STP220N6F7

N-channel 60 V, 0.0021 Ω typ., 120 A, STripFET™ F7 Power MOSFET in a TO-220 package

Datasheet - production data

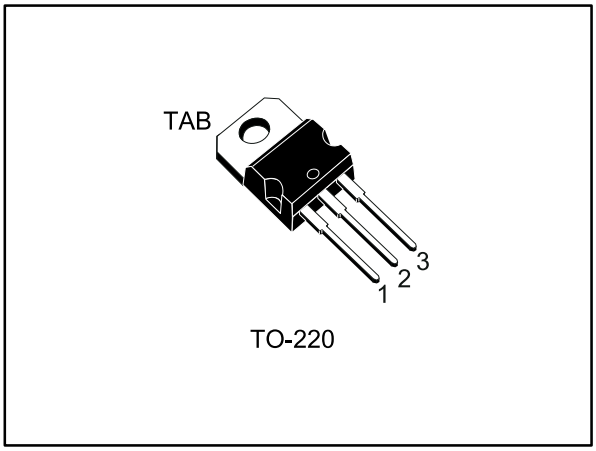
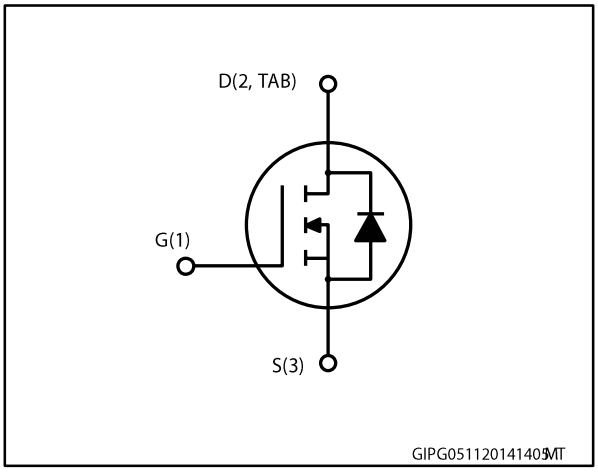


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)max}$	I_D	P_{TOT}
STP220N6F7	60 V	0.0024 Ω	120 A	237 W

- Among the lowest $R_{DS(on)}$ on the market
- Excellent figure of merit (FoM)
- Low C_{rss}/C_{iss} ratio for EMI immunity
- High avalanche ruggedness

Applications

- Switching applications

Description

This N-channel Power MOSFET utilizes STripFET™ F7 technology with an enhanced trench gate structure that results in very low on-state resistance, while also reducing internal capacitance and gate charge for faster and more efficient switching.

Table 1: Device summary

Order code	Marking	Package	Packaging
STP220N6F7	220N6F7	TO-220	Tube

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	60	V
V_{GS}	Gate-source voltage	±20	V
I_D(1)	Drain current (continuous)	120	A
I_D(1)	Drain current (continuous) at T_C = 100 °C	120	A
I_{DM}(2)	Drain current (pulsed) T_C = 25 °C	480	A
P_{TOT}	Total dissipation at T_C = 25 °C	237	W
E_{AS}(3)	Single pulse avalanche energy	1	J
T_J	Operating junction temperature	-55 to 175	°C
T_{stg}	Storage temperature		°C

Notes:

(1)Current limited by package

(2)Pulse width is limited by safe operating area

(3)Starting T_j = 25°C, I_d = 20 A, V_{dd} = 50 V

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.63	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.5	°C/W

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 4: On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0, I_D = 1 mA	60			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 60 V			1	µA
		V_{GS} = 0, V_{DS} = 60 V, T_C = 125 °C			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = + 20 V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2		4	V
$R_{DS(on)}$	Static drain-source on- resistance	V_{GS} = 10 V, I_D = 60 A		0.0021	0.0024	Ω

Table 5: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS} = 0, V_{DS} = 25 V, f = 1 MHz	-	6400	-	pF
C_{oss}	Output capacitance		-	3880	-	pF
C_{rss}	Reverse transfer capacitance		-	175	-	pF
Q_g	Total gate charge	V_{DD} = 30 V, I_D = 120 A, V_{GS} = 10 V (see *Figure 14: "Test circuit for gate charge behavior"*)	-	100	-	nC
Q_{gs}	Gate-source charge		-	36	-	nC
Q_{gd}	Gate-drain charge		-	24	-	nC

Table 6: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 30 V, I_D = 60 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 13: "Test circuit for resistive load switching times"*)	-	33	-	ns
t_r	Rise time		-	103	-	ns
$t_{d(off)}$	Turn-off delay time		-	54	-	ns
t_f	Fall time		-	29	-	ns

Table 7: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD} (1)	Forward on voltage	V_{GS} = 0, I_{SD} = 120 A	-	-	1.1	V
t_{rr}	Reverse recovery time	I_{SD} = 120 A, di/dt = 100 A/µs V_{DD} = 48 V, T_J = 150 °C (see *Figure 15: "Test circuit for inductive load switching and diode recovery times"*)	-	69		ns
Q_{rr}	Reverse recovery charge		-	104		nC
I_{RRM}	Reverse recovery current		-	3		A

Notes:

(1)Pulsed: pulse duration = 300 µs, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

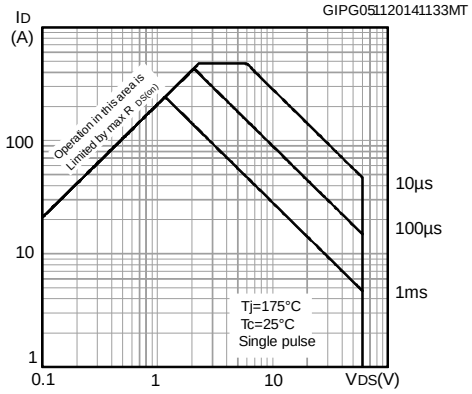


Figure 3: Thermal impedance

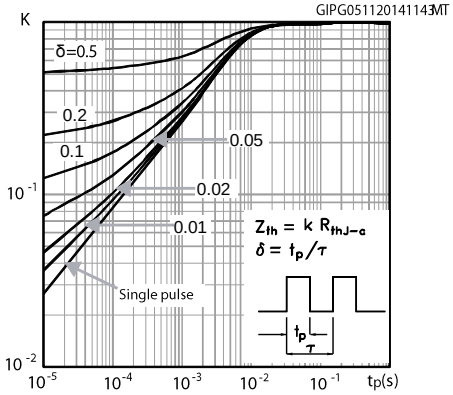


Figure 4: Output characteristics

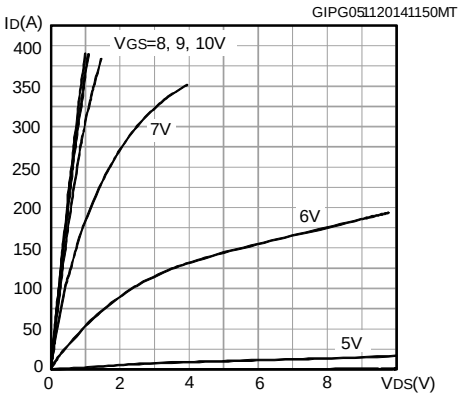


Figure 5: Transfer characteristics

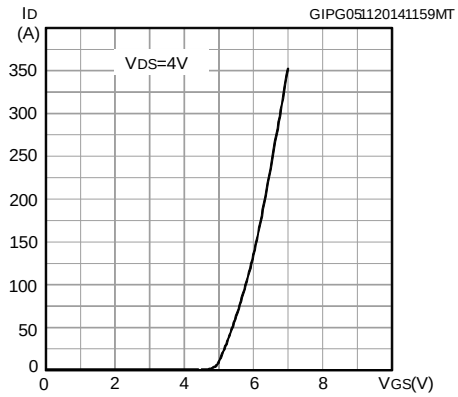


Figure 6: Gate charge vs gate-source voltage

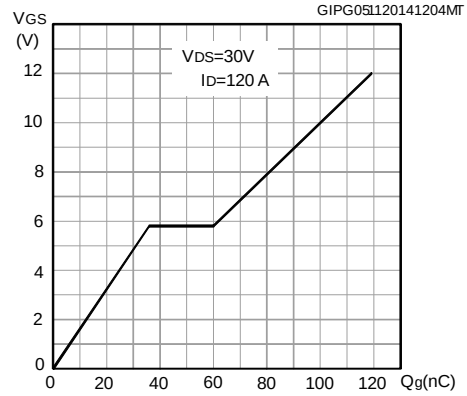


Figure 7: Static drain-source on-resistance

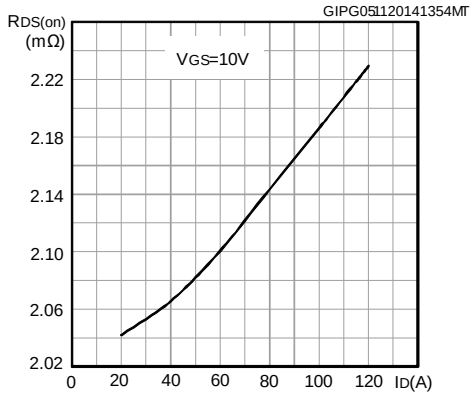


Figure 8: Capacitance variations

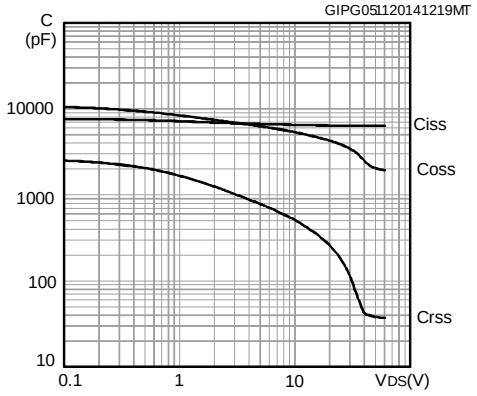


Figure 9: Normalized gate threshold voltage vs temperature

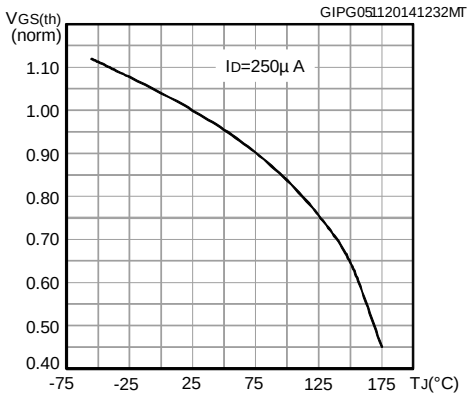


Figure 10: Normalized on-resistance vs temperature

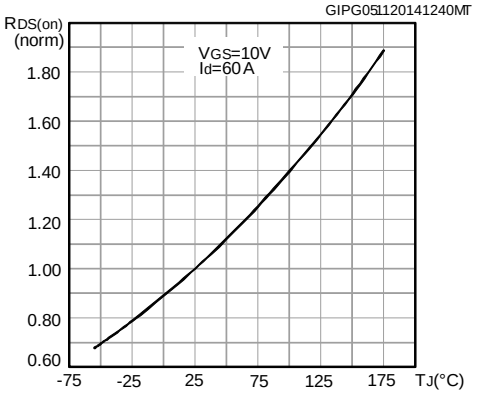


Figure 11: Normalized V(BR)DSS vs temperature

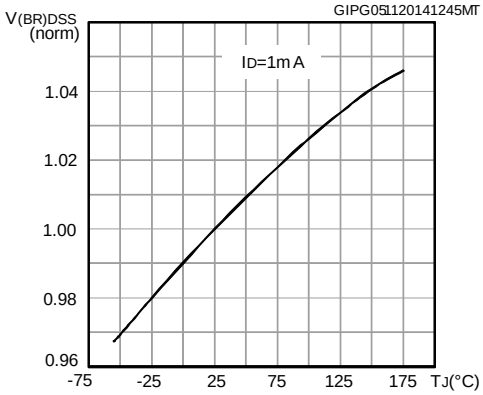
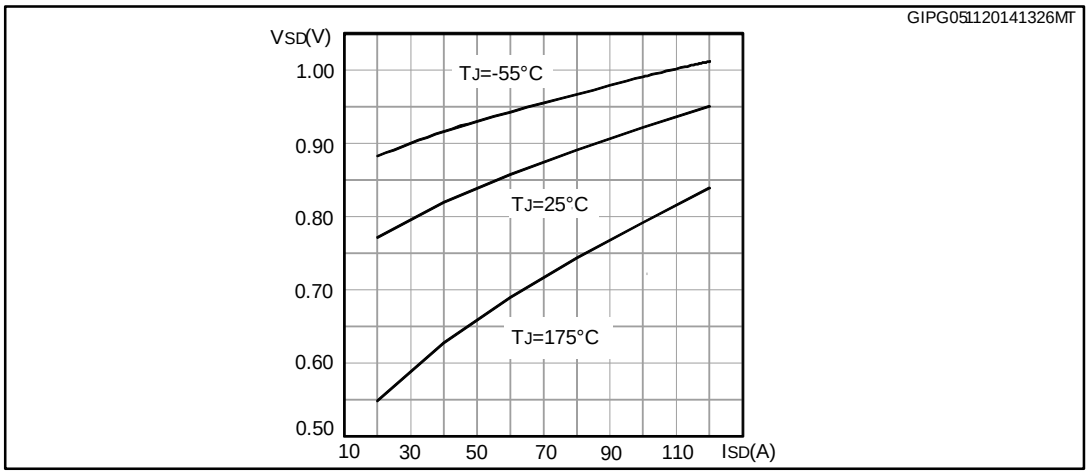


Figure 12: Source-drain diode forward characteristics



3 Test circuits

Figure 13: Test circuit for resistive load switching times

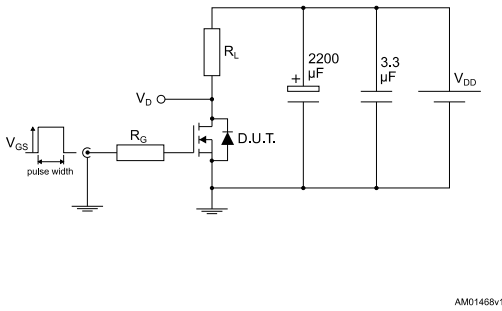


Figure 14: Test circuit for gate charge behavior

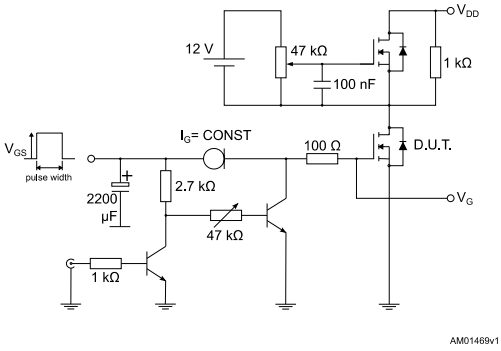


Figure 15: Test circuit for inductive load switching and diode recovery times

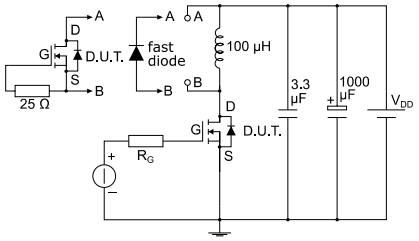


Figure 16: Unclamped inductive load test circuit

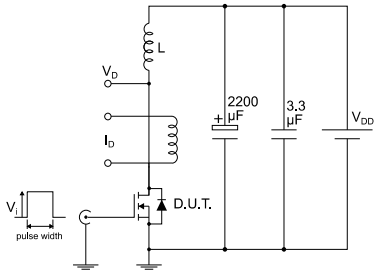


Figure 17: Unclamped inductive waveform

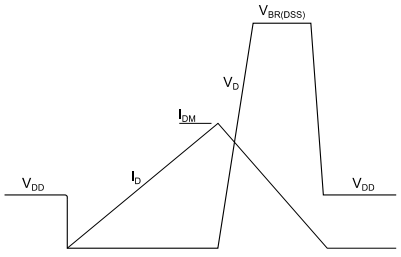
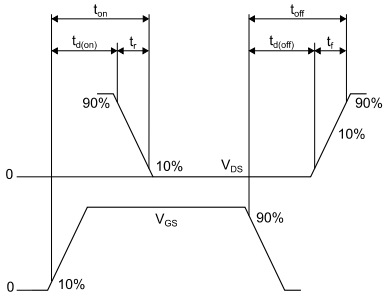


Figure 18: Switching time waveform



4 Package mechanical data

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

4.1 TO-220 package mechanical data

Figure 19: TO-220 type A package outline

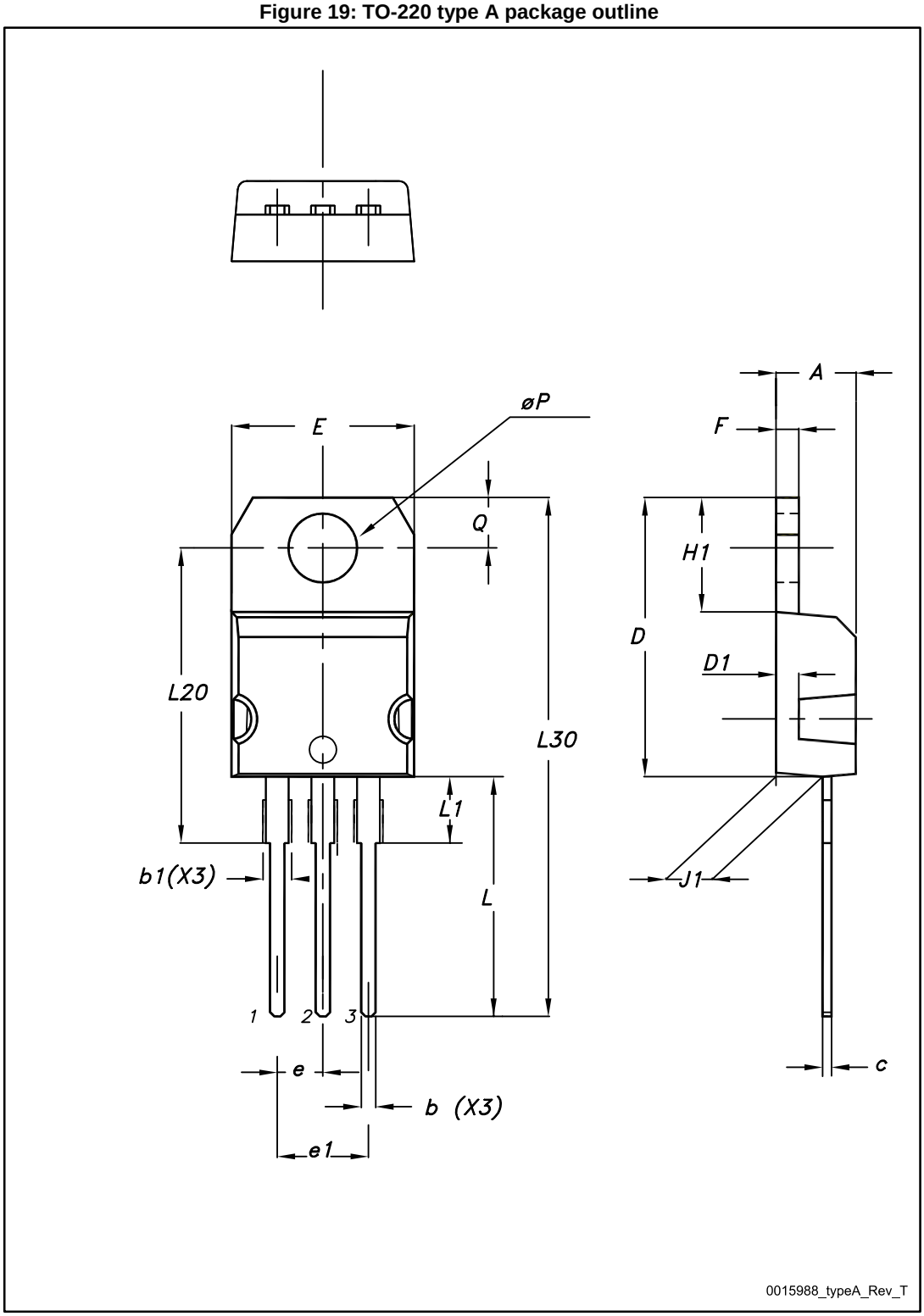


Table 8: TO-220 type A mechanical data

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
17-Jun-2014	1	Initial release.
05-Nov-2014	2	Updated title and features in cover page. Updated Electrical rating and Electrical characteristics. Added Electrical characteristics (curves) . Minor text changes.
07-Oct-2015	3	Document status promoted from preliminary to production data.

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