

## GENERAL DESCRIPTION

The SGM33685C is a power amplifier (PA) which can support 350MHz to 400MHz, 450MHz to 460MHz and 470MHz to 510MHz. The device uses advanced InGaP/GaAs HBT (heterojunction bipolar transistor) process, so it features high linearity, high efficiency and high ruggedness.

The SGM33685C is available in a Green TQFN-3×3-16L package.

## APPLICATIONS

Repeater  
ISM Band PA  
LTE Femtocell

## FEATURES

- **Supply Voltage: 3.3V and 5V**
- **Signal Gain at 5V:**
  - 34dB at 350MHz to 400MHz
  - 37dB at 450MHz to 460MHz
  - 36dB at 470MHz to 510MHz
- **Signal Gain at 3.3V:**
  - 33dB at 350MHz to 400MHz
  - 37dB at 450MHz to 460MHz
  - 35dB at 470MHz to 510MHz
- **P<sub>1dB</sub> Output Power at 5V:**
  - 31.5dBm at 350MHz to 400MHz
  - 33dBm at 450MHz to 460MHz
  - 32dBm at 470MHz to 510MHz
- **P<sub>1dB</sub> Output Power at 3.3V:**
  - 29.0dBm at 350MHz to 400MHz
  - 30.5dBm at 450MHz to 460MHz
  - 28.5dBm at 470MHz to 510MHz
- **On-Chip 50Ω Matching for Input Port**
- **Available in a Green TQFN-3×3-16L Package**

## BLOCK DIAGRAM

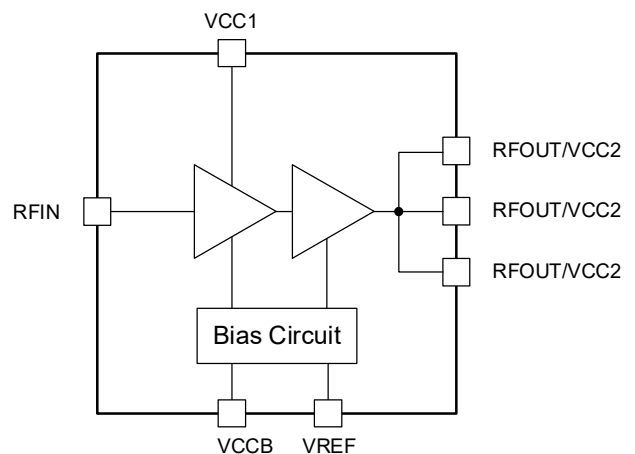


Figure 1. SGM33685C Block Diagram

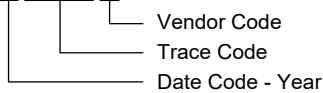
**PACKAGE/ORDERING INFORMATION**

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM33685C	TQFN-3x3-16L	-40°C to +105°C	SGM33685CGTQ16G/TR	0AJTQ XXXXX	Tape and Reel, 4000

**MARKING INFORMATION**

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.

**XXXXX**



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

**ABSOLUTE MAXIMUM RATINGS**

- Supply Voltage,  $V_{CC}$ ..... 5.5V
- Bias Control Voltage,  $V_{REF}$ ..... 3.2V
- RFIN, Under 50Ω Output Terminated,  $P_{IN}$  ..... 10dBm
- Storage Temperature Range ..... -40°C to +150°C
- Lead Temperature (Soldering, 10s) ..... +260°C
- ESD Susceptibility
- HBM..... 1000V

**RECOMMENDED OPERATING CONDITIONS**

- Operating Temperature Range ..... -40°C to +105°C
- Operating Frequency Range 1..... 350MHz to 400MHz
- Operating Frequency Range 2..... 450MHz to 460MHz
- Operating Frequency Range 3..... 470MHz to 510MHz
- Supply Voltage Range,  $V_{CC1}$ ,  $V_{CC2}$ ,  $V_{CCB}$  ..... 3.3V to 5.0V
- Bias Control Voltage,  $V_{REF}$  ..... 2.5V to 2.9V

**OVERSTRESS CAUTION**

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

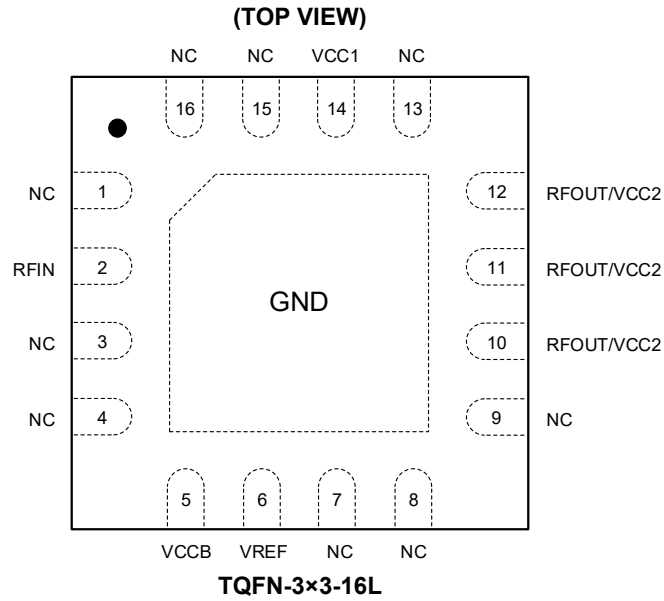
**ESD SENSITIVITY CAUTION**

This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

**DISCLAIMER**

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

**PIN CONFIGURATION**



**PIN DESCRIPTION**

PIN	NAME	FUNCTION
1, 3, 4, 7, 8, 9, 13, 15, 16	NC	No Connection. These pins cannot be connected to ground.
2	RFIN	RF Input.
5	VCCB	Power Supply for Bias Control Circuit.
6	VREF	Bias Control Voltage.
10, 11, 12	RFOUT/VCC2	RF Output and Power Supply for Power Stage-2. These pins are connected internally.
14	VCC1	Power Supply for Power Stage-1.
Exposed Pad	GND	Ground. Exposed pad must be connected to ground.

**ELECTRICAL CHARACTERISTICS**(T<sub>A</sub> = +25°C, 50Ω system with V<sub>CC1</sub> = V<sub>CC2</sub> = V<sub>CCB</sub> = 5V and 3.3V, V<sub>REF</sub> = 2.8V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>Characteristics at V<sub>CC</sub> = 5V, Frequency = 350MHz ~ 400MHz</b>						
Frequency Range	f <sub>0</sub>		350	375	400	MHz
Small Signal Gain	G	P <sub>IN</sub> = -30dBm	32.5	34		dB
1dB Output Compression Point	P <sub>1dB</sub>	1dB gain compression at 375MHz, CW		31.5		dBm
Power Added Efficiency	PAE	P <sub>OUT</sub> = 30dBm		26		%
Current Consumption	I <sub>CC</sub>	Quiescent (no RF)		107	140	mA
		P <sub>OUT</sub> = 30dBm		757	795	
Bias Current	I <sub>REF</sub>	Quiescent (no RF)		3		mA
Input Return Loss	RL <sub>I</sub>	P <sub>IN</sub> = -20dBm		-15		dB
Output Return Loss	RL <sub>O</sub>	P <sub>IN</sub> = -20dBm		-3		dB
2 <sup>nd</sup> Harmonics	2f <sub>0</sub>	f <sub>0</sub> = 375MHz, P <sub>OUT</sub> = 30dBm		-5		dBm
3 <sup>rd</sup> Harmonics	3f <sub>0</sub>	f <sub>0</sub> = 375MHz, P <sub>OUT</sub> = 30dBm		-31		dBm
Turn On/Off Time	t <sub>S</sub>	50% control to 90/10%RF		200	300	ns
Stability	S	Load VSWR = 6:1, all phase angles, RBW = 1MHz, P <sub>OUT</sub> = 30dBm		-36		dBm
Ruggedness	Ru	No damage or permanent degradation at P <sub>OUT</sub> = 32dBm, all phases angles		10:1		VSWR
<b>Characteristics at V<sub>CC</sub> = 3.3V, Frequency = 350MHz ~ 400MHz</b>						
Frequency Range	f <sub>0</sub>		350	375	400	MHz
Small Signal Gain	G	P <sub>IN</sub> = -30dBm	32	33		dB
1dB Output Compression Point	P <sub>1dB</sub>	1dB gain compression at 375MHz, CW		29		dBm
Power Added Efficiency	PAE	P <sub>OUT</sub> = 27dBm		28		%
Current Consumption	I <sub>CC</sub>	Quiescent (no RF)		96	130	mA
		P <sub>OUT</sub> = 27dBm		542	590	
Bias Current	I <sub>REF</sub>	Quiescent (no RF)		3		mA
Input Return Loss	RL <sub>I</sub>	P <sub>IN</sub> = -20dBm		-15		dB
Output Return Loss	RL <sub>O</sub>	P <sub>IN</sub> = -20dBm		-3		dB
2 <sup>nd</sup> Harmonics	2f <sub>0</sub>	f <sub>0</sub> = 375MHz, P <sub>OUT</sub> = 27dBm		-8		dBm
3 <sup>rd</sup> Harmonics	3f <sub>0</sub>	f <sub>0</sub> = 375MHz, P <sub>OUT</sub> = 27dBm		-34		dBm
Turn On/Off Time	t <sub>S</sub>	50% control to 90/10%RF		200	300	ns

**ELECTRICAL CHARACTERISTICS (continued)**(T<sub>A</sub> = +25°C, 50Ω system with V<sub>CC1</sub> = V<sub>CC2</sub> = V<sub>CCB</sub> = 5V and 3.3V, V<sub>REF</sub> = 2.8V, unless otherwise noted.)

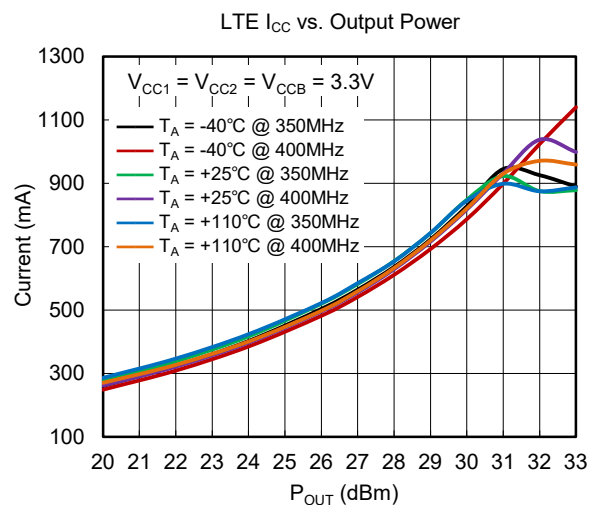
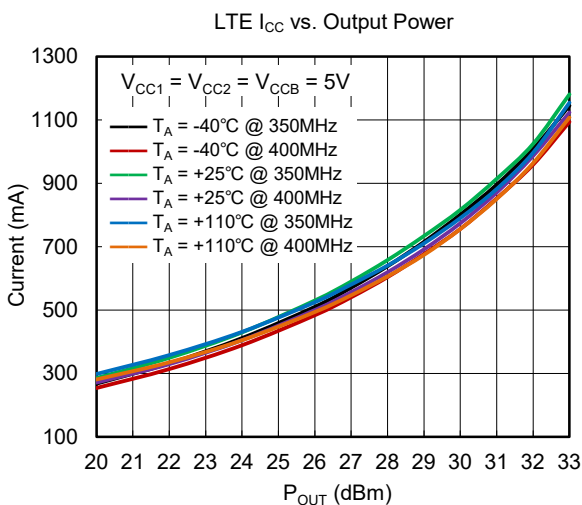
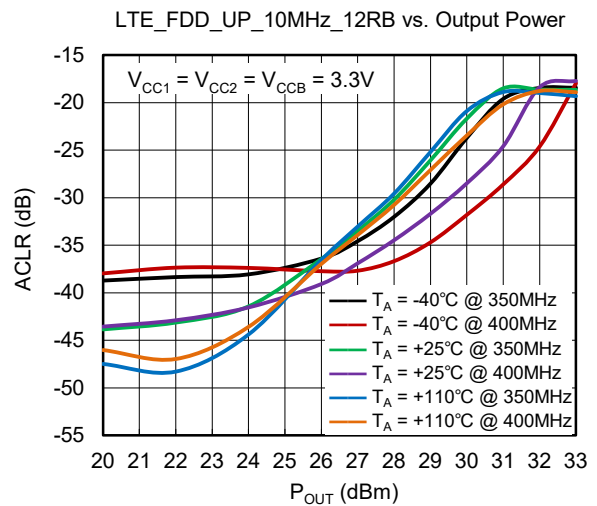
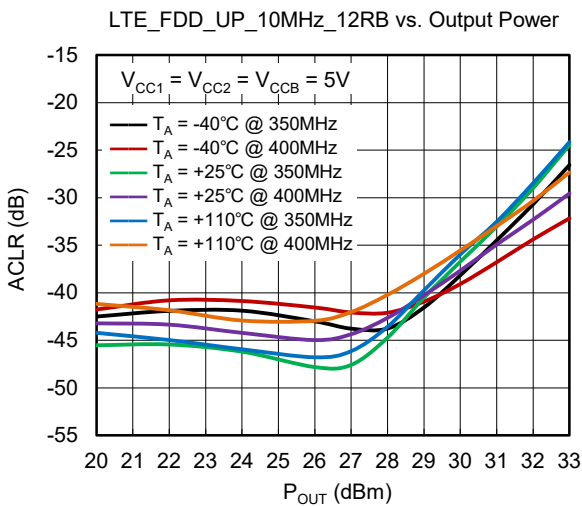
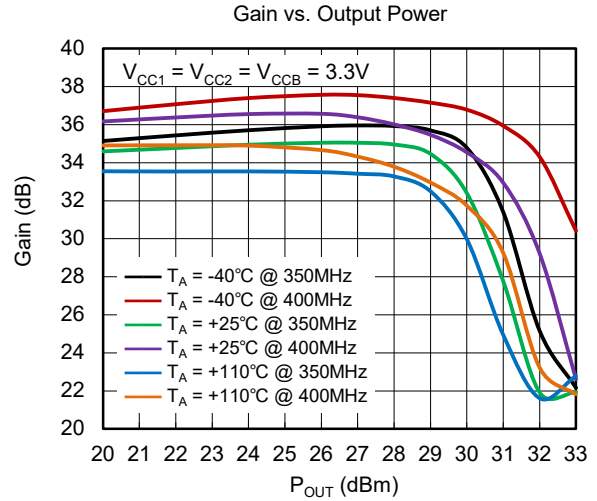
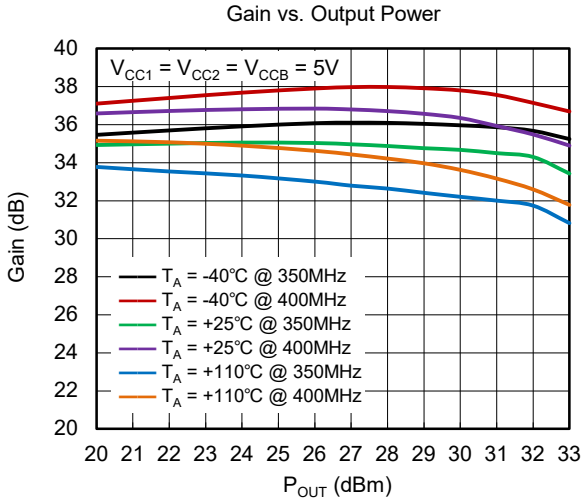
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>Characteristics at V<sub>CC</sub> = 5V, Frequency = 450MHz ~ 460MHz</b>						
Frequency Range	f <sub>0</sub>		450	455	460	MHz
Small Signal Gain	G	P <sub>IN</sub> = -30dBm		37		dB
1dB Output Compression Point	P <sub>1dB</sub>	1dB gain compression at 455MHz, CW		33		dBm
Power Added Efficiency	PAE	P <sub>OUT</sub> = 30dBm		34		%
Current Consumption	I <sub>CC</sub>	Quiescent (no RF)		116		mA
		P <sub>OUT</sub> = 30dBm		580		
Bias Current	I <sub>REF</sub>	Quiescent (no RF)		3		mA
Input Return Loss	RL <sub>I</sub>	P <sub>IN</sub> = -20dBm		-22		dB
Output Return Loss	RL <sub>O</sub>	P <sub>IN</sub> = -20dBm		-4		dB
2 <sup>nd</sup> Harmonics	2f <sub>0</sub>	f <sub>0</sub> = 455MHz, P <sub>OUT</sub> = 30dBm		-3		dBm
3 <sup>rd</sup> Harmonics	3f <sub>0</sub>	f <sub>0</sub> = 455MHz, P <sub>OUT</sub> = 30dBm		-28		dBm
Turn On/Off Time	t <sub>S</sub>	50% control to 90/10%RF		200		ns
Stability	S	Load VSWR = 6:1, all phase angles, RBW = 1MHz, P <sub>OUT</sub> = 30dBm		-36		dBm
Ruggedness	Ru	No damage or permanent degradation at P <sub>OUT</sub> = 32dBm, all phases angles		10:1		VSWR
<b>Characteristics at V<sub>CC</sub> = 3.3V, Frequency = 450MHz ~ 460MHz</b>						
Frequency Range	f <sub>0</sub>		450	455	460	MHz
Small Signal Gain	G	P <sub>IN</sub> = -30dBm		36		dB
1dB Output Compression Point	P <sub>1dB</sub>	1dB gain compression at 455MHz, CW		30.5		dBm
Power Added Efficiency	PAE	P <sub>OUT</sub> = 27dBm		37		%
Current Consumption	I <sub>CC</sub>	Quiescent (no RF)		101		mA
		P <sub>OUT</sub> = 27dBm		410		
Bias Current	I <sub>REF</sub>	Quiescent (no RF)		3		mA
Input Return Loss	RL <sub>I</sub>	P <sub>IN</sub> = -20dBm		-23		dB
Output Return Loss	RL <sub>O</sub>	P <sub>IN</sub> = -20dBm		-4		dB
2 <sup>nd</sup> Harmonics	2f <sub>0</sub>	f <sub>0</sub> = 455MHz, P <sub>OUT</sub> = 27dBm		-6		dBm
3 <sup>rd</sup> Harmonics	3f <sub>0</sub>	f <sub>0</sub> = 455MHz, P <sub>OUT</sub> = 27dBm		-30		dBm
Turn On/Off Time	t <sub>S</sub>	50% control to 90/10%RF		200		ns

**ELECTRICAL CHARACTERISTICS (continued)**(T<sub>A</sub> = +25°C, 50Ω system with V<sub>CC1</sub> = V<sub>CC2</sub> = V<sub>CCB</sub> = 5V and 3.3V, V<sub>REF</sub> = 2.8V, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>Characteristics at V<sub>CC</sub> = 5V, Frequency = 470MHz ~ 510MHz</b>						
Frequency Range	f <sub>0</sub>		470	490	510	MHz
Small Signal Gain	G	P <sub>IN</sub> = -30dBm		36		dB
1dB Output Compression Point	P <sub>1dB</sub>	1dB gain compression at 490MHz, CW		32		dBm
Power Added Efficiency	PAE	P <sub>OUT</sub> = 30dBm		34		%
Current Consumption	I <sub>CC</sub>	Quiescent (no RF)		105		mA
		P <sub>OUT</sub> = 30dBm		590		
Bias Current	I <sub>REF</sub>	Quiescent (no RF)		1.5		mA
Input Return Loss	RL <sub>I</sub>	P <sub>IN</sub> = -20dBm		-22		dB
Output Return Loss	RL <sub>O</sub>	P <sub>IN</sub> = -20dBm		-4		dB
2 <sup>nd</sup> Harmonics	2f <sub>0</sub>	f <sub>0</sub> = 455MHz, P <sub>OUT</sub> = 30dBm		-14		dBm
3 <sup>rd</sup> Harmonics	3f <sub>0</sub>	f <sub>0</sub> = 455MHz, P <sub>OUT</sub> = 30dBm		-22		dBm
Turn On/Off Time	t <sub>S</sub>	50% control to 90/10%RF		200		ns
Stability	S	Load VSWR = 6:1, all phase angles, RBW = 1MHz, P <sub>OUT</sub> = 30dBm		-36		dBm
Ruggedness	Ru	No damage or permanent degradation at P <sub>OUT</sub> = 32dBm, all phases angles		10:1		VSWR
<b>Characteristics at V<sub>CC</sub> = 3.3V, Frequency = 470MHz ~ 510MHz</b>						
Frequency Range	f <sub>0</sub>		470	490	510	MHz
Small Signal Gain	G	P <sub>IN</sub> = -30dBm		35		dB
1dB Output Compression Point	P <sub>1dB</sub>	1dB gain compression at 490MHz, CW		28.5		dBm
Power Added Efficiency	PAE	P <sub>OUT</sub> = 27dBm		37		%
Current Consumption	I <sub>CC</sub>	Quiescent (no RF)		92		mA
		P <sub>OUT</sub> = 27dBm		417		
Bias Current	I <sub>REF</sub>	Quiescent (no RF)		1.5		mA
Input Return Loss	RL <sub>I</sub>	P <sub>IN</sub> = -20dBm		-23		dB
Output Return Loss	RL <sub>O</sub>	P <sub>IN</sub> = -20dBm		-4		dB
2 <sup>nd</sup> Harmonics	2f <sub>0</sub>	f <sub>0</sub> = 455MHz, P <sub>OUT</sub> = 27dBm		-17		dBm
3 <sup>rd</sup> Harmonics	3f <sub>0</sub>	f <sub>0</sub> = 455MHz, P <sub>OUT</sub> = 27dBm		-25		dBm
Turn On/Off Time	t <sub>S</sub>	50% control to 90/10%RF		200		ns

TYPICAL PERFORMANCE CHARACTERISTICS

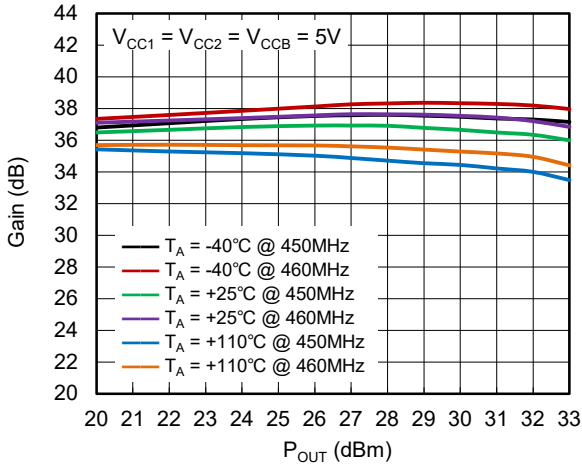
T<sub>A</sub> = +25°C, 50Ω system with V<sub>CC1</sub> = V<sub>CC2</sub> = V<sub>CCB</sub> = 5V and 3.3V, V<sub>REF</sub> = 2.8V, frequency = 350MHz to 400MHz, unless otherwise noted.



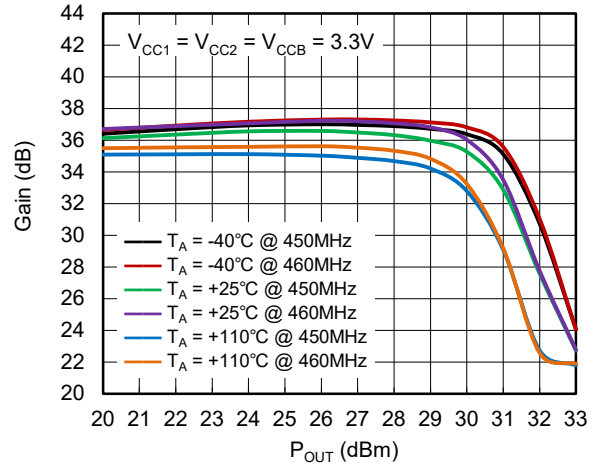
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T<sub>A</sub> = +25°C, 50Ω system with V<sub>CC1</sub> = V<sub>CC2</sub> = V<sub>CCB</sub> = 5V and 3.3V, V<sub>REF</sub> = 2.8V, frequency = 450MHz to 460MHz, unless otherwise noted.

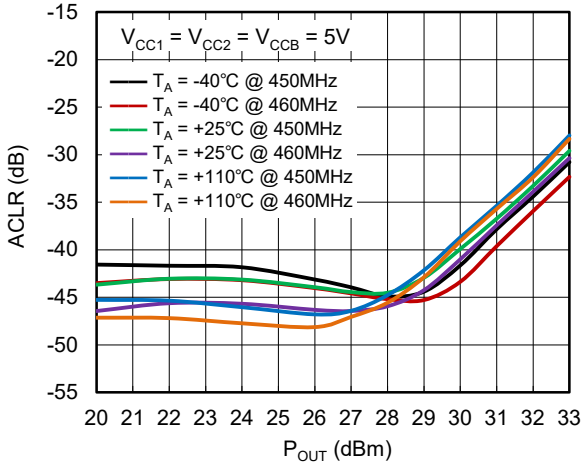
Gain vs. Output Power



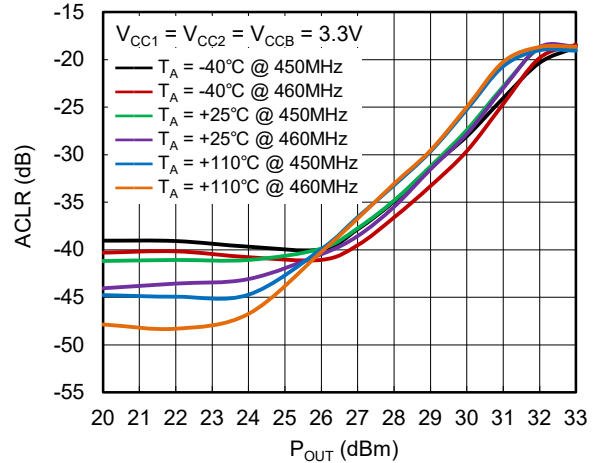
Gain vs. Output Power



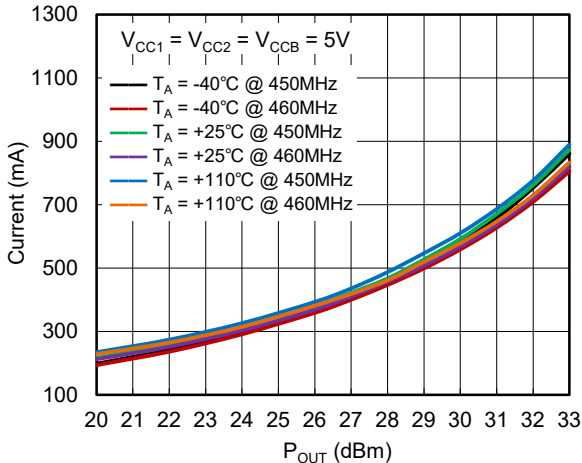
LTE\_FDD\_UP\_10MHz\_12RB vs. Output Power



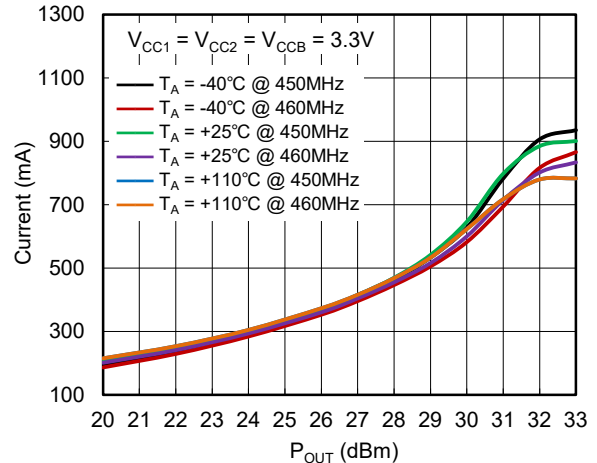
LTE\_FDD\_UP\_10MHz\_12RB vs. Output Power



LTE I<sub>CC</sub> vs. Output Power



LTE I<sub>CC</sub> vs. Output Power

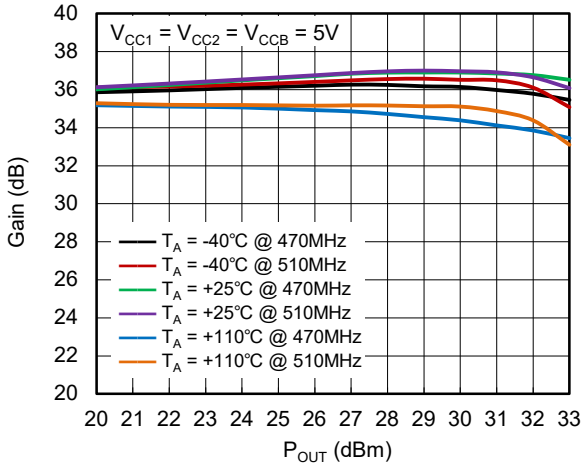




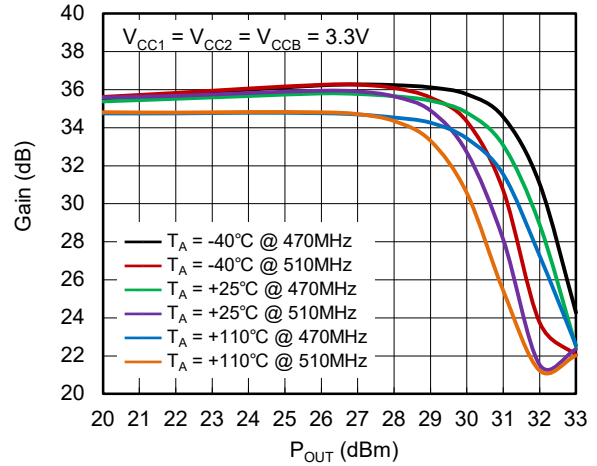
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T<sub>A</sub> = +25°C, 50Ω system with V<sub>CC1</sub> = V<sub>CC2</sub> = V<sub>CCB</sub> = 5V and 3.3V, V<sub>REF</sub> = 2.8V, frequency = 470MHz to 510MHz, unless otherwise noted.

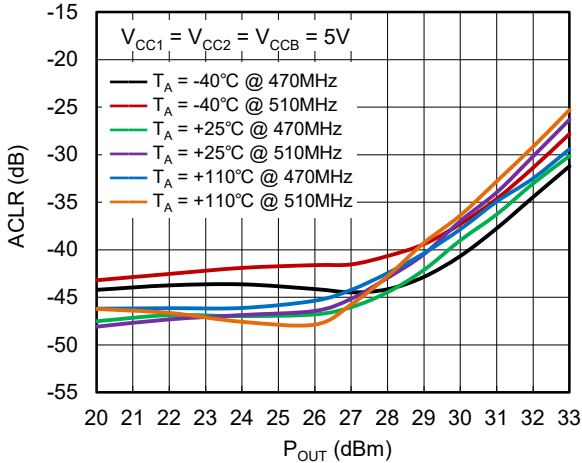
Gain vs. Output Power



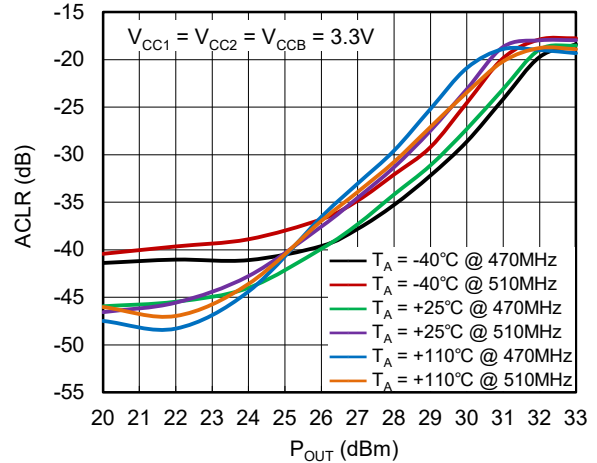
Gain vs. Output Power



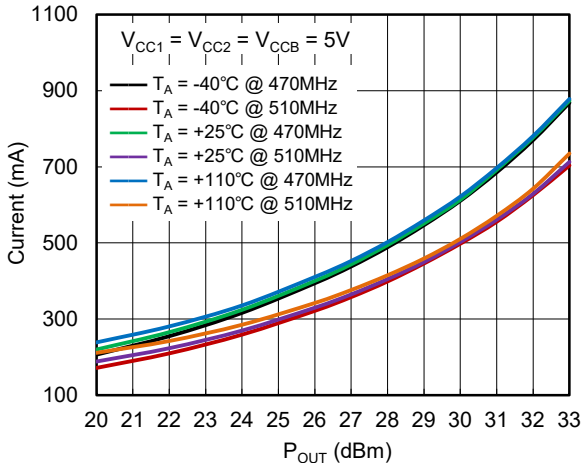
LTE\_FDD\_UP\_10MHz\_12RB vs. Output Power



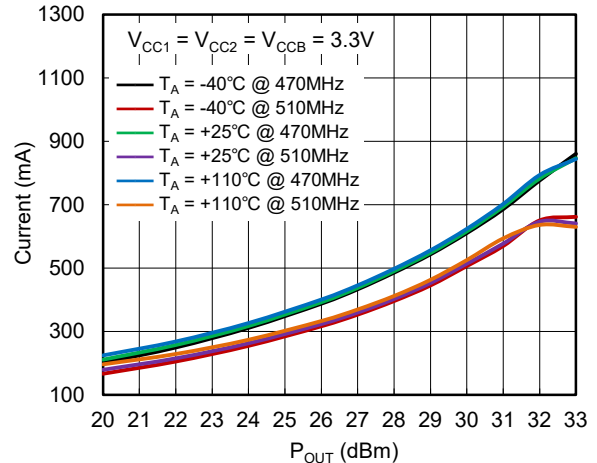
LTE\_FDD\_UP\_10MHz\_12RB vs. Output Power



LTE I<sub>CC</sub> vs. Output Power



LTE I<sub>CC</sub> vs. Output Power



TYPICAL APPLICATION CIRCUIT

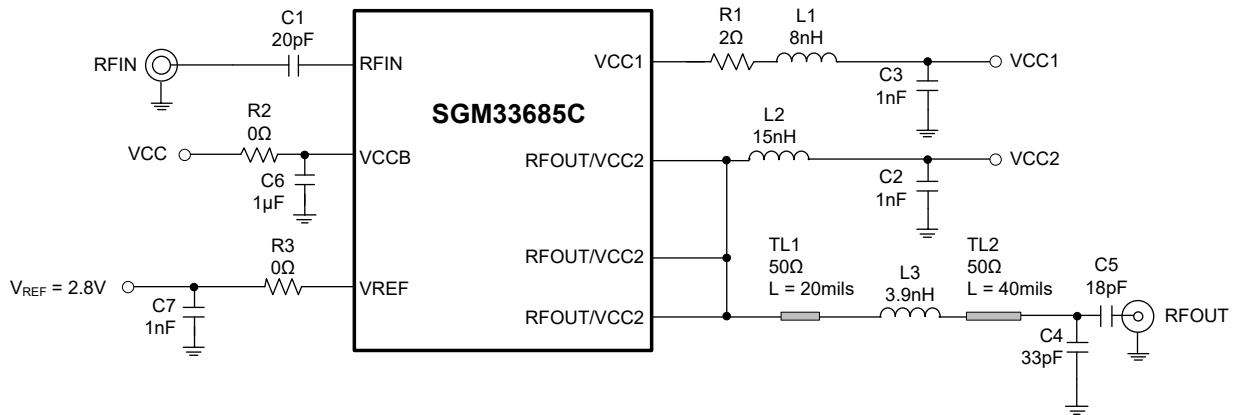


Figure 2. SGM33685C Typical Application Circuit for Frequency = 350MHz to 400MHz

Table 1. Evaluation Board Bill of Material for 350MHz to 400MHz

COMPONENT	VALUE	DESCRIPTION
IC		SGM33685C
C1	20pF	Matching capacitor
C2, C3, C7	1nF	De-coupling capacitor
C6	1μF	De-coupling capacitor
C4	33pF	Matching capacitor (GJM)
C5	18pF	DC blocking capacitor (GJM)
R2, R3	0Ω	
R1	2Ω	
L1	8nH	RF choke inductor
L2	15nH	RF choke inductor (size 0603)
L3	3.9nH	Matching inductor

TYPICAL APPLICATION CIRCUIT (continued)

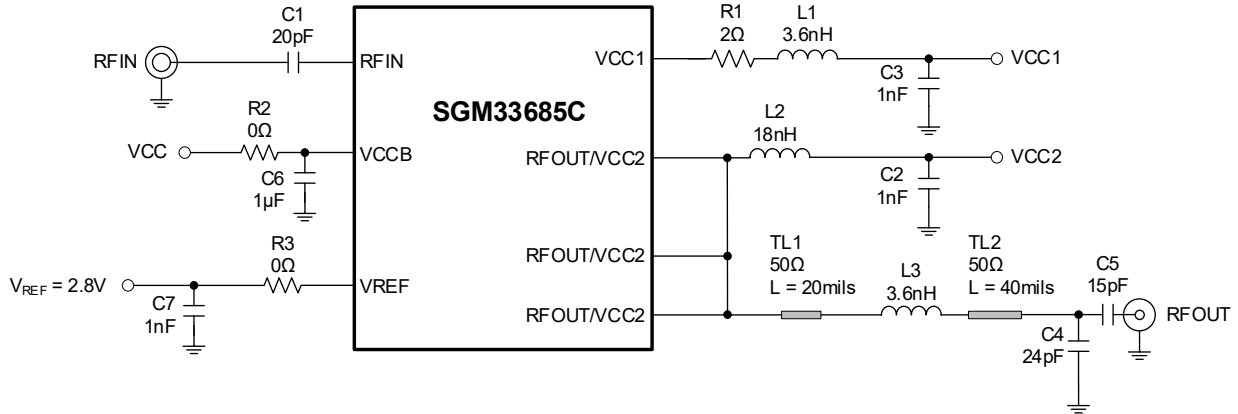


Figure 3. SGM33685C Typical Application Circuit for Frequency = 450MHz to 460MHz

Table 2. Evaluation Board Bill of Material for 450MHz to 460MHz

COMPONENT	VALUE	DESCRIPTION
IC		SGM33685C
C1	20pF	Matching capacitor
C2, C3, C7	1nF	De-coupling capacitor
C6	1μF	De-coupling capacitor
C4	24pF	Matching capacitor (GJM)
C5	15pF	DC blocking capacitor (GJM)
R2, R3	0Ω	
R1	2Ω	
L1	3.6nH	RF choke inductor
L2	18nH	RF choke inductor (size 0603)
L3	3.6nH	Matching inductor

TYPICAL APPLICATION CIRCUIT (continued)

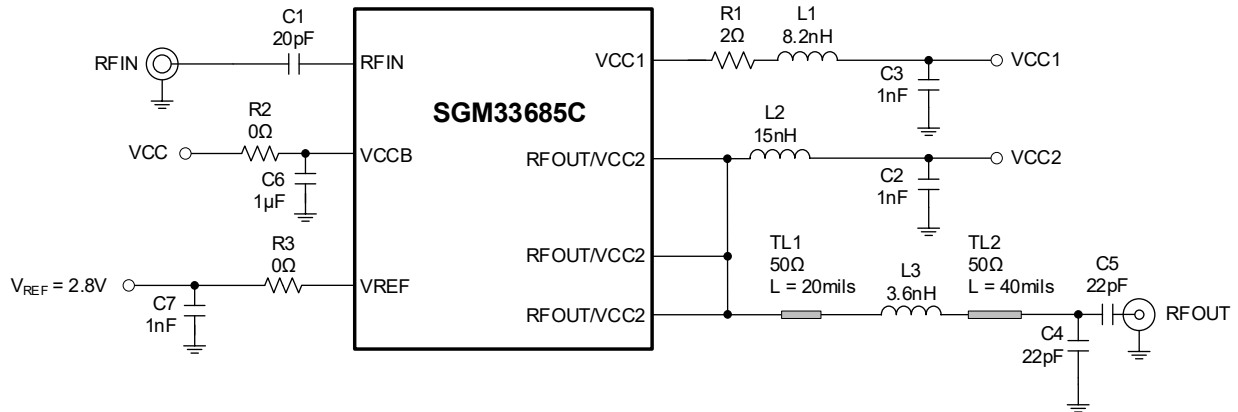


Figure 4. SGM33685C Typical Application Circuit for Frequency = 470MHz to 510MHz

Table 3. Evaluation Board Bill of Material for 470MHz to 510MHz

COMPONENT	VALUE	DESCRIPTION
IC		SGM33685C
C1	20pF	Matching capacitor
C2, C3, C7	1nF	De-coupling capacitor
C6	1μF	De-coupling capacitor
C4, C5	22pF	Matching capacitor (GJM)
R2, R3	0Ω	
R1	2Ω	
L1	8.2nH	RF choke inductor
L2	15nH	RF choke inductor (size 0603)
L3	3.6nH	Matching inductor

EVALUATION BOARD LAYOUT

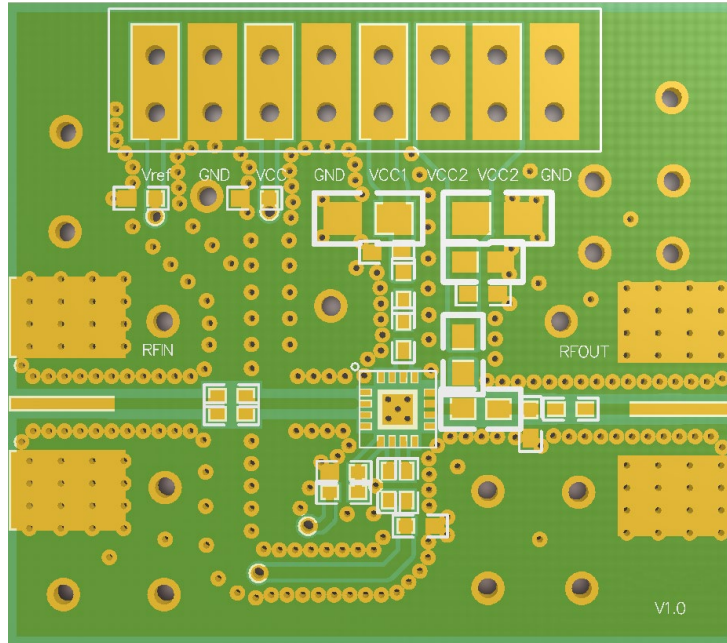


Figure 5. Evaluation Board Layout

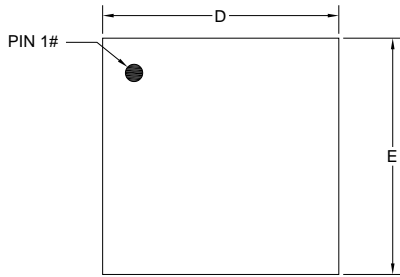
REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

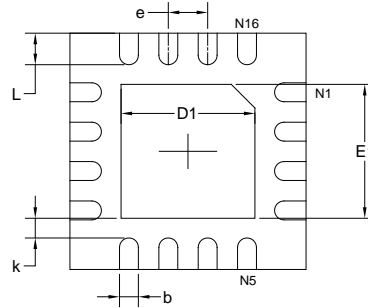
MAY 2024 – REV.A.1 to REV.A.2	Page
Updated Typical Application Circuit .....	12
MAY 2024 – REV.A to REV.A.1	Page
Updated Absolute Maximum Ratings .....	2
Changes from Original (FEBRUARY 2024) to REV.A	Page
Changed from product preview to production data .....	All

PACKAGE OUTLINE DIMENSIONS

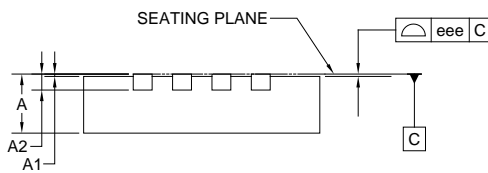
TQFN-3x3-16L



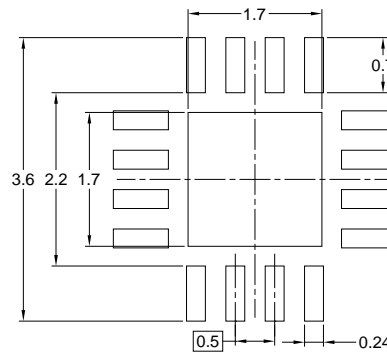
TOP VIEW



BOTTOM VIEW



SIDE VIEW



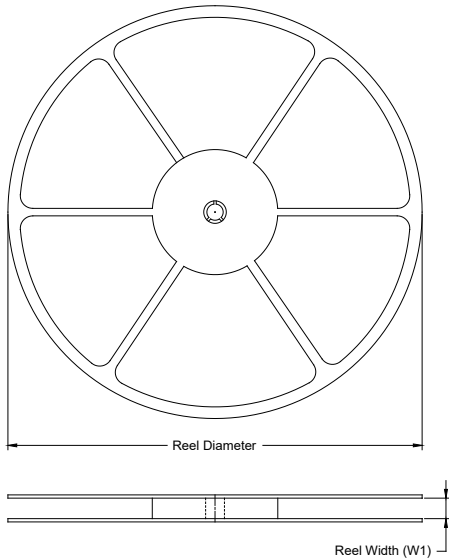
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020
eee	0.080		0.003	

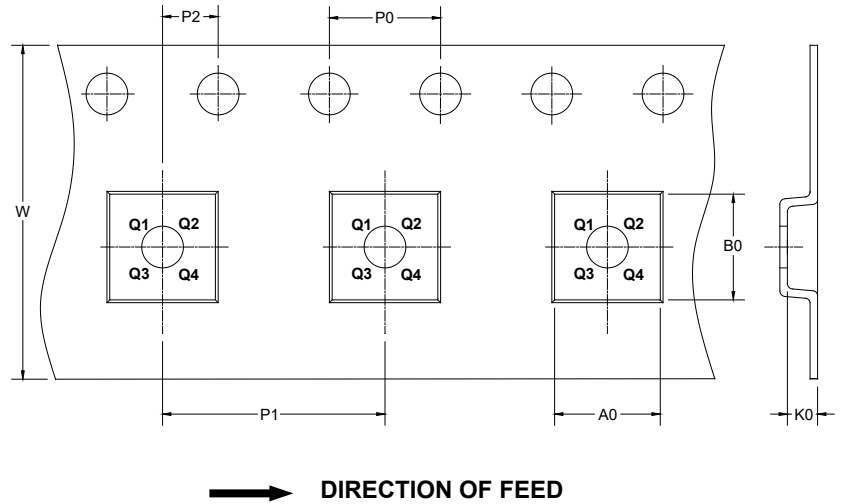
NOTE: This drawing is subject to change without notice.

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

### KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TQFN-3×3-16L	13"	12.4	3.3	3.3	1.1	4.0	8.0	2.0	12.0	Q2

D00001

# PACKAGE INFORMATION

## CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
13"	386	280	370	5

DD0002