

## 1. General description

WSJM65R600X is a high voltage N-channel MOSFET in TO220F package, which utilizes the advanced super-junction technology to provide superior FOM  $R_{DS(on)} * Q_g$  among silicon based MOSFETs. It is particularly suitable for applications require extreme high efficiency and power density.



## 2. Features and benefits

- Superior FOM  $R_{DS(on)} * Q_g$
- Extremely low switching loss
- 100% avalanche tested

## 3. Applications

- PFC stage and/or DC/DC converters in various high efficiency power suppliers, e.g. TV/sever/telecom/lighting power suppliers
- Inverters and motor drives

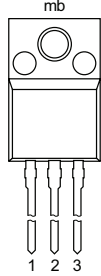
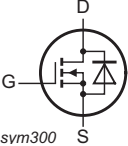
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Notes	Values			Unit
<b>Absolute maximum rating</b>							
$V_{DS}$	drain-source voltage			650			V
$V_{GS}$	gate-source voltage			±30			V
$I_D$	continuous drain current	$T_h = 25\text{ °C}$	[1]	8.0			A
$P_{tot}$	power dissipation	$T_h = 25\text{ °C}$		28			W
$T_j$	junction temperature			-55 to 150			°C
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
<b>Static characteristics</b>							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ , $I_D = 3.5\text{ A}$		-	522	600	mΩ
<b>Dynamic characteristics</b>							
$Q_{G(tot)}$	total gate charge	$I_D = 3.5\text{ A}$ ; $V_{DS} = 400\text{ V}$ ; $V_{GS} = 10\text{ V}$		-	12	-	nC
$E_{OSS}$	coss stored energy	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 0\text{ to }400\text{ V}$		-	1.8	-	μJ

## 5. Pinning information

**Table 2. Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	D	drain		
3	S	source		
mb	n.c.	mounting base; isolated		

## 6. Ordering information

**Table 3. Ordering information**

Type number	Package name	Orderable part number	Packing method	Small packing quantity	Package version	Package issue date
WSJM65R600X	TO220F	WSJM65R600XQ	Tube	50	SOT186A	14-Nov-2013

## 7. Marking

**Table 4. Marking codes**

Type number	Marking codes
WSJM65R600X	WSJM 65R600X

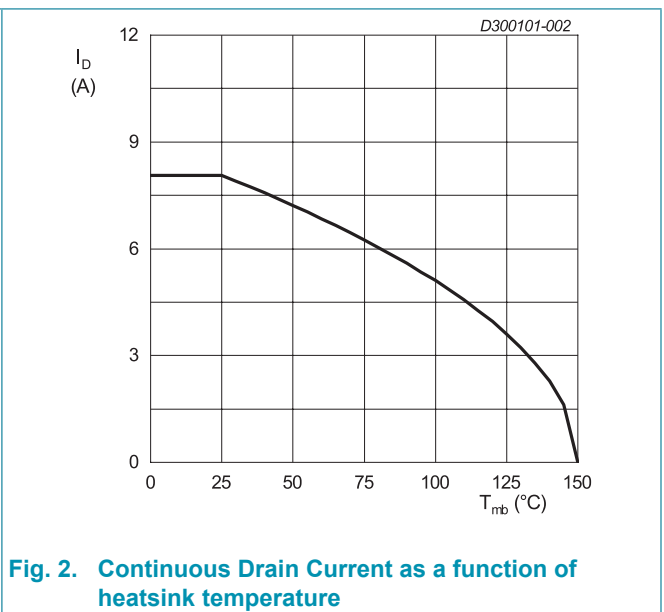
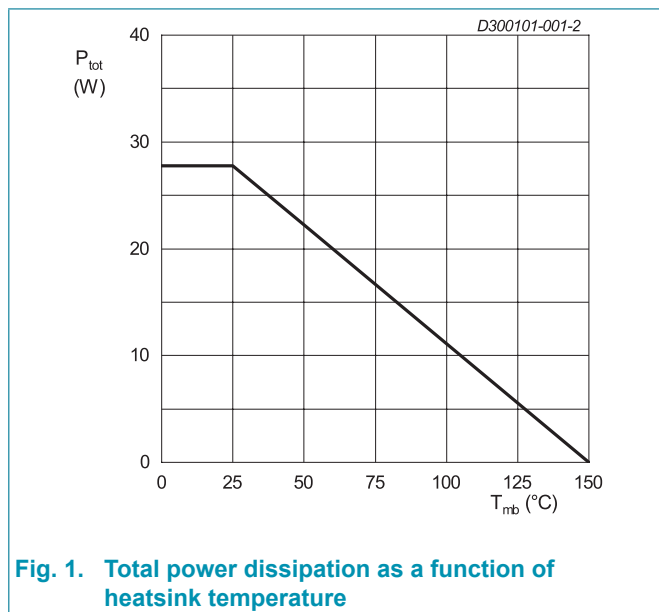
## 8. Limiting values

**Table 5. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Notes	Values	Unit
$V_{DS}$	drain-source voltage			650	V
$V_{GS}$	gate-source voltage			$\pm 30$	V
$I_D$	continuous drain current	$T_h = 25\text{ }^\circ\text{C}$	[1]	8.0	A
		$T_h = 100\text{ }^\circ\text{C}$	[1]	5.1	A
$I_{DM}$	pulsed drain current	$T_h = 25\text{ }^\circ\text{C}$		22	A
$P_{tot}$	power dissipation	$T_h = 25\text{ }^\circ\text{C}$		28	W
$E_{AS}$	single pulse drain-to-source avalanche	$I_{AS} = 2.1\text{ A}$ ; $R_{GS} = 25\text{ }\Omega$ ; $V_{DD} = 50\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$		22	mJ
$E_{AR}$	repetitive avalanche energy	$I_{AS} = 2.1\text{ A}$ ; $R_{GS} = 25\text{ }\Omega$ ; $V_{DD} = 50\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$		0.5	mJ
$I_{AS}$	avalanche current, single pulse			2.1	A
dv/dt	MOSFET dv/dt ruggedness			50	V/ns
dv/dt	reverse diode dv/dt			15	V/ns
dI <sub>r</sub> /dt	maximum diode commutation speed			500	A/ $\mu\text{s}$
$T_{stg}$	storage temperature			-55 to 150	$^\circ\text{C}$
$T_j$	junction temperature			-55 to 150	$^\circ\text{C}$

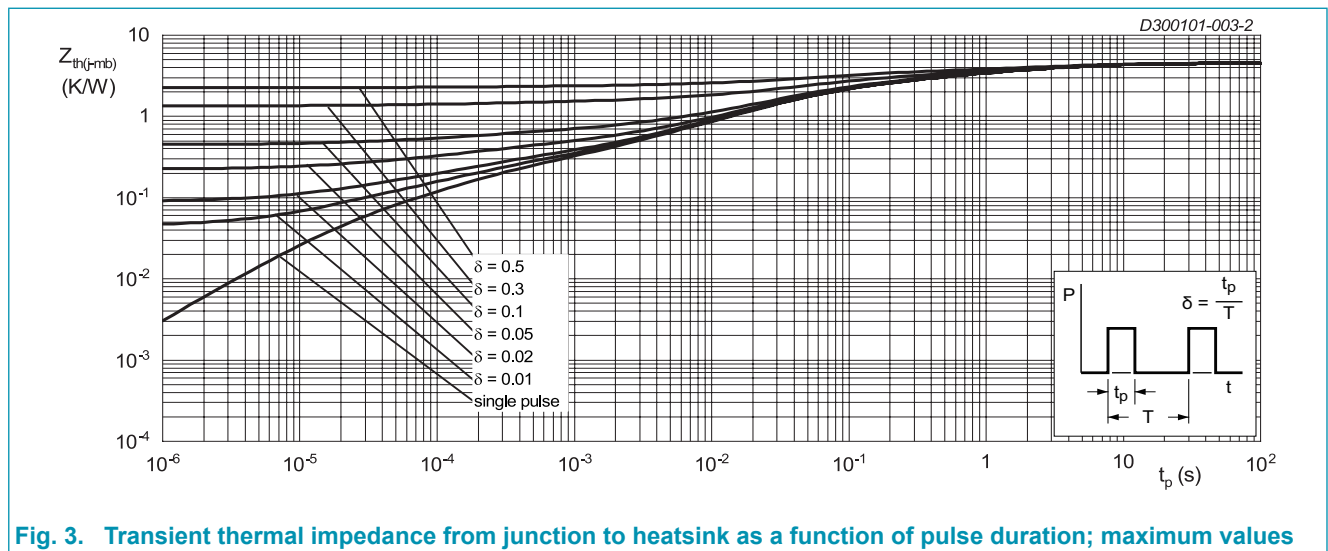
[1] Limited by maximum junction temperature, equivalent to TO220.



## 9. Thermal & Mechanical characteristics

**Table 6. Thermal & Mechanical characteristics**

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
$R_{th(j-h)}$	thermal resistance from junction to heatsink			-	3.6	4.5	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air		-	60	-	K/W

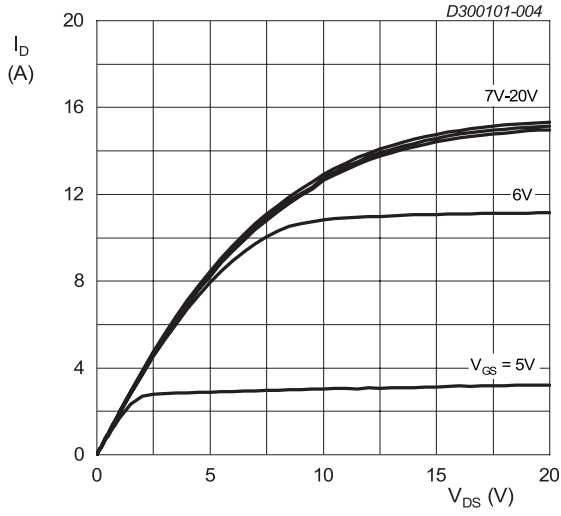


**Fig. 3. Transient thermal impedance from junction to heatsink as a function of pulse duration; maximum values**

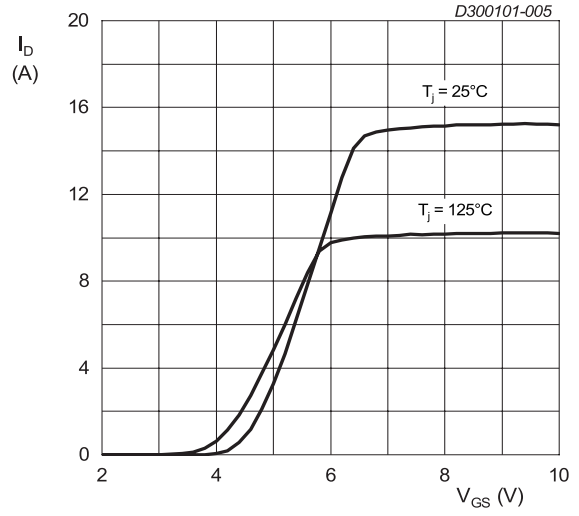
## 10. Characteristics

**Table 7. Characteristics**
 $T_j = 25\text{ }^\circ\text{C}$  unless otherwise noted

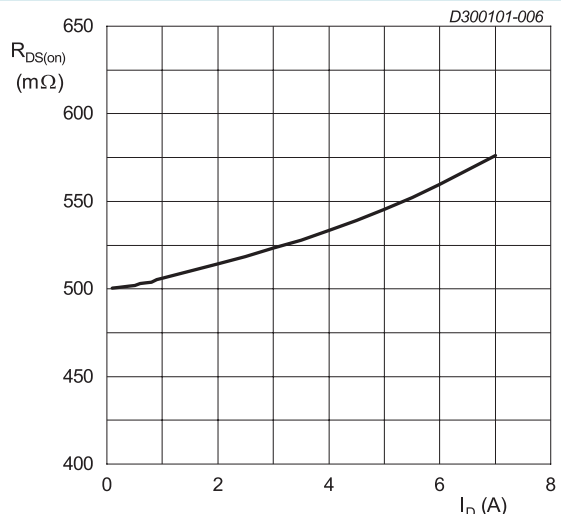
Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
<b>Static characteristics</b>							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}; V_{GS} = 0\text{ V}$		650	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 250\text{ }\mu\text{A}; V_{DS} = V_{GS}$		2.5	-	4.5	V
$I_{DSS}$	drain leakage current	$V_{DS} = 650\text{ V}; V_{GS} = 0\text{ V}$		-	-	1	$\mu\text{A}$
		$V_{DS} = 650\text{ V}; V_{GS} = 0\text{ V}; T_j = 125\text{ }^\circ\text{C}$		-	-	10	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = \pm 30\text{ V}; V_{DS} = 0\text{ V}$		-	-	$\pm 100$	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 3.5\text{ A}$		-	522	600	m $\Omega$
$R_G$	gate resistance	$f = 1\text{ MHz}$		-	8.5	-	$\Omega$
<b>Dynamic characteristics</b>							
$Q_{G(tot)}$	total gate charge	$I_D = 3.5\text{ A}; V_{DS} = 400\text{ V}; V_{GS} = 10\text{ V}$		-	12	-	nC
$Q_{GS}$	gate-source charge			-	2.6	-	nC
$Q_{GD}$	gate-drain charge			-	5.1	-	nC
$C_{iss}$	input capacitance	$V_{DS} = 400\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz}$		-	520	-	pF
$C_{oss}$	output capacitance			-	16	-	pF
$C_{rss}$	reverse transfer capacitance			-	2.6	-	pF
$C_{o(er)}$	effective output capacitance, energy related	$V_{GS} = 0\text{ V}; V_{DS} = 0\text{ to }400\text{ V}$		-	22	-	pF
$C_{o(tr)}$	effective output capacitance, time related			-	90	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 400\text{ V}; V_{GS} = 10\text{ V}; R_G = 2\text{ }\Omega;$ $I_D = 3.5\text{ A}$		-	18	-	ns
$t_r$	rise time			-	14	-	ns
$t_{d(off)}$	turn-off delay time			-	30	-	ns
$t_f$	fall time			-	16	-	ns
<b>Source-drain diode</b>							
$V_{SD}$	source-drain voltage	$V_{GS} = 0\text{ V}; I_S = 3.5\text{ A}$		-	0.8	1.1	V
$I_S$	body-diode continuous current	$T_h = 25\text{ }^\circ\text{C}$		-	-	8.0	A
$t_{rr}$	reverse recovery time	$V_R = 400\text{ V}; I_F = 3.5\text{ A}; di_F/dt = 100\text{ A}/\mu\text{s}$		-	182	-	ns
$Q_{rr}$	reverse recovered charge			-	1.5	-	$\mu\text{C}$
$I_{rrm}$	reverse recovery current			-	15	-	A



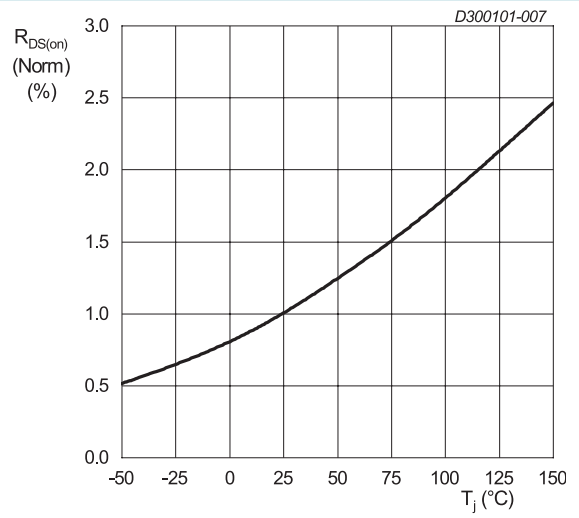
**Fig. 4. Drain current as a function of drain-source voltage; typical values**



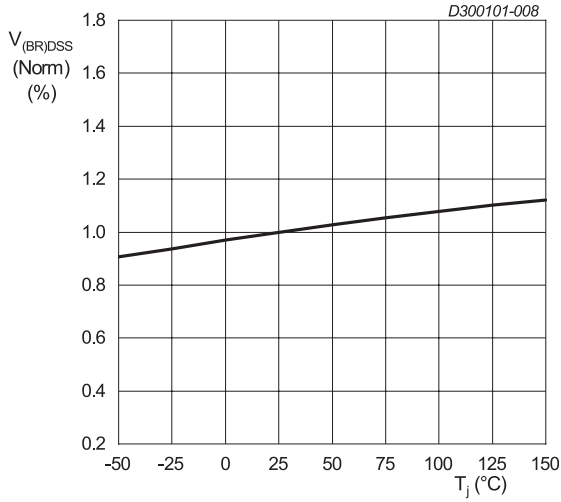
$V_{DS} = 20\text{ V}$   
**Fig. 5. Drain current as a function of gate-source voltage; typical values**



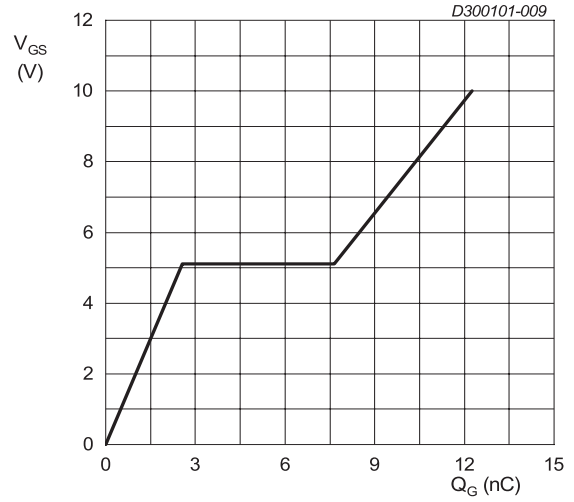
$V_{GS} = 10\text{ V}$   
**Fig. 6. Drain-source on-state resistance as a function of drain current; typical values**



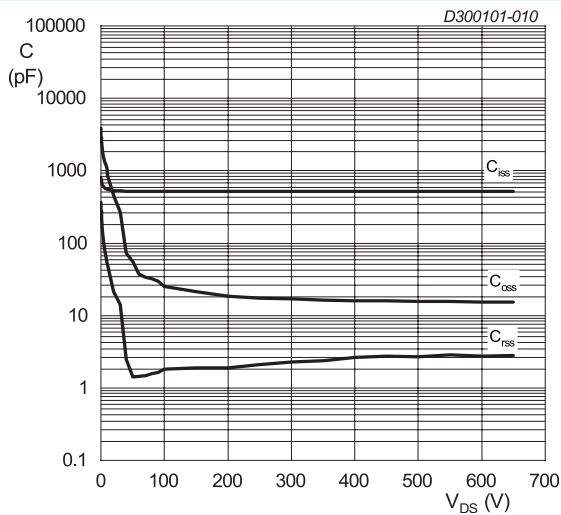
$V_{GS} = 10\text{ V}; I_D = 3.5\text{ A}$   
**Fig. 7. Normalized drain-source on-state resistance as a function of junction temperature**



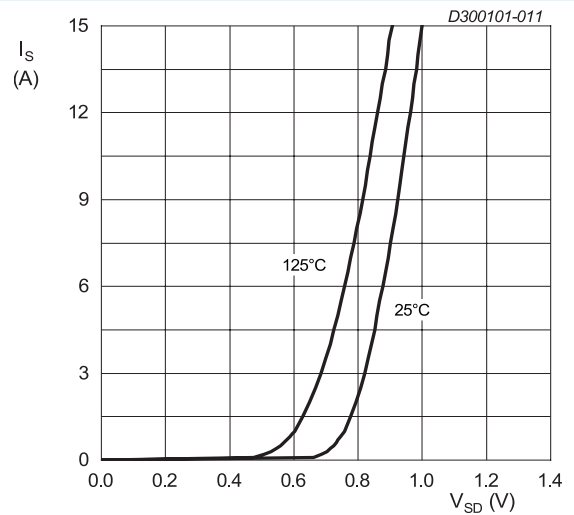
$I_D = 250 \mu A$   
**Fig. 8. Normalized drain-source breakdown voltage as a function of junction temperature**



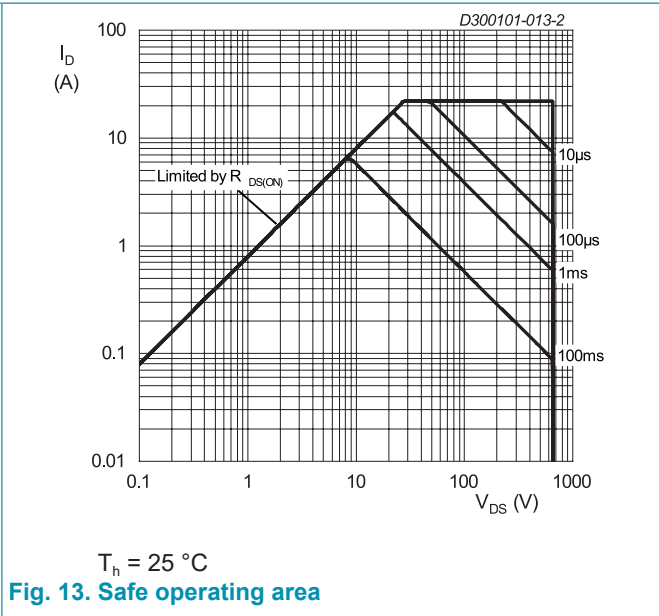
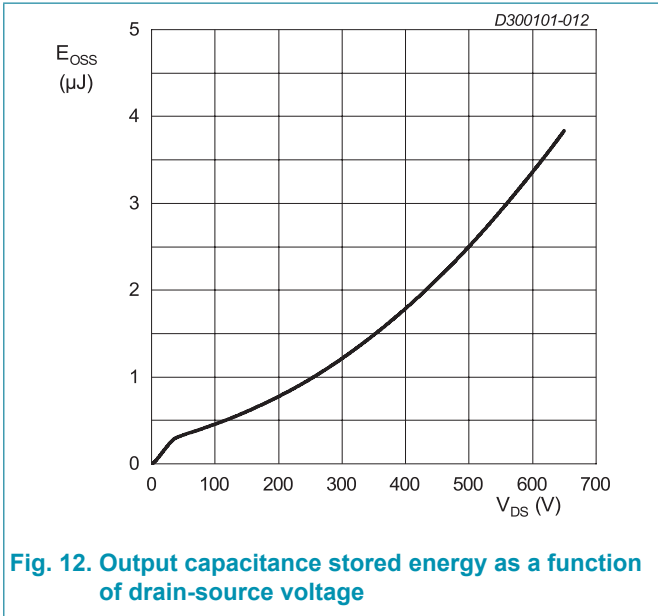
$I_D = 3.5 A; V_{DS} = 400 V$   
**Fig. 9. Gate-source voltage as a function of gate charge; typical values**



$V_{GS} = 0 V; f = 1 MHz$   
**Fig. 10. Capacitances as a function of drain-source voltage; typical values**



$V_{GS} = 0 V$   
**Fig. 11. Source current as a function of source-drain voltage; typical values**

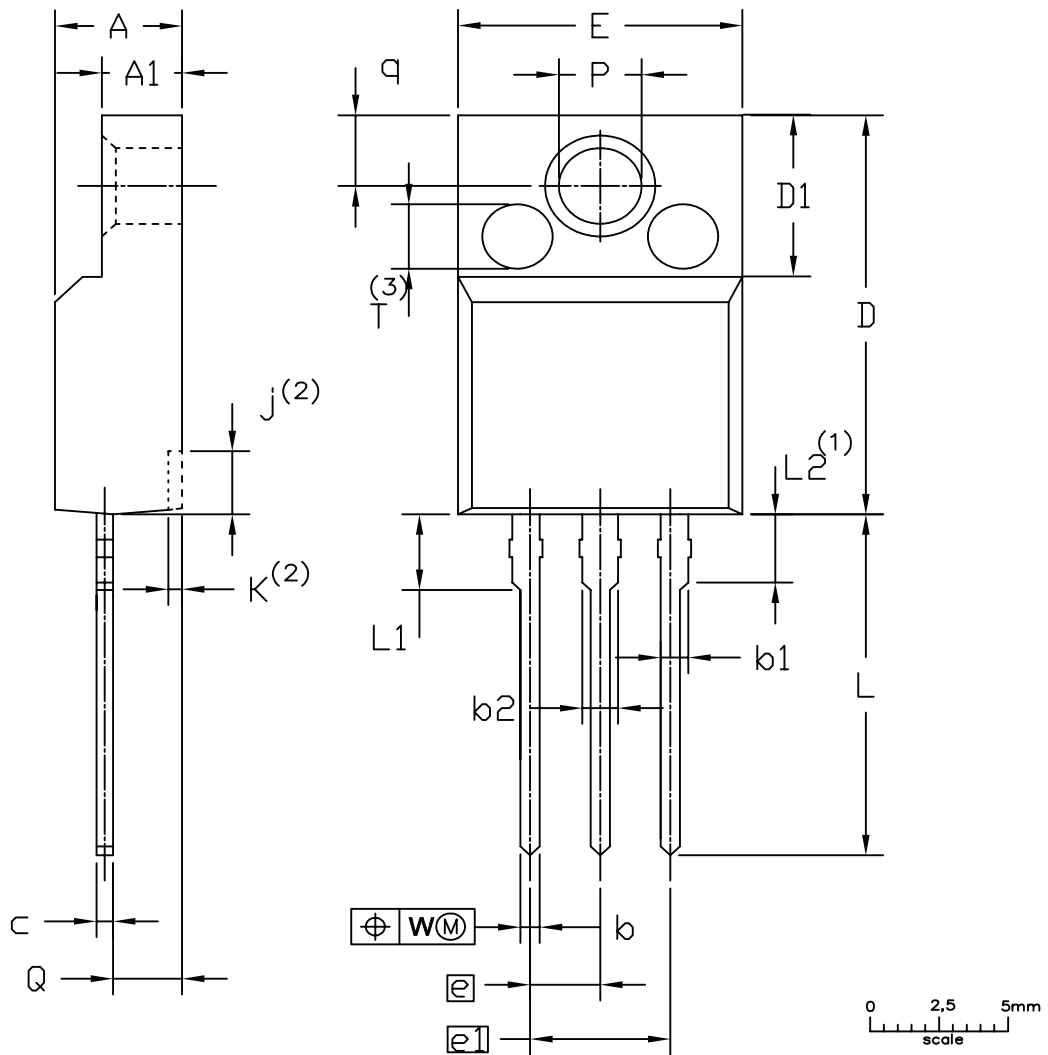




### 11. Package outline

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack"

SOT186A



UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	b <sub>2</sub>	c	D	D <sub>1</sub>	E	e	e <sub>1</sub>	j <sup>(2)</sup>	k <sup>(2)</sup>	L	L <sub>1</sub>	L <sub>2</sub> <sup>(1)</sup> max.	P	Q	q	W	T <sup>(3)</sup>
mm	4.6	2.9	0.9	1.1	1.4	0.7	15.8	6.5	10.3			2.7	0.6	14.4	3.30		3.2	2.6	3.0	0.4	2.5
	4.0	2.5	0.7	0.9	1.0	0.4	15.2	6.3	9.7	2.54	5.08	1.7	0.4	13.5	2.79	3	3.0	2.3	2.6		

- Notes
- Terminal dimensions within this zone are uncontrolled
  - Dot lines area designs may vary
  - Eject pin mark is for reference only

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT186A		3 LEADS TO220F			2013-11-14

## 12. Legal information

### Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
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