# ADR020B12MC

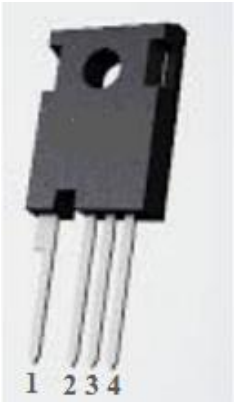
1200V / 20mΩ N-channel SiC Power MOSFET

ACTRON TECHNOLOGY CORP.

## Features

- Best thermal conductivity and behavior
- High speed switching
- High robustness of dv/dt
- Low capacitances and low gate charge
- Low gate resistance for high-frequency switching
- Easy to parallel

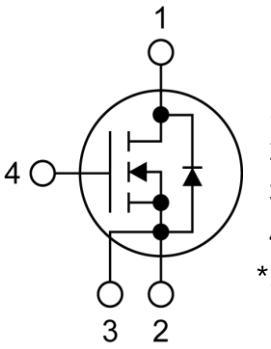
## Outline (TO247-4L)




## Applications

- Switching mode power supply
- PV inverter
- Uninterruptible Power Supply
- Motor Drives
- DC/DC converters
- EV charging

## Circuit Diagram

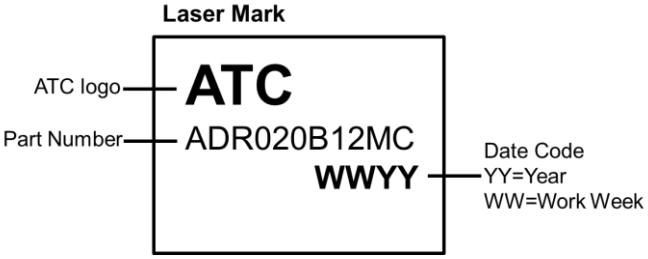



1: Drain
2: Power Source
3: Driver Source
4: Gate
*1: Body Diode

## Mechanical Characteristics

- TO247-4L package
- Halogen Free
- Pb free lead plating ; RoHS compliant
- Packaging: Tube

## Marking Diagram



## Absolute Maximum Rating (Ta = 25°C)

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DSS}$ | Drain-Source voltage | 1200 | V |
| $V_{GSS}$ | Gate-Source voltage (DC) | -4 to 20 | V |
| $I_D$ | Continuous Drain Current | 95 | A |
| $I_{DP}$ | Pulse Drain Current | 190 | A |
| $T_j$ | Junction temperature | 175 | °C |
| $T_{STG}$ | Storage temperature | -55/+175 | °C |
| $P_D$ | Power dissipation | 465 | W |

## Thermal characteristics

| Parameter | Symbol | Condition | Typ. | Unit |
|---|---|---|---|---|
| Thermal resistance | $\theta$ jc | Junction - Case | 0.2 | ℃ / W |

## Electrical Characteristics (Ta = 25 °C)

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Condition |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-Source breakdown voltage | 1200 | - | - | V | $V_{GS}$ = 0V, $I_D$=250uA |
| $I_{DSS}$ | Zero gate voltage drain current | -<br>- | 6.0<br>12 | 60<br>- | uA | $V_{DS}$=1200V, $V_{GS}$ = 0V,$T_j$= 25 °C<br>$V_{DS}$=1200V, $V_{GS}$ = 0V,$T_j$=150 °C |
| $R_{DS(on)}$ | Drain-Source on-state resistance | -<br>- | 20<br>40 | 26<br>- | mΩ | $V_{GS}$ = 18V, $I_D$ = 47.5A, $T_j$=25 °C<br>$V_{GS}$ = 18V, $I_D$ = 47.5A, $T_j$=125°C |
| $V_{GS(th)}$ | Gate threshold voltage | 2.0 | - | 3.0 | V | $V_{DS}$ = 10V, $I_D$ = 10mA |
| $I_{GSS+}$ | Gate-Source leakage current | - | - | 100 | nA | $V_{GD}$ = 20V, $V_{DS}$ = 0V |
| $I_{GSS-}$ | Gate-Source leakage current | - | - | -100 | nA | $V_{GD}$ = -4V, $V_{DS}$ = 0V |
| $R_G$ | Gate resistance | - | 2.0 | - | Ω | f = 1MHz, open drain |

## *Electrical Characteristics (Ta = 25 °C)*

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Condition |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | - | 5600 | - | pF | $V_{GS}$ = 0V<br>$V_{DS}$ = 800V<br>f = 1MHz |
| $C_{oss}$ | Output capacitance | - | 210 | - | pF | |
| $C_{rss}$ | Reverse capacitance | - | 30 | - | pF | |
| $Q_g$ | Total gate charge | - | 280 | - | nC | $V_{DS}$ = 800V<br>$I_D$ = 47.5A<br>$V_{GS}$ = 18V |
| $Q_{gs}$ | Gate to source charge | - | 45 | - | nC | |
| $Q_{gd}$ | Gate to drain charge | - | 110 | - | nC | |
| $t_{d(on)}$ | Turn - on delay time | - | 31 | - | ns | $V_{DS}$=800V<br>$V_{GS}$=0V/+18V<br>$R_{GS}$=2Ω |
| $t_r$ | Rise time | - | 34 | - | ns | |
| $t_{d(off)}$ | Turn - off delay time | - | 70 | - | ns | |
| $t_f$ | Fall time | - | 14 | - | ns | |

## *Body diode Electrical Characteristics (Ta = 25 °C)*

| Symbol | Parameter | Min. | Typ. | Max. | Units | Test Condition |
|---|---|---|---|---|---|---|
| $I_S$ | Body diode continuous, forward current | - | - | 95 | A | |
| $V_{SD}$ | Diode forward voltage | - | 4 | - | V | $V_{GS}$ = 0V, $I_S$ = 47.5A |
| $t_{rr}$ | Reverse recovery time | | 36 | | ns | $I_{SD}$=47.5A<br>$V_R$=800V<br>di/dt=1000A/us |
| $I_{rrm}$ | Peak reverse recovery current | | 20 | | A | |

**Typical Output Characteristics (I)**

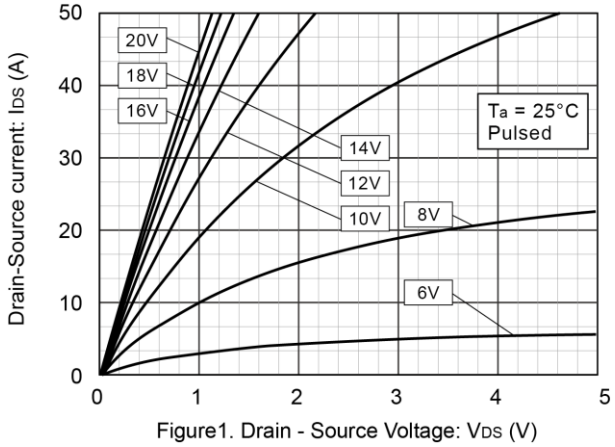


Figure1. Drain - Source Voltage: VDS (V)

**Typical Output Characteristics (II)**

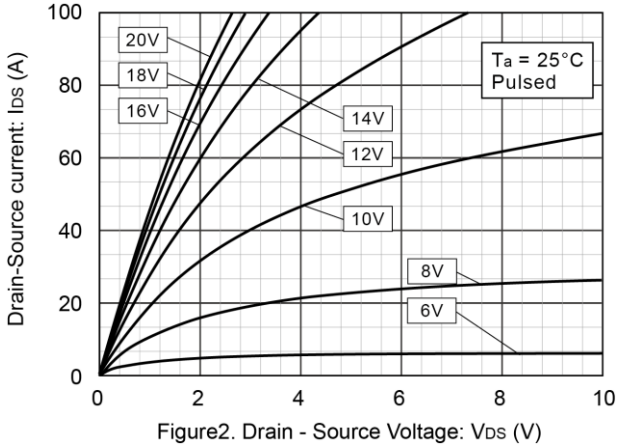


Figure2. Drain - Source Voltage: VDS (V)

**Typical Output Characteristics (III)** Ta =150ºC

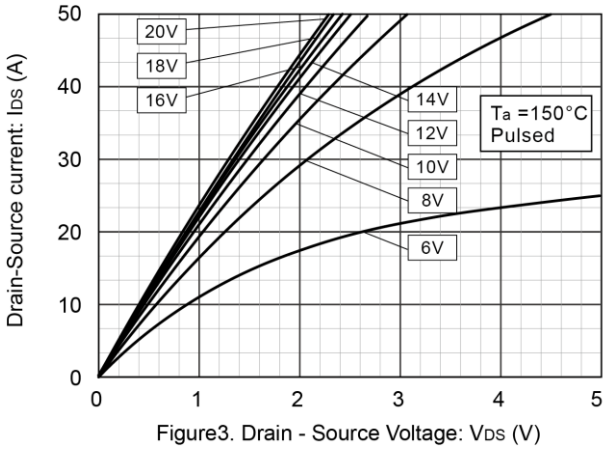


Figure3. Drain - Source Voltage: VDS (V)

**Typical Output Characteristics (IV)** Ta =150ºC

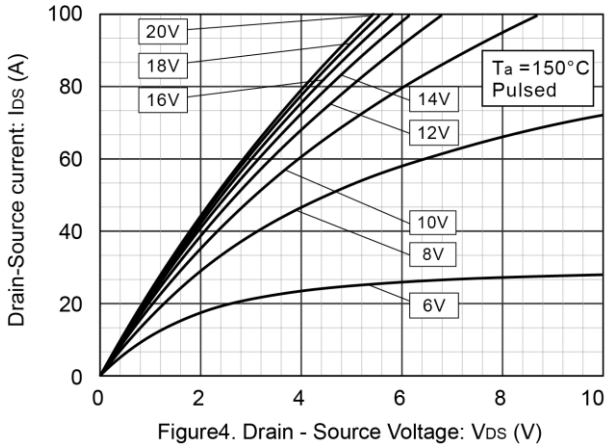


Figure4. Drain - Source Voltage: VDS (V)

### Typical Transfer Characteristics (I)

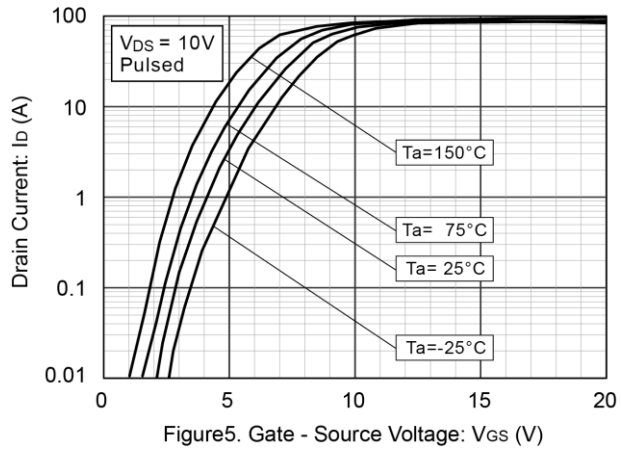


Figure5. Gate - Source Voltage: VGS (V)

### Typical Transfer Characteristics (II)

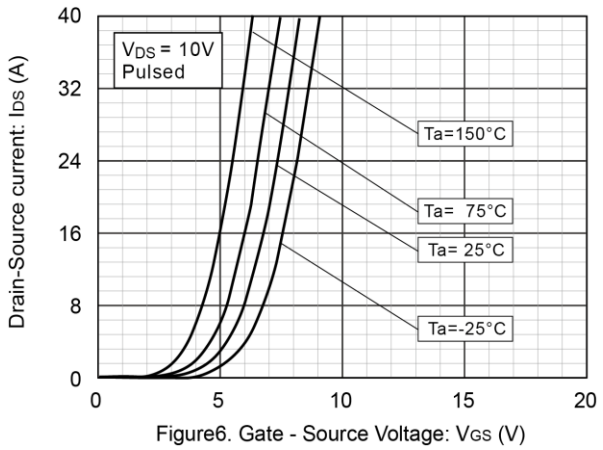


Figure6. Gate - Source Voltage: VGS (V)

### Drain – Source Voltage vs. Source - Drain current

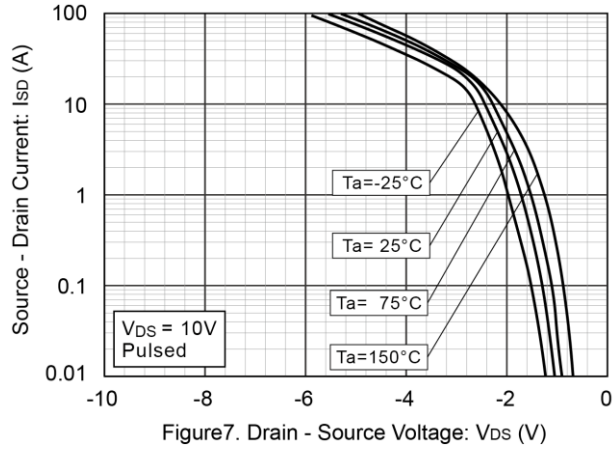


Figure7. Drain - Source Voltage: VDS (V)

### 3rd Quadrant Characteristic Ta =25ºC

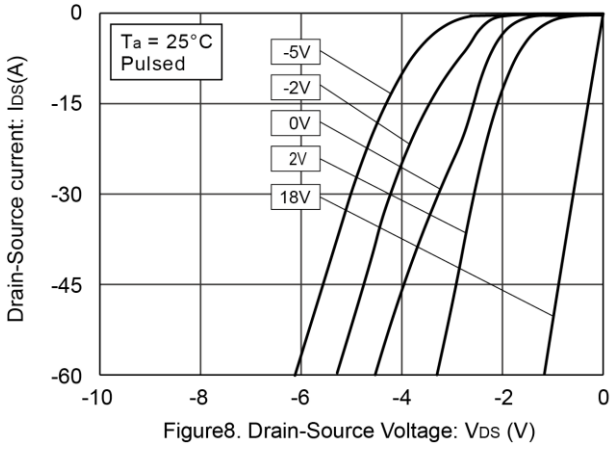


Figure8. Drain-Source Voltage: VDS (V)

### Gate Threshold Voltage vs. Junction Temperature

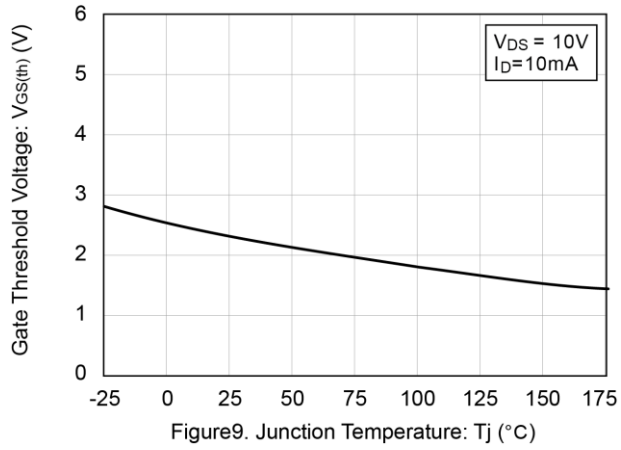


Figure9. Junction Temperature: Tj (°C)

### Static Drain - Source On - State Resistance vs. Gate - Source Voltage

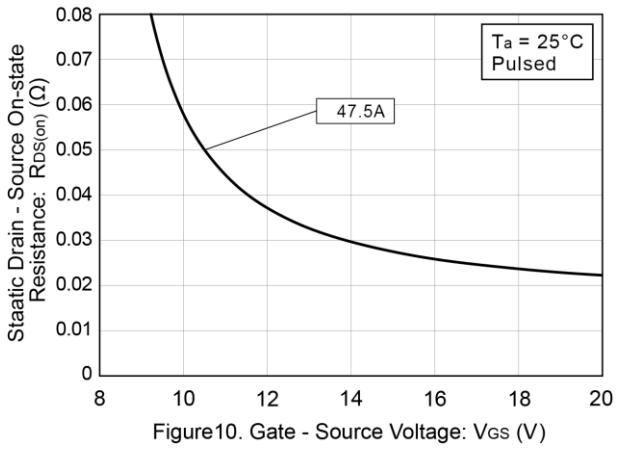


Figure10. Gate - Source Voltage: VGS (V)

### Static Drain - Source On - State Resistance vs. Junction Temperature

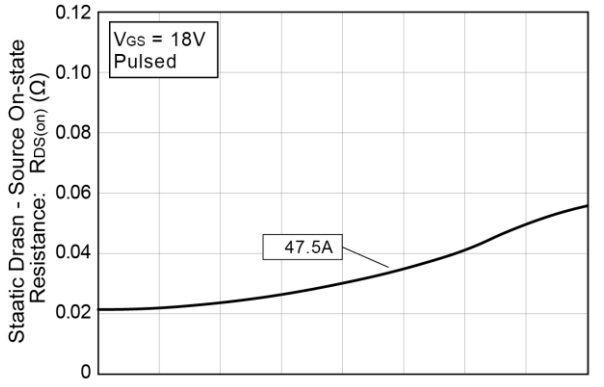



Figure11. Junction Temperature: $T_j$ (°C)

### Typical Capacitance vs. Drain – Source Voltage

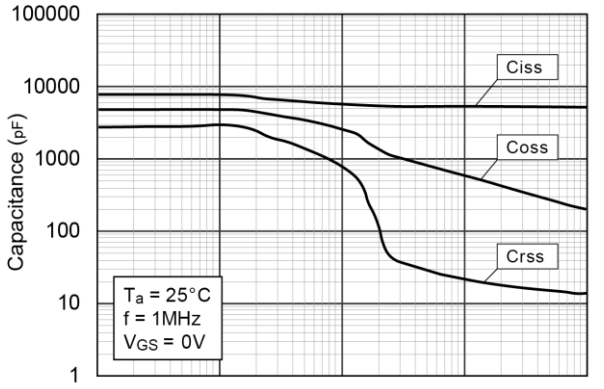



Figure12. Drain - Source Voltage: $V_{DS}$ (V)

### Typical Gate Charge

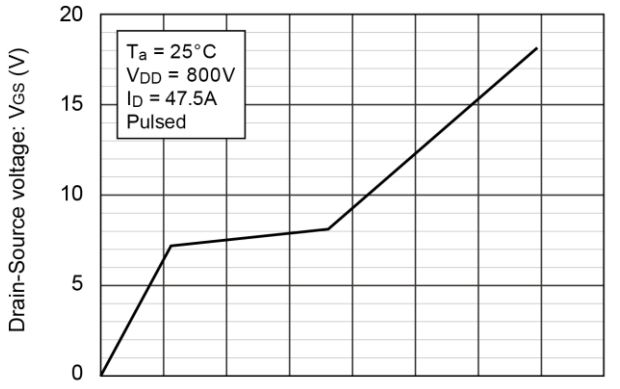



Figure13. Gate charege : $Q_g$ (nC)

### Maximum Safe Operating Area (SOA)

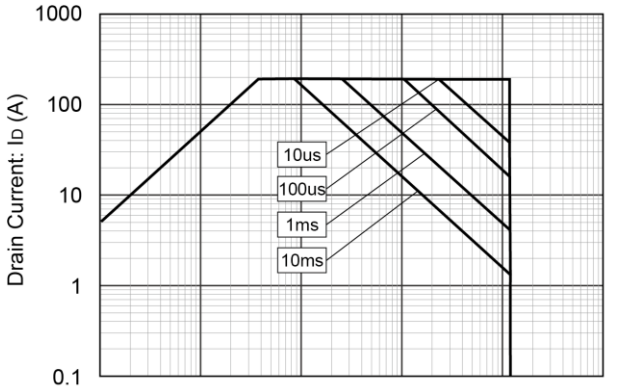



Figure16. Drain-Source Votlage: $V_{DS}$ (V)

### Reverse Bias Safe Operating Area (RBSOA)

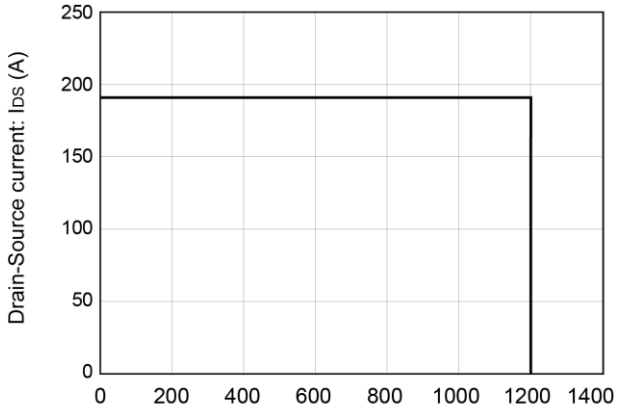



Figure17. Drain - Source Voltage: $V_{DS}$ (V)

### Typical Transient Thermal Resistance Vs. Pulse Width

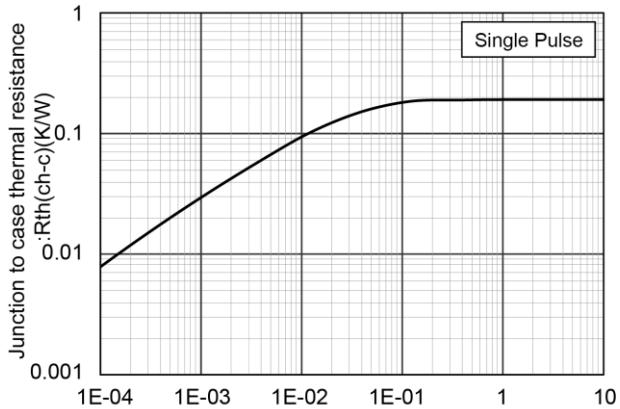



Figure18. Pulse Width: tw(S)

**Power dissipation vs. Junction Temperature**

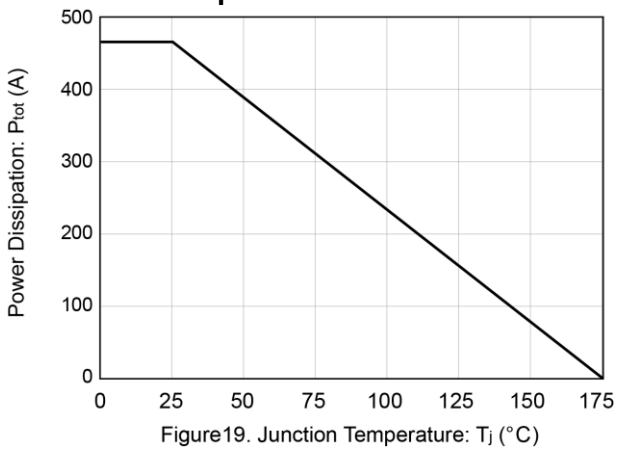
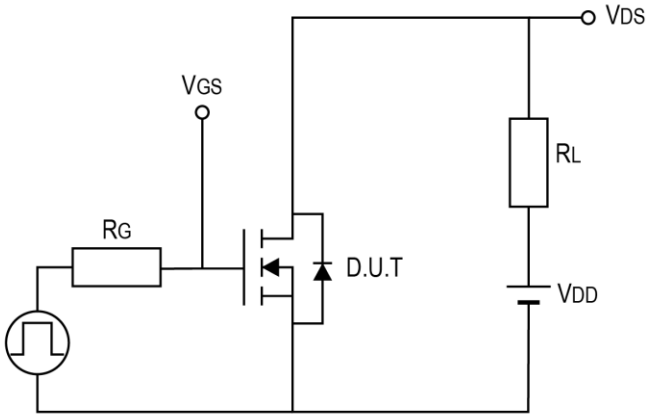
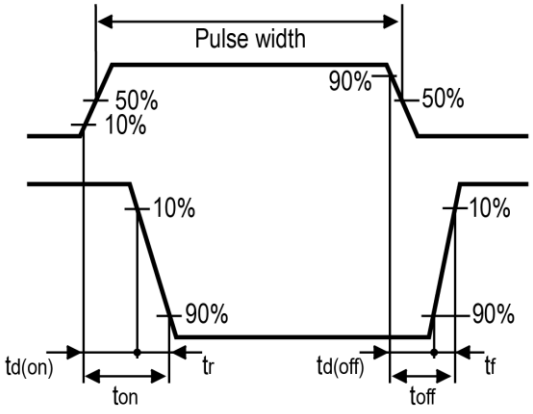


Figure19. Junction Temperature: Tj (°C)

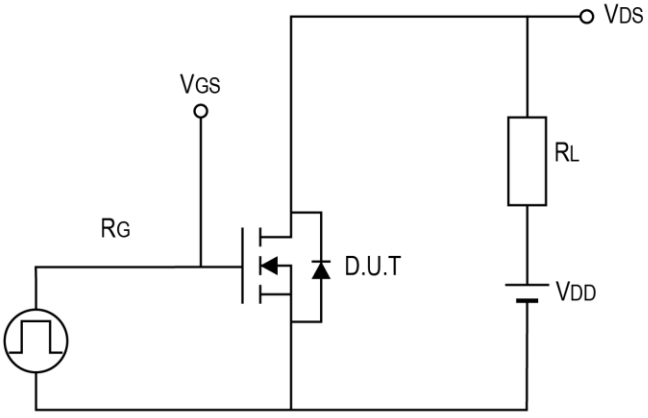
**Switching Time Measurement Circuit**



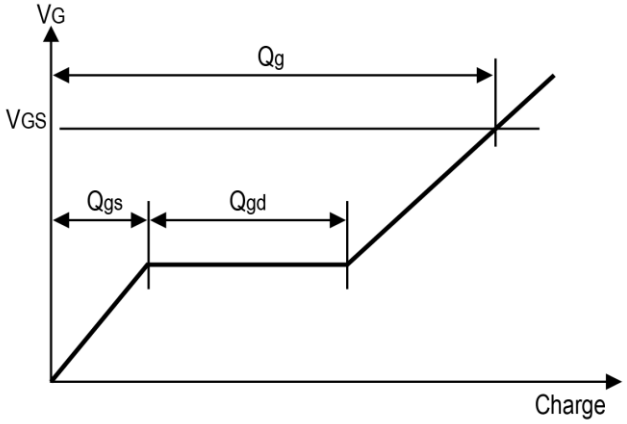

**Switching Waveform**



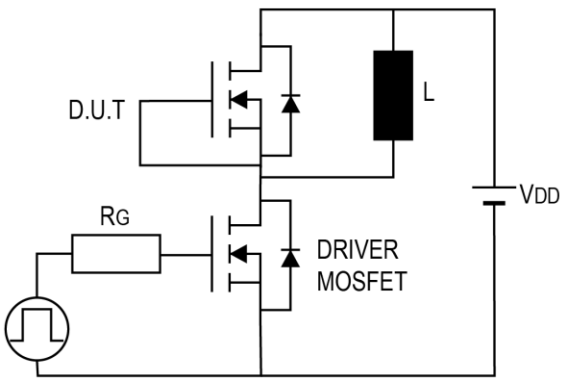

**Gate Charge Measurement Circuit**



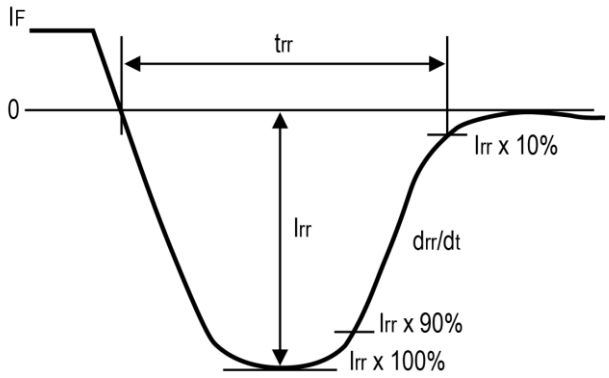

**Gate Charge Waveform**



**Reverse Recovery Time Measurement Circuit**

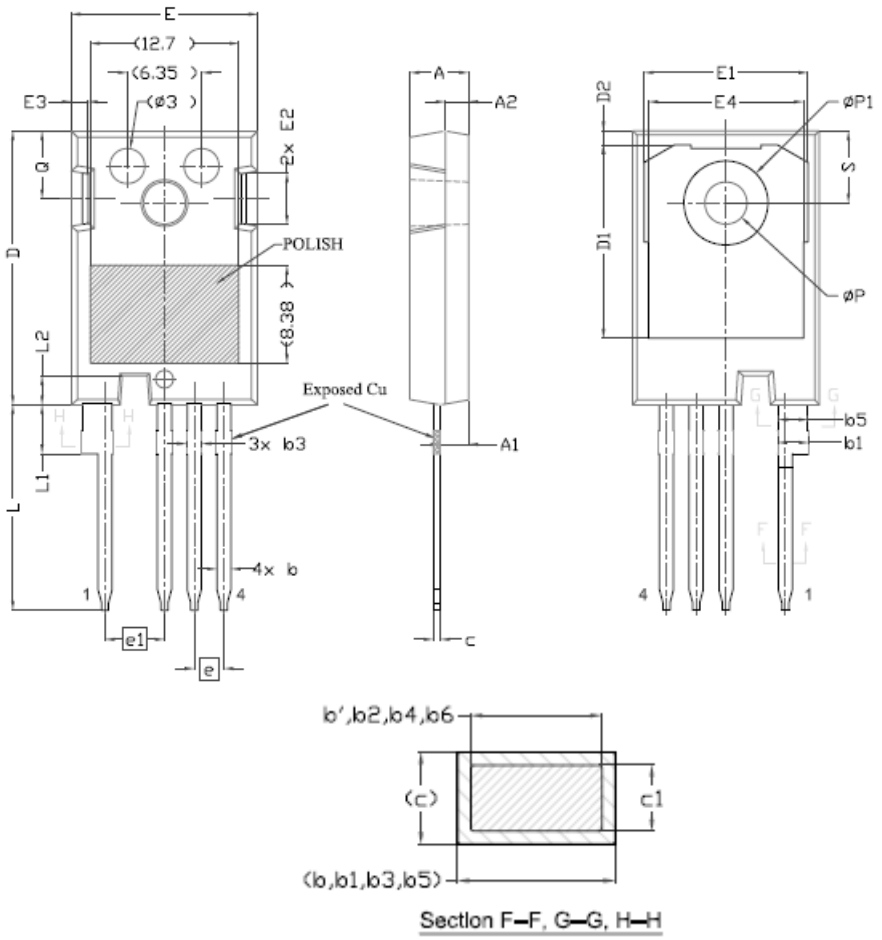



**Reverse Recovery Time Waveform**



## *Package Outline*

**TO-247-4L**




Unit : mm

| 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 |