

FMOS3416E-Q1

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FMOS3416E-Q1

6.5A 20V N-Channel Enhancement Mode Power MOSFET ESD Protection

Features

- $V_{DS}=20V$, $I_D=6.5A$.
- $R_{DS(ON)} \leq 22m\Omega$, @ $V_{GS}=4.5V$, $I_D=6.5A$.
- $R_{DS(ON)} \leq 26m\Omega$, @ $V_{GS}=2.5V$, $I_D=5.5A$.
- $R_{DS(ON)} \leq 34m\Omega$, @ $V_{GS}=1.8V$, $I_D=5.0A$.
- Advance trench technology.
- Excellent on-resistance and low gate charge.
- Gate-source ESD rating (HBM, method 3015) : 2KV.
- Qualified to AEC-Q101 standards for high reliability.
- Lead-free parts meet RoHS requirements
- Suffix "-H" indicates Halogen-free part, ex.FMOS3416E-Q1-H.

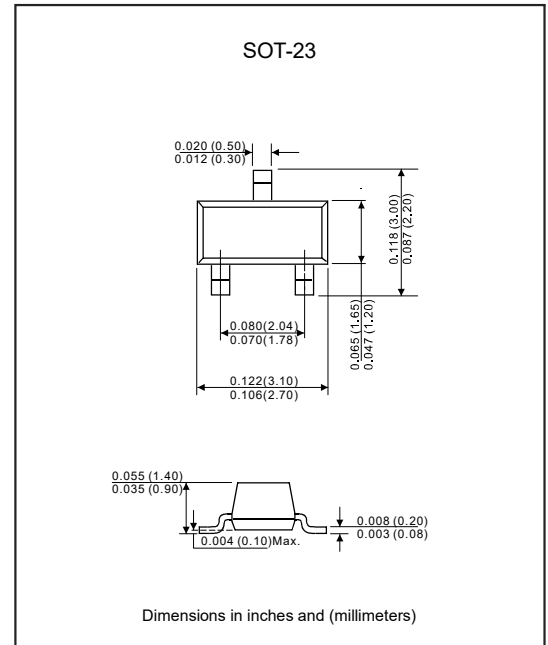
Application

- Load switch.
- PWM application.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant.
- Case : Molded plastic, SOT-23.
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026.
- Mounting Position : Any.

Package outline



Maximum Ratings (At $T_A=25^\circ C$ Unless otherwise noted)

Parameter	Symbol	Rating	Unit
Drain source voltage	V_{DS}	20	V
Gate source voltage	V_{GS}	± 8	V
Drain current continuous ($T_A=25^\circ C$)	I_D	6.5	A
($T_A=70^\circ C$)		5.2	
Pulsed drain current (Note 3)	I_{DM}	30	A
Power dissipation (Note 2) ($T_A=25^\circ C$)	P_D	1.4	W
($T_A=70^\circ C$)		0.9	
Thermal resistance, junction to ambient (Note1) ($t_s \leq 10s$)	$R_{\theta JA}$	90	$^\circ C/W$
Thermal resistance, junction to ambient (Note1,4) (Steady-state)		125	
Thermal resistance, junction to lead (Steady-state)	$R_{\theta JL}$	80	$^\circ C/W$
Operating junction temperature	T_J	+150	$^\circ C$
Storage temperature range	T_{STG}	-55 to +150	$^\circ C$

Notes : 1. The value of $R_{\theta JA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. copper, in a still air environment with $T_A=25^\circ C$. The value in any given application depends on the user's specific board design.

2. The power dissipation P_D is based on $T_{J(Max)}=150^\circ C$, using ≤ 10 seconds junction to ambient thermal resistance.

3. Repetitive rating, pulse with limited by junction temperature $T_{J(Max)}=150^\circ C$. rating are based on low frequency and duty cycles to keep initial $T_J=25^\circ C$.

4. The $R_{\theta JA}$ is the sum of the thermal impedance from junction to lead $R_{\theta JL}$ and lead to ambient.

5. The static characteristics in figures 1 to 6 are obtained using $< 300\mu s$ pulses, duty cycle 0.5% maximum.

6. These curves are based on the junction-ambient thermal impedance which is measured with the device mounted on 1in² FR-4 board with 2oz. copper, assuming a maximum junction temperature of $T_{J(Max)}=150^\circ C$. The SOA curve provides a single pulse rating.

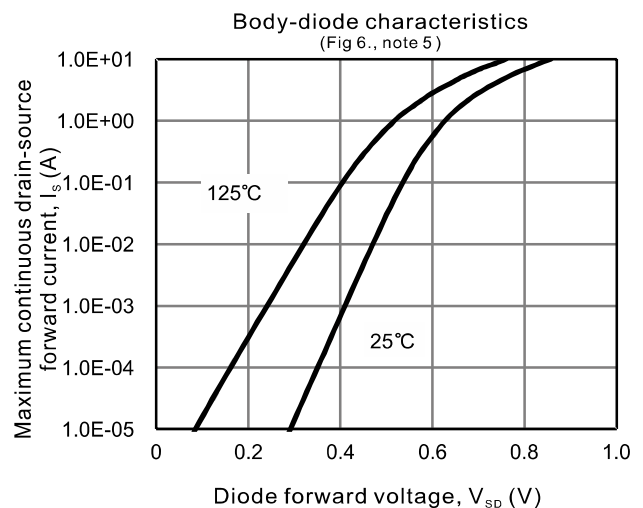
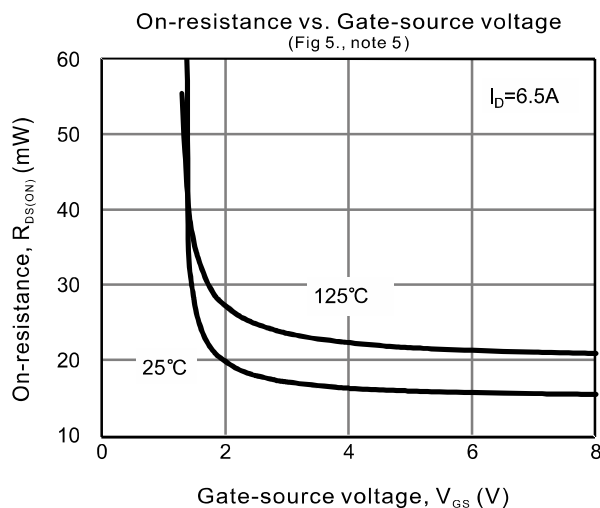
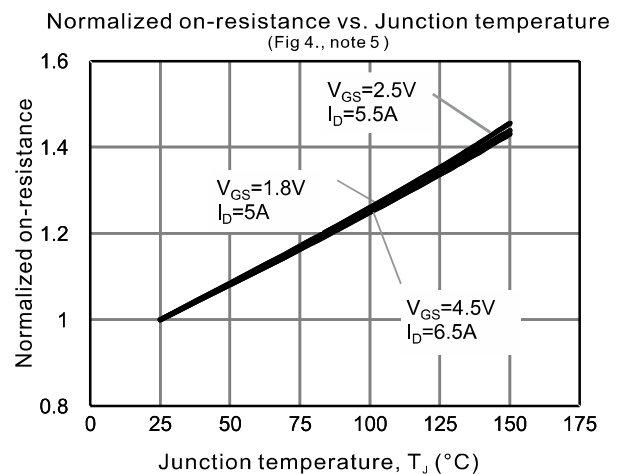
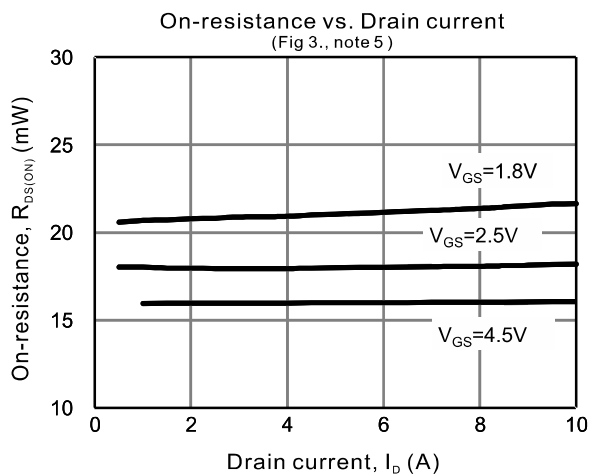
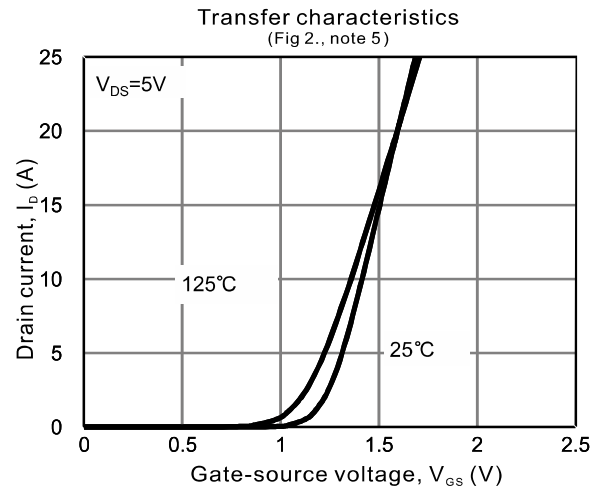
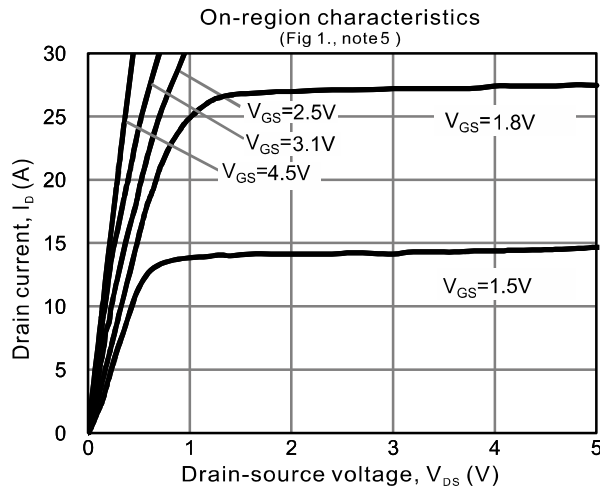
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Electrical characteristics (At $T_J=25^{\circ}\text{C}$ unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Off characteristics						
Drain-Source breakdown voltage	BV _{DSS}	I _D =250μA, V _{GS} =0V	20			V
Drain-Source leakage current	I _{DSS}	V _{DS} =20V, V _{GS} =0V			1	μA
		V _{DS} =20V, V _{GS} =0V, T _J =55°C			5	
Gate-Source leakage current	I _{GSS}	V _{GS} =±8V, V _{DS} =0V			±10	μA
On characteristics						
On state drain current	I _{D(ON)}	V _{GS} =4.5V, V _{DS} =5A	30			A
Gate threshold voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	0.4	0.7	1.1	V
Static drain-source on-resistance (Note2)	R _{DS(ON)}	V _{GS} =4.5V, I _D =6.5A		16	22	mΩ
		V _{GS} =4.5V, I _D =6.5A, T _J =125°C		22	30	
		V _{GS} =2.5V, I _D =5.5A		18	26	
		V _{GS} =1.8V, I _D =5.0A		21	34	
Forward transconductance	g _{FS}	V _{DS} =5V, I _D =6.5A		50		S
Dynamic characteristics						
Input capacitance	C _{iss}	V _{DS} =10V, V _{GS} =0V, f=1.0MHz		1295	1650	pF
Output capacitance	C _{oss}			160		
Reverse transfer capacitance	C _{rss}			87		
Gate resistance	R _g	V _{DS} =0V, V _{GS} =0V, f=1.0MHz		1.8		KΩ
Switching characteristics						
Total gate charge	Q _g	V _{GS} =4.5V, V _{DS} =10V, I _D =6.5A		10		nC
Gate-Source charge	Q _{gs}			4.2		
Gate-Drain Charge	Q _{gd}			2.6		
Turn-on delay time	t _{d(on)}	V _{DS} =10V, V _{GS} =4.5V, R _G =3Ω ,R _L =1.54Ω		280		ns
Turn-on rise time	t _r			328		
Turn-off delay time	t _{d(off)}			3.76		μs
Turn-off fall time	t _f			2.24		
Drain-Source diode characteristics and maximum ratings						
Drain-Source diode forward voltage	V _{SD}	I _S =1.0A, V _{GS} =0V		0.62	1	V
Maximum continuous drain-source forward current	I _S				2	A
Body diode reverse recovery time	t _{rr}	I _F =6.5A, dI/dt=100A/μs		31	41	ns
Body diode reverse recovery charge	Q _{rr}			6.8		nC

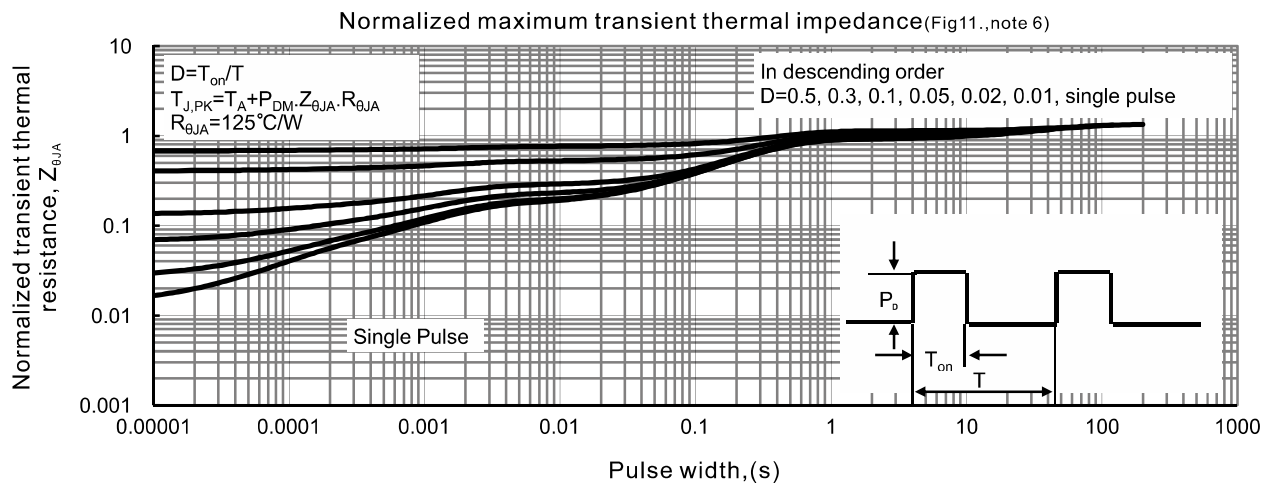
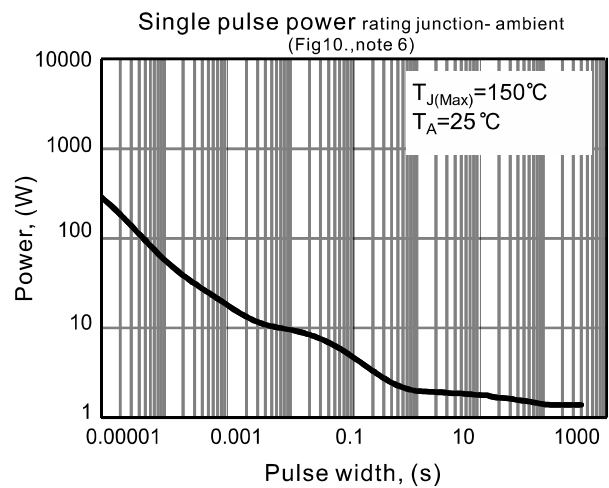
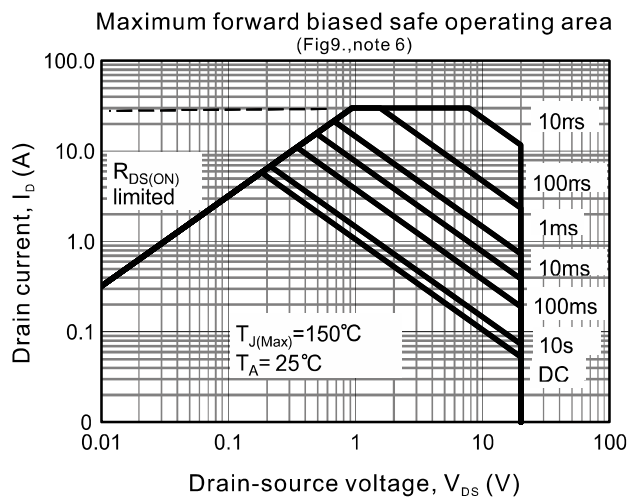
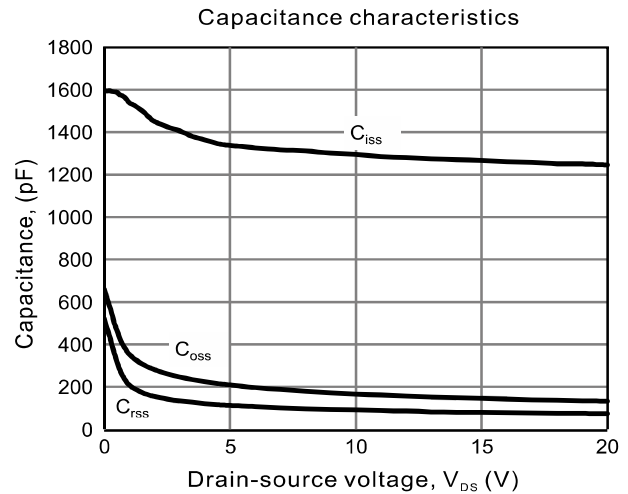
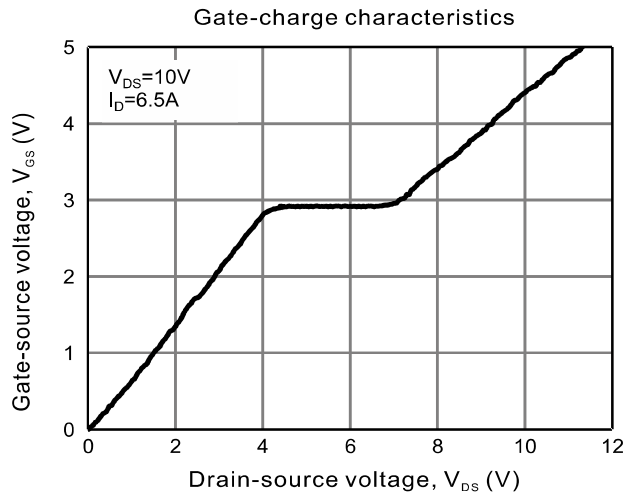
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Rating and characteristic curves



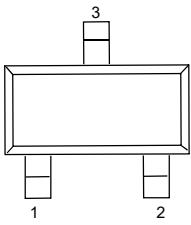
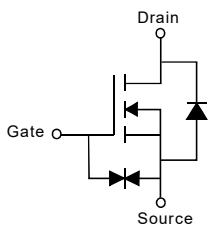
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Rating and characteristic curves



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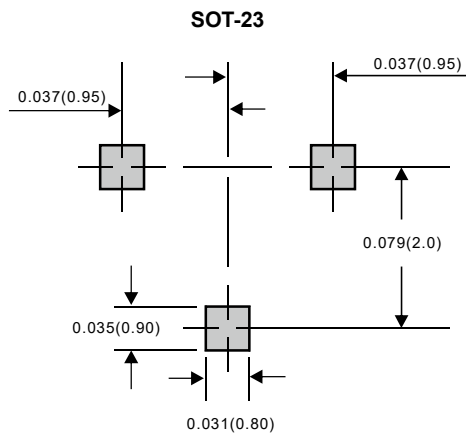
Pinning information

Pin	Simplified outline	Symbol
Pin 1 Gate Pin 2 Source Pin 3 Drain		

Marking

Type number	Marking code
FMOS3416E-Q1	3416

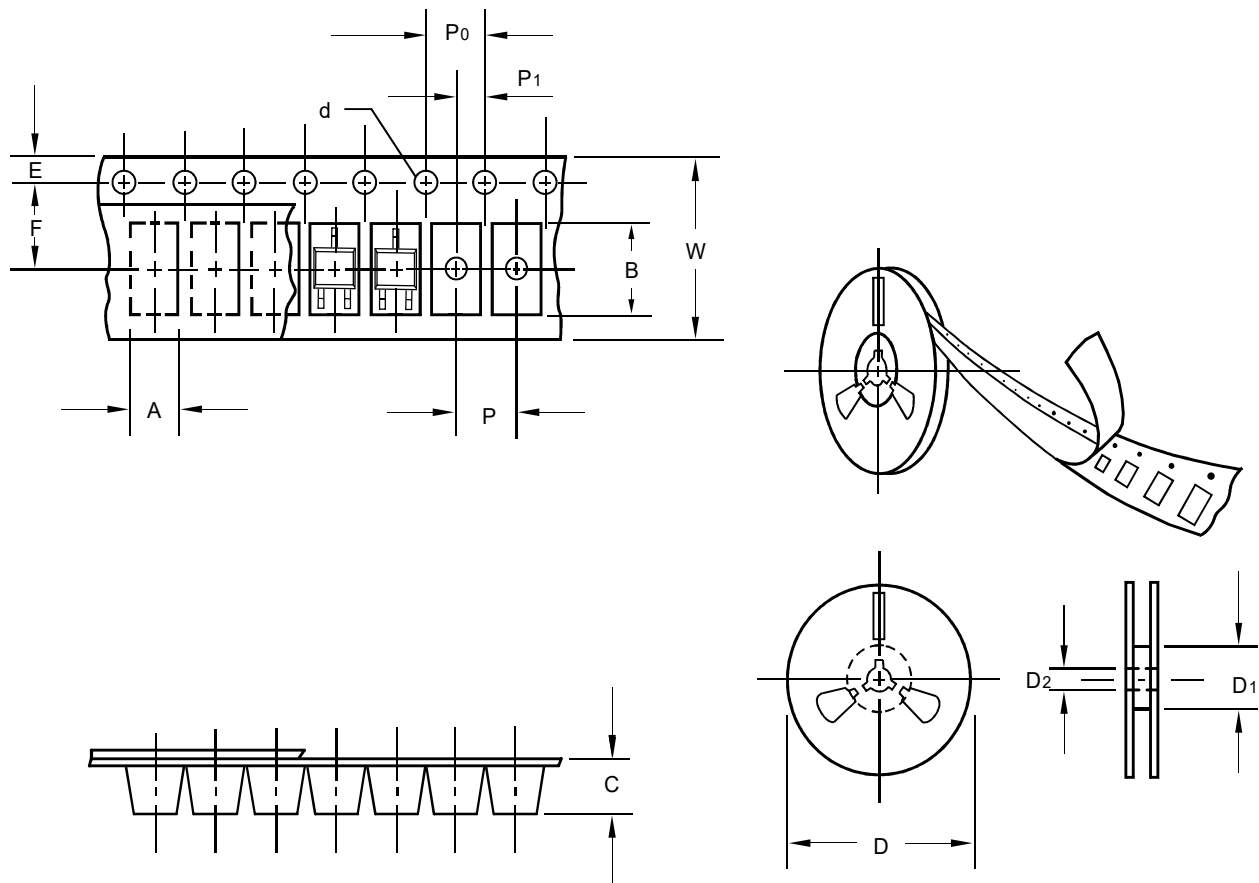
Suggested solder pad layout



Dimensions in inches and (millimeters)

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Packing information



unit:mm

Item	Symbol	Tolerance	SOT-23
Carrier width	A	0.1	3.15
Carrier length	B	0.1	2.77
Carrier depth	C	0.1	1.22
Sprocket hole	d	0.1	1.50
13" Reel outside diameter	D	2.0	-
13" Reel inner diameter	D1	min	-
7" Reel outside diameter	D	2.0	178.00
7" Reel inner diameter	D1	min	50.00
Feed hole diameter	D2	0.5	13.00
Sprocket hole position	E	0.1	1.75
Punch hole position	F	0.1	3.50
Punch hole pitch	P	0.1	4.00
Sprocket hole pitch	P0	0.1	4.00
Embossment center	P1	0.1	2.00

Note: Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.

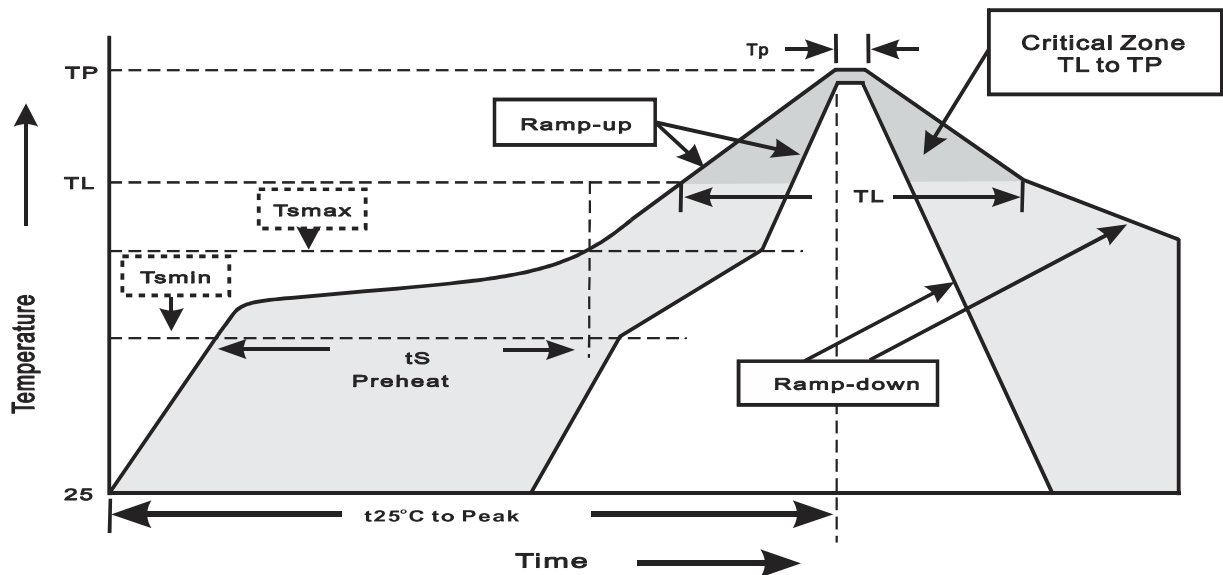
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Reel packing

PACKAGE	REEL SIZE	REEL (pcs)	COMPONENT SPACING (m/m)	BOX (pcs)	INNER BOX (m/m)	REEL DIA, (m/m)	CARTON SIZE (m/m)	CARTON (pcs)
SOT-23	7"	3,000	4.0	30,000	183*123*183	178	382*257*387	240,000

Suggested thermal profiles for soldering processes

- 1.Storage environment: Temperature=5°C~40°C Humidity=55%±25%
- 2.Reflow soldering of surface-mount devices



3.Reflow soldering

Profile Feature	Soldering Condition
Average ramp-up rate(T _L to T _P)	<3°C/sec
Preheat -Temperature Min(T _{smIn}) -Temperature Max(T _{smax}) -Time(min to max)(t _s)	150°C 200°C 60~120sec
T _{smax} to T _L -Ramp-upRate	<3°C/sec
Time maintained above: -Temperature(T _L) -Time(t _L)	217°C 60~260sec
Peak Temperature(T _P)	255°C-0/+5°C
Time within 5°C of actual Peak Temperature(t _P)	10~30sec
Ramp-down Rate	<6°C/sec
Time 25°C to Peak Temperature	<6minutes

FMOS3416E-Q1**High reliability test capabilities**

Item Test	Conditions	Reference
1. MSL Preconditioning	24hr bake@125°C+168hrs@85°C /85%RH+3xIR@260°C+1flux immersion+alcohol+DI H2O rinse	JESD22-A113
2. High Temperature Reverse Bias	$V_{DS}=V_{DS} \times 80\%$ ($T_J=T_J \text{ max.}$) Test Duration:1000hrs	JESD22-A108
3. High Temperature Storage Life	$T_a=150^\circ\text{C}$ Test Duration:1000hrs	JESD22 A-103
4. Temperature Cycle	-55°C (15min) to 150°C (15min) Test Cycles:1000cycles	JESD22 A-104
5. Autoclave	$P=2\text{atm}$ $T_a=121^\circ\text{C}$ $\text{RH}=100\%$ Test Duration:96hrs	JESD22 A-102
6. Solderability	$245 \pm 5^\circ\text{C}$ for 5sec	J-STD-002
7. Moisture Resistance	$T_a=85^\circ\text{C}$ / 85% Relative humidity Test Duration:1000hrs	MIL-STD-750E METHOD 1021.2
8. Resistance To Solder Heat	$260 \pm 5^\circ\text{C}$ for 10sec	JESD22 B-106
9. High Temperature High Humidity Reverse Bias	$T_a=85^\circ\text{C}$, 85%RH, $V_{DS}=80\%$ rated V_{DS} Test Duration: 1000hrs	JESD22-A101