

MMFA60R360Q

(600V 0.36Ω N-channel MOSFET)

(Green)

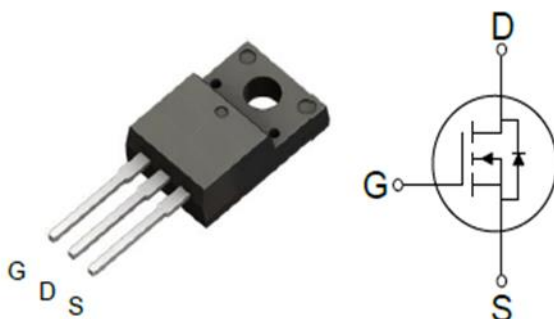
Reliability report

Report no.	QART-2207-003	Issued date	2022. 07. 06
◆ <u>Part number</u> MMFA60R360Q ◆ <u>Fabrication facility</u> Magnachip (Gumi / Fab. 3) ◆ <u>Package</u> TO-220F	Issued by		
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■ Key Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.36	Ω
$V_{TH,typ}$	3	V
I_D	11	A
$Q_{g,typ}$	19	nC

■ Package & Internal Circuit



■ Absolute Maximum Rating ($T_c=25^\circ\text{C}$ unless otherwise specified)

Parameter	Symbol	Rating	Unit	Note
Drain – Source voltage	V_{DSS}	600	V	
Gate – Source voltage	V_{GSS}	± 30	V	
Continuous drain current ⁽¹⁾	I_D	11	A	$T_c = 25^\circ\text{C}$
		7	A	$T_c = 100^\circ\text{C}$
Pulsed drain current ⁽²⁾	I_{DM}	33	A	
Power dissipation	P_D	30	W	
Single - pulse avalanche energy	E_{AS}	210	mJ	
MOSFET dv/dt ruggedness	dv/dt	50	V/ns	
Diode dv/dt ruggedness ⁽³⁾	dv/dt	15	V/ns	
Storage temperature	T_{stg}	-55 ~ 150	$^\circ\text{C}$	
Maximum operating junction temperature	T_j	150	$^\circ\text{C}$	

1) I_D limited by maximum junction temperature

2) Pulse width t_p limited by $T_{j,max}$

3) $I_{SD} \leq I_D$, $V_{DS\ peak} \leq V_{(BR)DSS}$

■ Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal resistance, junction-case max	R_{thjc}	4.2	$^\circ\text{C/W}$
Thermal resistance, junction-ambient max	R_{thja}	75	$^\circ\text{C/W}$



Results of reliability stress for MMFA60R360Q

◆ Life-time test

Test item	Test conditions	Duration	Sample size	Failure Q'ty	Judgment
HTRB	Ta = 150°C, V _{DS} = 80% of V _{DS.MAX}	1000 hours	231pcs / 3Lots	0	Pass
HTGB	Ta = 150°C, V _{GS} = 100% of V _{GS.MAX}	1000 hours	231pcs / 3Lots	0	Pass

◆ Environmental test

Test item	Test conditions	Duration	Sample size	Failure Q'ty	Judgment
T/C	Ta = -65°C (15m) ~ 150°C (15m)	500 cycles	135pcs / 3Lots	0	Pass
PCT	Ta = 121°C, 100% RH, 2atm	96 hours	231pcs / 3Lots	0	Pass

◆ ESD test : ESD test : Below ESD results are actual measured data.

Test Item	Test Conditions	Zapping	GND	Zap times	S/S [pcs]	Pass Level
HBM	100pF / 1.5KΩ, (Ref. JESD22A-114F)	G	D,S	1Cycle	3	1,300V
		D	G,S		3	6,000V
		S	G,D		3	6,000V
MM	200pF / 0Ω, (Ref. JESD22A-115A)	G	D,S	1Cycle	3	250V
		D	G,S		3	600V
		S	G,D		3	500V

We guarantee that ESD testing method, procedure and judgment according to JESD22-A114F (HBM), JESD22-A115A (MM).



Evaluation of failure rate

To estimate the failure rate, We assumed the accelerated factors as follow:

- Duration : 1000Hrs.
- Sample Size : 3Lots (77ea /LOT)
- Failure Quantity (# of total failure / Total sample sizes) : 0/231 ea

1. Test condition :

HTRB : $V_{DS} = 80\%$ of $V_{DS\cdot MAX}$, $T_a = 150^\circ C$

HTGB : $V_{GS} = 100\%$ of $V_{GS\cdot MAX}$, $T_a = 150^\circ C$

2. Using condition : $T_a = 55^\circ C$

3. Temperature acceleration factor (T.A.F) : From test to use conditions

$$A1 = \exp [(Ea/k) (1/T1)], A2 = \exp [(Ea/k) (1/T2)]$$

$$T.A.F = A1/A2 = \exp [(Ea/k) (1/T1 - 1/T2)]$$

$$= \exp [0.7/8.62 \times 10^{-5} (1/328 - 1/423)] = \mathbf{259.91}$$

Where, $T1 = (55^\circ C + 273^\circ C)^\circ K$, $T2 = (150^\circ C + 273^\circ C)^\circ K$

Ea : Activation energy (assuming 0.7eV : Oxide Weak)

k : Boltzmanns constant ($8.62 \times 10^{-5} \text{ eV } / ^\circ K$)

4. Device hours

$$(S/S \times \text{hours}) \times T.A.F = (231 \times 1000) \times 259.91 = 60,038,578.13$$

5. $\alpha = \chi^2 / 2 = 0.917$ (In case of 0 failure)

Where , χ^2 : Chi-square distribution ($\text{Chiinv}[0.4, 2(\text{Fail}+1)]$)

Confidence Level : C.L.=60%

6. Failure rates = $(1 / \text{Device Hours}) \times \alpha$ (C.L. = 60%)

$$= 0.917 / 60,038,578.13 \text{ (fails / hours)}$$

$$= \mathbf{15.27 \text{ FIT}} \text{ [FIT (Failure In Time) : fails / } 10^9 \text{ hours]}$$

7. MTTF(Mean time to failure)

$$= 10^9 / \text{FIT} = \mathbf{65,472,822.4 \text{ hours}}$$