# IMZ120R140M1HXKSA1

SiC Power MOSFET N-Channel Enhancement Mode

## Features

- 3rd generation SiC MOSFET technology
- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ($Q_{rr}$)
- Halogen free, RoHS compliant

## Benefits

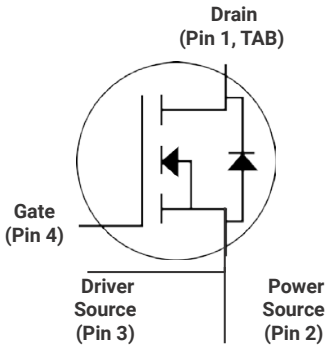
- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

## Applications

- Motor Control
- EV Battery Chargers
- High Voltage DC/DC Converters




**TO247-4L**
**Package**




| Ordering Part Number | Package | Qty(PCS) |
|---|---|---|
| IMZ120R140M1HXKSA1 | TO247-4L | 30 |

## Maximum Ratings ($T_C$ = 25 ˚C unless otherwise specified)

| Symbol | Parameter | | Value | Unit | Note |
|---|---|---|---|---|---|
| $V_{DSmax}$ | Drain - Source Voltage | | 1200 | V | |
| $V_{GSmax}$ | Gate - Source Voltage | | -8/+19 | V | Note: 1 |
| $I_D$ | Continuous Drain Current, $V_{GS}$ = 15 V | $T_C$ = 25˚C | 17.9 | A | Fig. 19<br>Note: 2 |
| | | $T_C$ = 100˚C | 13.5 | | |
| $I_{D(pulse)}$ | Pulsed Drain Current, Pulse width $t_P$ limited by $T_{jmax}$ | | 34 | A | Fig. 22 |
| $P_D$ | Power Dissipation, $T_C$=25˚C, $T_J$ = 175 ˚C | | 103 | W | Fig. 20<br>Note: 2 |
| $T_J$ , $T_{stg}$ | Operating Junction and Storage Temperature | | -55 to +175 | ˚C | |
| $T_L$ | Solder Temperature, 1.6mm (0.063”) from case for 10s | | 260 | ˚C | |
| $M_d$ | Mounting Torque , M3 or 6-32 screw | | 1<br>8.8 | Nm<br>lbf-in | |

Note (1): Recommended turn off / turn on gate voltage $V_{GS}$ - 4V...0V / +15V
Note (2): Verified by design

## Electrical Characteristics ($T_C$ = 25˚C unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | 1200 | | | V | $V_{GS}$ = 0 V, $I_D$ = 100 µA | |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1.8 | 2.8 | 3.6 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 2.33 mA | Fig. 11 |
| | | | 2.2 | | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 2.33 mA, $T_J$ = 175ºC | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | | 1 | 50 | µA | $V_{DS}$ = 1200 V, $V_{GS}$ = 0 V | |
| $I_{GSS}$ | Gate-Source Leakage Current | | 10 | 250 | nA | $V_{GS}$ = 15 V, $V_{DS}$ = 0 V | |
| $R_{DS(on)}$ | Drain-Source On-State Resistance | | 159 | 208 | mΩ | $V_{GS}$ = 15 V, $I_D$ = 8.5 A | Fig. 4, 5, 6 |
| | | | 280 | | | $V_{GS}$ = 15 V, $I_D$ = 8.5 A, $T_J$ = 175ºC | |
| $g_{fs}$ | Transconductance | | 4.9 | | S | $V_{DS}$= 20 V, $I_{DS}$= 8.5 A | Fig. 7 |
| | | | 4.6 | | | $V_{DS}$= 20 V, $I_{DS}$= 8.5 A, $T_J$ = 175ºC | |
| $C_{iss}$ | Input Capacitance | | 730 | | pF | $V_{GS}$ = 0 V, $V_{DS}$ = 0V to 1000 V<br>F = 1 MHz<br>$V_{AC}$ = 25 mV | Fig. 17, 18 |
| $C_{oss}$ | Output Capacitance | | 31 | | | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | 2 | | | | |
| $E_{oss}$ | $C_{oss}$ Stored Energy | | 17 | | µJ | | Fig. 16 |
| $C_{o(er)}$ | Effective Output Capacitance (Energy Related) | | 36 | | pF | $V_{GS}$ = 0 V, $V_{DS}$ = 0... 800V | Note: 3 |
| $C_{o(tr)}$ | Effective Output Capacitance (Time Related) | | 55 | | pF | | |
| $E_{ON}$ | Turn-On Switching Energy (External Diode) | | 81 | | µJ | $V_{DS}$= 800 V, $V_{GS}$= -4 V/15 V, $I_D$= 8.5 A,<br>$R_{G(ext)}$ = 2.5 Ω, L= 404 µH, $T_J$ = 175ºC<br>FWD = External SiC DIODE | Fig. 26, 28 |
| $E_{OFF}$ | Turn Off Switching Energy (External Diode) | | 16 | | | | |
| $E_{ON}$ | Turn-On Switching Energy (Body Diode FWD) | | 134 | | µJ | $V_{DS}$= 800 V, $V_{GS}$= -4 V/15 V, $I_D$= 8.5 A,<br>$R_{G(ext)}$ = 2.5 Ω, L= 404 µH, $T_J$ = 175ºC<br>FWD = Internal Body Diode | Fig. 26, 28 |
| $E_{OFF}$ | Turn-Off Switching Energy (Body Diode FWD) | | 15 | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | | 8 | | ns | $V_{DD}$ = 800 V, $V_{GS}$ = -4 V/15 V<br>$I_D$ = 8.5 A, $R_{G(ext)}$ = 2.5 Ω,<br>Timing relative to $V_{DS}$<br>Inductive load | Fig. 27, 28 |
| $t_r$ | Rise Time | | 9 | | | | |
| $t_{d(off)}$ | Turn-Off Delay Time | | 13 | | | | |
| $t_f$ | Fall Time | | 12 | | | | |
| $R_{G(int)}$ | Internal Gate Resistance | | 6.5 | | Ω | f = 1 MHz, $V_{AC}$ = 25 mV | |
| $Q_{gs}$ | Gate to Source Charge | | 10 | | nC | $V_{DS}$ = 800 V, $V_{GS}$ = -4 V/15 V<br>$I_D$ = 8.5 A<br>Per IEC60747-8-4 pg 21 | Fig. 12 |
| $Q_{gd}$ | Gate to Drain Charge | | 12 | | | | |
| $Q_g$ | Total Gate Charge | | 32 | | | | |

Note (3): $C_{o(er)}$, a lumped capacitance that gives same stored energy as Coss while Vds is rising from 0 to 800V
$C_{o(tr)}$, a lumped capacitance that gives same charging time as Coss while Vds is rising from 0 to 800V

## Reverse Diode Characteristics ($T_C$ = 25˚C unless otherwise specified)

| Symbol | Parameter | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Diode Forward Voltage | 4.8 | | V | $V_{GS}$ = -4 V, $I_{SD}$ = 4.25 A, $T_J$ = 25 °C | Fig. 8, 9, 10 |
| | | 4.2 | | V | $V_{GS}$ = -4 V, $I_{SD}$ = 4.25 A, $T_J$ = 175 °C | |
| $I_S$ | Continuous Diode Forward Current | | 17 | A | $V_{GS}$ = -4 V, $T_C$ = 25˚C | |
| $I_{S,\,pulse}$ | Diode pulse Current | | 34 | A | $V_{GS}$ = -4 V, pulse width $t_P$ limited by $T_{jmax}$ | |
| $t_{rr}$ | Reverse Recover time | 9 | | ns | $V_{GS}$ = -4 V, $I_{SD}$ = 8.5 A, $V_R$ = 800 V dif/dt = 6080 A/µs, $T_J$ = 175 °C | |
| $Q_{rr}$ | Reverse Recovery Charge | 169 | | nC | | |
| $I_{rrm}$ | Peak Reverse Recovery Current | 27 | | A | | |
| $t_{rr}$ | Reverse Recover time | 23 | | ns | $V_{GS}$ = -4 V, $I_{SD}$ = 8.5 A, $V_R$ = 800 V dif/dt = 1850 A/µs, $T_J$ = 175 °C | |
| $Q_{rr}$ | Reverse Recovery Charge | 147 | | nC | | |
| $I_{rrm}$ | Peak Reverse Recovery Current | 11 | | A | | |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance from Junction to Case | 1.13 | 1.45 | °C/W | | Fig. 21 |

## Typical Performance

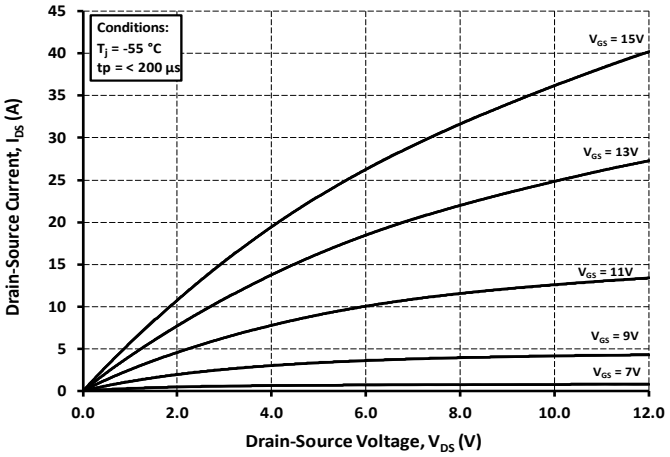



Figure 1. Output Characteristics $T_J$ = -55 ºC

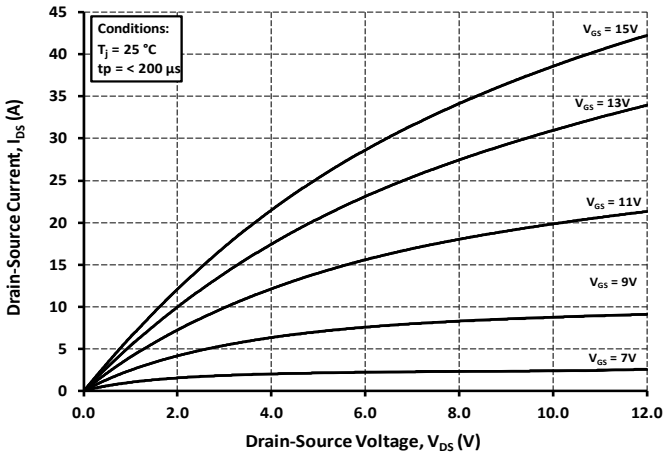



Figure 2. Output Characteristics $T_J$ = 25 ºC

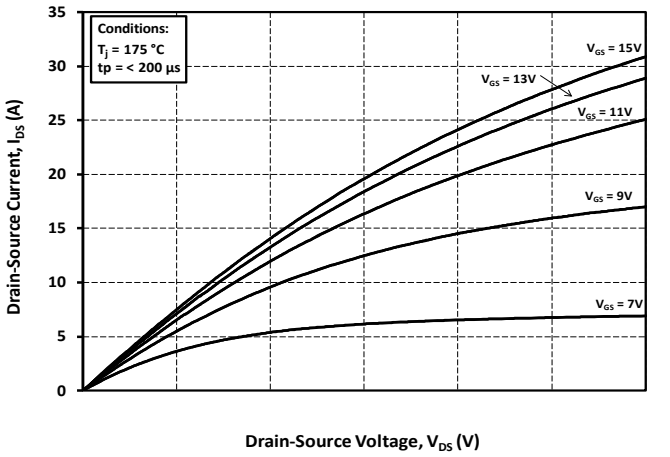



Figure 3. Output Characteristics $T_J$ = 175 ºC

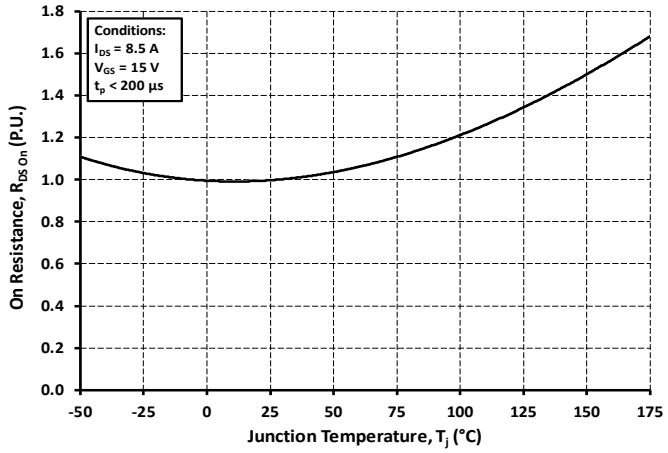



Figure 4. Normalized On-Resistance vs. Temperature

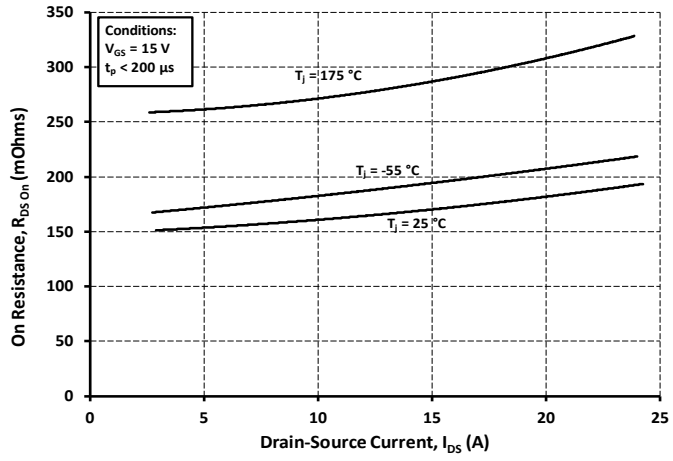



Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

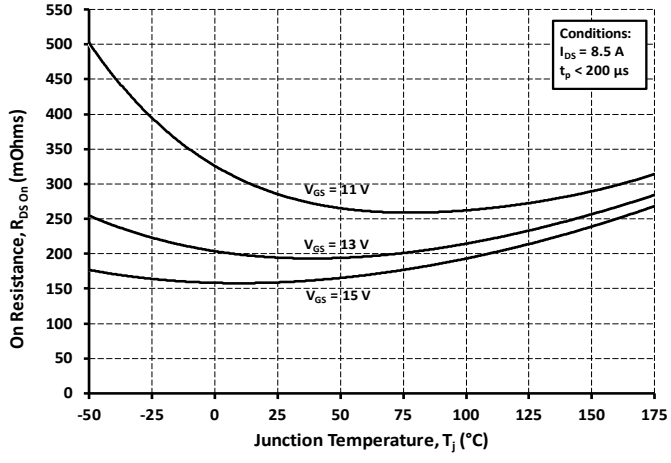



Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

## Typical Performance

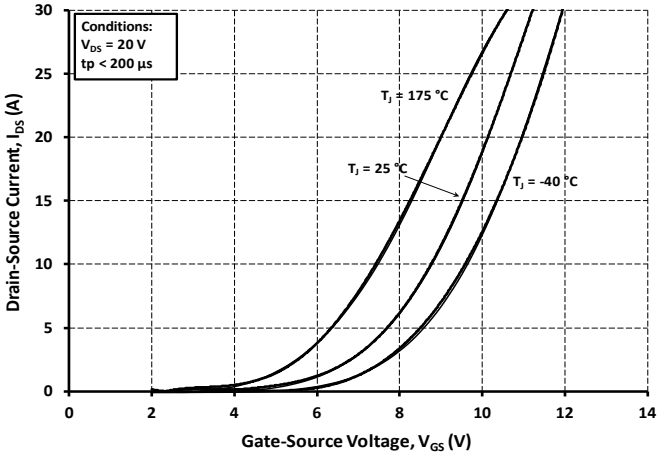



Figure 7. Transfer Characteristic for Various Junction Temperatures

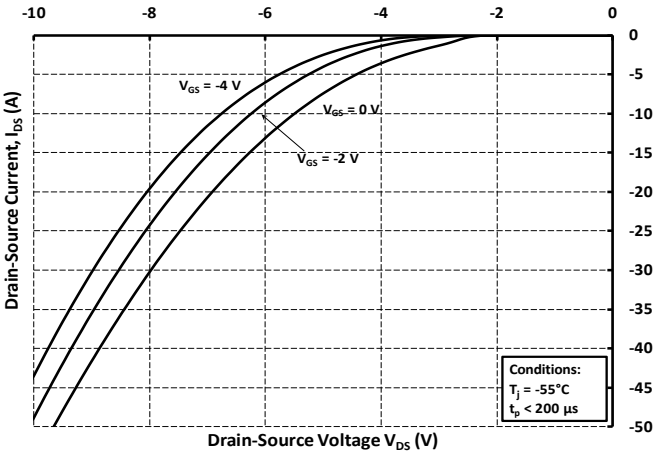



Figure 8. Body Diode Characteristic at -55 ºC

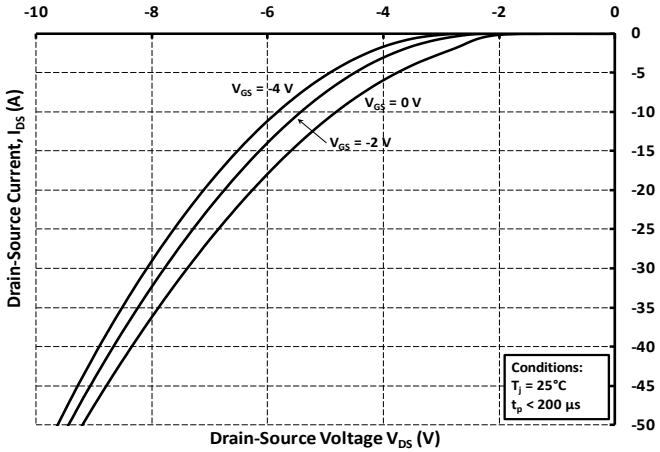



Figure 9. Body Diode Characteristic at 25 ºC

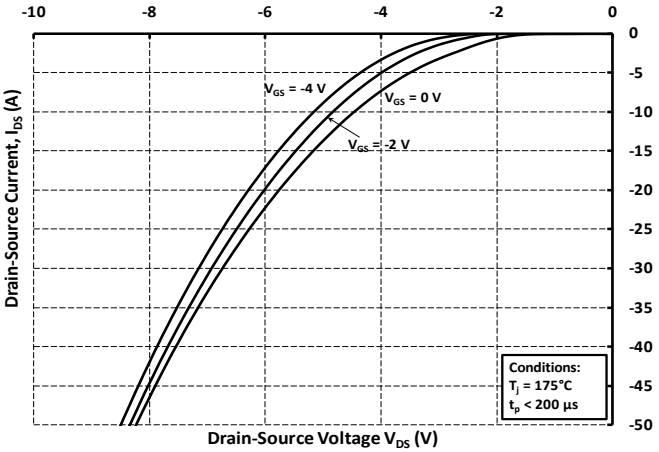



Figure 10. Body Diode Characteristic at 175 ºC

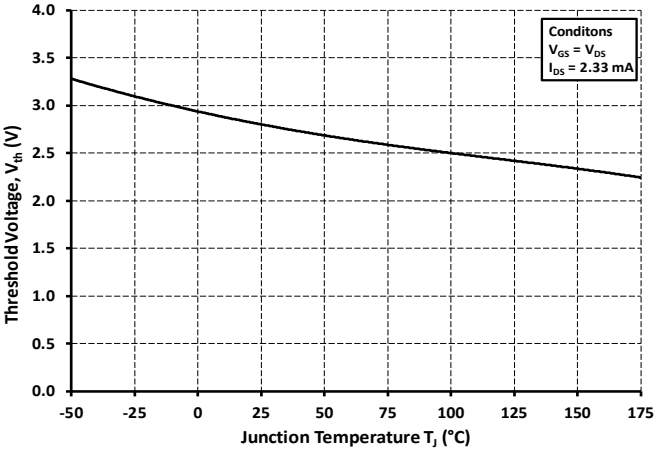



Figure 11. Threshold Voltage vs. Temperature

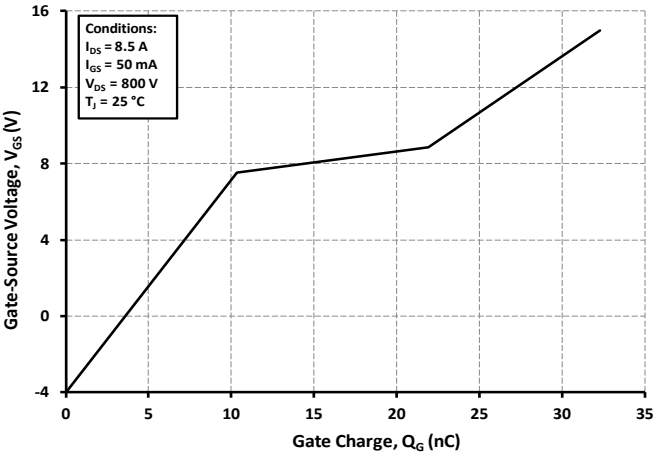



Figure 12. Gate Charge Characteristics

## Typical Performance

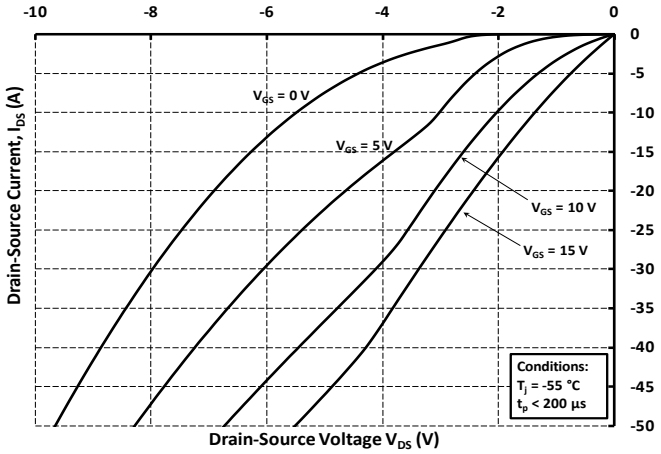



Figure 13. 3rd Quadrant Characteristic at -55 ºC

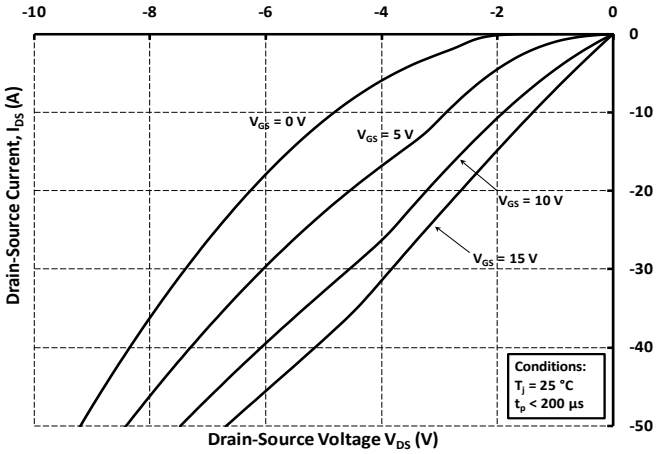



Figure 14. 3rd Quadrant Characteristic at 25 ºC

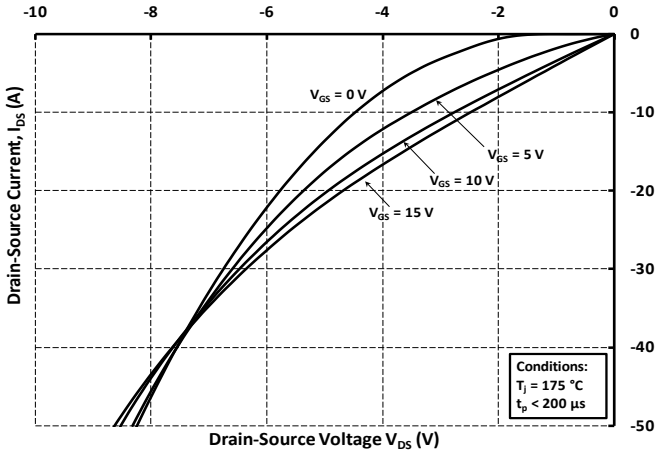



Figure 15. 3rd Quadrant Characteristic at 175 ºC

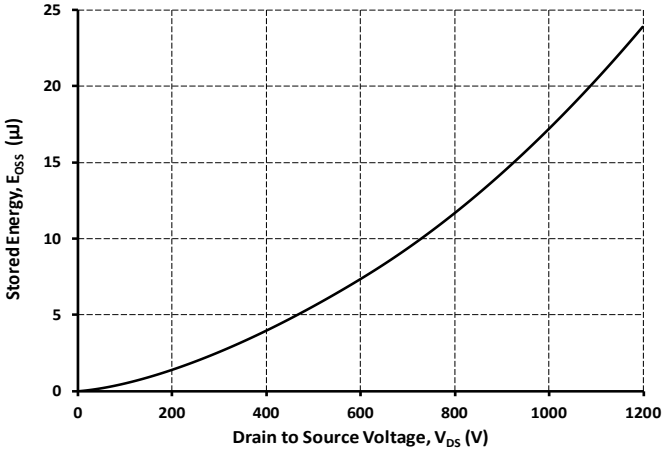



Figure 16. Output Capacitor Stored Energy

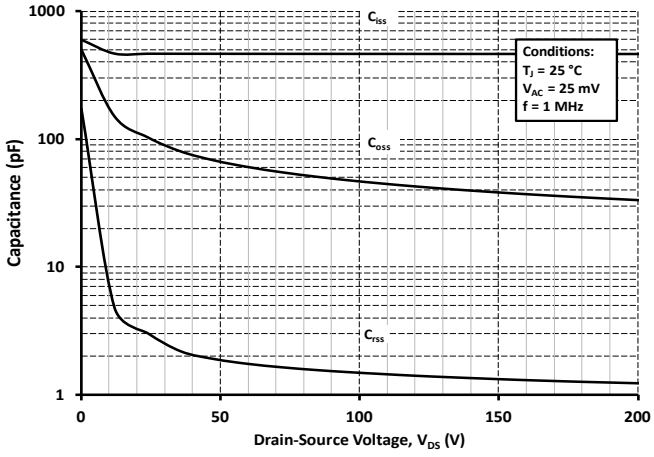



Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

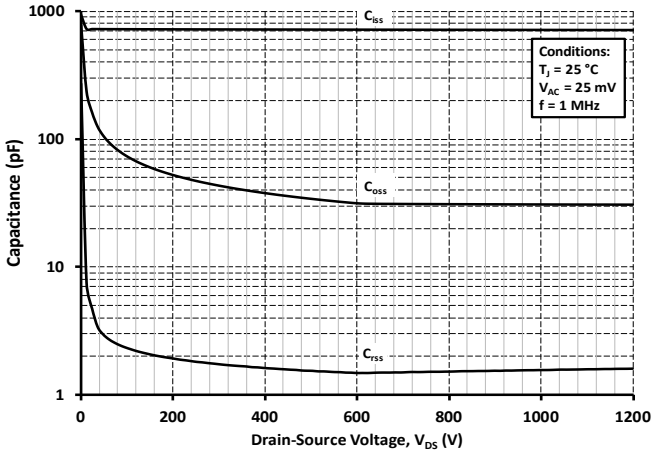



Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)

## Typical Performance

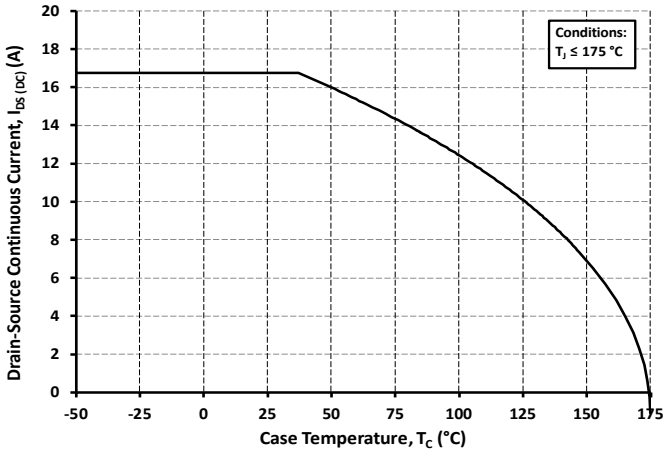



Figure 19. Continuous Drain Current Derating vs. Case Temperature

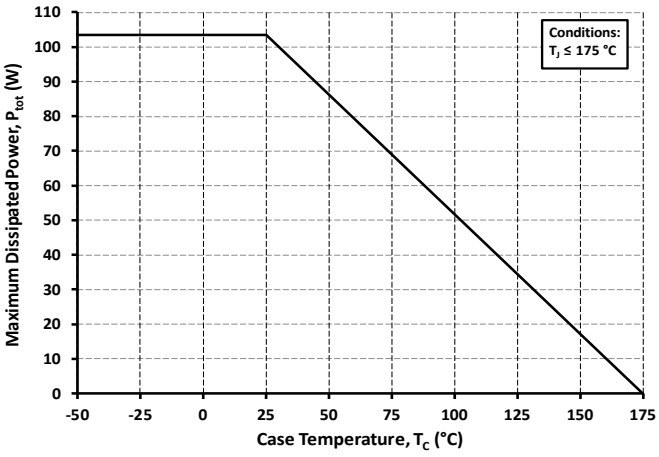



Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

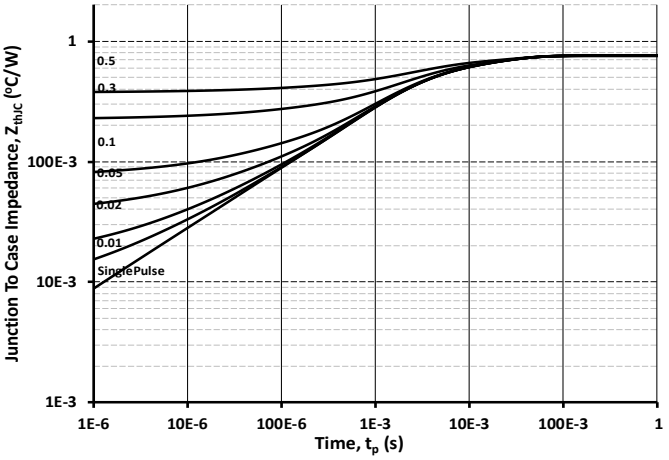



Figure 21. Transient Thermal Impedance (Junction - Case)

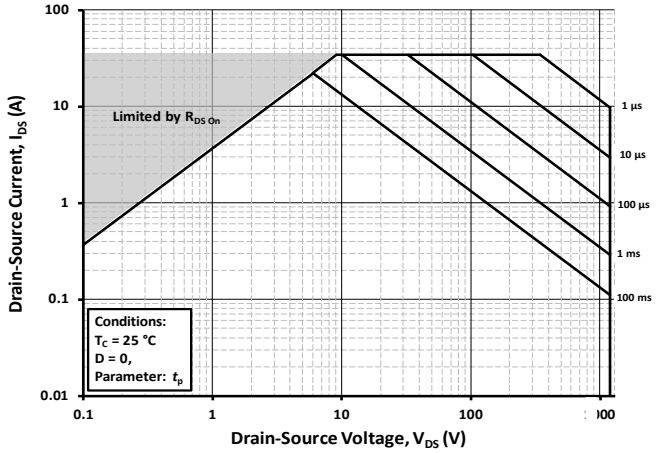



Figure 22. Safe Operating Area

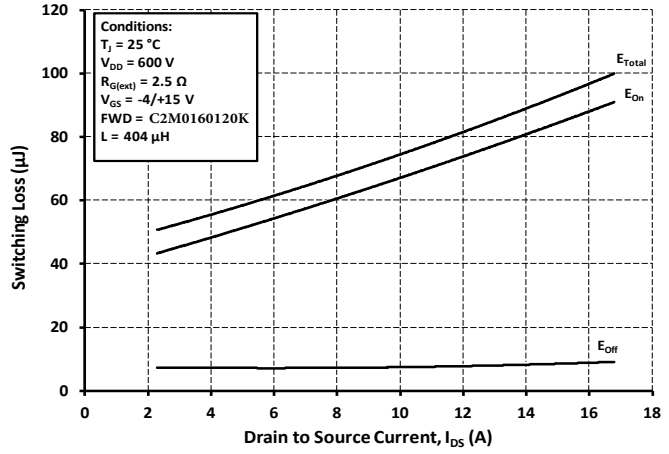



Figure 23. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD}$ = 600V)

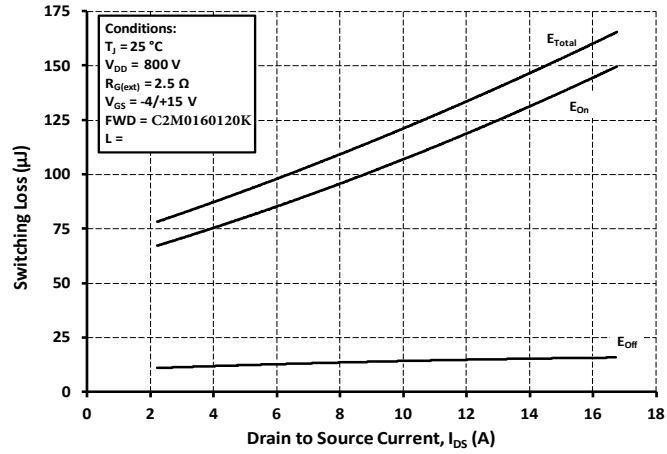



Figure 24. Clamped Inductive Switching Energy vs. Drain Current ($V_{DD}$ = 800V)

## Typical Performance

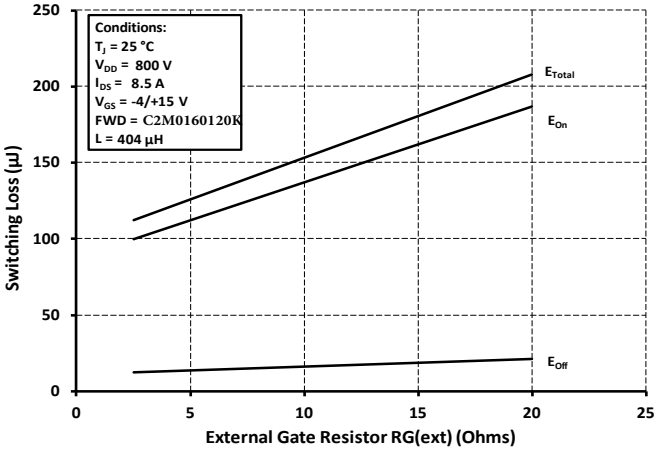



Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

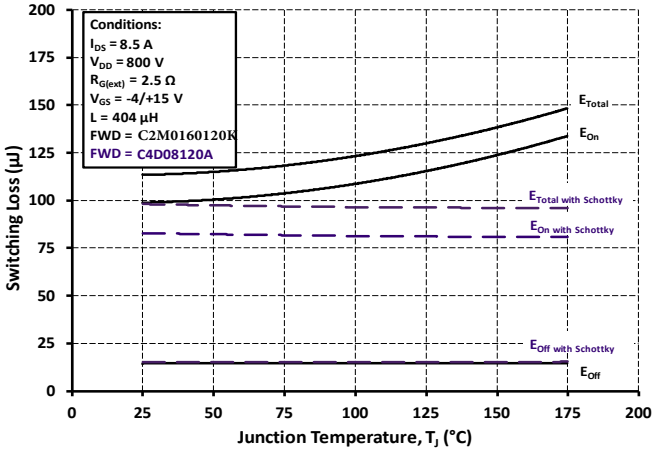



Figure 26. Clamped Inductive Switching Energy vs. Temperature

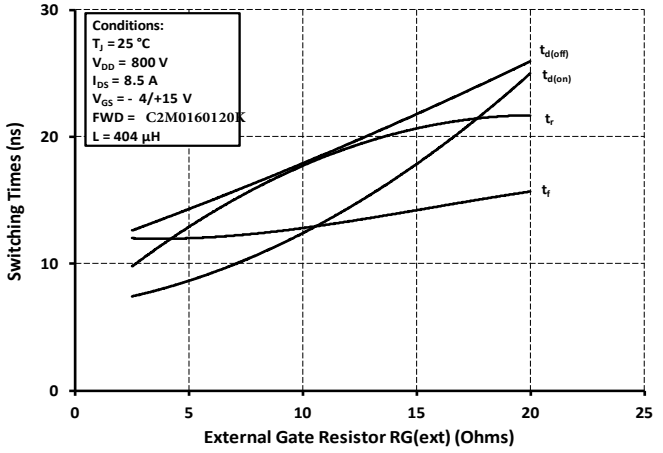



Figure 27. Switching Times vs. $R_{G(ext)}$

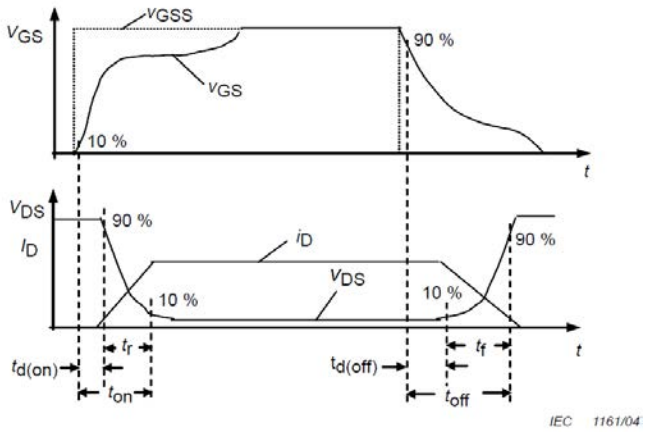



Figure 28. Switching Times Definition

## Test Circuit Schematic

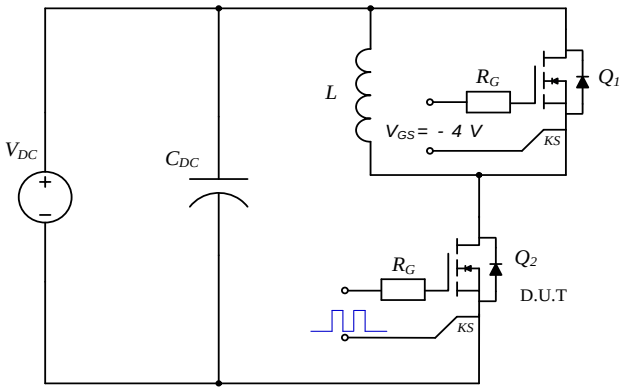
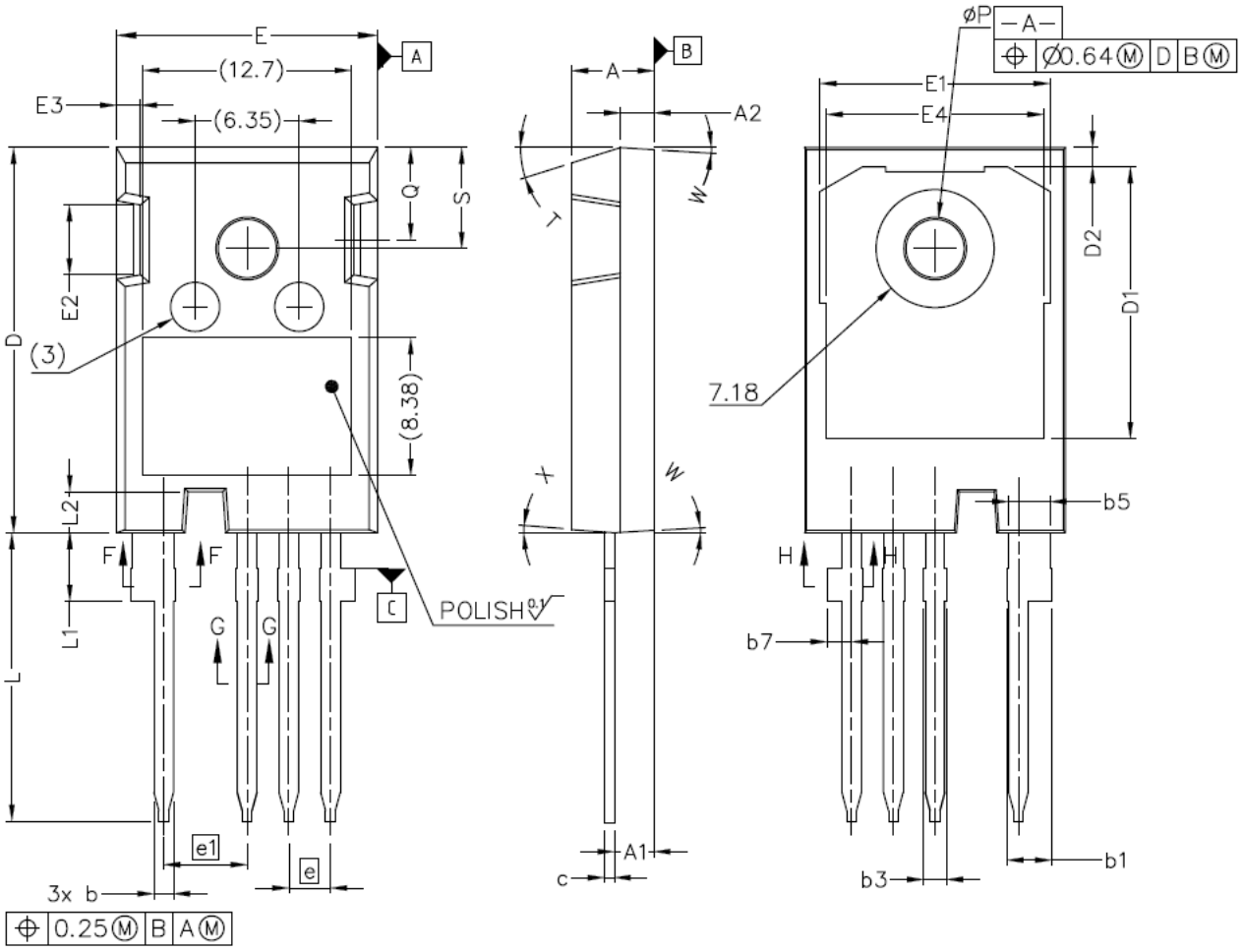
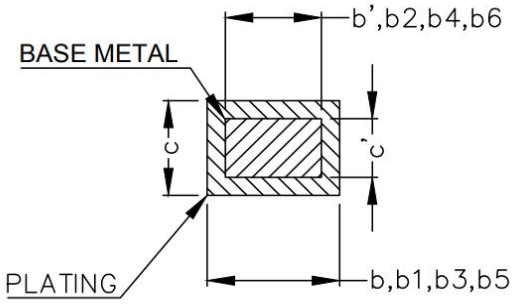



Figure 29. Clamped Inductive Switching Waveform Test Circuit

**Package Dimensions**

Package TO247-4L




SECTION "F-F", "G-G" AND "H-H"
SCALE: NONE

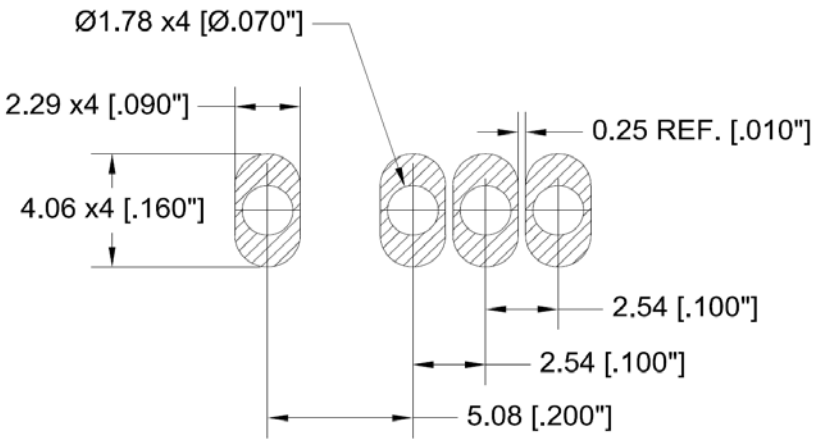
**Package Dimensions**

Package TO247-4L

NOTE ;
1. ALL METAL SURFACES: TIN PLATED, EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
4. 'N' IS THE NUMBER OF TERMINAL POSITIONS

| SYM | MILLIMETERS | |
|---|---|---|
| | MIN | MAX |
| A | 4.83 | 5.21 |
| A1 | 2.29 | 2.54 |
| A2 | 1.91 | 2.16 |
| b` | 1.07 | 1.28 |
| b | 1.07 | 1.33 |
| b1 | 2.39 | 2.94 |
| b2 | 2.39 | 2.84 |
| b3 | 1.07 | 1.60 |
| b4 | 1.07 | 1.50 |
| b5 | 2.39 | 2.69 |
| b6 | 2.39 | 2.64 |
| b7 | 1.30 | 1.70 |
| c` | 0.55 | 0.65 |
| c | 0.55 | 0.68 |
| D | 23.30 | 23.60 |
| D1 | 16.25 | 17.65 |
| D2 | 0.95 | 1.25 |
| E | 15.75 | 16.13 |

| SYM | MILLIMETERS | |
|---|---|---|
| | MIN | MAX |
| E1 | 13.10 | 14.15 |
| E2 | 3.68 | 5.10 |
| E3 | 1.00 | 1.90 |
| E4 | 12.38 | 13.43 |
| e | 2.54 BSC | |
| e1 | 5.08 BSC | |
| N* | 4 | |
| L | 17.31 | 17.82 |
| L1 | 3.97 | 4.37 |
| L2 | 2.35 | 2.65 |
| Ø P | 3.51 | 3.65 |
| Q | 5.49 | 6.00 |
| S | 6.04 | 6.30 |
| T | 17.5° REF. | |
| W | 3.5° REF. | |
| X | 4° REF. | |



## Attention

■ Any and all HUA XUAN YANG ELECTRONICS products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your HUA XUAN YANG ELECTRONICS representative nearest you before using any HUA XUAN YANG ELECTRONICS products described or contained herein in such applications.

■ HUA XUAN YANG ELECTRONICS assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all HUA XUAN YANG ELECTRONICS products described or contained herein.

■ Specifications of any and all HUA XUAN YANG ELECTRONICS products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

■ HUA XUAN YANG ELECTRONICS CO.,LTD. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could
give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.

■ In the event that any or all HUA XUAN YANG ELECTRONICS products(including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.

■ No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of HUA XUAN YANG ELECTRONICS CO.,LTD.

■ Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. HUA XUAN YANG ELECTRONICS believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

■ Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the HUA XUAN YANG ELECTRONICS product that you intend to use.

# Unikeyic Electronics

Global Electronic Components Distributor

Click to view pricing, inventory, delivery, and lifecycle information:

## HXY MOSFET:

ISL28233FUZ-T7 MUR1040FCT CH440G SGM3798YG/TR DMPH6250SQ-13 S3D08065E
TPS7A0533PDBZR-HXY IRLML2244TRPBF-HXY ISL28133FHZ-T7 MJD127G PTVSHC3D5VU S4D15120H
AOD403-HXY C3M0040120D C6D06065Q-TR 1SMB5930BT3G C4D08120E-TR MSC040SMA120B4
TPD1E0B04DPYR 2N7002-HXY IDL10G65C5XUMA2 SG3525-HXY SS5150 Si2323DS-T1-E3-HXY
TLV74318PDBVR-HXY E4D10120A HBAS40-05LT1G 1SMB5934B BD237STU DSC06065