KSMD12N20 / KSMU12N20

200V N-Channel MOSFET

KERSEMI

KERSEMI ELECTRONIC CO.,LTD.

Features

- 9.0A, 200V, $R_{DS(on)}$ = 0.28Ω @V_{GS} = 10 V
- Low gate charge (typical 18 nC)
- Low Crss (typical 18 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

TO-252   TO-251

General Description

These N-Channel enhancement mode power field effect transistors are produced using Kersemi proprirtary, 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 switching DC/DC converters, switch mode power supply, DC-AC converters for uninterrupted power supply, motor control.
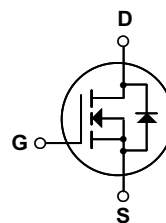
Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter			KSMD12N20 / KSMU12N20	Units
V_{DSS}	Drain-Source Voltage			200	V
I_D	Drain Current	- Continuous (T_C = 25°C)		9.0	A
		- Continuous (T_C = 100°C)		5.7	A
I_{DM}	Drain Current	- Pulsed	(Note 1)	36	A
V_{GSS}	Gate-Source Voltage			± 30	V
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	210	mJ
I_{AR}	Avalanche Current		(Note 1)	9.0	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	5.5	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	5.5	V/ns
P_D	Power Dissipation (T_A = 25°C) *			2.5	W
	Power Dissipation (T_C = 25°C)			55	W
	- Derate above 25°C			0.44	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150	°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds			300	°C

Thermal Characteristics

Symbol	Parameter	Typ	Max	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	--	2.27	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient *	--	50	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	--	110	°C/W

* When mounted on the minimum pad size recommended (PCB Mount)

Electrical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units

Off Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	200	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	--	0.14	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 200 V, V_{GS} = 0 V	--	--	1	µA
		V_{DS} = 160 V, T_C = 125°C	--	--	10	µA
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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 4.5 A	--	0.21	0.28	Ω
g_{FS}	Forward Transconductance	V_{DS} = 40 V, I_D = 4.5 A (Note 4)	--	7.3	--	S

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	700	910	pF
C_{oss}	Output Capacitance		--	125	160	pF
C_{rss}	Reverse Transfer Capacitance		--	18	25	pF

Switching Characteristics

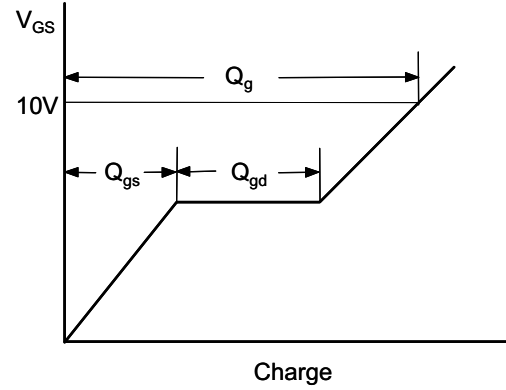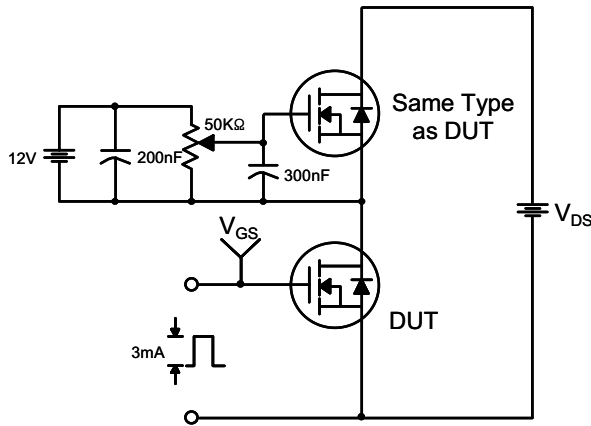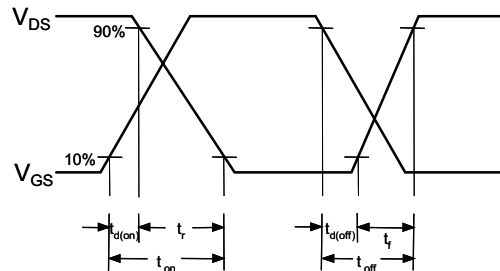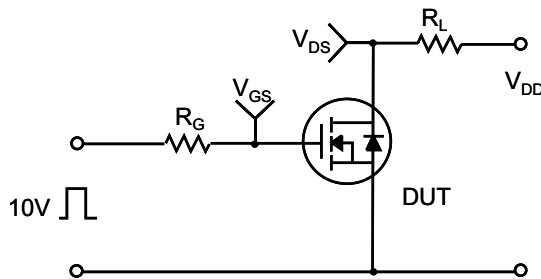| Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 100 V, I_D = 11.6 A, R_G = 25 Ω	--	13	35	ns
t_r	Turn-On Rise Time		--	120	250	ns
$t_{d(off)}$	Turn-Off Delay Time		--	30	70	ns
t_f	Turn-Off Fall Time	(Note 4, 5)	--	55	120	ns
Q_g	Total Gate Charge	V_{DS} = 160 V, I_D = 11.6 A, V_{GS} = 10 V	--	18	23	nC
Q_{gs}	Gate-Source Charge		--	5	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4, 5)	--	8	--	nC

Drain-Source Diode Characteristics and Maximum Ratings

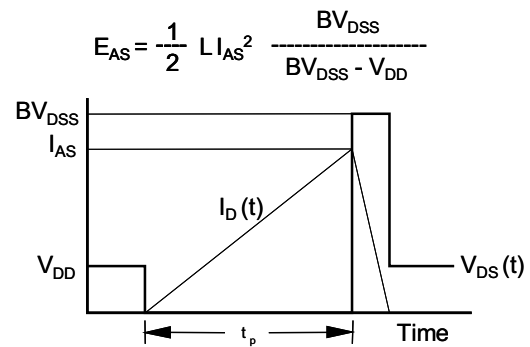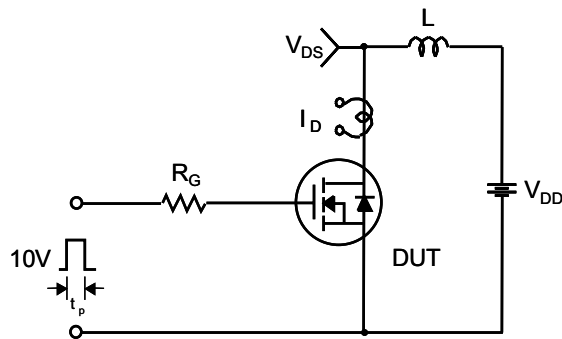| Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	9.0	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	36	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 9.0 A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 11.6 A,	--	130	--	ns
Q_{rr}	Reverse Recovery Charge	dI_F / dt = 100 A/µs (Note 4)	--	0.63	--	µC

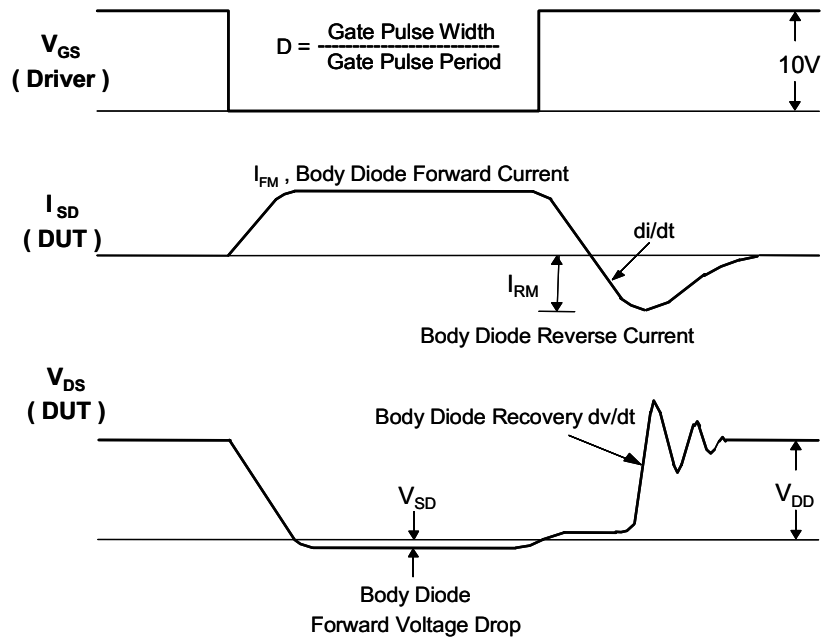**Notes:**
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 3.9mH, I_{AS} = 9.0A, V_{DD} = 50V, R_G = 25 Ω, Starting T_J = 25°C
3. $I_{SD} \leq$ 11.6A, di/dt $\leq$ 300A/µs, $V_{DD} \leq BV_{DSS}$, Starting T_J = 25°C
4. Pulse Test : Pulse width $\leq$ 300µs, Duty cycle $\leq$ 2%
5. Essentially independent of operating temperature

Typical Characteristics
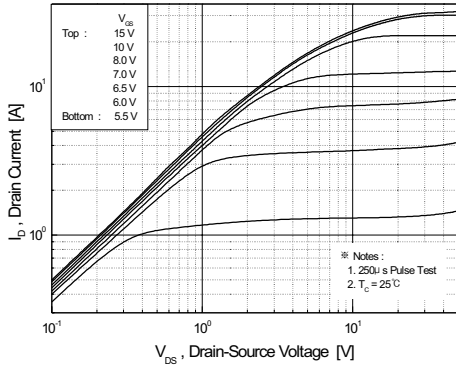
Figure 1. On-Region Characteristics
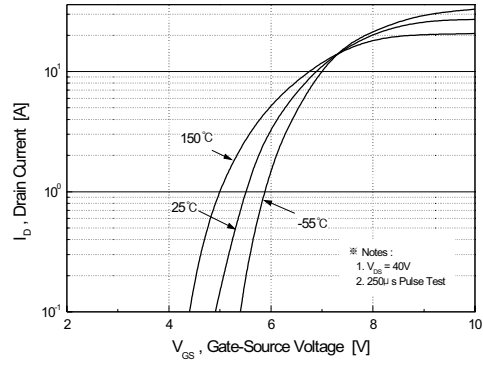
Figure 2. Transfer Characteristics
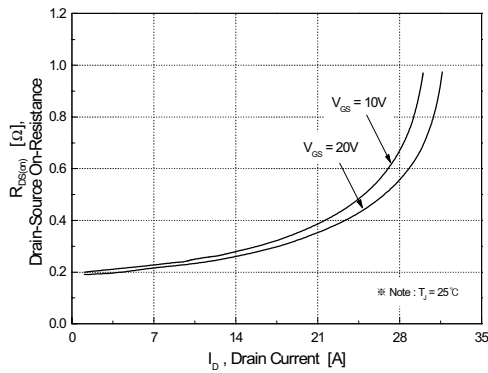
Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage
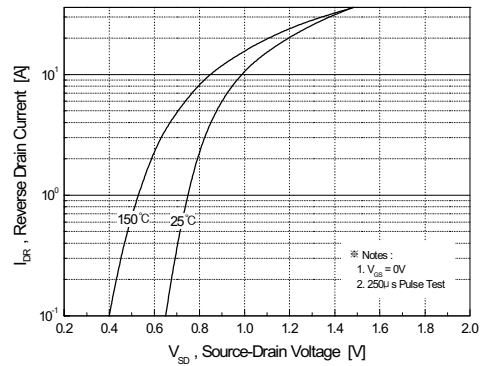
Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature
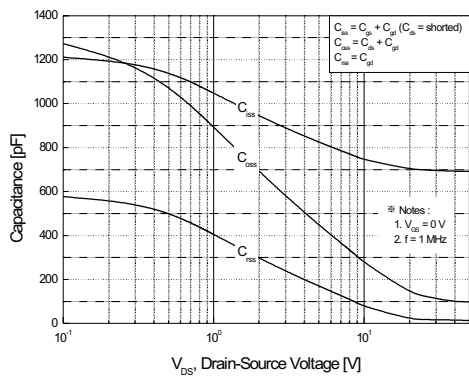
Figure 5. Capacitance Characteristics
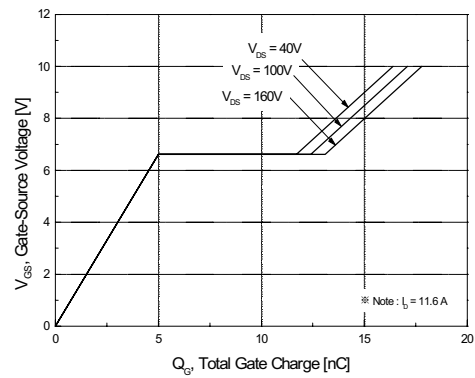
Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)
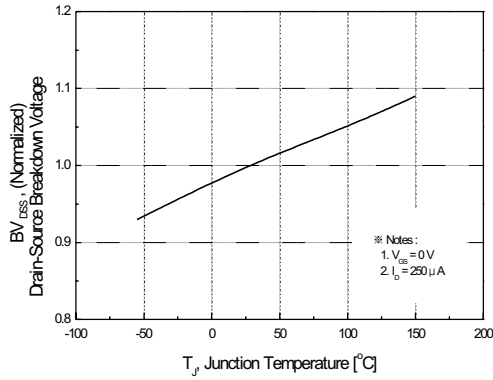
Figure 7. Breakdown Voltage Variation vs. Temperature
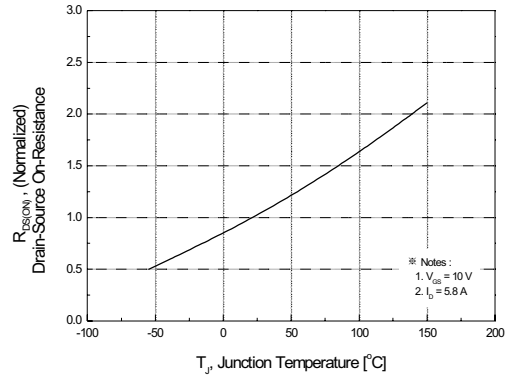
Figure 8. On-Resistance Variation vs. Temperature
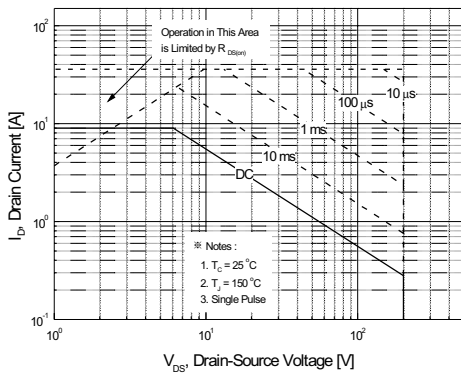
Figure 9. Maximum Safe Operating Area
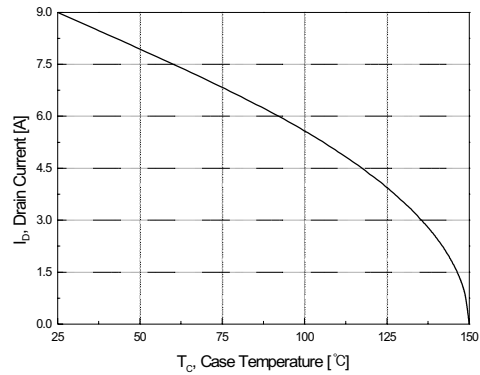
Figure 10. Maximum Drain Current vs. Case Temperature
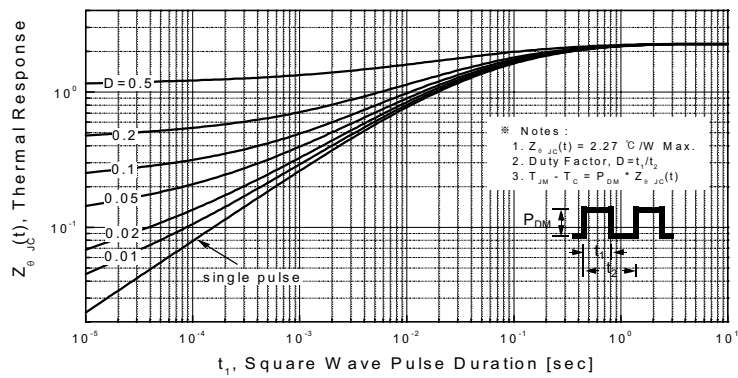
Figure 11. Transient Thermal Response Curve

Gate Charge Test Circuit & Waveform

12V 200nF 50KΩ 300nF Same Type as DUT V_{DS} V_{GS} DUT 3mA

V_{GS} 10V Q_g Q_{gs} Q_{gd} Charge

Resistive Switching Test Circuit & Waveforms

R_L V_{DS} V_{GS} V_{DD} R_G 10V DUT

V_{DS} 90% V_{GS} 10% $t_{d(on)}$ t_r t_{on} $t_{d(off)}$ t_f t_{off}

Unclamped Inductive Switching Test Circuit & Waveforms

L V_{DS} I_D R_G V_{DD} 10V DUT t_p

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$

BV_{DSS} I_{AS} $I_D(t)$ V_{DD} $V_{DS}(t)$ t_p Time

Peak Diode Recovery dv/dt Test Circuit & Waveforms

DUT

V_{DS}

I_{SD}

L

Driver

R_G

Same Type
as DUT

V_{DD}

V_{GS}

• dv/dt controlled by R_G
• I_{SD} controlled by pulse period

V_{GS}
(Driver)

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop
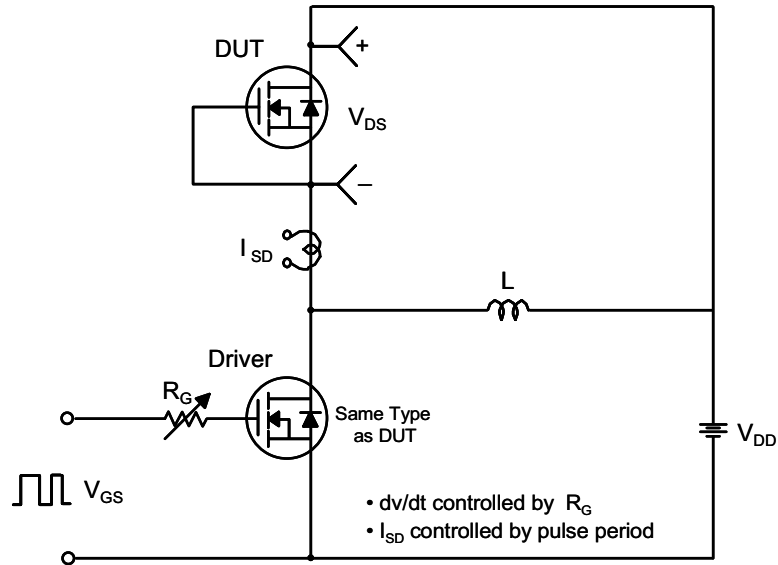
Package Dimensions

DPAK
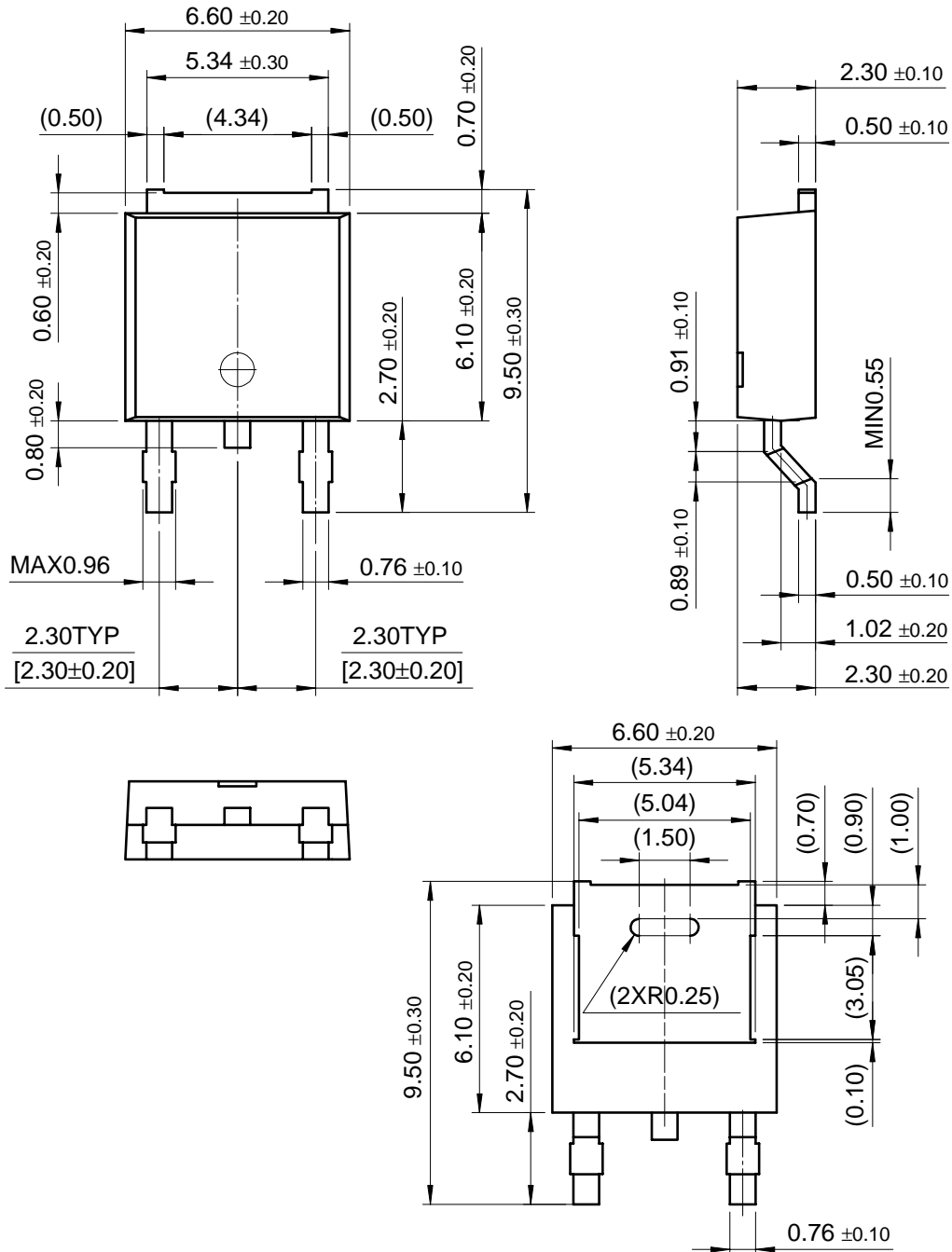
Package Dimensions (Continued)

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