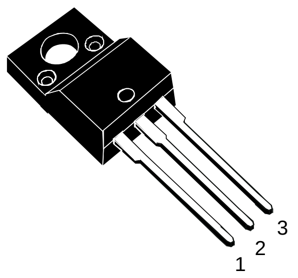
STGF20NB60S

PowerMESH™ IGBT, S series
600 V, 13 A low drop

Datasheet - production data



TO-220FP

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- High current capability

Applications

- Light dimmer
- Static relays
- Motor control

Description

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performance. The suffix “S” represents a series optimized to achieve minimum on-voltage drop for low frequency applications.

Figure 1: Internal schematic diagram

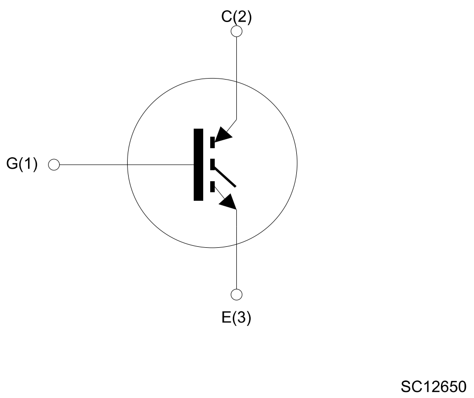


Table 1: Device summary

Order code	Marking	Package	Packing
STGF20NB60S	GF20NB60S	TO-220FP	Tube

This is information on a product in full production.

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	600	V
V_{ECS}	Emitter-collector voltage (V_{GE} = 0 V)	-20	V
V_{GE}	Gate-emitter voltage	±20	V
I_C	Continuous collector current at T_C = 25 °C	24	A
	Continuous collector current at T_C = 100 °C	13	
I^{CL}	Turn-off latching current	70	A
I_{CM} (1)	Pulsed collector current	70	A
P_{TOT}	Total dissipation at T_C = 25 °C	40	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s, T_C = 25 °C)	2.5	kV
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature		

Notes:

(1)Pulse width limited by safe operating area.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	3.1	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	62.5	

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 4: Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 250 µA	600			V
$V_{(BR)ECS}$	Emitter-collector breakdown voltage	V_{GE} = 0 V, I_C = 10 mA	-20			V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 600 V			10	µA
		V_{GE} = 0 V, V_{CE} = 600 V, T_C = 125 °C			100	µA
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±100	nA
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 250 µA	2.5		5	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 20 A		1.25	1.7	V
		V_{GE} = 15 V, I_C = 20 A, T_J = 150 °C		1.2		V

Table 5: Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} [(1)]	Forward transconductance	V_{CE} = 10 V, I_C = 8 A	-	20	-	S
C_{ies}	Input capacitance	V_{CE}= 25 V, f = 1 MHz, V_{GE} = 0 V	-	1820	-	pF
C_{oes}	Output capacitance		-	167	-	
C_{res}	Reverse transfer capacitance		-	27	-	
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V (see *Figure 17: "Gate charge test circuit"*)	-	83	115	nC
Q_{ge}	Gate-emitter charge		-	10	-	
Q_{gc}	Gate-collector charge		-	27	-	

Notes:

(1)Pulse duration= 300 µs, duty cycle 1.5 %

Table 6: Inductive load switching on characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V, R_G = 100 Ω (see *Figure 16: "Test circuit for inductive load switching"*)	-	92	-	ns
t_r	Current rise time		-	70	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	340	-	A/µs
$t_{d(on)}$	Turn-on delay time	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V, R_G = 100 Ω, T_j = 125 °C (see *Figure 16: "Test circuit for inductive load switching"*)	-	80	-	ns
t_r	Current rise time		-	73	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	320	-	A/µs

Table 7: Inductive load switching off characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_c	Cross-over time	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V, R_G = 100 Ω (see *Figure 16: "Test circuit for inductive load switching"*)	-	1.6	-	ns
$t_r(V_{off})$	Off voltage rise time		-	0.8	-	
$t_{d(off)}$	Turn-off delay time		-	1.1	-	
t_f	Current fall time		-	0.8	-	
t_c	Cross-over time	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V, R_G = 100 Ω, T_j = 125 °C (see *Figure 16: "Test circuit for inductive load switching"*)	-	2.4	-	ns
$t_r(V_{off})$	Off voltage rise time		-	1.1	-	
$t_{d(off)}$	Turn-off delay time		-	2.4	-	
t_f	Current fall time		-	1.2	-	

Table 8: Inductive load switching loss characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} (1)	Turn-on switching loss	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V, R_G = 100 Ω (see *Figure 18: "Switching waveform"*)	-	0.84	-	mJ
E_{off} (2)	Turn-off switching loss		-	7.4	-	
E_{ts}	Total switching loss		-	8.24	-	
E_{on} (1)	Turn-on switching loss	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V, R_G = 100 Ω, T_j = 125 °C (see *Figure 18: "Switching waveform"*)	-	0.86	-	mJ
E_{off} (2)	Turn-off switching loss		-	11.5	-	
E_{ts}	Total switching loss		-	12.36	-	

Notes:

(1) E_{on} is the turn-on loss when a external diode is used in the test circuit in *Figure 16: "Test circuit for inductive load switching"*.

(2) Turn-off loss includes the tail of the collector current.

2.1 Electrical characteristics (curves)

Figure 2: Output Characteristics

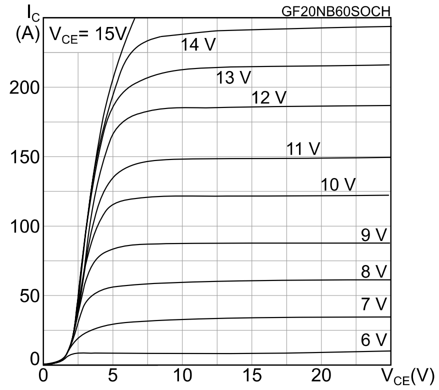


Figure 3: Transfer Characteristics

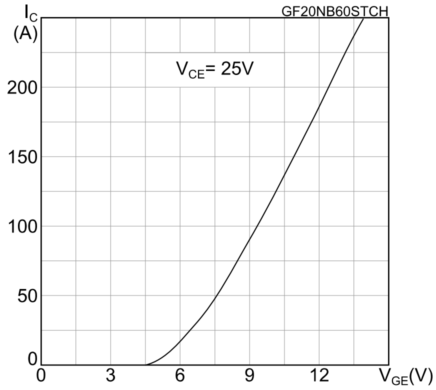


Figure 4: Transconductance

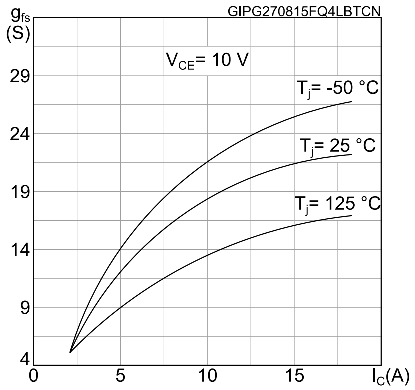


Figure 5: Normalized collector-emitter on voltage vs temperature

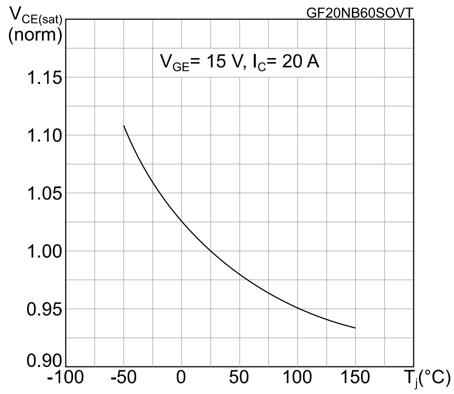


Figure 6: Collector-Emitter on voltage vs collector current

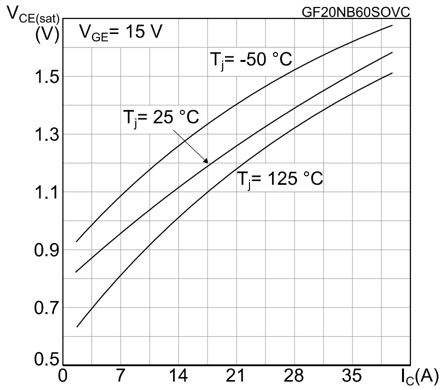


Figure 7: Normalized gate threshold vs temperature

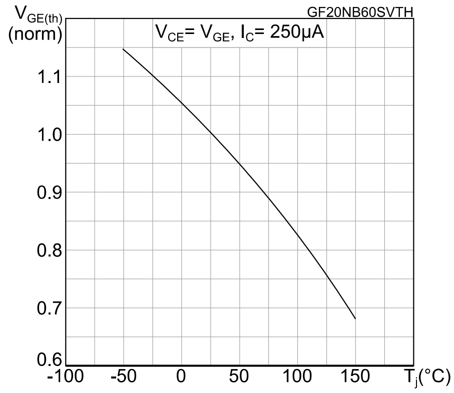


Figure 8: Normalized breakdown voltage vs temperature

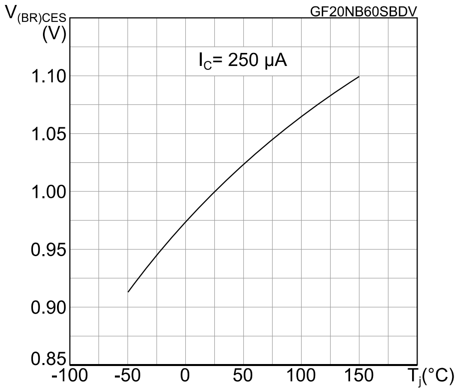


Figure 9: Gate charge vs gate-emitter voltage

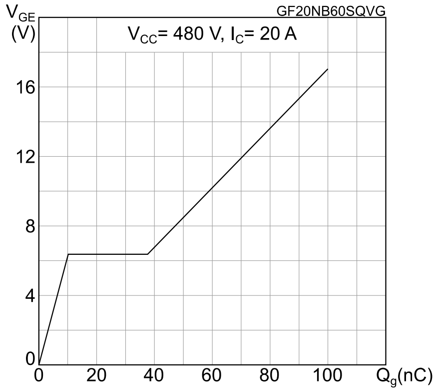


Figure 10: Capacitance variations

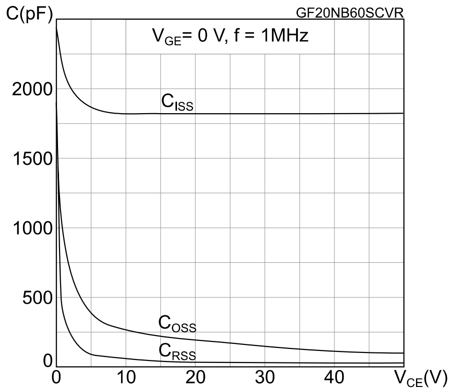


Figure 11: Switching loss vs gate resistance

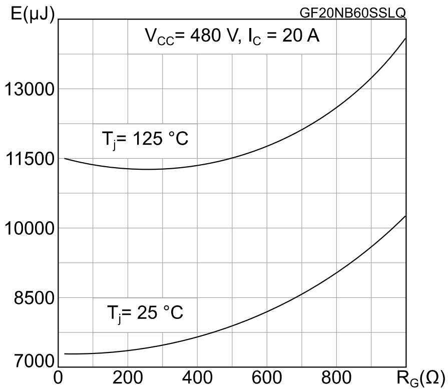


Figure 12: Switching loss vs temperature

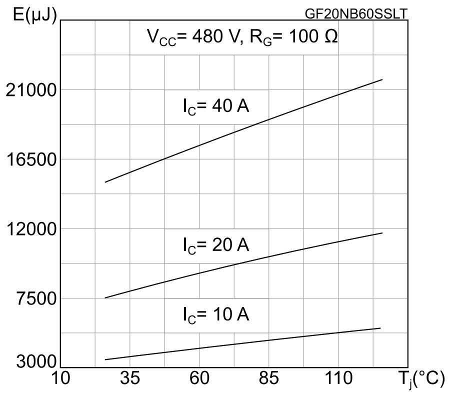


Figure 13: Switching loss vs collector current

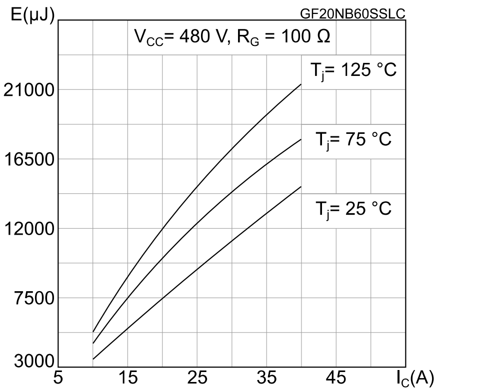


Figure 14: Thermal impedance

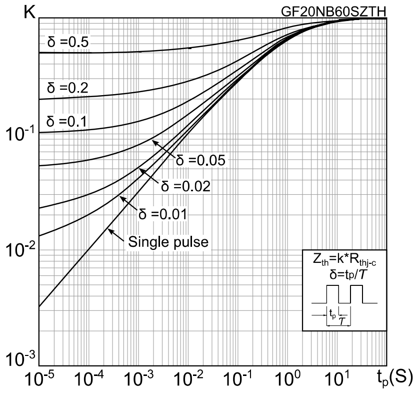
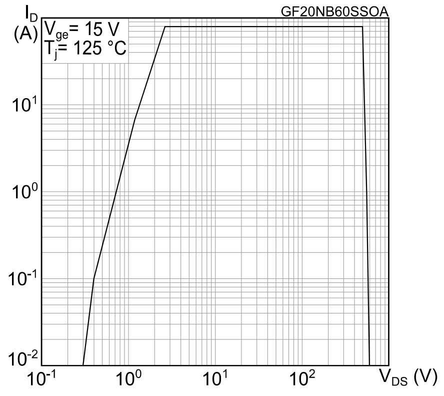


Figure 15: Turn-off SOA



3 Test circuits

Figure 16: Test circuit for inductive load switching

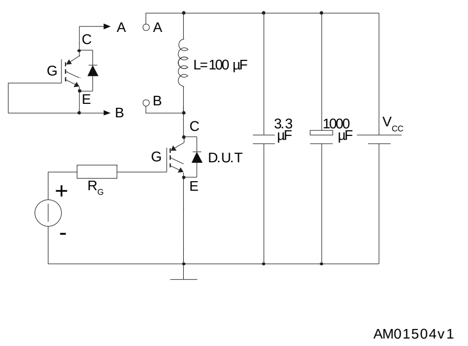


Figure 17: Gate charge test circuit

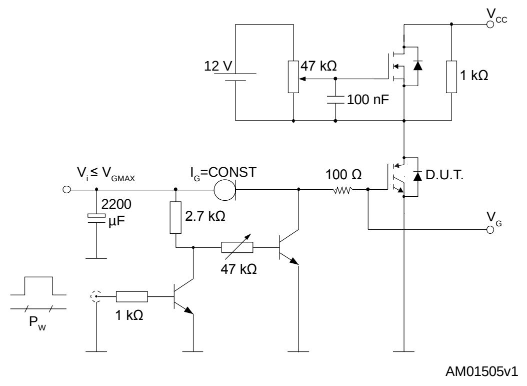
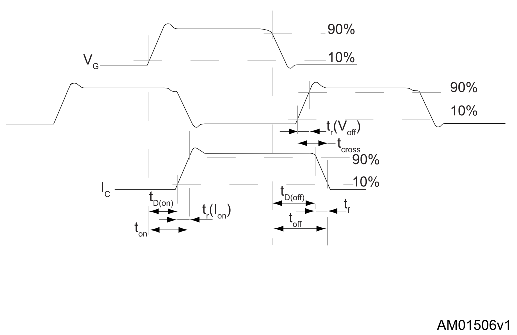


Figure 18: Switching waveform



4 Package information

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-220FP package information

Figure 19: TO-220FP package outline

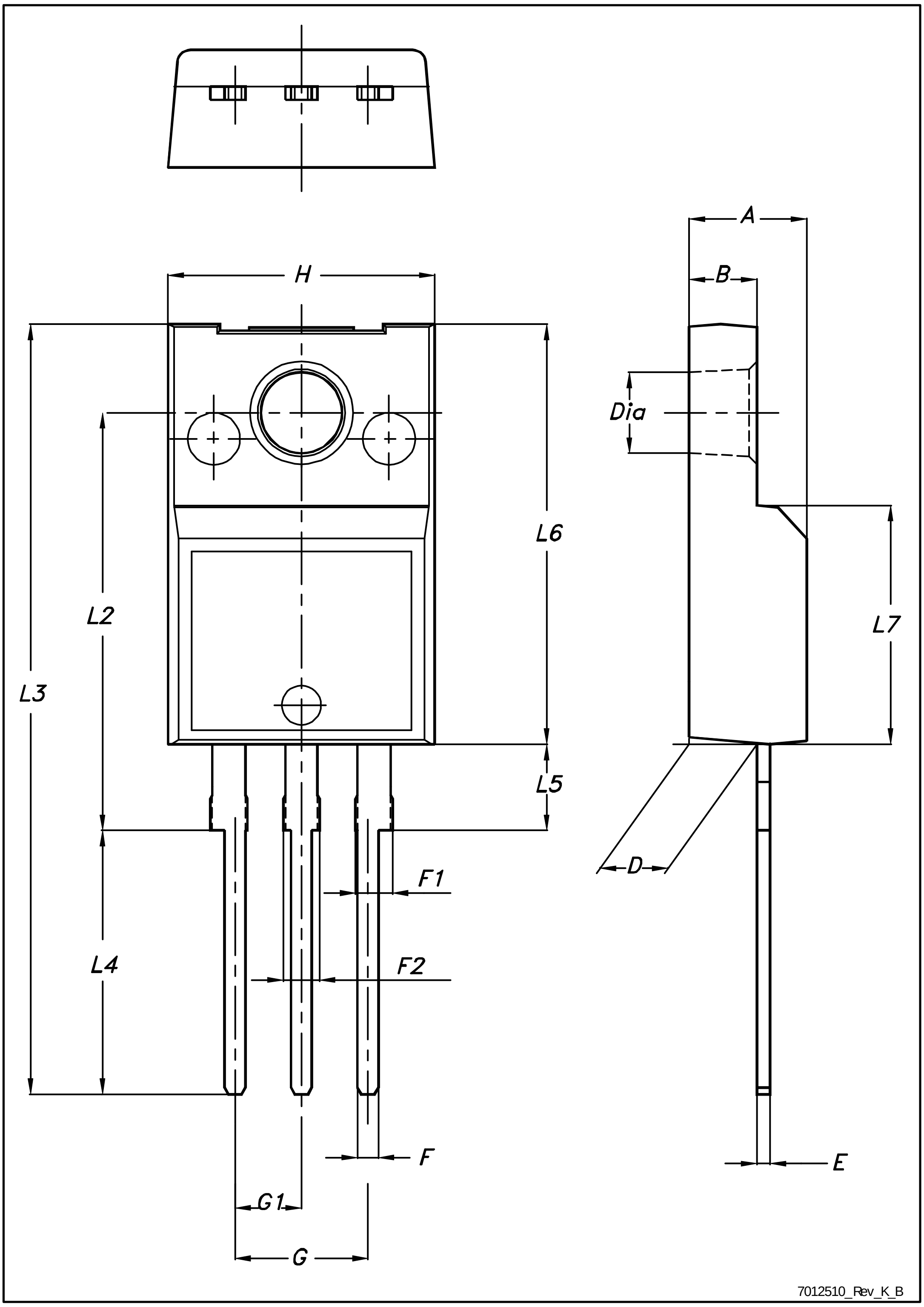


Table 9: TO-220FP package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
17-Dec-2004	2	New template, no content change
05-Aug-2005	3	Some values changed in table 6
02-Dec-2015	4	Text and formatting changes throughout document On cover page: - updated Title, Features and Description Added Electrical ratings section heading In section Electrical ratings: - updated tables Absolute Maximum ratings and Thermal Data In section Electrical characteristics: - updated table Static characteristics Added section Package information Updated TO-220FP package information

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