# MGZ31N65

650V GaN FET Enhancement Mode

Features

- 650V, 6.5A, $R_{DS(on)}$(typ.) = 230mΩ@VGS = 8V.
- Very low Q_{RR}
- Reduced Crossover Loss
- Easy to drive with commonly-used gate drivers
- Enables AC-DC bridgeless totem-pole PFC designs
  - —Increased power density
  - —Reduced system size and weight
  - —Overall lower system cost
- Achieves increased efficiency in both hard- and soft switched circuits
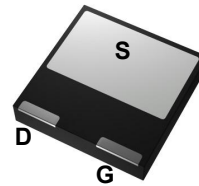
**DFN8X8-3L
Bottom View**

Application

- Power adapters
- Low power SMPS
- Lighting
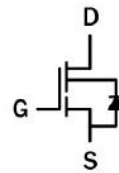
Cascode Schematic Symbol
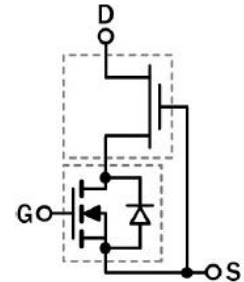
Cascode Device Structure

Absolute Maximum Ratings （Tc = 25°C unless otherwise noted）

Symbol	Parameter		Limit	Unit
V_{DS}	Drain-Source Voltage		650	V
$V_{(TR)DSS}$	Transient Drain to Source Voltage [a]		800	V
V_{GSS}	Gate-Source Voltage		± 18	V
P_D	Maximum power Dissipation @T_C = 25°C		21.6	W
I_D	Drain Current-Continuous	T_C = 25°C [b]	6.5	A
	Drain Current-Continuous	T_C = 100°C [b]	4.1	A
I_{DM}	Drain Current-Pulsed	Pulse Width = 10µs	30	A
T_C	Operating Temperature Case		-55 to +150	°C
T_J	Operating Temperature Junction		-55 to +150	°C
T_S	Storage Temperature		-55 to +150	°C
T_{SOLD}	Soldering Peak Temperature [c]		260	°C

Thermal Characteristics

Symbol	Parameter	Typical	Unit
$R_{θJC}$	Thermal Resistance Junction-Case	5.8	°C/W
$R_{θJA}$	Thermal Resistance Junction-Ambient [d]	52	°C/W

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

■ Off Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{(BL)DSS}$	Reverse Breakdown Voltage	V_{GS} = 0V	650	-	-	V
I_{DSS}	Reverse Leakage Current	V_{GS} = 0V, V_{DS} = 650V T_J = 25°C	-	1.0	10	µA
		V_{GS} = 0V, V_{DS} = 650V T_J = 150°C	-	2.0	-	µA
I_{GSS}	Gate-to-source Leakage Current	V_{DS} = 0V, V_{GS} = ±18V	-	-	±100	nA

■ On Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D =500µA	1.6	2.1	2.6	V
$R_{DS(on)eff}$	On Resistance	V_{GS} = 8V, I_D =5A T_J = 25°C	-	230	300	mΩ
		V_{GS} = 8V, I_D =5A T_J = 150°C	-	405	-	

■ Dynamic Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
C_{ISS}	Input Capacitance	V_{GS} = 0 V, V_{DS} = 400 V f=1MHz	-	793	-	pF
C_{OSS}	Output Capacitance		-	33	-	
C_{RSS}	Transfer Capacitance		-	2.7	-	
$C_{o(er)}$	Output Capacitance, energy related	V_{GS} = 0 V, V_{DS} = 0~400 V	-	99	-	pF
$C_{o(tr)}$	Output Capacitance, time related		-	71	-	

■ On Characteristics

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-On Delay Time	V_{GS} = 0~8 V, V_{DS} = 400 V , I_D = 4 A , Rg = 30 Ω	-	13	-	ns
t_r	Turn-On Rise Time		-	25	-	
$t_{d(off)}$	Turn-Off Delay Time		-	47	-	
t_f	Turn-Off Fall Time		-	34	-	
Q_G	Total Gate Charge	V_{GS} = 0~8 V, V_{DS} = 400 V , I_D = 4 A	-	9.0	-	nC
Q_{GS}	Gate-Source Charge		-	1.6	-	
Q_{GD}	Gate-Drain Charge		-	2.4	-	
Q_{OSS}	Output Charge	V_{GS}=0V,V_{DS}=0~400 V	-	28	-	nC

■ **Drain-Source Diode Characteristics**

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
I_S	Reverse Current	V_{GS} = 0 V	-	-	6.5	A
V_{SD}	Reverse Voltage	V_{GS} = 0V, I_S = 2 A	-	1.2	-	V
		V_{GS} = 0V, I_S = 5 A	-	2.0	-	V
t_{RR}	Reverse Recovery Time	I_S = 5 A ,V_{DS}= 400V, di/dt = 200 A/μs	-	14	-	ns
Q_{RR}	Reverse Recovery Charge		-	11	-	nC

Notes:

a. In off-state, spike duty cycle D<0.01, spike duration <1μs .

b. For increased stability at high current operation.

c. Reflow MSL3 .

d. Device on one layer epoxy PCB for drain connection (vertical and without air stream cooling, with 6cm^2 copper area and 70μm thickness).

Typical Characteristics (T$_C$ = 25°C unless otherwise noted)
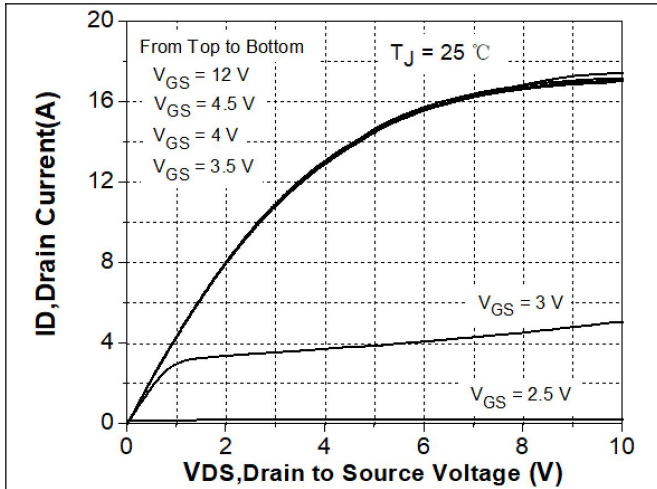
Figure 1. Typical Output Characteristics T$_J$=25°C
Parameter: V$_{GS}$
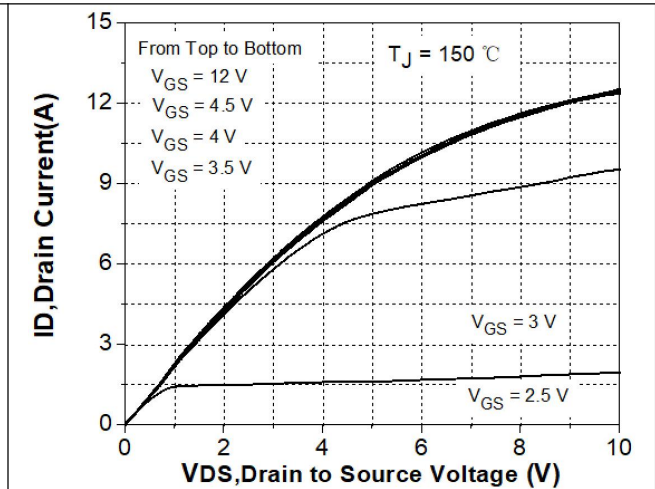
Figure 2. Typical Output Characteristics T$_J$ = 150°C
Parameter: V$_{GS}$
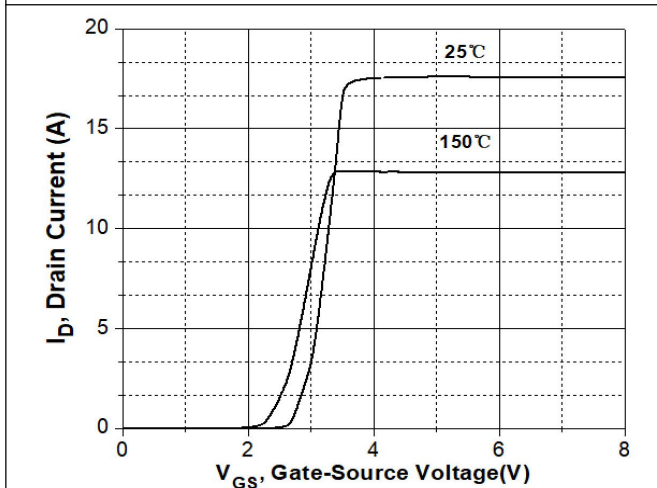
Figure 3. Typical Transfer Characteristics V$_{DS}$=10V
Parameter: T$_J$

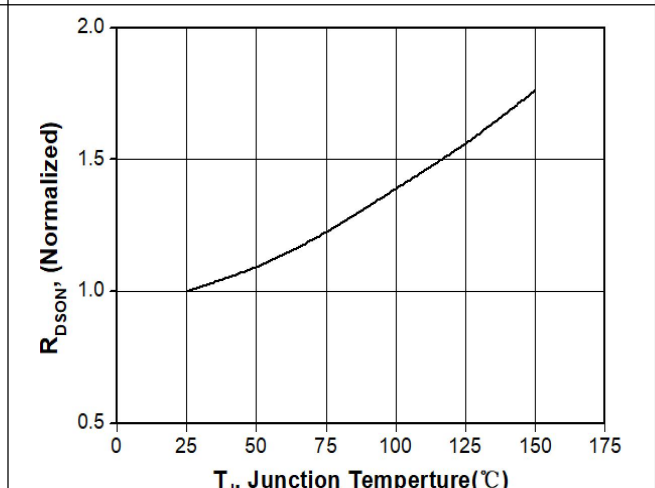Figure 4. Normalized On-resistance
I$_D$ = 16 A, V$_{GS}$ = 10 V

Figure 5. Typical Capacitance
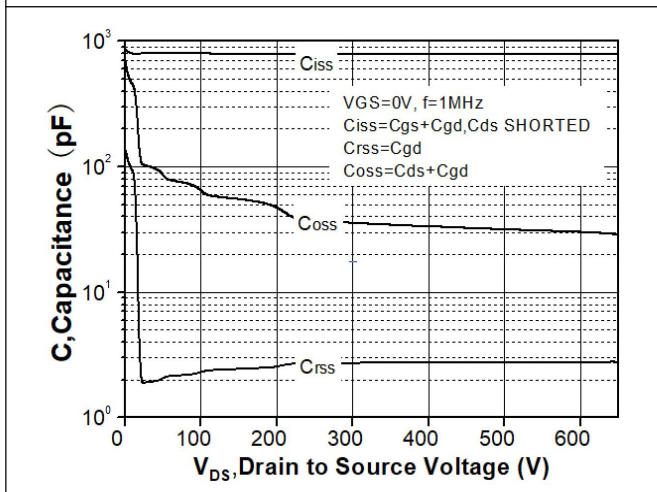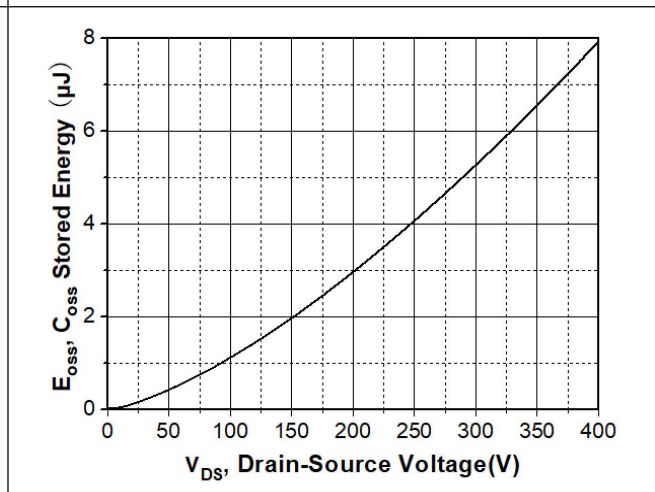V$_{GS}$ = 0V, f = 1MHz

Figure 6. Typical C$_{OSS}$ Stored Energy

Typical Characteristics (T$_C$ = 25°C unless otherwise noted)
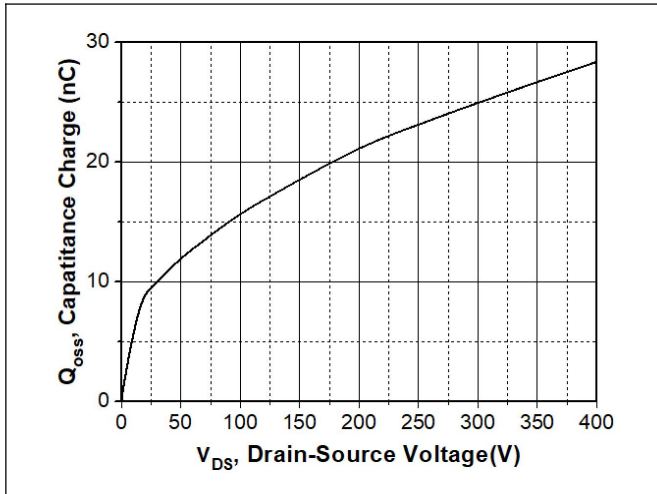
Figure 7. Typical Q$_{OSS}$

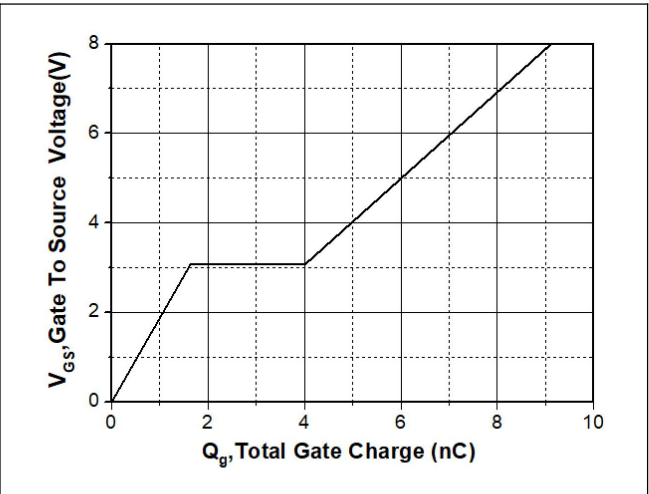**Figure 8. Typical Gate Charge**
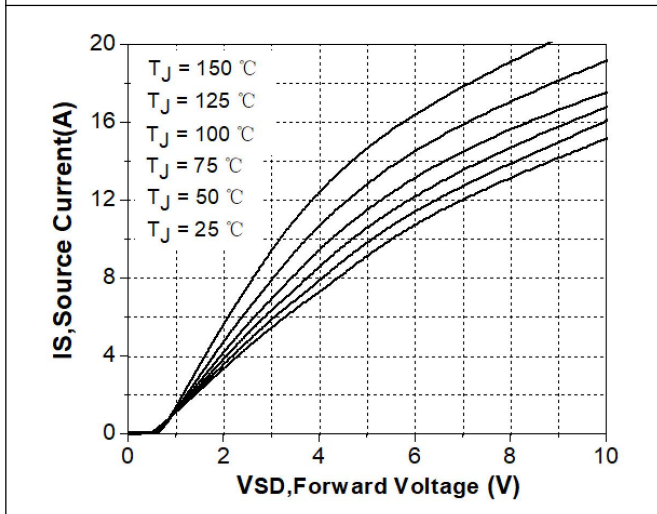
I$_{DS}$ = 10A, V$_{DS}$ = 400V

Figure 9. Forward Characteristics of Rev.

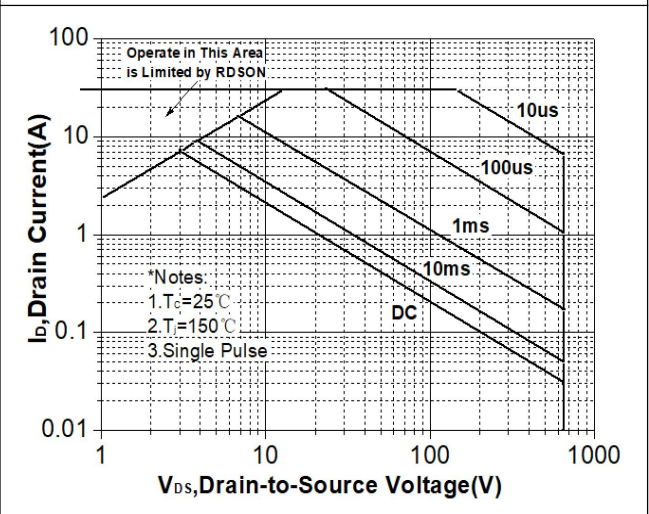**Diode I$_S$ = f(V$_{SD}$), Parameter T$_J$**

Figure 10. Safe Operating Area T$_C$ = 25°C
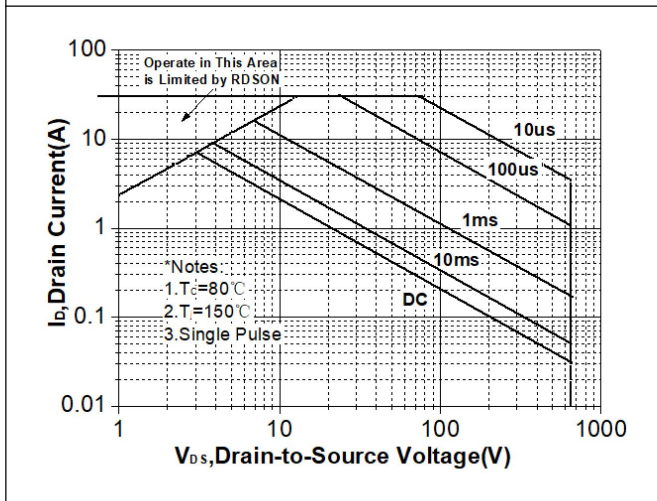
(calculated based on thermal limit)

Figure 11. Safe Operating Area T$_C$ = 80°C

(calculated based on thermal limit)
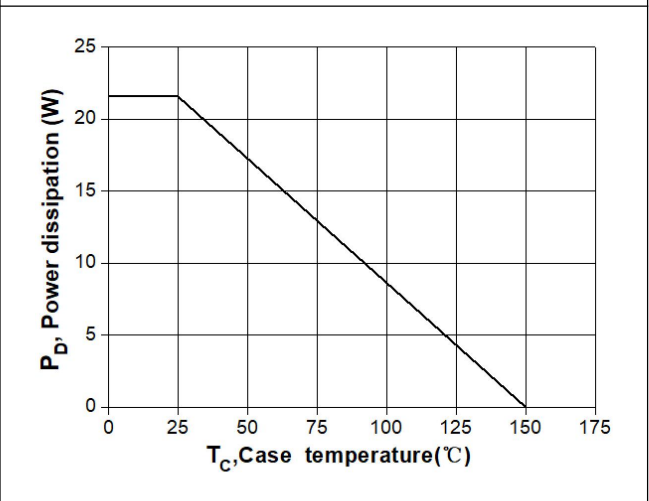
Figure 12. Power Dissipation

Typical Characteristics (T_C = 25°C unless otherwise noted)

*Notes:
1. $T_j - T_c = P_{DM} * Z_{\theta jc}(t)$
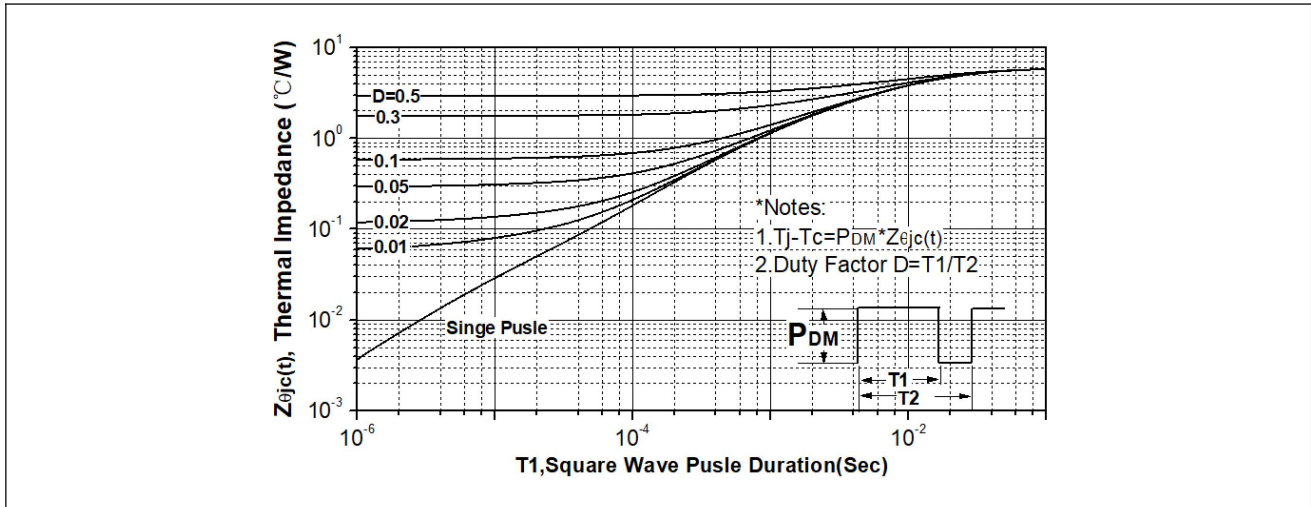2. Duty Factor $D = T1/T2$

Figure 13. Transient Thermal Resistance
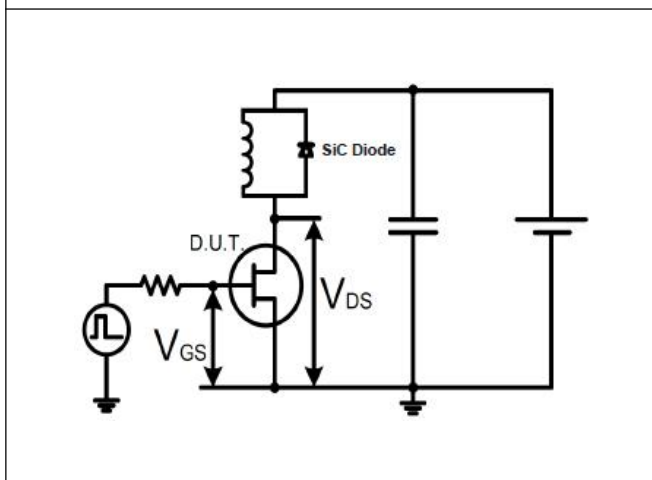

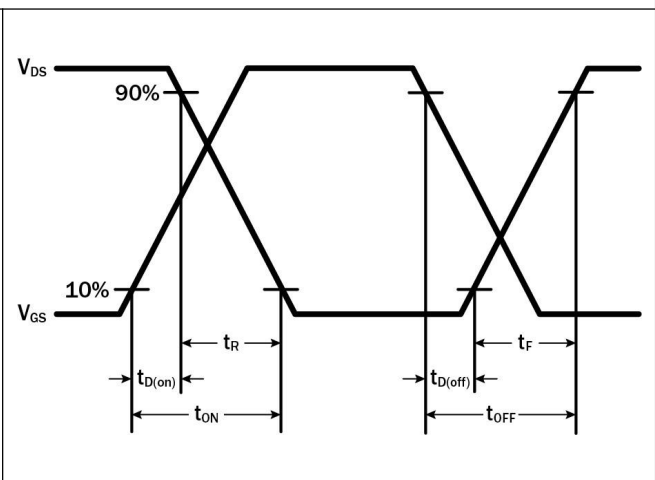**Figure 14. Switching Time Test Circuit**

Figure 15. Switching Time Waveform
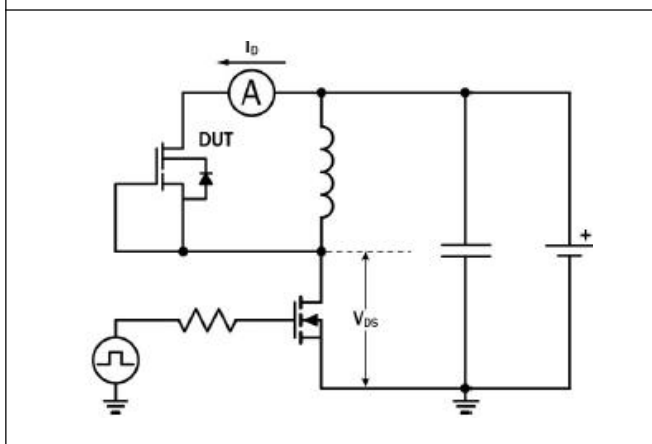
Figure 16. Diode Characteristics Test Circuit

$t_{RR} = t_s + t_F$
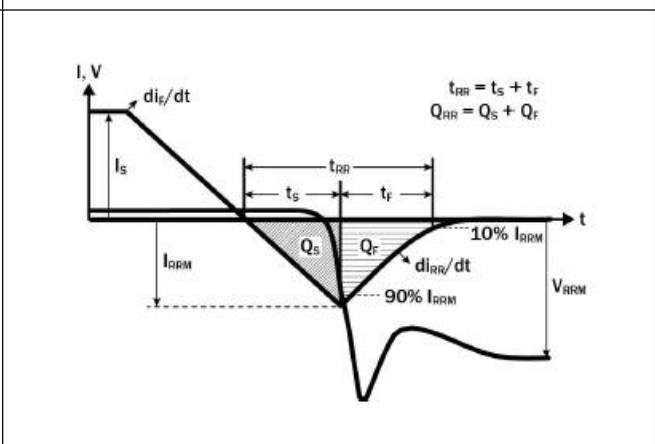$Q_{RR} = Q_S + Q_F$

Figure 17. Diode Recovery Waveform

■ DFN8X8-3L Package Information

SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.00	---	0.05
b	2.20	2.25	2.30
c	0.20 REF.		
D	7.90	8.00	8.10
D2	6.85	7.00	7.15
E	7.90	8.00	8.10
E2	4.03	4.18	4.33
e	4.75 BSC		
K	2.50	---	---
L	0.70	0.80	0.90
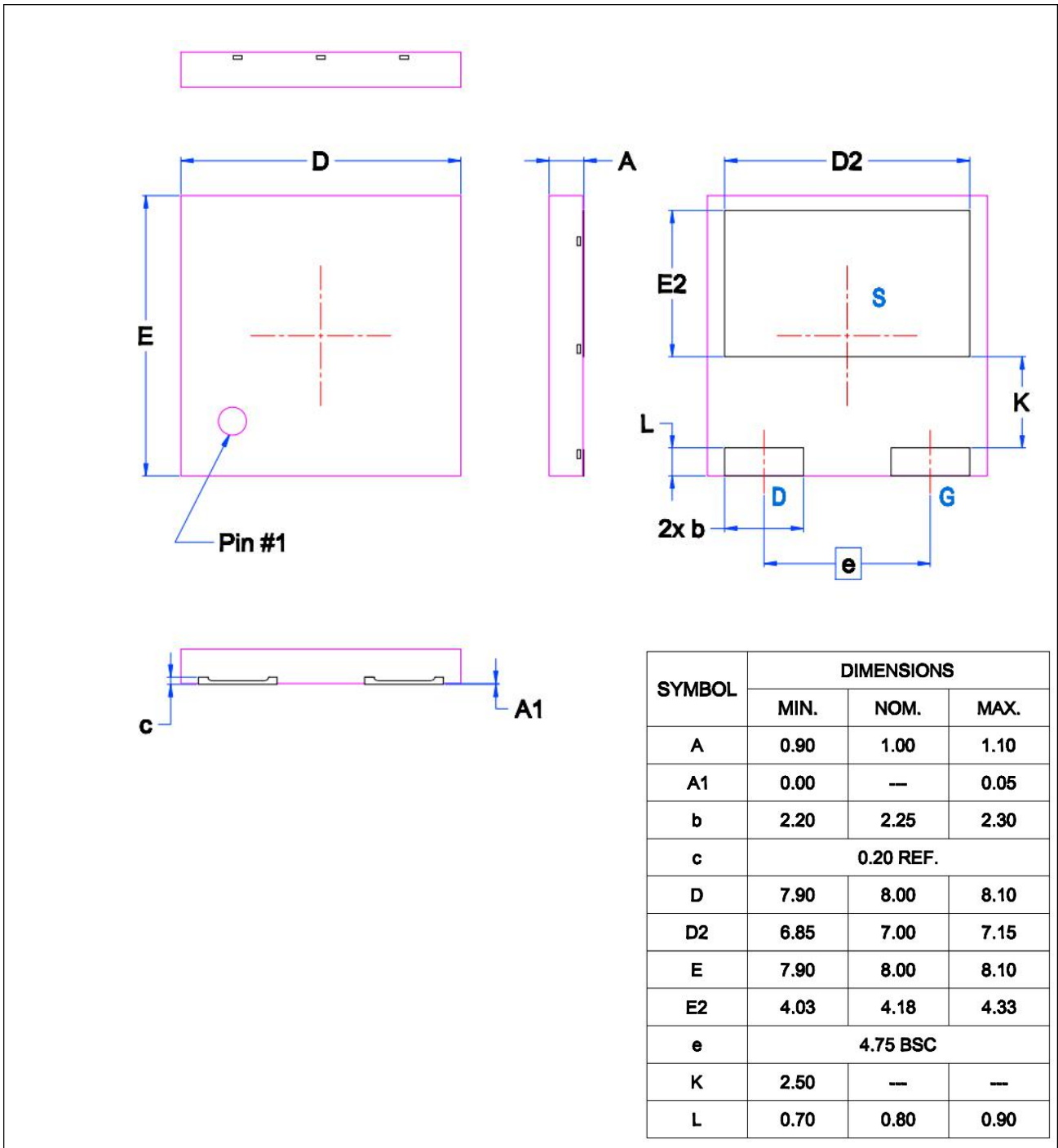
■ Revision History

Version	Date	Subjects (major changes since last revision)
0.1	2021-05-07	Preliminary Version
1.0	2021-12-10	Datasheet Complete