

TD99101 Evaluation Kit

TD99101 EVALUATION KIT USER'S GUIDE

This evaluation kit (EVK) is an evaluation system for the TD99101 GaN FET Driver and EVG100E15 GaN FETs. The kit includes one TD99101 integrated circuit (IC), two EVG100E15 FETs, a supply voltage regulator and an input driver. Note: These EVKs are built with ES (prototype) units.

(NOTE: THE EVALUATION MODULE IS SYMBOLIZED AS THE “PE99101 EVK”, BUT THE PART NUMBER WAS CHANGED TO TD99101 AFTER THE PCB WAS RELEASED. THIS WILL BE UPDATE IN THE NEXT BUILD.)

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1. Features

- Complete evaluation kit for the TD99101 GaN FET driver and the EVG100E15 GaN FETs.
- Includes regulated supply voltage to support the TD99101.
- Includes a buffer for the input signal for the TD99101.

1.1. Kit Contents

- TD99101 / EVG100E15 circuit module.

1.2. Ordering Information

Table 1: Ordering Information

| EVK PART NUMBER | DB NUMBER | PACKAGE OPTION |
|-----------------|-----------|----------------|
| 99101D-X00 | 76939 | 16-PIN CSP |
| 99101P-X00 | 76940 | 16-PIN CLCC |

1.3. Documentation

See the device data sheets for TD99101 and the EVG100E15 devices for detailed performance data for these devices.

1.4. TD99101 / EVG100E15 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the TD99101 / EVG100E15 circuit module.

Table 2: Input Specification Table

| Specification | Minimum | Typical | Maximum | Units |
|-----------------------------|---------|---------|---------|-------|
| Input voltage at 9V_EXT | | | | |
| 9V_EXT to 6V jumper open | 7 | 9 | 11 | V |
| 9V_EXT to 6V jumper shorted | 5 | 5.5 | 6 | V |
| Input Voltage at INPUT | 0 | 4 | 5 | V |
| Input Voltage at VIN+ | 0 | | 20 | V |
| Input frequency at INPUT | 1 | 3 | 10 | MHz |
| Load Current | | 3 | 5 | A |

2. TD99101 EVK Quick Start Guide

This section provides the step-by-step procedures required to take a new EVK and configure it for operation in a laboratory environment.

2.1. Items needed for EVK setup and Evaluation

- TD99101 / EVG100E15 circuit module
- A DC power supply that can supply 9V and 1A.
- A DC power supply that can supply 100V and 10A.
- A signal generator that can provide up to a 10MHz square wave.
- Oscilloscope

2.2. EVM Connections

This section covers the hardware connections for the EVK. See Figure 1.

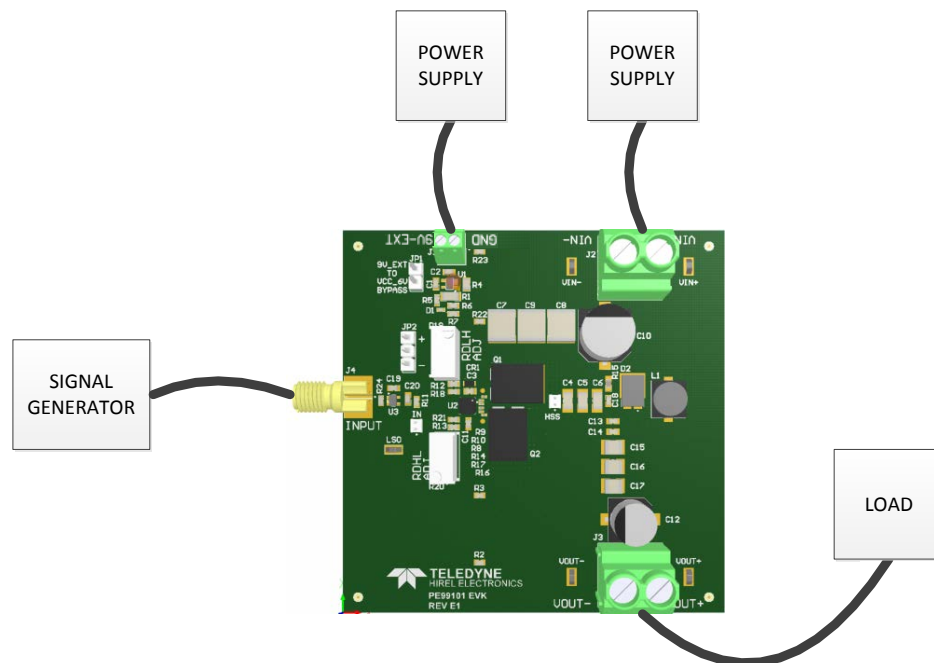


Figure 1: TD99101 Circuit Module Connections to Test Equipment and Load

- The supply voltage for the TD99101 GaN FET Driver connection across 9V-EXT and GND

Attach power supply for the TD99101 GaN FET Driver to the J1 terminal block. The positive wire should be connected to the 9V-EXT terminal block position. The negative wire should be connected to the GND terminal block position. See **Figure 1**. Reference Table 2 to set the supply voltage.

- The supply voltage for the EVG100E15 GaN FET output stage connection across VIN+ and VIN-

Attach power supply for the output stage to the J2 terminal block. The positive wire should be connected to the VIN+ terminal block position. The negative wire should be connected to the VIN- terminal block position. See **Figure 1**. Reference Table 2 to set the supply voltage.

- The PWM input signal for the TD99101 GaN FET Driver connection to the INPUT port

The single-ended pulse width modulation (PWM) input signal is connected to the J4 SMA connector. See **Figure 1**. Reference Table 2 to select the switching frequency.

- The system load connection across VOUT+ and VOUT-

Attach the load to the J3 terminal block. The positive load wire should be connected to the VOUT+ terminal block position. The negative load wire should be connected to the VOUT- terminal block position. See **Figure 1**.

- The TD99101 supply voltage regulator bypass jumper – JP1

The TD99101 supply voltage regulator provides a regulated 6V input to power the device. The regulator can be bypassed by placing a shunt across the JP1 jumper and providing a supply voltage across the 9V-EVT and GND inputs on the J1 terminal block. Reference **Table 2** to set the supply voltage.

- The TD99101 enable jumper – JP2

The TD99101 device is enabled by placing a shunt across the center position and the (-) position on the JP2 jumper. The device is disabled by placing a shunt across the center position and the (+) position on the JP2 jumper.

2.3. Initial Settings Table

This section provides an example setup for the EVK.

Table 3: Initial Setup

| Terminal Block / Jumper | Setting | Units |
|--------------------------------|----------------|-----------------|
| J1 | 8 | V |
| J2 | 20 | V |
| J3 | 10 | ohms |
| J4 | 4 | V |
| | 3 | MHz |
| JP1 | open | position |
| JP2 | (-) | position |

2.4. Power-up sequence

- Remove the load.
- Enable the signal generator output.
- Turn the 9V-EXT power supply on.
- Turn the VIN+ power supply on.
- Use an oscilloscope to probe the high-side and low-side gate drive signals to inspect the dead-time. Use the R19 (RDLH) and R20 (RDHL) to adjust the dead-time to prevent the signals from overlapping and causing shoot through in the FETs.

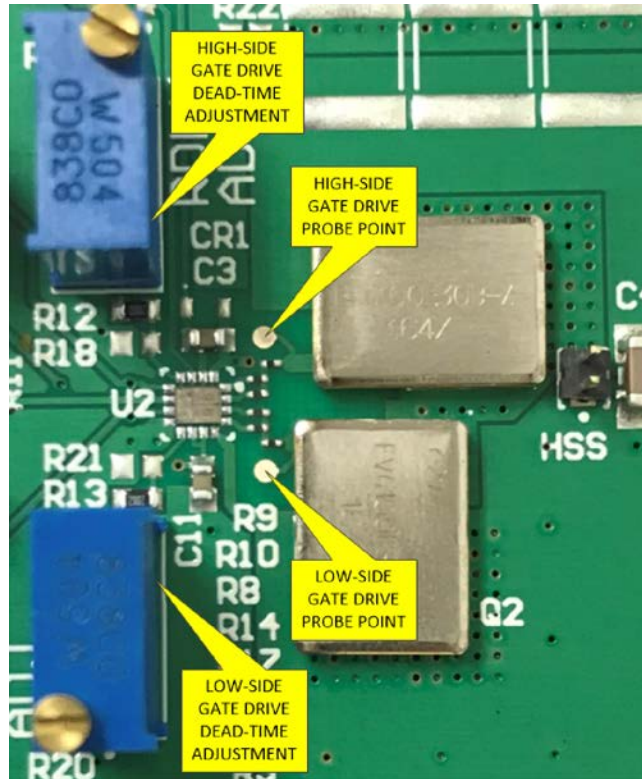


Figure 2: Gate drive dead-time adjustment

- Apply the load.
- Re-check the dead-time and adjust as-needed. Re-check the dead-time after changing the operating frequency or the load and optimize it to improve the output efficiency.

3. Circuit Module Physical Layouts

This section contains the printed-circuit board (PCB) layout, assembly drawings, and schematic for the TD99101 EVK.

3.1. Board Layout

This section shows the dimensions, PCB layers (**Error! Reference source not found.** through Figure 8), and assembly drawing for the TD99101 EVK's.

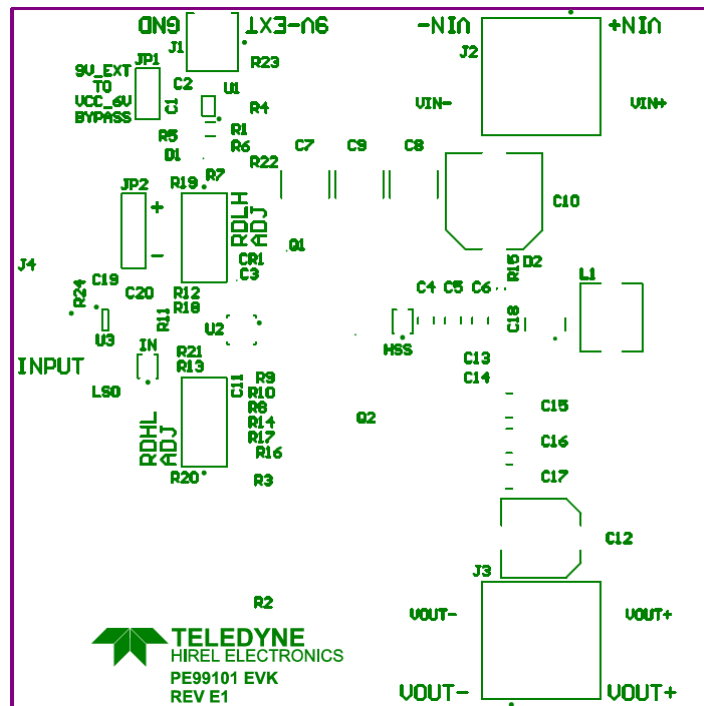


Figure 3: Top Silk Screen

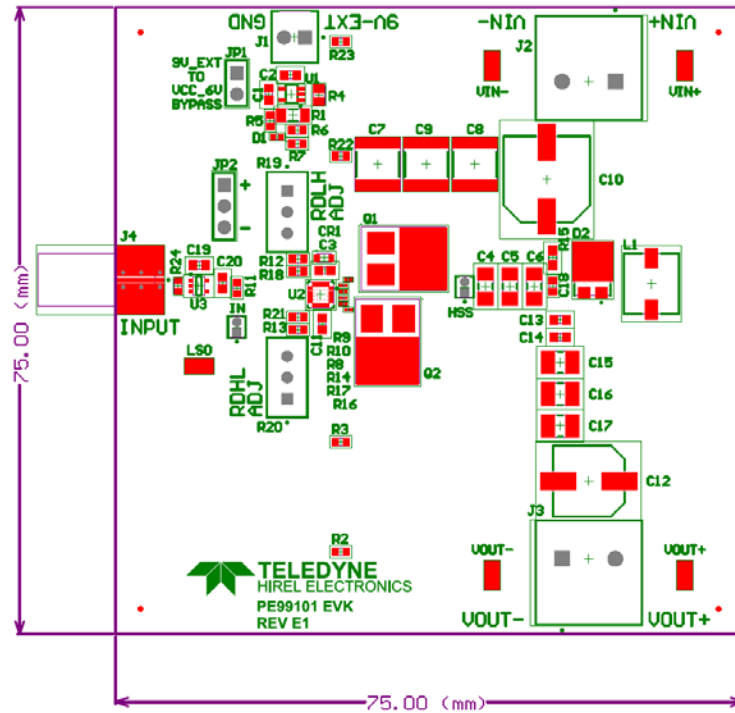


Figure 4: Top Assembly

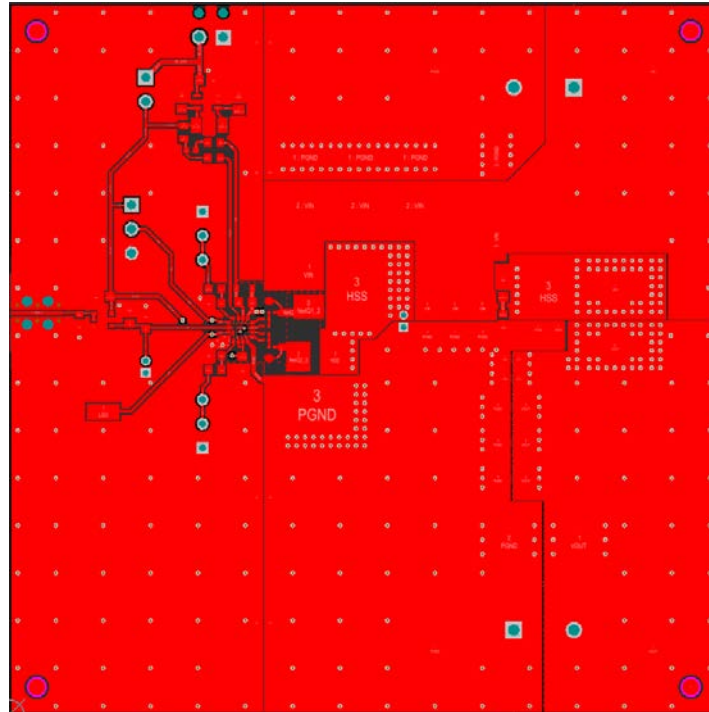


Figure 5: Top Layer

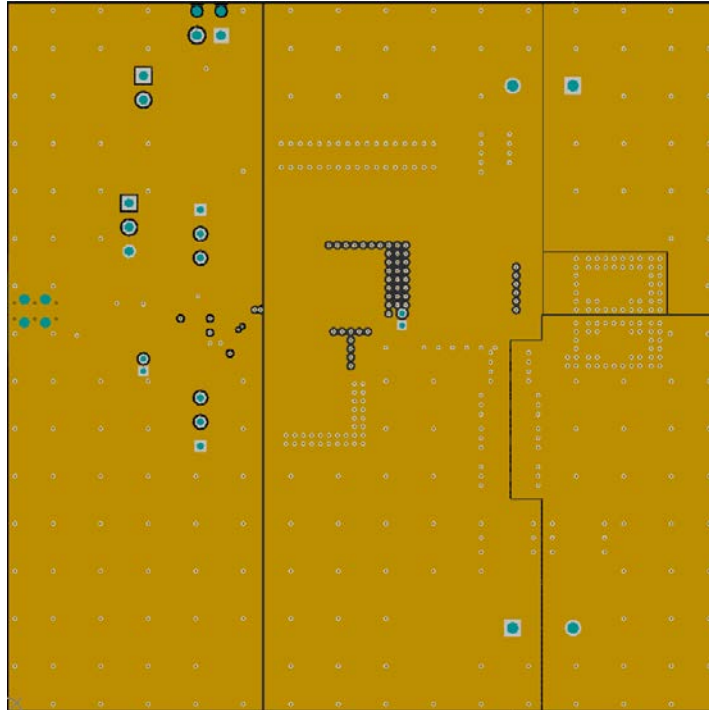


Figure 6: Internal Layer 1

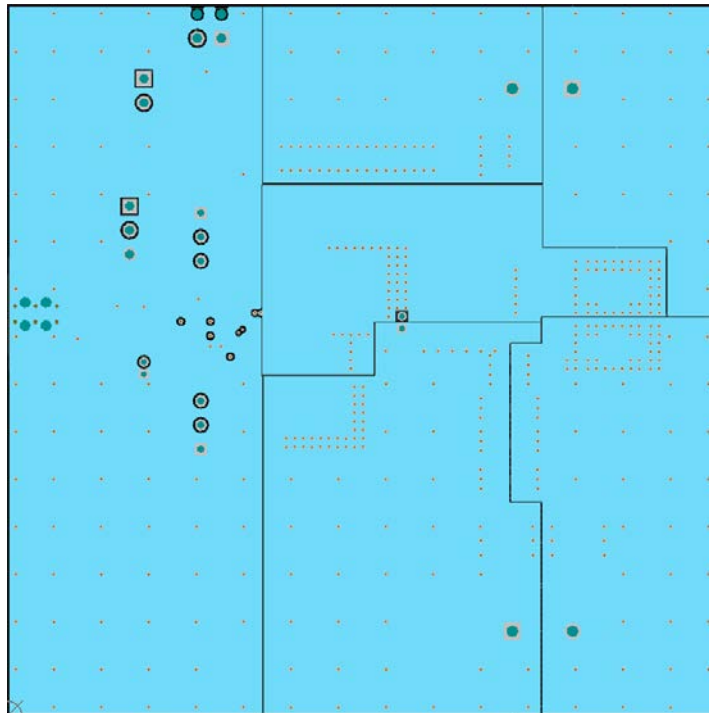


Figure 7: Internal Layer 2

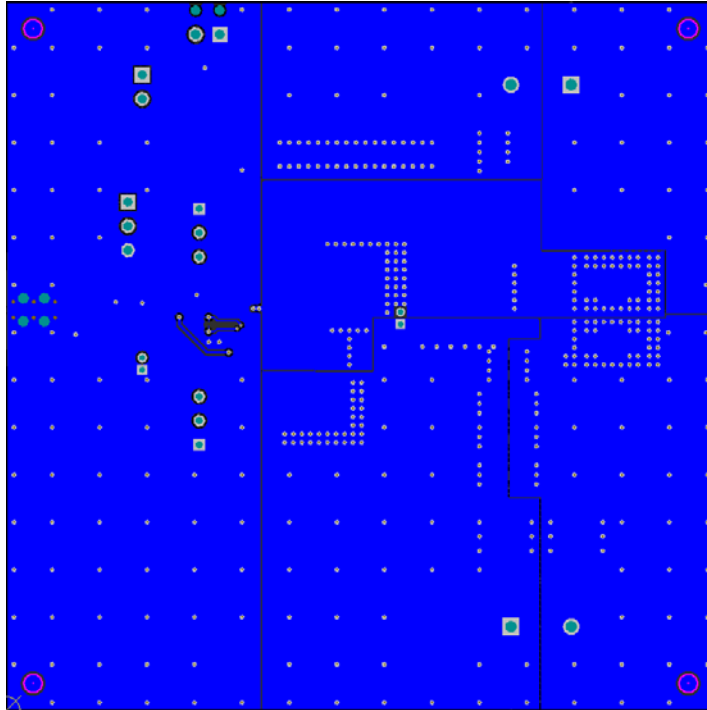


Figure 8: Bottom Layer

3.2. Schematic

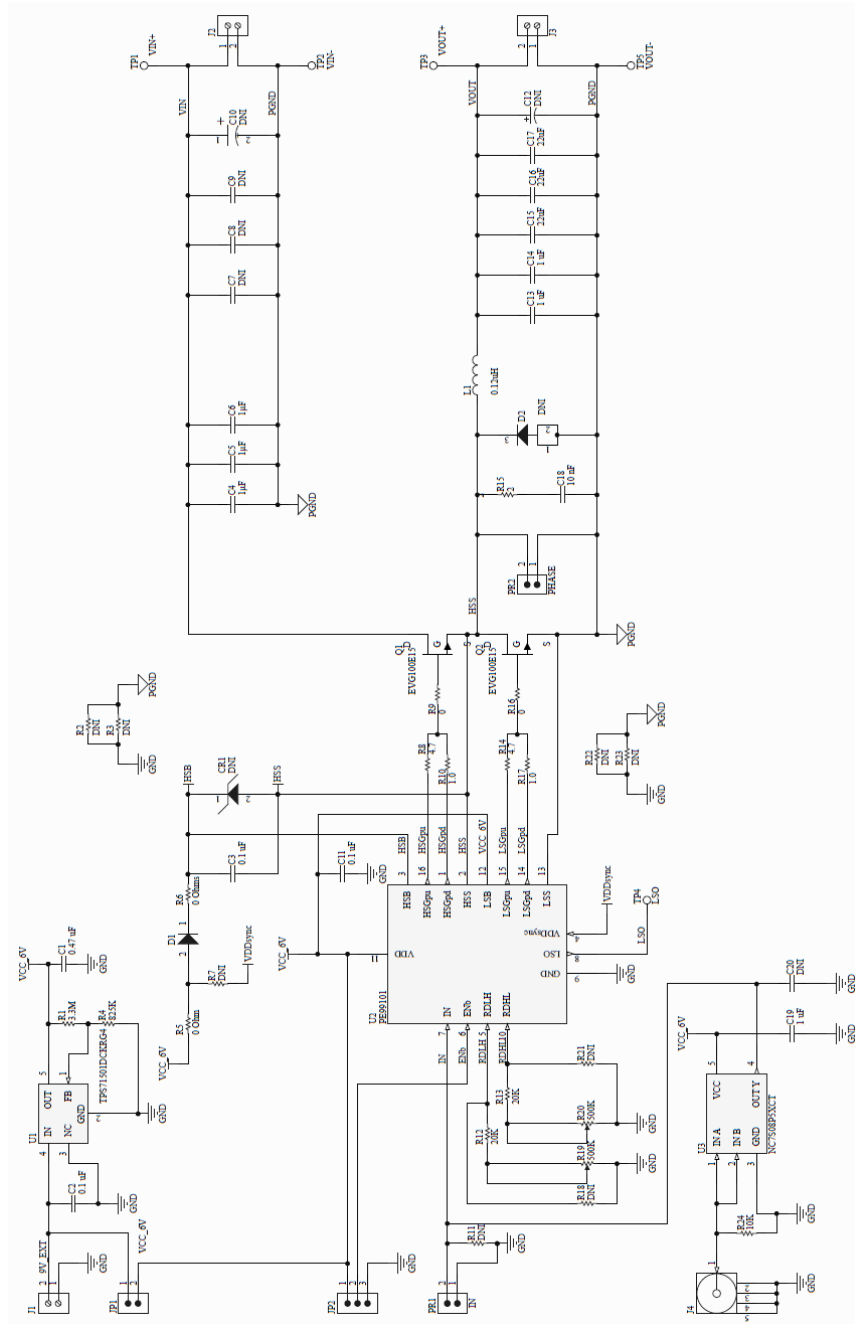


Figure 9: Schematic

4. Bill of Materials

| Qty | Designator | Value | Description | Part Number | Size |
|-----|-------------------|------------|--|--------------------------|----------------------|
| 1 | C1 | 0.47 uF | 0.47µF ±10% 50V Ceramic Capacitor X7R 0603 (1608 Metric) | CGA3E3X7R1H4 74K080AE | 0603 |
| 2 | C2, C3 | 0.1 uF | 0.1µF ±10% 50V Ceramic Capacitor X7R 0603 (1608 Metric) | CGA3E2X7R1H1 04K080AA | 0603 |
| 3 | C4, C5, C6 | 1µF | Chip Capacitor, 1 uF, 1µF ±10% 100V Ceramic Capacitor X7R 1206 (3216 Metric) | GRM31CR72A10 5KA01L | 1206 |
| 0 | C7, C8, C9 | DNI | 10µF ±10% 100V Ceramic Capacitor X7S 2220 (5750 Metric) | C5750X7S2A106 K230KB | 2220 |
| 0 | C10 | DNI | 47µF 80V Aluminum Electrolytic Capacitors Radial, Can - SMD 2000 Hrs @ 105°C | EEE-FK1K470P | 10.30mm x 10.30mm |
| 1 | C11 | 0.1 uF | 0.1µF ±10% 50V Ceramic Capacitor X7R 0603 (1608 Metric) | CGA3E2X7R1H1 04K080AA | 0603 |
| 0 | C12 | DNI | Aluminum Electrolytic Capacitor, 220 uF, +/220µF 25V Aluminum Electrolytic Capacitors Radial, Can - SMD 2000 Hrs @ 105°C | EEE-FK1E221P | 8.30mm x 8.30mm |
| 3 | C13, C14, C19 | 1 uF | 1µF ±10% 25V Ceramic Capacitor X7R 0603 (1608 Metric) | C1608X7R1E105 K080AB | 0603 |
| 3 | C15, C16, C17 | 22uF | 22µF ±10% 25V Ceramic Capacitor X7R 1210 (3225 Metric) | C1210C226K3RA C7800 | 1210 |
| 1 | C18 | 10 nF | 10000pF ±10% 50V Ceramic Capacitor X7R 0603 (1608 Metric) | GRM188R71H10 3KA01D | 0603 |
| 0 | C20 | DNI | 1µF ±10% 25V Ceramic Capacitor X7R 0603 (1608 Metric) | C1608X7R1E105 K080AB | 0603 |
| 0 | CR1 | DNI | Zener Diode 6.2V 150mW ±5% Surface Mount 0603/SOD-523F | CZRU52C6V2 | SOD-523F |
| 1 | D1 | BAS70LP-TP | Diode Schottky 70V 70mA (DC) Surface Mount SOD-882 | BAS70LP-TP | SOD-882 |
| 0 | D2 | DNI | Diode Schottky 120V 15A Surface Mount TO-277-3 | FSV15120V | TO-277-3 |
| 4 | F1, F2, F3, F4 | | Bumper Square, Tapered 0.500" L x 0.500" W (12.70mm x 12.70mm) Polyurethane Black | SJ-5518 | 12.7 x 12.7 mm |

| | | | | | |
|---|----------|--------|--|-------------------|------------------|
| 1 | J1 | | Male2 Position Wire to Board Terminal Block Horizontal with Board 0.100" (2.54mm) Through Hole | 1725656 | 6.2mm x 5.54mm |
| 2 | J2, J3 | | PC Terminal Block, Pitch 6.35 mm, 1 x 2 Position, Height 21.5 mm, Tail Length 5.1 mm, RoHS, Bulk | 1714955 | 19.05mm x 12.5mm |
| 1 | J4 | | SMA High Freq End Launch Jack Receptacle, PCB Mount, 10 MIL Pin, 26.5 GHz, 50 Ohm, -65 to 165 degC, Round Body Radius 6.27 mm, Body Length 9.52 mm, RoHS | 142-0761-881 | 142-0761-881-5 |
| 2 | JP1, JP2 | | 2 Positions Header Connector 0.100" (2.54mm) Through Hole Gold | TSW-102-26-G-S | TSW-102-26-XX-S |
| 1 | L1 | 0.12uH | Fixed Inductors 0.12uH .77mOhms 30A +/- 20% | FCUL0630-H-R12M | 0402-A |
| 2 | PR1, PR2 | | 2 Positions Header Connector 0.050" (1.27mm) Through Hole Gold | GRPB021VWVN-RC | 1.27mm pitch |
| 2 | Q1, Q2 | | 100 V enhancement mode GaN transistor, 19mohm, 100V, 15A | EVG100E15 | 7.52mm x 10.16mm |
| 1 | R1 | 3.3M | 3.3 MOhms ±0.1% 0.25W, 1/4W Chip Resistor 1206 (3216 Metric) | RG3216P-3304-B-T1 | 1206 |
| 0 | R2, R3 | DNI | 0 Ohms Jumper 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thick Film | ERJ-3GEY0R00V | 0603 |
| 1 | R4 | 825K | Thin Film Resistors - SMD 0805 825Kohm 0.1% 25ppm | ERA-6AEB8253V | 0805 |
| 2 | R5, R6 | 0 Ohm | 0 Ohms Jumper 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thick Film | ERJ-3GEY0R00V | 0603 |
| 0 | R7 | DNI | 0 Ohms Jumper 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thick Film | ERJ-3GEY0R00V | 0603 |
| 2 | R8, R14 | 4.7 | 4.7 Ohms ±5% 0.05W, 1/20W Chip Resistor 0201 (0603 Metric) Thick Film | ERJ-1GEJ4R7C | 0201 |
| 1 | R9 | 0 | 0 Ohms Jumper 0.05W, 1/20W Chip Resistor 0201 (0603 Metric) | ERJ-1GN0R00C | 0201 |
| 1 | R10 | 1.0 | 1 Ohms ±5% 0.05W, 1/20W Chip Resistor 0201 (0603 Metric) Thick Film | ERJ-1GEJ1R0C | 0201 |
| 0 | R11 | DNI | 20 kOhms ±1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) | ERJ-3EKF2002V | 0603 |

| | | | | | |
|----|-------------------------|-------------|--|-------------------|-----------------|
| 2 | R12, R13 | 20K | 20 kOhms $\pm 1\%$ 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) | ERJ-3EKF2002V | 0603 |
| 1 | R15 | 2 | 2 Ohms $\pm 1\%$ 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) | CRCW06032R00 FKEA | 0603 |
| 1 | R16 | 0 | 0 Ohms Jumper 0.05W, 1/20W Chip Resistor 0201 (0603 Metric) | ERJ-1GN0R00C | 0201 |
| 1 | R17 | 1.0 | 1 Ohms $\pm 5\%$ 0.05W, 1/20W Chip Resistor 0201 (0603 Metric) Thick Film | ERJ-1GEJ1R0C | 0201 |
| 0 | R18, R21 | DNI | 20 kOhms $\pm 1\%$ 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) | ERJ-3EKF2002V | 0603 |
| 2 | R19, R20 | 500K | 3296 - 3/8 " Square Trimptot(R) Trimming Potentiometer, 500 KOhm, +/- 10%, 0.5 W, -55 to 125 degC, 3-Pin THD, RoHS, Tube | 3296W-1-504 | 9.53mm x 4.83mm |
| i0 | R22, R23 | DNI | 0 Ohms Jumper 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thick Film | ERJ-3GEY0R00V | 0603 |
| 1 | R24 | 10K | 10 kOhms $\pm 1\%$ 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) | ERJ-3EKF1002V | 0603 |
| 2 | SH-JP1, SH-JP2 | | Shunt, 100mil, Gold plated, Black | 969102-0000-DA | Shunt |
| 5 | TP1, TP2, TP3, TP4, TP5 | | Test Point, White, SMT | 5015 | 3.4mm x 1.8mm |
| 1 | U1 | | Single Output LDO, 50 mA, Adjustable 1.2 to 15 V Output, 3 to 24 V Input, 5-pin SC70 (DCK), -40 to 125 degC, Green (RoHS & no Sb/Br) | TPS71501DCKR G4 | DCK5 |
| 1 | U2 | TD99101 | | TD99101 | 3.00mm x 3.0mm |
| 1 | U3 | NC7S08P5XCT | AND Gate IC 1 Channel SC-70-5 | NC7S08P5X | SC70-5 |

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