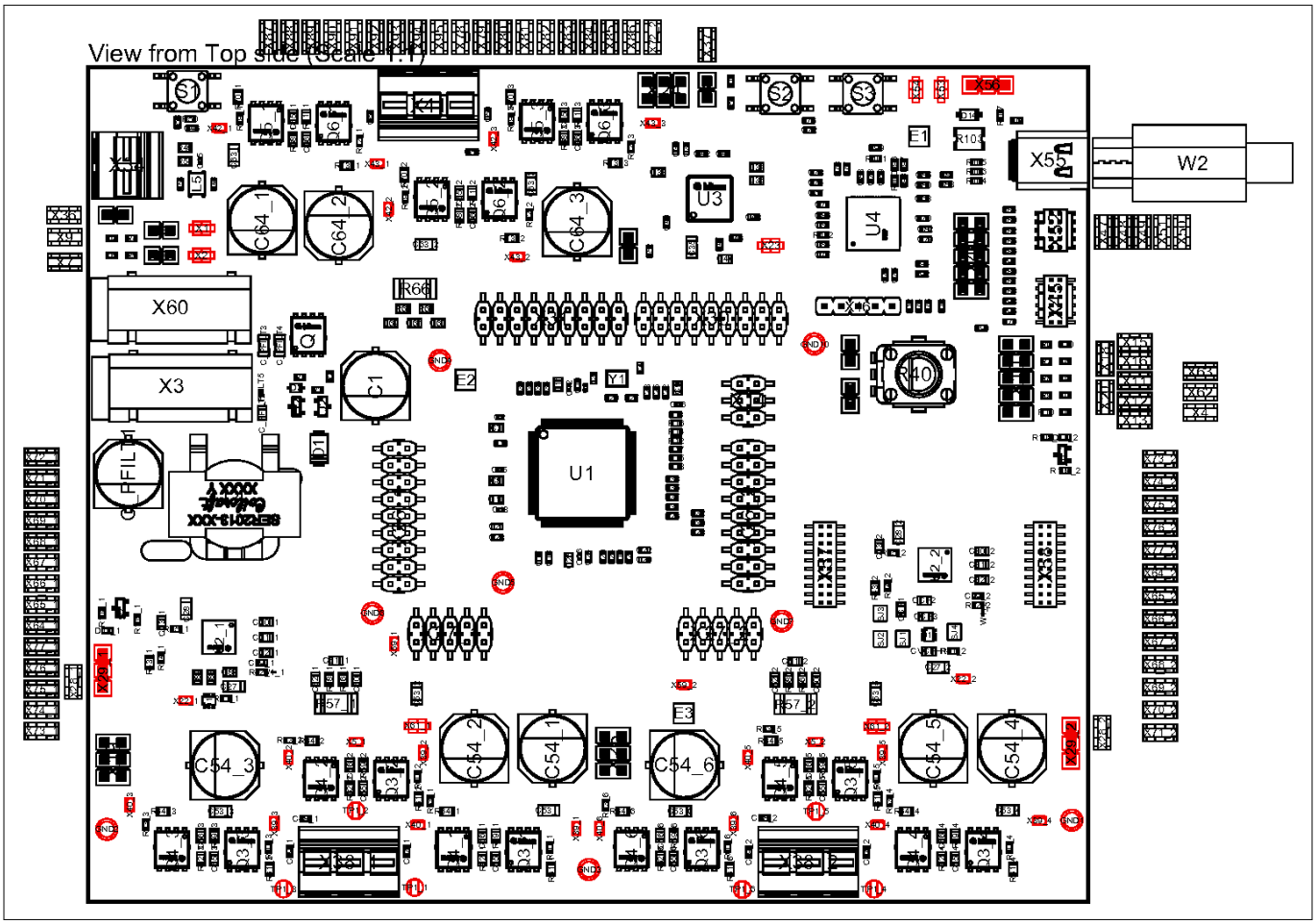

Figure 5 Test points

Table 4 Test points

Functionality	Designator	Description
VS	X1	Test point to measure supply voltage of MOTIX™ SBC TLE9563 and MOTIX™ BD TLE9186
V_{BAT}	X2	Test point to measure supply voltage
GH_x	X42(_1,_2_3)	Test point to measure gate voltage for high-side MOTIX™ SBC TLE9563
GL_x	X43(_1,_2,_3)	Test point to measure gate voltage for low-side MOTIX™ SBC TLE9563
VCC1	X23	Test points to measure the digital supply voltage of TRAVEO™ CYT2B7 and MOTIX™ BD TLE9186
V_{BUS}	X53	Test point to measure supply voltage of on-board debugger circuit
GND	X54,X56,GND1,GND2,GND3,GND4,GND5,GND6,GND7,GND10	Test points to connect to ground
GH_x	X39(_1,_2,_3,_4,_5,_6)	Test point to measure gate voltage for high-side MOTIX™ BD TLE9186 #1,#2

(table continues...)

Table 4 (continued) Test points

Functionality	Designator	Description
GL_x	X40(_1,_2,_3,_4,_5,_6)	Test point to measure gate voltage for low-side MOTIX™ BD TLE9186 #1, #2
U,V,W	TP(_1,_2_3,_4,_5,_6)	Test point to measure phase voltage for MOTIX™ BD TLE9186 #1, #2 half-bridge output
VCPH	X22(_1,_2)	Test point to measure charge pump output voltage for MOTIX™ BD TLE9186 #1, #2
CSO	X59(_1,_2)	Test point to measure current sense output voltage for MOTIX™ BD TLE9186 #1, #2
VDC_{LINK}	X61(_1,_2)	Test point to measure supply voltage for MOTIX™ BD TLE9186 #1, #2 external MOSFET

2.1.3 LEDs

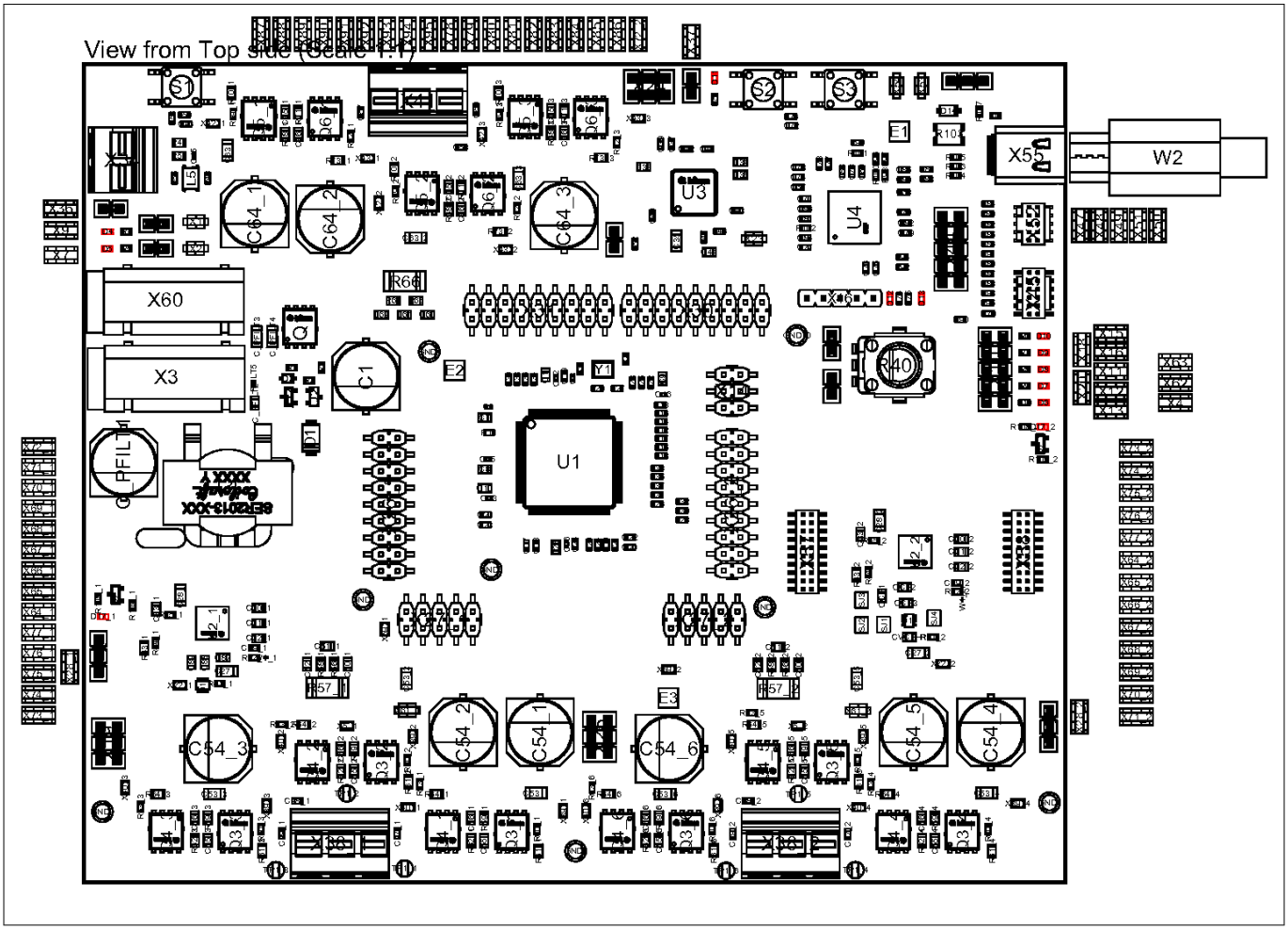

Figure 6 LEDs

Table 5 LEDs

Designator	Description
D4	Indicates that supply voltage, *VS* is active for the board after reverse recovery protection
D5	Indicates that there is a positive voltage at *battery voltage supply (VBAT)*
D11	Indicates that digital supply voltage for TRAVEO™ CYT2B7 and MOTIX ™ BD TLE9186
D12	Indicates the supply of the on-board debugger circuit, VBUS is active
D13	Status of the KitProg3
D6,D7,D8,D9,D10	Can be connected to TRAVEO™ CYT2B7) with jumper X10, as described in Pushbuttons
D17(_1,_2)	Status of ERRN #1,#2 of MOTIX™ BD TLE9186

2.1.4 Pushbuttons

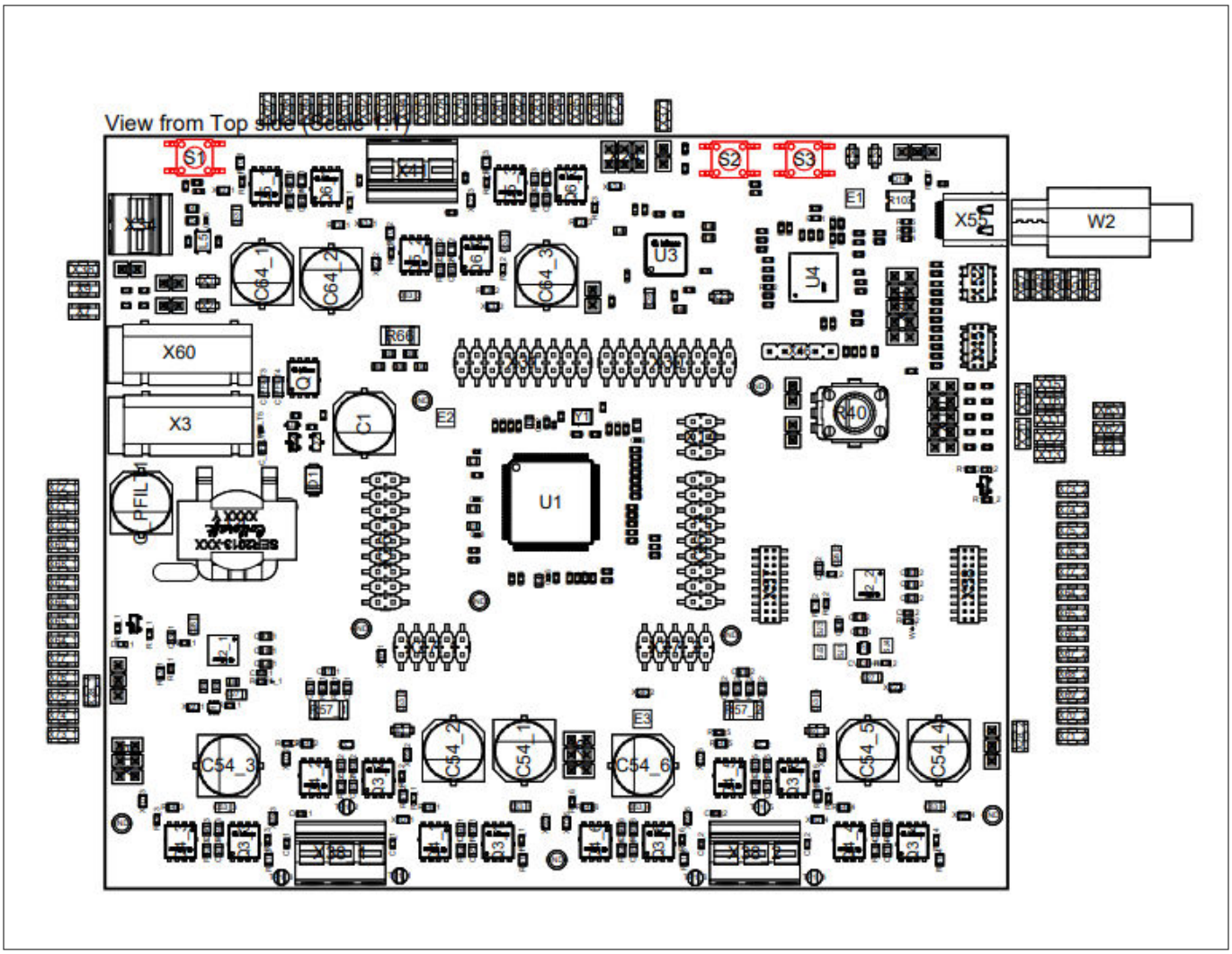

Figure 7 Pushbuttons

Table 6 Pushbuttons

Designator	Description
S1	WK1: Wake input trigger pushbutton for MOTIX™ SBC TLE9563, Trigger is connected to the HS1 of the MOTIX™ SBC TLE9563
S2	RESET: Reset pushbutton for TRAVEO™ CYT2B7 microcontroller
S3	Mode switch: Pushbutton to switch the debug circuit to CMSIS-DAP mode

2.2 Interfaces

2.2.1 Motor power stage

The half-bridge output connector of MOTIX™ SBC TLE9563 (marked at the top of the picture with a red frame) has three push-in slots for the U, V, and W phases of a *brushless DC motor (BLDC motor)*.

The TRAVEO™ CYT2B7 controls the digital *pulse-width modulation (PWM)* inputs. Ensure that the jumpers are placed on all six pins (PWM 1-6) of the connectors X30 and X31.

Half-bridge outputs connector of MOTIX™ BD TLE9186 (marked on bottom of the picture) has three push-in slots for the U, V, W phases of a BLDC motor. Each MOTIX™ BD TLE9186 has one designated connector.

The TRAVEO™ CYT2B7 controls the *GPIO*. Ensure that the jumpers are placed on all six pins (IH_x_N, IL_x) of the connectors X26_1, X26_2 and X27_1, X27_2.

For each phase of the motor power stage there are two individual N-channel MOSFETS, six in total for each device (Q5, Q6 for MOTIX™ SBC TLE9563 and Q3, Q4 for each MOTIX™ BD TLE9186). Externally each gate of external transistors has an additional gate resistor R69 (high), R72 (low) for MOTIX™ SBC TLE9563 and R60 (high), R63 (low) for MOTIX™ BD TLE9186.

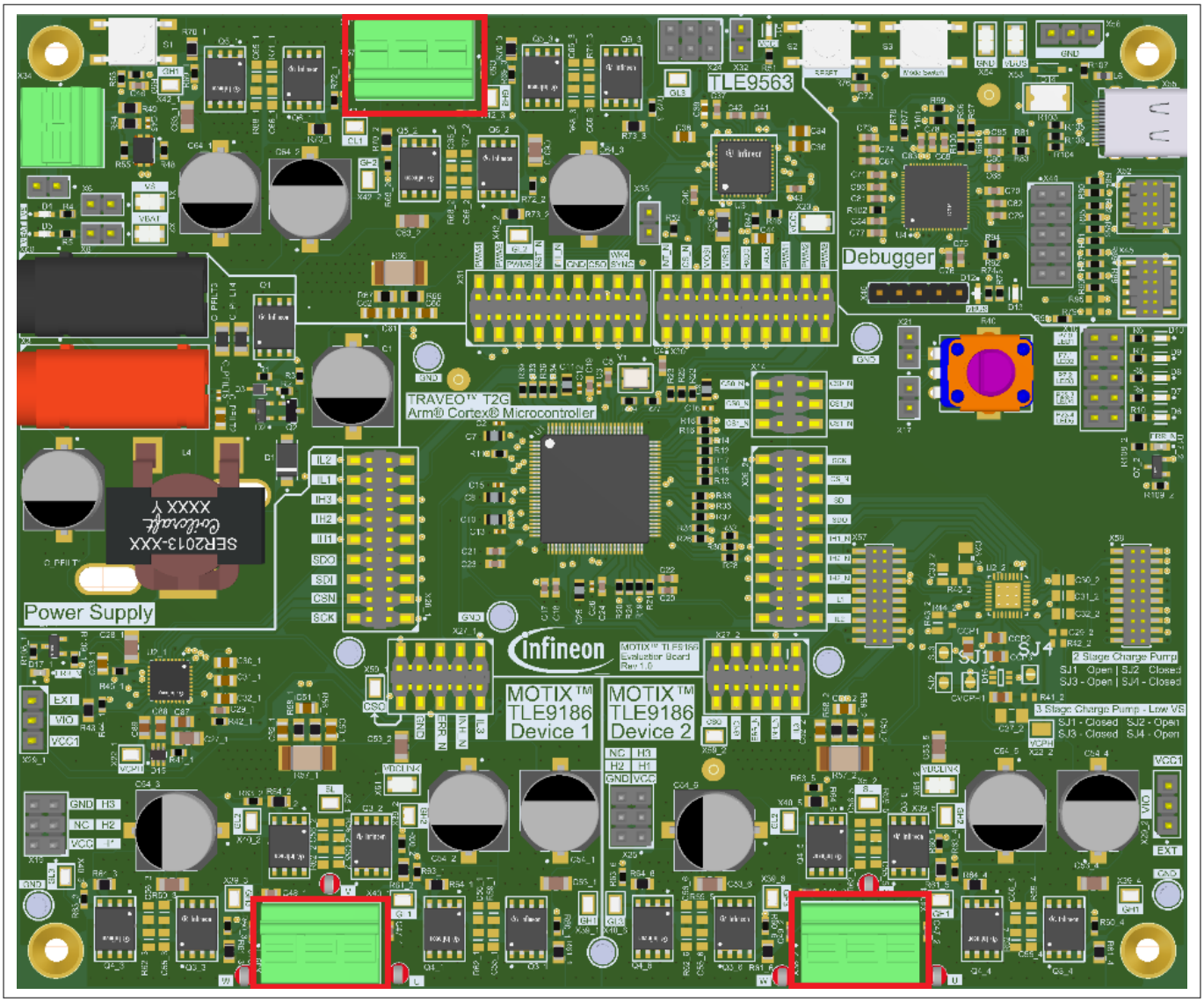

Figure 8 Motor power stage interface

2.2.2 CAN

You can use the X34 *PCB* terminal block to connect the CAN_P and CAN_N cables (green connector marked with red). The *CAN* termination resistors R49 and R54 are mounted by default. Additionally, the capacitor C45 is mounted between the resistors (marked with blue square). A placement option is available to solder a common mode choke L5 (marked with yellow square). If you place L5, you must remove the 0 Ω resistors R48 and R55.

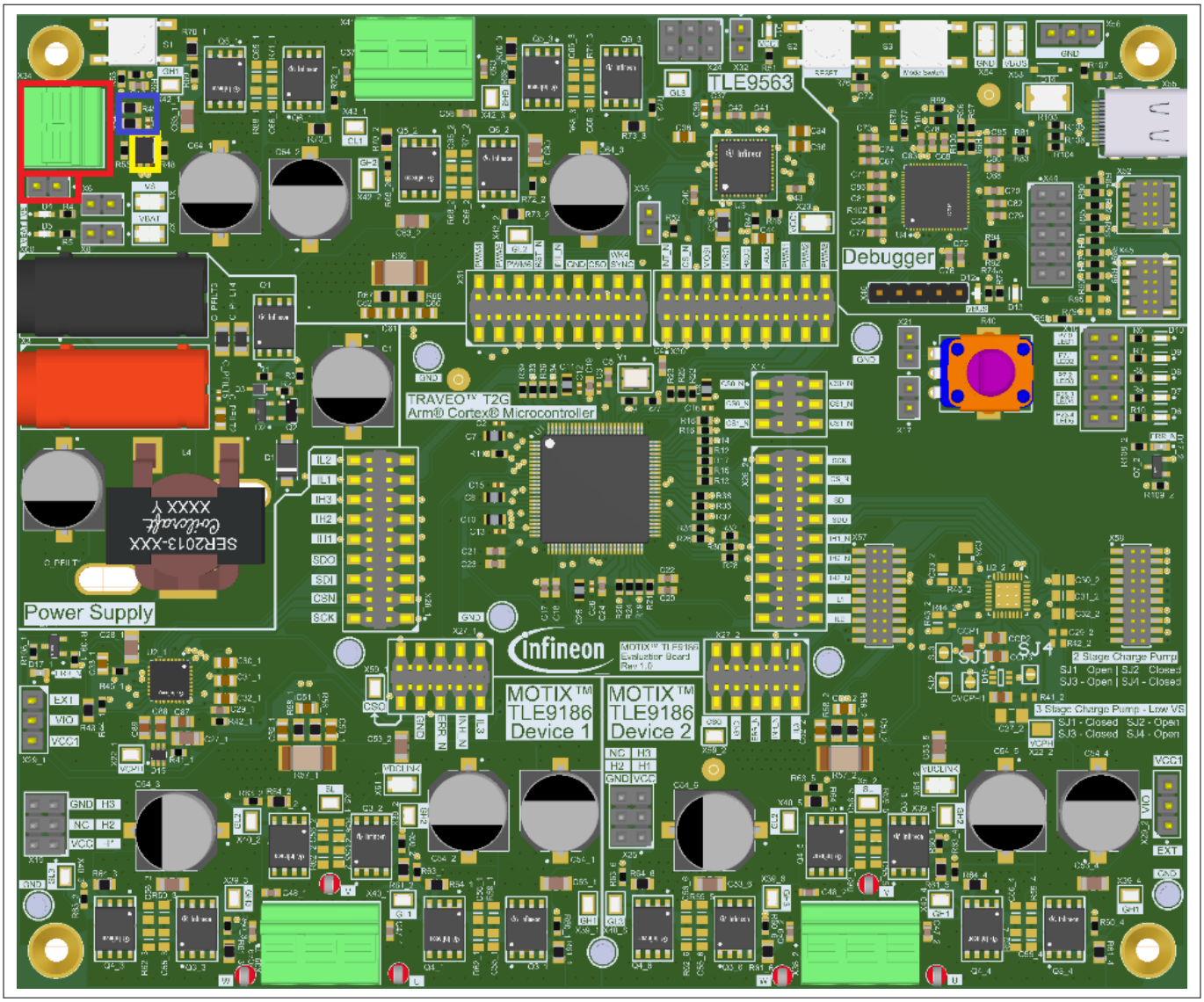

Figure 9 CAN interface

2.2.3 Potentiometer

The board contains a potentiometer, supplied through VCC1 to jumper X21. The output of the potentiometer is connected to the port P8_1 (pin 36) of the TRAVEO™ CYT2B7 to jumper X17.

Ensure that both jumpers are connected.

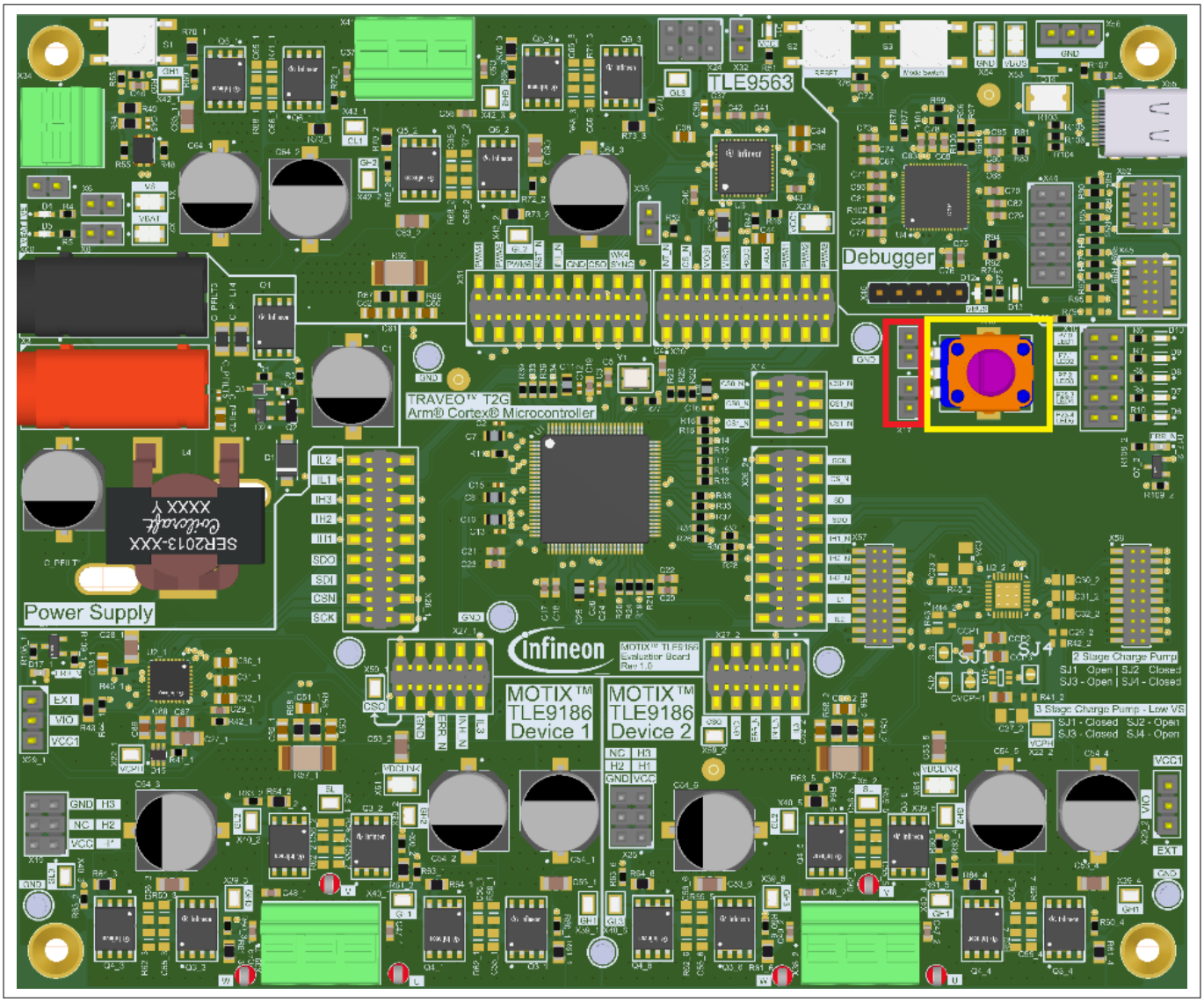

Figure 10 Potentiometer interface

2.2.4 Debugging and virtual COM port

To flash and debug user code, use the on-board debug circuit (CY8C5868LTI-LP039). It connects the PC with the TRAVEO™ CYT2B7 as KitProg3 USB-UART, and provides a *SWD* interface and a virtual COM port.

To use the board with other SWD debug linkers using the SWD connector, remove the jumper bridges X44 to disconnect the on-board debug circuit from the TRAVEO™ CYT2B7.

Only use the Tracebox connector while the on-board circuit is disconnected.

*Tip: If the PC does not recognize the KitProg3, click **MODE** to switch the debug circuit to CMSIS-DAP mode.*

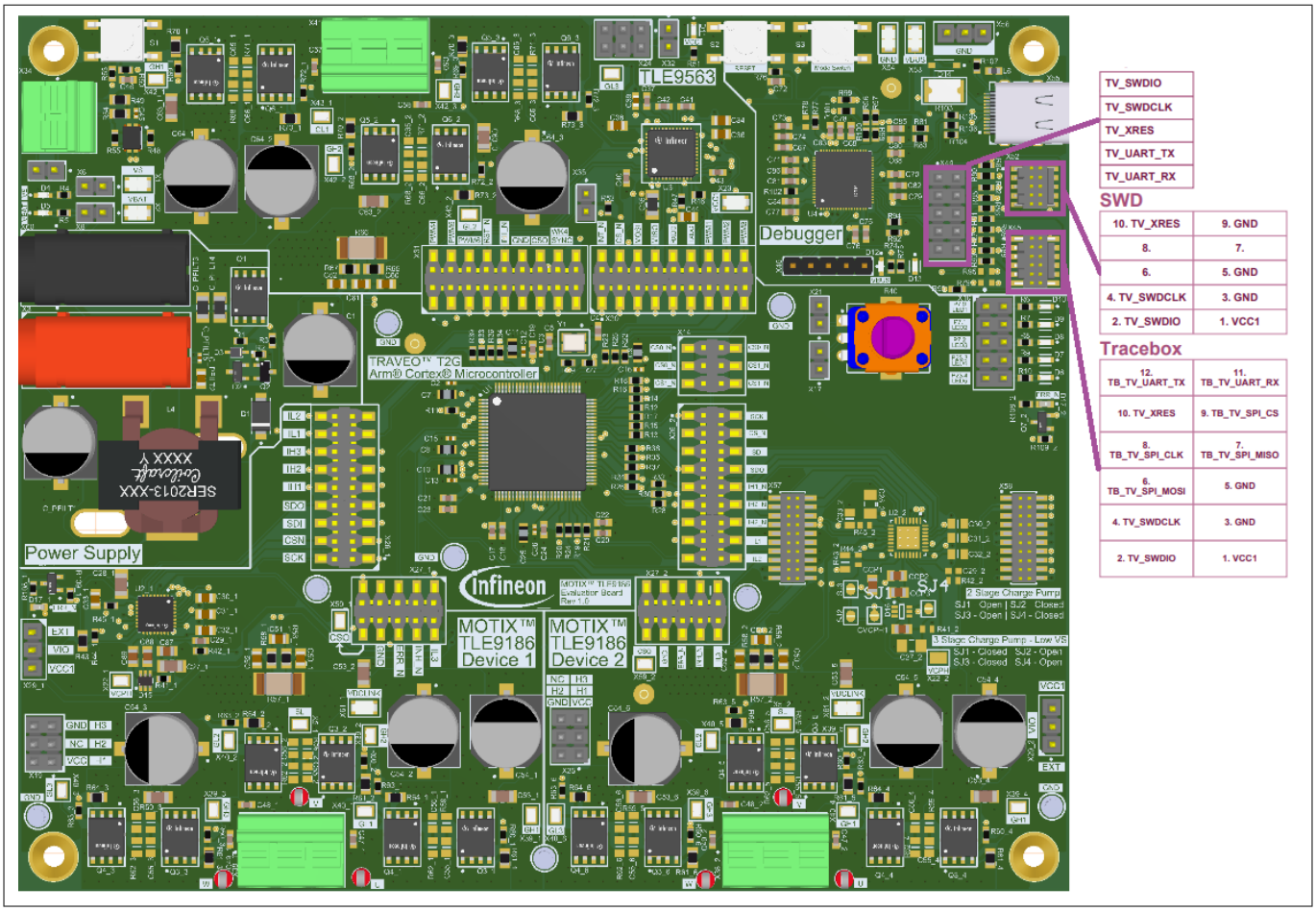

Figure 11 **On-board debugger and virtual COM port, SWD and Tracebox connector pinout**

Table 7 **TRAVEO™ CYT2B7 microcontroller pinout for on-board debugger**

Signal	TRAVEO™ CYT2B7 Port (pin)
TV_XRES	XRES_L_N (pin 85)
TV_SWDCLK	P23_5 (pin 97)
TV_SWDIO	P23_6 (pin 98)
TV_UART_TX	P17_1 (pin 65)
TV_UART_RX	P17_2 (pin 66)
TB_TV_UART_TX	P0_0 (pin 2)
TB_TV_UART_RX	P0_1 (pin 3)
TB_TV_SPI_MOSI(X86-MOSI)	P13_1 (pin 53)
TB_TV_SPI_MISO(X86-MISO)	P13_0 (pin 52)
TB_TV_SPI_CLK(X86-CLK)	P13_2 (pin 54)
TB_TV_SPI_CS(X86-CSN)	P13_6 (pin 58)

3 Assembly options

Not all components of the evaluation board are assembled by default. You can solder them, if necessary, corresponding to the two MOTIX™ BD TLE9186 devices.

Additionally, you can replace the second MOTIX™ BD TLE9186 solder device with a socket adapter for debugging purposes.

4 Software toolchain

To download the tools and embedded software for this evaluation board, refer to the MOTIX™ BD TLE9186 website.

5 Design files

5.1 Schematics MOTIX™ TLE9186 evaluation board

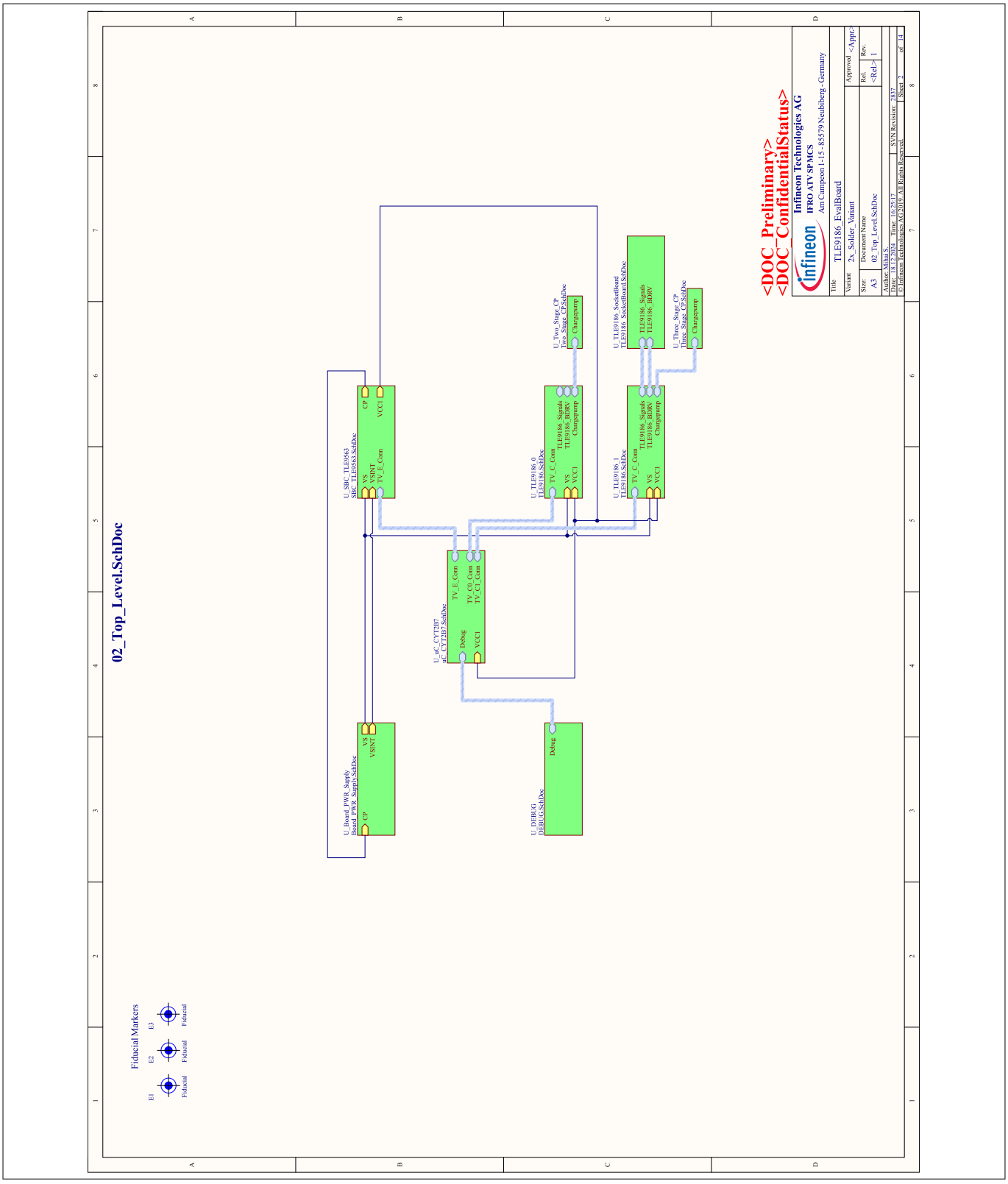

Figure 12 MOTIX™ TLE9186 evaluation board, sheet 1

5 Design files

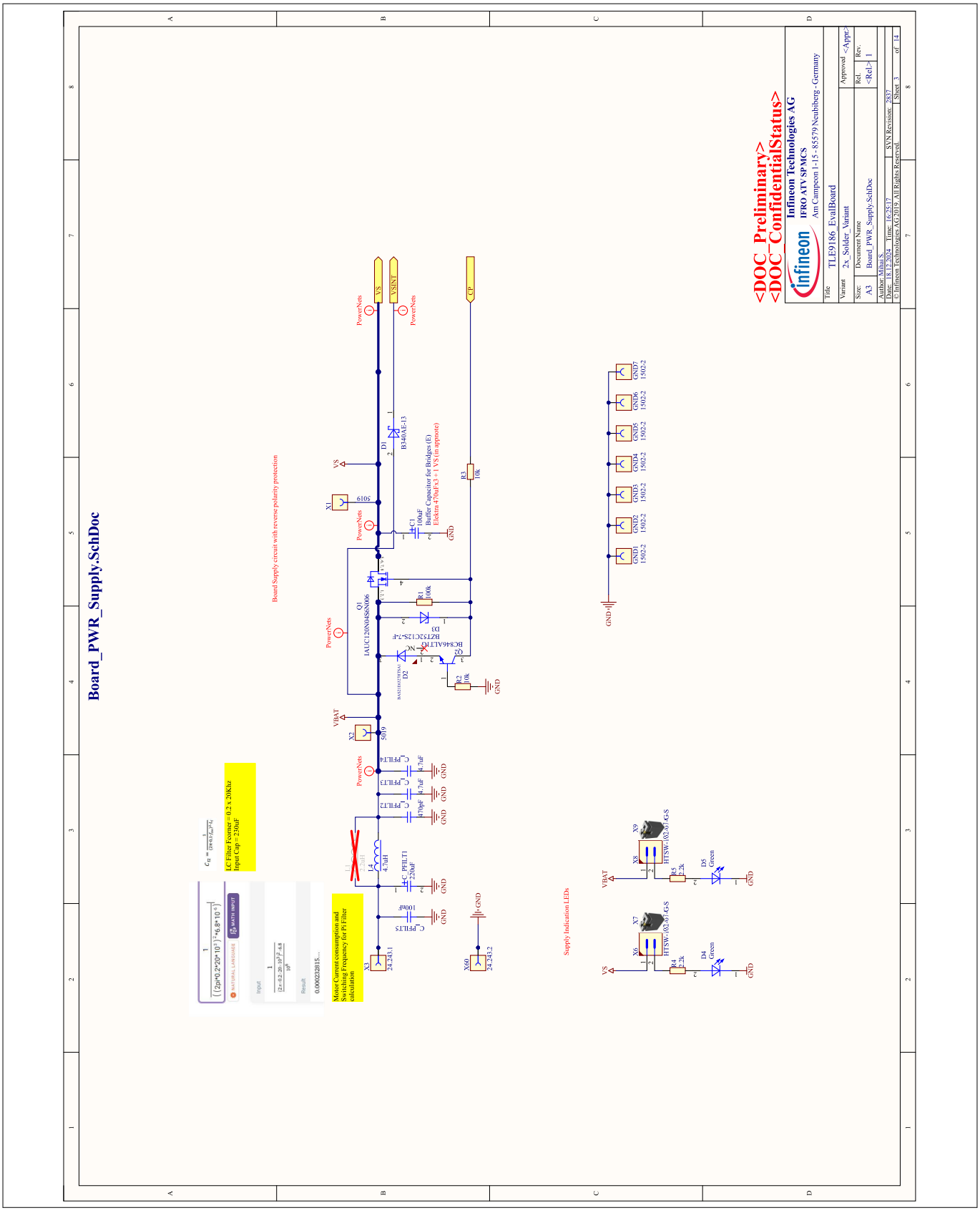

Figure 13 MOTIX™ TLE9186 evaluation board, sheet 2

5 Design files

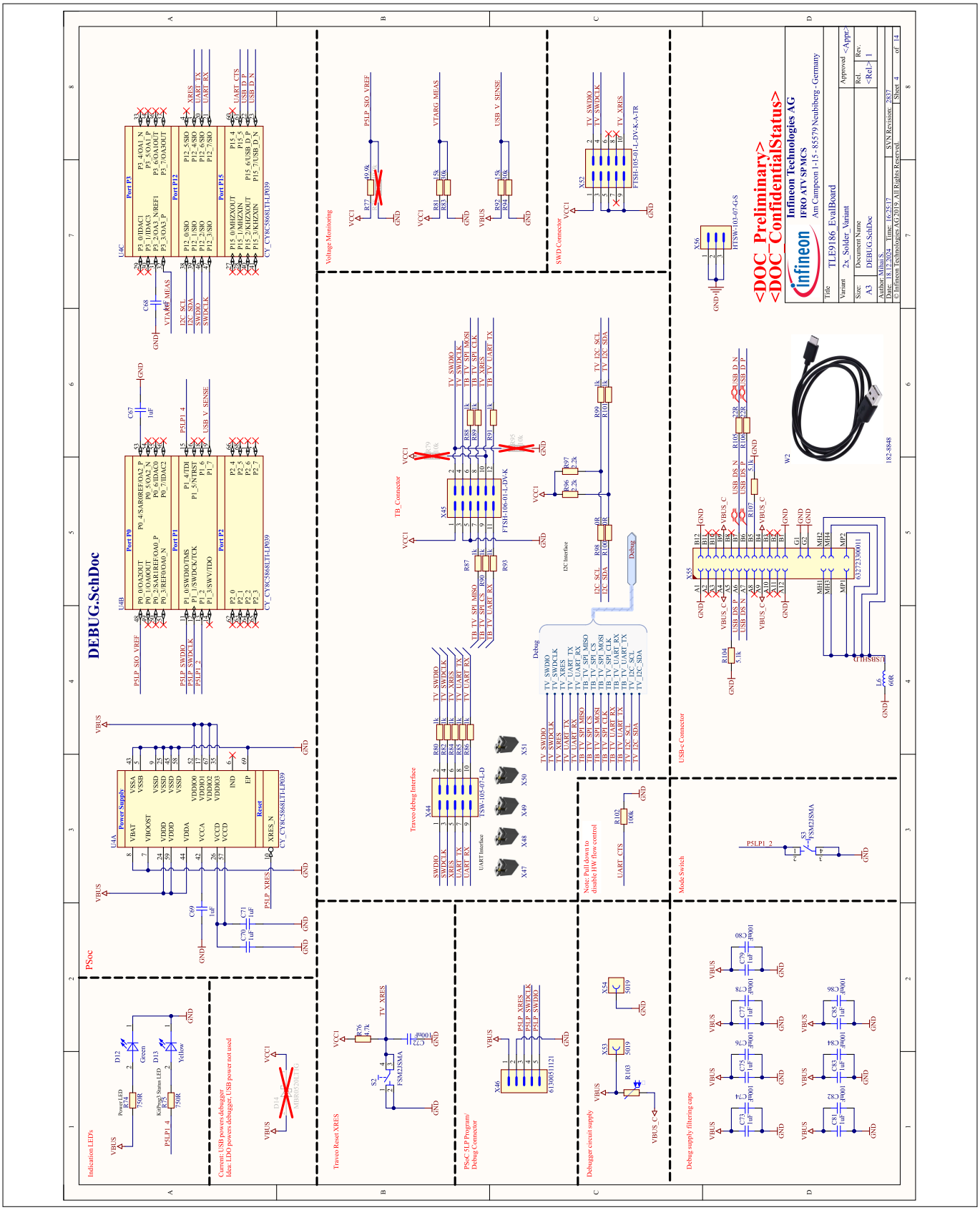

Figure 14 MOTIX™ TLE9186 evaluation board, sheet 3

5 Design files

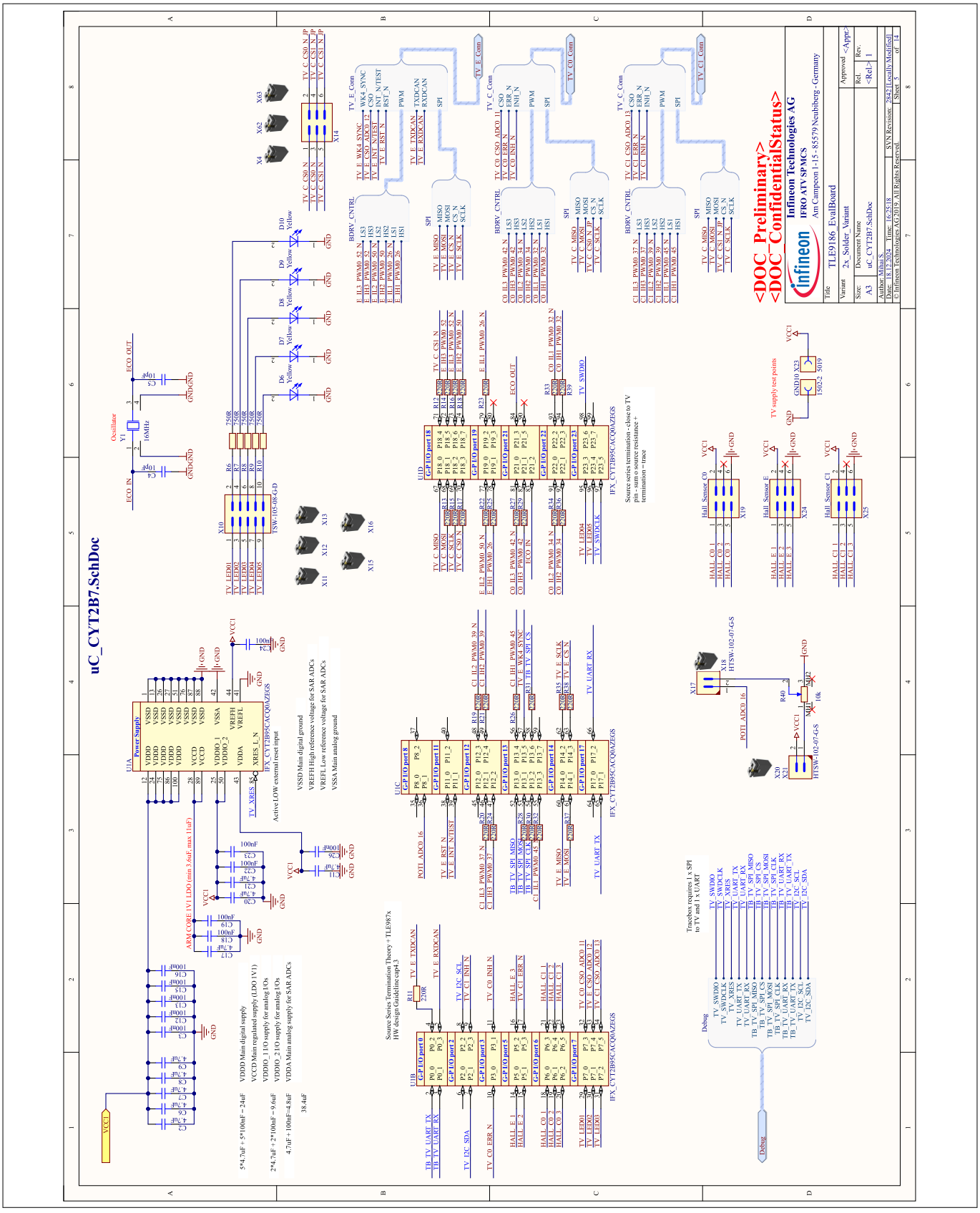

Figure 15 MOTIX™ TLE9186 evaluation board, sheet 4

5 Design files

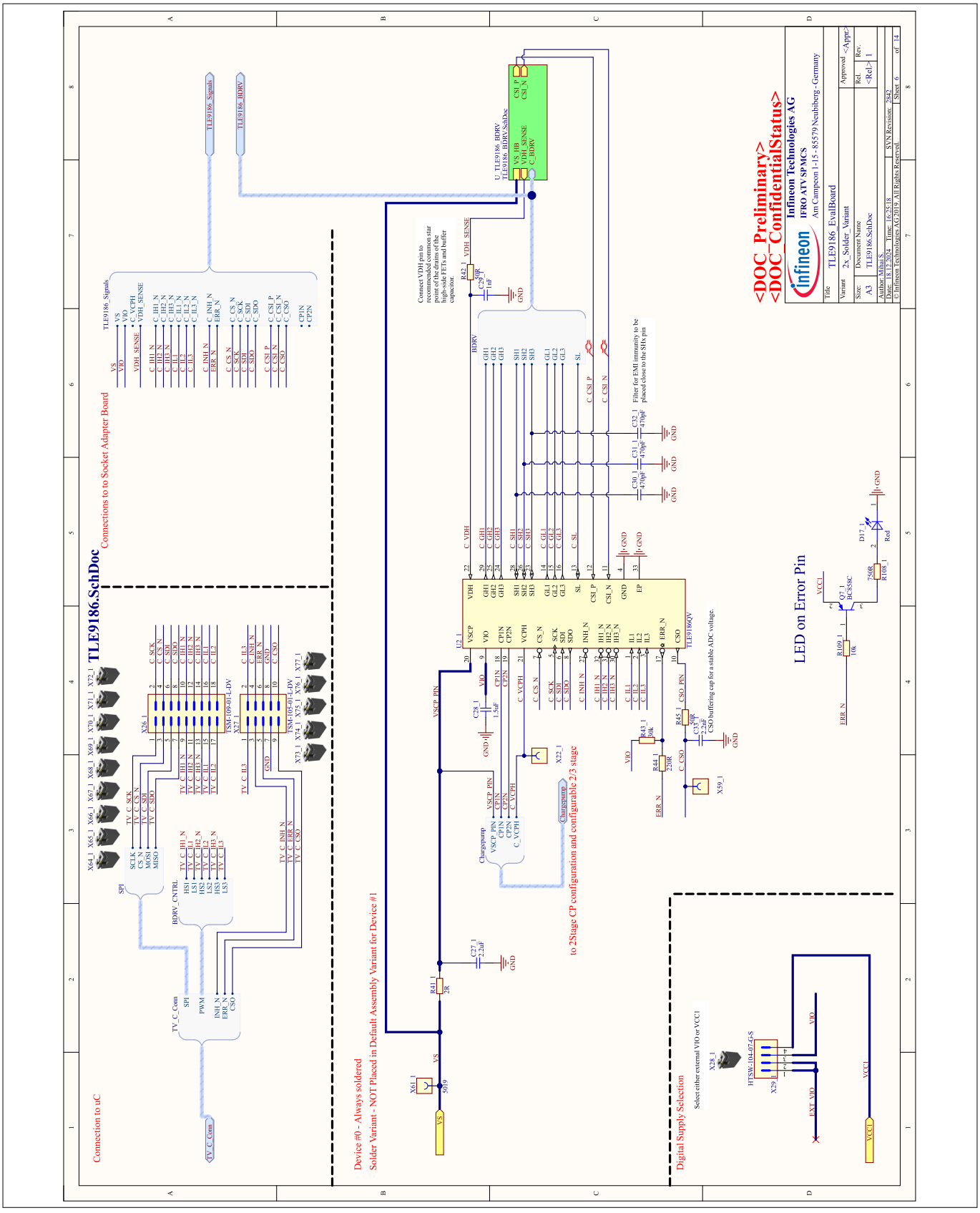

Figure 16 MOTIX™ TLE9186 evaluation board, sheet 5

5 Design files

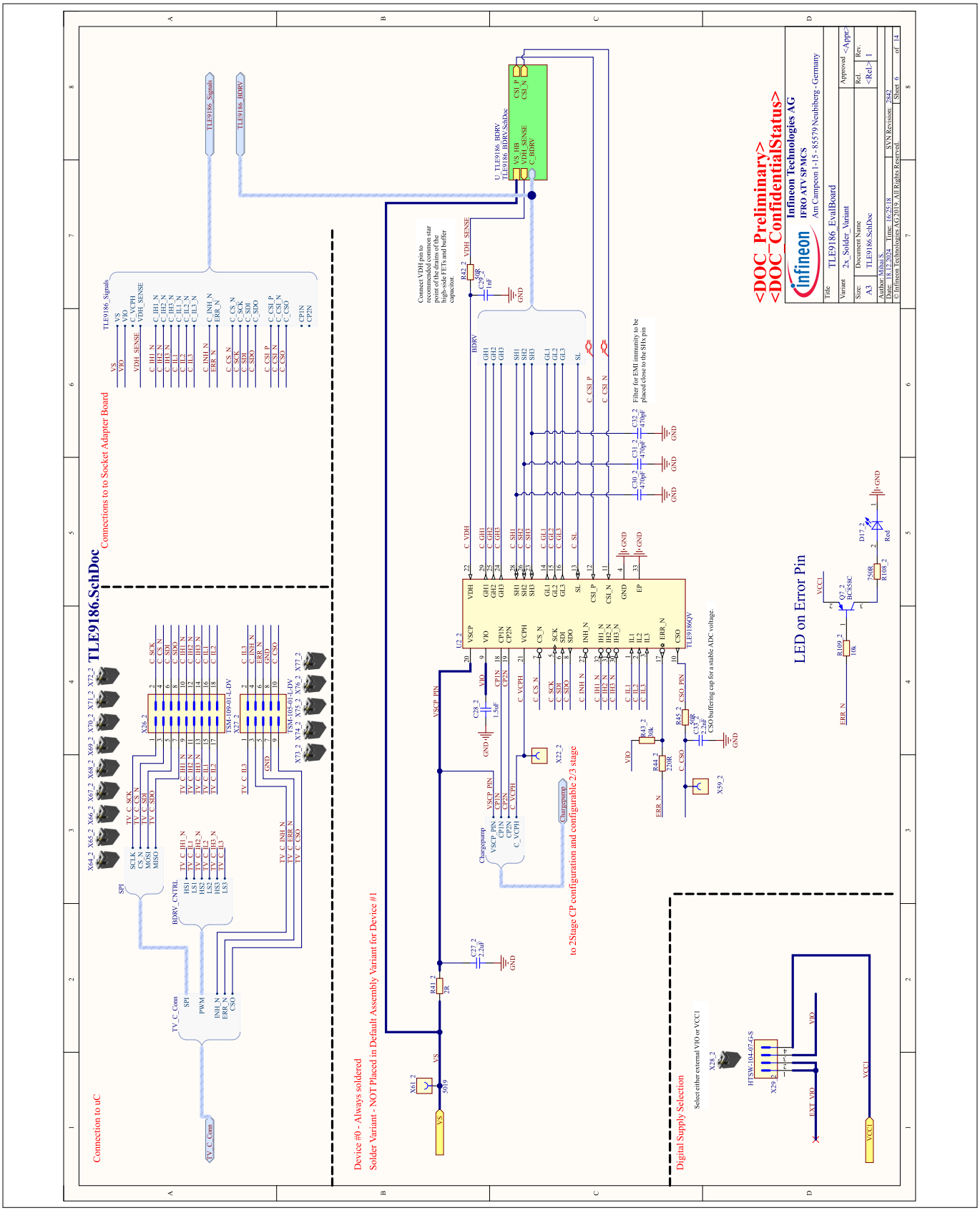

Figure 17 MOTIX™ TLE9186 evaluation board, sheet 6

5 Design files

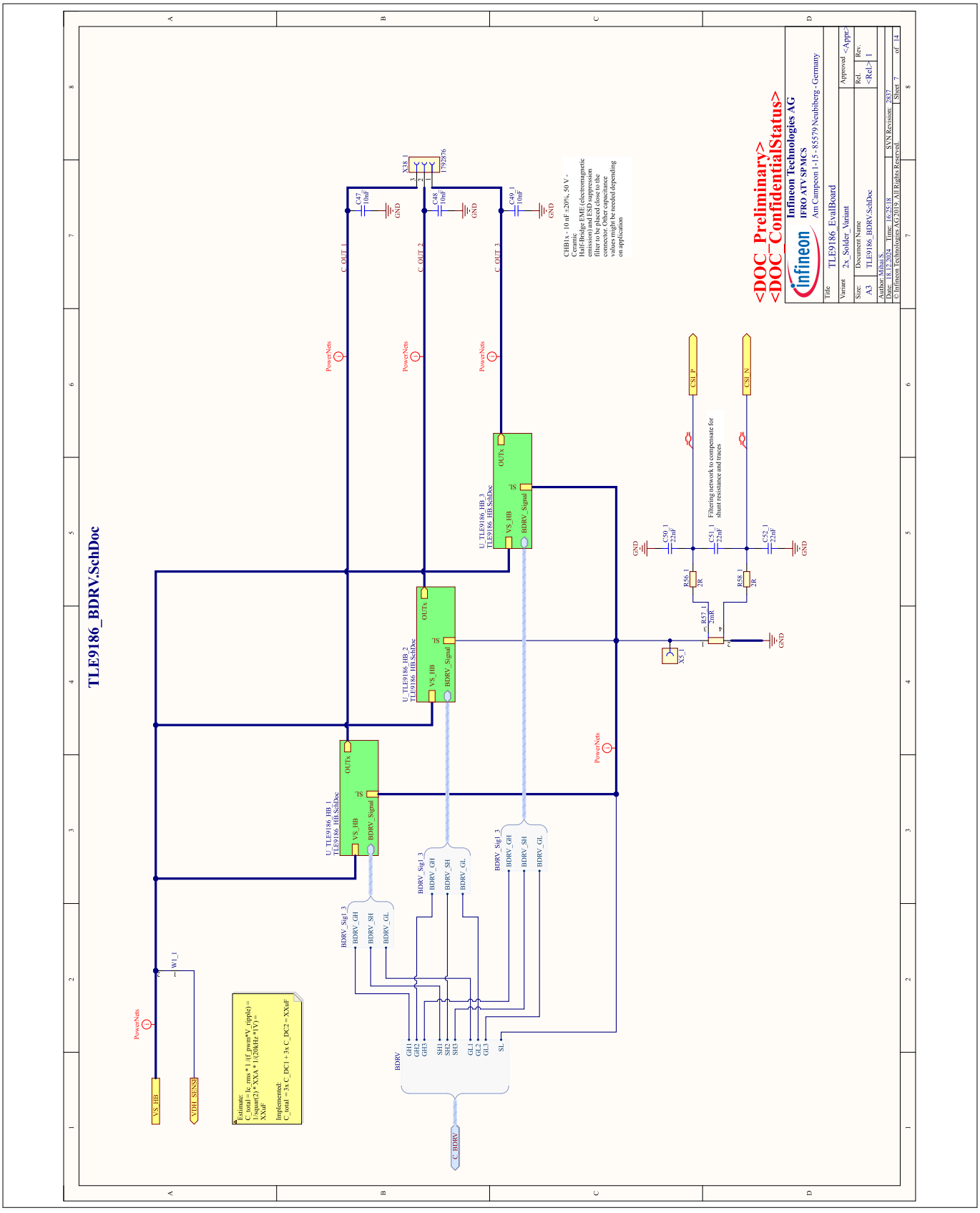

Figure 18 MOTIX™ TLE9186 evaluation board, sheet 7

5 Design files

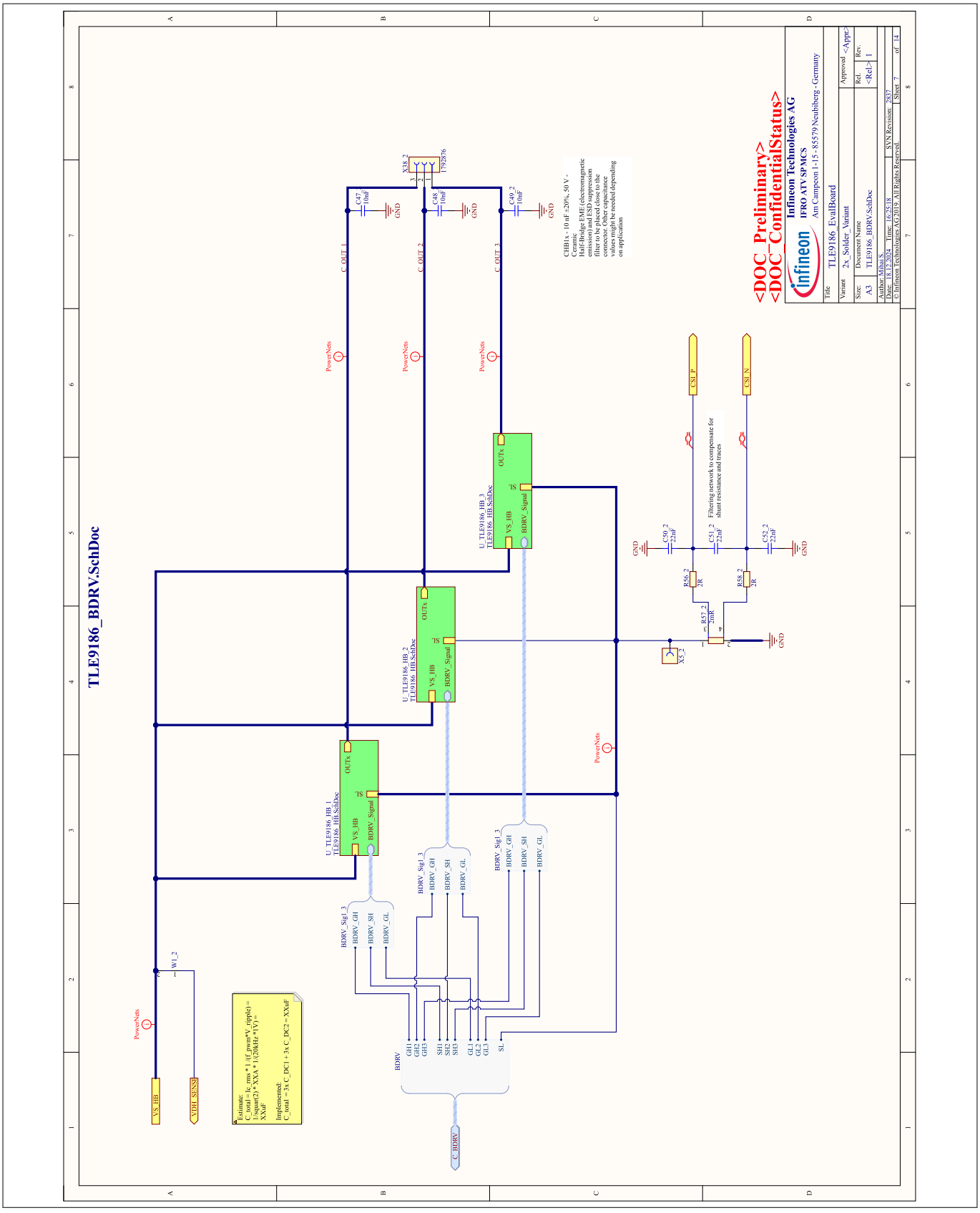

Figure 19 MOTIX™ TLE9186 evaluation board, sheet 8

5 Design files

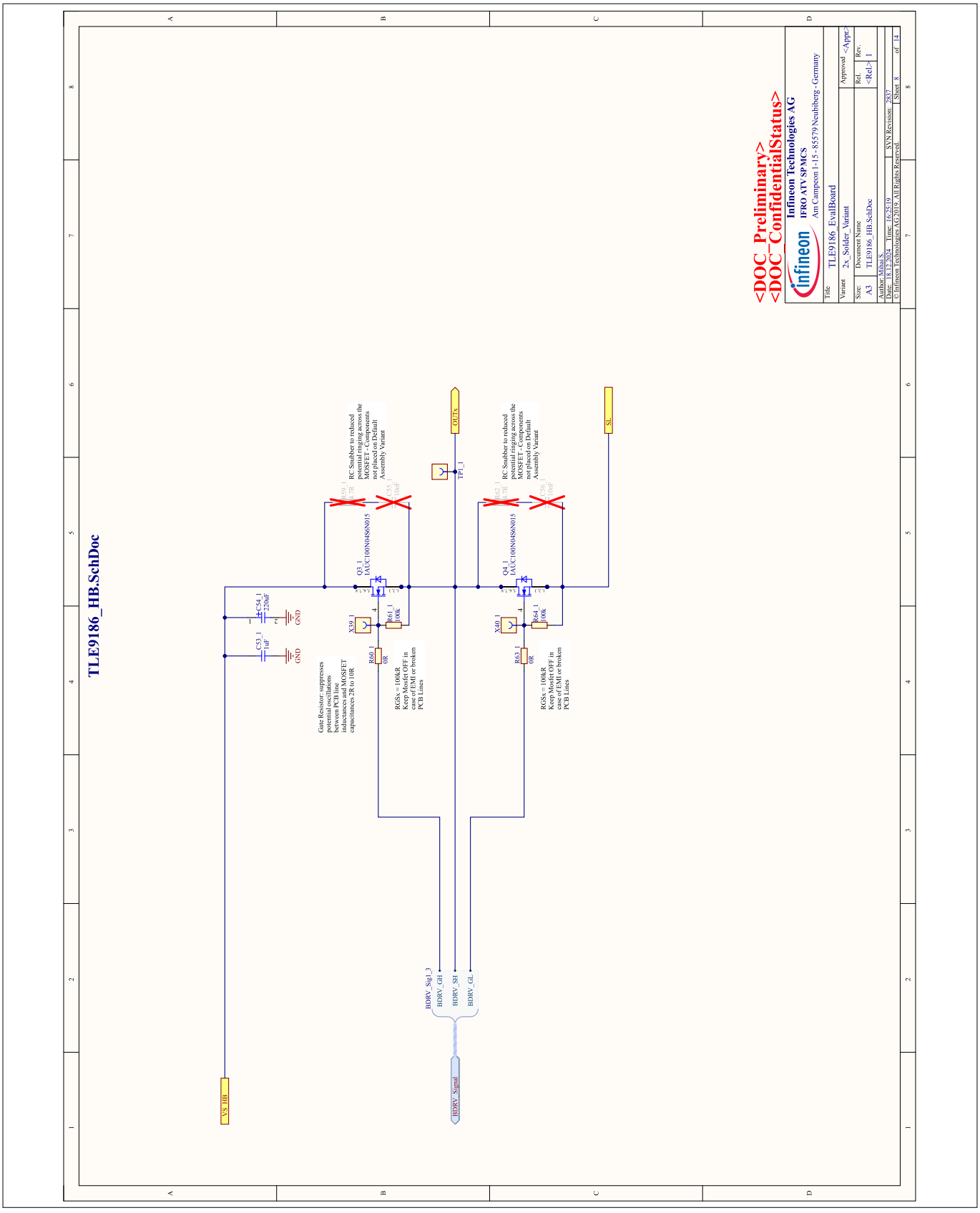

Figure 20 MOTIX™ TLE9186 evaluation board, sheet 9

5 Design files

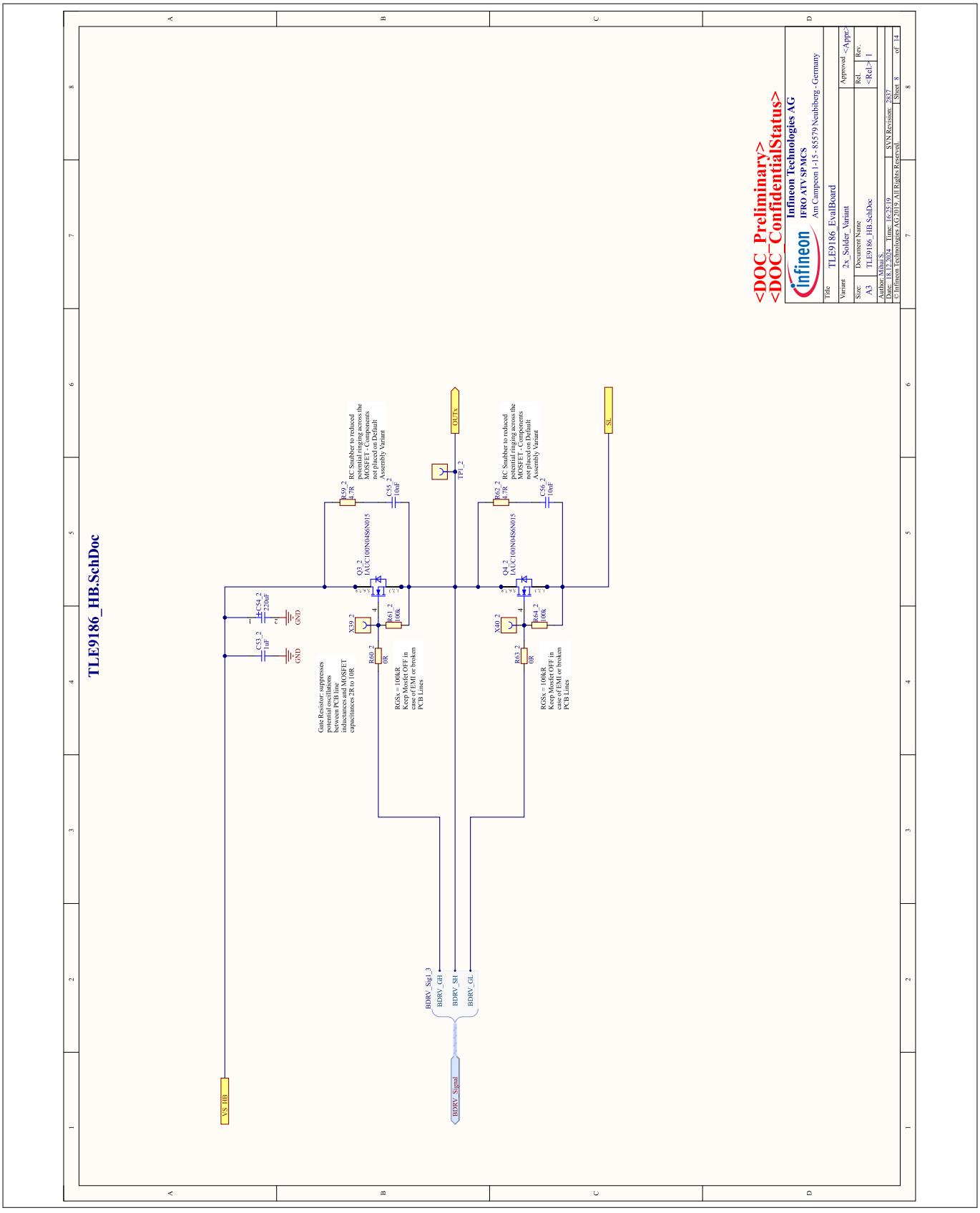

Figure 21 MOTIX™ TLE9186 evaluation board, sheet 10

5 Design files

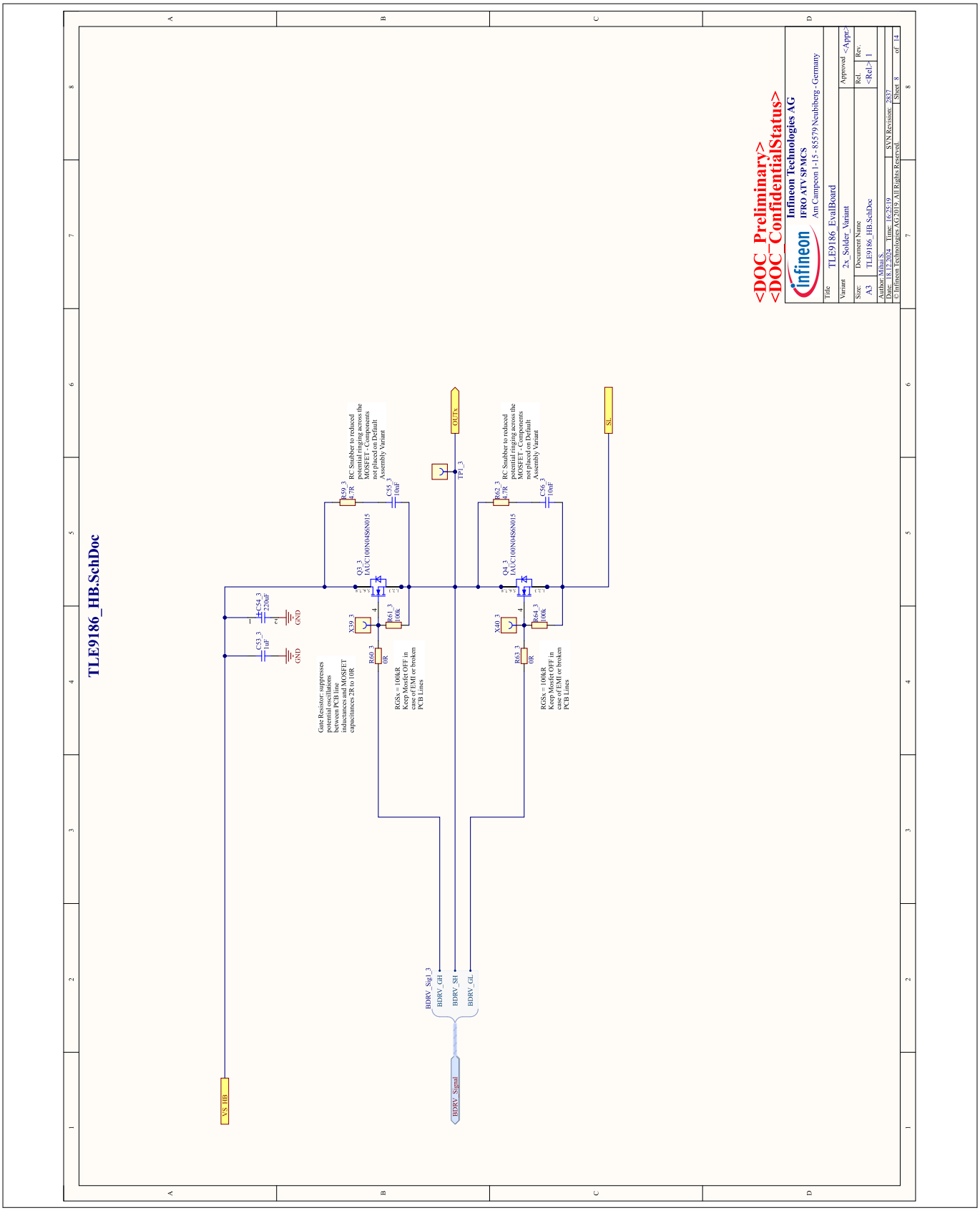

Figure 22 MOTIX™ TLE9186 evaluation board, sheet 11

5 Design files

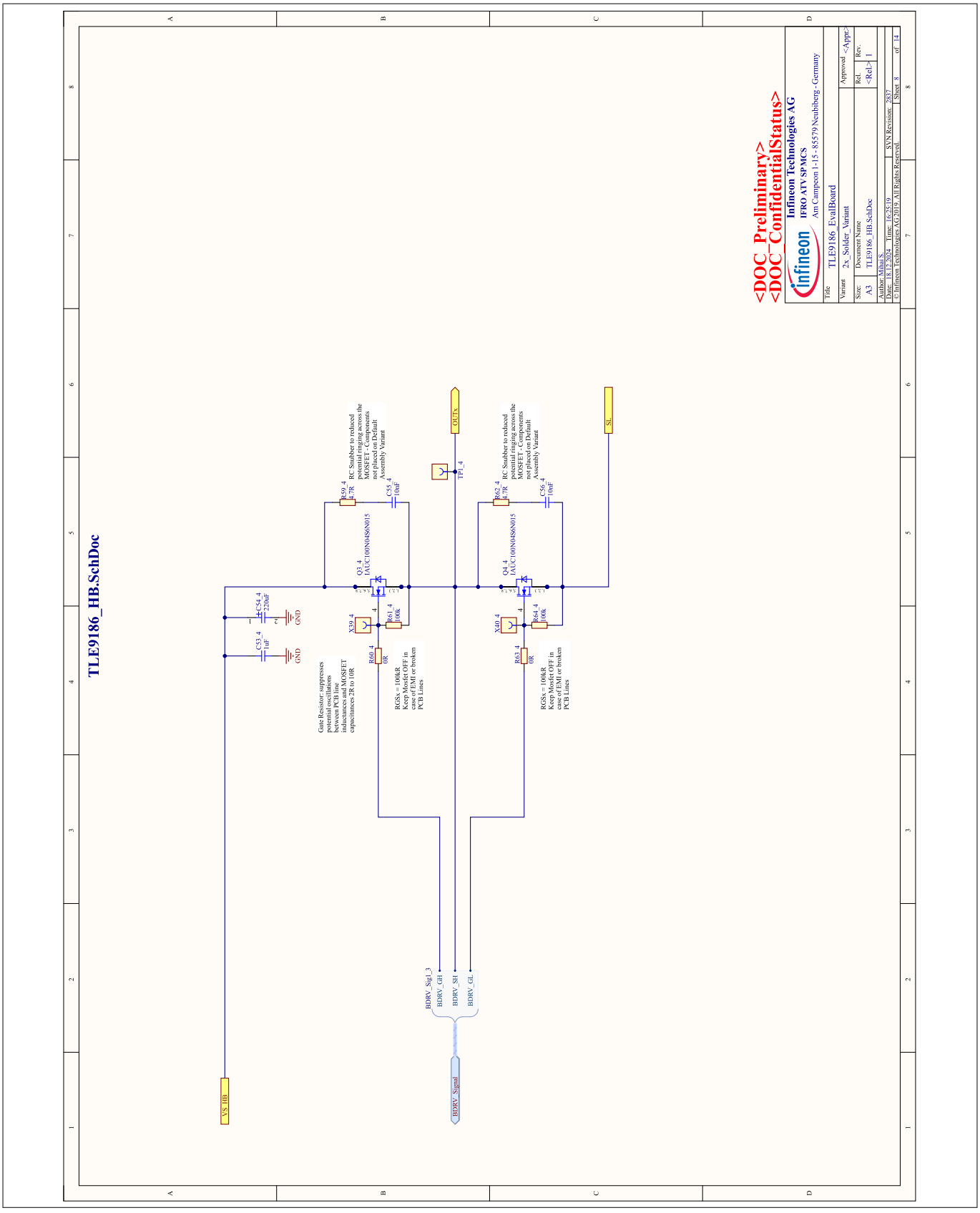

Figure 23 MOTIX™ TLE9186 evaluation board, sheet 12

5 Design files

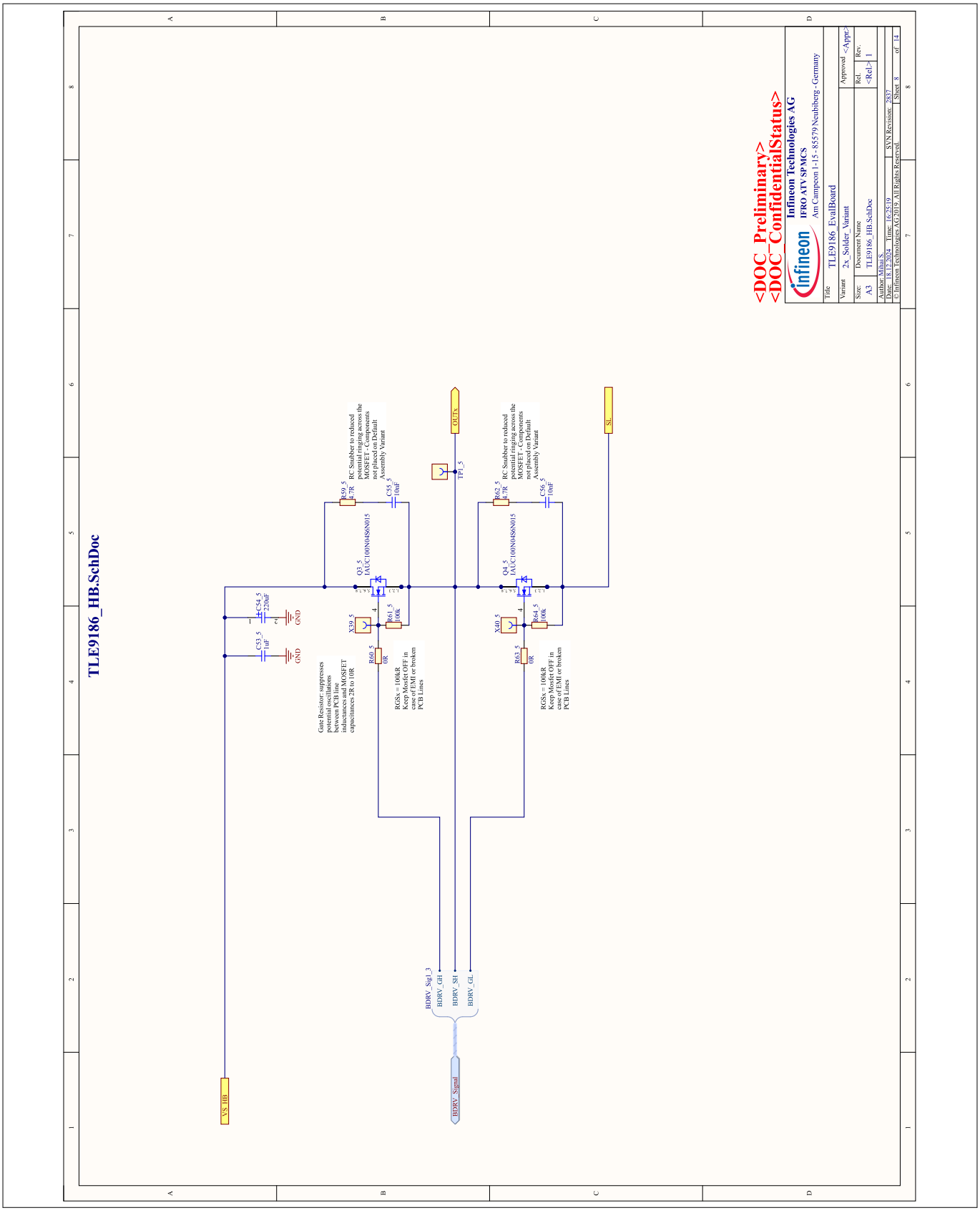

Figure 24 MOTIX™ TLE9186 evaluation board, sheet 13

5 Design files

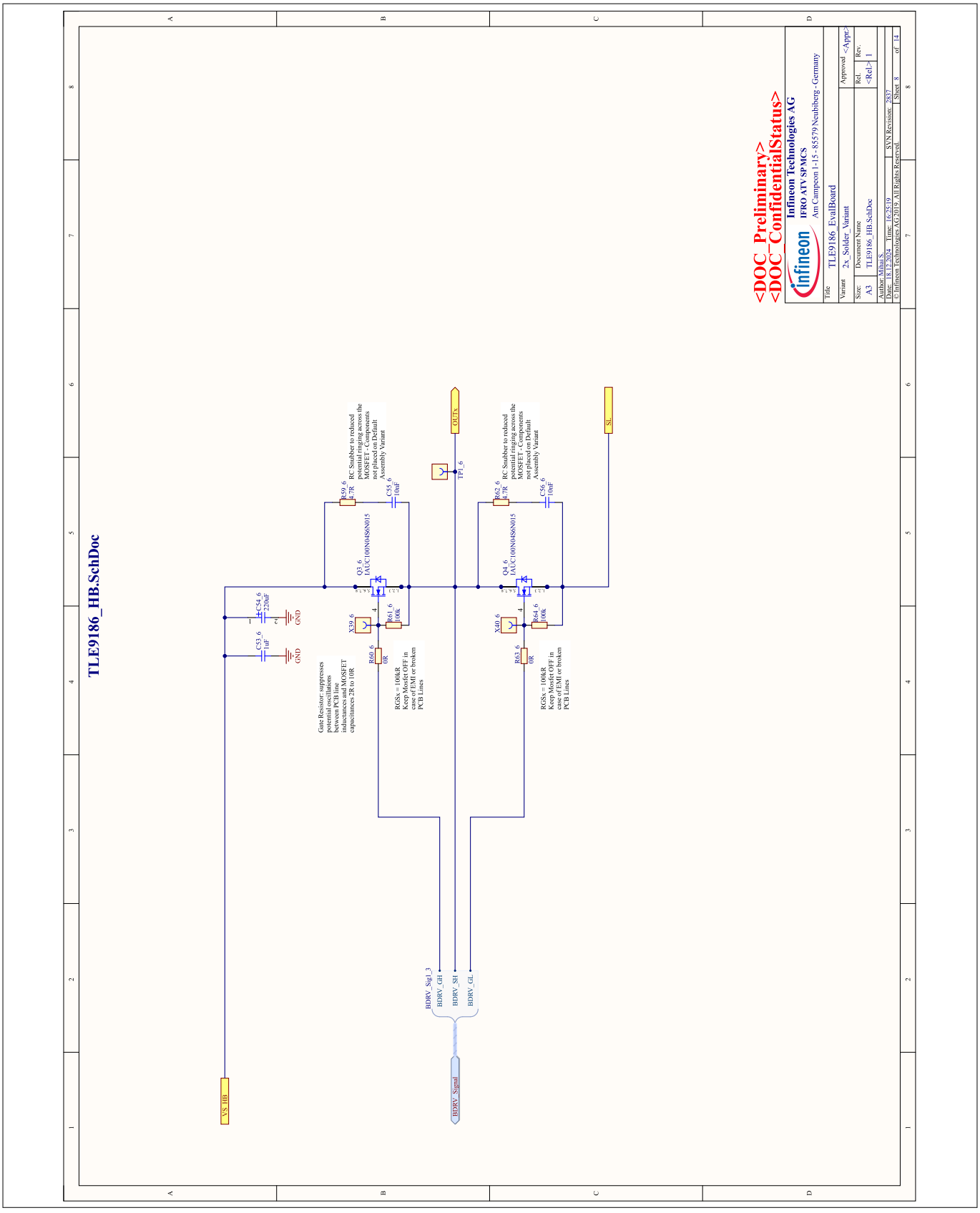

Figure 25 MOTIX™ TLE9186 evaluation board, sheet 14

5 Design files

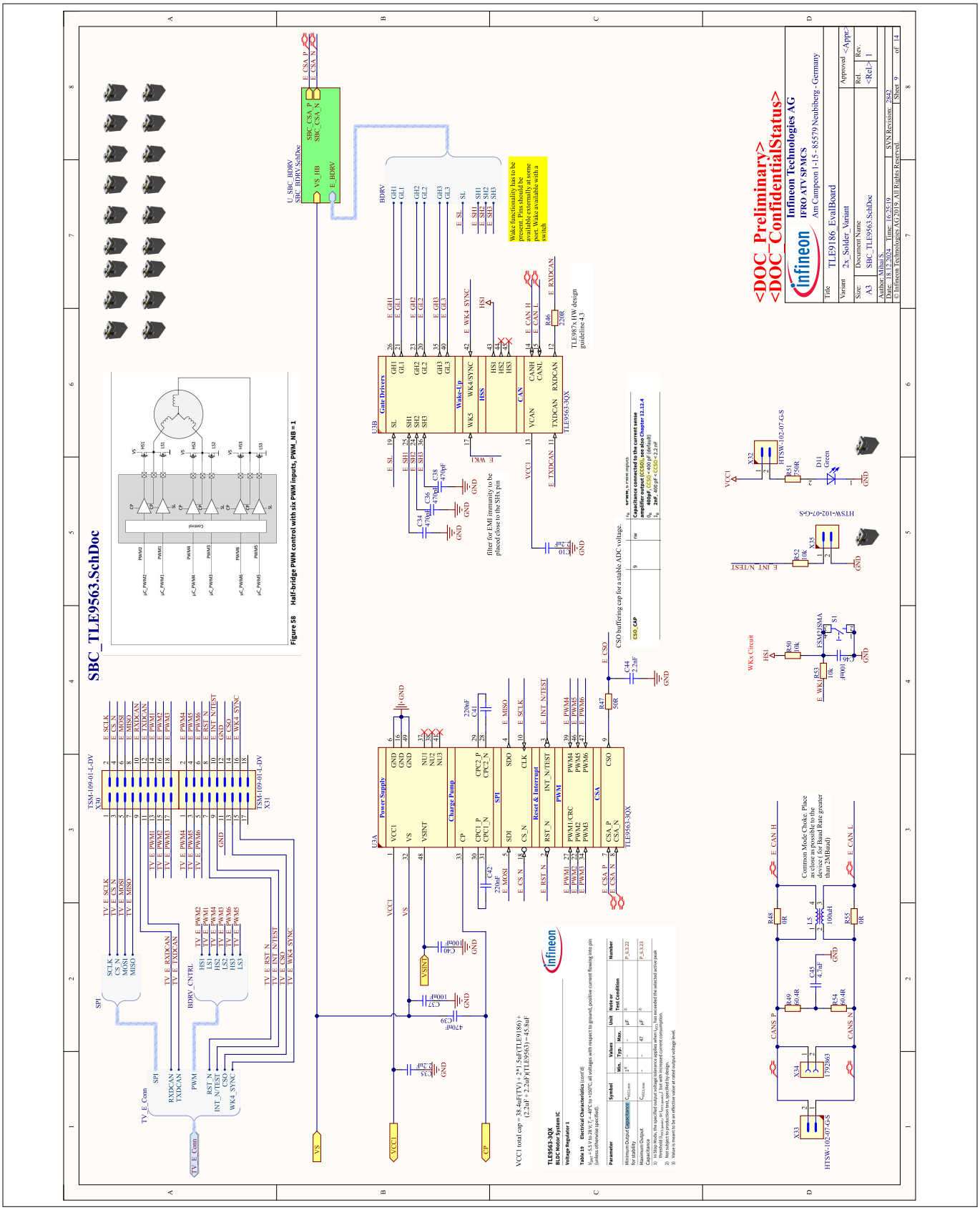

Figure 26 MOTIX™ TLE9186 evaluation board, sheet 15

5 Design files

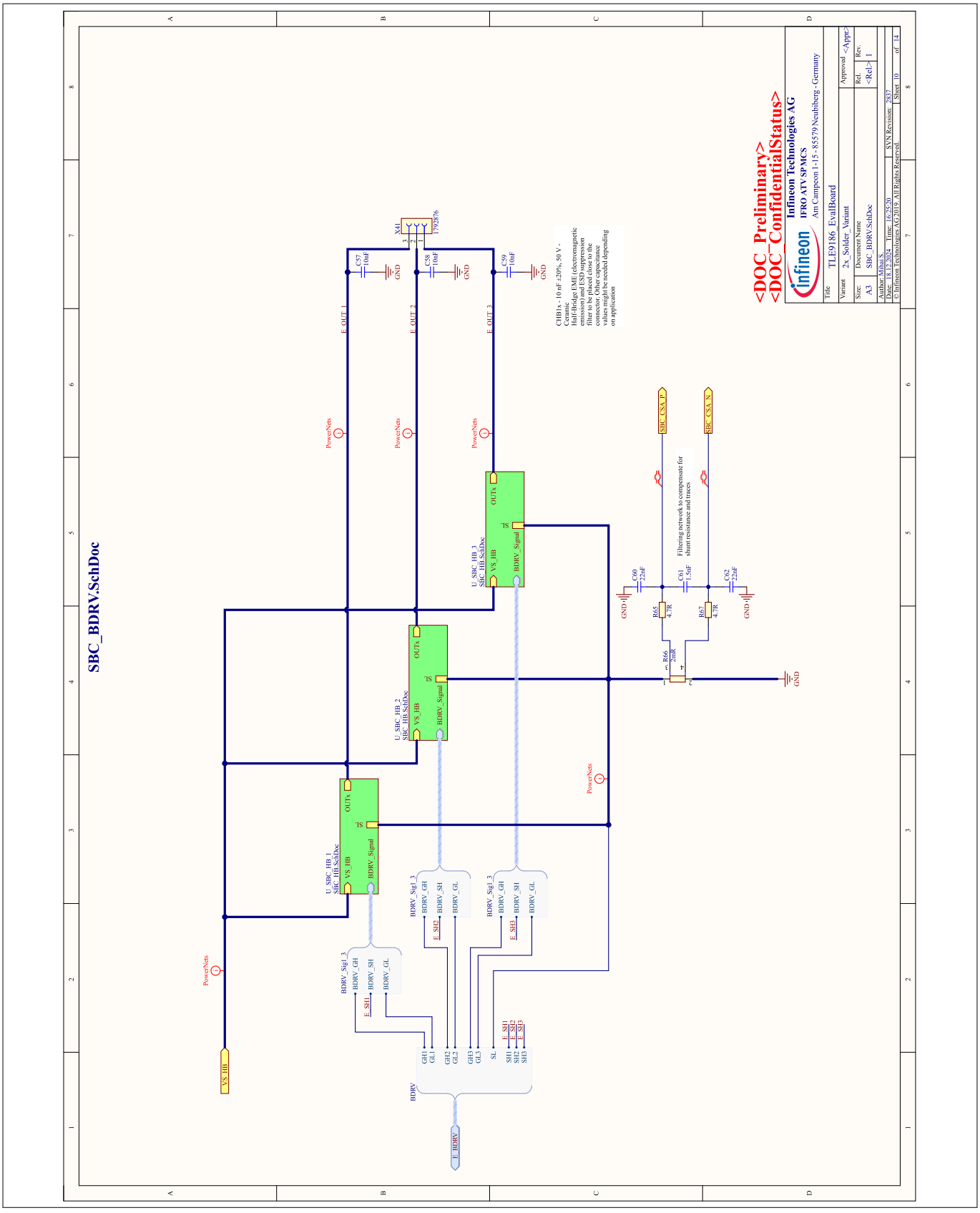

Figure 27 MOTIX™ TLE9186 evaluation board, sheet 16

5 Design files

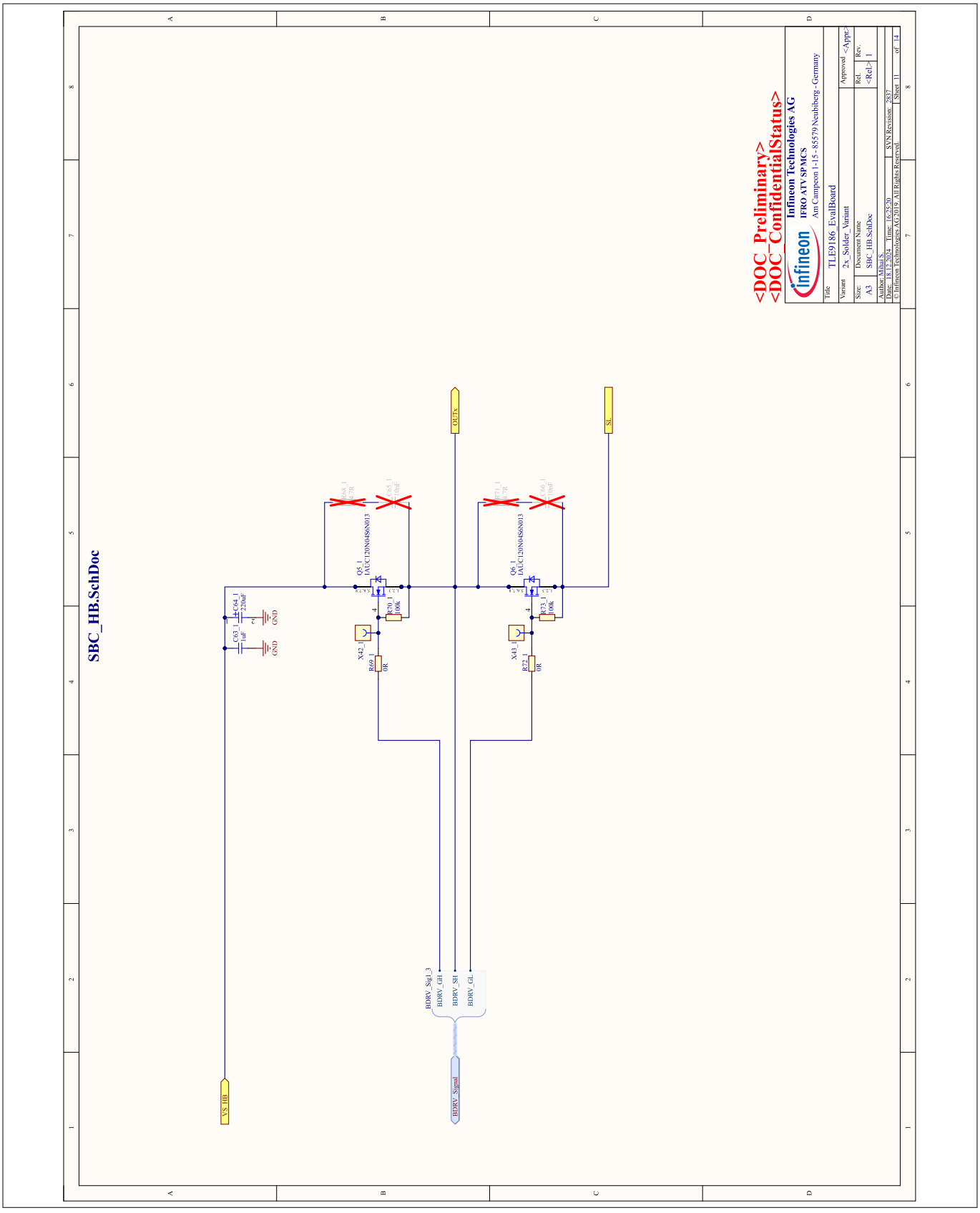

Figure 28 MOTIX™ TLE9186 evaluation board, sheet 17

5 Design files

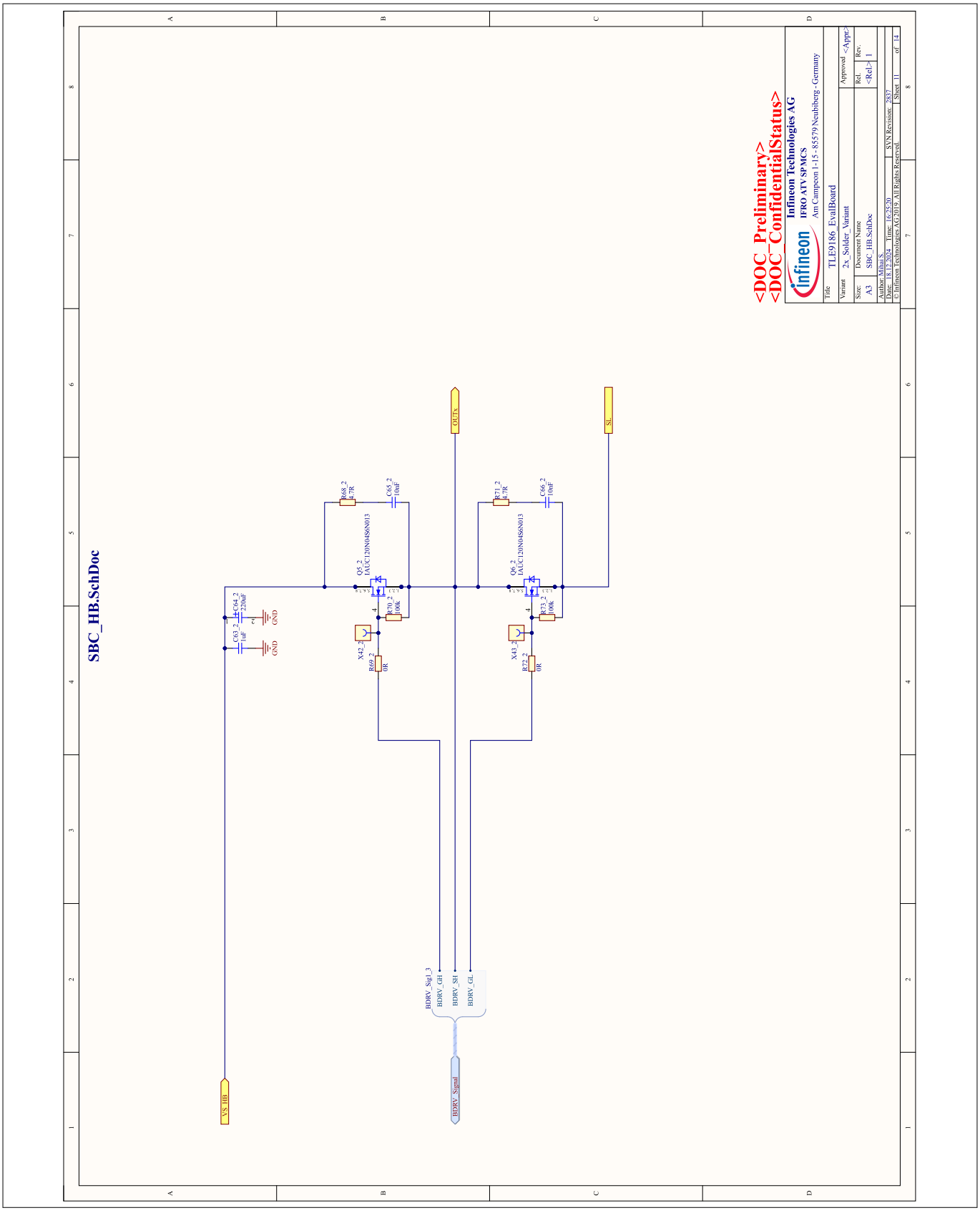

Figure 29 MOTIX™ TLE9186 evaluation board, sheet 18

5 Design files

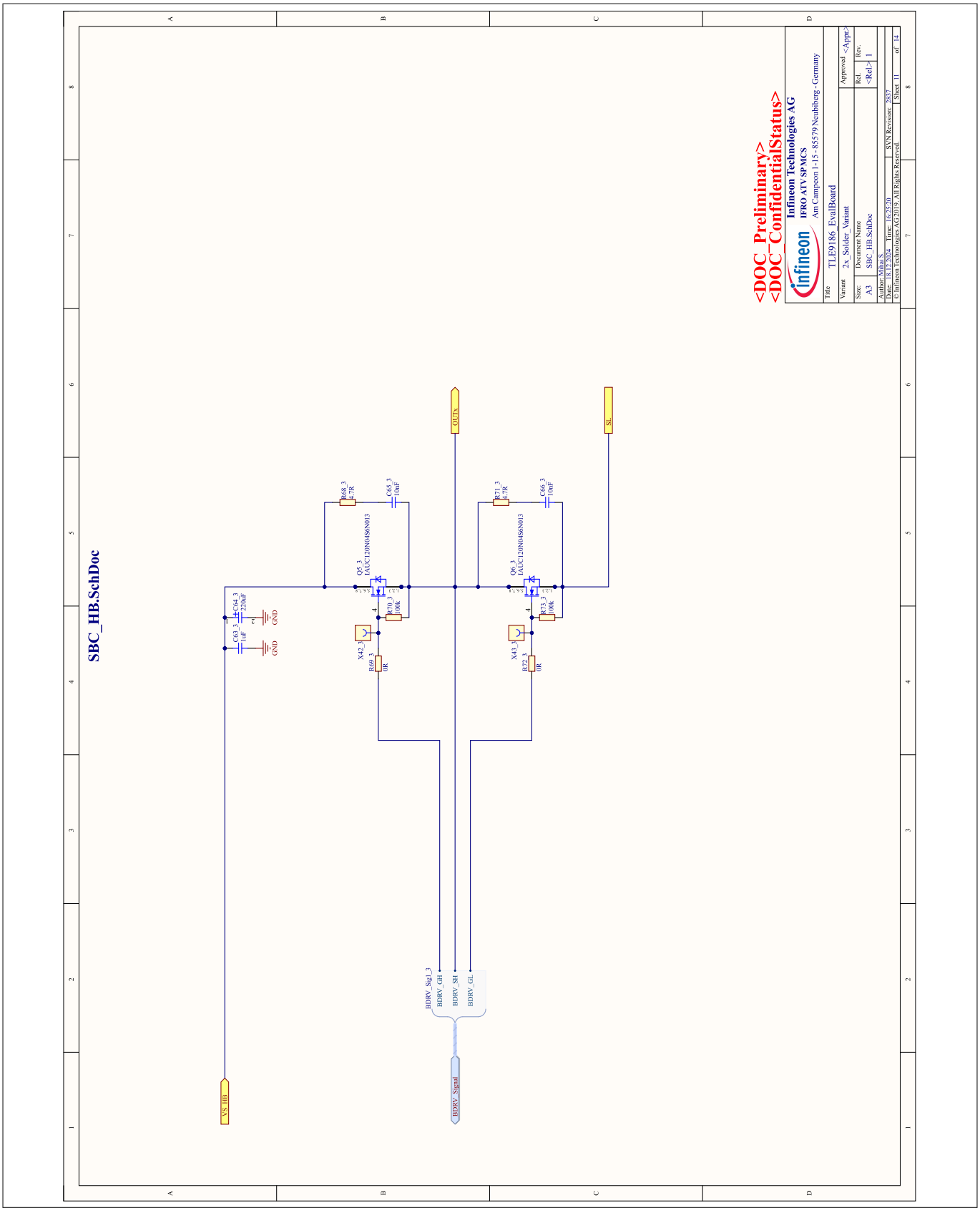

Figure 30 MOTIX™ TLE9186 evaluation board, sheet 19

5 Design files

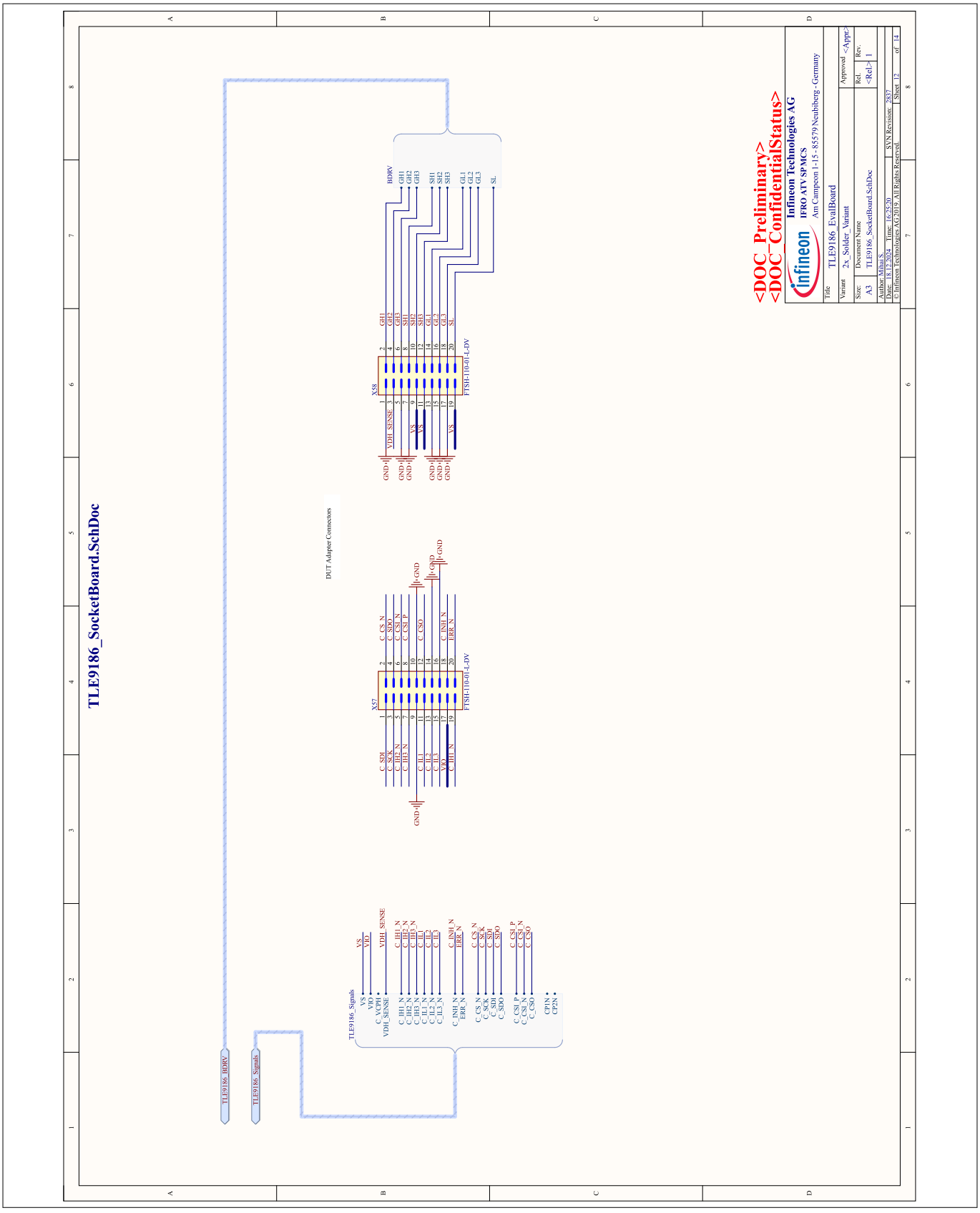

Figure 31 MOTIX™ TLE9186 evaluation board, sheet 20

5 Design files

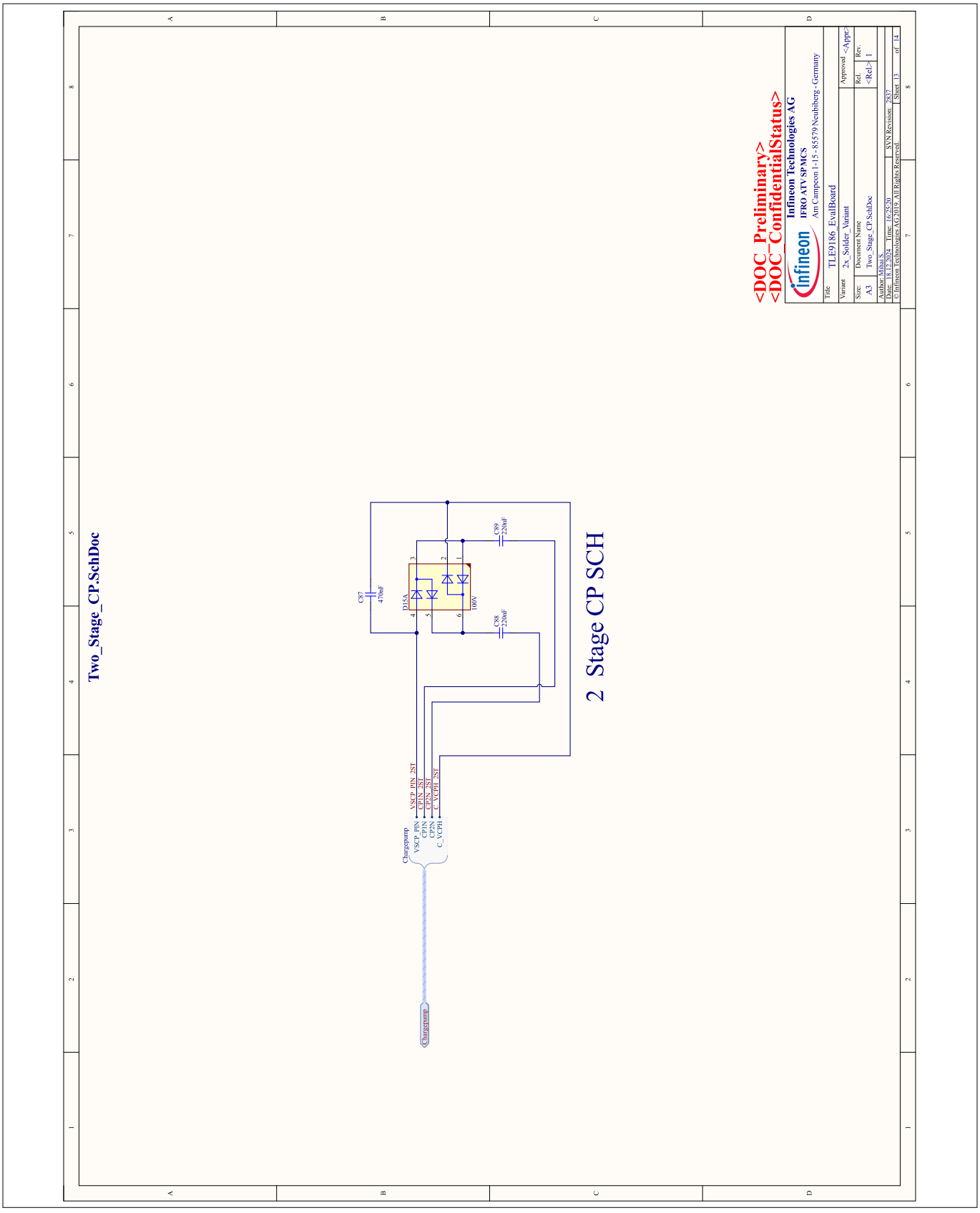

Figure 32 MOTIX™ TLE9186 evaluation board, sheet 21

5 Design files

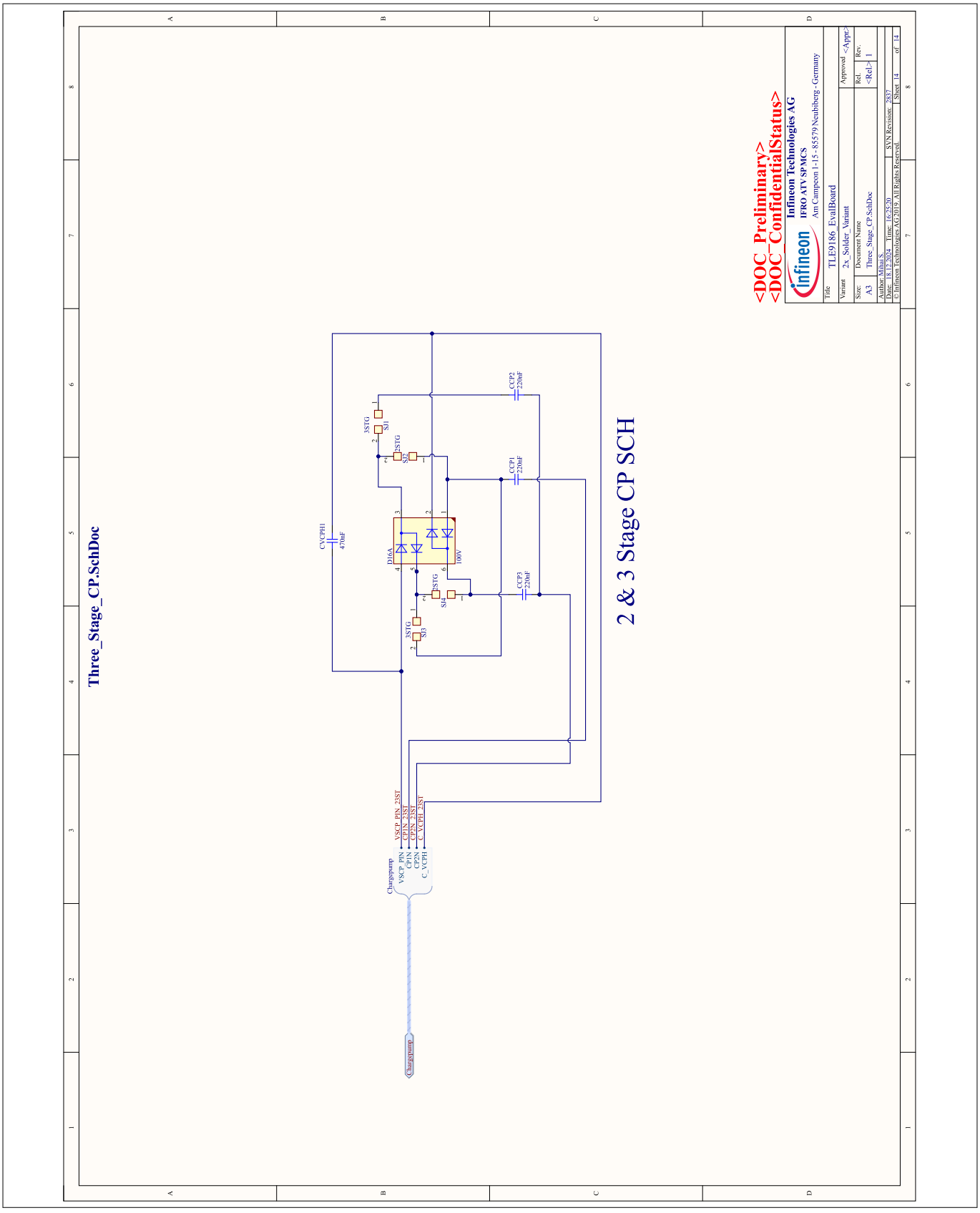

Figure 33 MOTIX™ TLE9186 evaluation board, sheet 22

5.2 Layout MOTIX™ TLE9186 evaluation board

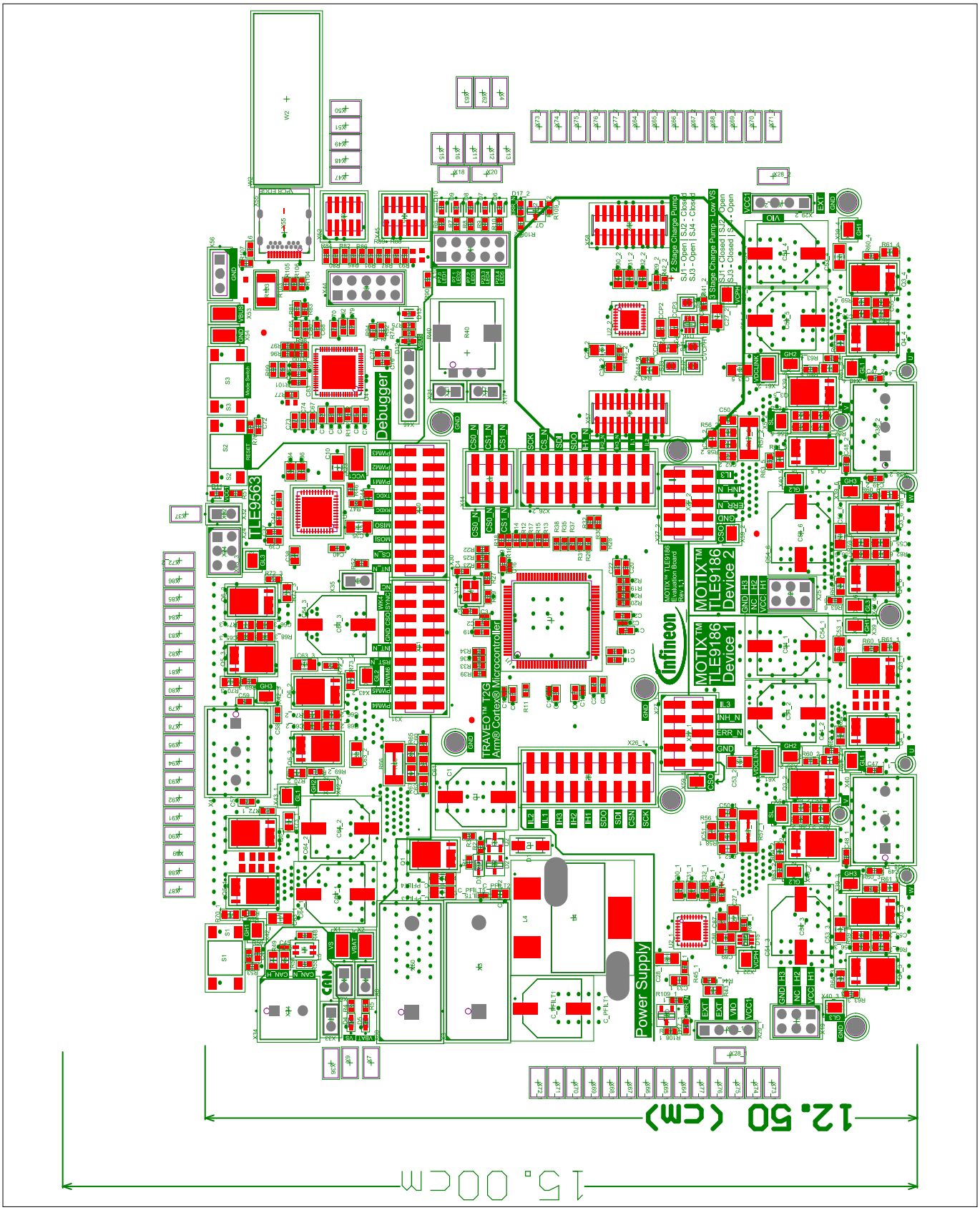

Figure 34 MOTIX™ TLE9186 evaluation board layer 1 (top layer, signal)

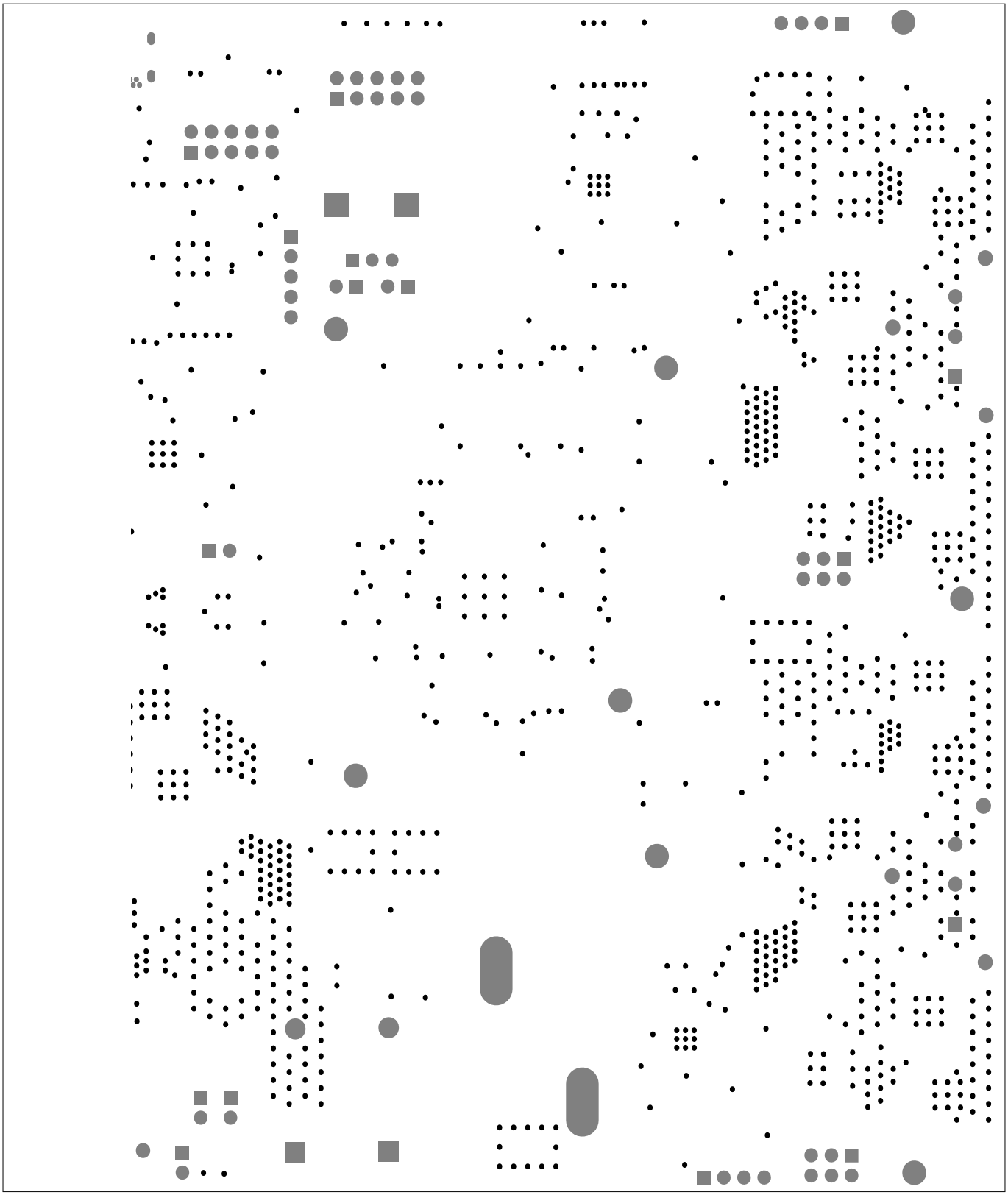

Figure 35 MOTIX™ TLE9186 evaluation board layer 1 (bottom layer, GND)

5.3 Bill of material MOTIX™ TLE9186 evaluation board

Table 8 Table 9 BOM MOTIX™ TLE9186 evaluation board

Designator	Description	Quantity	Manufacturer Order Number	Manufacturer
R103	RES / PTC / - / 800mW / - / - / - / 1812 / SMD / -	1	MF-MSMF030-2	Bourns
R98, R100	RES / STD / 0R / - / 0% / - / -55°C to 155°C / 0603(1608) / SMD / -	2	CRCW06030000Z0EA	Vishay
R48, R55	RES / STD / 0R / 100mW / 0R / 0ppm/K / -55°C to 155°C / 0603 / SMD / -	2	AC0603JR-070RL	Yageo
R80, R82, R84, R85, R86, R87, R88, R89, R90, R91, R93, R99, R101	RES / STD / 1k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	13	RC0603FR-071KL	Yageo
C29_1, C29_2	CAP / CERA / 1nF / 50V / 10% / X8R (EIA) / -55°C to 150°C / 63(1608) / SMD / -	2	GCM188R91H102KA37D	MuRata
C53_1, C53_2, C53_3, C53_4, C53_5, C53_6, C63_1, C63_2, C63_3	CAP / CERA / 1uF / 50V / 10% / X8R (EIA) / -55°C to 150°C / 1206(3216) / SMD / -	9	CGA5L3X8R1H105K160AB	TDK Corporation
C67, C68, C69, C70, C71, C73, C75, C77, C79, C81, C83, C85	CAP / CERA / 1uF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / -	12	GCM188R71E105KA64	MuRata
C61	CAP / CERA / 1.5nF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / -	1	GRM216R71E152KA01	MuRata
C28_1, C28_2	CAP / CERA / 1.5uF / 25V / 10% / X8R (EIA) / -55°C to 150°C / 1206(3216) / SMD / -	2	CGA5L3X8R1E155K160AB	TDK Corporation
R57_1, R57_2, R66	RES / STD / 2mR / 3W / 1% / 50ppm/K / -55°C to 170°C / 2512(6332) / SMD / -	3	BVT-I-R0020-1.0	Isabellenhuette
R41_1, R41_2	RES / STD / 2R / 63mW / 0.1% / 25ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	CPF0603B2R0E1	TE Connectivity
R56_1, R56_2, R58_1, R58_2	RES / STD / 2R / 500mW / 1% / 100ppm/K / - / 0805(2012) / SMD / -	4	CRCW08052R00FKEAHP	Vishay
SJ2, SJ4	Solder Jumper 2 Pins	2	Solder Jumper 2 Pins	Infineon Technologies
R4, R5, R96, R97	RES / STD / 2.2k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	4	CRCW06032K20FK	Vishay
C33_1, C33_2, C44	CAP / CERA / 2.2nF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / -	3	GRM219R71H222KA17	MuRata

(table continues...)

Table 8 (continued) Table 9 BOM MOTIX™ TLE9186 evaluation board

Designator	Description	Quantity	Manufacturer Order Number	Manufacturer
C35	CAP / CERA / 2.2uF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 1206 / SMD / -	1	CGA5L3X7R1H225K160AB	TDK Corporation
C27_1, C27_2	CAP / CERA / 2.2uF / 50V / 10% / X8L (EIA) / -55°C to 150°C / 1206(3216) / SMD / -	2	CGA5L1X8L1H225K160AC	TDK Corporation
L1	IND / STD / 2.2uH / 110A / 20% / -40°C to 180°C / 400uR / 20.73 mm x 21.75 mm x 25.53 mm / Inductor,THT, 2 Pin, 25.53mm L X 20.73mm W X 22.75mm H body / - / -	1	IHDM1008BCEV2R2M3A	Vishay
SJ1, SJ3	Solder Jumper 2 Pins	2	Solder Jumper 2 Pins	Infineon Technologies
R76	RES / STD / 4.7k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	1	CRCW06034K70FK	Vishay
C45	CAP / CERA / 4.7nF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0402(1005) / SMD / -	1	GRM155R71H472KA01	MuRata
R59_4, R59_5, R59_6, R62_4, R62_5, R62_6, R65, R67, R68_1, R68_2, R68_3, R71_1, R71_2, R71_3	RES / STD / 4.7R / 500mW / 1% / 100ppm/K / -55°C to 155°C / 0805(2012) / SMD / -	14	CRCW08054R70FKEAHP	Vishay
C_PFILT3, C_PFILT4	CAP / CERA / 4.7uF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 1206(3216) / SMD / -	2	CGA5L3X7R1H475K160AB	TDK Corporation
C17, C20, C21, C43	CAP / CERA / 4.7uF / 25V / 10% / X6S (EIA) / -55°C to 105°C / 0603(1608) / SMD / -	4	GRT188C81E475KE13D	MuRata
L4	IND / STD / 4.7uH / 18A / 20% / -40°C to 85°C / 1.82mR / SMD / Inductor, SMD, 9.27mm L X 19.18mm W X 12.95mm H / SMD / -	1	SER2013-472MLB	Coilcraft
R104, R107	RES / STD / 5.1k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	CRCW06035K10FK	Vishay
R40	RES / VAR / 10k / 50mW / 20% / - / -10°C to 70°C / THT, 2.5 mm pitch, 5 Pins, 11.80 mm L X 11.40 mm W X 15 mm H body / THT / -	1	RK09K1130A6S	ALPS
R79, R95	RES / STD / 10k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	RC0603FR-0710KL	Yageo

(table continues...)

Table 8 (continued) Table 9 BOM MOTIX™ TLE9186 evaluation board

Designator	Description	Quantity	Manufacturer Order Number	Manufacturer
R2, R3, R50, R52, R53, R109_1, R109_2	RES / STD / 10k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -, RES / STD / 10k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603 / SMD / -	7	CRCW060310K0FKEA	Vishay
C47_1, C47_2, C48_1, C48_2, C49_1, C49_2, C57, C58, C59	CAP / CERA / 10nF / 50V / 20% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / -	9	GRM188R71H103MA01	MuRata
C55_4, C55_5, C55_6, C56_4, C56_5, C56_6, C65_1, C65_2, C65_3, C66_1, C66_2, C66_3	CAP / CERA / 10nF / 100V / 20% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / -	12	GRM21BR72A103MA01	MuRata
C4, C5	CAP / CERA / 10pF / 50V / 5% / C0G (EIA) / NP0 / -55°C to 125°C / 0603(1608) / SMD / -	2	GCM1885C1H100JA16	MuRata
R60_1, R60_2, R60_3, R60_4, R60_5, R60_6, R63_1, R63_2, R63_3, R63_4, R63_5, R63_6, R69_1, R69_2, R69_3, R72_1, R72_2, R72_3	RES / STD / 10R / 100mW / 1% / 200ppm/K / -55°C to 155°C / 0603 / SMD / -	18	RC0603FR-0710RL	Yageo
C7, C8, C9, C10, C11, C25	CAP / CERA / 10uF / 10V / 10% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / -	6	885012207026	Wurth Elektronik
D3	Surface Mount Zener Diode	1	BZT52C12S-7-F	Diodes Incorporated
R81, R92	RES / STD / 15k / 100mW / 5% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	RC0603JR-0715KL	Yageo
Y1	Surface Mount Compact Crystal Unit	1	NX3225GA-16.000M-STD-CRG-2	Nihon Dempa Kogyo
C60, C62	CAP / CERA / 22nF / 25V / 10% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / -	2	GRM216R71E223KA01	MuRata
C50_1, C50_2, C51_1, C51_2, C52_1, C52_2	CAP / CERA / 22nF / 50V / 5% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / -	6	GCM216R71H223JA37	MuRata
R105, R106	RES / STD / 22R / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	CRCW060322R0FK	Vishay
R83, R94	RES / STD / 30k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	CRCW060330K0FK	Vishay
R43_1, R43_2	RES / STD / 30k / 125mW / 1% / 100ppm/K / -55°C to 155°C / 0805(2012) / SMD / -	2	CRCW080530K0FK	Vishay

(table continues...)

Table 8 (continued) Table 9 BOM MOTIX™ TLE9186 evaluation board

Designator	Description	Quantity	Manufacturer Order Number	Manufacturer
R77, R78	RES / STD / 49.9k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	CRCW060349K9FK	Vishay
R42_1, R42_2, R45_1, R45_2, R47	RES / STD / 50R / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	5	CRCW060350R0FK	Vishay
L6	IND / FERR / 60R / 1A / - / -55°C to 125°C / 100mR / 0603(1608) / Inductor,Chip;1.60mm L X 0.80mm W X 0.95mm H / SMD / -	1	BLM18PG600SN1D	MuRata
R49, R54	RES / STD / 60.4R / 125mW / 1% / 100ppm/K / -55°C to 155°C / 0805 / SMD / -	2	CRCW080560R4FK	Vishay
R1, R102	RES / STD / 100k / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	CRCW0603100KFK	Vishay
R61_1, R61_2, R61_3, R61_4, R61_5, R61_6, R64_1, R64_2, R64_3, R64_4, R64_5, R64_6, R70_1, R70_2, R70_3, R73_1, R73_2, R73_3	RES / STD / 100k / 125mW / 1% / 100ppm/K / -55°C to 155°C / 0805(2012) / SMD / -	18	CRCW0805100KFKEA	Vishay
C2, C3, C12, C13, C15, C16, C26, C_PFILT5	CAP / CERA / 100nF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0402(1005) / SMD / -	8	GRM155R71H104KE14D	MuRata
C18, C19, C22, C23, C24, C37, C40, C46, C72, C74, C76, C78, C80, C82, C84, C86	CAP / CERA / 100nF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / -	16	06035C104K4Z2A	AVX
C1	CAP / ELCO / 100uF / 50V / 20% / Aluminiumelectrolytic / -40°C to 105°C / 10.30mm L X 10.30mm W X 10.50mm H / SMD / -	1	EEE-HA1H101P	Panasonic
L5	IND / STD / 100uH / 150mA / 50% / -55°C to 150°C / 1.5R / 1210(3225) / Filter SMD, 4-Leads, Molded Body 3.20mm L X 2.50mm W X 2.5mm H / SMD / -	1	ACT1210-101-2P-TL00	TDK Corporation
D15, D16	High Speed Switching Diode with Reverse Polarity Protection	2	BAV99S,115	Nexperia
R108_1, R108_2	RES / STD / 120R / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603 / SMD / -	2	CRCW0603120RFK	Vishay
W2	Male USB C to Male USB A USB Cable	1	182-8848	RS Pro

(table continues...)

Table 8 (continued) Table 9 BOM MOTIX™ TLE9186 evaluation board

Designator	Description	Quantity	Manufacturer Order Number	Manufacturer
C41, C42	CAP / CERA / 220nF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / -	2	GCM188R71H224KA64	MuRata
C88, C89, CCP1, CCP2, CCP3	CAP / CERA / 220nF / 50V / 10% / X8R (EIA) / -55°C to 150°C / 0805(2012) / SMD / -	5	CGA4J3X8R1H224K125AB	TDK Corporation
R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R44_1, R44_2, R46	RES / STD / 220R / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	32	CRCW0603220RFK	Vishay
C54_1, C54_2, C54_3, C54_4, C54_5, C54_6, C64_1, C64_2, C64_3, C_PFILT1	CAP / ELCO / 220uF / 50V / 20% / - / -55°C to 105°C / 10.30mm L X 10.30mm W X 10.50mm H / SMD / -	10	EEEFK1H221P	Panasonic
C39	CAP / CERA / 470nF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0603 / SMD / -	1	CGA3E3X7R1H474K080AE	TDK Corporation
C87, CVCPH1	CAP / CERA / 470nF / 50V / 10% / X8L (EIA) / -55°C to 150°C / 0805(2012) / SMD / -	2	CGA4J1X8L1H474K125AE	TDK Corporation
C30_1, C30_2, C31_1, C31_2, C32_1, C32_2, C34, C36, C38, C_PFILT2	CAP / CERA / 470pF / 50V / 10% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / -	10	GRM216R71H471KA01	MuRata
R6, R7, R8, R9, R10, R51, R74, R75	RES / STD / 750R / 100mW / 1% / 100ppm/K / -55°C to 155°C / 0603 / SMD / -	8	CRCW0603750RFK	Vishay
GND1, GND2, GND3, GND4, GND5, GND6, GND7, GND10	Solder Terminal, Double Turret, .109 Long	8	1502-2	Keystone Electronics Corp.
X34	PCB terminal block, nominal current: 16 A, rated voltage : 400 V, 2 Positions	1	1792863	Phoenix Contact
X38_1, X38_2, X41	PCB terminal block, Nominal current: 12 A, Nom. voltage: 400 V, 3 Positions	3	1792876	Phoenix Contact
X3	Banana Test Connector, 4mm, Socket, PCB Mount, 24 A, 60 VDC, Silver Plated Contacts, Red	1	24.243.1	Multicomp
X60	Banana Test Connector, 4mm, Socket, PCB Mount, 24 A, 60 VDC, Silver Plated Contacts, Black	1	24.243.2	Multicomp

(table continues...)

Table 8 (continued) Table 9 BOM MOTIX™ TLE9186 evaluation board

Designator	Description	Quantity	Manufacturer Order Number	Manufacturer
X1, X2, X23, X53, X54, X61_1, X61_2	Test Point, Compact, Surface Mount, Finish- Silver Plate	7	5019	Keystone Electronics Corp.
X46	WR-PHD 2.54 mm Pitch, 5Pins, THT Pin Header	1	61300511121	Wurth Elektronik
X55	WR-COM USB 3.1 Type C Horizontal, 20V Working Voltage and 5A Rated Current	1	632723300011	Wurth Elektronik
D1	3.0A Surface Mount Schottky Barrier Rectifier	1	B340AE-13	Diodes Incorporated
D2	Silicon Switching Diode	1	BAS21E6327HTSA1	Infineon Technologies
Q2	General Purpose Transistors NPN Silicon	1	BC846ALT1G	ON Semiconductor
Q7_1, Q7_2	PNP Silicon AF Transistor	2	BC858C	Infineon Technologies
X4, X7, X9, X11, X12, X13, X15, X16, X18, X20, X28_1, X28_2, X36, X37, X47, X48, X49, X50, X51, X62, X63, X64_1, X64_2, X65_1, X65_2, X66_1, X66_2, X67_1, X67_2, X68_1, X68_2, X69_1, X69_2, X70_1, X70_2, X71_1, X71_2, X72_1, X72_2, X73_1, X73_2, X74_1, X74_2, X75_1, X75_2, X76_1, X76_2, X77_1, X77_2, X78, X79, X80, X81, X82, X83, X84, X85, X86, X87, X88, X89, X90, X91, X92, X93, X94, X95	Jumper, 1x2-Positions, Pitch 2,54mm, Body 5,08x2,54mm, black, Au, with handle	67	SNT-100-BK-G-H	Samtec
U4	Programmable System-on-Chip (PSoC™)	1	CY8C5868LTI-LP039	Cypress Semiconductor
S1, S2, S3	Micro Miniature Pushbutton Switch	3	FSM2JSMA	Tyco Electronics
X52	SMT Micro Header, 1.27mm pitch, 10 pin, Vertical, Double Row, Keying Shroud with Alignment pin, DAP	1	FTSH-105-01-L-DV-K-A-TR	Samtec
X45	Connector Header Surface Mount 12 position 0.050 (1.27mm)	1	FTSH-106-01-L-DV-K	Samtec

(table continues...)

Table 8 (continued) Table 9 BOM MOTIX™ TLE9186 evaluation board

Designator	Description	Quantity	Manufacturer Order Number	Manufacturer
X57, X58	Surface Mount Micro Header, 1.27 mm Pitch, 20 Pin, 10Pins Per Row, Dual Row, Vertical, 3.4A	2	FTSH-110-01-L-DV	Samtec
D11	Chip LED, 573nm, Green, Electronic Equipment Applications	1	LG Q396-PS-35	OSRAM Opto Semiconductors
D4, D5, D12	EXCELED Series Chip LED, Green, 560nm	3	SML-D12P8WT86C	ROHM Semiconductors
X19	Through hole .025 SQ Post Header, 2.54mm pitch, 6 pin, vertical, double row	1	TSW-103-07-L-D	Samtec
X25	Through hole .025 SQ Post Header, 2.54mm pitch, 6 pin, vertical, double row	1	TSW-103-07-L-D	Samtec
X24	Through hole .025 SQ Post Header, 2.54mm pitch, 6 pin, vertical, double row	1	TSW-103-07-L-D	Samtec
X14	SMT .025 SQ Post Header, 2.54mm Pitch, 6 Pins, Vertical, Double Row	1	TSM-103-01-L-DV	Samtec
X6, X8, X17, X21, X32, X33, X35	Through hole .025 SQ Post Header, 2.54mm pitch, 2 pin, vertical, single row	7	HTSW-102-07-G-S	Samtec
X29_1, X29_2, X56	Through hole .025 SQ Post Header, 2.54mm pitch, 3 pin, vertical, single row	3	HTSW-103-07-G-S	Samtec
Q3_1, Q3_2, Q3_3, Q3_4, Q3_5, Q3_6, Q4_1, Q4_2, Q4_3, Q4_4, Q4_5, Q4_6	OptiMOS- 6 Power-Transistor	12	IAUC100N04S6N015	Infineon Technologies
Q5_1, Q5_2, Q5_3, Q6_1, Q6_2, Q6_3	OptiMOS- 6 Power-Transistor	6	IAUC120N04S6N013	Infineon Technologies
U1	Family of Traveo T2G microcontrollers targeted at automotive systems	1	CYT2B95CACQ0AZEGS	Infineon Technologies
Q1	OptiMOS™ - power MOSFET for automotive applications, N-channel - Enhancement mode - Normal Level	1	IAUC120N04S6N006	Infineon Technologies
TP1_1, TP1_2, TP1_3, TP1_4, TP1_5, TP1_6	Test Point THT, Red	6	5000	Keystone Electronics Corp.
D14	Surface Mount Schottky Power Rectifier,0.5A/20V	1	MBR0520LT1G	ON Semiconductor

(table continues...)

Table 8 (continued) Table 9 BOM MOTIX™ TLE9186 evaluation board

Designator	Description	Quantity	Manufacturer Order Number	Manufacturer
X5_1, X5_2, X22_1, X22_2, X39_1, X39_2, X39_3, X39_4, X39_5, X39_6, X40_1, X40_2, X40_3, X40_4, X40_5, X40_6, X42_1, X42_2, X42_3, X43_1, X43_2, X43_3, X59_1, X59_2	SMD Circuit Probe Pad	24	RCT-0C	TE Connectivity
D17_1, D17_2	Standard 0603 SMD LED, 2.1V Red, Luminous Intensity 63 mcd	2	TLMS1100-GS08	Vishay
U3	Bridge SBC Family	1	TLE9563-3QX	Infineon Technologies
X27_1, X27_2	SMT .025 SQ Post Header, 2.54mm pitch, 10 pin, vertical, double row	2	TSM-105-01-L-DV	Samtec
X26_1, X26_2, X30, X31	SMT .025 SQ Post Header, 2.54mm pitch, 18 pin, vertical, double row	4	TSM-109-01-L-DV	Samtec
X44	Through hole .025 SQ Post Header, 2.54mm pitch, 10 pin, vertical, double row	1	TSW-105-07-L-D	Samtec
X10	Through hole .025 SQ Post Header, 2.54mm pitch, 10 pin, vertical, double row	1	TSW-105-08-G-D	Samtec
U2_1, U2_2	Automotive 3-Phase bridge Driver Unit	2	TLE9186QV	Infineon Technologies
D6, D7, D8, D9, D10, D13	Chip LED, 589nm, Yellow, Electronic Equipment Applications	6	LY Q396-P1Q2-36	OSRAM Opto Semiconductors

Glossary

BLDC motor
brushless DC motor (BLDC motor)
A synchronous motor using a direct current electric power supply.

BLDC
brushless direct current (BLDC)

CAN
controller area network (CAN)

CSN
chip select negated (CSN)
A low-active input pin, which enables communication with the specific peripheral.

GPIO
general purpose input output (GPIO)

IC
integrated circuit (IC)
A miniature electronic circuit built on the surface of a thin substrate of a semiconductor material.

LED
light-emitting diode (LED)
A semiconductor circuit that emits light when activated.

PCB
printed circuit board (PCB)
A board that mechanically supports and electrically connects electronic components using conductive tracks, pads, and other features etched from copper sheets laminated onto a non-conductive substrate.

PWM
pulse-width modulation (PWM)
A technique to encode an analog value into the duty cycle of a pulsing signal with arbitrary amplitude.

SWD
serial wire debug (SWD)
A communication interface and protocol used for debugging and programming embedded systems, particularly microcontrollers and other integrated circuits.

USB
universal serial bus (USB)
An industry standard that defines cables, connectors, and communication protocols used in a bus for connection, communication, and power supply between computers and electronic devices.

VBAT
battery voltage supply (VBAT)

VS

voltage supply (VS)

Revision history

Document version	Date of release	Description of changes
Rev. 1.00	2025-03-21	• Initial document release

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