



FQD1N60 FQU1N60 FQI1N60

600V, 1.3A N-Channel MOSFET

General Description

The FQD1N60 & FQU1N60 & FQI1N60 have been fabricated using an advanced high voltage MOSFET process that is designed to deliver high levels of performance and robustness in popular AC-DC applications.

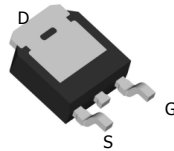
By providing low $R_{DS(on)}$, C_{iss} and C_{rss} along with guaranteed avalanche capability these parts can be adopted quickly into new and existing offline power supply designs.

Product Summary

| | |
|---------------------------------|------------|
| V_{DS} | 700V@150°C |
| I_D (at $V_{GS}=10V$) | 1.3A |
| $R_{DS(ON)}$ (at $V_{GS}=10V$) | < 9Ω |

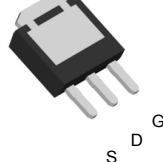
100% UIS Tested!
100% R_g Tested!

TO252
DPAK
Bottom View



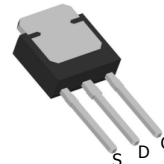
FQD1N60

TO251A
IPAK
Bottom View

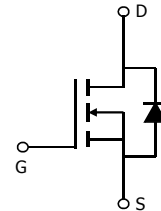


FQI1N60

TO251
Bottom View



FQU1N60



Absolute Maximum Ratings $T_A=25^\circ C$ unless otherwise noted

| Parameter | Symbol | Maximum | Units |
|--|----------------|-------------------|-------|
| Drain-Source Voltage | V_{DS} | 600 | V |
| Gate-Source Voltage | V_{GS} | ±30 | V |
| Continuous Drain Current ^B | I_D | $T_C=25^\circ C$ | 1.3 |
| | | $T_C=100^\circ C$ | 0.8 |
| Pulsed Drain Current ^C | I_{DM} | 4 | A |
| Avalanche Current ^C | I_{AR} | 1 | A |
| Repetitive avalanche energy ^C | E_{AR} | 15 | mJ |
| Single pulsed avalanche energy ^H | E_{AS} | 30 | mJ |
| Peak diode recovery dv/dt | dv/dt | 5 | V/ns |
| Power Dissipation ^B | P_D | $T_C=25^\circ C$ | 45 |
| | | Derate above 25°C | 0.36 |
| Junction and Storage Temperature Range | T_J, T_{STG} | -50 to 150 | °C |
| Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds | T_L | 300 | °C |

Thermal Characteristics

| Parameter | Symbol | Typical | Maximum | Units |
|--|-----------------|---------|---------|-------|
| Maximum Junction-to-Ambient ^{A,G} | $R_{\theta JA}$ | 45 | 55 | °C/W |
| Maximum Case-to-sink ^A | $R_{\theta CS}$ | - | 0.5 | °C/W |
| Maximum Junction-to-Case ^{D,F} | $R_{\theta JC}$ | 2.3 | 2.8 | °C/W |

Electrical Characteristics (T_J=25°C unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|------------------------------------|---------------------------------------|---|-----|------|------|-------|
| STATIC PARAMETERS | | | | | | |
| BV _{DSS} | Drain-Source Breakdown Voltage | I _D =250μA, V _{GS} =0V, T _J =25°C | 600 | | | V |
| | | I _D =250μA, V _{GS} =0V, T _J =150°C | | 700 | | |
| BV _{DSS} /ΔT _J | Zero Gate Voltage Drain Current | I _D =250μA, V _{GS} =0V | | 0.6 | | V/°C |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} =600V, V _{GS} =0V | | | 1 | μA |
| | | V _{DS} =480V, T _J =125°C | | | 10 | |
| I _{GSS} | Gate-Body leakage current | V _{DS} =0V, V _{GS} =±30V | | | 100 | nA |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} =5V, I _D =250μA | 3 | 4.1 | 4.5 | V |
| R _{DS(ON)} | Static Drain-Source On-Resistance | V _{GS} =10V, I _D =0.65A | | 7.5 | 9 | Ω |
| g _{FS} | Forward Transconductance | V _{DS} =40V, I _D =0.65A | | 0.9 | | S |
| V _{SD} | Diode Forward Voltage | I _S =1A, V _{GS} =0V | | 0.65 | 1 | V |
| I _S | Maximum Body-Diode Continuous Current | | | | 1 | A |
| I _{SM} | Maximum Body-Diode Pulsed Current | | | | 4 | A |
| DYNAMIC PARAMETERS | | | | | | |
| C _{iss} | Input Capacitance | V _{GS} =0V, V _{DS} =25V, f=1MHz | 105 | 130 | 160 | pF |
| C _{oss} | Output Capacitance | | 12 | 14.5 | 18 | pF |
| C _{rss} | Reverse Transfer Capacitance | | 1.5 | 1.8 | 2.2 | pF |
| R _g | Gate resistance | V _{GS} =0V, V _{DS} =0V, f=1MHz | 2.9 | 3.5 | 5.3 | Ω |
| SWITCHING PARAMETERS | | | | | | |
| Q _g | Total Gate Charge | V _{GS} =10V, V _{DS} =480V, I _D =1A | | 6.1 | 8 | nC |
| Q _{gs} | Gate Source Charge | | | 1.3 | 2 | nC |
| Q _{gd} | Gate Drain Charge | | | 3.1 | 4 | nC |
| t _{D(on)} | Turn-On DelayTime | V _{GS} =10V, V _{DS} =300V, I _D =1A, R _G =25Ω | | 10 | 13 | ns |
| t _r | Turn-On Rise Time | | | 6.7 | 13 | ns |
| t _{D(off)} | Turn-Off DelayTime | | | 20 | 26 | ns |
| t _f | Turn-Off Fall Time | | | 11.5 | 23 | ns |
| t _{rr} | Body Diode Reverse Recovery Time | I _F =1.3A, di/dt=100A/μs, V _{DS} =100V | | 114 | 137 | ns |
| Q _{rr} | Body Diode Reverse Recovery Charge | I _F =1.3A, di/dt=100A/μs, V _{DS} =100V | | 0.63 | 0.76 | μC |

A. The value of R_{θJA} is measured with the device in a still air environment with T_A=25°C.

B. The power dissipation P_D is based on T_{J(MAX)}=150°C in a TO252 package, using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

C. Repetitive rating, pulse width limited by junction temperature T_{J(MAX)}=150°C.

D. The R_{θJA} is the sum of the thermal impedance from junction to case R_{θJC} and case to ambient.

E. The static characteristics in Figures 1 to 6 are obtained using <300 μs pulses, duty cycle 0.5% max.

F. These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of T_{J(MAX)}=150°C.

G. These tests are performed with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with T_A=25°C.

H. L=60mH, I_{AS}=1A, V_{DD}=150V, R_G=10Ω, Starting T_J=25°C

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

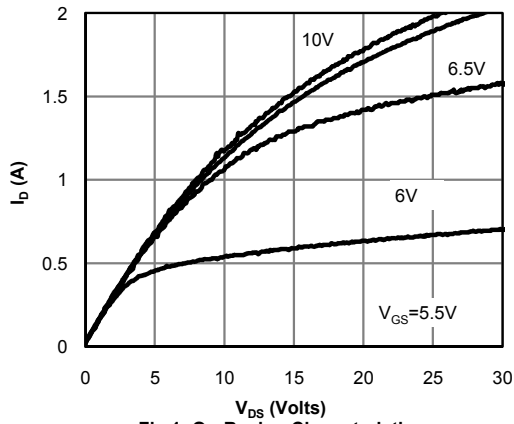


Fig 1: On-Region Characteristics

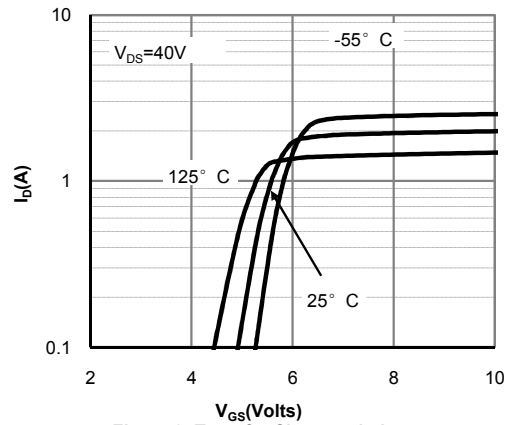


Figure 2: Transfer Characteristics

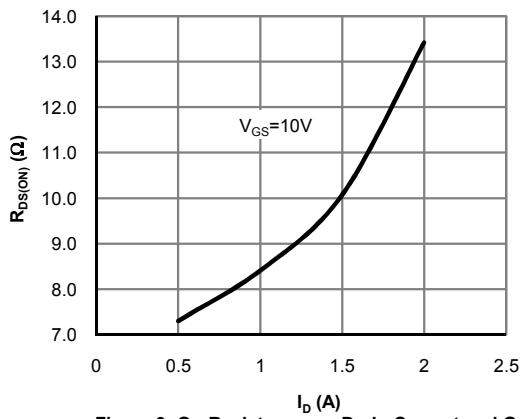


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

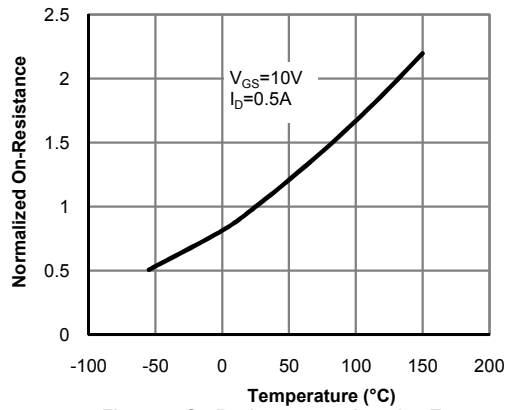


Figure 4: On-Resistance vs. Junction Temperature

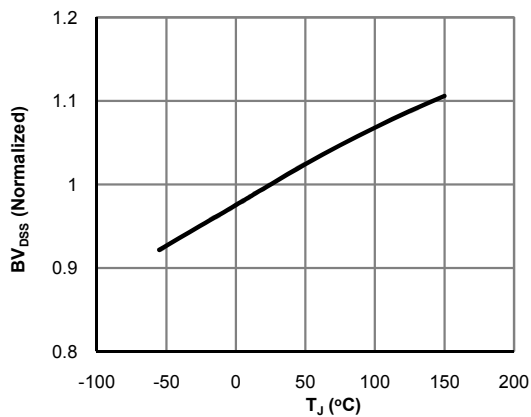


Figure 5: Break Down vs. Junction Temperature

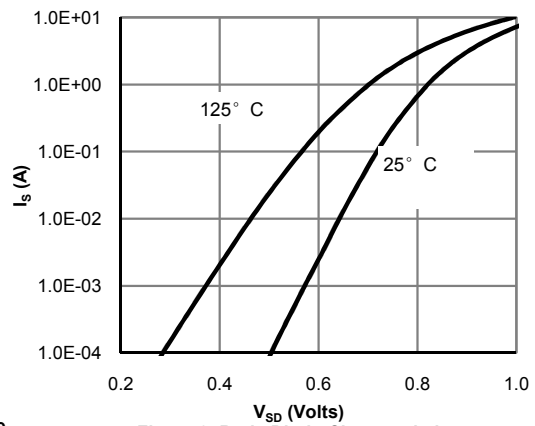


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

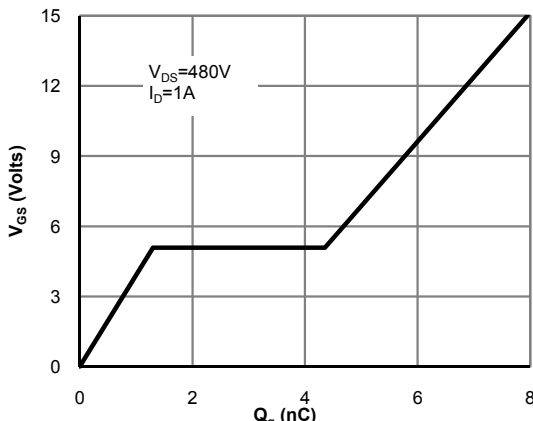


Figure 7: Gate-Charge Characteristics

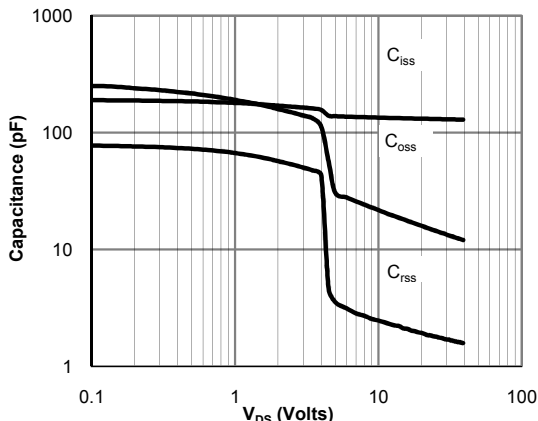


Figure 8: Capacitance Characteristics

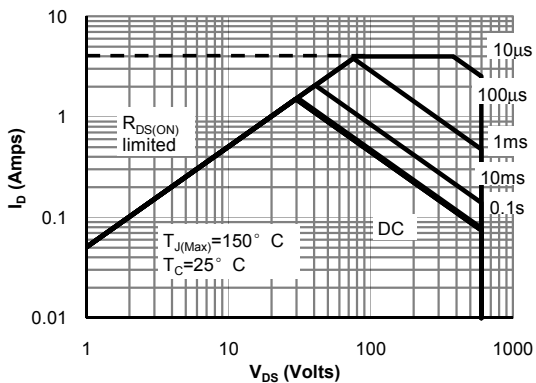


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

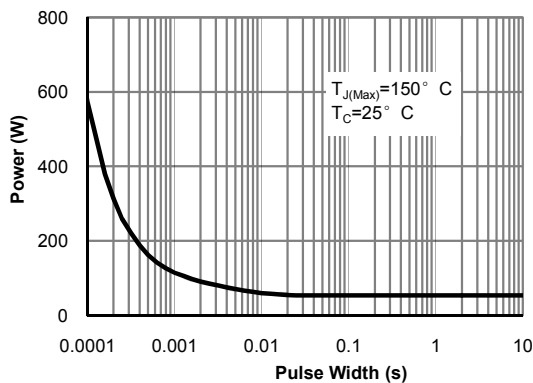


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

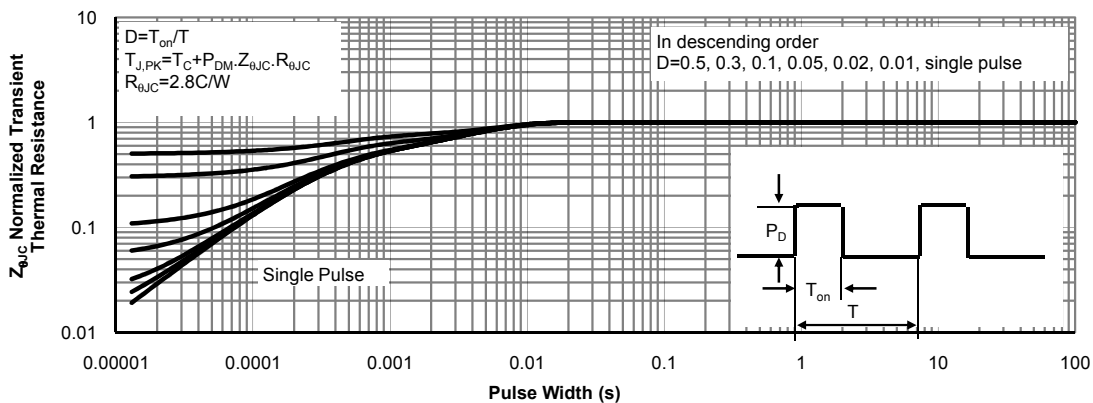


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

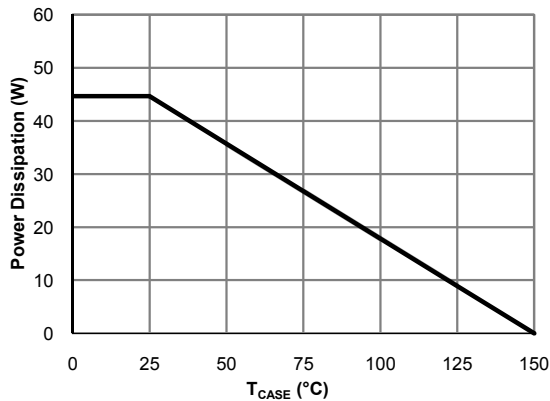


Figure 12: Power De-rating (Note B)

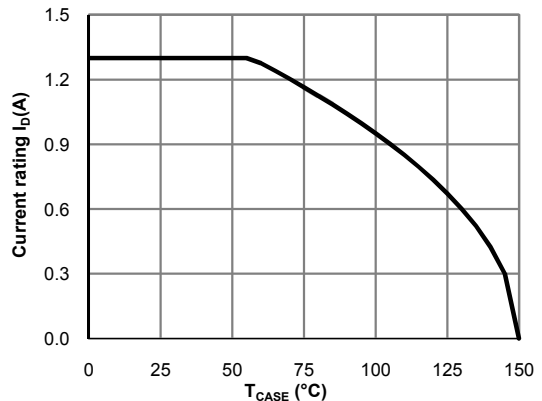


Figure 13: Current De-rating (Note B)

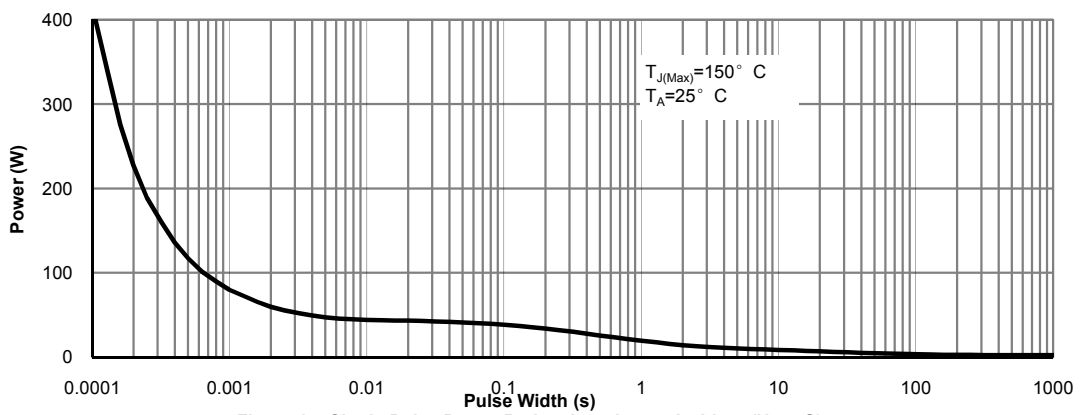


Figure 14: Single Pulse Power Rating Junction-to-Ambient (Note G)

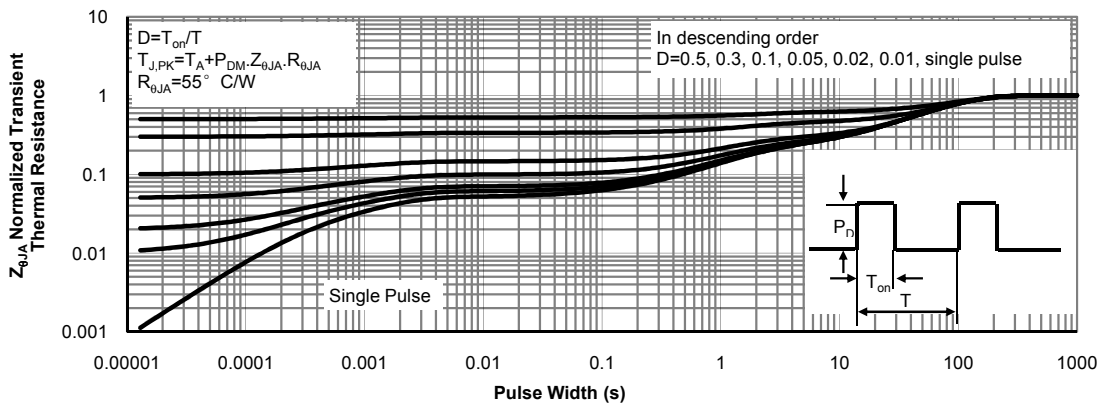
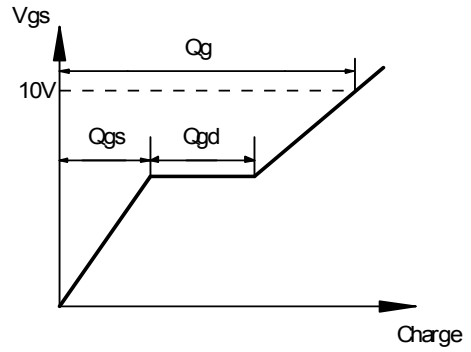
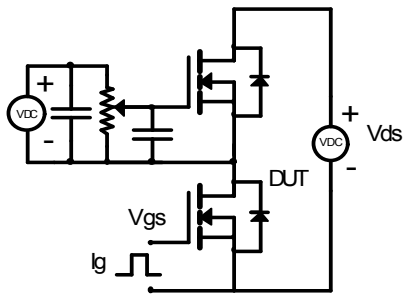
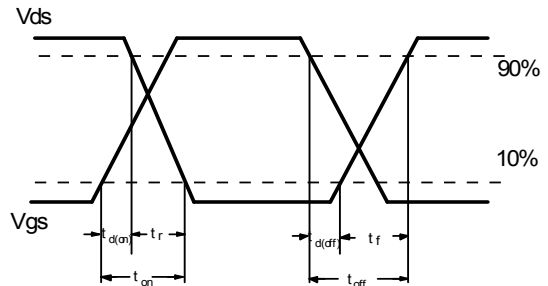
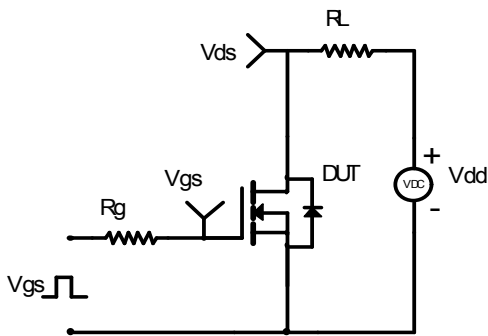


Figure 15: Normalized Maximum Transient Thermal Impedance (Note G)

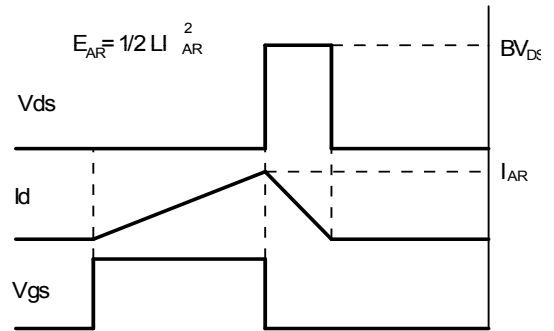
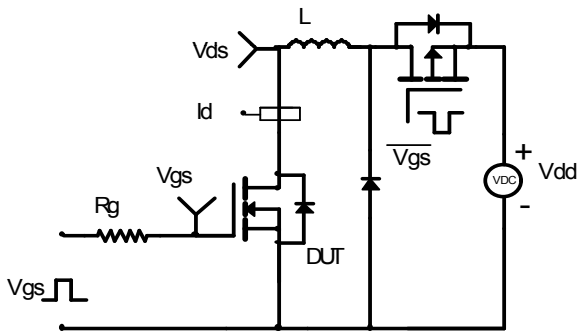
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

