

## N-channel 30 V, 2.5 mΩ typ., 120 A STripFET™ H6 Power MOSFET in a TO-220 package

Datasheet - production data

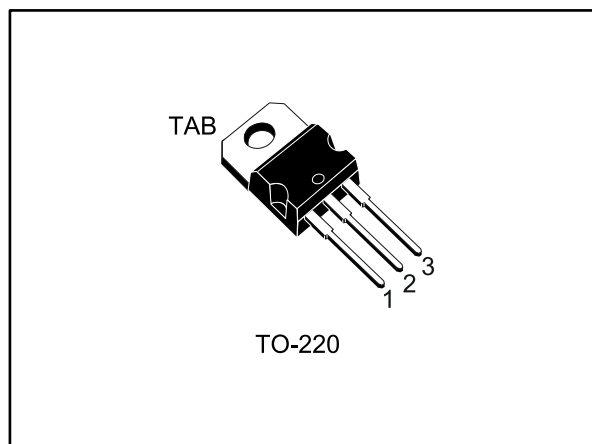
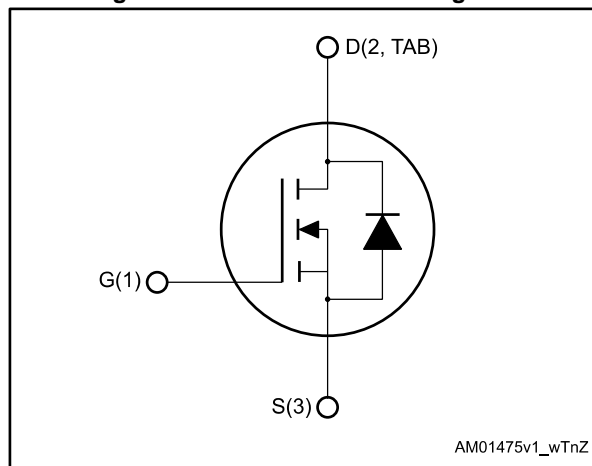


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STP160N3LL	30 V	3.2 mΩ	120 A	136 W

- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using the STripFET™ H6 technology with a new trench gate structure. The resulting Power MOSFET exhibits very low R<sub>DS(on)</sub> in all packages.

Table 1: Device summary

Order code	Marking	Package	Packing
STP160N3LL	160N3LL	TO-220	Tube

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	30	V
$V_{GS}$	Gate-source voltage	$\pm 20$	V
$I_D^{(1)}$	Drain current (continuous) at $T_{case} = 25\text{ }^{\circ}\text{C}$	120	A
$I_D$	Drain current (continuous) at $T_{case} = 100\text{ }^{\circ}\text{C}$	112	
$I_{DM}^{(2)}$	Drain current (pulsed)	480	
$P_{TOT}$	Total dissipation at $T_{case} = 25\text{ }^{\circ}\text{C}$	136	W
$E_{AS}^{(3)}$	Single pulse avalanche energy	150	mJ
$T_{stg}$	Storage temperature	-55 to 175	$^{\circ}\text{C}$
$T_j$	Operating junction temperature		

**Notes:**

<sup>(1)</sup> Current is limited by package.

<sup>(2)</sup> Pulse width is limited by safe operating area.

<sup>(3)</sup> starting  $T_j = 25\text{ }^{\circ}\text{C}$ ,  $I_D = 40\text{ A}$

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	1.1	$^{\circ}\text{C/W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	

## 2 Electrical characteristics

( $T_{\text{case}} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

**Table 4: Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 250\text{ }\mu\text{A}$	30			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 30\text{ V}$			1	$\mu\text{A}$
		$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 30\text{ V}$ , $T_{\text{case}} = 125\text{ }^{\circ}\text{C}$			10	
$I_{\text{GSS}}$	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 20\text{ V}$			$\pm 100$	nA
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = 250\text{ }\mu\text{A}$	1		2.5	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 60\text{ A}$		2.5	3.2	m $\Omega$
		$V_{\text{GS}} = 4.5\text{ V}$ , $I_{\text{D}} = 60\text{ A}$		3.2	4.2	

**Table 5: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{\text{iss}}$	Input capacitance	$V_{\text{DS}} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{\text{GS}} = 0\text{ V}$	-	3500	-	pF
$C_{\text{oss}}$	Output capacitance		-	400	-	
$C_{\text{rss}}$	Reverse transfer capacitance		-	380	-	
$Q_{\text{g}}$	Total gate charge	$V_{\text{DD}} = 15\text{ V}$ , $I_{\text{D}} = 120\text{ A}$ , $V_{\text{GS}} = 4.5\text{ V}$ (see <a href="#">Figure 14: "Gate charge test circuit"</a> )	-	42	-	nC
$Q_{\text{gs}}$	Gate-source charge		-	9	-	
$Q_{\text{gd}}$	Gate-drain charge		-	18	-	
$R_{\text{G}}$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$ , gate DC bias = $0\text{ V}$ , magnitude of alternative signal = $20\text{ mV}$	-	1	-	$\Omega$

**Table 6: Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 15\text{ V}$ , $I_{\text{D}} = 60\text{ A}$ , $R_{\text{G}} = 4.7\text{ }\Omega$ , $V_{\text{GS}} = 5\text{ V}$ (see <a href="#">Figure 13: "Switching times test circuit for resistive load"</a> and <a href="#">Figure 18: "Switching time waveform"</a> )	-	19	-	ns
$t_{\text{r}}$	Rise time		-	91	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	24.5	-	
$t_{\text{f}}$	Fall time		-	23.4	-	

Table 7: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{SD}^{(1)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 60\text{ A}$	-		1.1	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 120\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 24\text{ V}$ (see <a href="#">Figure 15: "Test circuit for inductive load switching and diode recovery times"</a> )	-	28.6		ns
$Q_{rr}$	Reverse recovery charge		-	22.8		nC
$I_{RRM}$	Reverse recovery current		-	1.6		A

**Notes:**

<sup>(1)</sup> Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

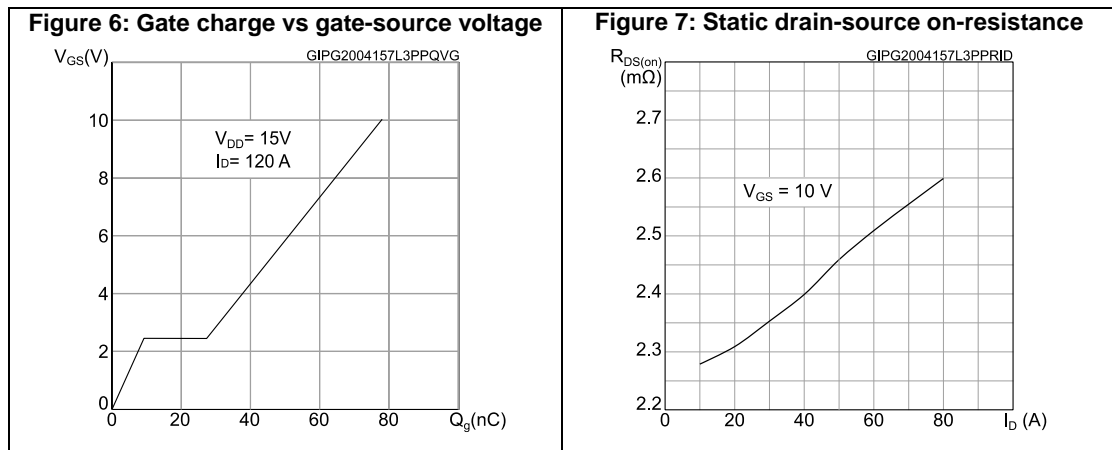
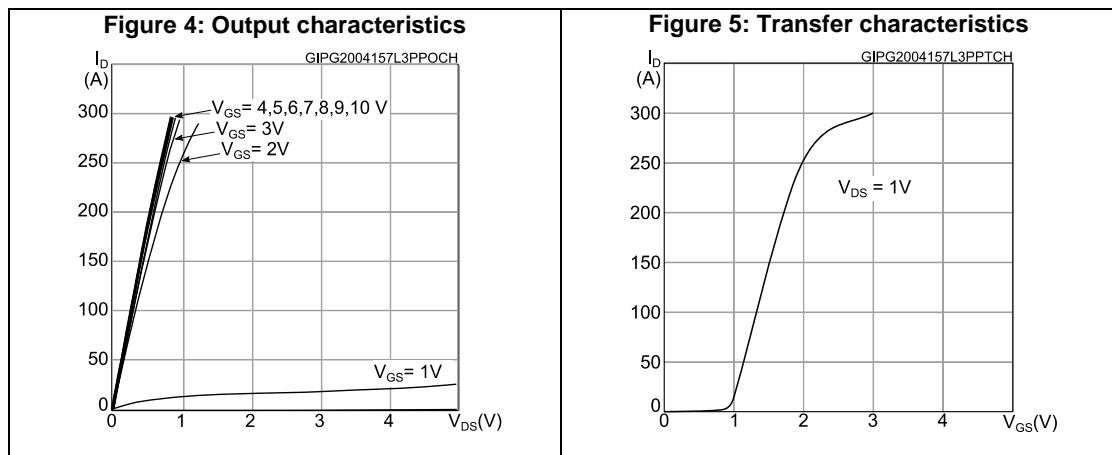
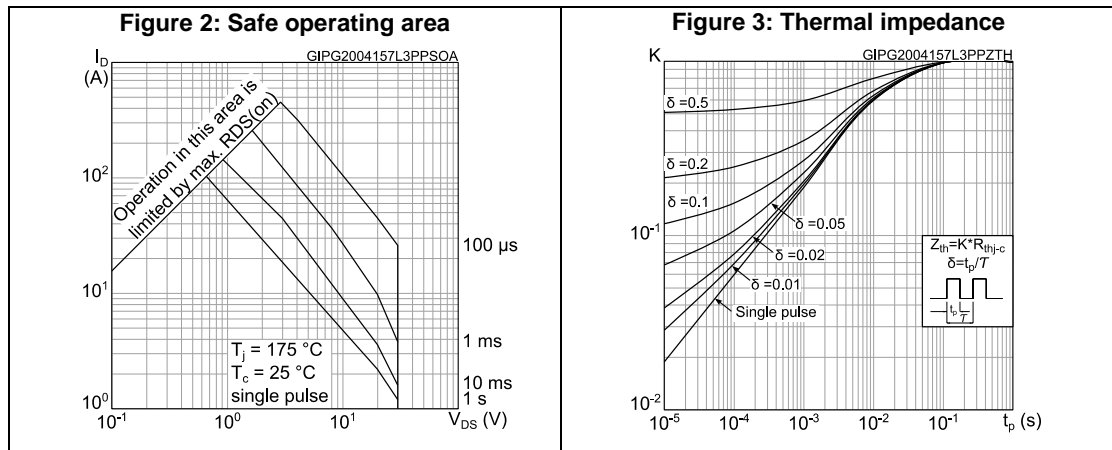


Figure 8: Capacitance variations

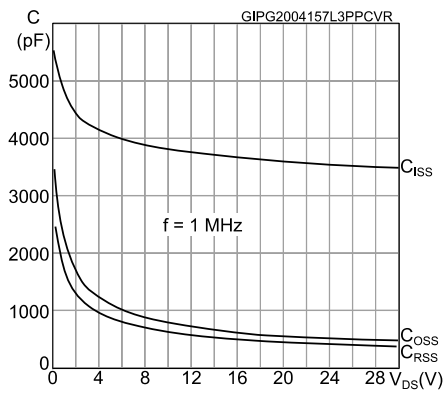


Figure 9: Normalized gate threshold voltage vs temperature

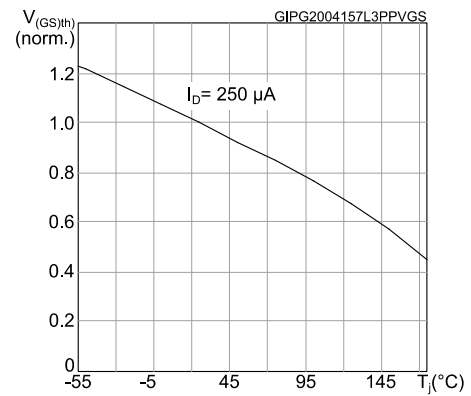


Figure 10: Normalized on-resistance vs temperature

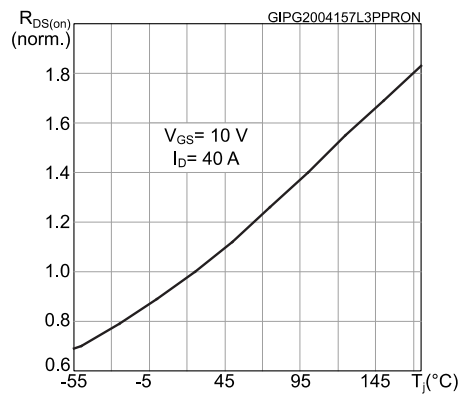
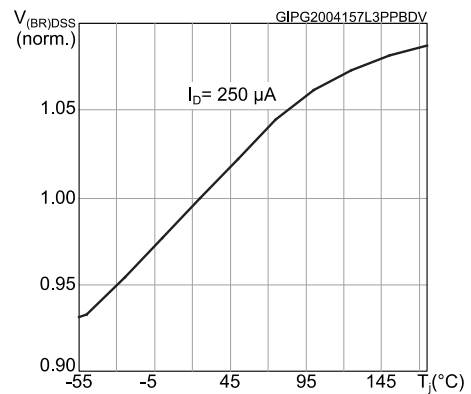
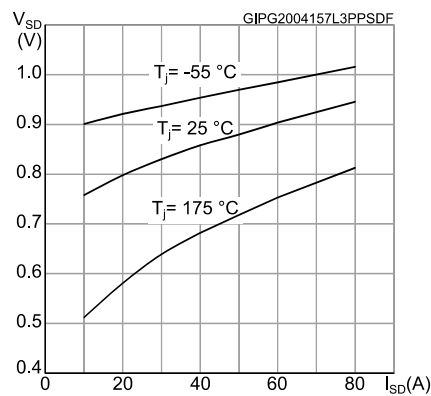
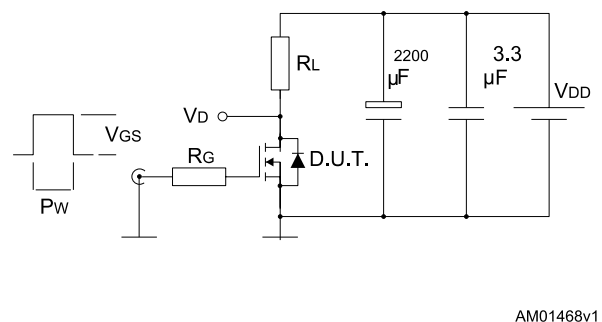
Figure 11: Normalized  $V_{(BR)DSS}$  vs temperature

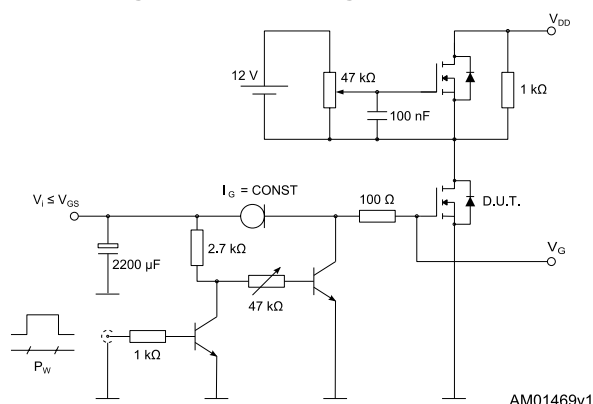
Figure 12: Source-drain diode forward characteristics



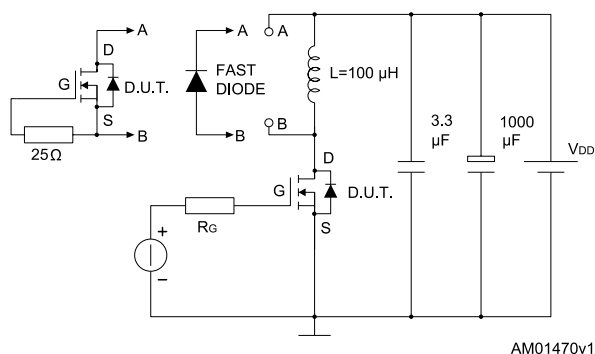
**Figure 13: Switching times test circuit for resistive load**



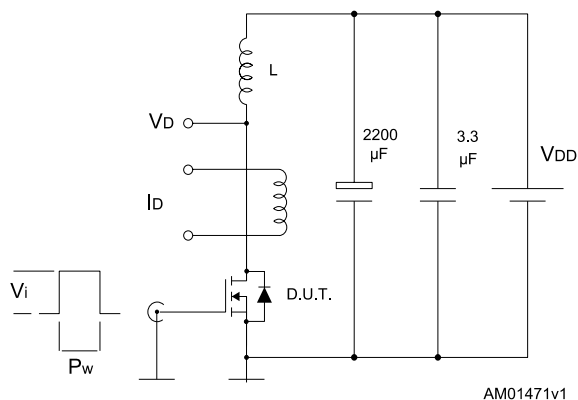
**Figure 14: Gate charge test circuit**



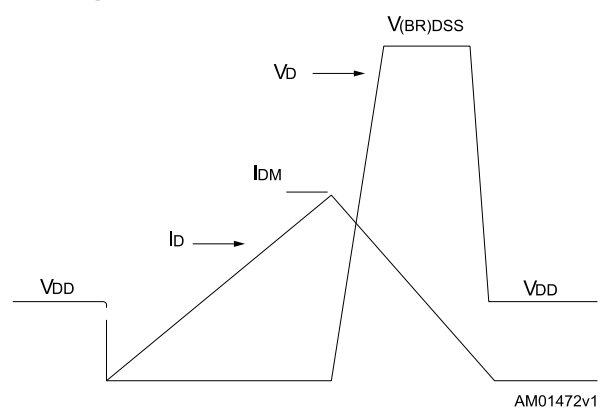
**Figure 15: Test circuit for inductive load switching and diode recovery times**



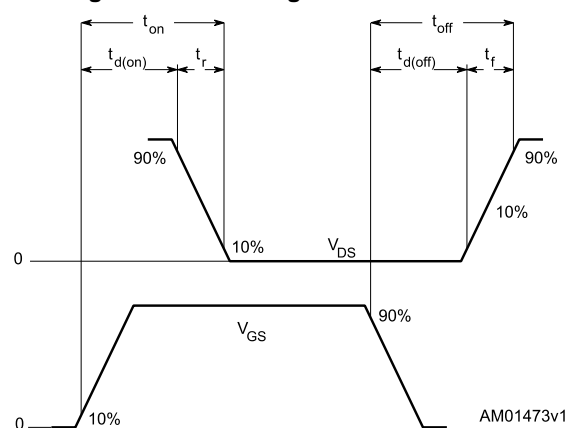
**Figure 16: Unclamped inductive load test circuit**



**Figure 17: Unclamped inductive waveform**



**Figure 18: Switching time waveform**





## 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: **[www.st.com](http://www.st.com)**. ECOPACK<sup>®</sup> is an ST trademark.

## 4.1 TO-220 type A package information

Figure 19: TO-220 type A package outline

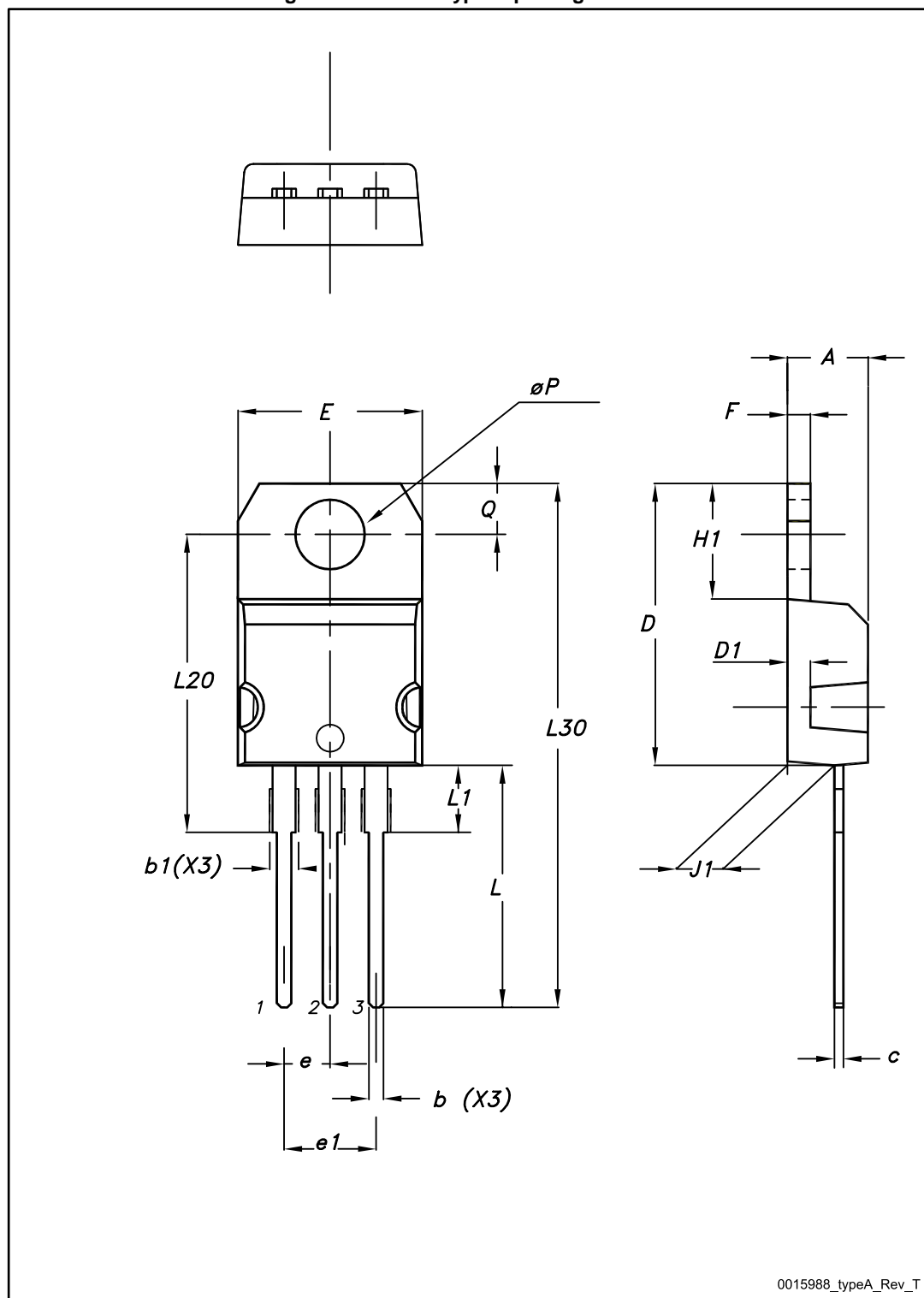


Table 8: TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

## 5 Revision history

**Table 9: Document revision history**

Date	Revision	Changes
31-Jul-2013	1	First release.
04-Jun-2015	2	Text edits and formatting changes throughout document In section 2 Electrical characteristics: - updated Table 4 Static - updated Table 5 Dynamic - updated Table 7 Source-drain diode - added Section 2.1 Electrical characteristics (curves) Updated and renamed Section 4 Package information (was Package mechanical data)
26-Jun-2015	3	On cover page: - updated Title and Description In Section Electrical ratings: - updated Table Absolute maximum ratings

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