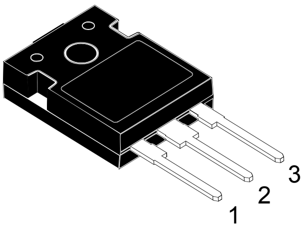
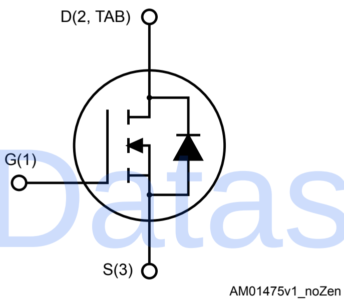
Automotive-grade silicon carbide Power MOSFET 1200 V, 20 A, 189 mΩ (typ., T_J=150 °C), in an HiP247™ package



HiP247™



Product status link
SCT20N120AG

Product summary	
Order code	SCT20N120AG
Marking	
Package	HiP247™
Packing	Tube

Features

- AEC-Q101 qualified
- Very tight variation of on-resistance vs. temperature
- Very high operating temperature capability (T_J = 200 °C)
- Very fast and robust intrinsic body diode
- Low capacitance

Applications

- Motor drives
- EV chargers
- High voltage DC-DC converters
- Switch mode power supplies

Description

This silicon carbide Power MOSFET is produced exploiting the advanced, innovative properties of wide bandgap materials. This results in unsurpassed on-resistance per unit area and very good switching performance almost independent of temperature. The outstanding thermal properties of the SiC material, combined with the device's housing in the proprietary HiP247™ package, allows designers to use an industry-standard outline with significantly improved thermal capability. These features render the device perfectly suitable for high-efficiency and high power density applications.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	1200	V
V_{GS}	Gate-source voltage	-10 to 25	V
I_D	Drain current (continuous) at T_C = 25 °C	20	A
I_D	Drain current (continuous) at T_C = 100 °C	16	A
I_{DM} (1)	Drain current (pulsed)	45	A
P_{TOT}	Total power dissipation at T_C = 25 °C	175	W
T_{stg}	Storage temperature range	-55 to 200	°C
T_j	Operating junction temperature range		°C

1. *Pulse width limited by safe operating area.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	1	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	40	°C/W

2 Electrical characteristics

(T_{CASE} = 25 °C unless otherwise specified).

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	1200			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 1200 V			10	µA
		V_{GS} = 0 V, V_{DS} = 1200 V, T_J = 200 °C		50		
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = -10 to 25 V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 1 mA	2	3.5		V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 20 V, I_D = 10 A		169	239	mΩ
		V_{GS} = 20 V, I_D = 10 A, T_J = 150 °C		189		
		V_{GS} = 20 V, I_D = 10 A, T_J = 200 °C		220		

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 400 V, f = 1 MHz, V_{GS} = 0 V	-	650	-	pF
C_{oss}	Output capacitance		-	65	-	pF
C_{rss}	Reverse transfer capacitance		-	14	-	pF
Q_g	Total gate charge	V_{DD} = 800 V, I_D = 10 A, V_{GS} = 0 to 20 V	-	45	-	nC
Q_{gs}	Gate-source charge		-	7	-	nC
Q_{gd}	Gate-drain charge		-	11.7	-	nC
R_g	Gate input resistance	f=1 MHz, I_D = 0 A	-	7	-	Ω

Table 5. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on}	Turn-on switching energy	V_{DD} = 800 V, I_D = 10 A R_G= 6.8 Ω, V_{GS} = -2 to 20 V	-	160	-	µJ
E_{off}	Turn-off switching energy		-	90	-	µJ
E_{on}	Turn-on switching energy	V_{DD} = 800 V, I_D = 10 A R_G= 6.8 Ω, V_{GS} = -2 to 20 V, T_J= 150 °C	-	165	-	µJ
E_{off}	Turn-off switching energy		-	100	-	µJ

Table 6. **Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)V}$	Turn-on delay time	V_{DD} = 800 V, I_D = 10 A, R_G = 0 Ω, V_{GS} = 0 to 20 V	-	10	-	ns
$t_{f(V)}$	Fall time		-	17	-	ns
$t_{d(off)V}$	Turn-off delay time		-	27	-	ns
$t_{r(V)}$	Rise time		-	16	-	ns

Table 7. **Reverse SiC diode characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD}	Diode forward voltage	I_F = 5 A, V_{GS} = -5 V	-	3.6	-	V
t_{rr}	Reverse recovery time	I_{SD} =10 A, V_{GS} = -5 V, V_R = 800 V, dif/dt = 1650 A/µs	-	15	-	ns
Q_{rr}	Reverse recovery charge		-	75	-	nC
I_{rrm}	Peak reverse recovery current		-	8	-	A

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

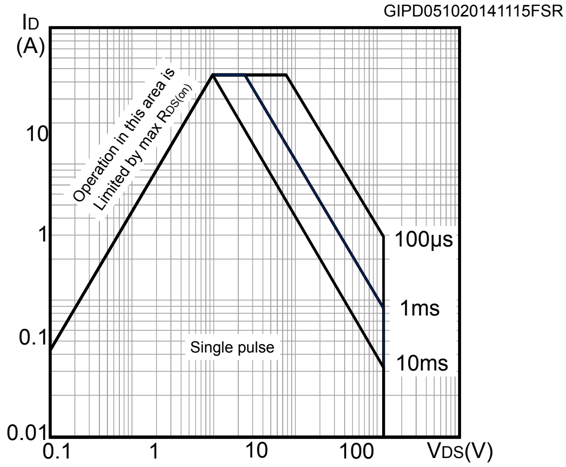


Figure 2. Thermal impedance

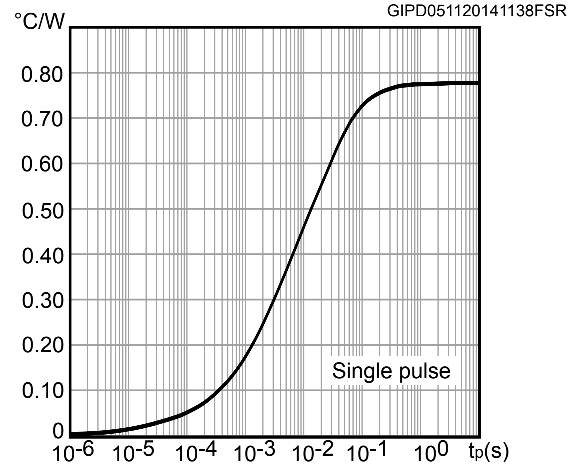


Figure 3. Output characteristics @ T_J = 25 °C

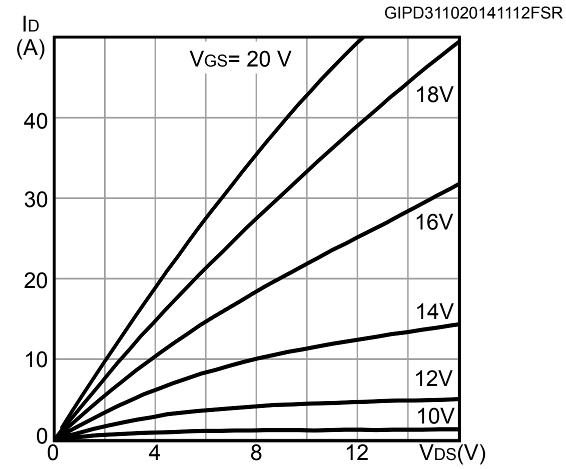


Figure 4. Output characteristics @ T_J = 200 °C

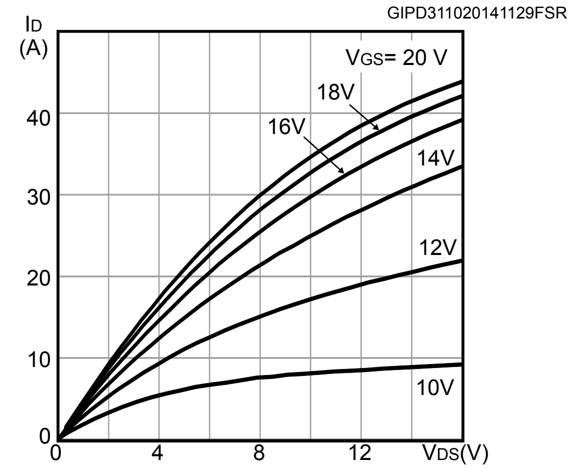


Figure 5. Transfer characteristics

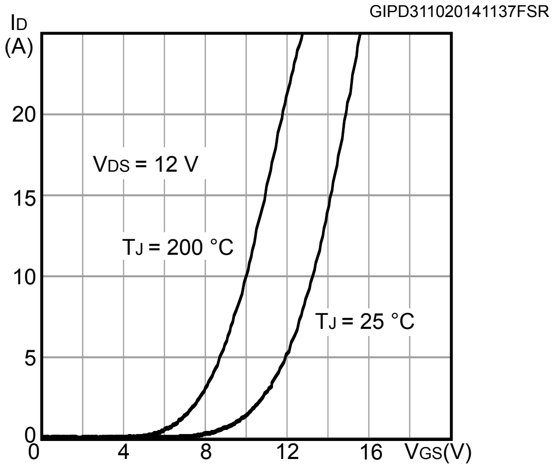


Figure 6. Body diode characteristics @ T_J = -50 °C

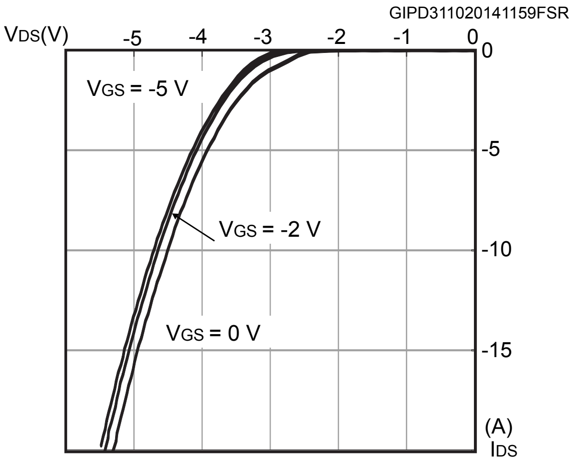


Figure 7. Body diode characteristics @ T_J = 25 °C

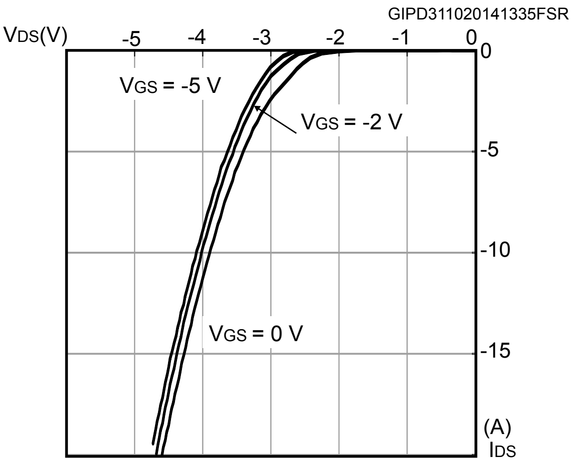


Figure 8. Body diode characteristics @ T_J = 150 °C

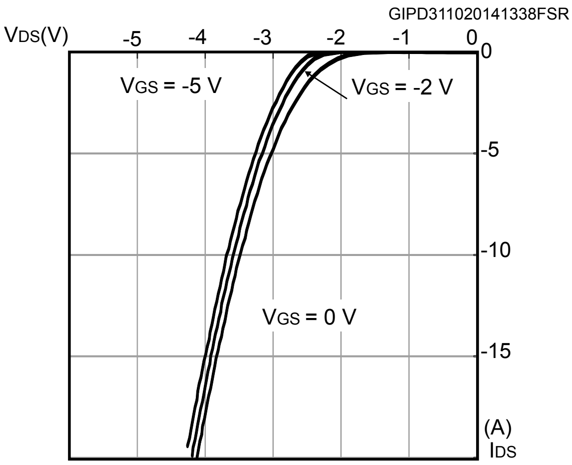


Figure 9. 3rd quadrant characteristics @ T_J = -50 °C

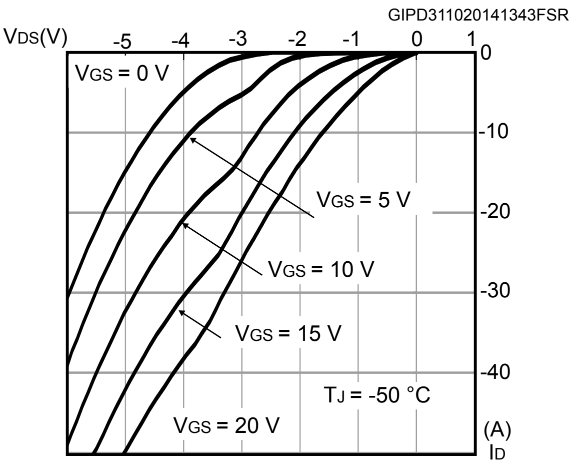


Figure 10. 3rd quadrant characteristics @ T_J = 25 °C

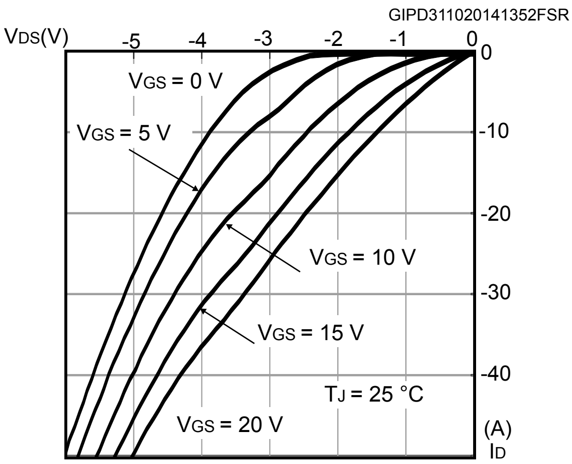


Figure 11. 3rd quadrant characteristics @ T_J = 150 °C

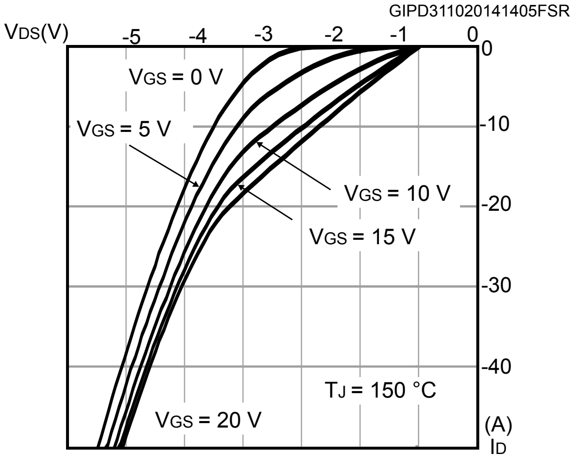


Figure 12. Normalized V_{TH} vs. temperature

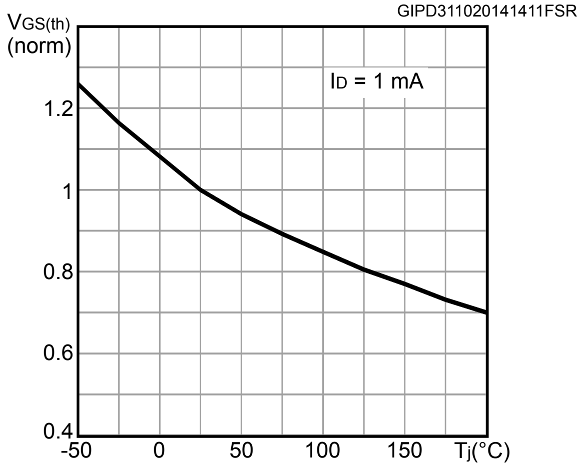


Figure 13. Normalized $R_{DS(on)}$ vs. temperature

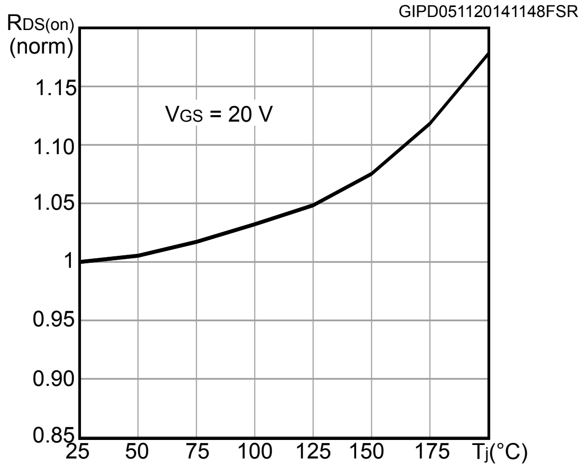
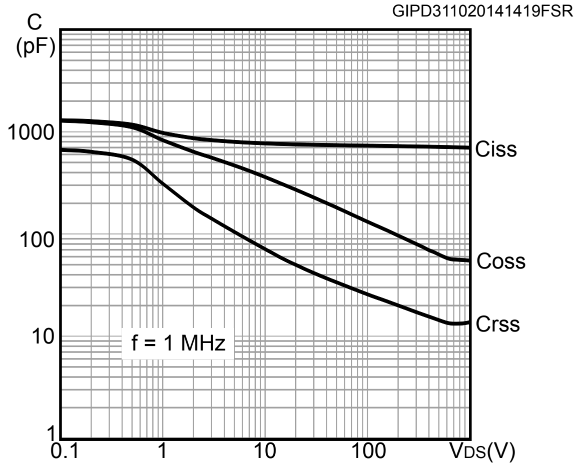


Figure 14. Capacitances variation



3 Test circuits

Figure 15. **Switching test waveforms for transition times**

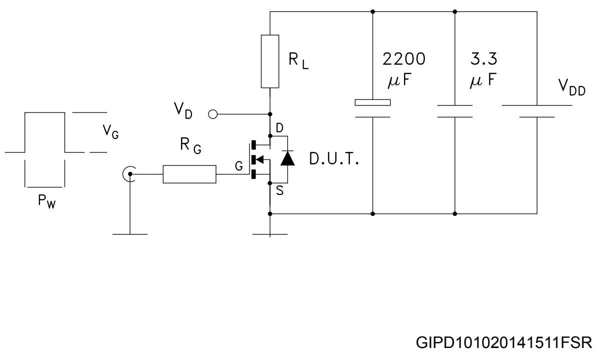
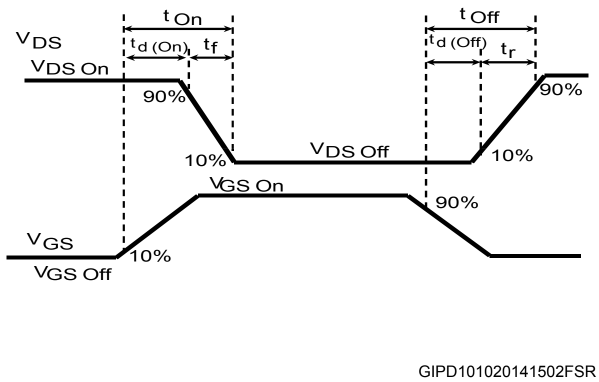


Figure 16. **Clamped inductive switching waveform**



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 HiP247 package information

Figure 17. HiP247™ package outline

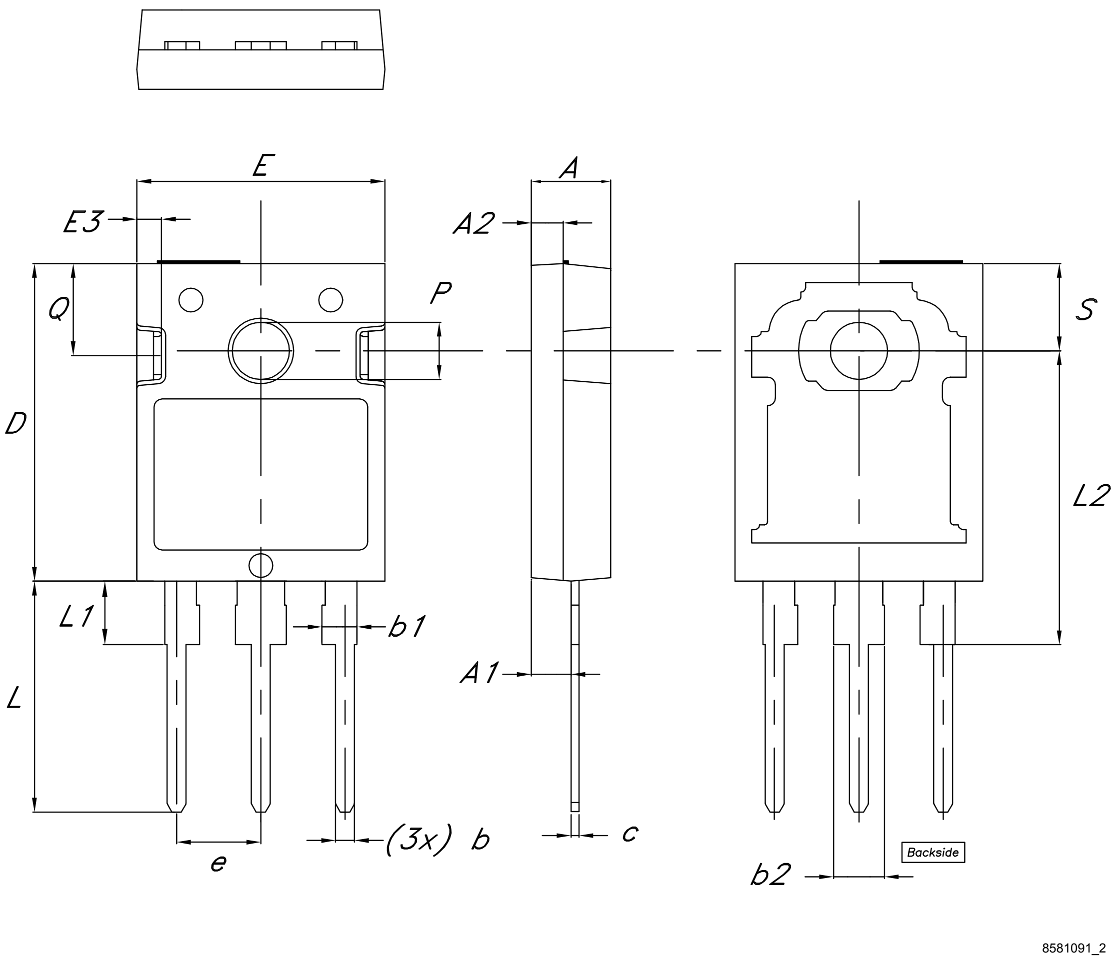


Table 8. **HiP247™ package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85	5.00	5.15
A1	2.20		2.60
A2	1.90	2.00	2.10
b	1.00		1.40
b1	2.00		2.40
b2	3.00		3.40
c	0.40		0.80
D	19.85	20.00	20.15
E	15.45	15.60	15.75
E3	1.45		1.65
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2	18.30	18.50	18.70
P	3.55		3.65
Q	5.65		5.95
S	5.30	5.50	5.70

Revision history

Table 9. Document revision history

Date	Revision	Changes
21-Mar-2018	1	First release
01-Mar-2019	2	Updated Table 3. On/off states. Updated package information.

Contents