2N7587U3,U3C;
2N7591U3,U3C;
2N7593U3,U3C;

N-Channel Radiation Hardened MOSFET (TO-276AA)

Rev. V7

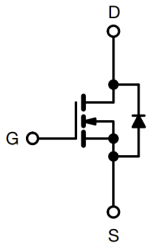
Introduction

VPT Components' new radiation tolerant power MOSFETs are now available in die and U3/U3C standard package options, as well as custom packaging for HiRel environments. Applications within military, aerospace, medical, nuclear power generation and high energy physics research laboratories can benefit from the use of this new series of MOSFETs. VPT Components' Power MOSFETS are radiation tolerant to 100 krad (Si) and SEGR/SEB immune to their full rated breakdown potential.

Operational power losses are minimized by VPT Components' ideal combination of low $r_{DS(on)}$ and gate charge. Die size is optimized for maximum current rating while meeting industry norms. These units are suitable for stand alone and hybrid applications.

These MOSFETs are well suited for low loss switching applications, such as DC to DC converters and solid-state relays. Die performance is drop-in compatible with industry standards.

FIGURE 1:
TO-276AA, SMD-0.5 (U3, U3C)
Package



N-Channel MOSFET

Features

- Available in JANSR, JANVR
  Per MIL-PRF-19500/746
- TO-276AA, SMD-0.5 (U3, U3C) Package
- Hermetically Sealed

Maximum Ratings (T_A = +25°C unless otherwise specified)

Type	P_T T_C = +25°C (1)	P_T T_A= +25°C (free air)	$R_{\theta JC}$	V_{DS}	V_{DG}	V_{GS}	I_{D1} T_C = +25°C	I_{D2} T_C = +100°C	I_S	I_{DM}	T_J & T_{STG}	Max $r_{DS(on)1}$ V_{GS} = 10 V dc, I_D = I_{D2} T_J = +25°C (1)
	W	W	°C/W	V dc	V dc	V dc	A dc	A dc	A dc	A (pk)	°C	Ω
2N7587U3,U3C 2N7591U3,U3C 2N7593U3,U3C	75	1.56	1.67	100 200 250	100 200 250	±20	22 16 12.4	19 10 7.8	22 16 12.4	88 64 49.6	-55 to +150	0.042 0.130 0.210

NOTES:
1. Derate linearly 0.6 W/°C for T_C > +25°C.

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N-Channel Radiation Hardened MOSFET (TO-276AA)

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Primary Electrical Characteristics (2N7587U3,U3C; 2N7591U3,U3C; 2N7593U3,U3C)

Characteristics	Test Conditions	Symbol	Min.	Max.	Unit
Drain-Source Breakdown Voltage 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = 0 V, I_D = 1 mA	$V_{(BR)DSS}$	100 200 250	—	V
Gate-Threshold Voltage	$V_{DS} \geq V_{GS}$, I_D = 1.0 mA	$V_{GS(TH)1}$	2.0	4.0	V
Gate-Body Leakage Forward	V_{GS} = +20V, V_{DS} = 0V	I_{GSSF1}	—	+100	nA
Gate-Body Leakage Reverse	V_{GS} = -20V, V_{DS} = 0V	I_{GSSR1}	—	-100	nA
Zero-Gate Voltage Drain Current 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = 0V, V_{DS} = 80V V_{DS} = 160V V_{DS} = 200V	I_{DSS1}	—	10	µA
Forward Voltage Drain Diode Pulsed dc Voltage 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = 0V, V_{GS} = 0V, I_D = 22A I_D = 16A I_D = 12.4A	V_{SD}	—	1.2 1.2 1.2	V
Forward Transconductance 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{DD} = 12V I_D = 19 I_D = 10 I_D = 7.8	g_{FS}	14 10 8.8	—	S
Turn-on Delay Time 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = 12V,R_G = 7.5Ω, I_D = 22A V_{DD} = 50V I_D = 16A V_{DD} = 100V I_D = 12.4A V_{DD} = 125V	$t_{d(on)}$	—	25	ns
Rise Time 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = 12V,R_G = 7.5Ω, I_D = 22A V_{DD} = 50V I_D = 16A V_{DD} = 100V I_D = 12.4A V_{DD} = 125V	t_r	—	30	ns
Turn-off Delay Time 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = 12V,R_G = 7.5Ω, I_D = 22A V_{DD} = 50V I_D = 16A V_{DD} = 100V I_D = 12.4A V_{DD} = 125V	$t_{d(off)}$	—	60	ns
Fall Time 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = 12V,R_G = 7.5Ω, I_D = 22A V_{DD} = 50V I_D = 16A V_{DD} = 100V I_D = 12.4A V_{DD} = 125V	t_f	—	30	ns

NOTE: All voltages and currents are in dc.

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N-Channel Radiation Hardened MOSFET (TO-276AA)

Primary Electrical Characteristics (2N7587U3,U3C; 2N7591U3,U3C; 2N7593U3,U3C)

Characteristics	Test Conditions	Sym-	Min.	Max.	Unit
On-state Gate Charge 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = ±20V, T_A = +175°C, t=24 hours I_D = 20A, V_{DD} = 65V I_D = 12A, V_{DD} = 100V I_D = 10A, V_{DD} = 125V	$Q_{G(on)}$	—	50	nC
Gate to Source Charge 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = ±20V, T_A = +175°C, t=24 hours I_D = 20A, V_{DD} = 65V I_D = 12A, V_{DD} = 100V I_D = 10A, V_{DD} = 125V	Q_{GS}	—	15	nC
Gate to Drain Charge 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	V_{GS} = ±20V, T_A = +175°C, t=24 hours I_D = 20A, V_{DD} = 65V I_D = 12A, V_{DD} = 100V I_D = 10A, V_{DD} = 125V	Q_{GD1}	—	20	nC
Reverse Recovery Time 2N7587U3, U3C 2N7591U3, U3C 2N7593U3, U3C	di/dt = 100A/µs, V_{DD} ≤ 50V, I_D = 20A I_D = 12A I_D = 10A	t_{rr}	—	250 300 300	ns

Temperature Testing Electrical Characteristics (2N7587U3,U3C; 2N7591U3,U3C; 2N7593U3,U3C)

Characteristics	Test Conditions	Symbol	Min.	Max.	Unit
High Temperature Operation	$T_C = T_J$ = +125°C	—	—	—	—
Gate-Body Leakage Forward	V_{GS} = +20V, V_{DS} = 0V	I_{GSSF2}	—	+200	nA
Gate-Body Leakage Reverse	V_{GS} = -20V, V_{DS} = 0V	I_{GSSR2}	—	-200	nA
Zero-Gate Voltage Drain Current 2N7587U3,U3C 2N7591U3,U3C 2N7593U3,U3C	V_{GS} = 0V V_{DS} = 80V V_{DS} = 160V V_{DS} = 200V	I_{DSS2}	—	25	µA
Drain-Source On-Resistance 2N7587U3,U3C 2N7591U3,U3C 2N7593U3,U3C	V_{GS} = 12V, I_D = 19A I_D = 10A I_D = 7.8A	$r_{DS(on)3}$	—	0.080 0.176 0.273	Ω
Gate-Threshold Voltage	V_{DS} ≥ V_{GS}, I_D = 1.0mA	$V_{GS(TH)2}$	1.0	—	V

Characteristics	Test Conditions	Symbol	Min.	Max.	Unit
Low Temperature Operation	$T_C = T_J$ = -55°C	—	—	—	—
Gate-Threshold Voltage	V_{DS} ≥ V_{GS}, I_D = 1.0 mA	$V_{GS(TH)3}$	—	5.0	V

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Outline Drawing (TO-276AA, SMD-0.5)

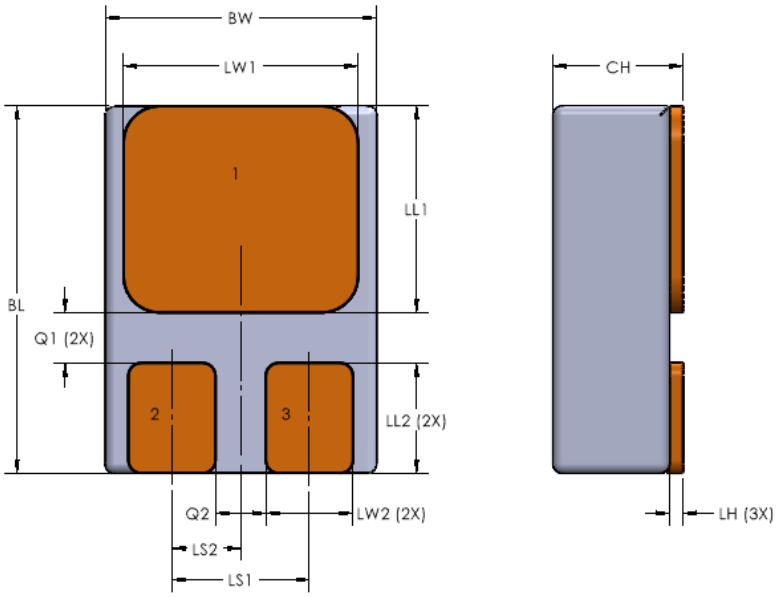

FIGURE 2: Dimensions and configuration of surface mount (TO-276AA, SMD-0.5) package.

Symbol	Inches		mm	
	Min	Max	Min	Max
BL	.395	.405	10.03	10.29
BW	.291	.301	7.39	7.65
CH (for U3)	.108	.124	2.74	3.15
CH (for		.1335		3.39
LW1	.281	.291	7.14	7.39
LW2	.090	.100	2.29	2.54
LL1	.220	.230	5.59	5.84
LL2	.115	.125	2.93	3.18
LS1	.150 BSC		3.81BSC	
LS2	.075 BSC		1.91 BSC	
Q1	.030		.76	
Q2	.030		.76	
TERM 1	Drain			
TERM 2	Gate			
TERM 3	Source			

NOTES:
1. Dimensions are in inches. Millimeters are given for information only.
2. Terminal 1 is the drain, terminal 2 is the gate, and terminal 3 is the source.
3. The following suffixes apply to this package configuration: Metal lid: U3 suffix; Ceramic lid: U3C suffix.
4. The lid shall be electrically isolated from the drain, gate, and source.

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