

### General Description

This silicon carbide Power MOSFET device has been developed using ZMJ's advanced 2nd generation SiC MOSFET technology. The device features a very low  $R_{DS(on)}$  over the entire temperature range combined with low capacitances and very high switching operations. It improves application performance in frequency, energy efficiency, system size and weight reduction.

### Features

- High Blocking Voltage
- High Speed Switching With Low Capacitances
- Low  $R_{DS(on)}$  to Minimize Conductive Loss
- Low Gate Charge For Fast Switching
- Low Thermal Resistance
- 100% Avalanche Tested
- AEC-Q101 Qualified

### Application

- Motor Drives
- On Board Charger
- DC-DC
- Auxiliary Drives

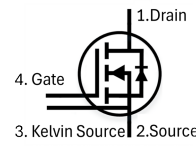
### Ordering Information:

|                           |               |
|---------------------------|---------------|
| Part NO.                  | ZMCA040R120C4 |
| Marking                   | ZMC040R120    |
| Packing Information       | TUBE          |
| Basic ordering unit (pcs) | 600           |

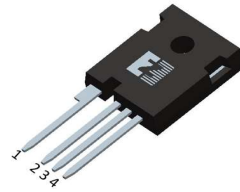
### Absolute Maximum Ratings ( $T_A=25^{\circ}\text{C}$ , unless otherwise specified)

| Parameter                         | Symbol        | Conditions                                                       | Min. | Max. | Unit               |
|-----------------------------------|---------------|------------------------------------------------------------------|------|------|--------------------|
| Drain-Source Voltage              | $V_{DS}$      |                                                                  | -    | 1200 | V                  |
| Gate-Source Voltage①              | $V_{GS}$      | Transient Voltage                                                | -10  | 25   | V                  |
|                                   | $V_{GS}$      | Static Voltage                                                   | -10  | 24   | V                  |
| Recommended turn on gate voltage  | $V_{GS(on)}$  |                                                                  | 15   | 18   | V                  |
| Recommended turn off gate voltage | $V_{GS(off)}$ |                                                                  | -4   | 0    | V                  |
| Continuous Drain Current          | $I_D$         | $V_{GS}=18\text{V}, T_C=25^{\circ}\text{C}$                      | -    | 54   | A                  |
|                                   | $I_D$         | $V_{GS}=18\text{V}, T_C=75^{\circ}\text{C}$                      | -    | 44   | A                  |
|                                   | $I_D$         | $V_{GS}=18\text{V}, T_C=100^{\circ}\text{C}$                     | -    | 38   | A                  |
| Pulsed Drain Current ①            | $I_{DM}$      | Pulsed; $t_p \leq 10 \mu\text{s}$ ; $T_C = 25^{\circ}\text{C}$ ; | -    | 216  | A                  |
| Total Power Dissipation           | $P_D$         | $T_C=25^{\circ}\text{C}$                                         | -    | 221  | W                  |
| Total Power Dissipation           | $P_D$         | $T_A=25^{\circ}\text{C}$                                         | -    | 3.8  | W                  |
| Operating Junction Temperature    | $T_J$         |                                                                  | -55  | 175  | $^{\circ}\text{C}$ |
| Storage Temperature               | $T_{STG}$     |                                                                  | -55  | 175  | $^{\circ}\text{C}$ |
| Single Pulse Avalanche Energy     | $E_{AS}$      | $L=0.5\text{mH}, V_{GS}=18\text{V}, R_g=25\Omega$ ,              | -    | 529  | mJ                 |
| ESD Level (HBM)                   | CLASS 2       |                                                                  |      |      |                    |

### Product Summary



$V_{DS} = 1200\text{V}$   
 $R_{DS(on)} = 37\text{m}\Omega$   
 $I_D = 54\text{A}$



TO-247-4



**•Thermal resistance**

| Parameter                            | Symbol         | Min. | Typ. | Max. | Unit |
|--------------------------------------|----------------|------|------|------|------|
| Thermal resistance, junction - case  | $R_{thJC}$     | -    | -    | 0.68 | °C/W |
| Thermal resistance, junction-ambient | $R_{thJA}^{②}$ | -    | -    | 40   | °C/W |
| Soldering temperature                | Tsold          | -    | -    | 260  | °C   |

**•Electronic Characteristics (Tj=25°C,unless otherwise specified)**

| Parameter                         | Symbol       | Condition                              | Min. | Typ. | Max. | Unit       |
|-----------------------------------|--------------|----------------------------------------|------|------|------|------------|
| Drain-Source Breakdown Voltage    | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$              | 1200 | -    | -    | V          |
| Gate Threshold Voltage            | $V_{GS(TH)}$ | $V_{GS}=V_{DS}, I_D=5mA$               | 2    | 2.8  | 4    | V          |
| Drain-Source Leakage Current      | $I_{DSS}$    | $V_{GS}=0V, V_{DS}=1200V$              | -    | -    | 10   | $\mu A$    |
| Gate- Source Leakage Current      | $I_{GSS}$    | $V_{GS}=-10V, V_{DS}=0V$               | -    | -    | -100 | nA         |
|                                   | $I_{GSS}$    | $V_{GS}=25V, V_{DS}=0V$                | -    | -    | 100  | nA         |
| Static Drain-source On Resistance | $R_{DS(ON)}$ | $V_{GS}=18V, I_D=30A, T_J=25^\circ C$  | -    | 37   | 44   | m $\Omega$ |
|                                   |              | $V_{GS}=18V, I_D=30A, T_J=175^\circ C$ | -    | 62.5 | -    | m $\Omega$ |
|                                   |              | $V_{GS}=15V, I_D=30A, T_J=25^\circ C$  | -    | 44   | -    | m $\Omega$ |
| Forward Transconductance          | $g_{FS}$     | $V_{DS}=10V, I_{SD}=30A$               | -    | 7.5  | -    | S          |
| Diode Forward Voltage             | $V_{FSD}$    | $V_{GS}=-4V, I_{SD}=30A$               | -    | 4.4  | 5    | V          |

**•Dynamic characteristics (Tj=25°C,unless otherwise specified)**

| Parameter                    | Symbol       | Condition                                            | Min. | Typ. | Max. | Unit     |
|------------------------------|--------------|------------------------------------------------------|------|------|------|----------|
| Input capacitance            | $C_{iss}$    | $f=100KHz, V_{DS}=800V, V_{GS}=0V$                   | -    | 2226 | -    | pF       |
| Output capacitance           | $C_{oss}$    |                                                      | -    | 95   | -    |          |
| Reverse transfer capacitance | $C_{rss}$    |                                                      | -    | 3    | -    |          |
| Output Charge                | $Q_{oss}$    | $f=100KHz, V_{GS}=0V, V_{DS}=0V \text{ to } 800V$    | -    | 131  | -    | nC       |
| Coss Stored Energy           | $E_{oss}$    |                                                      | -    | 36   | -    | $\mu J$  |
| Gate Resistance              | $R_g$        | $f=1MHz$                                             | -    | 0.9  | -    | $\Omega$ |
| Total gate charge            | $Q_g$        | $V_{DD}=800V, I_D=30A, V_{GS}=-4V/18V$               | -    | 87.1 | -    | nC       |
| Gate - Source charge         | $Q_{gs}$     |                                                      | -    | 27.5 | -    |          |
| Gate - Drain charge          | $Q_{gd}$     |                                                      | -    | 29.3 | -    |          |
| Turn-ON Delay time           | $t_{D(on)}$  | $V_{GS}=-4V/18V, V_{DS}=800V, R_G=10\Omega, I_D=30A$ | -    | 18   | -    | ns       |
| Turn-ON Rise time            | $t_r$        |                                                      | -    | 36   | -    | ns       |
| Turn-Off Delay time          | $t_{D(off)}$ |                                                      | -    | 48   | -    | ns       |
| Turn-Off Fall time           | $t_f$        |                                                      | -    | 71   | -    | ns       |
| Turn-On Energy               | $E_{on}$     |                                                      | -    | 1068 | -    | $\mu J$  |
| Turn-Off Energy              | $E_{off}$    |                                                      | -    | 1080 | -    | $\mu J$  |
| Reverse Recovery Time        | $t_{rr}$     |                                                      | -    | 24   | -    | ns       |
| Reverse Recovery Charge      | $Q_{rr}$     | $V_{DD}=100V, dI_S/dt=260A/\mu s, I_S=30A$           | -    | 50   | -    | nC       |

Fig.1 Gate-source voltage as a function of gate charge; Typical values;  $T_j=25^\circ\text{C}$

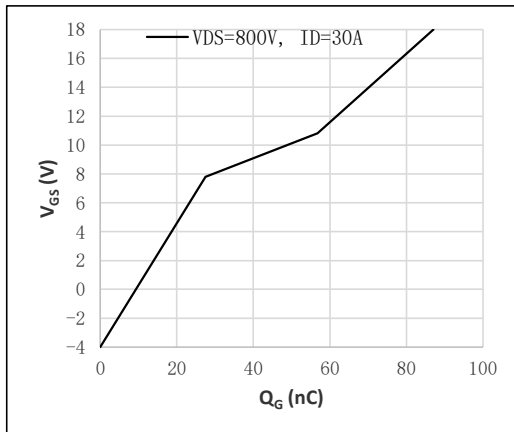


Fig.2 Input, output and reverse transfer capacitances as a function of drain-source voltage; Typical values;  $T_j=25^\circ\text{C}$

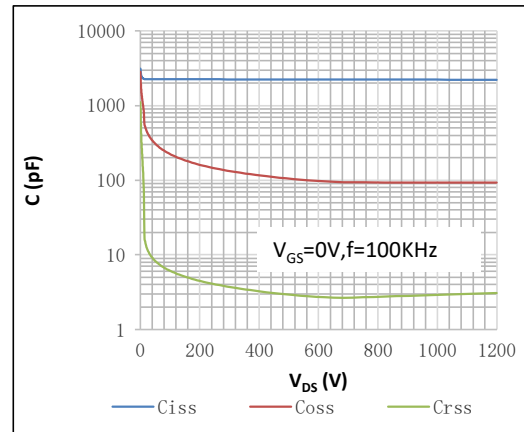


Fig.3 Output characteristics: drain current as a function of drain-source voltage; Typical values;  $T_j=25^\circ\text{C}$

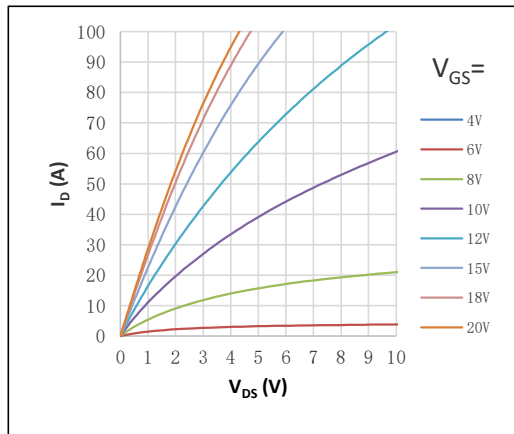


Fig.4 Output characteristics: drain current as a function of drain-source voltage; Typical values: Expanded curve;  $T_j=25^\circ\text{C}$

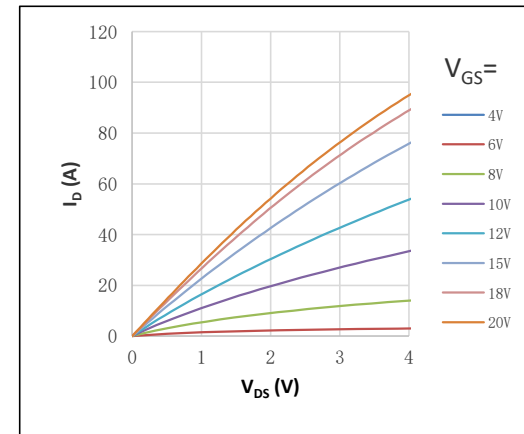


Fig.5 Gate-source threshold voltage as a function of junction temperature; Typical values

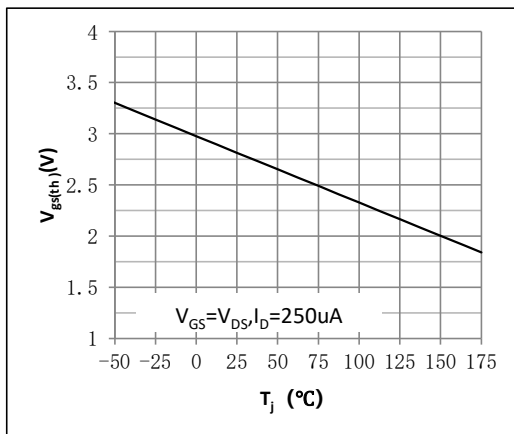


Fig.6 Drain-source on-state resistance as a function of drain current; Typical values;  $T_j=25^\circ\text{C}$

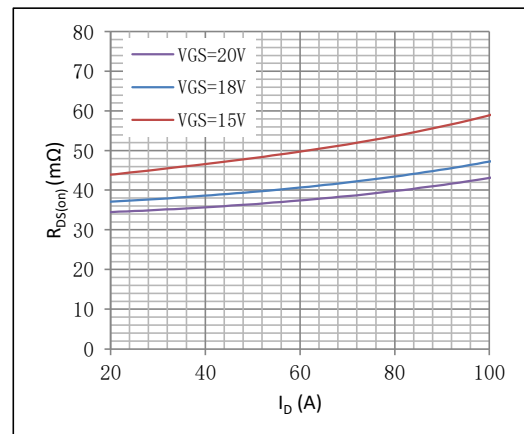


Fig.7 Drain-source on-state resistance as a function of gate-source voltage;Typical values

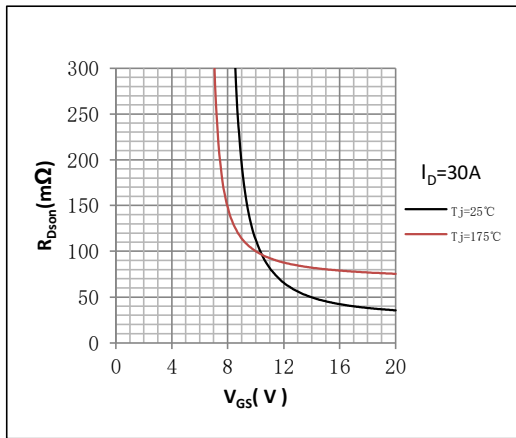


Figure 9. Source (diode forward) current as a function of source-drain (diode forward) voltage ;Typical values

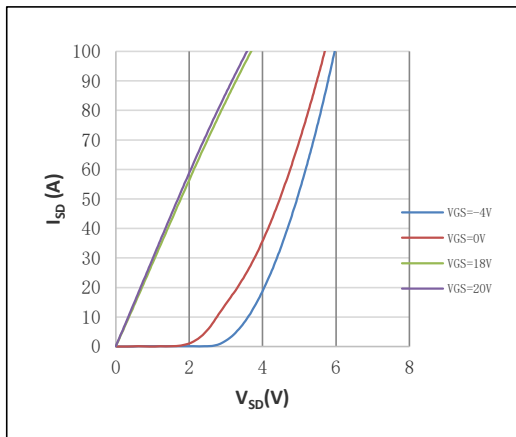


Fig.11 Safe operating area: continuous and peak drain currents as a function of drain-source voltage;Calculative values

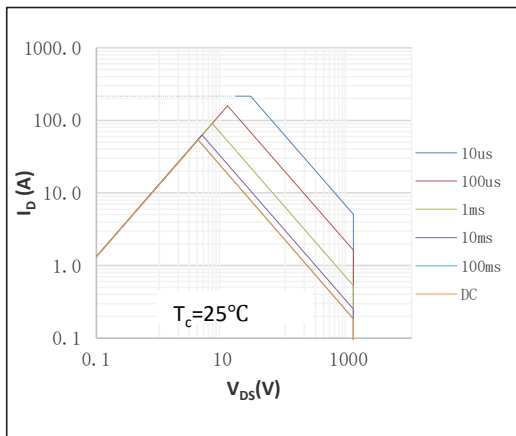


Fig.8 Normalized drain-source on-state resistance factor as a function of junction temperature;Typical values  
Normalized On-Resistance= $R_{DS(on)}/R_{DS(on)}(25^{\circ}\text{C})$

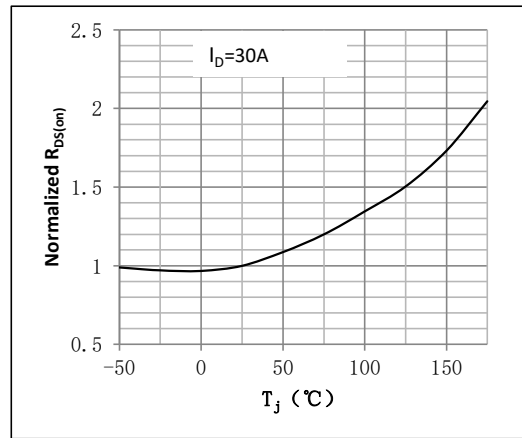


Figure 10. Transfer characteristics: drain current as a function of gate-source voltage;Typical values

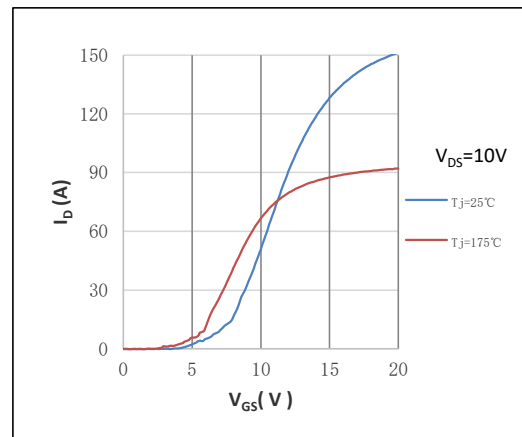


Fig.12 Continuous drain current as a function of case temperature<sup>Θ</sup>;Calculative values

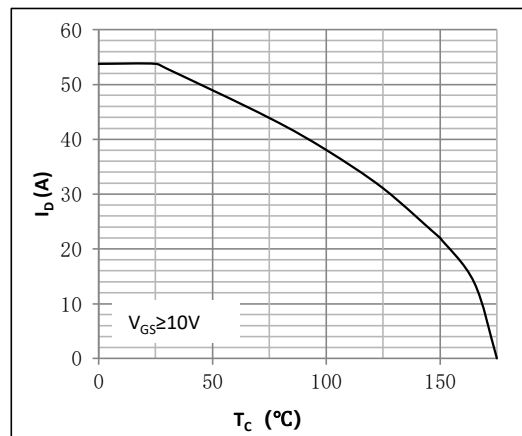


Fig.13 Drain-source breakdown voltage as a function of junction temperature; Typical values  
Normalized BVDSS=BVDSS/BVDSS(25°C)

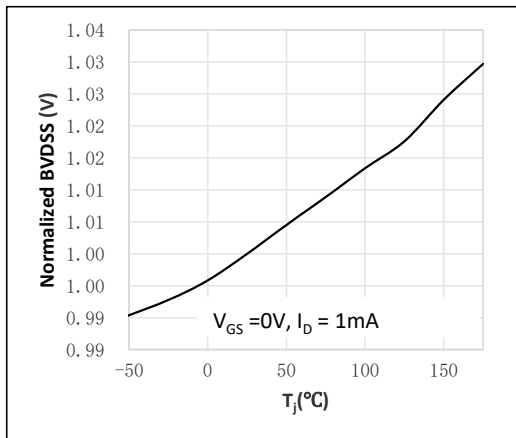


Fig.14 Normalized total power dissipation as a function of case temperature; Calculative values  
Normalized Power Dissipation= $P_d/P_d(25^\circ C)$

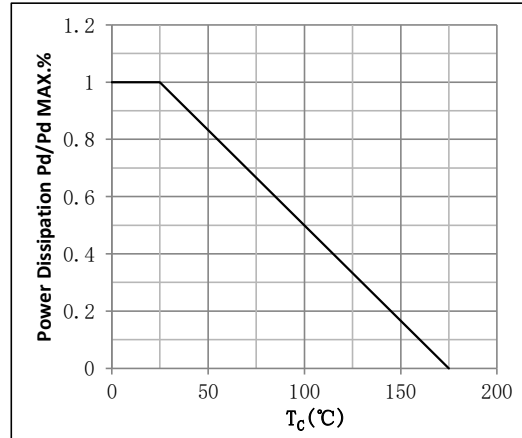


Fig.15 Transient thermal impedance from junction to case as a function of pulse duration; max values

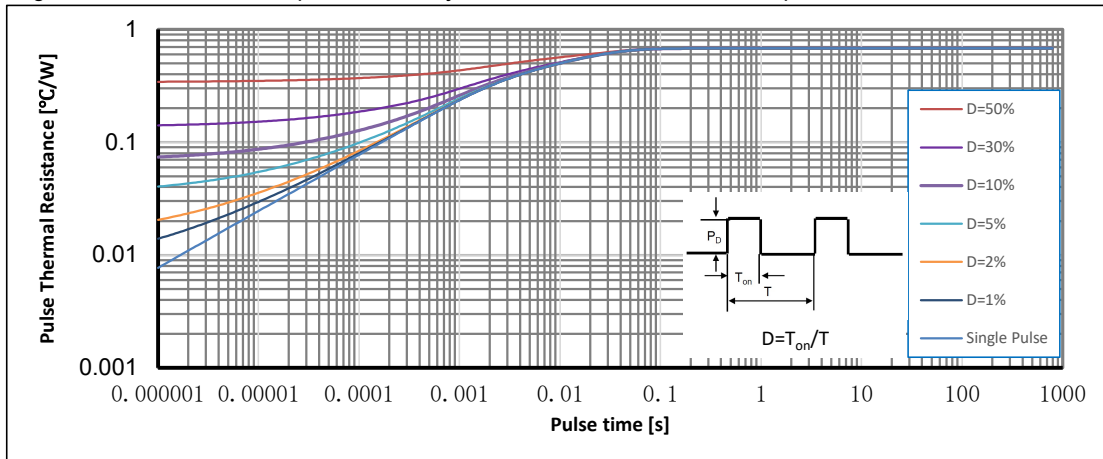
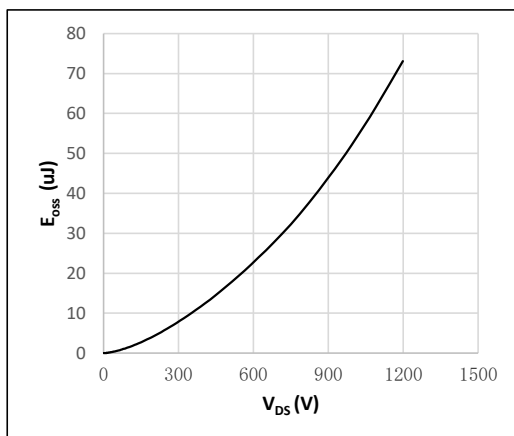
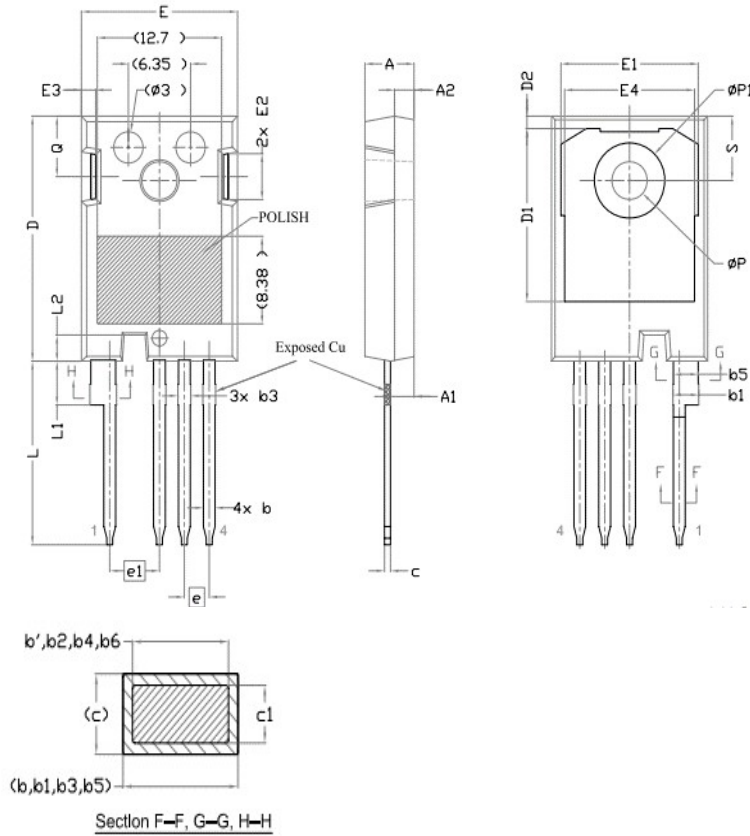


Fig.16 Output capacitor stored energy as a function of drain-source voltage; Typical values;  
 $T_j=25^\circ C$



•TO-247-4 Package Outline



| SYMBOL | DIMENSIONS |       |       |
|--------|------------|-------|-------|
|        | MIN.       | NOM.  | MAX.  |
| A      | 4.83       | 5.02  | 5.21  |
| A1     | 2.29       | 2.41  | 2.54  |
| A2     | 1.91       | 2.00  | 2.16  |
| b'     | 1.07       | 1.20  | 1.28  |
| b      | 1.07       | 1.20  | 1.33  |
| b1     | 2.39       | 2.67  | 2.94  |
| b2     | 2.39       | 2.67  | 2.84  |
| b3     | 1.07       | 1.30  | 1.60  |
| b4     | 1.07       | 1.30  | 1.50  |
| b5     | 2.39       | 2.53  | 2.69  |
| b6     | 2.39       | 2.53  | 2.64  |
| c      | 0.55       | 0.60  | 0.68  |
| c1     | 0.55       | 0.60  | 0.65  |
| D      | 23.30      | 23.45 | 23.60 |
| D1     | 16.25      | 16.55 | 17.65 |
| D2     | 0.95       | 1.19  | 1.25  |
| E      | 15.75      | 15.94 | 16.13 |
| E1     | 13.10      | 14.02 | 14.15 |
| E2     | 3.68       | 4.40  | 5.10  |
| E3     | 1.00       | 1.45  | 1.90  |
| E4     | 12.38      | 13.26 | 13.43 |
| e      | 2.54 BSC   |       |       |
| e1     | 5.08 BSC   |       |       |
| L      | 17.31      | 17.57 | 17.82 |
| L1     | 3.97       | 4.19  | 4.37  |
| L2     | 2.35       | 2.50  | 2.65  |
| ØP     | 3.51       | 3.61  | 3.65  |
| ØP1    | 7.19 REF.  |       |       |
| Q      | 5.49       | 5.79  | 6.00  |
| S      | 6.04       | 6.17  | 6.30  |

**Note:**

- ① The value of R $\theta$ JA is measured with the device in a still environment with TA=25°C
- ② Practically the current will be limited by PCB, thermal design and operating temperature. VGS=18V.

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| Version | Date      | Change |
|---------|-----------|--------|
| A       | 2025/2/19 | New    |
|         |           |        |
|         |           |        |
|         |           |        |
|         |           |        |