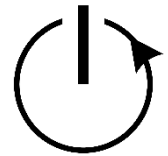


GaN HEMT DYNAMIC R_{DS-ON} EVALUATION PLATFORM



Tell-i Technologies

DESCRIPTION:

The evaluation boards are optimized for GaN HEMT dynamic R_{DS-ON} characterization. Dynamic R_{DS-ON} can be calculated using the DUT (device under test) clamped voltage and current or inductor current. If inductor current is used for dynamic R_{DS-ON} calculation, the shunt resistor can be replaced with a 0Ω shunt making the switch loop even more optimized. The evaluation boards, manufacturing design files, and the BOM (bill of materials) can be acquired separately.

- Inductor current measurement using an ultrafast non-invasive Tell-i current sensor with DC-10 MHz bandwidth.
- Accurate and fast DUT current measurement using coaxial shunt resistor.
- A fast clamp circuit to capture accurate on-state voltage drop across the DUT.
- Easily reconfigurable for different testing scenarios

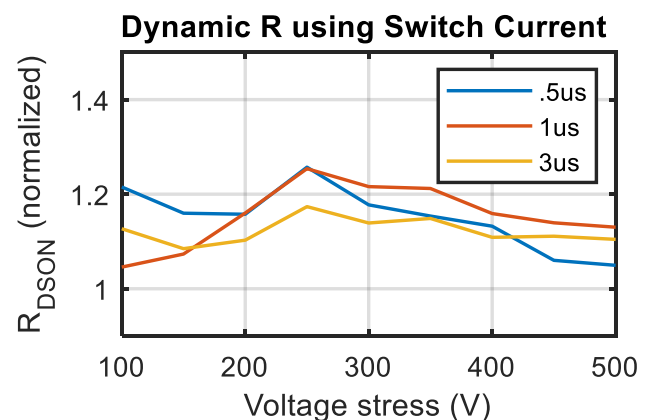


Dynamic R_{DS-ON} Evaluation Board
#Tell-i-Eval-DynR-A



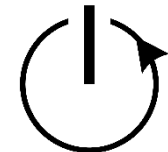
Dynamic R_{DS-ON} Evaluation Board
#Tell-i-Eval-DynR-B

For more information on evaluation boards or designs, visit <https://www.tell-i.com>



Board A- Dynamic R_{DS-ON} vs. voltage stress calculated after different time instances.

GaN HEMT DYNAMIC R_{DS-ON} EVALUATION PLATFORM



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SPECIFICATION:

Table 1: **Tell-i-Eval-DynR-A** specifications

| Parameter | Value | | | Unit | Note |
|---------------------------|-------|------|------|------|------------------------------|
| | Min. | Typ. | Max. | | |
| Control Power supply | 4.5 | 5.0 | 5.5 | V | |
| PWM input logic level | 0 | - | 5 | V | |
| DC+ to DC- | 0 | | 600 | V | |
| Transistor current DC | | | 12 | A | Case temperature below 125°C |
| Transistor current pulse | | | 35 | A | Case temperature below 125°C |
| Operating frequency | | | 1 | MHz | |
| Gate Driver voltage level | -9 | | 4 | V | |

Table 2: **Tell-i-Eval-DynR-B** specifications

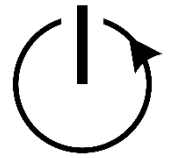
DUT: GS66516B

| Parameter | Value | | | Unit | Note |
|---------------------------|-------|------|------|------|---------------------------|
| | Min. | Typ. | Max. | | |
| Control Power supply | 4.5 | 5.0 | 5.5 | V | |
| PWM input logic level | 0 | - | 5 | V | |
| DC+ to DC- | 0 | | 650 | V | |
| Transistor current DC | | | 47 | A | At 100°C case temperature |
| Transistor current pulse | | | 144 | A | At 100°C case temperature |
| Operating frequency | | | 1 | MHz | |
| Gate Driver voltage level | -3 | | 6 | V | |

FUNCTIONAL DESCRIPTION:

The evaluation board is optimized for dynamic RDSON evaluation in a double or multi-pulse test. Accurate on-state voltage and current through the Device Under Test (DUT) is required for dynamic RDSON calculation. Usually, the DUT current is used for dynamic RDSON calculation, but in a double/multi-pulse test, the inductor current can be used for the dynamic RDSON calculation, as the inductor current is almost equal to the DUT current after few hundred

GaN HEMT DYNAMIC R_{DS-ON} EVALUATION PLATFORM



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nanoseconds from the DUT turn on. This evaluation board has provision of both DUT current and inductor current measurement. For the on-state voltage measurement, a fast clamping circuit is used. The clamping circuit clamps the off-state voltage to 4.0 volts to get higher resolution during the on-state. The functional block diagram of the evaluation board is presented in Figure 1.

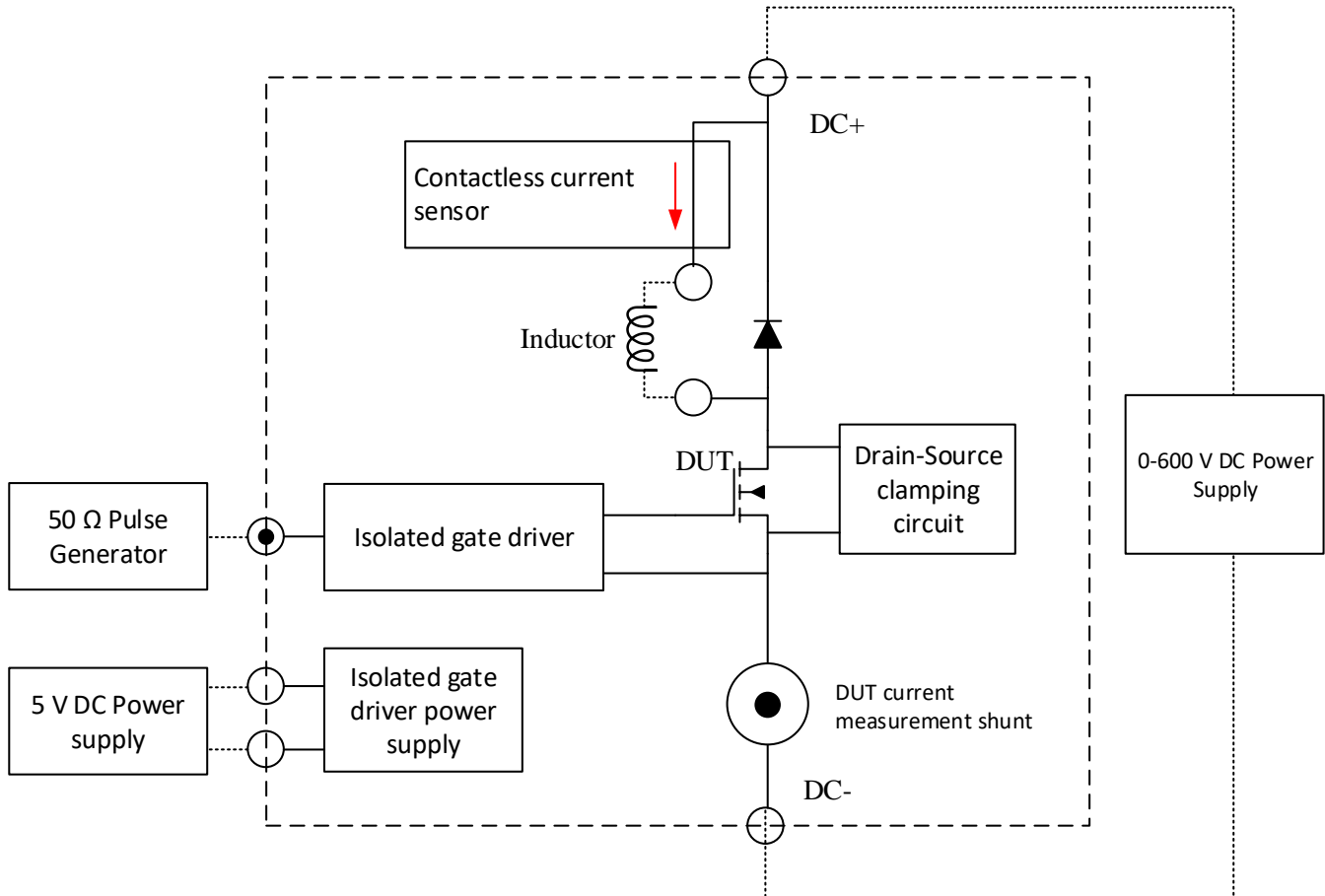
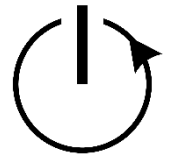


Figure 1. Functional block diagram of the evaluation board.

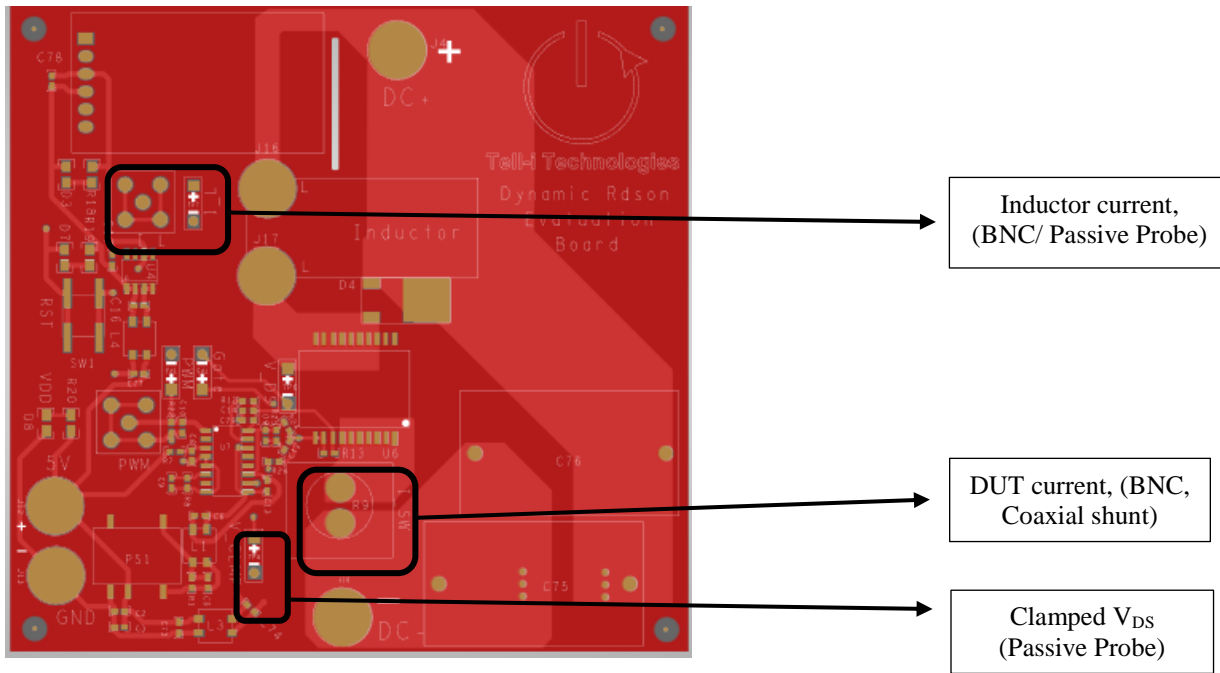
GaN HEMT DYNAMIC R_{DS-ON} EVALUATION PLATFORM



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TEST POINTS:

Tell-i-Eval-DynR-A



Tell-i-Eval-DynR-B

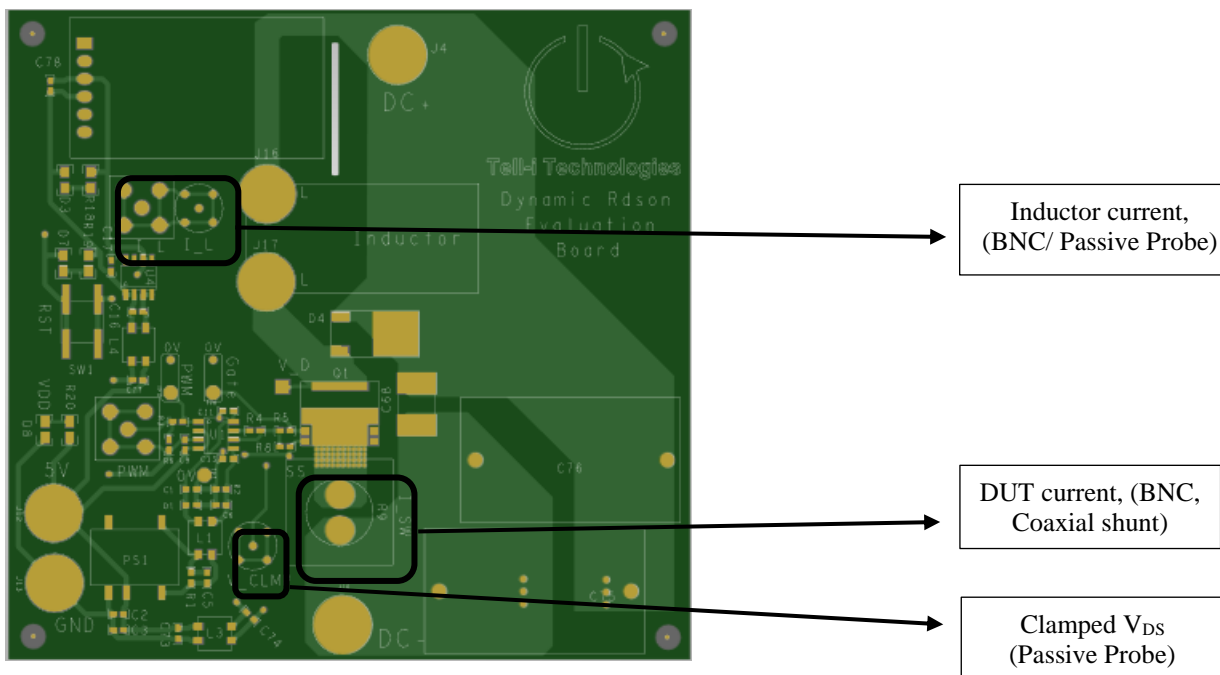
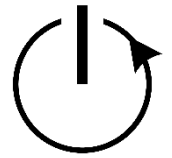


Figure 2. Major test points.

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DYNAMIC R_{DS-ON} CALCULATION:

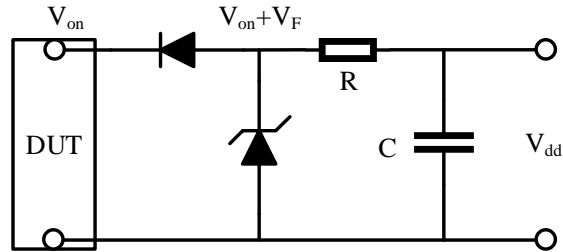


Figure 3. Clamping circuit for on-state voltage measurement.

On-state voltage:

$$V_{DS-ON} = V_{clamp} - V_F \dots (\text{Eqn. 1})$$

Where V_F is the forward voltage drop in the clamping circuit diode. Part number of the diode can be found in the BOM. Calibrated simplified equation of the diode current and forward voltage drop is given below:

$$V_F = 0.81 + 1.5 I_F \dots (\text{Eqn. 2})$$

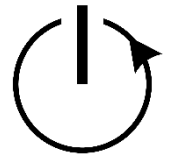
I_F is the forward diode current. Which can be found using the equation below:

$$I_F = (V_{dd} - V_{clamp})/R \dots (\text{Eqn. 3}) \quad (R= 100 \Omega)$$

$$R_{DS-ON} = \frac{V_{DS-ON}}{I} \dots (\text{Eqn. 4})$$

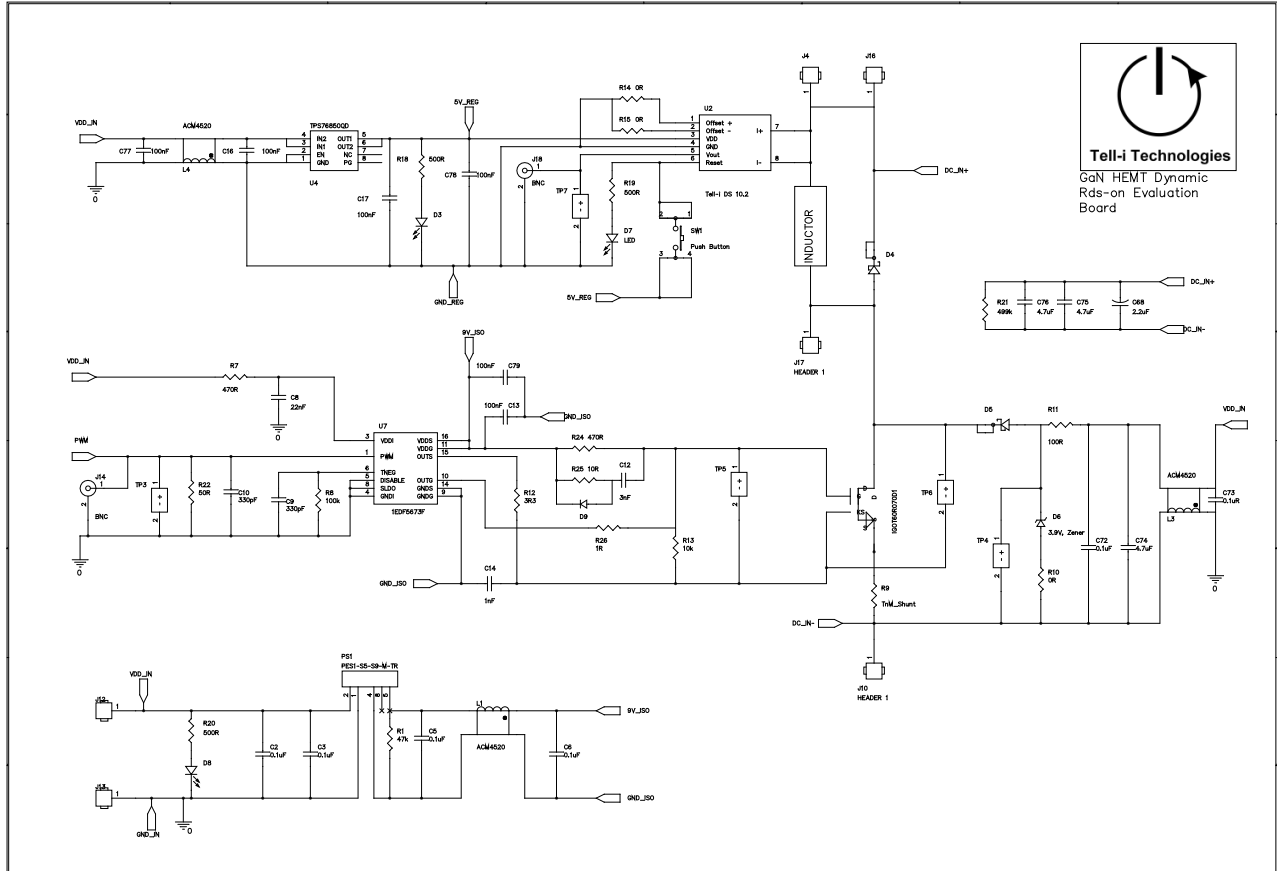
Where I is DUT current or inductor current.

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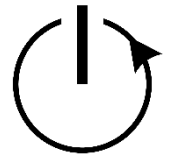


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COMPLETE SCHEMATIC Tell-i-Eval-DynR-A

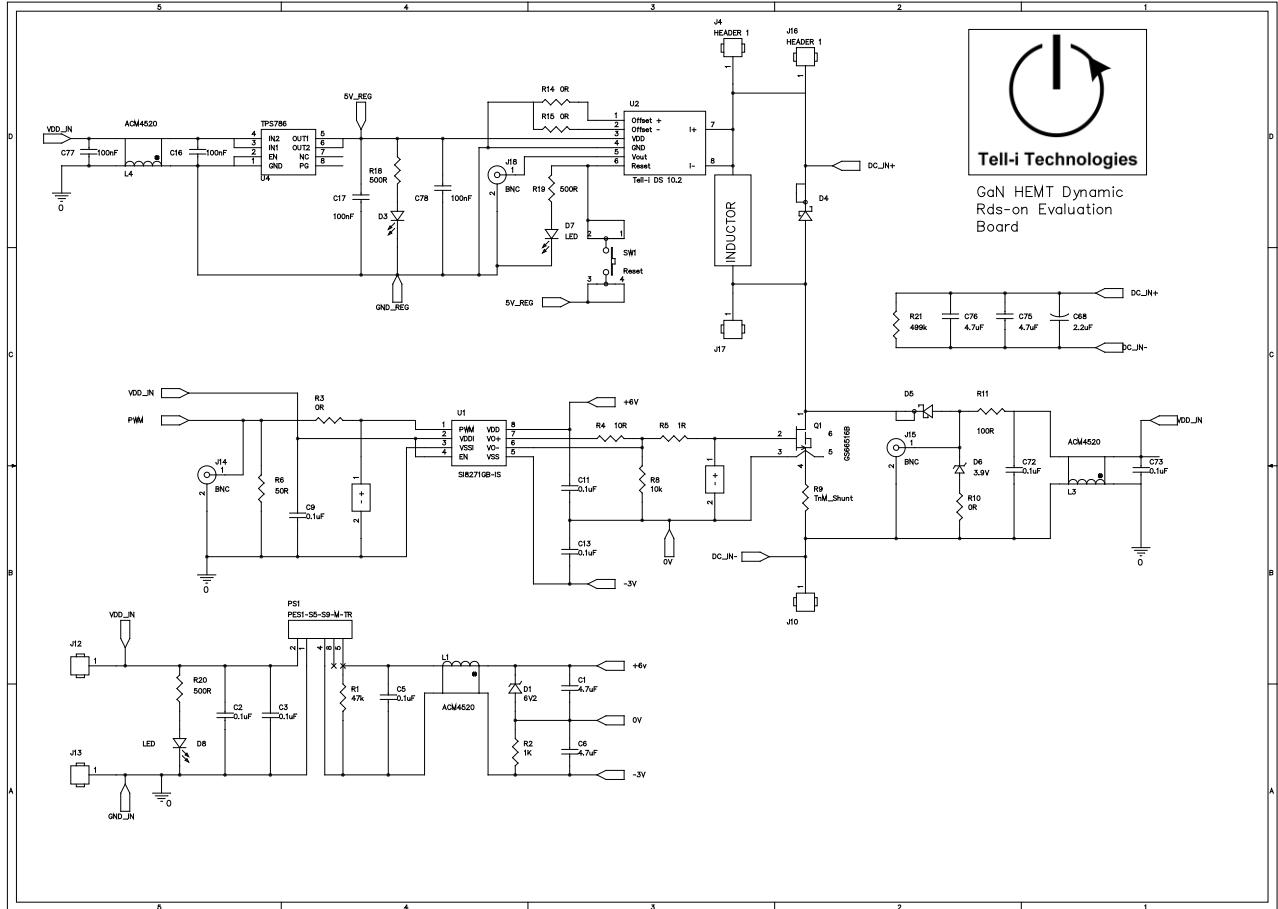


GaN HEMT DYNAMIC R_{DS-ON} EVALUATION PLATFORM

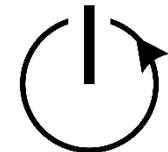


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Tell-i-Eval-DynR-B



GaN HEMT DYNAMIC R_{DS-ON} EVALUATION PLATFORM



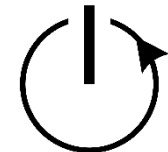
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BILL OF MATERIAL:

Tell-i-Eval-DynR-A

| Item | Quantity | Reference | Value / Part # | Description |
|------|----------|-------------------------|-----------------|----------------------------|
| 1 | 5 | C2,C3,C5,C6,C72 | 0.1uF | Ceramic capacitor 0603 |
| 2 | 1 | C8 | 22nF | Ceramic capacitor 0603 |
| 3 | 2 | C9,C10 | 330pF | Ceramic capacitor 0603 |
| 4 | 1 | C12 | 3nF | Ceramic capacitor 0603 |
| 5 | 6 | C13,C16,C17,C77,C78,C79 | 100nF | Ceramic capacitor 0603 |
| 6 | 1 | C14 | 1nF | Ceramic capacitor 0603 |
| 7 | 1 | C68 | 2.2uF | Ceramic capacitor 2220 |
| 8 | 1 | C73 | 0.1uR | Ceramic capacitor 0603 |
| 9 | 3 | C74,C75,C76 | 4.7uF | Film capacitor |
| 10 | 3 | D3,D7,D8 | LED | LED 0603 |
| 11 | 1 | D4 | C3D08065E | SiC schottkey diode |
| 12 | 1 | D5 | CSD01060 | Schottkey diode |
| 13 | 1 | D6 | 3.9V | Zener diode |
| 14 | 1 | D9 | 30V 200 mA | Schottkey diode |
| 15 | 6 | J4,J10,J12,J13,J16,J17 | | Bushing type connector |
| 16 | 2 | J14,J18 | | SMA connector |
| 17 | 3 | L1,L3,L4 | ACM4520 | Comon mode choke |
| 18 | 1 | PS1 | PES1-S5-S9-M-TR | Isolated power supply |
| 19 | 1 | R1 | 47k | 1/4 W Resistor 0603 |
| 20 | 2 | R7,R24 | 470R | 1/4 W Resistor 0603 |
| 21 | 1 | R8 | 100k | 1/4 W Resistor 0603 |
| 22 | 1 | R9 | TnM_Shunt | Coaxial shunt resistor |
| 23 | 3 | R10,R14,R15 | 0R | Jumper resistor |
| 24 | 1 | R11 | 100R | 1/4 W Resistor 0603 |
| 25 | 1 | R12 | 3R3 | 1/4 W Resistor 0603 |
| 26 | 1 | R13 | 10k | 1/4 W Resistor 0603 |
| 27 | 3 | R18,R19,R20 | 500R | 1/4 W Resistor 0603 |
| 28 | 1 | R21 | 499k | 1 W Resistor 2220 |
| 29 | 1 | R22 | 50R | 1/4 W Resistor 0603 |
| 30 | 1 | R25 | 10R | 1/4 W Resistor 0603 |
| 31 | 1 | R26 | 1R | 1/4 W Resistor 0603 |
| 32 | 1 | SW1 | Push Button | Pushbutton switch |
| 33 | 5 | TP3,TP4,TP5,TP6,TP7 | Test Point | Test point |
| 34 | 1 | U2 | Tell-i DS 10.2 | Contactless current sensor |
| 35 | 1 | U4 | TPS76850QD | Linear regulator |

GaN HEMT DYNAMIC R_{DS-ON} EVALUATION PLATFORM



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| | | | | |
|----|---|----|--------------|----------------------|
| 36 | 1 | U6 | IGOT60R070D1 | 600 V GaN Transistor |
| 37 | 1 | U7 | 1EDF5673F | GaN Gate driver |

Tell-i-Eval-DynR-B

| Item | Quantity | Reference | Value / Part # | Description |
|------|----------|-----------------------------|-----------------|----------------------------|
| 1 | 4 | C1,C6,C75,C76 | 4.7uF | Ceramic capacitor 0603 |
| 2 | 8 | C2,C3,C5,C9,C11,C13,C72,C73 | 0.1uF | Ceramic capacitor 0603 |
| 3 | 4 | C16,C17,C77,C78 | 100nF | Ceramic capacitor 0603 |
| 4 | 1 | C68 | 2.2uF | Ceramic capacitor 2220 |
| 5 | 1 | D1 | 6V2 | Zener diode |
| 6 | 3 | D3,D7,D8 | LED | LED 0603 |
| 7 | 1 | D4 | C3D08065E | SiC schottkey diode |
| 8 | 1 | D5 | CSD01060 | Schottkey diode |
| 9 | 1 | D6 | 3.9V | Zener diode |
| 10 | 6 | J4,J10,J12,J13,J16,J17 | | Bushing type connector |
| 11 | 3 | J14,J15,J18 | | SMA connector |
| 12 | 3 | L1,L3,L4 | ACM4520 | Comon mode choke |
| 13 | 1 | PS1 | PES1-S5-S9-M-TR | Isolated power supply |
| 14 | 1 | Q1 | GS66516B | 650 V GaN Transistor |
| 15 | 1 | R1 | 47k | 1/4 W Resistor 0603 |
| 16 | 1 | R2 | 1K | 1/4 W Resistor 0603 |
| 17 | 4 | R3,R10,R14,R15 | 0R | 1/4 W Resistor 0603 |
| 18 | 1 | R4 | 10R | 1/4 W Resistor 0603 |
| 19 | 1 | R5 | 1R | 1/4 W Resistor 0603 |
| 20 | 1 | R6 | 50R | 1/4 W Resistor 0603 |
| 21 | 1 | R8 | 10k | 1/4 W Resistor 0603 |
| 22 | 1 | R9 | TnM_Shunt | 1/4 W Resistor 0603 |
| 23 | 1 | R11 | 100R | 1/4 W Resistor 0603 |
| 24 | 3 | R18,R19,R20 | 500R | 1/4 W Resistor 0603 |
| 25 | 1 | R21 | 499k | 1 W Resistor 2220 |
| 26 | 1 | SW1 | | Pushbutton switch |
| 27 | 2 | TP6,TP10 | Test Point | Test Point |
| 28 | 1 | U1 | SI8271GB-IS | GaN Gate driver |
| 29 | 1 | U2 | Tell-i DS 10.2 | Contactless current sensor |
| 30 | 1 | U4 | TPS76850QD | Linear regulator |