

## Gate Drivers Base Board - Evaluation Board User's Manual

### Description

SECO-GDBB-EVB is a baseboard conceived for use as a plug and play environment for testing various types of gate drivers. The main goal is to feed the drivers with the same control signal under same conditions and compare their capabilities.

It is set up to accommodate up to six driver boards (daughter boards) designed to test gate drivers functions and features (all driver boards are pin compatible with baseboard).

User can choose to place capacitor or power device as a load to the driver. Power devices are soldered to the board or connected to the board using screw terminals (TO-247 packages).

PWM signal is generated on board and is activated supplying voltage to the board. Onboard PWM is adjustable and user can define frequency in range of 10–200 kHz and duty cycle 0–100%. For fine-tuning and wider frequency range, it is possible to connect signal generator with BNC connector.

Nominal supply voltage is 15 V. Three isolated DC/DC converters provide supply for driver boards. Additional power connector is available to supply power devices, which are protected with 10 k $\Omega$  resistors. Board is not designed for power testing.

### Features

- Plug and Play
- Adjustable Onboard PWM (Frequency and Duty Cycle)
- External PWM Generator
- 3 Isolated DC/DC Power Supplies for Driver Boards
- Gate Current and Gate Voltage Measurement
- Supply Voltage Range 15 V  $\pm$ 1 V

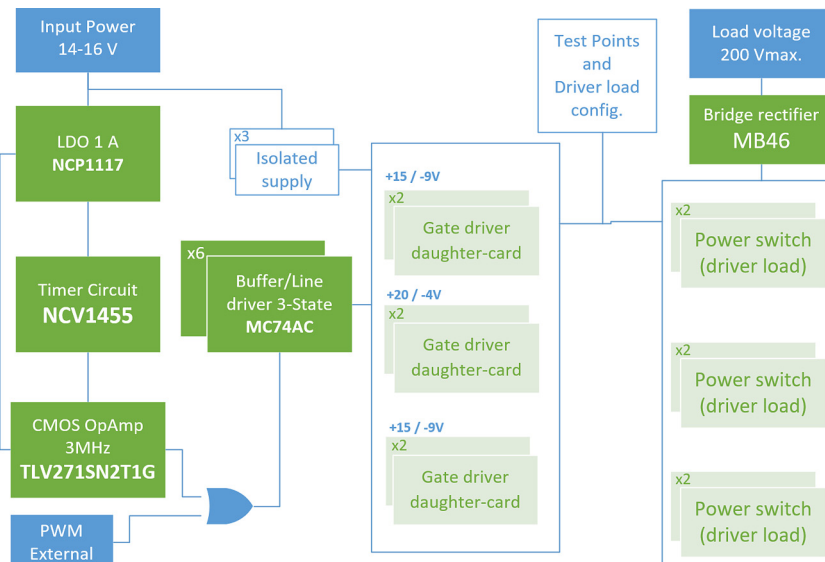


Figure 2. Block Diagram



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## EVAL BOARD USER'S MANUAL

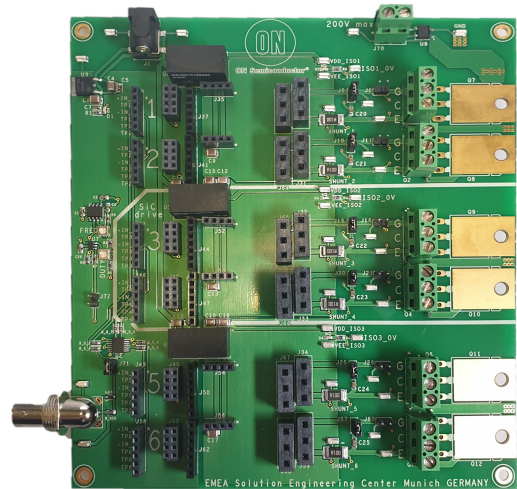


Figure 1. Evaluation Board Photo

## User Interface Locations

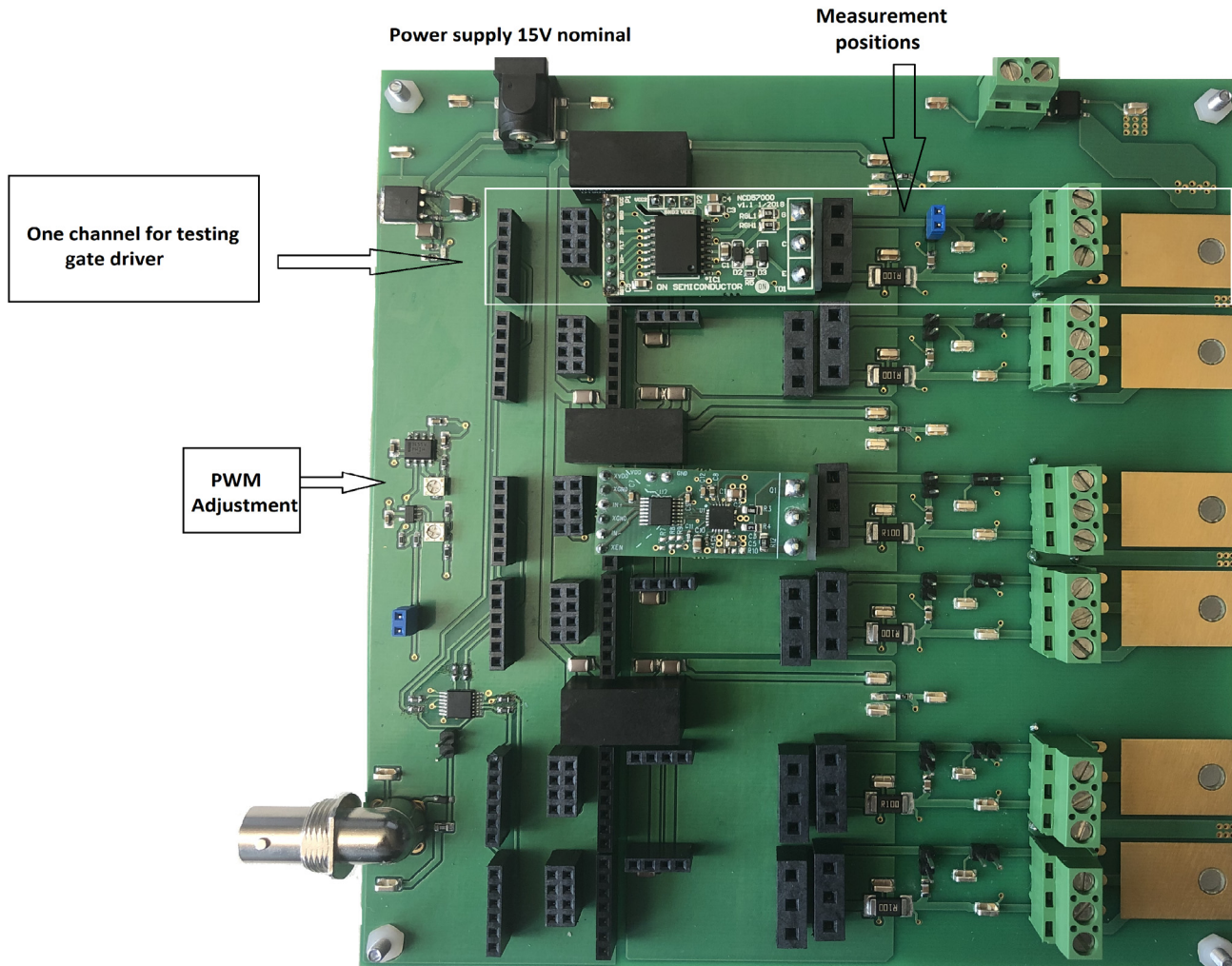


Figure 3. Board and Notable Segments

### Voltage Supply

Once user has daughter boards with drivers to test, he should mount them into specified connectors.

NOTE: *Customer should take care on voltage supply for driver boards. Two middle positions on baseboard have supply of +20/-4 V, intended for SiC drivers. Other channels are supplied with +15/-9 V. Each channel provides also unipolar supply.*

After applying supply voltage to the board, all DC/DC converters will supply driver boards. (Figure 4.)

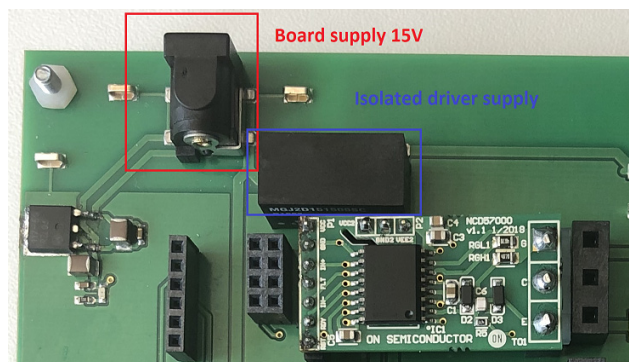


Figure 4.

## PWM Generator

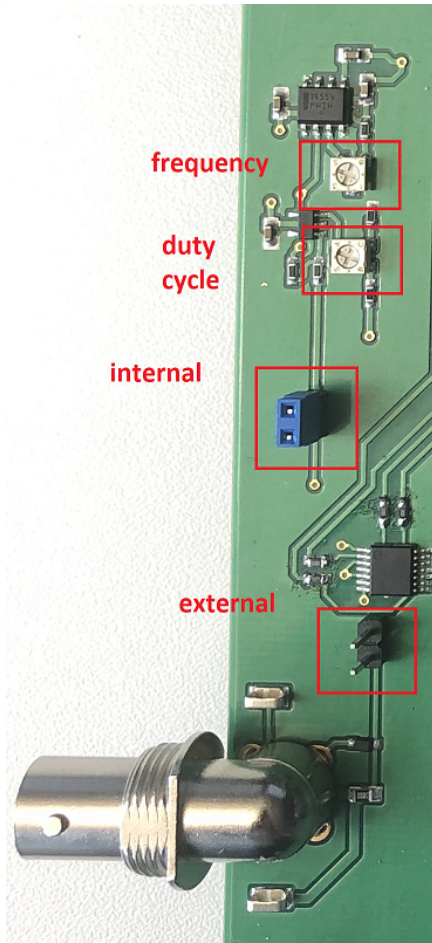


Figure 5. PWM Generator

Use potentiometers (Figure 5) to adjust frequency in range from 10–200 kHz and duty cycle from 0–100%. (Figure 6 and Figure 7).

First set up frequency and then duty cycle. Duty cycle sensitivity is decreasing with higher frequency.

Use jumpers in order to choose internal PWM generator or external one using BNC connector (Figure 5).

Internal PWM generator is activated immediately by applying voltage supply. Jumper should be placed once frequency and duty cycle are set up appropriately (in accordance to the limits of gate drivers in order to avoid possible damages).

Only one jumper shall be used for external or internal PWM generator. It is not advisable to connect external generator while internal one is not disconnected.

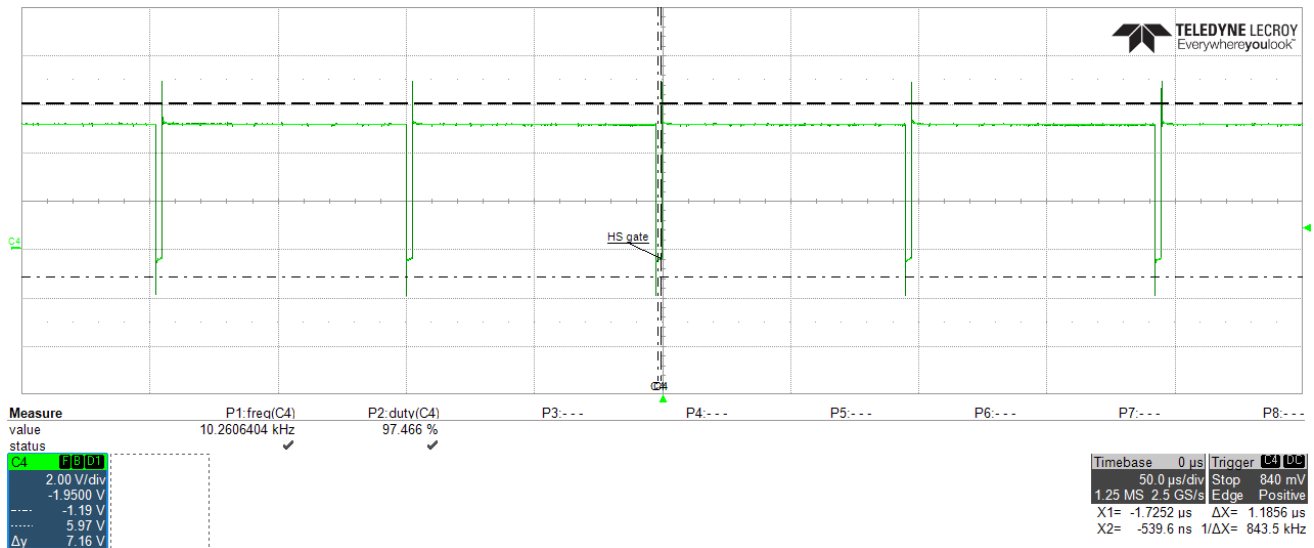


Figure 6. Minimum Frequency (On Board PWM Generator)



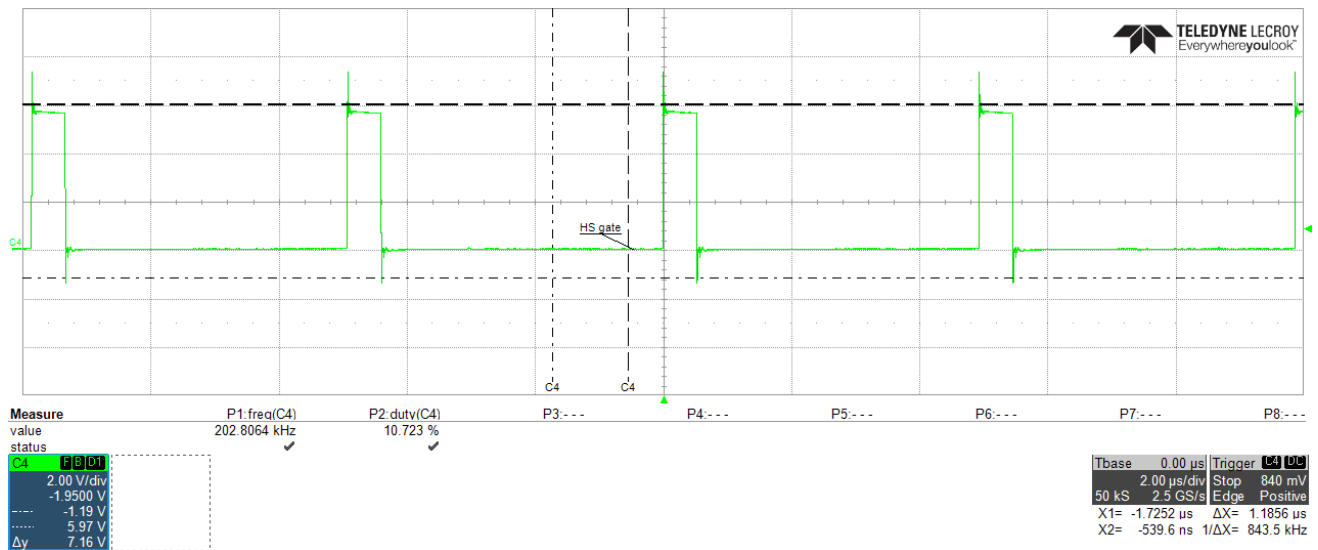


Figure 7. Maximum Frequency (On Board PWM Generator)

### Capacitive Load or Power Device

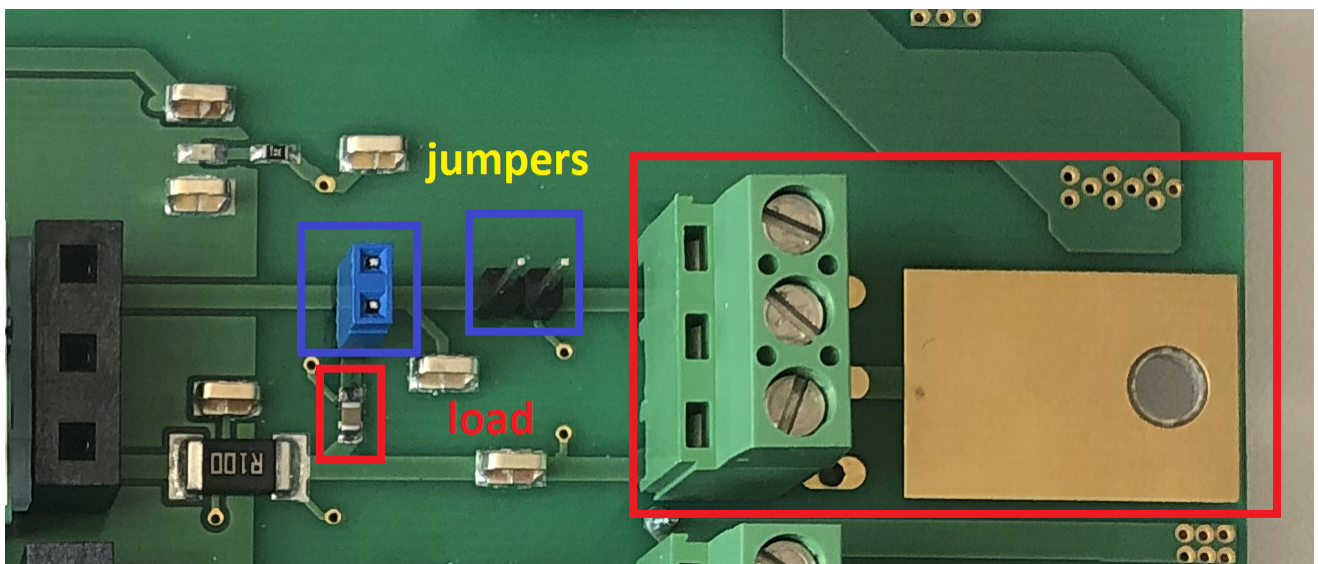


Figure 8. Driver Load (Capacitor or Power Device, Marked Red), Jumpers to Choose Load (Marked Blue)

User can choose capacitor or real power device as a load for gate driver. With jumpers user can select which one to use (Figure 8.)

If gate driver board with driver that supports de-saturation detection is in use and user chooses to use capacitor as a load, then collector/drain must be shorted

with emitter/source. Reason for that is when using capacitor as a load, driver is sensing collector/drain signal, which will be high and driver can recognize that as de-saturation and stop switching. Some drivers than need to reset in order to start switching again.

## Gate Voltage and Gate Current Measurement

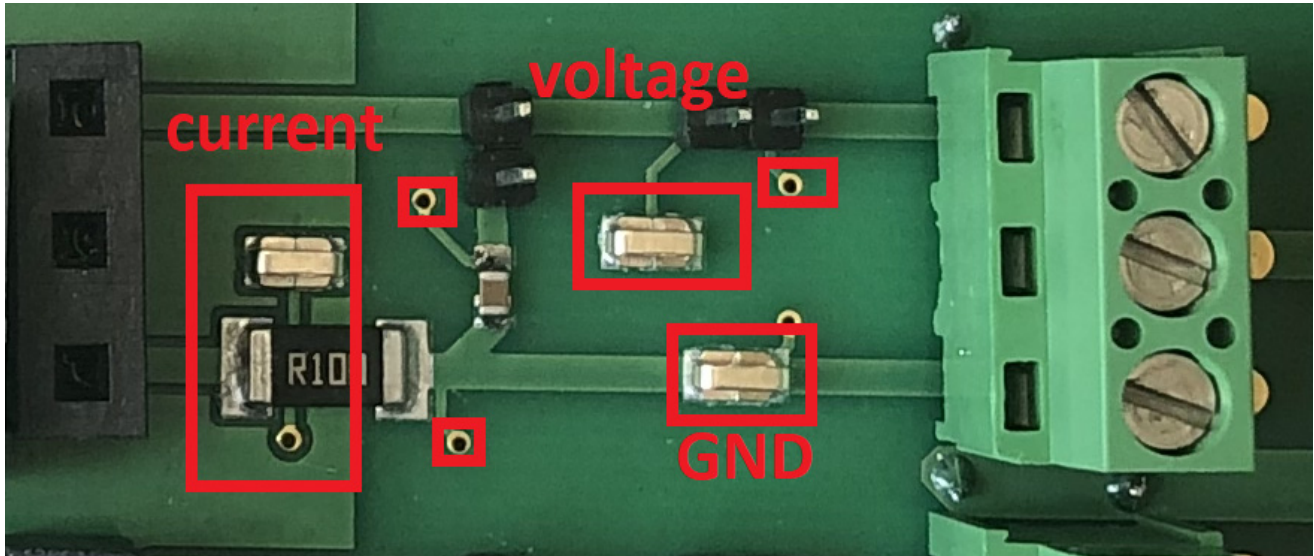


Figure 9. Measuring Positions

To measure gate current user can measure voltage drop across 100 mΩ shunt. It is recommended to use via connections and short measuring loops, but connectors are also provided. Gate voltage can be measured on capacitor

and/or power device, using connector or via connections. Figure 9 shows measuring positions and Figure 10 shows measuring result.

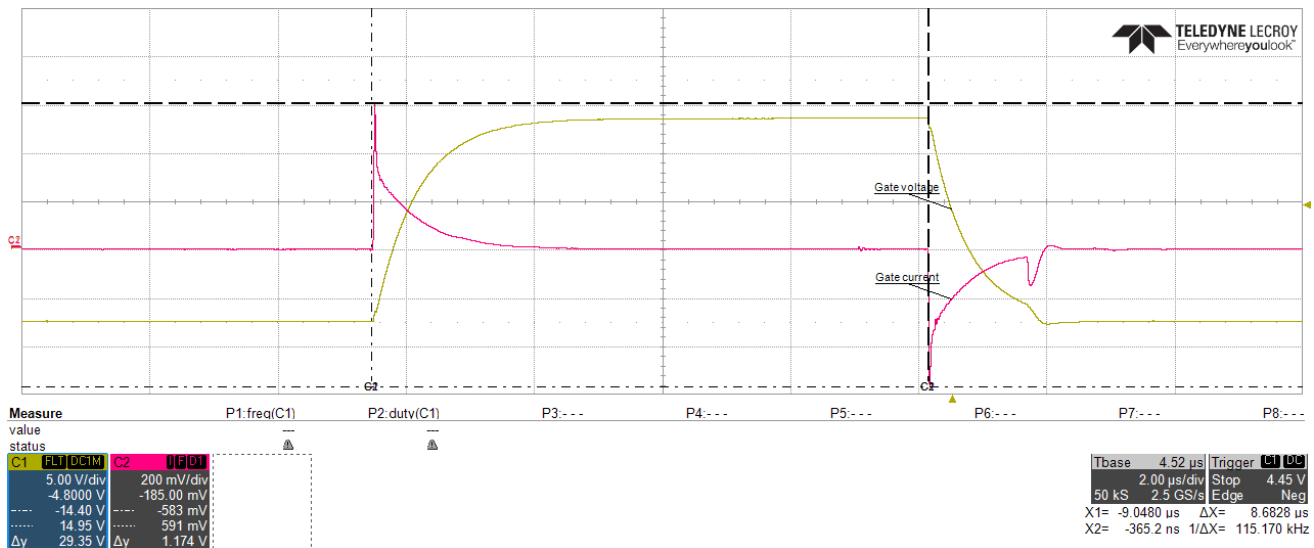


Figure 10. Gate Current and Voltage Measurements (Used Driver Board NCD57000)

## Miller Effect

In order to evaluate driver's performance with Miller effect, it is necessary to load driver with real power device and supply it with external voltage. Since this board is not

designed for power testing, user will not be able to apply high load currents and create high dv/dt (to increase Miller effect dominance).



SCHEMATICS (Continued)

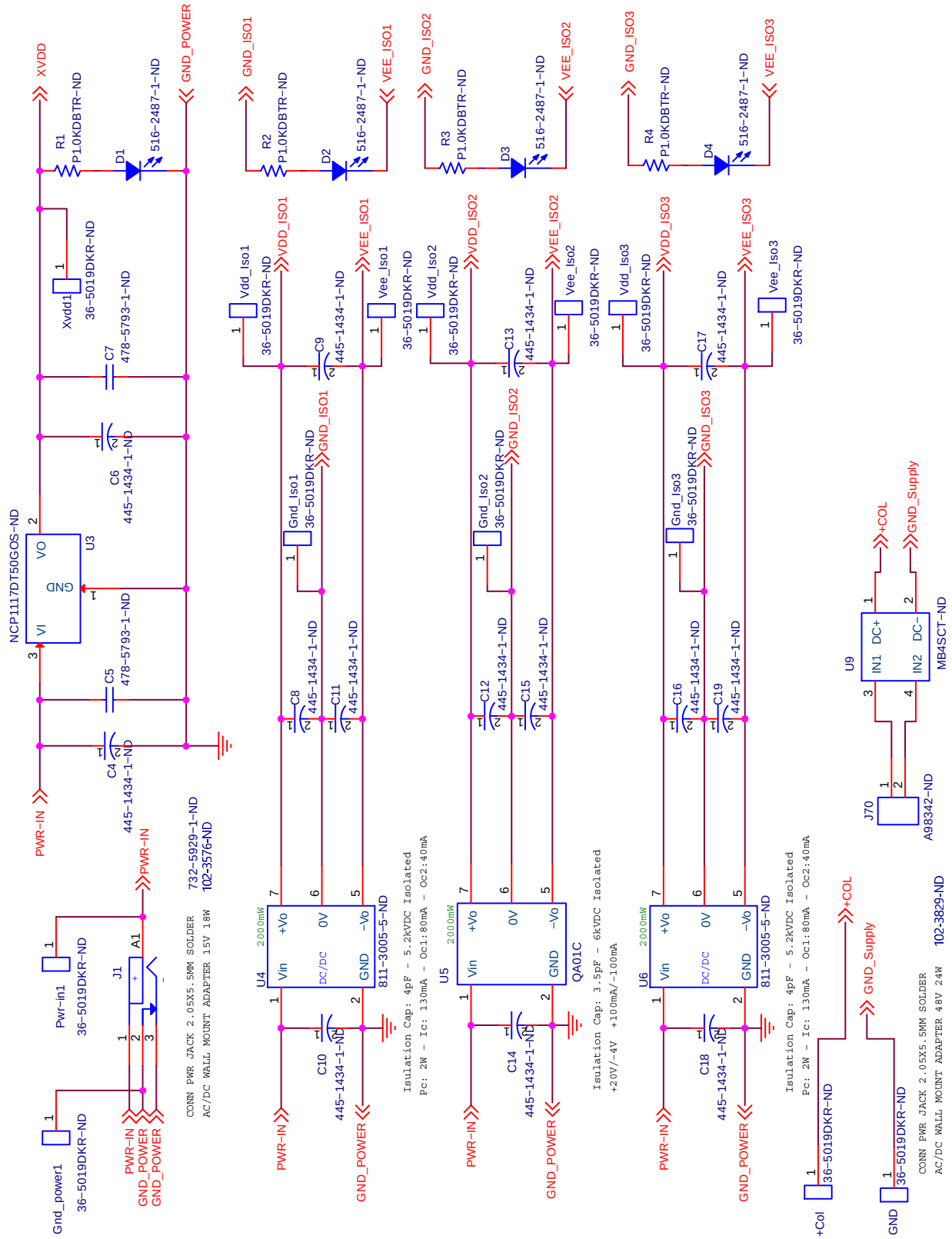


Figure 12. PWM Supply

SCHEMATICS (Continued)

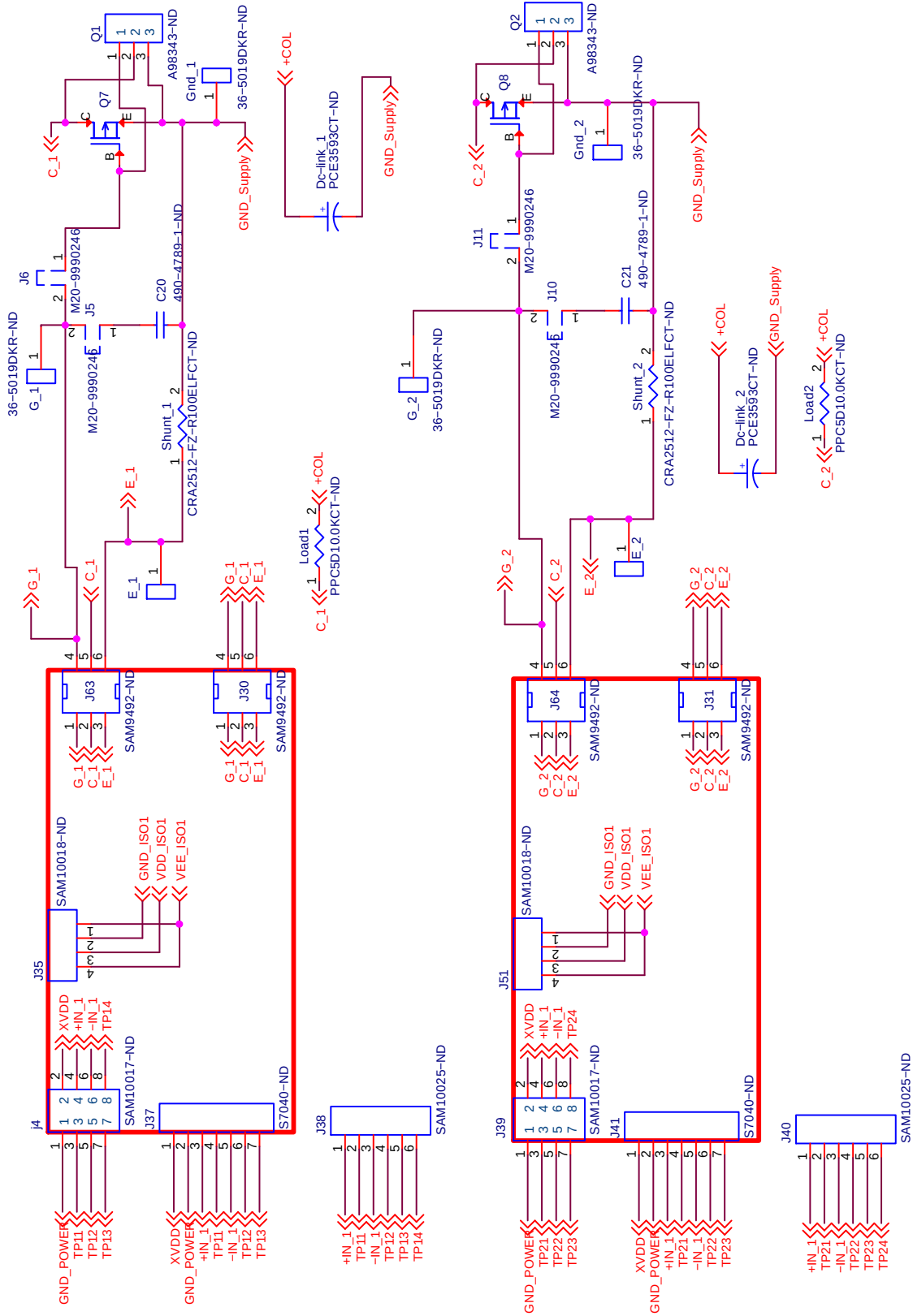
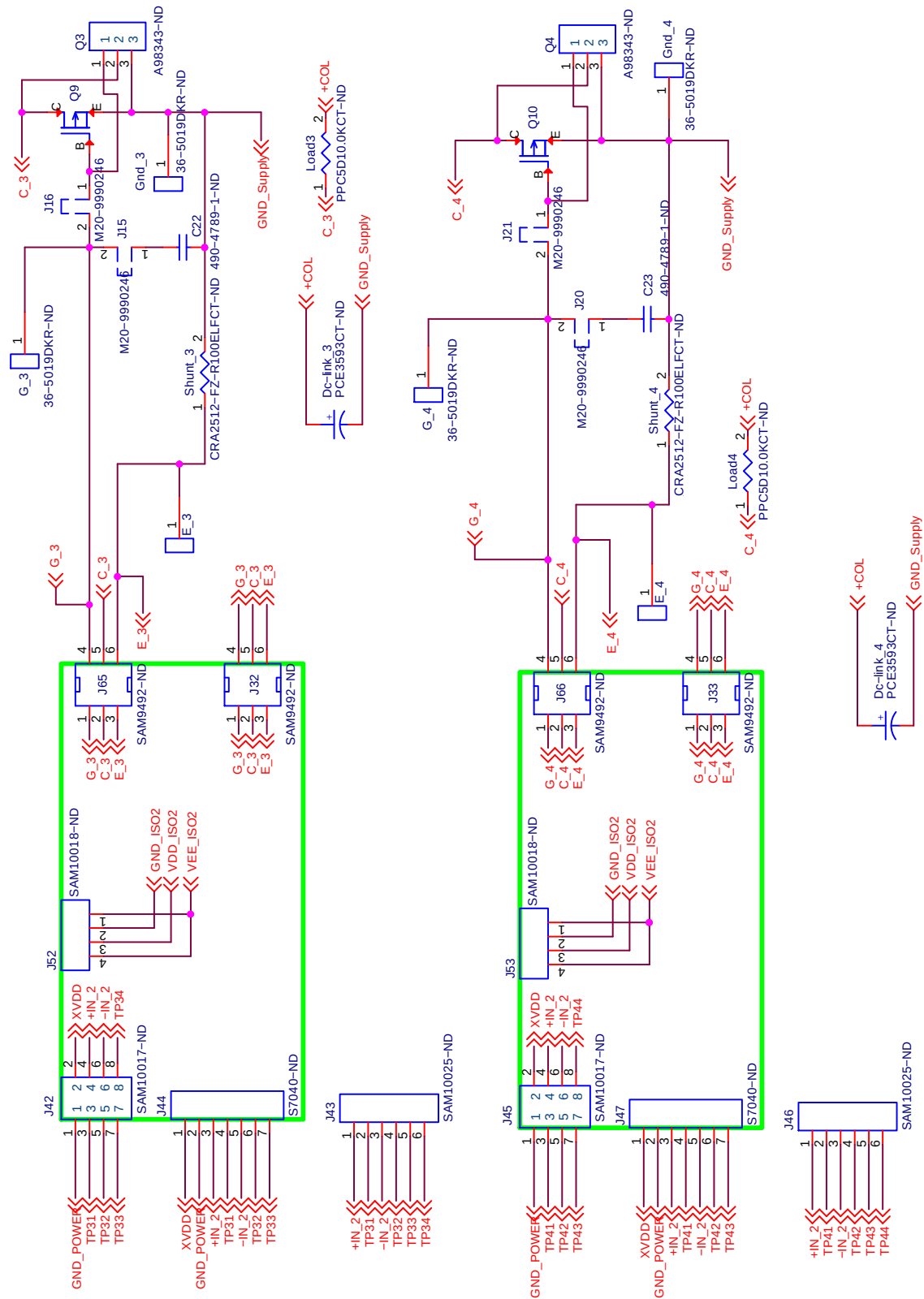


Figure 13. Channels 1 and 2 for Gate Drivers



### SCHEMATICS (Continued)



### Figure 14. Channels 3 and 4 for Gate Drivers

SCHEMATICS (Continued)

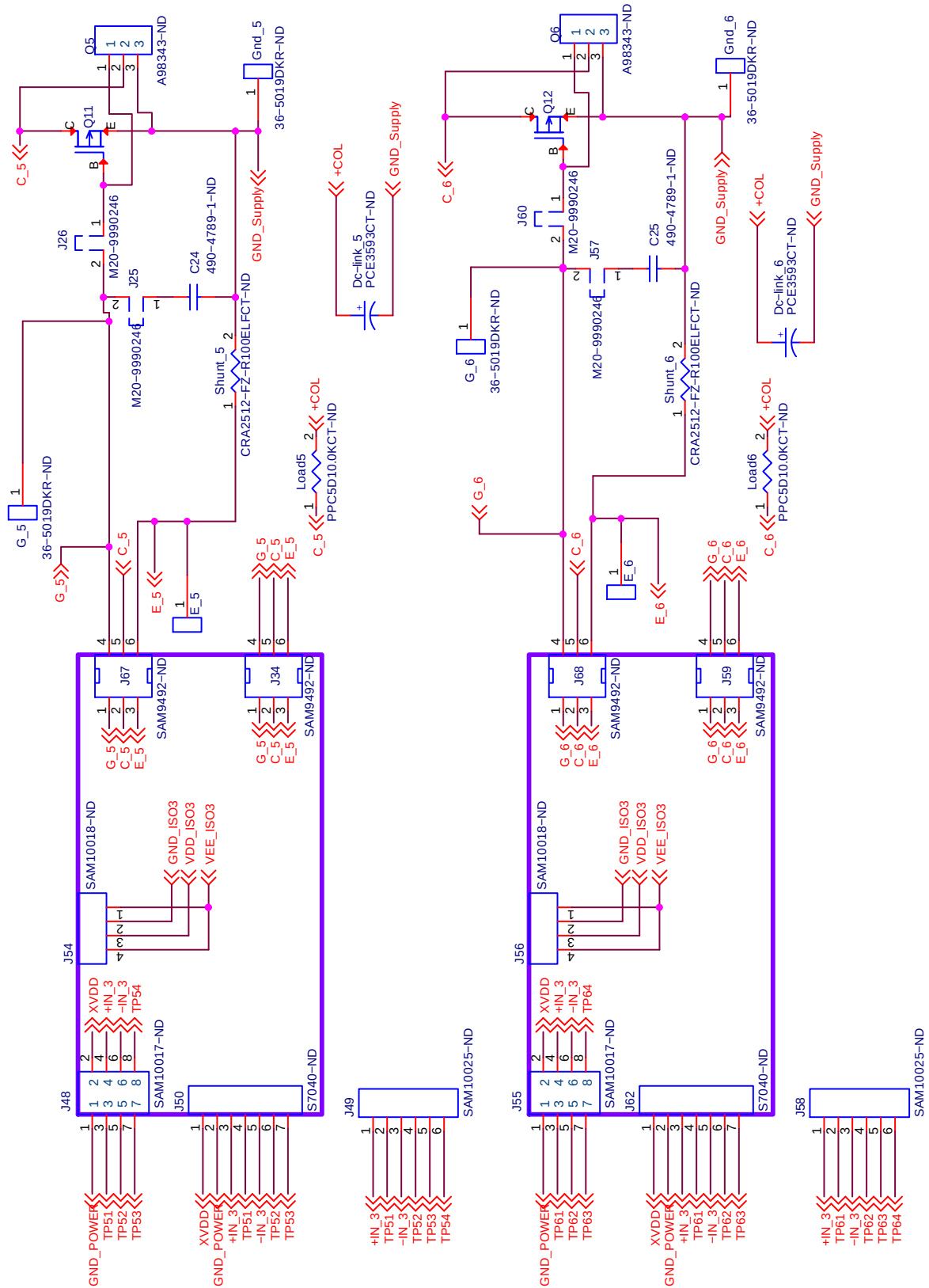


Figure 15. Channels 5 and 6 for Gate Drivers

ASSEMBLY

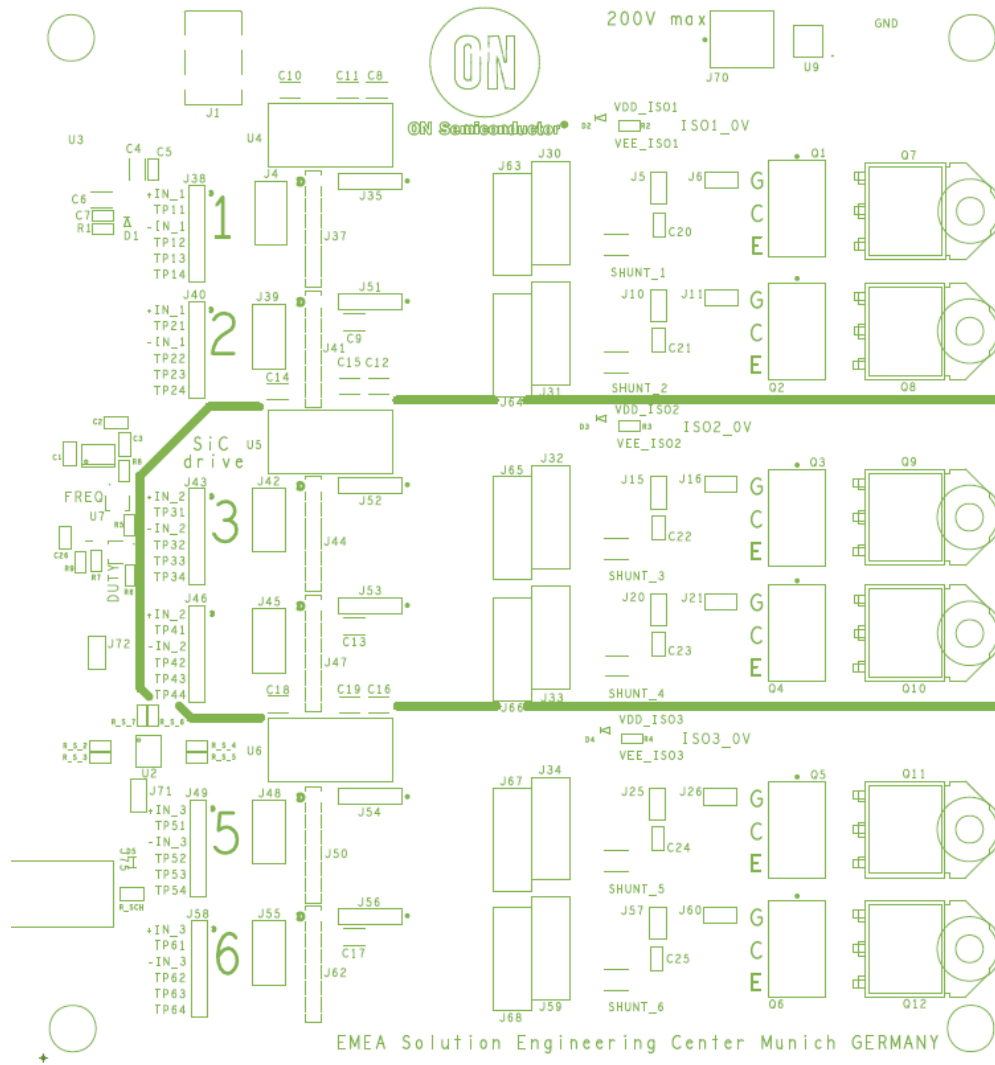


Figure 16. Top Side Assembly

ASSEMBLY (Continued)

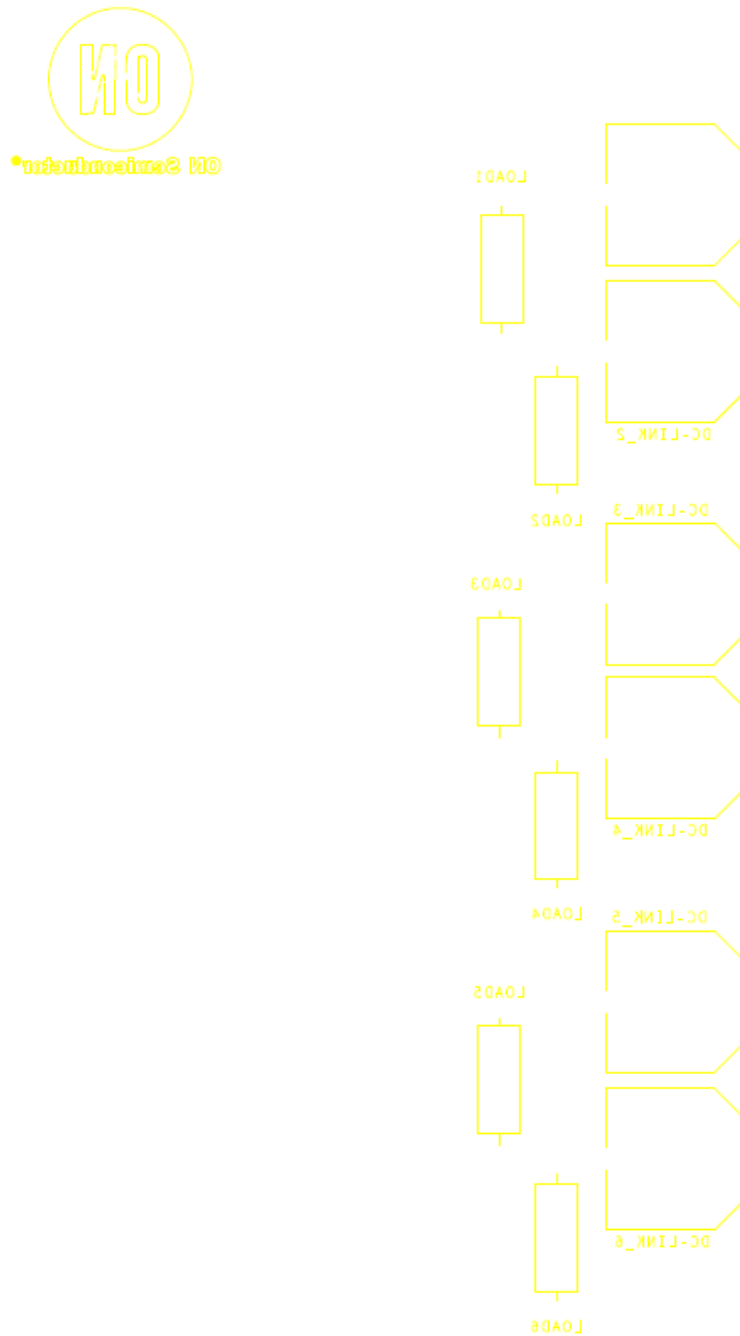


Figure 17. Bottom Side Assembly

# EVBUM2702/D

## BILL OF MATERIALS

**Table 1. BILL OF MATERIALS**

| Item | Qty | Reference                                                                                                                                                                                                                                                | Part                | Manufacturer     | Detailed Description                                                           | PCB Footprint       |
|------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------|--------------------------------------------------------------------------------|---------------------|
| 1    | 1   | U1                                                                                                                                                                                                                                                       | NCV1455BDR2G        | ON Semiconductor | IC OSC SINGLE TIMER 8SOIC                                                      | SOIC-8              |
| 2    | 1   | U2                                                                                                                                                                                                                                                       | MC74AC14DTR2G       | ON Semiconductor | IC INVERTER 6CH 6-INP 14TSSOP                                                  | TSSOP-14            |
| 3    | 1   | U3                                                                                                                                                                                                                                                       | NCP1117DT50G        | ON Semiconductor | Linear Voltage Regulator IC Positive Fixed 1 Output 5 V 1 A D <sup>2</sup> PAK | DPAK                |
| 4    | 1   | U7                                                                                                                                                                                                                                                       | TLV271SN2T1G        | ON Semiconductor | IC OPAMP GP 1 CIRCUIT 5TSOP                                                    | SOT23-5             |
| 5    | 1   | U9                                                                                                                                                                                                                                                       | MB4S                | ON Semiconductor | Full bridge rectification, 400 V, 0.5 A                                        | SOIC254P695X242-4N  |
| 6    | 34  | Xvdd1, Vee_Iso1, Vdd_Iso1, Pwr-in1, Gnd_power1, Gnd_Iso1, Gnd_1, G_1, E_1, Vee_Iso2, Vdd_Iso2, Gnd_Iso2, Gnd_2, G_2, E_2, Vee_Iso3, Vdd_Iso3, Gnd_Iso3, Gnd_3, G_3, E_3, Gnd_4, G_4, E_4, Gnd_5, G_5, E_5, Gnd_6, G_6, E_6, GND, +Col, Pwm_out1, Pwm_Gnd | 5019                |                  | TEST POINT MINI SMD                                                            | 36-5019DKR-ND       |
| 7    | 3   | C1, C2, C26                                                                                                                                                                                                                                              | GCM188R71H104KA57D  |                  | CAP CER 0.1 $\mu$ F 50 V X7R 0603                                              | sm_c_0805           |
| 8    | 1   | C3                                                                                                                                                                                                                                                       | GCJ188R71H473KA12D  |                  | 1 M $\Omega$ $\pm$ 1% 0.1 W, Chip-Widerstand 0603                              | sm_c_0805           |
| 9    | 14  | C4, C6, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19                                                                                                                                                                                         | C3225X7R1H106M250AC |                  | 10 $\mu$ F $\pm$ 20% 50 V Ceramic Capacitor X7R 1210 (3225 Metric)             | 1210                |
| 10   | 2   | C5, C7                                                                                                                                                                                                                                                   | GCM188R71H104KA57D  |                  | 0.1 $\mu$ F $\pm$ 10% 50 V Ceramic Capacitor X7R 0603 (1608 Metric)            | sm_c_0603           |
| 11   | 6   | C20, C21, C22, C23, C24, C25                                                                                                                                                                                                                             | C0805C472K5RACTU    |                  | 4.7 nF $\pm$ 10% 50 V Ceramic Capacitor X7R 0805 (2012 Metric)                 | sm_c_0805           |
| 12   | 6   | Dc-link_1, Dc-link_2, Dc-link_3, Dc-link_4, Dc-link_5, Dc-link_6                                                                                                                                                                                         | EEV-EB2V100SM       |                  | CAP ALUM 10 $\mu$ F 20% 350 V SMD                                              | CAPAE1710X1650N     |
| 13   | 1   | Duty                                                                                                                                                                                                                                                     | PVG3A503C01R00      |                  | TRIMMER 50 k $\Omega$ 0.25 W J LEAD TOP                                        | TRIM_PVG3A200C01R00 |
| 14   | 4   | D1, D2, D3, D4                                                                                                                                                                                                                                           | HSMA-C191           |                  | Amber 592 nm LED Indication - Discrete 1.9 V 0603 (1608 Metric)                | 603                 |
| 15   | 1   | D5                                                                                                                                                                                                                                                       | MM3Z5V6B            |                  | DIODE ZENER 5.6 V 200 MW SOD323F                                               | sod-323f            |
| 16   | 1   | Freq                                                                                                                                                                                                                                                     | PVG3A102C01R00      |                  | TRIMMER 1 k $\Omega$ 0.25 W J LEAD TOP                                         | TRIM_PVG3A200C01R00 |
| 17   | 1   | J1                                                                                                                                                                                                                                                       | 694106106102        |                  | Power connector jack                                                           | 69410X106102        |



Table 1. BILL OF MATERIALS (continued)

| Item | Qty | Reference                                                                   | Part               | Manufacturer | Detailed Description                                                                                         | PCB Footprint         |
|------|-----|-----------------------------------------------------------------------------|--------------------|--------------|--------------------------------------------------------------------------------------------------------------|-----------------------|
| 18   | 14  | J5, J6, J10, J11,<br>J15, J16, J20,<br>J21, J25, J26,<br>J57, J60, J71, J72 | M20-9990246        |              | CONN HEADER VERT<br>2POS 2.54 MM                                                                             | SAMTEC_TS-102-G-A     |
| 19   | 12  | J30, J31, J32,<br>J33, J34, J59,<br>J63, J64, J65,<br>J66, J67, J68         | HPF-03-01-T-S      |              | CONN RCPT 3POS 0.2<br>TIN PCB                                                                                | SAM9492-ND            |
| 20   | 6   | J35, J51, J52,<br>J53, J54, J56                                             | SSW-104-01-F-S     |              | CONN RCPT 4POS 0.1<br>GOLD PCB                                                                               | TE_826629-4           |
| 21   | 6   | J37, J41, J44,<br>J47, J50, J62                                             | PPPC071LFBN-RC     |              | CONN HDR 7POS 0.1<br>GOLD PCB                                                                                | SAMTEC_SSQ-107-01-T-S |
| 22   | 6   | J38, J40, J43,<br>J46, J49, J58                                             | SSW-106-01-F-S     |              | CONN RCPT 6POS 0.1<br>GOLD PCB                                                                               | SAMTEC_TLW-106-05-G-S |
| 23   | 6   | J4, J39, J42, J45,<br>J48, J55                                              | SSW-104-01-F-D     |              | CONN RCPT 8POS 0.1<br>GOLD PCB                                                                               | SAMTEC_TD-104-G-A     |
| 24   | 1   | J70                                                                         | 282841-2           |              | Terminal block, wire to<br>board                                                                             | TE_282841-2           |
| 25   | 1   | J75                                                                         | 5-16345-3-1        |              | BNC LOW PROFILE<br>ELBOW SOCKET 50 $\Omega$                                                                  | TE_5-1634513-1        |
| 26   | 6   | Load1, Load2,<br>Load3, Load4,<br>Load5, Load6                              | PAC500001002FAC000 |              | RES 10 k $\Omega$ 5 W 1%<br>AXIAL                                                                            | res_2w                |
| 27   | 6   | Q1, Q2, Q3, Q4,<br>Q5, Q6                                                   | 282841-3           |              | TERM BLK 3P SIDE ENT<br>5.08 MM PCB                                                                          | TE_282841-3           |
| 28   | 6   | Q7, Q8, Q9, Q10,<br>Q11, Q12                                                |                    |              | No component, only<br>footprint                                                                              | SOT93                 |
| 29   | 1   | R_SCH                                                                       | RMCF0805FT300R     |              | RES 300 $\Omega$ 1% 1/8 W<br>0805                                                                            | sm_r_0805             |
| 30   | 4   | R1, R2, R3, R4                                                              | RMCF0603FT300R     |              | 300 $\Omega$ $\pm$ 1% 0.1 W, 1/10 W<br>Chip Resistor 0603<br>(1608 Metric) Automotive<br>AEC-Q200 Thick Film | sm_r_0603             |
| 31   | 2   | R5, R6                                                                      | ERJ-3EKF3902V      |              | 39 k $\Omega$ $\pm$ 1% 0.1 W,<br>Chip-Widerstand 0603                                                        | sm_r_0603             |
| 32   | 2   | R7, R8                                                                      | ERJ-3EKF22R0V      |              | 22 $\Omega$ $\pm$ 1% 0.1 W,<br>Chip-Widerstand 0603                                                          | sm_r_0603             |
| 33   | 1   | R9                                                                          | ERJ-3EKF1001V      |              | 1 M $\Omega$ $\pm$ 1% 0.1 W,<br>Chip-Widerstand 0603                                                         | sm_r_0603             |
| 34   | 6   | Shunt_1, Shunt_2,<br>Shunt_3, Shunt_4,<br>Shunt_5, Shunt_6                  | CRA2512-FZ-R100ELF |              | RES 0.1 $\Omega$ 1% 3 W 2512                                                                                 | SM_R_2512_bourns_cra  |
| 35   | 2   | U4, U6                                                                      | MGJ2D151509SC      |              | Isolated Module DC DC<br>Converter 2 Output 15 V<br>-8.7 V 80 mA, 40 mA<br>13.5 V-16.5 V Input               | SIP-7                 |
| 36   | 1   | U5                                                                          | MGJ2D152005SC      |              | DC/DC isolated converter<br>15 Vin, +20/-4 V output                                                          | SIP-7                 |
| 37   | 6   | R_S_2, R_S_3,<br>R_S_4, R_S_5,<br>R_S_6, R_S_7                              | RC0603JR-070RL     |              | 0 $\Omega$ SMD Resistor 0603                                                                                 | sm_r_0603             |
| 38   | 8   | J5, J10, J15, J20,<br>J25, J57, J71                                         | QPC02SXGN-RC       |              | CONN JUMPER<br>SHORTING .100" GOLD                                                                           | no footprint          |

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