STEVAL-L99MH98 evaluation board

Introduction

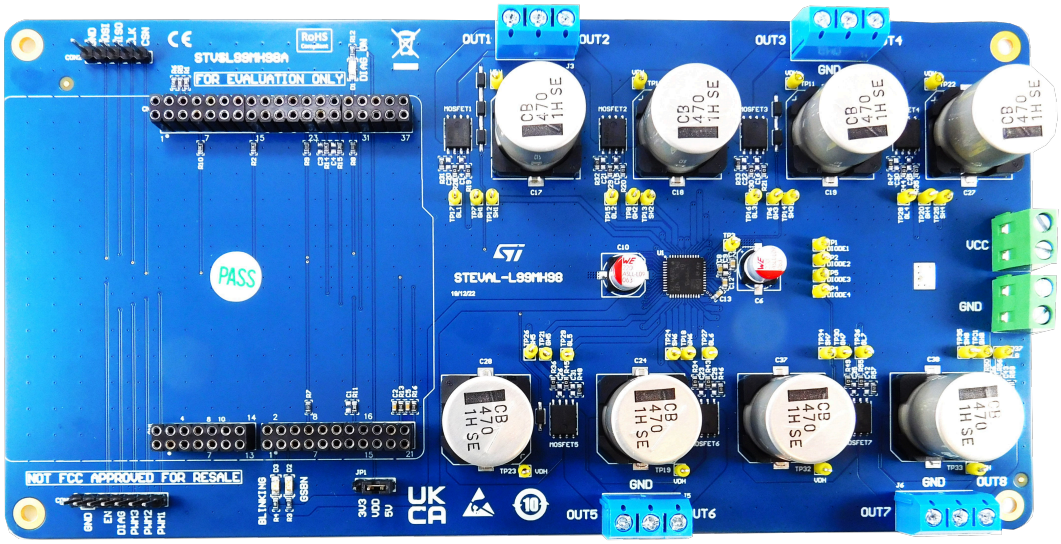
The STEVAL-L99MH98 is a low-cost application board designed to evaluate L99MH98, a smart power device designed by STMicroelectronics inVFQFN48L package with exposed pad.

L99MH98 is an integrated octal half-bridge pre-driver dedicated to control up to sixteen N-channel MOSFETs. It is intended for DC motor control applications such as automotive power seat control or other applications. A 24-bit serial peripheral interface (SPI) is used for configuring and controlling the eight half-bridges or four H-bridge. SPI status registers provide high-level diagnostic information such as supply voltage monitoring, the charge pump voltage monitoring, temperature warning and overtemperature shutdown. Each gate driver monitors independently its external MOSFET drain-source voltage for fault conditions. The L99MH98 supports indirect current measurement on external MOSFETs, allowing cost saving and lower system complexity, avoiding the usage of shunt resistors. A more efficient gate current control of the external MOSFETs, called “three stages gate current”, decreases and optimizes electromagnetic interference (EMI). Protection features (drain-source monitoring for short circuit detection, overtemperature warning and shutdown,

timeout watchdog for MCU control, detailed off-state diagnostic via SPI) ensure the ASIL-B achievement according to ISO 26262 standard.

Thanks to the expansion connectors, STEVAL-L99MH98 allows the complete control of L99MH98 communication interface (SPI) and parallel input/output. The evaluation board can be also controlled using a Graphical User Interface.

Figure 1. STEVAL-L99MH98 board



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1 Hardware description

The STEVAL-L99MH98 is intended as low-cost application board to evaluate all the functionalities of L99MH98. An optimized BOM has been analysed:

- All components are automotive grade (AEC-Q100)
- Dimensioning has been made considering the real application range and cost

STEVAL-L99MH98 power supply:

- **VDH:** 6V - 28 V, 60 mA at least, provided by external supply
- **VDD:** 3V - 5.5 V, 10 mA at least, provided by uC or external supply

STEVAL-L99MH98 consumption:

- Board output current: 10-15 A typically, 30 - 40 A max output current
- Board single channel output: 10 A typically

STEVAL-L99MH98 features:

- Octal half-bridge or quad H-bridge, pre-driver
- Independent channel driver up to 8 high-side or 8 low-side
- Driving logic permits any H-bridge configuration, pairing different half-bridges, using the internal gate drivers (GHx/SHx/GLx can be associated to any GHy/SHy/GLy)
- Support logic level and standard level MOSFETs
- Control of reverse battery protection MOSFET
- Fully configurable half-bridge driver in case of fault occurrence
- Generator mode for power trunk/tailgate applications
- Supporting indirect current measurement of external MOSFETs
- SPI configurable overvoltage threshold
- Adaptive MOSFET gate control
- Three steps gate control of external HS/LS
- Improved electromagnetic emission
- Programmable gate current up to 120 mA
- Reduced switching losses in PWM mode
- Vds monitoring
- High-side and low-side capable of protection and diagnosis
- Four external diodes control, needed for assisting calibration of indirect current measurement, can be used for steady - temperature monitoring
- Drain-source monitoring for short circuit detection
- Overtemperature warning and shutdown
- Timeout watchdog for MCU control
- Detailed off-state diagnostic (open load, short circuit to battery or short circuit to GND) via SPI
- Three PWM inputs
- High-side and low-side PWM capable
- Active free-wheeling
- Up to 50 kHz PWM frequency
- Out-of-frame serial peripheral interface (SPI), 24 bits
- 200x100 mm 4 layers PCB

2 STEVAL-L99MH98 board description

L99MH98 must be driven from a microcontroller to work correctly, so three connectors (CN1, CN7 and CN10) have been integrated on the STEVAL-L99MH988 board to plug an EV-SPC582B-DIS v1.0 Chorus application board (see Figure 1). Other two connectors, CON1 and CON2, have been inserted to foresee the possibility to connect ext PWMs (CON1) or ext SPI (CON2).

A dedicated GUI (Graphical User Interface) must be used to control STEVAL-L99MH98 + EV-SPC582B-DIS v1.0 Chorus application boards.

Figure 2. STEVAL-L99MH98 top view: main connectors

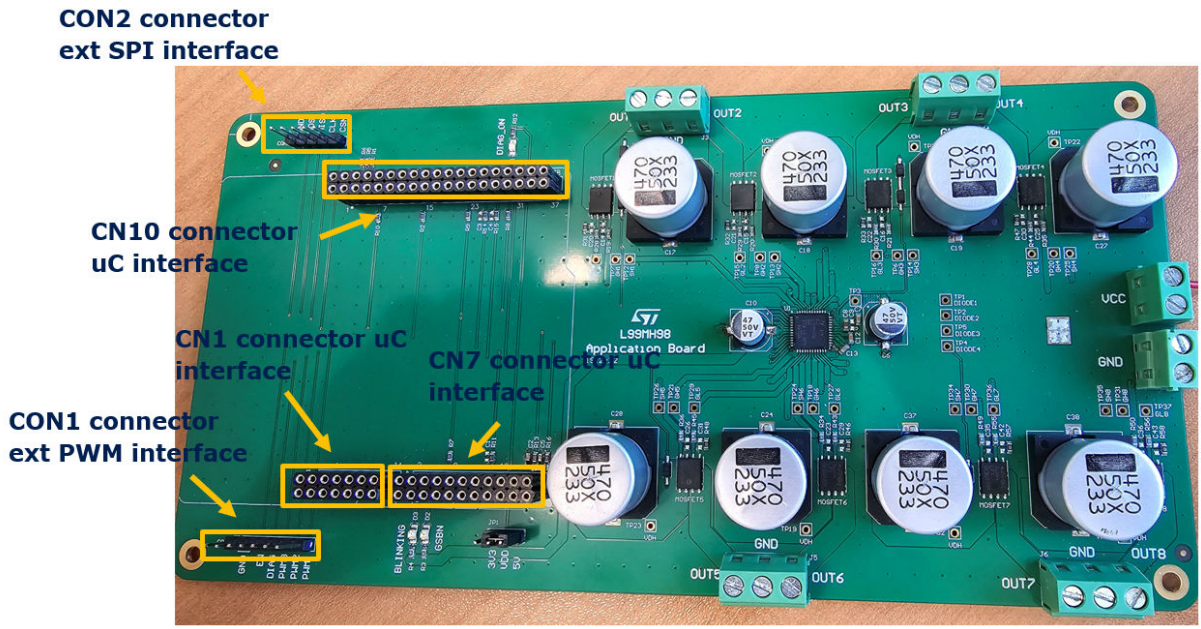
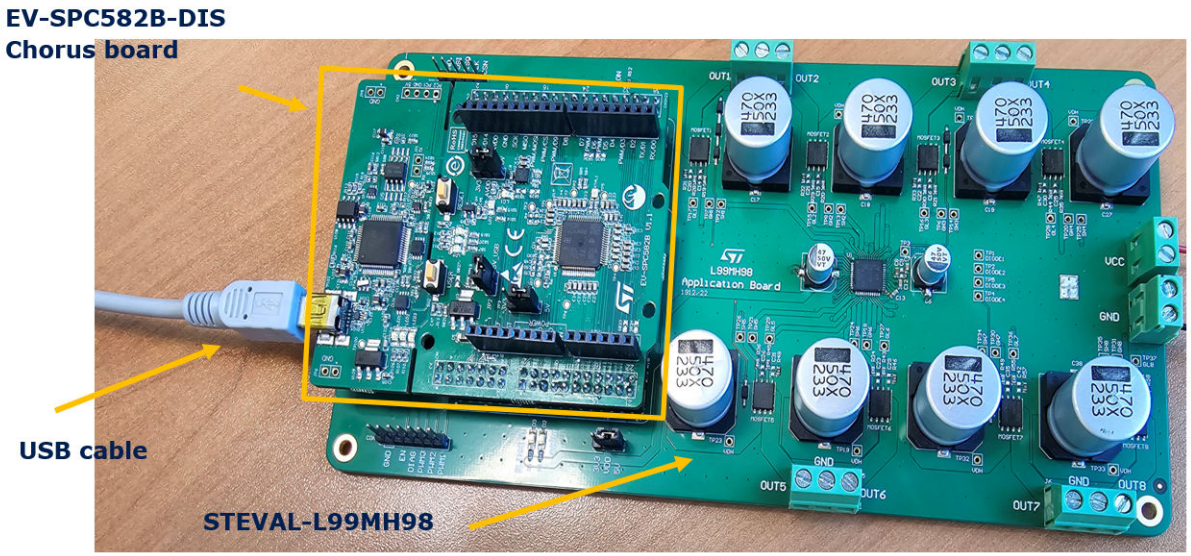


Figure 3. PC connected through USB cable that connects app kit

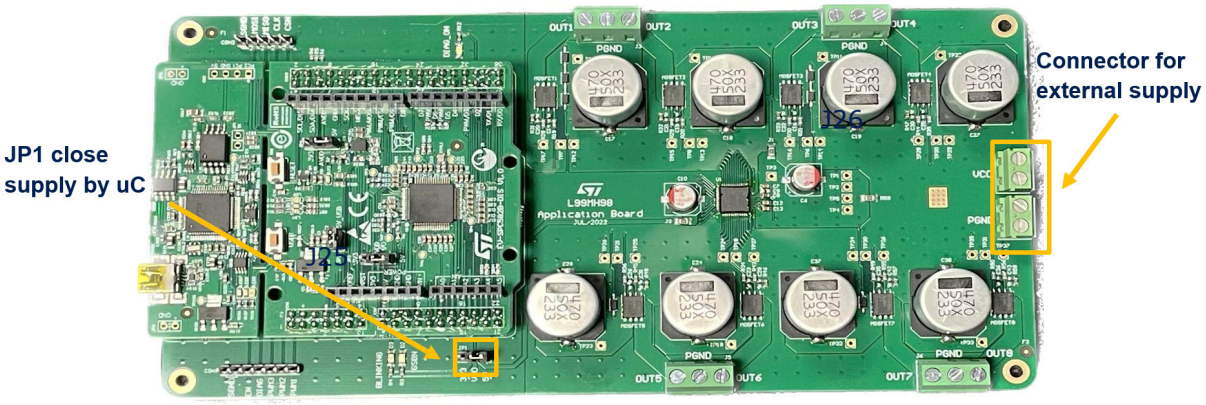


2.1 Boards Power supply

The following power supply must be guaranteed to the STEVAL-L99MH98 to make the hardware works correctly:

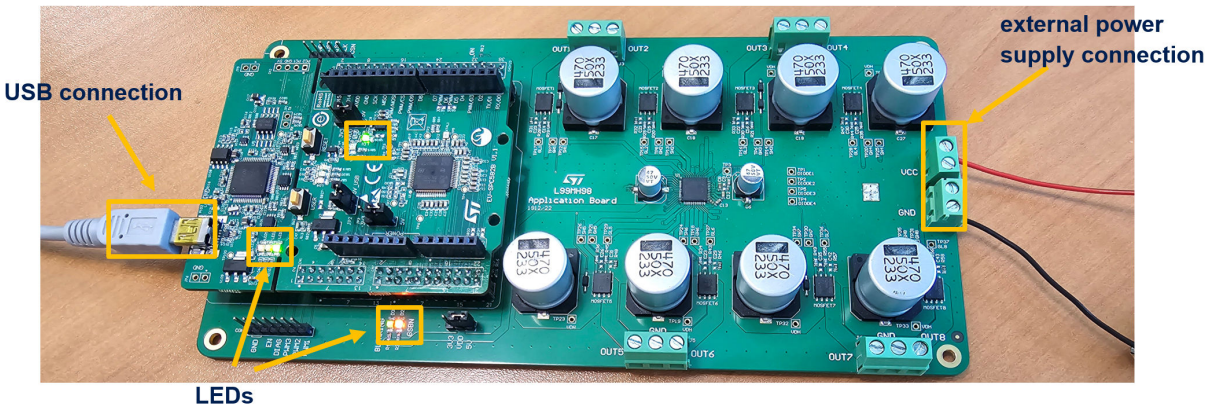
- **VCC** external supply voltage (battery voltage 6-28 V);
- **VDD** supply voltage 5 V/3.3 V by the microcontroller (by closing JP1 on 5 V or 3.3 V) as shown in Figure 4 it depends if it is required to operate 5 V/3.3 V
- **EV-SPC582B-DIS** board via USB

Figure 4. Jumpers configuration and supply voltages



The EV-SPC582B-DIS board must be connected to the USB-port of the Windows PC/Laptop by means of the USB Type-A to type-B cable. When the USB is connected some LEDs brink both in the EV-SPC582B-DIS and on STEVAL-L99MH98.

Figure 5. LEDs that light up after USB connection and external power supply



2.2 Connectors

Table 1. **STEVAL-L99MH98 board connectors**

Name	Description	Type
CN10	Expansion connector: Pin 4: VDH Pin 6: CSN Pin 9, 10, 20, 32: GND Pin 14: EN Pin 24: MOSI Pin 25: PWM1 Pin 27: PWM3 Pin 29: MISO Pin 30: DIAGN All the other pins are not connected	19 x 2 Header
CN7	Expansion connector: Pin 1: LED-GREEN Pin 3: LED-RED Pin 5: CLK Pin 6, 11: GND Pin 14: PWM2 Pin 15: VDD 3V3 Pin 17: VDD 5V Pin 19: CSO1 Pin 21: CSO2 All the other pins are not connected	11 x 2 Header
CON1	Expansion connector: Pin 1, 2: GND Pin 3: EN Pin 4: DIAGN Pin 5, 6, 7: PWM1, 2, 3 Pin 8: Not connected	8 P single row terminal
CON2	Expansion connector: Pin 1: GND Pin 2: MOSI Pin 3: MISO Pin 4: CLK Pin 5: CSN	5 P single row terminal
CON3	Power supply connector: Pin 1, 2: VDH	2 x Screw connector
CON4	Power supply connector: Pin 1, 2: GND	2 x Screw connector
J3	Pin 1: MOSFET1 Output Pin 2: PGND Pin 3: MOSFET2 Output	3 x Screw connector

Name	Description	Type
J4	Pin 1: MOSFET3 Output Pin 2: PGND Pin 3: MOSFET4 Output	3 x Screw connector
J5	Pin 1: MOSFET5 Output Pin 2: PGND Pin 3: MOSFET6 Output	3 x Screw connector
J6	Pin 1: MOSFET7 Output Pin 2: PGND Pin 3: MOSFET8 Output	3 x Screw connector

3 Getting started

3.1 Minimum setup

To operate the STEVAL-L99MH98 + EV-SPC582B-DIS the following tools are necessary:

- Power supply 6 V - 28 V, current capability more than 10 A
- Loads: DC motor 2 A, 20 kHz, Duty: 50%
- STEVAL-L99MH98 GUI

3.2 STEVAL-L99MH98 operation mode

Start-up phase:

1. **Reset state**: EN pin low (controlled by microcontroller)
2. **Active state**: as soon as the microcontroller drives the EN pin high and VDD is above VDDPOR_OFF the board will be out of the reset mode. In this case the registers will be set with their default values. After the board goes out of the reset phase the power-up state and charge pump enabling state start just before to reach the active state.

For further details of how to program register of the L99MH98 please refer to DS14611 and L99MH98_GUI user manual.

4 PCB layout

Figure 6. **Assembly top**

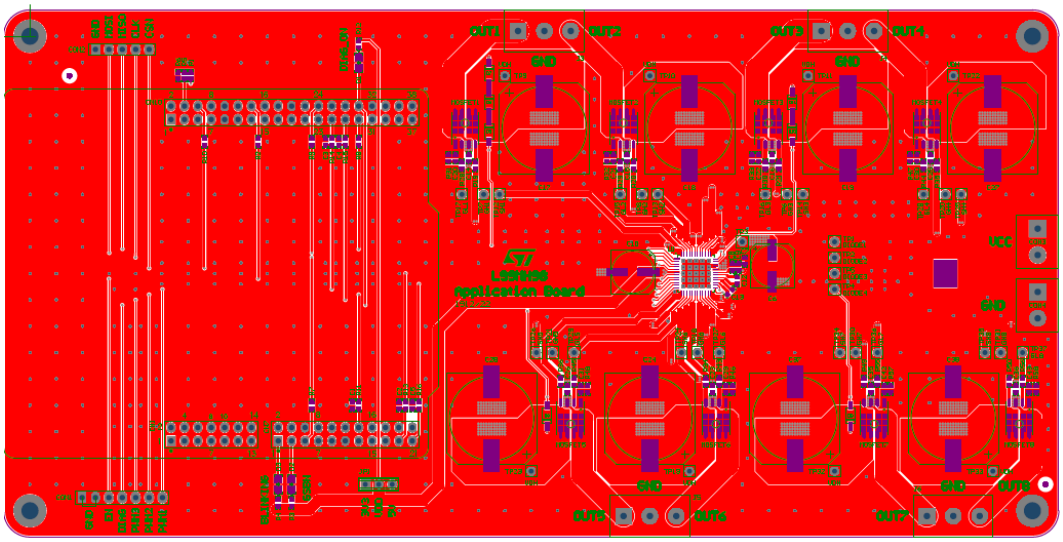


Figure 7. **Assembly bottom**

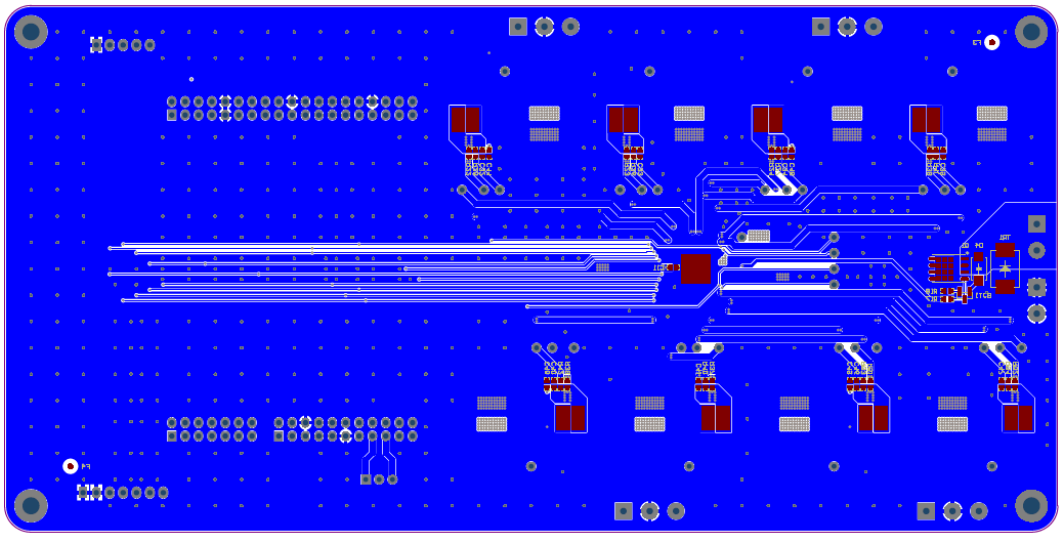


Figure 8. **Inner 1**

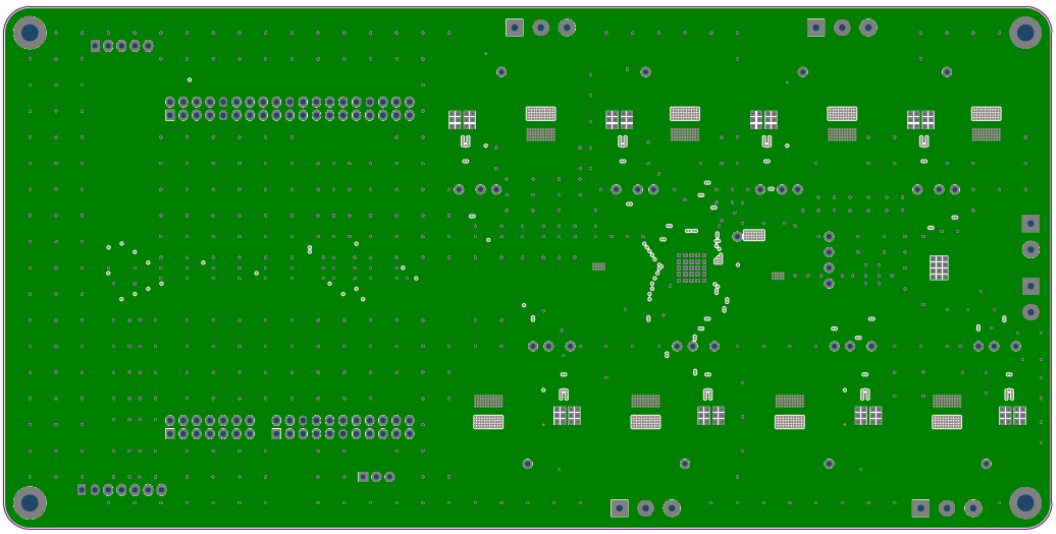
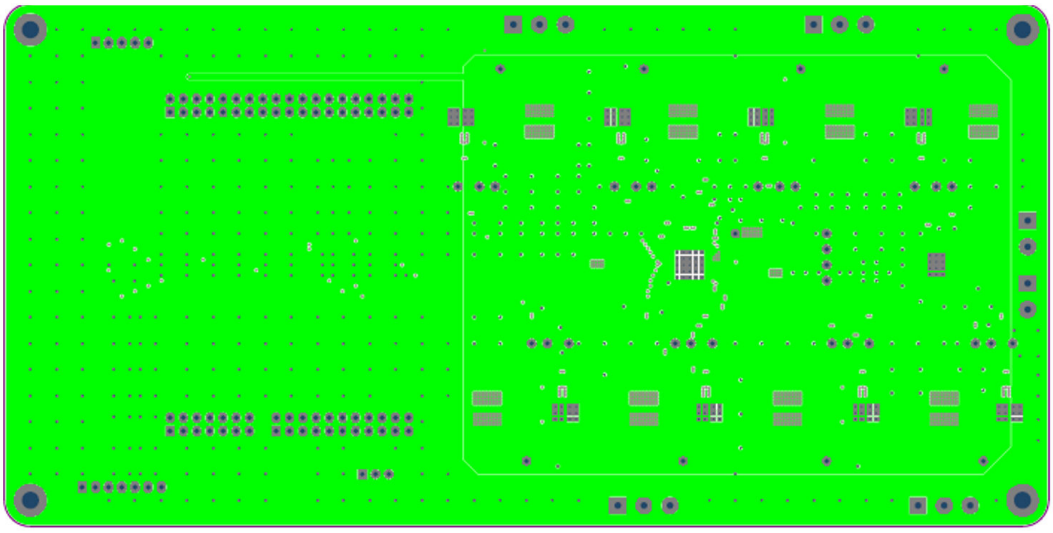


Figure 9. **Inner 2**



5 Schematic diagrams

Figure 10. **STEVAL-L99MH98 schematic diagram - [1 of 3]**

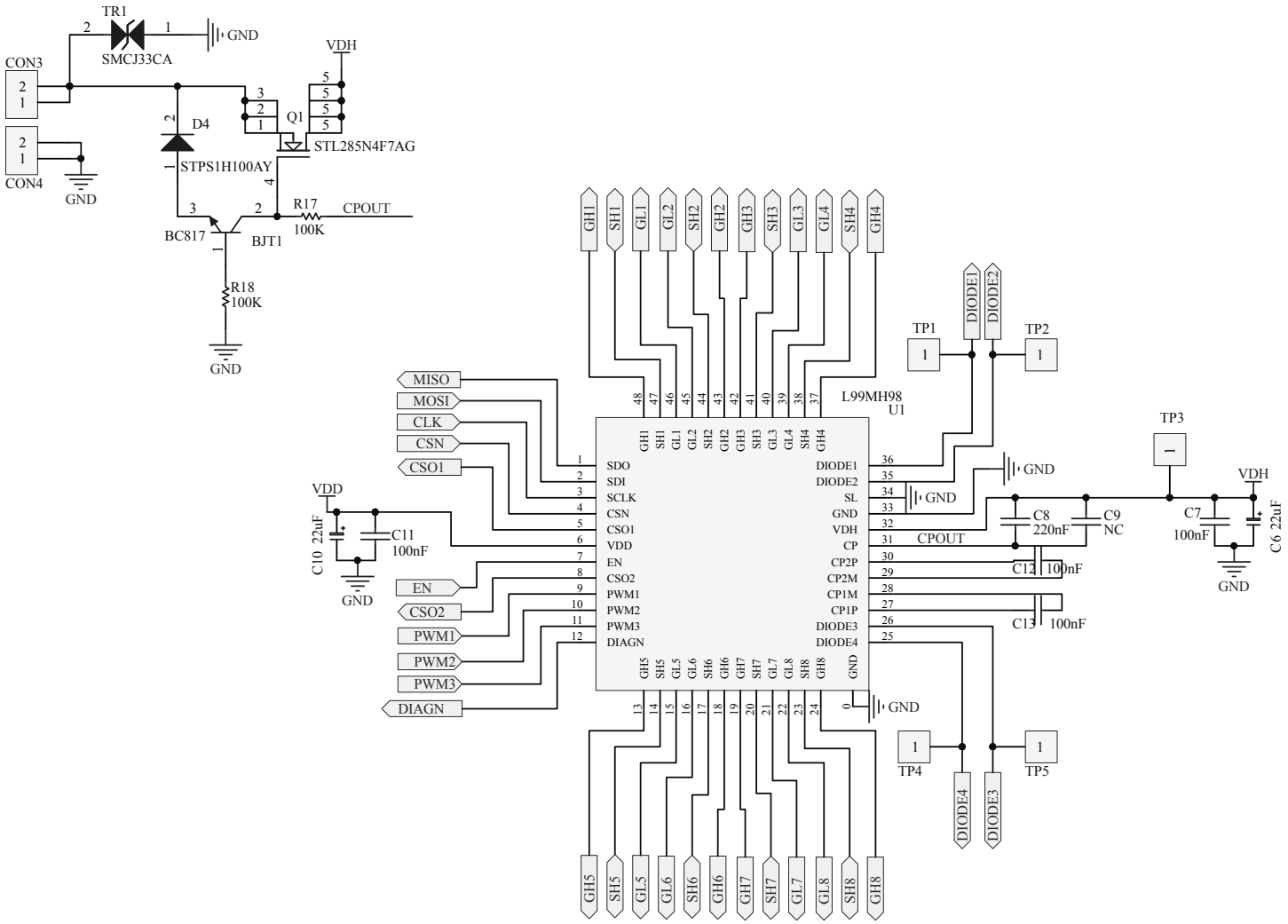


Figure 11. STEVAL-L99MH98 schematic diagram - [2 of 3]

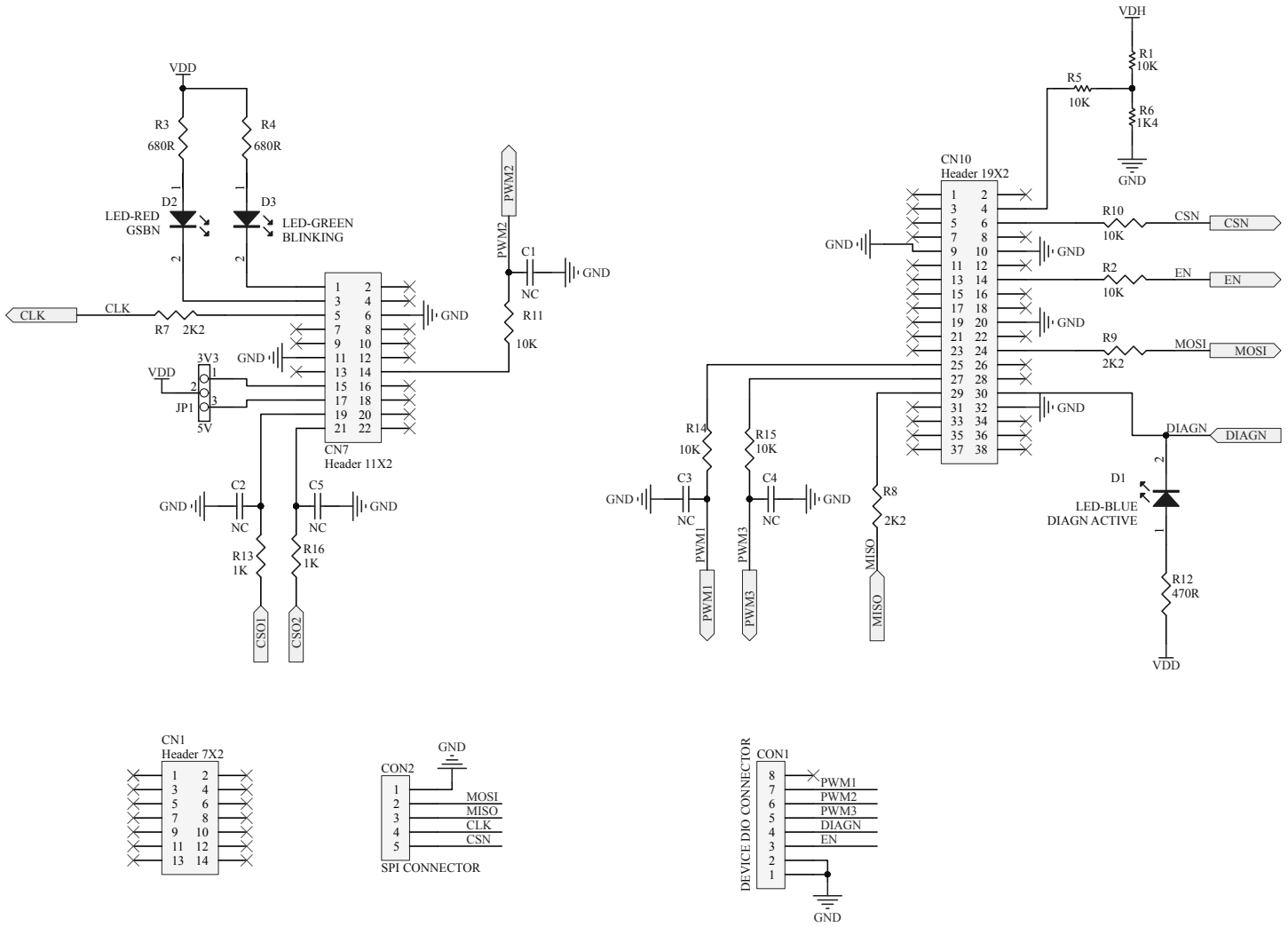
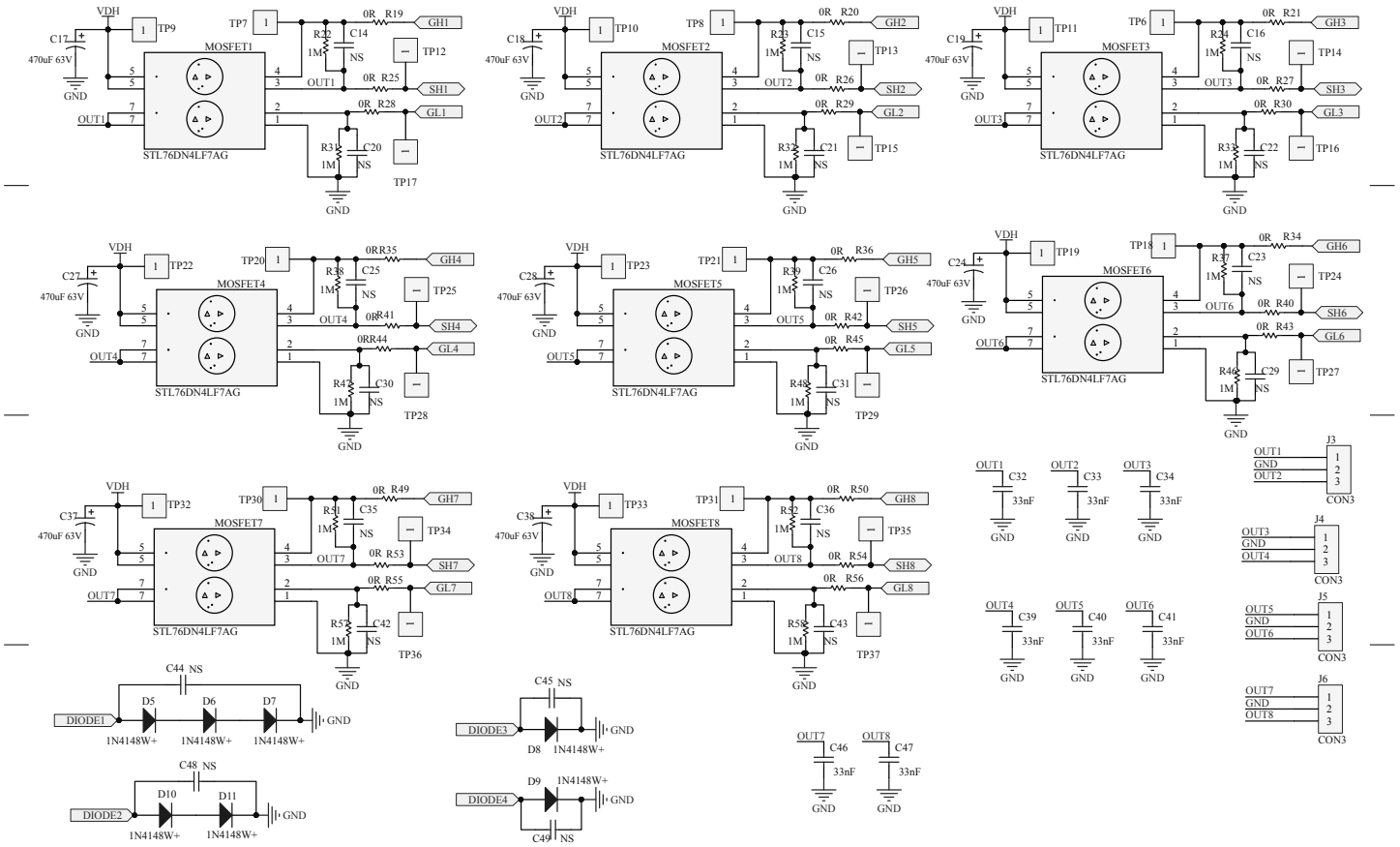


Figure 12. STEVAL-L99MH98 schematic diagram - [3 of 3]



6 Bill of materials

Table 2. **STEVAL-L99MH98 bill of materials**

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	1	BJT1	BC817	NPN Bipolar Transistor	Onsemi	BC817-16LT1G
2	4	C1, C3, C4, C9	NC	Not Connected		
3	2	C2, C5	1nF	CSO filtering	Samsung	CL10B102KB8WPNC
4	2	C6, C10	22uF	Capacitor	Wurth Elektronik	865060745003
5	4	C7, C11, C12, C13	100nF	Capacitor	Samsung	CL10B104KB8WPNC
6	1	C8	220nF	Capacitor	Murata	GRM188R71H224KAC4D
7	20	C14, C15, C16, C20, C21, C22, C23, C25, C26, C29, C30, C31, C35, C36, C42, C43, C44, C45, C48, C49	NC	Capacitor		
8	8	C32, C33, C34, C39, C40, C41, C46, C47	33nF	Capacitor (Semiconductor SIM Model)	Multicomp PRO	MC0603B333K500CT
9	8	C17, C18, C19, C24, C27, C28, C37, C38	470uF	Polarized Capacitor (Surface Mount)	Multicomp PRO	MCVFZ050M471JB7L
10	1	CN1	Header 7X2	Header, 7-Pin, Dual row	Preci-Dip	803-87-014-10-001101
11	2	CON3, CON4	CON2	Connector	Wurth Elektronik	691213510002
12	1	CN7	Header 11X2	Header, 11-Pin, Dual row	Preci-Dip	803-87-022-10-001101
13	1	CN10	Header 19X2	Header, 19-Pin, Dual row	Preci-Dip	803-87-038-10-001101
14	1	CON1	Header 8X1	Header, 8-Pin, Single row	Molex	22-28-4082
15	1	CON2	Header 5X1	Header, 5-Pin, Single row	Molex	22-28-4051
16	1	D1	LED-BLUE		Dialight	5988191107F
17	1	D2	LED-RED		Dialight	5988130107F
18	1	D3	LED-GREEN		Lumex	SML-LX0805SGC-TR.
19	1	D4	STPS1H100AY, SMA	Default Diode	ST	STPS1H100AY
20	7	D5, D6, D7, D8, D9, D10, D11	1N4148W+	Default Diode	Vishay	1N4148W+
21	4	J3, J4, J5, J6	CON3	Connector	Camdenboss	CTBP0500/3
22	7	R1, R2, R5, R10, R11, R14, R15	10K		TE connectivity	1622829-2
23	1	R6	1K4		Vishay	CRCW06031K40FKEA
24	2	R3, R4	680R	Resistor	Multicomp PRO	MCWR06X6800FTL
25	3	R7, R8, R9	2K2		Walsin	WF06P2201FTL

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
26	2	R13, R16	1K		TE connectivity	CRG0603F1K0
27	1	R12	470R	Resistor	TE connectivity	CRGH0603J470R
28	2	R17, R18	100K	Resistor	TE connectivity	1622827-1
29	24	R19, R20, R21, R25, R26, R27, R28, R29, R30, R34, R35, R36, R40, R41, R42, R43, R44, R45, R49, R50, R53, R54, R55, R56	0R	Resistor	Vishay	WSL251200000ZEA9
30	16	R22, R23, R24, R31, R32, R33, R37, R38, R39, R46, R47, R48, R51, R52, R57, R58	1M	Resistor	TE connectivity	CRGH0603J1M0
31	37	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP35, TP36, TP37	CON1	Connector	Vero	20-313143
32	1	TR1	SMCJ33CA		Littelfuse	SMCJ33CA
33	1	Q1	STL285N4F7AG, PowerFLAT 5x6 WF	Reverse battery mosfet	ST	STL285N4F7AG
34	1	JP1	Header 3x1	JUMPER 3CH	Molex	22-28-4031
35	8	Mosfet1, Mosfet2, Mosfet3, Mosfet4, Mosfet5, Mosfet6, Mosfet7, Mosfet8	STL76DN4LF7AG, PowerFLAT 5x6 double island WF		ST	STL76DN4LF7AG
36	1	Pre Driver	L99MH98, VFQFN 7X7X0.9 48L WETT. FLANKS	Octal Half-bridge Pre Driver	ST	L99MH98-TR

7 Board versions

Table 3. **STEVAL-L99MH98 versions**

Finished good	Schematic diagrams	Bill of materials
STV$L99MH98A (1)	STV$L99MH98A schematic diagrams	STV$L99MH98A bill of materials

1. *This code identifies the STEVAL-L99MH98 evaluation board first version.*

8 Regulatory compliance information

Notice for US Federal Communication Commission (FCC)

For evaluation only; not FCC approved for resale

FCC NOTICE - This kit is designed to allow:

(1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine

whether to incorporate such items in a finished product and

(2) Software developers to write software applications for use with the end product.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter 3.1.2.

Notice for Innovation, Science and Economic Development Canada (ISED)

For evaluation purposes only. This kit generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to Industry Canada (IC) rules.

À des fins d'évaluation uniquement. Ce kit génère, utilise et peut émettre de l'énergie radiofréquence et n'a pas été testé pour sa conformité aux limites des appareils informatiques conformément aux règles d'Industrie Canada (IC).

Notice for the European Union

This device is in conformity with the essential requirements of the Directive 2014/30/EU (EMC) and of the Directive 2011/65/EU (RoHS II), including subsequent revisions and additions, as well as amended by the Delegated Directive 2015/863/EU (RoHS III).

Notice for the United Kingdom

This device is in compliance with the UK Electromagnetic Compatibility Regulations 2016 (UK S.I. 2016 No. 1091) and with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (UK S.I. 2012 No. 3032).

Appendix A Reference documents

Table 4. **Reference documents**

Doc Name	ID	Title
DSL99MH98		Octal half-bridge pre-driver
L99MH98_GUI user manual		

Revision history

Table 5. **Document revision history**

Date	Revision	Changes
03-Dec-2024	1	Initial release.
18-Nov-2025	2	Updated Section 5: Schematic diagrams.

Contents

List of tables

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