

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 Ω 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

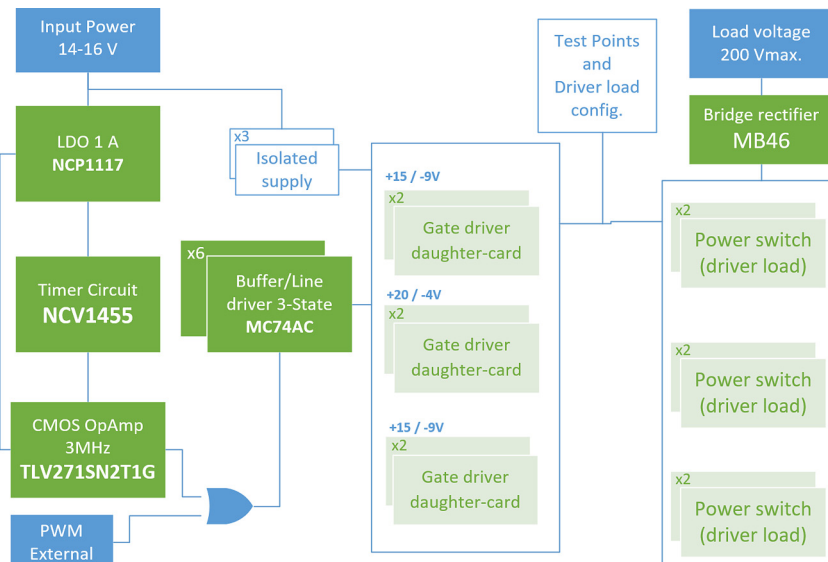


Figure 2. Block Diagram



ON Semiconductor®

www.onsemi.com

EVAL BOARD USER'S MANUAL

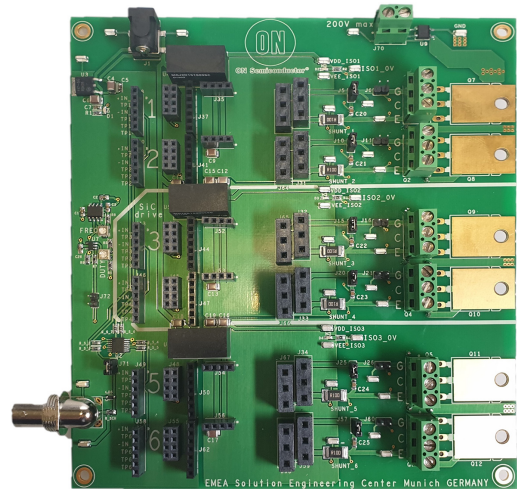


Figure 1. Evaluation Board Photo

User Interface Locations

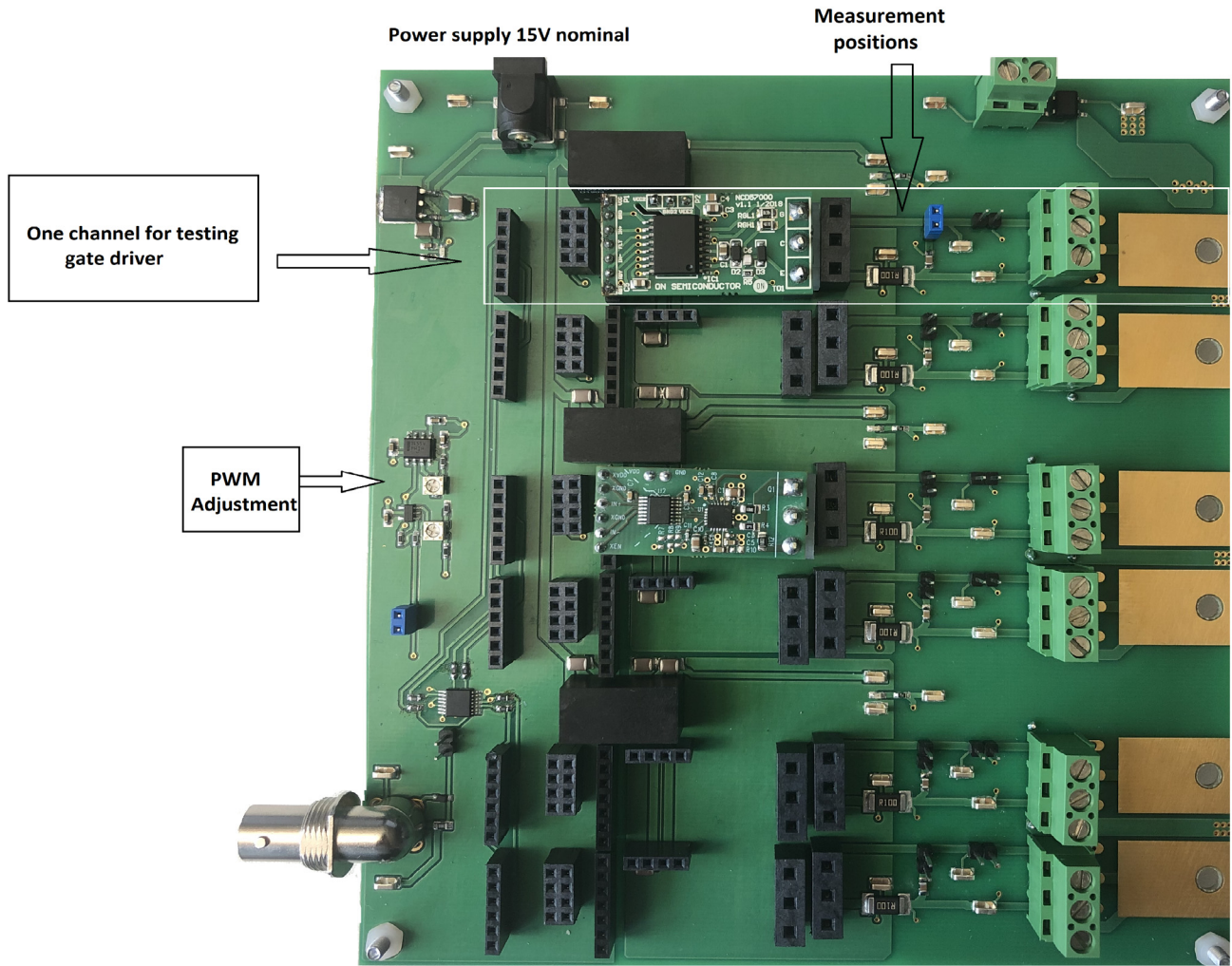


Figure 3. Board and Notable Segments

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.)

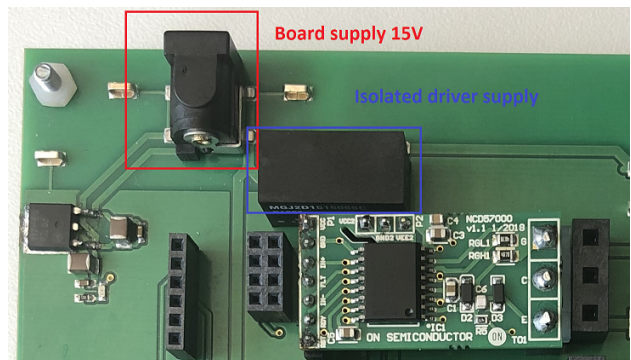


Figure 4.

PWM Generator

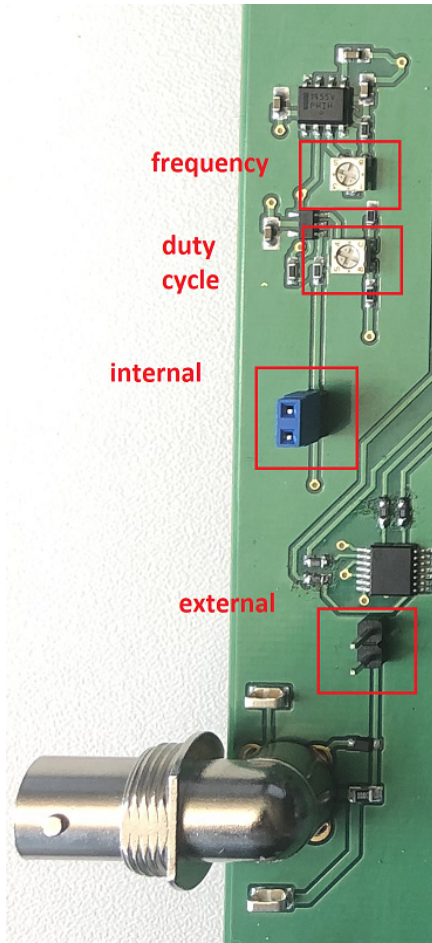


Figure 5. PWM Generator

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.

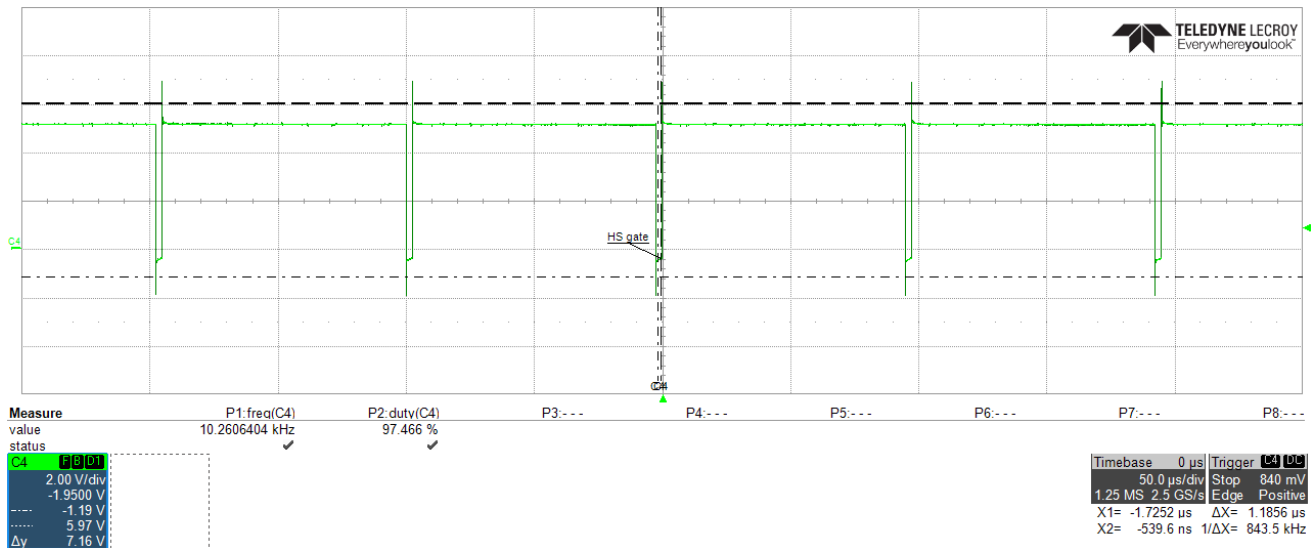


Figure 6. Minimum Frequency (On Board PWM Generator)

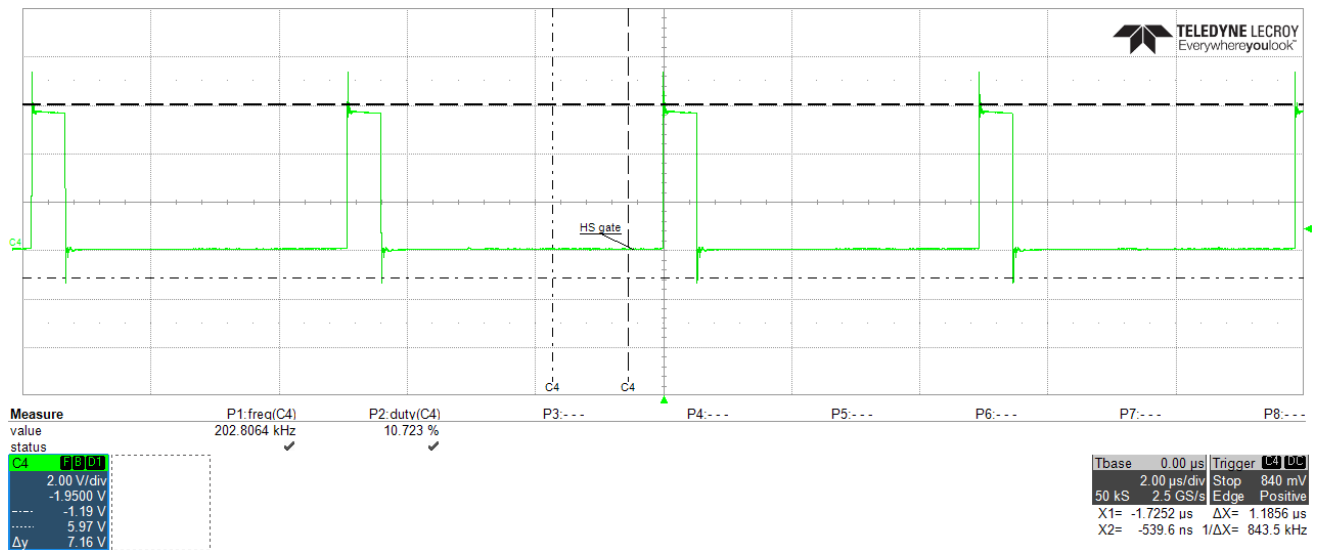


Figure 7. Maximum Frequency (On Board PWM Generator)

Capacitive Load or Power Device

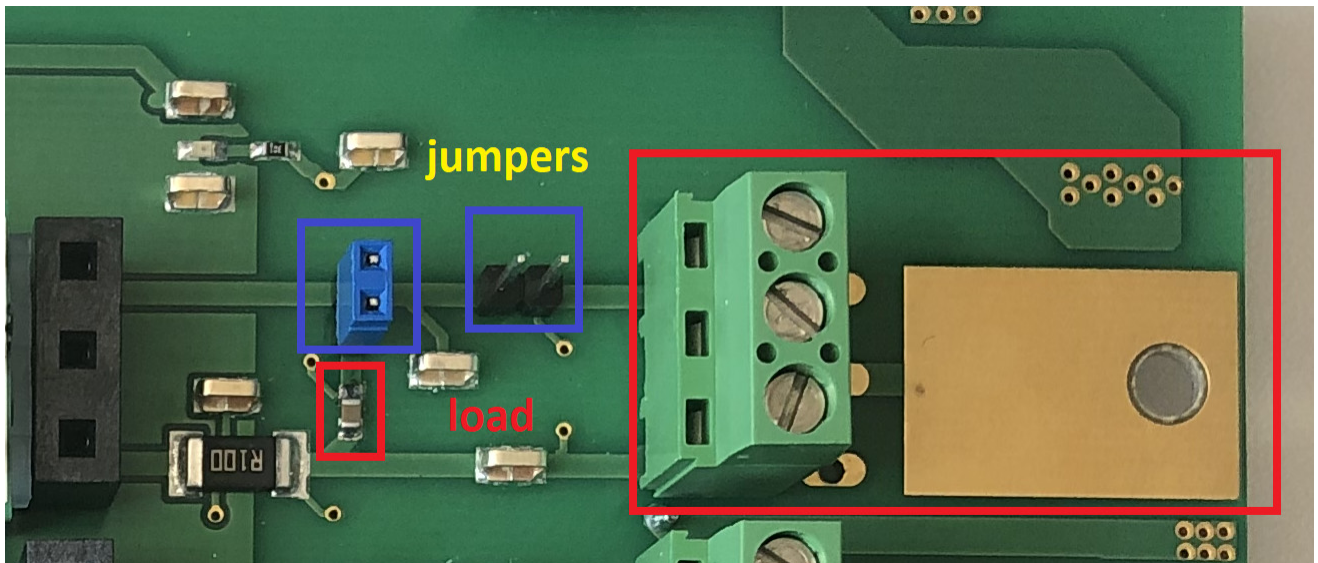


Figure 8. Driver Load (Capacitor or Power Device, Marked Red),
Jumpers to Choose Load (Marked Blue)

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

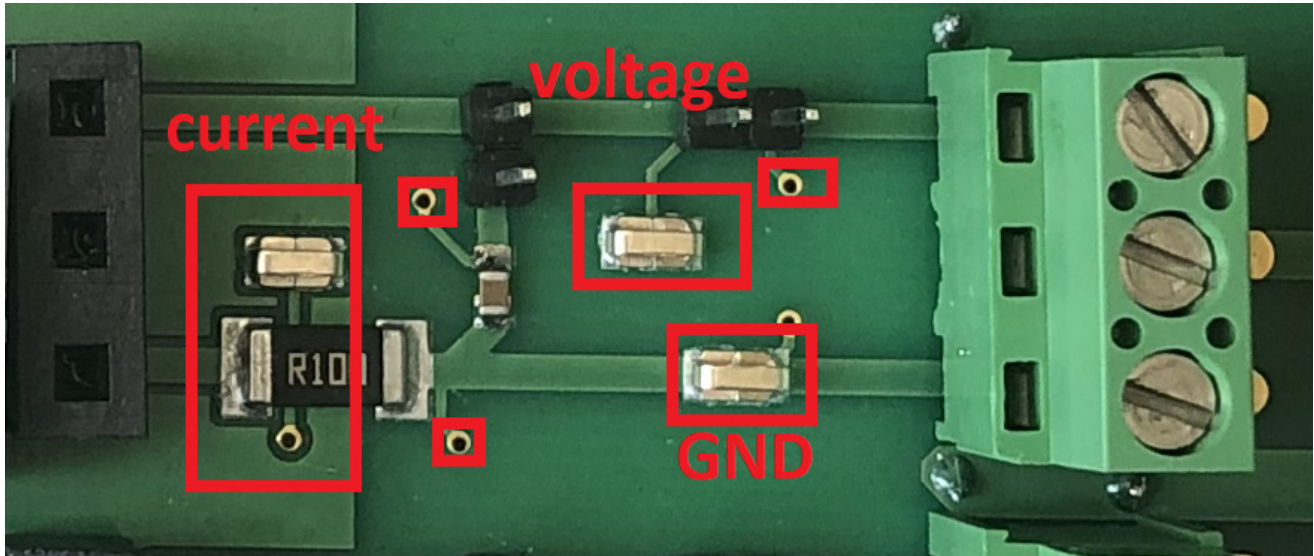


Figure 9. Measuring Positions

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.

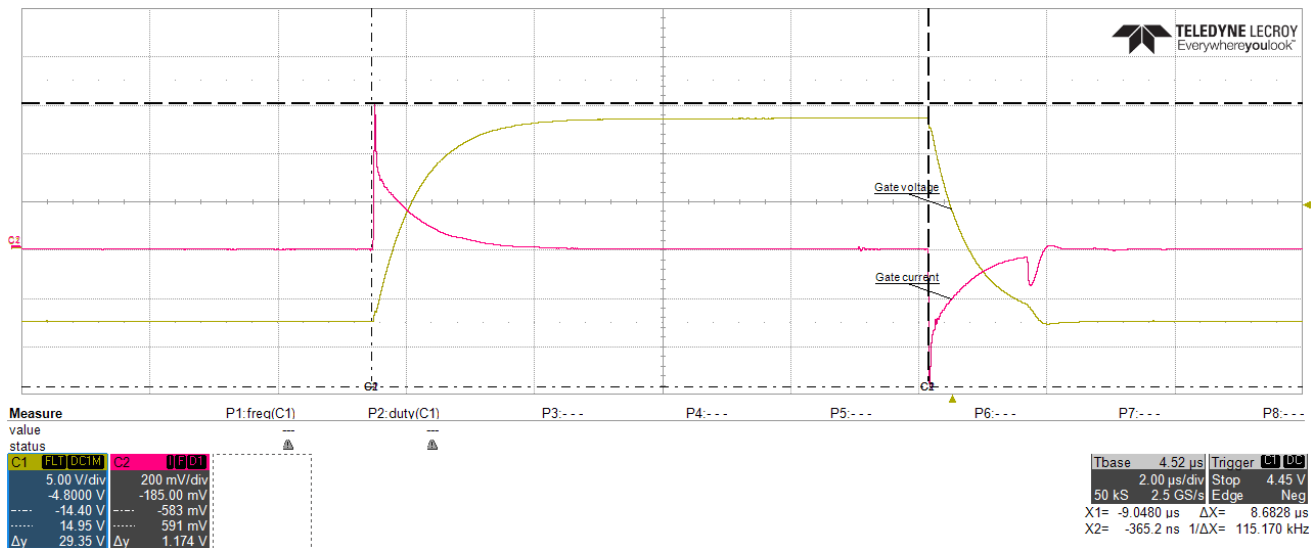
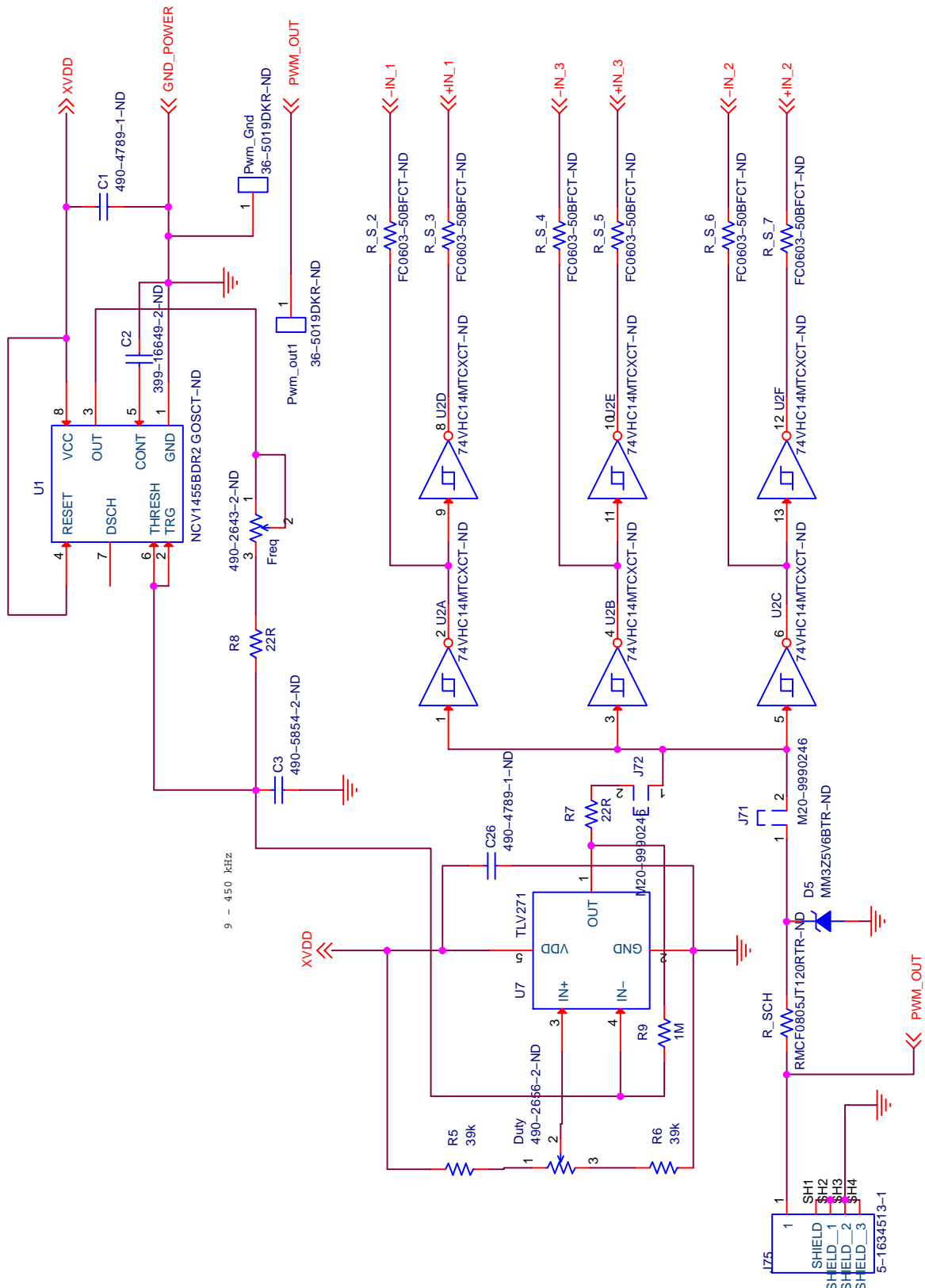


Figure 10. Gate Current and Voltage Measurements (Used Driver Board NCD57000)

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)

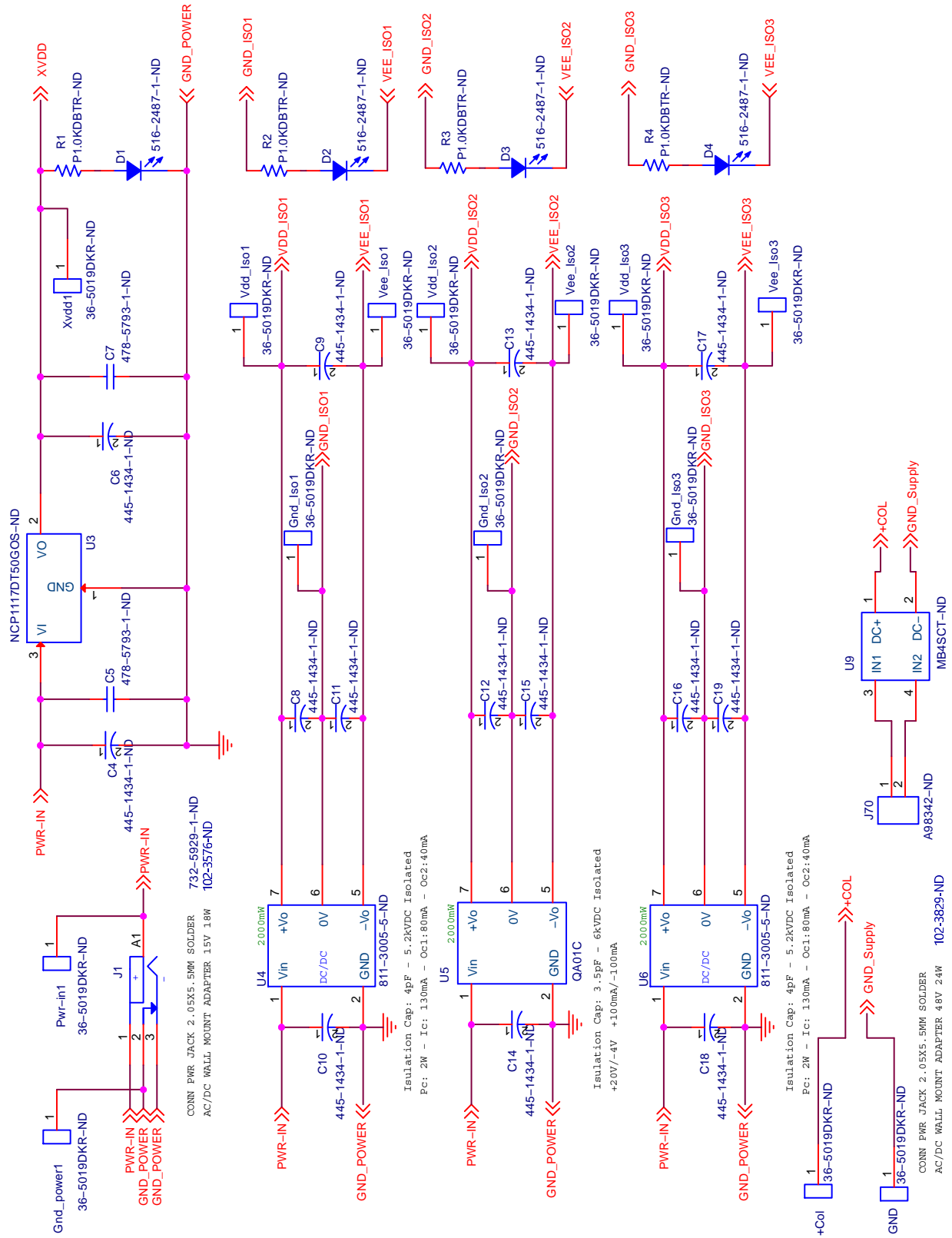


Figure 12. PWM Supply

SCHEMATICS (Continued)

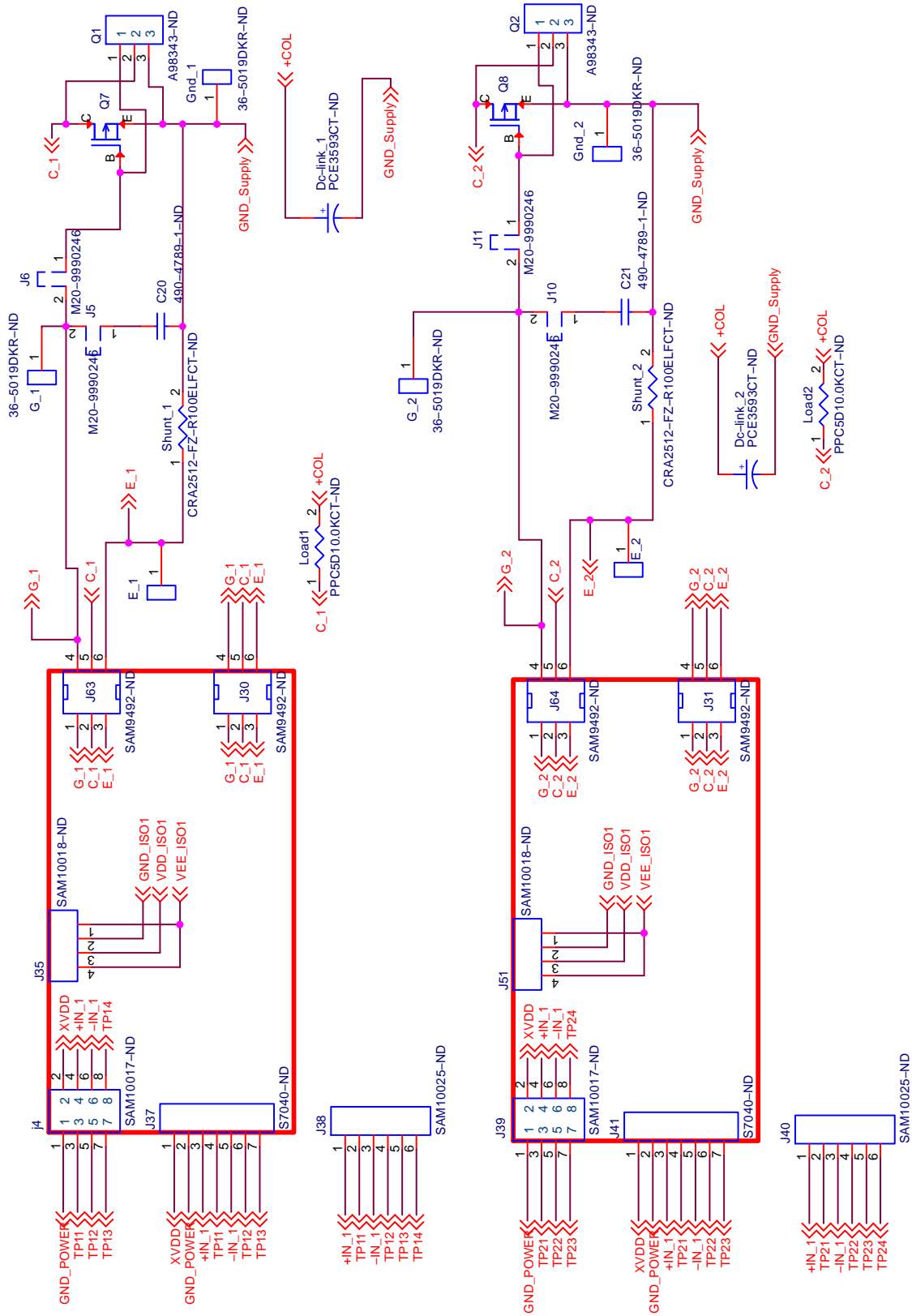


Figure 13. Channels 1 and 2 for Gate Drivers

SCHEMATICS (Continued)

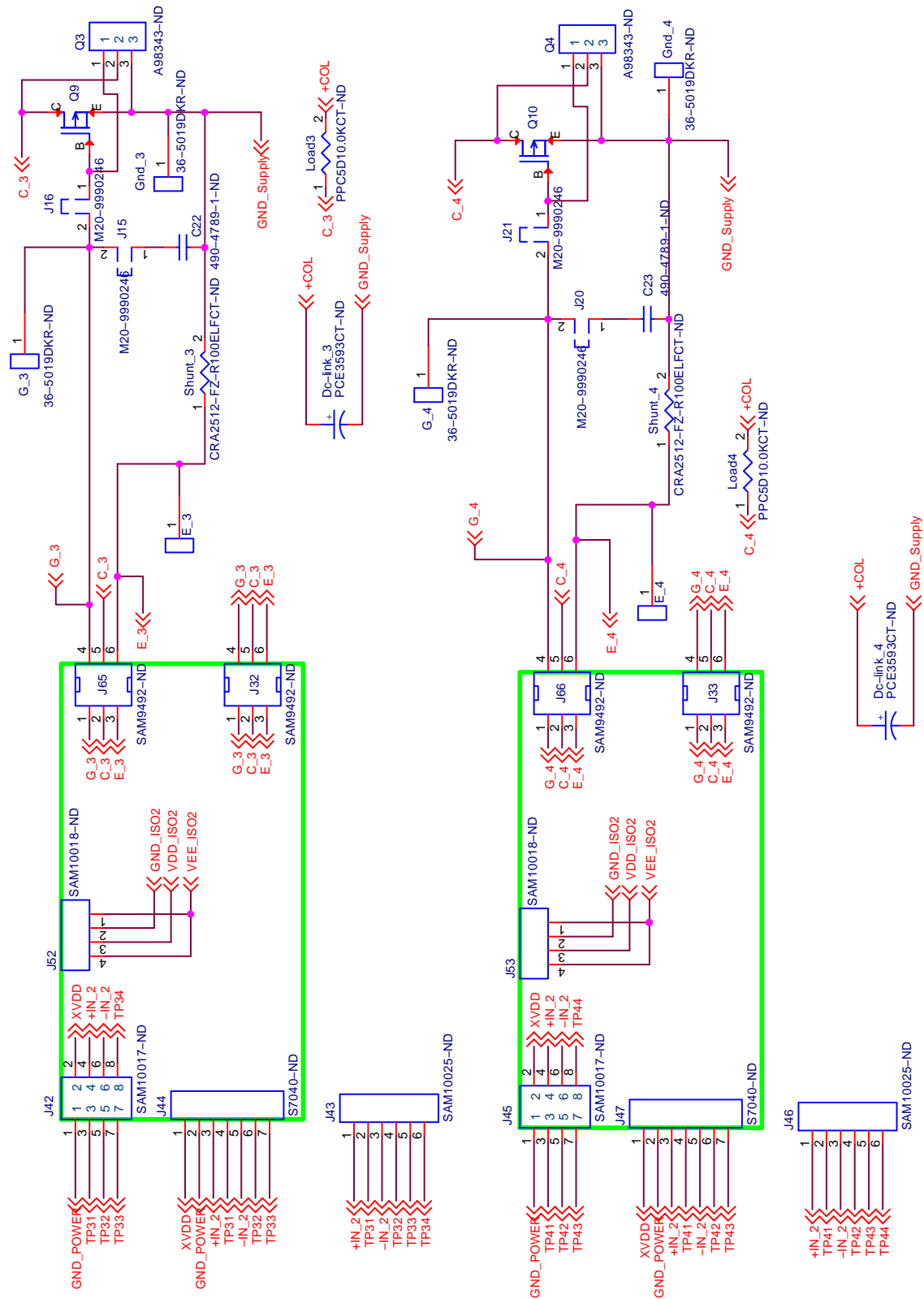
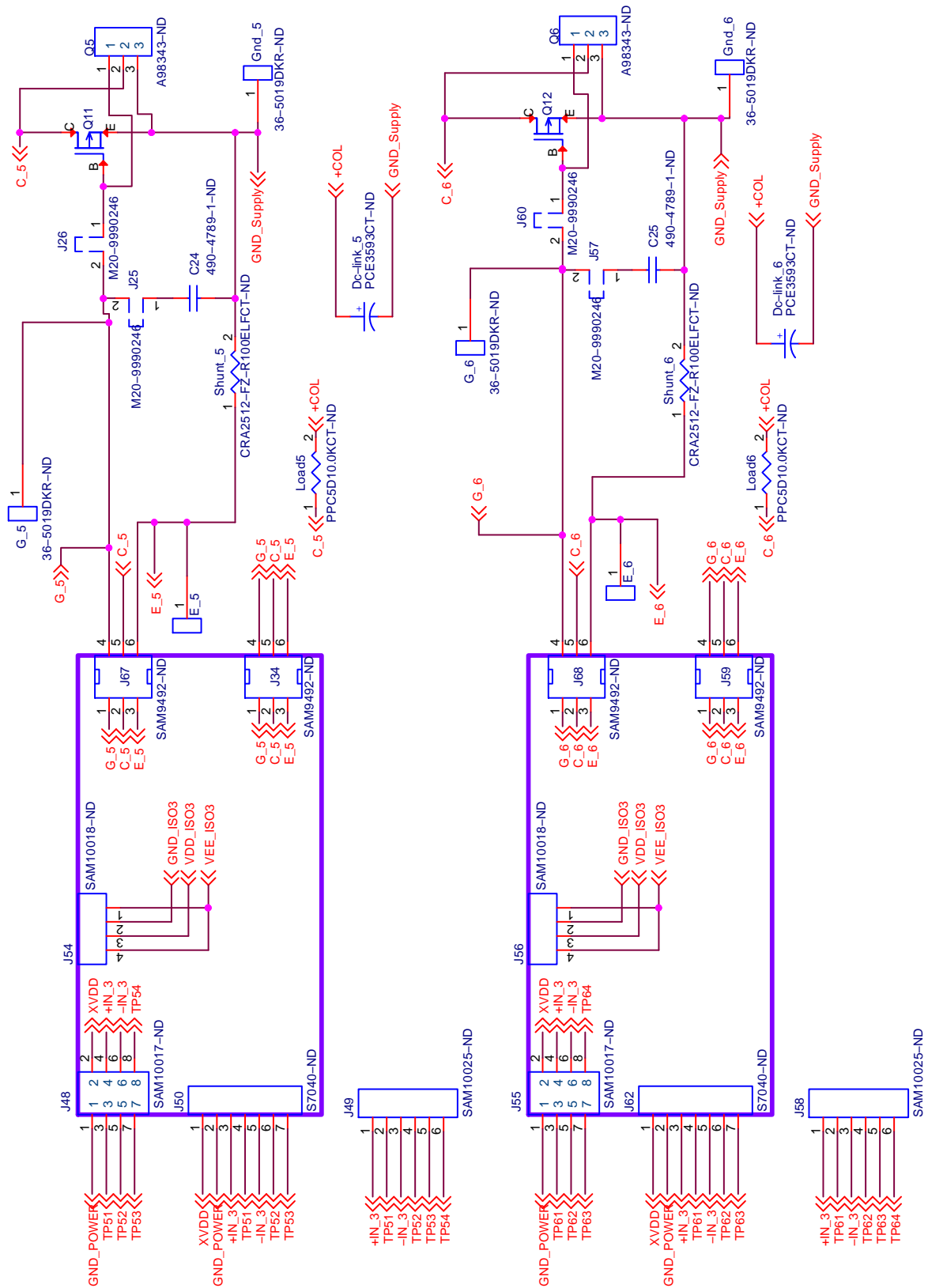


Figure 14. Channels 3 and 4 for Gate Drivers



ASSEMBLY



ASSEMBLY (Continued)

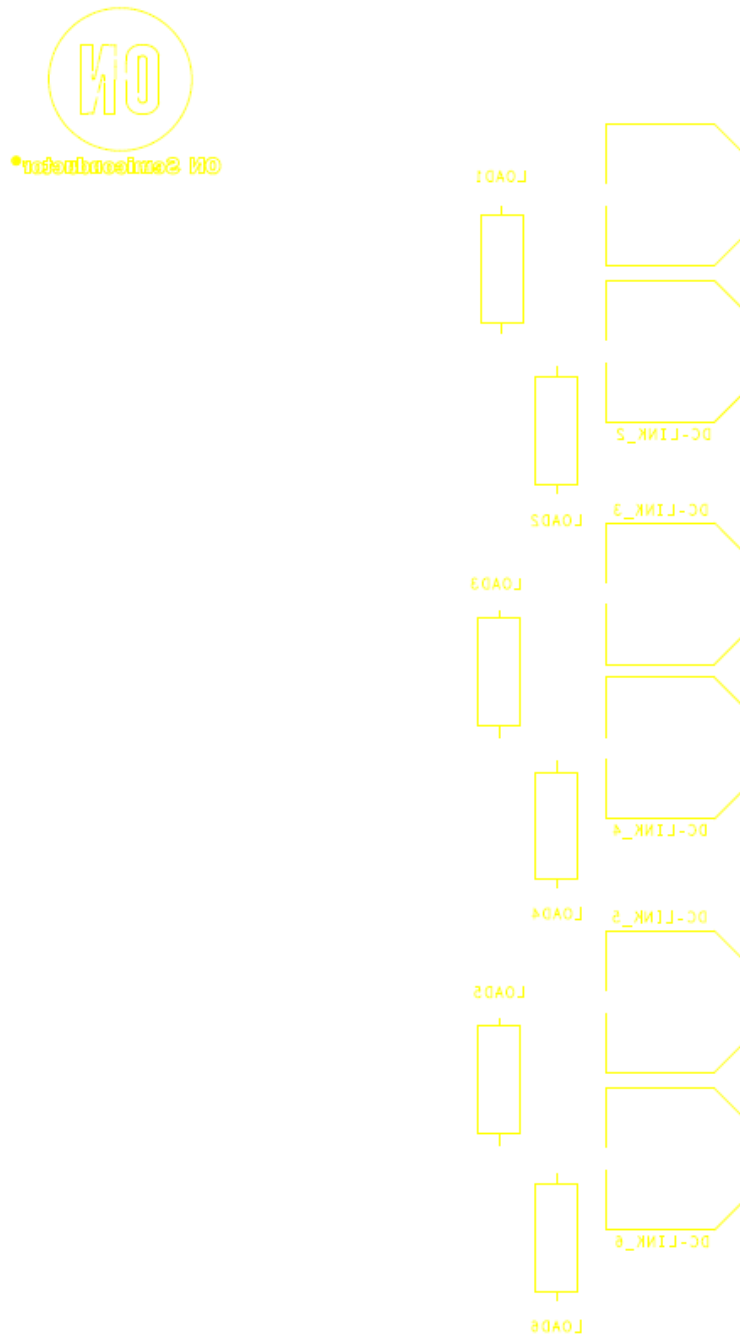


Figure 17. Bottom Side Assembly

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 ² 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 μ F 50 V X7R 0603 | sm_c_0805 |
| 8 | 1 | C3 | GCJ188R71H473KA12D | | 1 M Ω \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 μ F \pm 20% 50 V Ceramic Capacitor X7R 1210 (3225 Metric) | 1210 |
| 10 | 2 | C5, C7 | GCM188R71H104KA57D | | 0.1 μ 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 μ F 20% 350 V SMD | CAPAE1710X1650N |
| 13 | 1 | Duty | PVG3A503C01R00 | | TRIMMER 50 k Ω 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 Ω 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, J15, J16, J20, J21, J25, J26, J57, J60, J71, J72 | M20-9990246 | | CONN HEADER VERT 2POS 2.54 MM | SAMTEC_TS-102-G-A |
| 19 | 12 | J30, J31, J32, J33, J34, J59, J63, J64, J65, J66, J67, J68 | HPF-03-01-T-S | | CONN RCPT 3POS 0.2 TIN PCB | SAM9492-ND |
| 20 | 6 | J35, J51, J52, J53, J54, J56 | SSW-104-01-F-S | | CONN RCPT 4POS 0.1 GOLD PCB | TE_826629-4 |
| 21 | 6 | J37, J41, J44, J47, J50, J62 | PPPC071LFBN-RC | | CONN HDR 7POS 0.1 GOLD PCB | SAMTEC_SSQ-107-01-T-S |
| 22 | 6 | J38, J40, J43, J46, J49, J58 | SSW-106-01-F-S | | CONN RCPT 6POS 0.1 GOLD PCB | SAMTEC_TLW-106-05-G-S |
| 23 | 6 | J4, J39, J42, J45, J48, J55 | SSW-104-01-F-D | | CONN RCPT 8POS 0.1 GOLD PCB | SAMTEC_TD-104-G-A |
| 24 | 1 | J70 | 282841-2 | | Terminal block, wire to board | TE_282841-2 |
| 25 | 1 | J75 | 5-16345-3-1 | | BNC LOW PROFILE ELBOW SOCKET 50 Ω | TE_5-1634513-1 |
| 26 | 6 | Load1, Load2, Load3, Load4, Load5, Load6 | PAC500001002FAC000 | | RES 10 k Ω 5 W 1% AXIAL | res_2w |
| 27 | 6 | Q1, Q2, Q3, Q4, Q5, Q6 | 282841-3 | | TERM BLK 3P SIDE ENT 5.08 MM PCB | TE_282841-3 |
| 28 | 6 | Q7, Q8, Q9, Q10, Q11, Q12 | | | No component, only footprint | SOT93 |
| 29 | 1 | R_SCH | RMCF0805FT300R | | RES 300 Ω 1% 1/8 W 0805 | sm_r_0805 |
| 30 | 4 | R1, R2, R3, R4 | RMCF0603FT300R | | 300 Ω \pm 1% 0.1 W, 1/10 W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thick Film | sm_r_0603 |
| 31 | 2 | R5, R6 | ERJ-3EKF3902V | | 39 k Ω \pm 1% 0.1 W, Chip-Widerstand 0603 | sm_r_0603 |
| 32 | 2 | R7, R8 | ERJ-3EKF22R0V | | 22 Ω \pm 1% 0.1 W, Chip-Widerstand 0603 | sm_r_0603 |
| 33 | 1 | R9 | ERJ-3EKF1001V | | 1 M Ω \pm 1% 0.1 W, Chip-Widerstand 0603 | sm_r_0603 |
| 34 | 6 | Shunt_1, Shunt_2, Shunt_3, Shunt_4, Shunt_5, Shunt_6 | CRA2512-FZ-R100ELF | | RES 0.1 Ω 1% 3 W 2512 | SM_R_2512_bourns_cra |
| 35 | 2 | U4, U6 | MGJ2D151509SC | | Isolated Module DC DC Converter 2 Output 15 V -8.7 V 80 mA, 40 mA 13.5 V-16.5 V Input | SIP-7 |
| 36 | 1 | U5 | MGJ2D152005SC | | DC/DC isolated converter 15 Vin, +20/-4 V output | SIP-7 |
| 37 | 6 | R_S_2, R_S_3, R_S_4, R_S_5, R_S_6, R_S_7 | RC0603JR-070RL | | 0 Ω SMD Resistor 0603 | sm_r_0603 |
| 38 | 8 | J5, J10, J15, J20, J25, J57, J71 | QPC02SXGN-RC | | CONN JUMPER SHORTING .100" GOLD | no footprint |

onsemi, **onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and will only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

THE BOARD IS PROVIDED BY ONSEMI TO YOU "AS IS" AND WITHOUT ANY REPRESENTATIONS OR WARRANTIES WHATSOEVER. WITHOUT LIMITING THE FOREGOING, ONSEMI (AND ITS LICENSORS/SUPPLIERS) HEREBY DISCLAIMS ANY AND ALL REPRESENTATIONS AND WARRANTIES IN RELATION TO THE BOARD, ANY MODIFICATIONS, OR THIS AGREEMENT, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY AND ALL REPRESENTATIONS AND WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, AND THOSE ARISING FROM A COURSE OF DEALING, TRADE USAGE, TRADE CUSTOM OR TRADE PRACTICE.

onsemi reserves the right to make changes without further notice to any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by **onsemi** shall not constitute any representation or warranty by **onsemi**, and no additional obligations or liabilities shall arise from **onsemi** having provided such information or services.

onsemi products including the boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. You agree to indemnify, defend and hold harmless **onsemi**, its directors, officers, employees, representatives, agents, subsidiaries, affiliates, distributors, and assigns, against any and all liabilities, losses, costs, damages, judgments, and expenses, arising out of any claim, demand, investigation, lawsuit, regulatory action or cause of action arising out of or associated with any unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of any products and/or the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

FCC WARNING – This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by **onsemi** to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

onsemi does not convey any license under its patent rights nor the rights of others.

LIMITATIONS OF LIABILITY: **onsemi** shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if **onsemi** is advised of the possibility of such damages. In no event shall **onsemi**'s aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

The board is provided to you subject to the license and other terms per **onsemi**'s standard terms and conditions of sale. For more information and documentation, please visit www.onsemi.com.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales