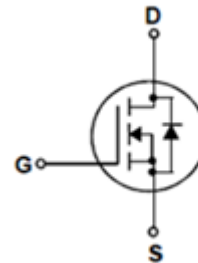
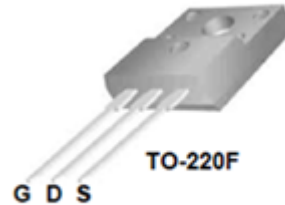


650V N-Channel MOSFET

General Description

This Power MOSFET is produced using advanced planar stripe DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.

These devices are well suited for high efficiency switched mode power supplies, active power factor correction based on half bridge topology.



Features

13A, 650V, $R_{DS(on)typ.} = 0.6\Omega @ V_{GS} = 10V$

Smart design in high voltage technology

Ultra low gate charge

Fast switching

Low reverse recovery charge.

Improved dv/dt capability

Absolute Maximum Ratings $T_c = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	JFFM13N65D	Units
V_{DSS}	Drain – Source Voltage	650	V
I_D	Drain Current	Continuous ($T_c = 25^\circ\text{C}$)	13*
		Continuous ($T_c = 100^\circ\text{C}$)	7.5*
I_{DM}	Drain Current - Pulsed (Note 1)	48	A
V_{GSS}	Gate – Source Voltage	± 30	V
EAS	Single Pulsed Avalanche Energy (Note 2)	230	mJ
I_{AR}	Avalanche Current (Note 1)	13	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	26	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5	V/ns
P_D	Power Dissipation ($T_c = 25^\circ\text{C}$) -Derate above 25°C	42	W
		0.34	W/ $^\circ\text{C}$
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
T_L	Maximum lead temperature for soldering purposes 1/8" from case for 5 seconds	300	$^\circ\text{C}$

*Drain current limited by maximum junction temperature.

Thermal characteristics

Symbol	Parameter	JFFM13N65D	Units
R _{θJC}	Thermal Resistance, Junction-to-Case	2.98	°C/W
R _{θJS}	Thermal Resistance, Case-to-Sink Typ.	--	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient	62.5	°C/W

Electrical Characteristics T_c = 25 °C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV _{DSS}	Drain – Source Breakdown Voltage	V _{GS} = 0 V, I _D = 250 uA	650	--	--	V
ΔBV _{DSS} /ΔT _J	Breakdown Voltage Temperature Coefficient	I _D = 250 uA, Referenced to 25°C	--	0.6	--	V/°C
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 650 V, V _{GS} = 0 V	--	--	1	uA
		V _{DS} = 520 V, T _c = 125 °C	--	--	10	uA
I _{GSSF}	Gate-Body Leakage Current, Forward	V _{GS} = 30 V, V _{DS} = 0 V	--	--	100	nA
I _{GSSR}	Gate-Body Leakage Current, Reverse	V _{GS} = -30 V, V _{DS} = 0 V	--	--	-100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250 uA	2.0	--	4.0	V
R _{DS(on)}	Static Drain-Source on-Resistance	V _{GS} = 10 V, I _D = 6.5A	--	0.6	0.75	Ω
g _{FS}	Forward Transconductance	V _{DS} = 40 V, I _D = 6.5A (Note 4)	--	11	--	S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} = 25 V, V _{GS} = 0 V, f = 1.0 MHz	--	1600	--	pF
C _{oss}	Output Capacitance		--	135	--	pF
C _{rss}	Reverse Transfer Capacitance		--	14	--	pF
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time	V _{DS} = 325 V, I _D = 13.0 A, R _G = 25Ω, V _{GS} = 10 V (Note 4,5)	--	30	--	ns
t _r	Turn-On Rise Time		--	25	--	ns
t _{d(off)}	Turn-Off Delay Time		--	60	--	ns
t _f	Turn-Off Fall Time		--	40	--	ns
Q _g	Total Gate Charge		V _{DS} = 520 V, I _D = 13.0 A V _{GS} = 10 V (Note 4,5)	--	47	--
Q _{gs}	Gate-Source Charge	--		10	--	nC
Q _{gd}	Gate-Drain Charge	--		16.5	--	nC
Drain – Source Diode Characteristics and Maximum Ratings						
I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	13	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	52	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0 V, I _S = 13.0 A	--	--	1.4	V
t _{rr}	Reverse Recovery Time	V _{GS} = 0 V, I _S = 13.0 A	--	500	--	ns
Q _{rr}	Reverse Recovery Charge	dI _F /dt = 100 A/us (Note 4)	--	5.6	--	uC

Notes:

1. Repetitive Rating : Pulsed width limited by maximum junction temperature
2. L = 3.0mH, I_{AS} = 13A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3. I_{SD} ≤ 13.0A, di/dt ≤ 200A/us, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4. Pulsed Test : Pulsed width ≤ 300us, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

Typical Characteristics

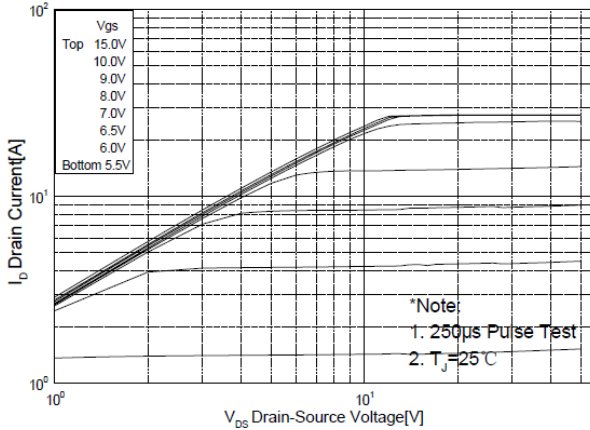


Figure 1. On-Region Characteristics

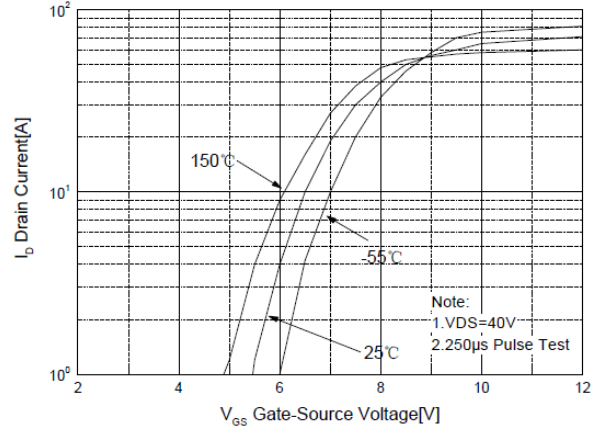


Figure 2. Transfer Characteristics

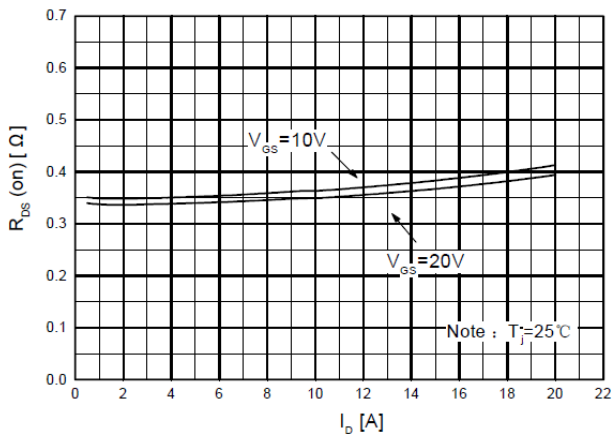


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

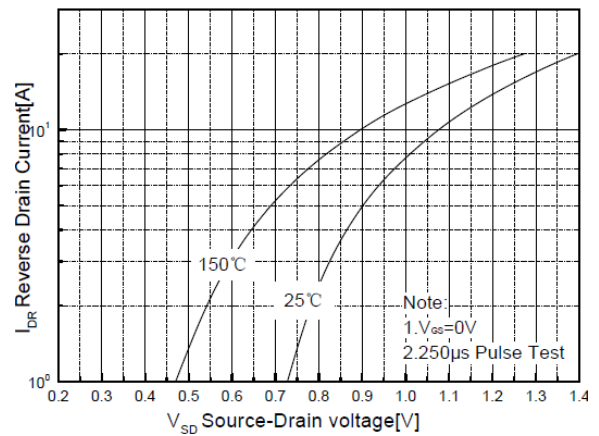


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

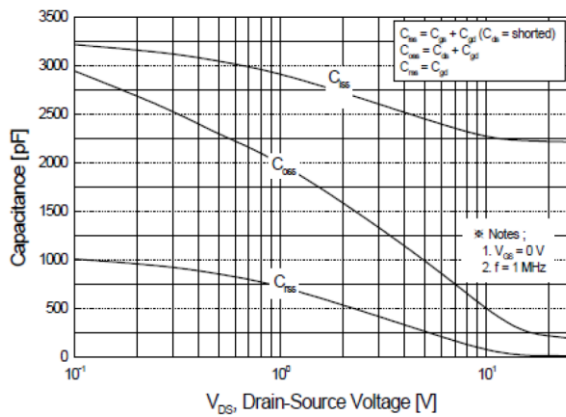


Figure 5. Capacitance Characteristics

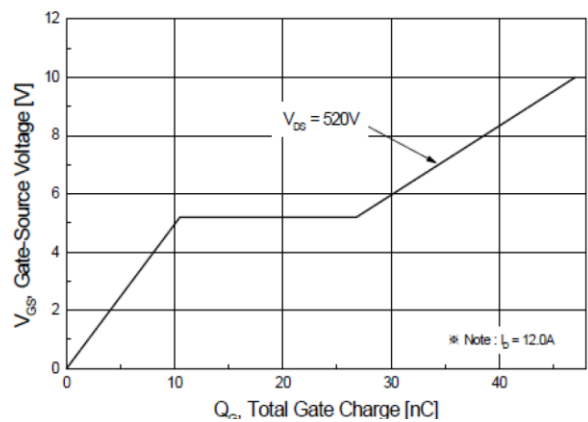


Figure 6. Gate Charge Characteristics

Typical Characteristics

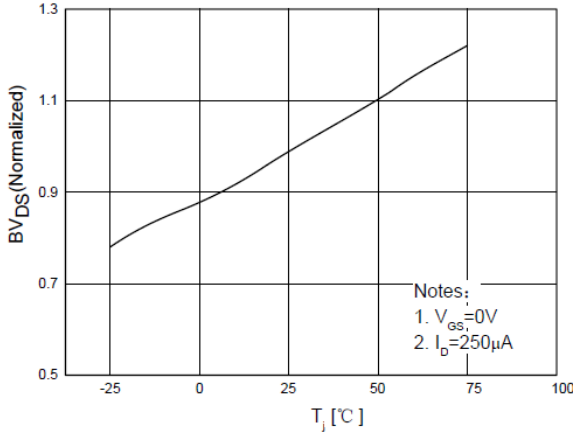


Figure 7. Breakdown Voltage Variation vs Temperature

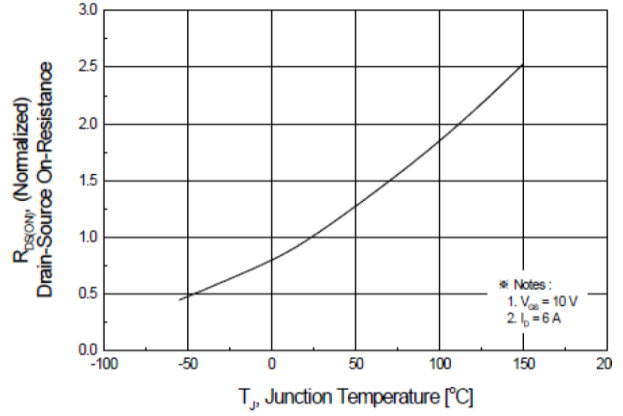


Figure 8. On-Resistance Variation vs Temperature

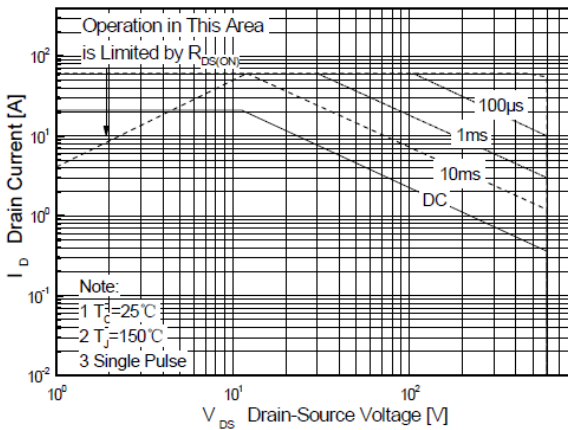


Figure 9-2. Maximum Safe Operating Area for JFFM20N60C

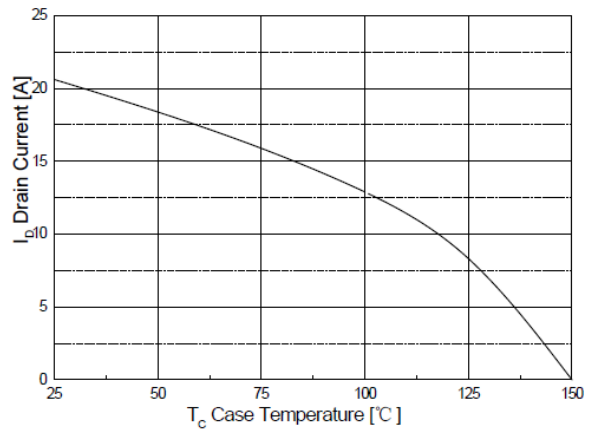


Figure 10. Maximum Drain Current vs Case Temperature

Typical Characteristics

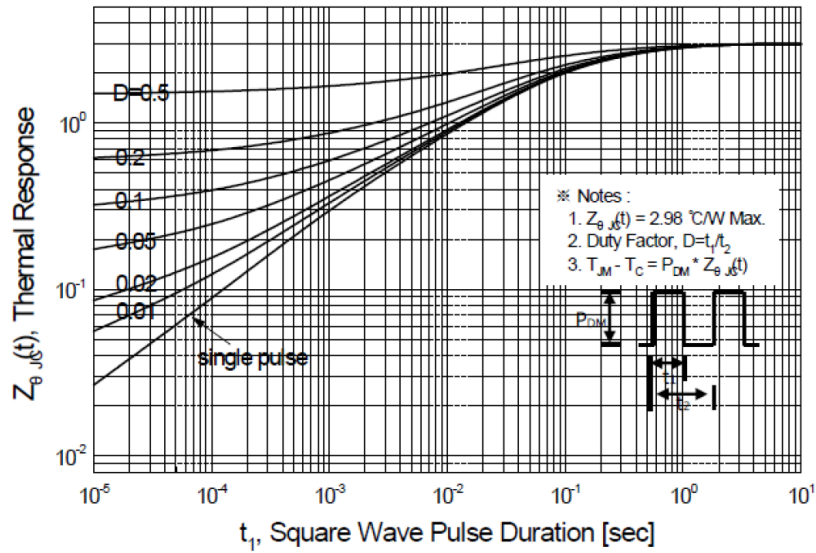
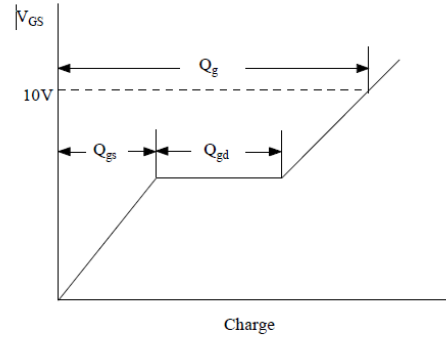
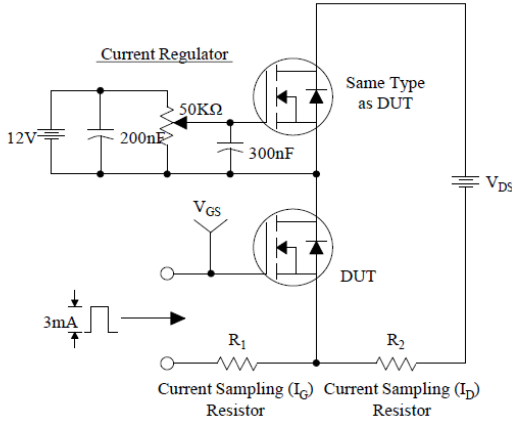
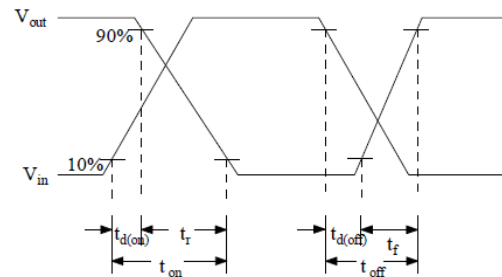
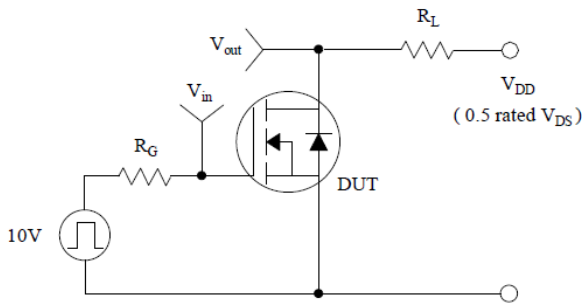


Figure 11-2. Transient Thermal Response Curve for JFFM13N65D

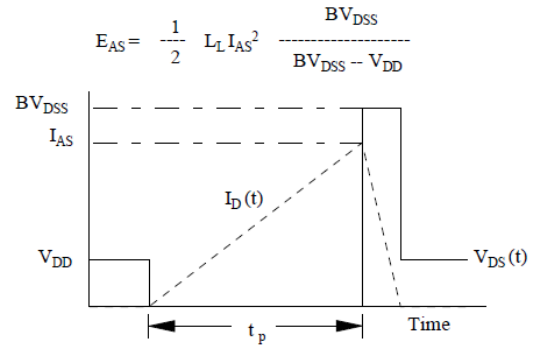
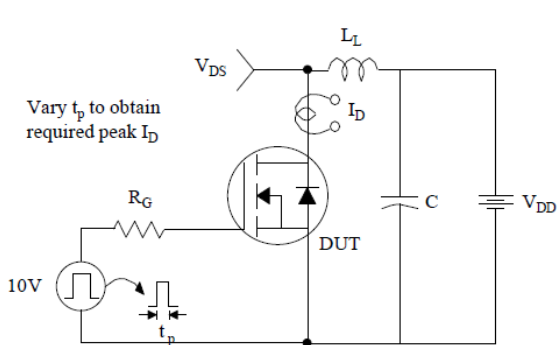
Test Circuit & Waveform



Gate Charge Test Circuit & Waveform

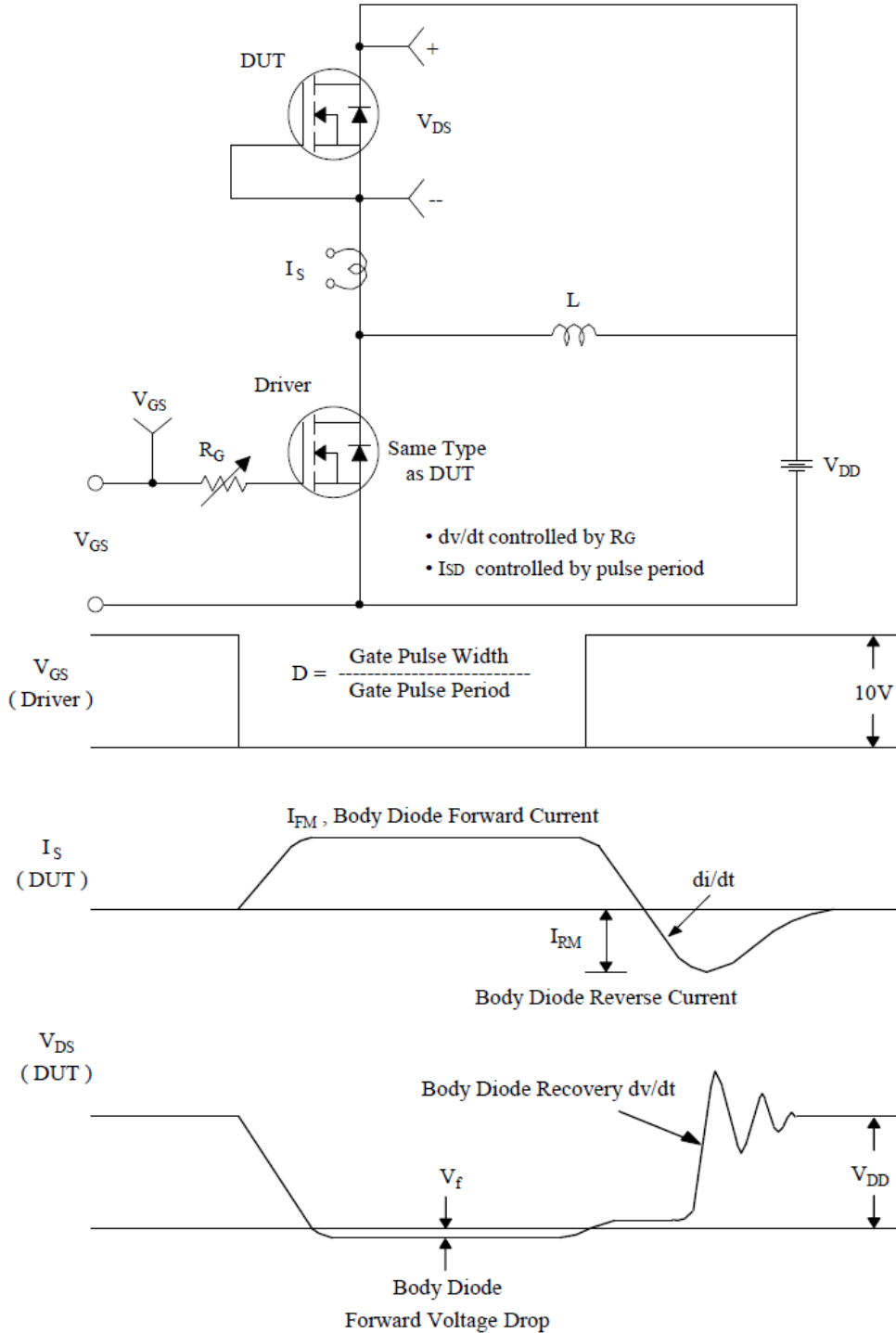


Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

Test Circuit & Waveform



Peak Diode Recovery dv/dt Test Circuit & Waveforms