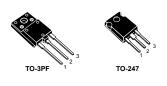


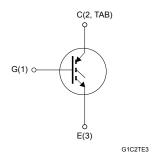
# STGFW40H65FB, STGW40H65FB, STGWA40H65FB

**Datasheet** 

## Trench gate field-stop 650 V, 40 A high speed HB series IGBT







#### **Features**

- Maximum junction temperature: T<sub>J</sub> = 175 °C
- · High speed switching series
- · Minimized tail current
- Very low saturation voltage:  $V_{CE(sat)} = 1.6 \text{ V (typ)} \otimes I_C = 40 \text{ A}$
- · Safe paralleling
- Tight parameter distribution
- · Low thermal resistance

#### **Applications**

- Welding
- Power factor correction
- UPS
- Solar inverters
- Chargers

### **Description**

These devices are IGBTs developed using an advanced proprietary trench gate field-stop structure. These devices are part of the new HB series of IGBTs, which represent an optimum compromise between conduction and switching loss to maximize the efficiency of any frequency converter. Furthermore, the slightly positive  $V_{\text{CE}(\text{sat})}$  temperature coefficient and very tight parameter distribution result in safer paralleling operation.



Product status link
STGFW40H65FB
STGW40H65FB
STGWA40H65FB



# 1 Electrical ratings

Table 1. Absolute maximum ratings

Complete	Downword or	Value		
Symbol	Parameter	TO-247, TO-247 long leads	TO-3PF	Unit
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GE</sub> = 0 V)	650		V
	Continuous collector current at T <sub>C</sub> = 25 °C	80		
I <sub>C</sub>	Continuous collector current at T <sub>C</sub> = 100 °C	C 40		Α
I <sub>CP</sub> (1)	Pulsed collector current	160		Α
$V_{GE}$	Gate-emitter voltage	±20		V
P <sub>TOT</sub>	Total power dissipation at T <sub>C</sub> = 25 °C	283	98.6	W
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink $(t=1 \text{ s; } T_C=25 \text{ °C})$		3.5	kV
T <sub>STG</sub>	Storage temperature range -55 to 150		°C	
TJ	Operating junction temperature range	-55 to 175		°C

<sup>1.</sup> Pulse width is limited by maximum junction temperature.

Table 2. Thermal data

Symbol	Parameter	Value	Unit	
	Farameter	TO-247, TO-247 long leads	TO-3PF	Onit
R <sub>thJC</sub>	Thermal resistance, junction-to-case	0.53 1.52		°C/W
R <sub>thJA</sub>	Thermal resistance, junction-to-ambient	50		°C/W

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## 2 Electrical characteristics

 $T_C$  = 25 °C unless otherwise specified

**Table 3. Static characteristics** 

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V <sub>(BR)CES</sub>	Collector-emitter breakdown voltage	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 2 mA	650			V
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 40 A		1.6	2	
V <sub>CE(sat)</sub>	Collector-emitter saturation voltage	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 40 A, T <sub>J</sub> = 125 °C		1.7		V
		V <sub>GE</sub> = 15 V, I <sub>C</sub> = 40 A, T <sub>J</sub> = 175 °C		1.8		
V <sub>GE(th)</sub>	Gate threshold voltage	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1 mA	5	6	7	V
I <sub>CES</sub>	Collector cut-off current	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 650 V			25	μA
I <sub>GES</sub>	Gate-emitter leakage current	V <sub>CE</sub> = 0 V, V <sub>GE</sub> = ±20 V			±250	nA

**Table 4. Dynamic characteristics** 

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C <sub>ies</sub>	Input capacitance		-	5412	-	
C <sub>oes</sub>	Output capacitance	V <sub>CE</sub> = 25 V, f = 1 MHz, V <sub>GE</sub> = 0 V	-	198	-	pF
C <sub>res</sub>	Reverse transfer capacitance		-	107	-	
Qg	Total gate charge		-	210	-	
Q <sub>ge</sub>	Gate-emitter charge	$V_{CC}$ = 520 V, $I_{C}$ = 40 A, $V_{GE}$ = 0 to 15 V (see Figure 27. Gate charge test circuit)	-	39	-	nC
Q <sub>gc</sub>	Gate-collector charge		-	82	-	

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Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t <sub>d(on)</sub>	Turn-on delay time		-	40	-	no
t <sub>r</sub>	Current rise time		-	13	-	ns
(di/dt) <sub>on</sub>	Turn-on current slope		-	2413	_	A/µs
t <sub>d(off)</sub>	Turn-off delay time	V <sub>CE</sub> = 400 V, I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V,	-	142	-	no
t <sub>f</sub>	Current fall time	$R_G$ = 5 Ω (see Figure 26. Test circuit for inductive load switching)	-	27	-	ns
E <sub>on</sub> (1)	Turn-on switching energy		-	498	-	
E <sub>off</sub> (2)	Turn-off switching energy		-	363	-	μJ
E <sub>ts</sub>	Total switching energy		-	861	-	
t <sub>d(on)</sub>	Turn-on delay time		-	38	-	
t <sub>r</sub>	Current rise time		-	14	_	ns
(di/dt) <sub>on</sub>	Turn-on current slope		-	2186	_	A/µs
t <sub>d(off)</sub>	Turn-off delay time	$V_{CE}$ = 400 V, $I_{C}$ = 40 A, $V_{GE}$ = 15 V, $R_{G}$ = 5 $\Omega$ , $T_{J}$ = 175 °C (see	-	141	-	
t <sub>f</sub>	Current fall time	Figure 26. Test circuit for inductive load switching)	-	61	_	ns
E <sub>on</sub> (1)	Turn-on switching energy	Switching)	-	1417	-	
E <sub>off</sub> (2)	Turn-off switching energy		-	764	-	μJ
E <sub>ts</sub>	Total switching energy		-	2181	-	

<sup>1.</sup> Including the reverse recovery of the external diode. The diode is the same of the co-packed STGW40H65DFB.

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<sup>2.</sup> Including the tail of the collector current.



#### 2.1 Electrical characteristics (curves)

Figure 1. Power dissipation vs. case temperature for TO-247 and TO-247 long leads

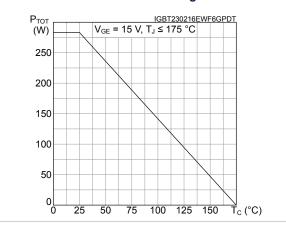


Figure 2. Collector current vs. case temperature for TO-247 and TO-247 long leads

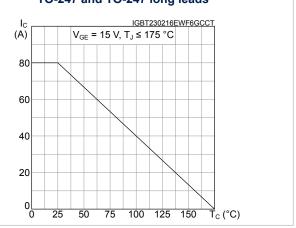


Figure 3. Power dissipation vs. case temperature for TO-3PF

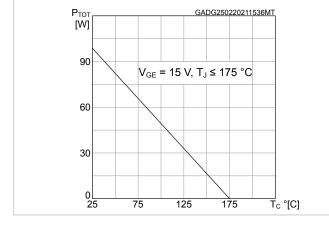


Figure 4. Collector current vs. case temperature for TO-3PF

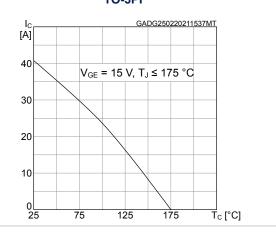


Figure 5. Output characteristics (T<sub>J</sub> = 25 °C)

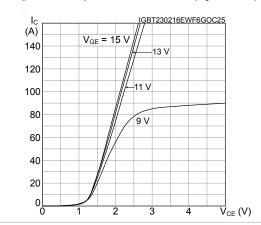
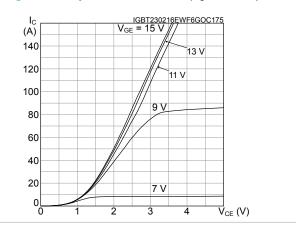


Figure 6. Output characteristics (T<sub>J</sub> = 175 °C)



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Figure 7. V<sub>CE(sat)</sub> vs. junction temperature

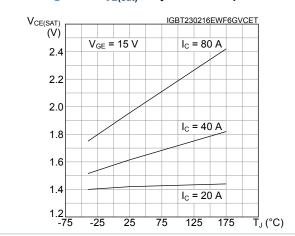


Figure 8. V<sub>CE(sat)</sub> vs. collector current

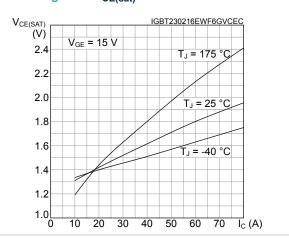


Figure 9. Collector current vs. switching frequency for TO-247 and TO-247 long leads

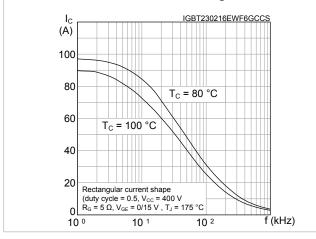


Figure 10. Collector current vs. switching frequency for TO-3PF

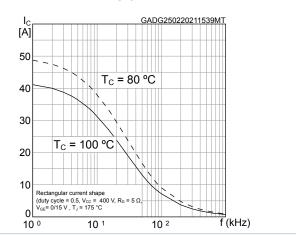


Figure 11. Forward bias safe operating area for TO-247 and TO-247 long leads

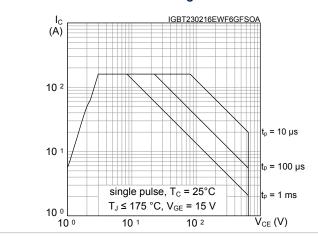
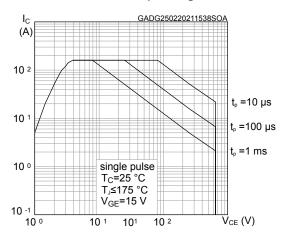


Figure 12. Forward bias safe operating area for TO-3PF



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Figure 13. Transfer characteristics

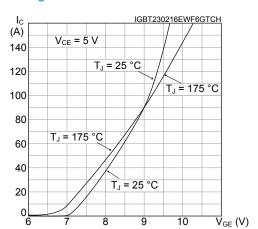


Figure 14. Normalized V<sub>GE(th)</sub> vs. junction temperature

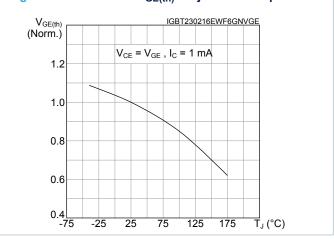


Figure 15. Normalized  $V_{(BR)CES}$  vs. junction temperature

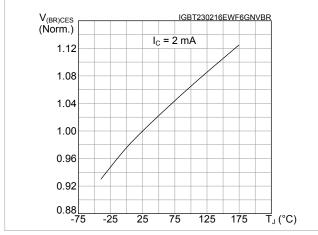


Figure 16. Capacitance variation

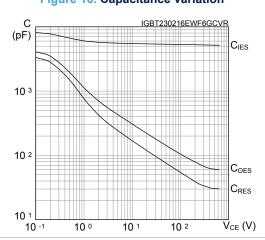


Figure 17. Gate charge vs. gate-emitter voltage

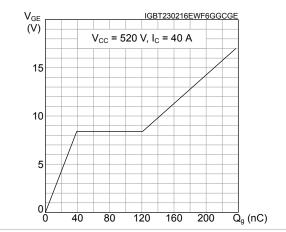
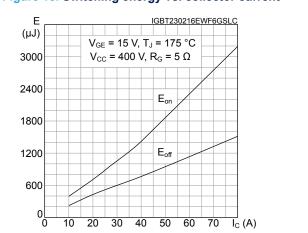


Figure 18. Switching energy vs. collector current



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Figure 19. Switching energy vs. gate resistance

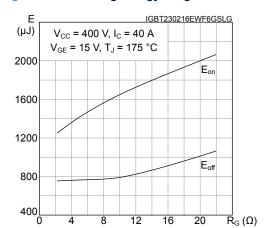


Figure 20. Switching energy vs. temperature

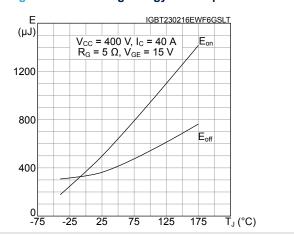


Figure 21. Switching energy vs. collector emitter voltage

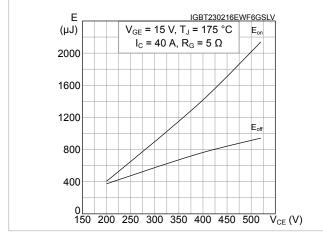


Figure 22. Switching times vs. collector current

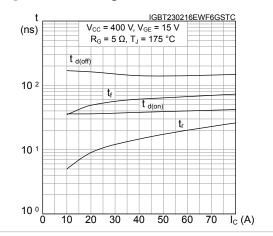
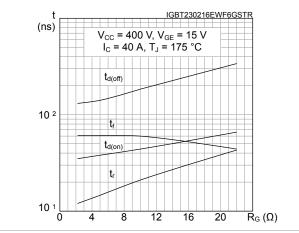
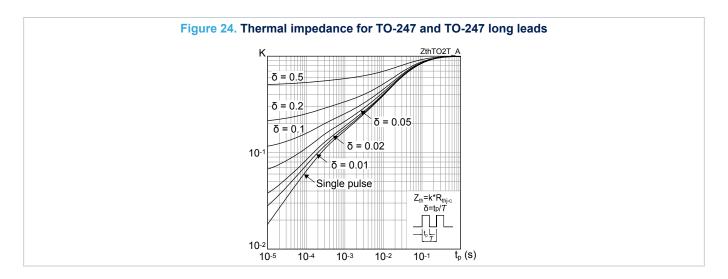


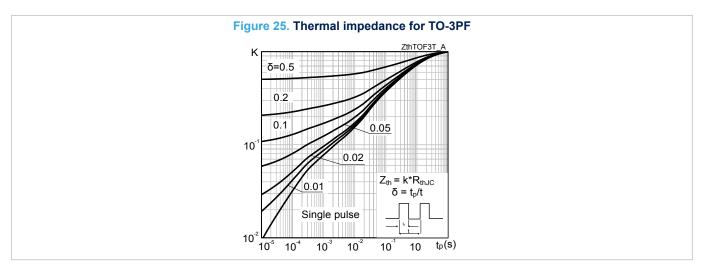
Figure 23. Switching times vs. gate resistance



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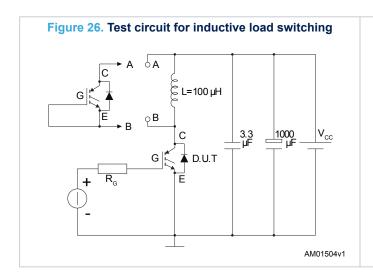


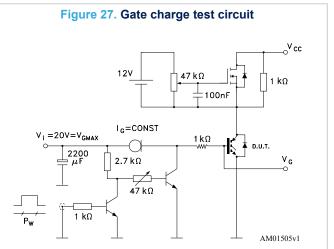


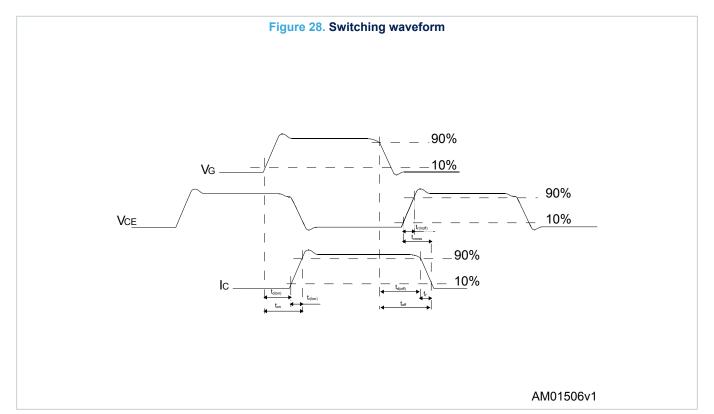
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## 3 Test circuits







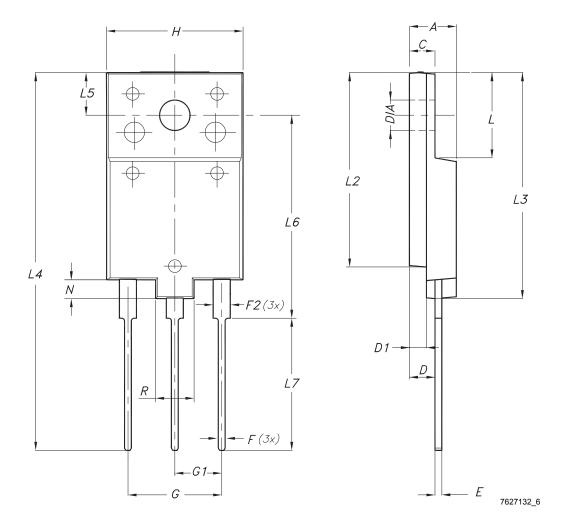


## 4 Package information

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-3PF package information

Figure 29. TO-3PF package outline



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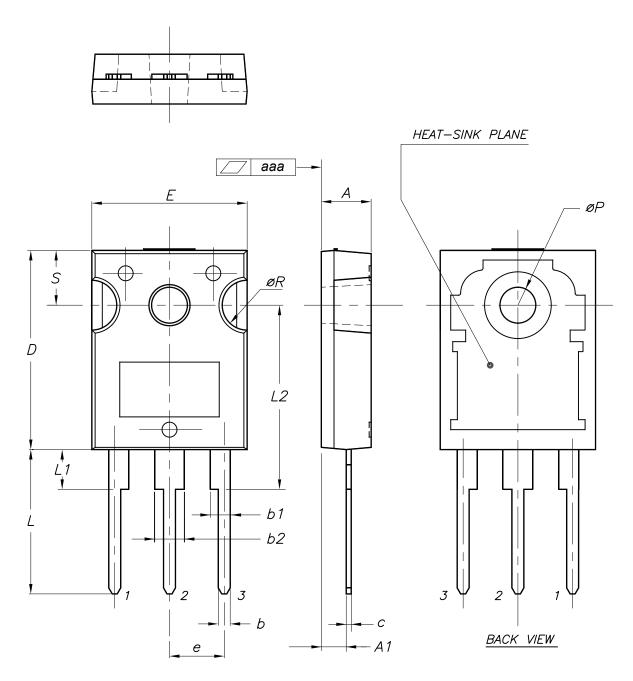
Table 6. TO-3PF mechanical data

Dim		mm	
Dim.	Min.	Тур.	Max.
А	5.30		5.70
С	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
Н	15.30		15.70
L	9.80	10.00	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15.00
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80



## 4.2 TO-247 package information

Figure 30. TO-247 package outline



0075325\_10



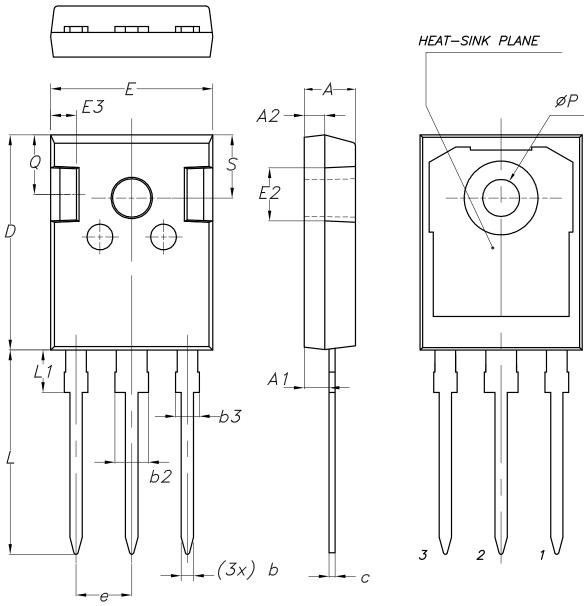
Table 7. TO-247 package mechanical data

Dim.		mm	
Dim.	Min.	Тур.	Max.
Α	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
С	0.40		0.80
D	19.85		20.15
E	15.45		15.75
е	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70
aaa		0.04	0.10



## 4.3 TO-247 long leads package information

Figure 31. TO-247 long leads package outline



8463846\_2\_F



Table 8. TO-247 long leads package mechanical data

Dim.		mm	
Dim.	Min.	Тур.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
С	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
е	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
Р	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

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# 5 Ordering information

Table 9. Order codes

Order code	Marking	Package	Packing
STGFW40H65FB	GFW40H65FB	TO-3PF	
STGW40H65FB	GW40H65FB	TO-247	Tube
STGWA40H65FB	GWA40H65FB	TO-247 long leads	

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## **Revision history**

Table 10. Document revision history

Date	Revision	Changes
30-Aug-2013	1	Initial release
11-Sep-2013	2	Document status changed from preliminary to production data. Inserted Section 2.1: Electrical characteristics (curves).
28-Feb-2014	3	Updated title and description in cover page.
05-Mar-2014	4	Updated units in Table 6: Switching characteristics (inductive load).
11-Apr-2014	5	Added part number and references for the device in a TO-3PF package.
		Added device in TO-247 long leads and updated the document accordingly.
03-Nov-2016	6	Updated Section 2.1: Electrical characteristics (curves) and Section 4.3: TO-247 long leads, package information.
		Minor text changes.
		Updated Table 1: "Device summary".
21-Mar-2017	7	Added Figure 26: "Thermal impedance for TO-3PF".
		Minor text changes
		The part number STGWT40H65FB has been removed and the document has been updated accordingly.
09-Mar-2021	8	Updated title in cover page.
		Updated Section 1 Electrical ratings and Section 2.1 Electrical characteristics (curves).
		Minor text changes

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