Power Rectifiers

Ultrafast "E" Series with High Reverse Energy Capability

The MUR8100 and MUR880E diodes are designed for use in switching power supplies, inverters and as free wheeling diodes.

Features

- 20 mJ Avalanche Energy Guaranteed
- Excellent Protection Against Voltage Transients in Switching Inductive Load Circuits
- Ultrafast 75 Nanosecond Recovery Time
- 175°C Operating Junction Temperature
- Popular TO–220 Package
- Epoxy Meets UL 94 V–0 @ 0.125 in.
- Low Forward Voltage
- Low Leakage Current
- High Temperature Glass Passivated Junction
- Reverse Voltage to 1000 V
- Pb–Free Package is Available

Mechanical Characteristics

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds

ULTRAFAST RECTIFIERS
8.0 A, 800 V – 1000 V
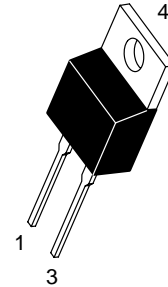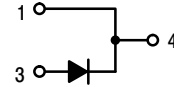
**TO–220AC
CASE 221B**

MUR8100E, MUR880E

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage MUR880E MUR8100E	V_{RRM} V_{RWM} V_R	800 1000	V

Average Rectified Forward Current
   (Rated V_R, $T_C = 150°C$)
                 Total Device
	$I_{F(AV)}$	8.0	A

Peak Repetitive Forward Current
   (Rated V_R, Square Wave,
   20 kHz, $T_C = 150°C$)
	I_{FM}	16	A

Non−Repetitive Peak Surge Current (Surge Applied at Rated Load Conditions Halfwave, Single Phase, 60 Hz)	I_{FSM}	100	A
Operating Junction and Storage Temperature Range	T_J, T_{stg}	−65 to +175	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Maximum Thermal Resistance, Junction−to−Case	$R_{\theta JC}$	2.0	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit

Maximum Instantaneous Forward Voltage (Note 1)
   ($i_F = 8.0$ A, $T_C = 150°C$)
   ($i_F = 8.0$ A, $T_C = 25°C$)
	v_F	1.5
		1.8
			V

Maximum Instantaneous Reverse Current (Note 1)
   (Rated DC Voltage, $T_C = 100°C$)
   (Rated DC Voltage, $T_C = 25°C$)
	i_R	500
		25
			μA

Maximum Reverse Recovery Time
   ($I_F = 1.0$ A, $di/dt = 50$ A/μs)
   ($I_F = 0.5$ A, $i_R = 1.0$ A, $I_{REC} = 0.25$ A)
	t_{rr}	100
		75
			ns

Controlled Avalanche Energy (See Test Circuit in Figure 6)	W_{AVAL}	20	mJ

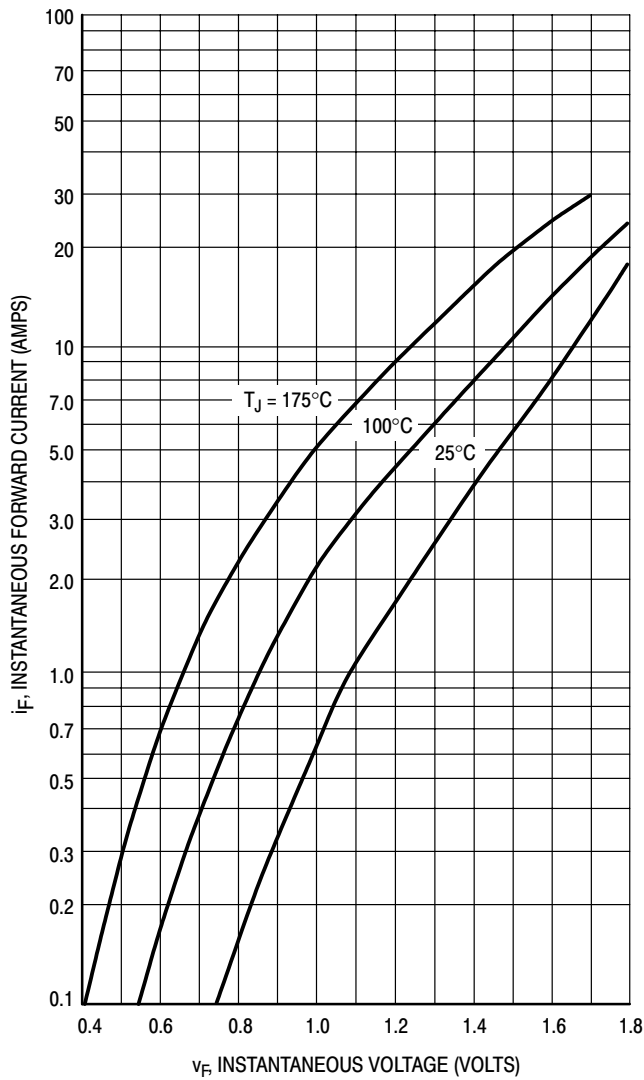1. Pulse Test: Pulse Width = 300 μs, Duty Cycle ≤ 2.0%.
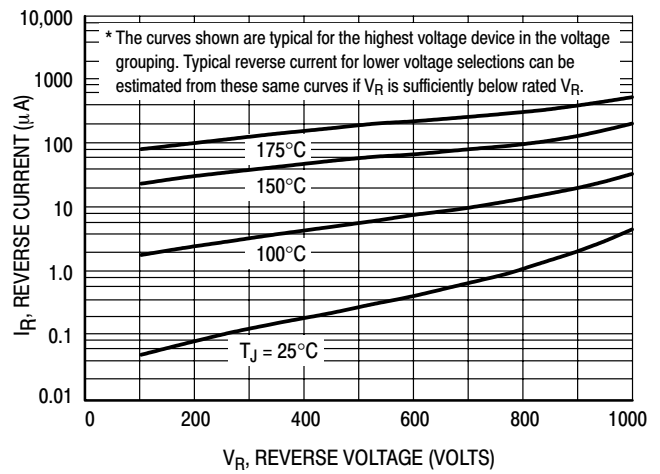
MUR8100E, MUR880E

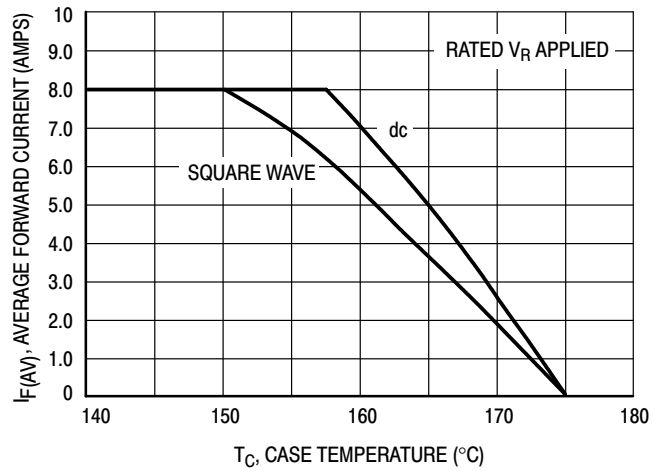Figure 1. Typical Forward Voltage

Figure 2. Typical Reverse Current*

* The curves shown are typical for the highest voltage device in the voltage grouping. Typical reverse current for lower voltage selections can be estimated from these same curves if V_R is sufficiently below rated V_R.

Figure 3. Current Derating, Case
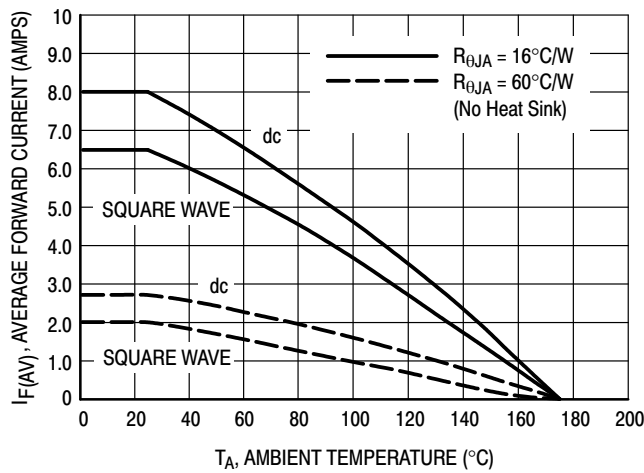
Figure 4. Current Derating, Ambient
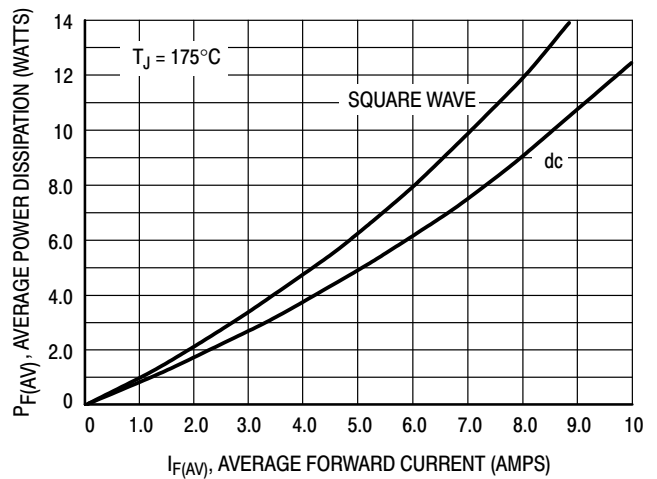
Figure 5. Power Dissipation
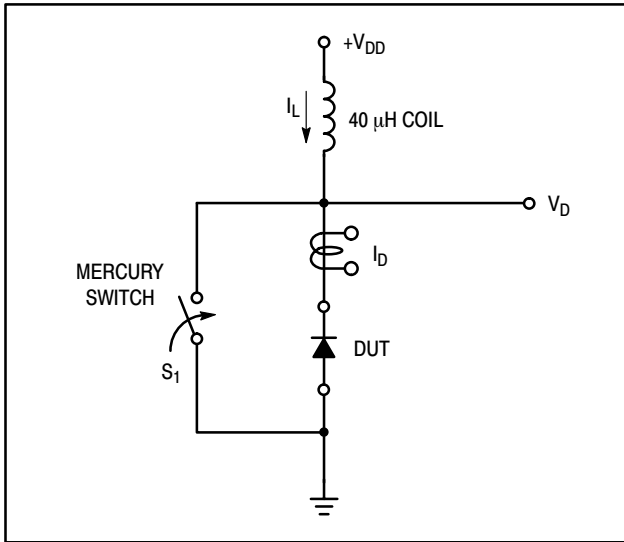
Figure 6. Test Circuit

Figure 7. Current–Voltage Waveforms

The unclamped inductive switching circuit shown in Figure 6 was used to demonstrate the controlled avalanche capability of the new "E" series Ultrafast rectifiers. A mercury switch was used instead of an electronic switch to simulate a noisy environment when the switch was being opened.

When S_1 is closed at t_0 the current in the inductor I_L ramps up linearly; and energy is stored in the coil. At t_1 the switch is opened and the voltage across the diode under test begins to rise rapidly, due to di/dt effects, when this induced voltage reaches the breakdown voltage of the diode, it is clamped at BV_{DUT} and the diode begins to conduct the full load current which now starts to decay linearly through the diode, and goes to zero at t_2.

By solving the loop equation at the point in time when S_1 is opened; and calculating the energy that is transferred to the diode it can be shown that the total energy transferred is equal to the energy stored in the inductor plus a finite amount of energy from the V_{DD} power supply while the diode is in
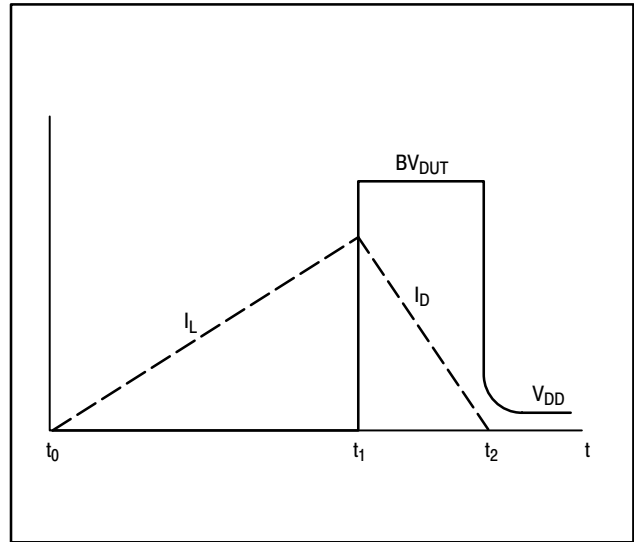
breakdown (from t_1 to t_2) minus any losses due to finite component resistances. Assuming the component resistive elements are small Equation (1) approximates the total energy transferred to the diode. It can be seen from this equation that if the V_{DD} voltage is low compared to the breakdown voltage of the device, the amount of energy contributed by the supply during breakdown is small and the total energy can be assumed to be nearly equal to the energy stored in the coil during the time when S_1 was closed, Equation (2).

The oscilloscope picture in Figure 8, shows the MUR8100E in this test circuit conducting a peak current of one ampere at a breakdown voltage of 1300 V, and using Equation (2) the energy absorbed by the MUR8100E is approximately 20 mjoules.
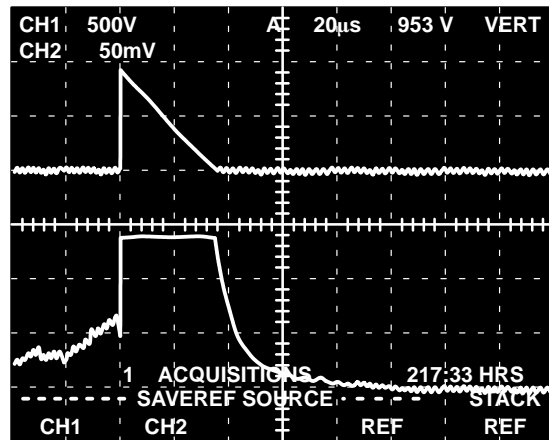
Although it is not recommended to design for this condition, the new "E" series provides added protection against those unforeseen transient viruses that can produce unexplained random failures in unfriendly environments.

EQUATION (1):

$$W_{AVAL} \approx \frac{1}{2}LI_{LPK}^2\left(\frac{BV_{DUT}}{BV_{DUT}-V_{DD}}\right)$$

EQUATION (2):

$$W_{AVAL} \approx \frac{1}{2}LI_{LPK}^2$$

CHANNEL 2:
I_L
0.5 AMPS/DIV.

CHANNEL 1:
V_{DUT}
500 VOLTS/DIV.

TIME BASE:
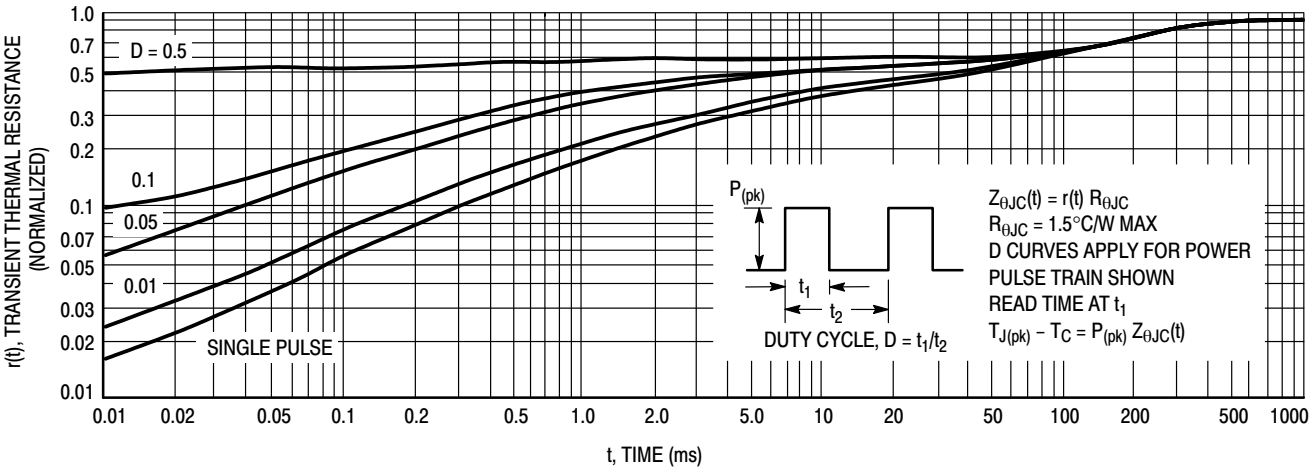20 μs/DIV.

Figure 8. Current–Voltage Waveforms

r(t), TRANSIENT THERMAL RESISTANCE (NORMALIZED)

D = 0.5

0.1

0.05

0.01

SINGLE PULSE

$P_{(pk)}$

t_1

t_2

DUTY CYCLE, D = t_1/t_2

$Z_{\theta JC}(t) = r(t)\, R_{\theta JC}$
$R_{\theta JC} = 1.5°C/W$ MAX
D CURVES APPLY FOR POWER
PULSE TRAIN SHOWN
READ TIME AT t_1
$T_{J(pk)} - T_C = P_{(pk)}\, Z_{\theta JC}(t)$

t, TIME (ms)

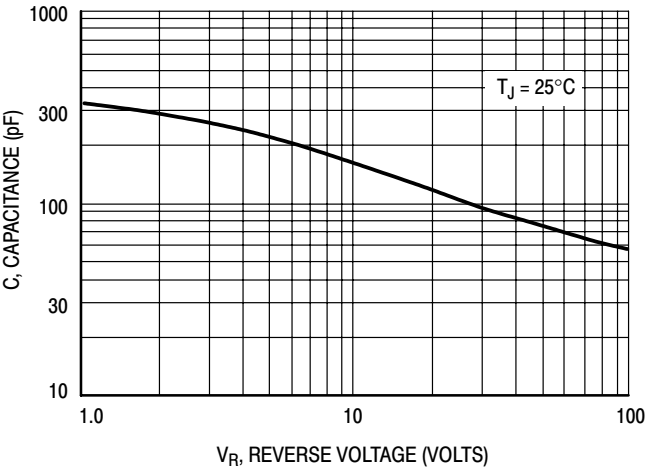**Figure 9. Thermal Response**

C, CAPACITANCE (pF)

$T_J = 25°C$

V_R, REVERSE VOLTAGE (VOLTS)

Figure 10. Typical Capacitance