

## High efficiency rectifier

### Features

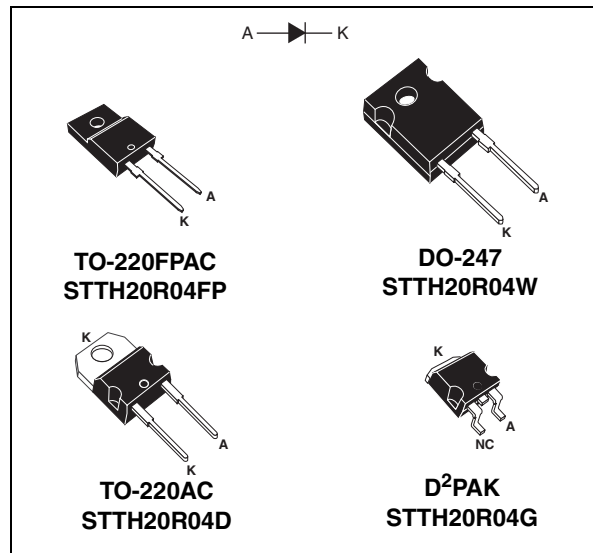
- Ultrafast recovery
- Low power losses
- High surge capability
- Low leakage current
- High junction temperature

### Description

The **STTH20R04** is an ultrafast recovery power rectifier dedicated to **energy recovery in PDP application**.

It is especially designed for clamping function in energy recovery block.

The compromise between forward voltage drop and recovery time offers optimized performances.



**Table 1. Device summary**

$I_{F(\text{peak})}$	20 A
$V_{RRM}$	400 V
$t_{rr} \text{ (typ)}$	18 ns
$T_j$	175 °C
$V_F \text{ (typ)}$	1.15 V

# 1 Characteristics

**Table 2. Absolute ratings (limiting values)**

Symbol	Parameter		Value	Unit	
$V_{RRM}$	Repetitive peak reverse voltage		400	V	
$I_{F(RMS)}$	RMS forward current		50	A	
$I_{F(peak)}$	Peak working forward current	DO-247, TO-220AC, D <sup>2</sup> PAK	$T_c = 135\text{ °C}$ $\delta = 0.5$ Square signal	20	A
		TO-220FPAC	$T_c = 105\text{ °C}$ $\delta = 0.5$ Square signal		
$I_{FSM}$	Surge non repetitive forward current		$t_p = 10\text{ ms}$ sinusoidal	150	A
$T_{stg}$	Storage temperature range		-65 to + 175	°C	
$T_j$	Maximum operating junction temperature		175	°C	

**Table 3. Thermal parameters**

Symbol	Parameter		Value	Unit
$R_{th(j-c)}$	Junction to case	DO-247, TO-220AC, D <sup>2</sup> PAK	2.8	°C/W
		TO-220FPAC	5	

**Table 4. Static electrical characteristics**

Symbol	Parameter	Test conditions		Min	Typ	Max	Unit
$I_R^{(1)}$	Reverse leakage current	$T_j = 25\text{ °C}$	$V_R = V_{RRM}$			20	$\mu\text{A}$
		$T_j = 125\text{ °C}$			20	200	
$V_F^{(2)}$	Forward voltage drop	$T_j = 25\text{ °C}$	$I_F = 20\text{ A}$		1.5	1.7	V
		$T_j = 125\text{ °C}$			1.15	1.35	

1. Pulse test:  $t_p = 5\text{ ms}$ ,  $\delta < 2\%$

2. Pulse test:  $t_p = 380\text{ }\mu\text{s}$ ,  $\delta < 2\%$

To evaluate the conduction losses use the following equation:

$$P = 1.05 \times I_{F(AV)} + 0.015 I_{F(RMS)}^2$$

**Table 5. Recovery characteristics**

Symbol	Parameter	Test conditions		Min	Typ	Max	Unit
$t_{rr}$	Reverse recovery time	$T_j = 25\text{ °C}$	$I_F = 0.5\text{ A}$ , $I_{rr} = 0.25\text{ A}$ , $I_R = 1\text{ A}$		18	25	ns
			$I_F = 1\text{ A}$ , $V_R = 30\text{ V}$ , $di_F/dt = -50\text{ A}/\mu\text{s}$		35	45	
$t_{fr}$	Forward recovery time	$T_j = 25\text{ °C}$	$I_F = 20\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ $V_{FR} = 1.1 \times V_{Fmax}$			150	ns
$V_{FP}$	Peak forward voltage	$T_j = 25\text{ °C}$	$I_F = 20\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$		1.7	2.5	V
$I_{RM}$	Reverse recovery current	$T_j = 125\text{ °C}$	$I_F = 20\text{ A}$ , $V_{CC} = 200\text{ V}$ $di_F/dt = 200\text{ A}/\mu\text{s}$		8	11	A
$S_{factor}$	Softness factor				0.3		

Figure 1. Conduction losses versus average forward current

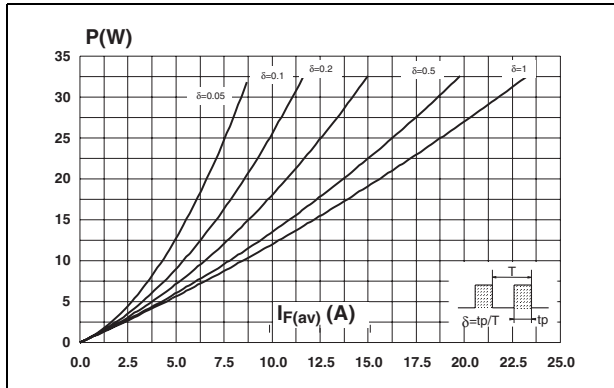


Figure 2. Forward voltage drop versus forward current

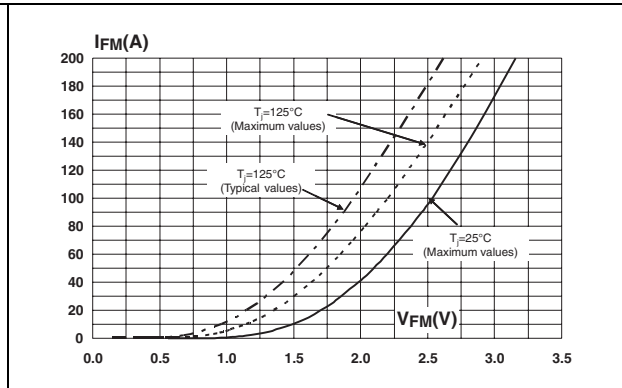


Figure 3. Relative variation of thermal impedance junction to case versus pulse duration

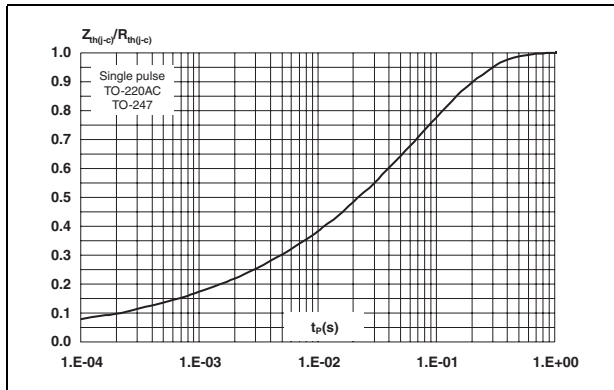


Figure 4. Relative variation of thermal impedance junction to case versus pulse duration

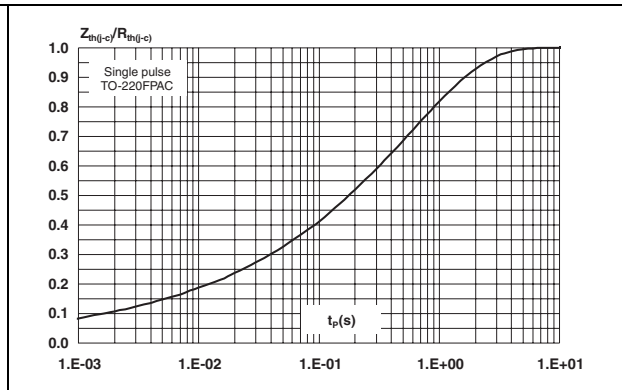


Figure 5. Peak reverse recovery current versus di\_F/dt (typical values)

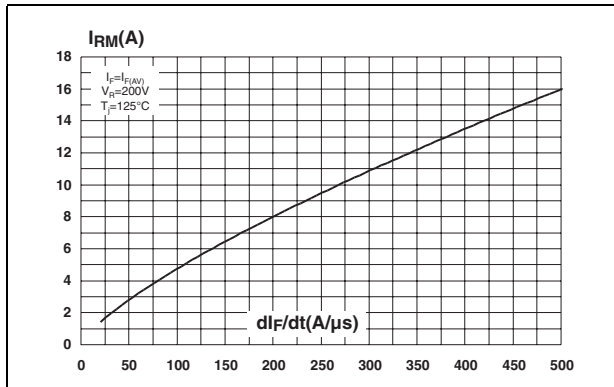


Figure 6. Reverse recovery time versus di\_F/dt (typical values)

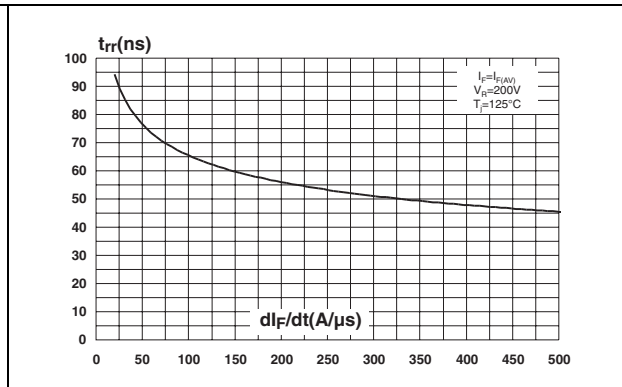


Figure 7. Reverse recovery charges versus  $di_F/dt$  (typical values)

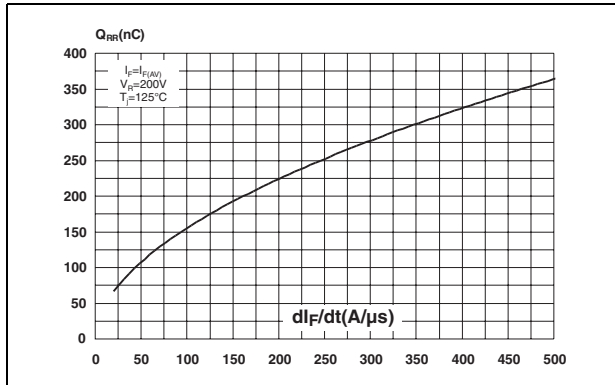


Figure 8. Reverse recovery softness factor versus  $di_F/dt$  (typical values)

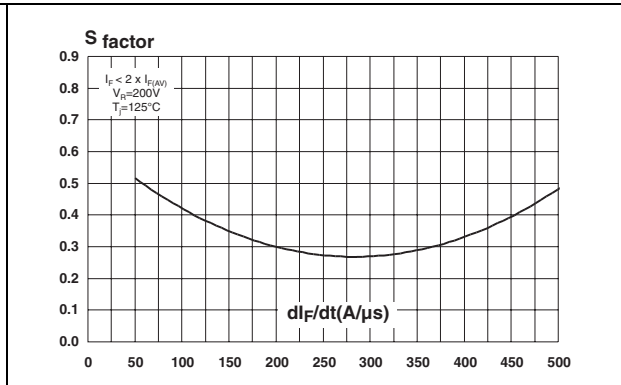


Figure 9. Relative variations of dynamic parameters versus junction temperature

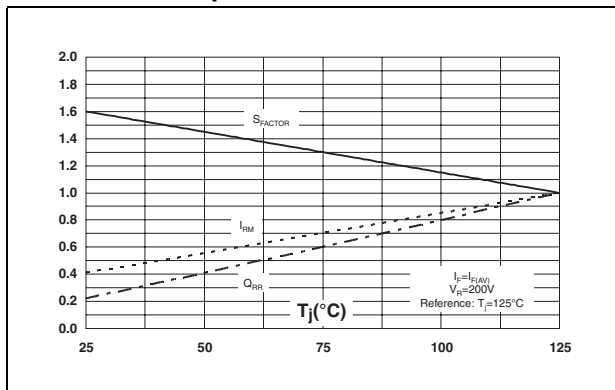


Figure 10. Transient peak forward voltage versus  $di_F/dt$  (typical values)

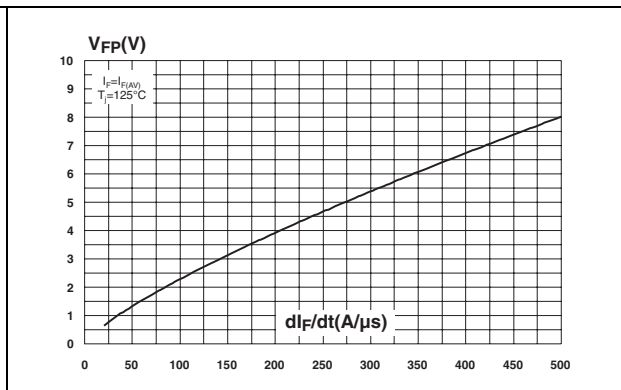


Figure 11. Forward recovery time versus  $di_F/dt$  (typical values)

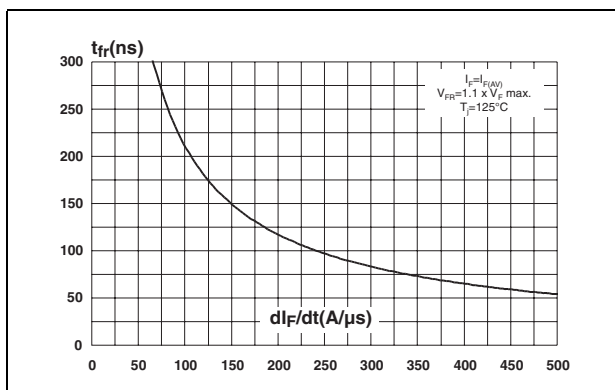
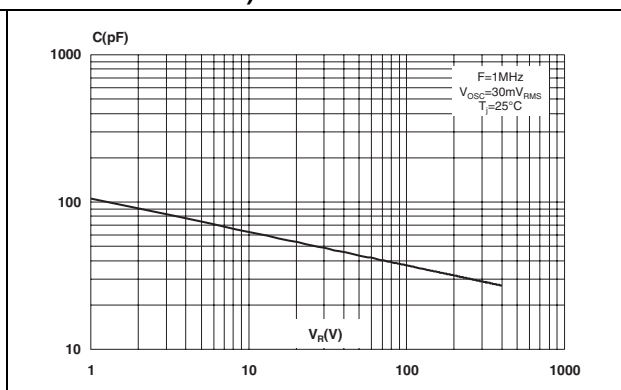


Figure 12. Junction capacitance versus reverse voltage applied (typical values)



## 2 Package information

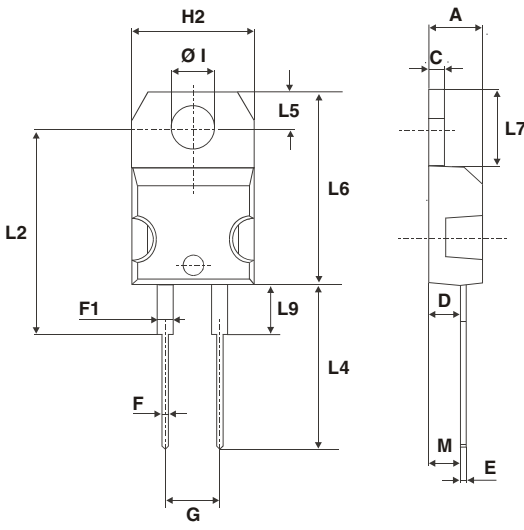
- Epoxy meets UL94, V0
- Cooling method: by conduction (C)
- Recommended torque value: 0.8 N·m
- Maximum torque value: 1.0 N·m

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

**Table 6. DO-247 dimensions**

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.85		5.15	0.191		0.203
D	2.20		2.60	0.086		0.102
E	0.40		0.80	0.015		0.031
F	1.00		1.40	0.039		0.055
F2		2.00			0.078	
F3	2.00		2.40	0.078		0.094
G		10.90			0.429	
H	15.45		15.75	0.608		0.620
L	19.85		20.15	0.781		0.793
L1	3.70		4.30	0.145		0.169
L2		18.50			0.728	
L3	14.20		14.80	0.559		0.582
L4		34.60			1.362	
L5		5.50			0.216	
M	2.00		3.00	0.078		0.118
V		5°			5°	
V2		60°			60°	
Dia.	3.55		3.65	0.139		0.143

Table 7. TO-220AC dimensions



Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
C	1.23	1.32	0.048	0.051
D	2.40	2.72	0.094	0.107
E	0.49	0.70	0.019	0.027
F	0.61	0.88	0.024	0.034
F1	1.14	1.70	0.044	0.066
G	4.95	5.15	0.194	0.202
H2	10.00	10.40	0.393	0.409
L2	16.40 typ.		0.645 typ.	
L4	13.00	14.00	0.511	0.551
L5	2.65	2.95	0.104	0.116
L6	15.25	15.75	0.600	0.620
L7	6.20	6.60	0.244	0.259
L9	3.50	3.93	0.137	0.154
M	2.6 typ.		0.102 typ.	
Diam. I	3.75	3.85	0.147	0.151

Table 8. D<sup>2</sup>PAK dimensions

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
A1	2.49	2.69	0.098	0.106
A2	0.03	0.23	0.001	0.009
B	0.70	0.93	0.027	0.037
B2	1.14	1.70	0.045	0.067
C	0.45	0.60	0.017	0.024
C2	1.23	1.36	0.048	0.054
D	8.95	9.35	0.352	0.368
E	10.00	10.40	0.393	0.409
G	4.88	5.28	0.192	0.208
L	15.00	15.85	0.590	0.624
L2	1.27	1.40	0.050	0.055
L3	1.40	1.75	0.055	0.069
M	2.40	3.20	0.094	0.126
R	0.40 typ.		0.016 typ.	
V2	0°	8°	0°	8°

Figure 13. D<sup>2</sup>PAK footprint (dimensions in mm)

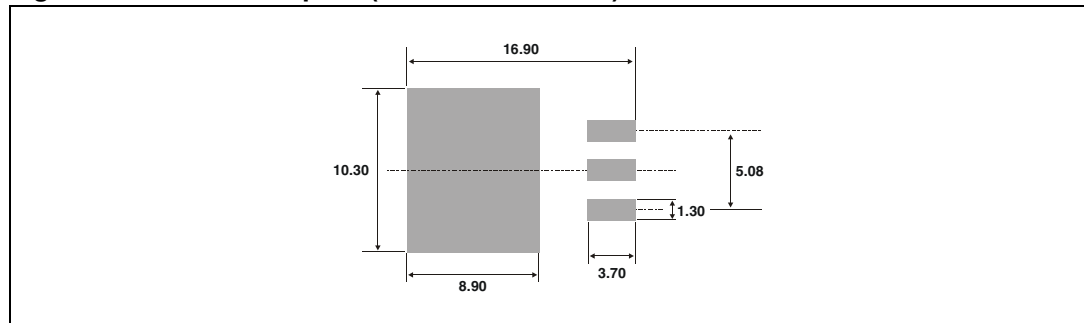


Table 9. TO-220FPAC dimensions

Ref.	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.4	4.6	0.173	0.181
B	2.5	2.7	0.098	0.106
D	2.5	2.75	0.098	0.108
E	0.45	0.70	0.018	0.027
F	0.75	1	0.030	0.039
F1	1.15	1.70	0.045	0.067
G	4.95	5.20	0.195	0.205
G1	2.4	2.7	0.094	0.106
H	10	10.4	0.393	0.409
L2	16 Typ.		0.63 Typ.	
L3	28.6	30.6	1.126	1.205
L4	9.8	10.6	0.386	0.417
L5	2.9	3.6	0.114	0.142
L6	15.9	16.4	0.626	0.646
L7	9.00	9.30	0.354	0.366
Dia.	3.00	3.20	0.118	0.126



### 3 Ordering information

**Table 10. Ordering information**

Order code	Marking	Package	Weight	Base qty	Delivery mode
STTH20R04FP	STTH20R04FP	TO-220FPAC	1.64 g	50	Tube
STTH20R04D	STTH20R04D	TO-220AC	1.86 g	50	Tube
STTH20R04W	STTH20R04W	DO-247	4.4 g	50	Tube
STTH20R04G	STTH20R04G	D <sup>2</sup> PAK	1.48 g	50	Tube
STTH20R04G-TR	STTH20R04G			1000	Tape and reel

### 4 Revision history

**Table 11. Document revision history**

Date	Revision	Description of changes
08-Nov-2007	1	First issue

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