

GENERAL DESCRIPTION

The SGM33685G1 is a high performance RF front-end module (FEM), which integrates a fully matched 900MHz power amplifier (PA), low noise amplifier (LNA), SPDT T/R switch, and a controller inside.

The device is designed for IoT and industrial applications supporting the frequency range from 860MHz to 930MHz. External V_{REF} is not required.

The SGM33685G1 is available in a Green TLGA-4×4-24L package.

APPLICATIONS

Internet of Things
Industrial Applications
Smart Meters

BLOCK DIAGRAM

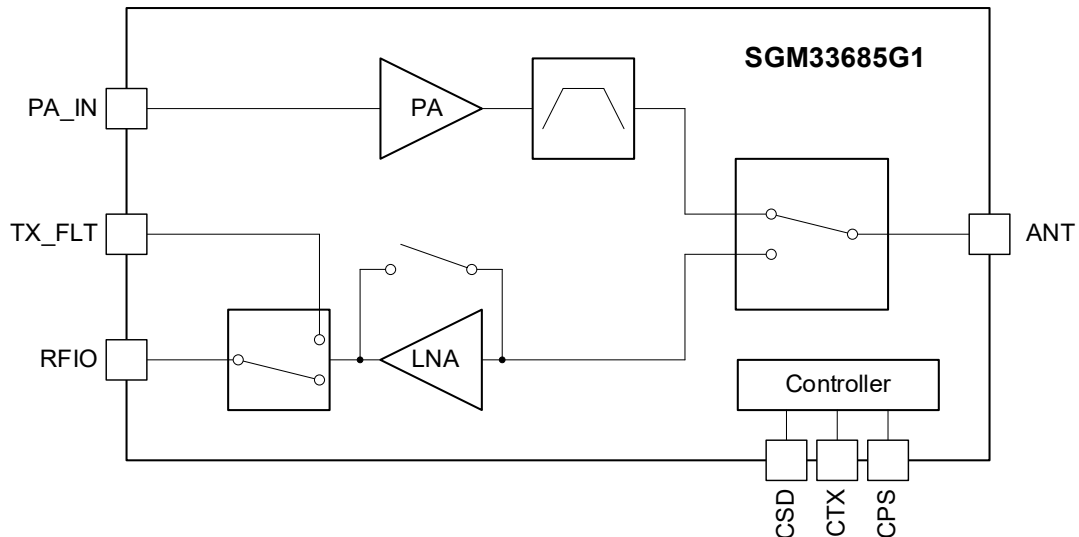


Figure 1. SGM33685G1 Block Diagram

FEATURES

- VCC0/VCC1/VCC2 Supply Voltage: 3.2V to 5.25V
- Saturated Output Power at 5.0V:
 - ♦ 34.0dBm at 860MHz to 876MHz
 - ♦ 33.3dBm at 900MHz to 930MHz
- Current Consumption
 - ♦ 630mA at $P_{OUT} = 30\text{dBm}$, 860MHz to 876MHz
 - ♦ 600mA at $P_{OUT} = 30\text{dBm}$, 900MHz to 930MHz
- Sleep Mode Current: 0.3μA
- Integrated LNA with Bypass
- FEM Noise Figure: 2.4dB
- CMOS Controller Integrated
- On-Chip 50Ω Matching for Input Port and Output Port
- Available in a Green TLGA-4×4-24L Package (MSL3, 260°C per JEDEC J-STD-020)

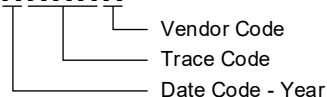
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM33685G1	TLGA-4×4-24L	-40°C to +105°C	SGM33685G1GTLAM24G/TR	SGM1J8 GTLAM24 XXXXXX	Tape and Reel, 3000

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_{CC0} , V_{CC1} , V_{CC2}	5.5V
Control Voltage, CPS, CSD, CTX	3.6V
Max TX Input Power, Under 50Ω Output Terminated, P_{IN}	15dBm
Max RX Input Power, Under 50Ω Output Terminated, P_{IN}	15dBm
Package Thermal Resistance	
TLGA-4×4-24L, θ_{JA}	40.9°C/W
TLGA-4×4-24L, θ_{JB}	15.6°C/W
TLGA-4×4-24L, θ_{JC} (TOP)	48.8°C/W
TLGA-4×4-24L, θ_{JC} (BOT)	14.0°C/W
Storage Temperature Range	-40°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C
ESD Susceptibility ^{(1) (2)}	
HBM	±1000V
CDM	±2000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.
2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Operating Ambient Temperature	-40°C to +105°C
Operating Frequency Range 1	860MHz to 876MHz
Operating Frequency Range 2	900MHz to 930MHz
Supply Voltage, V_{CC0} , V_{CC1} , V_{CC2}	3.2V to 5.25V
Control Voltage, CPS _{IH} , CSD _{IH} , CTX _{IH}	1.55V to 3.3V
Control Voltage, CPS _{IL} , CSD _{IL} , CTX _{IL}	0V to 0.45V

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.

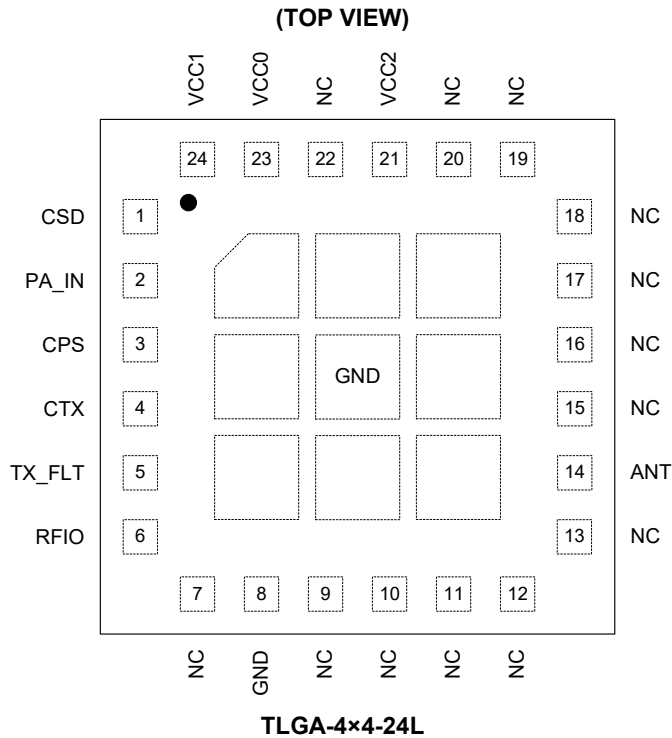
ESD SENSITIVITY CAUTION

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	CSD	Control Input Shutdown.
2	PA_IN	PA Input from TX_FLT Pin.
3	CPS	RX Path Select Control.
4	CTX	TX Enable.
5	TX_FLT	TX Input from SP2T.
6	RFIO	TX Input from Transceiver/RX Output to Transceiver.
8	GND	Ground.
7, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 22	NC	No Connection.
14	ANT	Antenna Port.
21	VCC2	Supply Voltage 2 for FEM.
23	VCC0	Supply Voltage 0 for FEM.
24	VCC1	Supply Voltage 1 for FEM.
Exposed Pad	GND	Exposed Pad. Must be connected to ground.

CONTROL LOGIC

Mode	CPS	CSD	CTX
RX LNA Bypass Mode-ANT	0	1	0
RX LNA Mode-ANT	1	1	0
TX-ANT EN	X	1	1
Sleep Mode	0	0	0

ELECTRICAL CHARACTERISTICS (TX Mode 860MHz to 876MHz)

(T_A = +25°C, 50Ω system with V_{CC0} = V_{CC1} = V_{CC2} = 5V, CW, frequency range = 860MHz to 876MHz, unless otherwise noted. Input port RFIO, Output port ANT.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Frequency Range	f ₀		860	868	876	MHz
Saturated Output Power	P _{SAT}	V _{CC0} = V _{CC1} = V _{CC2} = 5V		34		dBm
		V _{CC0} = V _{CC1} = V _{CC2} = 3.3V		30.4		dBm
Gain	Gain	P _{OUT} = 30dBm	28.5	30.5	33.5	dB
Power Added Efficiency	PAE	P _{OUT} = 30dBm	27	31		%
Current Consumption	I _{CC}	P _{OUT} = 30dBm		630	760	mA
Error Vector Magnitude	EVM	P _{OUT} = 30dBm, Wi-SUN OFDM option1 MCS0		-19		dB
		P _{OUT} = 30dBm, Wi-SUN OFDM option1 MCS3		-18		dB
		P _{OUT} = 29dBm, Wi-SUN OFDM option3 MCS6		-21		dB
2 nd Harmonics	2f ₀	P _{OUT} = 30dBm		-55	-44 ⁽¹⁾	dBm
3 rd Harmonics	3f ₀			-56	-50 ⁽¹⁾	dBm
4 th Harmonics	4f ₀			-55	-44 ⁽¹⁾	dBm
Turn-On Time	t _{ON}	50% control to 90% RF		2.2	3.4	μs
Turn-Off Time	t _{OFF}	50% control to 10% RF		0.15	0.25	μs
Input Return Loss	S11	P _{IN} = -20dBm		19		dB
Stability	S	Load VSWR = 6:1, all phase angles, P _{OUT} = 30dBm, 100MHz to 20GHz			-43	dBm
Ruggedness	Ru	No damage or permanent degradation at P _{OUT} = 32dBm, all phases angles,	10:1			VSWR

NOTE:

1. The maximum value is measured on 860MHz only.

ELECTRICAL CHARACTERISTICS (TX Mode 900MHz to 930MHz)

(T_A = +25°C, 50Ω system with V_{CC0} = V_{CC1} = V_{CC2} = 5V, CW, frequency range = 900MHz to 930MHz, unless otherwise noted. Input port RFIO, Output port ANT, 0Ω connected between the TX_FLT and PA_IN.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Frequency Range	f ₀		900	915	930	MHz
Saturated Output Power	P _{SAT}	V _{CC0} = V _{CC1} = V _{CC2} = 5V		33.3		dBm
		V _{CC0} = V _{CC1} = V _{CC2} = 3.3V		29.8		dBm
Gain	Gain	P _{OUT} = 30dBm	28.5	30.5	34	dB
Power Added Efficiency	PAE	P _{OUT} = 30dBm	27	32.5		%
Current Consumption	I _{CC}	P _{OUT} = 30dBm		600	740	mA
Error Vector Magnitude	EVM	P _{OUT} = 30dBm, Wi-SUN OFDM option1 MCS0		-18		dB
		P _{OUT} = 30dBm, Wi-SUN OFDM option1 MCS3		-17		dB
		P _{OUT} = 29dBm, Wi-SUN OFDM option3 MCS6		-21		dB
2 nd Harmonics	2f ₀	P _{OUT} = 30dBm		-58	-53	dBm
3 rd Harmonics	3f ₀			-60	-53	dBm
4 th Harmonics	4f ₀			-52	-46	dBm
Input Return Loss	S11	P _{IN} = -20dBm		15		dB
Stability	S	Load VSWR = 6:1, all phase angles, P _{OUT} = 30dBm, 100MHz to 20GHz			-43	dBm
Ruggedness	Ru	No damage or permanent degradation at P _{OUT} = 32dBm, all phases angles	10:1			VSWR

ELECTRICAL CHARACTERISTICS (RX Mode)

(T_A = +25°C, 50Ω system with V_{CC0} = V_{CC1} = V_{CC2} = 5V, CW, frequency range = 860MHz to 876MHz and 900MHz to 930MHz, unless otherwise noted. Input port ANT, Output port RFIO.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Frequency Range	f ₀		860		930	MHz
Receive Gain	Gain	P _{IN} = -30dBm	17	18.5		dB
Noise Figure	NF			2.4		dB
Input 1dB Compression Point	P _{1dB}			-9		dBm
Turn-On Time	t _{ON}	50% control to 90% RF		1.3	1.9	μs
Turn-Off Time	t _{OFF}	50% control to 10% RF		0.17	0.27	μs
Input Return Loss	S11	P _{IN} = -20dBm		17		dB
Gain in Bypass Mode	Gain_bypass	P _{IN} = -20dBm	-5.9	-5.2		dB
RX LNA Mode Current	I _{RX}			11	17	mA
RX LNA Bypass Mode Current	I _{BYPASS}			340	390	μA
Sleep Mode Current	I _{OFF}			0.3	1.2	μA

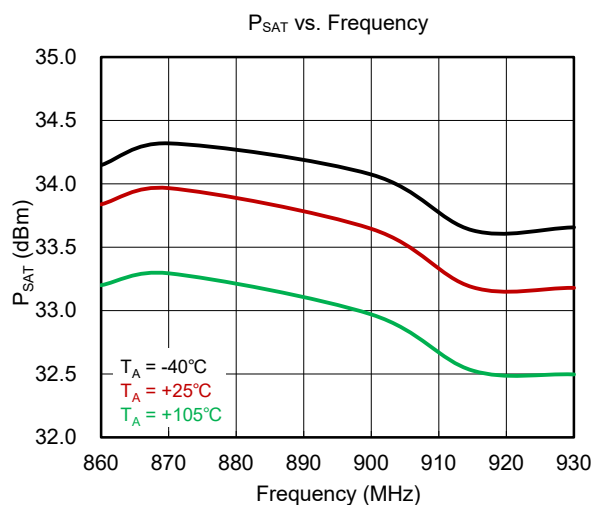
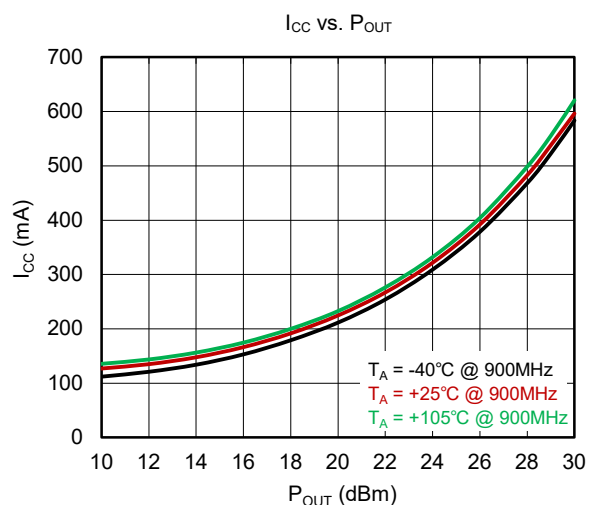
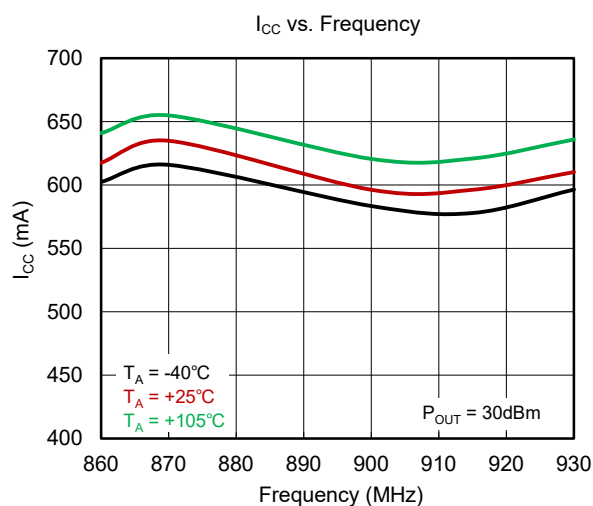
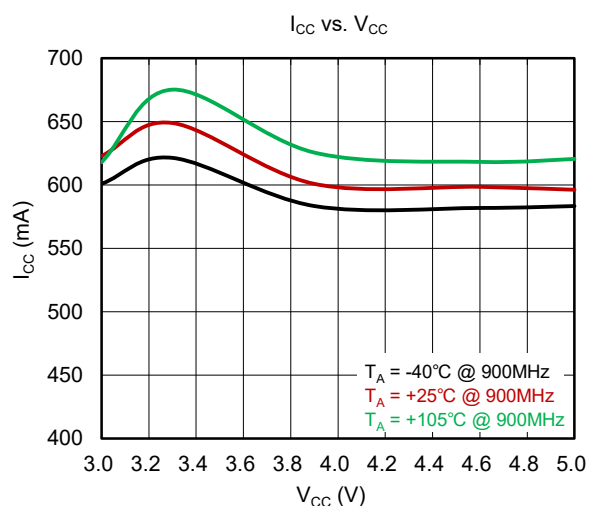
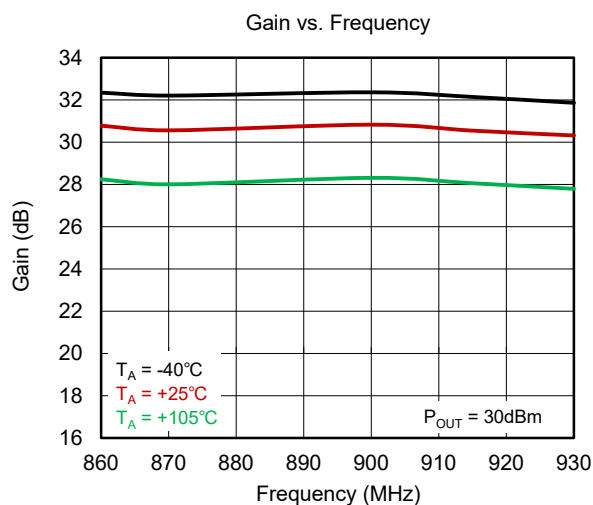
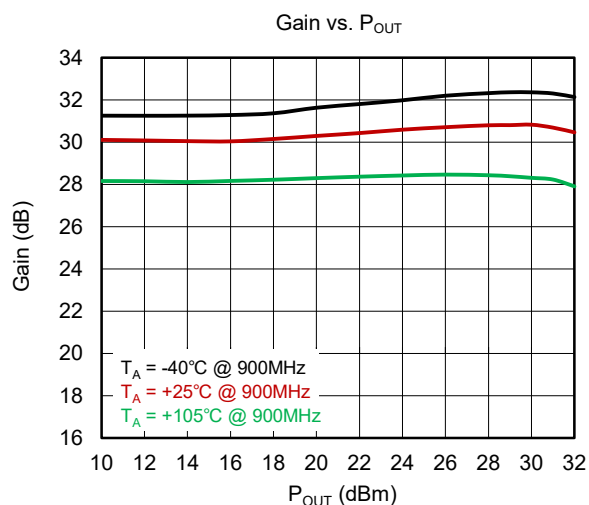
ELECTRICAL CHARACTERISTICS (TRX Port)

(T_A = +25°C, 50Ω system with V_{CC0} = V_{CC1} = V_{CC2} = 5V, CW, frequency range = 860MHz to 876MHz and 900MHz to 930MHz, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Frequency Range	f ₀		860		930	MHz
Insertion Loss from RFIO to TX_FLT	TXRX_TX	P _{IN} = -20dBm		0.35		dB

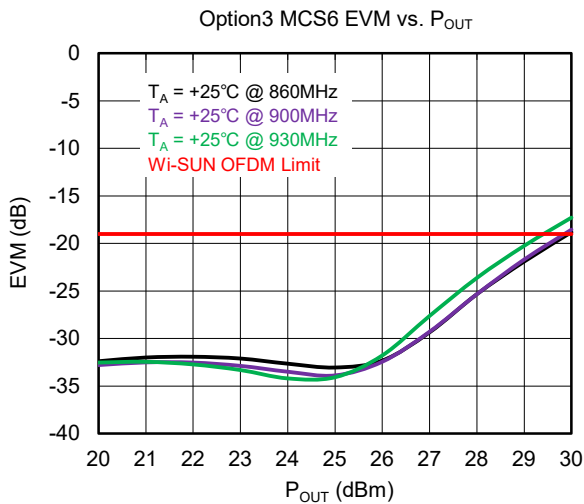
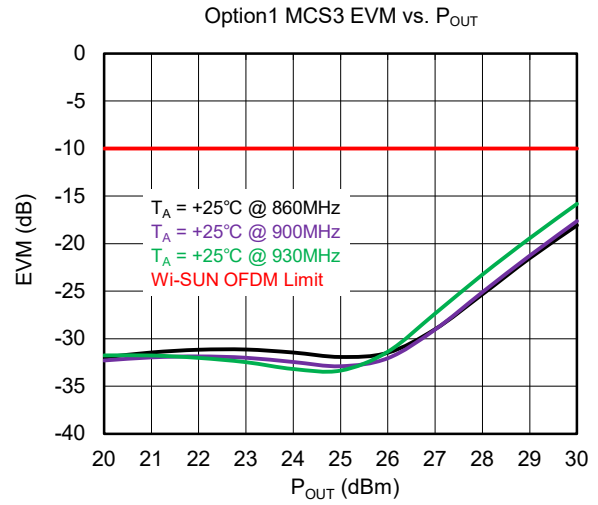
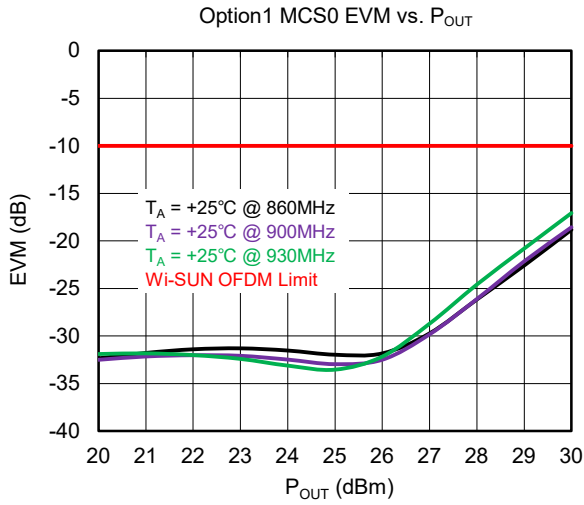
TYPICAL PERFORMANCE CHARACTERISTICS (Transmission Mode)

$T_A = +25^\circ\text{C}$, 50Ω system with $V_{CC0} = V_{CC1} = V_{CC2} = 5\text{V}$, CW, frequency range = 860MHz to 876MHz and 900MHz to 930MHz, unless otherwise noted. Input port RFIO, output port ANT.



TYPICAL PERFORMANCE CHARACTERISTICS (Transmission Mode)

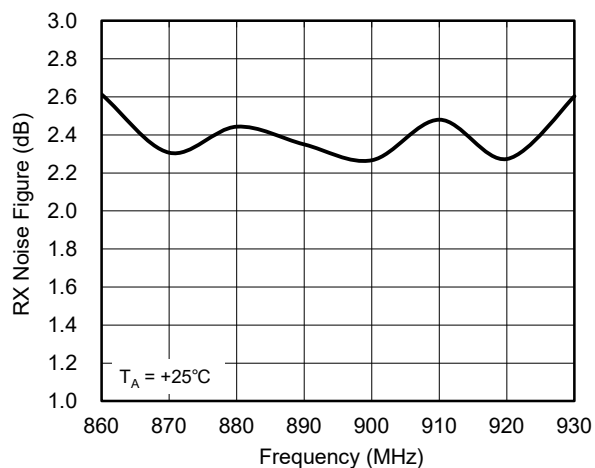
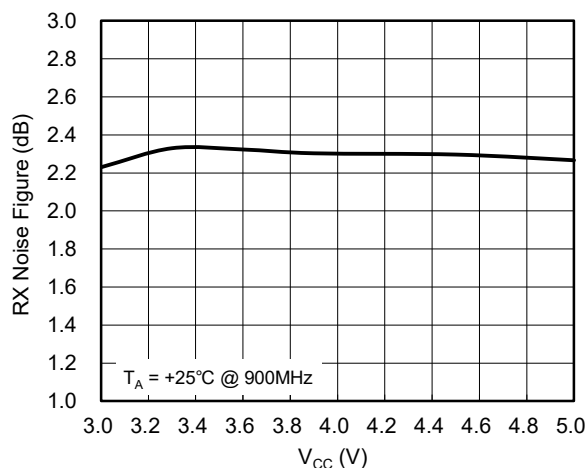
$T_A = +25^\circ\text{C}$, 50Ω system with $V_{CC0} = V_{CC1} = V_{CC2} = 5\text{V}$, Wi-SUN OFDM, frequency range = 860MHz to 876MHz and 900MHz to 930MHz, unless otherwise noted. Input port RFIO, output port ANT.



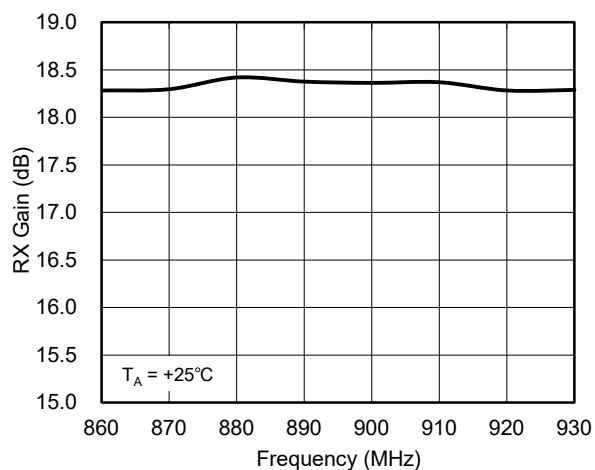
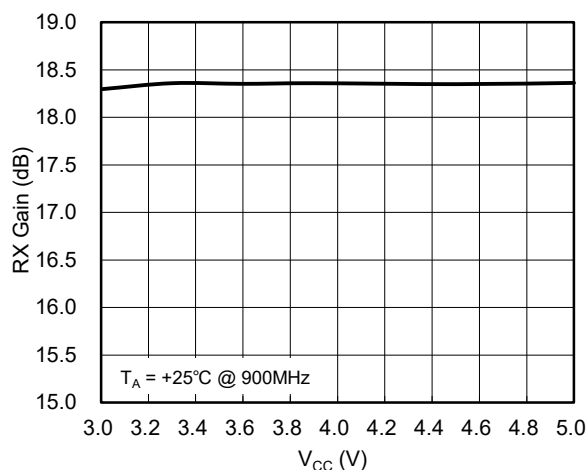
TYPICAL PERFORMANCE CHARACTERISTICS (Receive Mode)

$T_A = +25^\circ\text{C}$, 50Ω system with $V_{CC0} = V_{CC1} = V_{CC2} = 5\text{V}$, CW, frequency range = 860MHz to 876MHz and 900MHz to 930MHz, unless otherwise noted. Input port ANT1 or ANT2, output port RFIO, 0Ω connected between the RX_FLT and RX_IN pin.

RX Noise Figure vs. Frequency

RX Noise Figure vs. V_{CC} 

RX Gain vs. Frequency

RX Gain vs. V_{CC} 

TIMING SEQUENCE

The SGM33685G1 recommended control timing for high power mode operation is shown below. The control signal CTX/CPS/CSD must be set after VCC0/VCC1/VCC2 has been applied at least $t_1 = 1\mu\text{s}$. The control signal CTX/CPS/CSD shall be turned off before $1\mu\text{s}$ of the falling stage of VCC0/VCC1/VCC2.

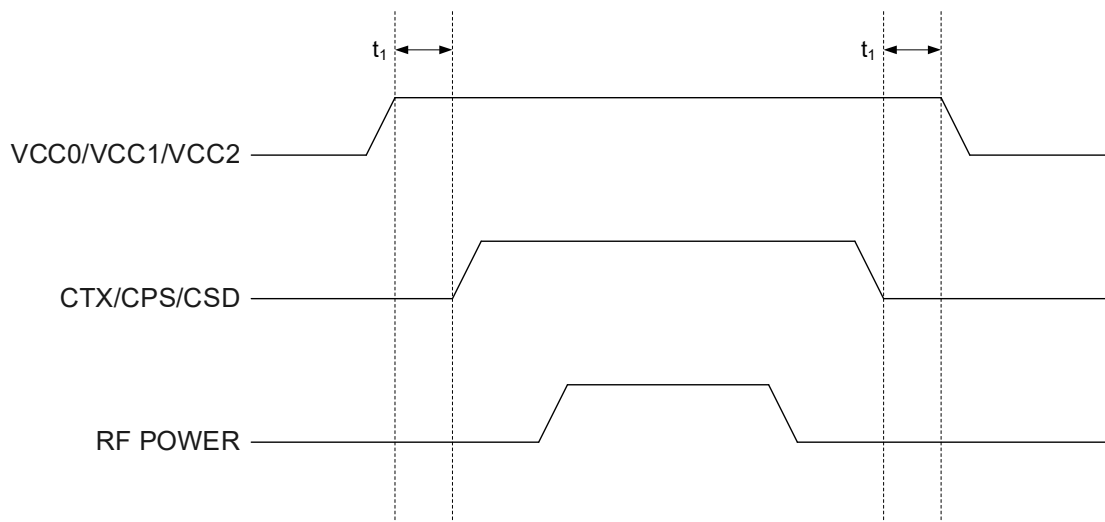


Figure 2. Detail Timing Sequence

TYPICAL APPLICATION CIRCUIT

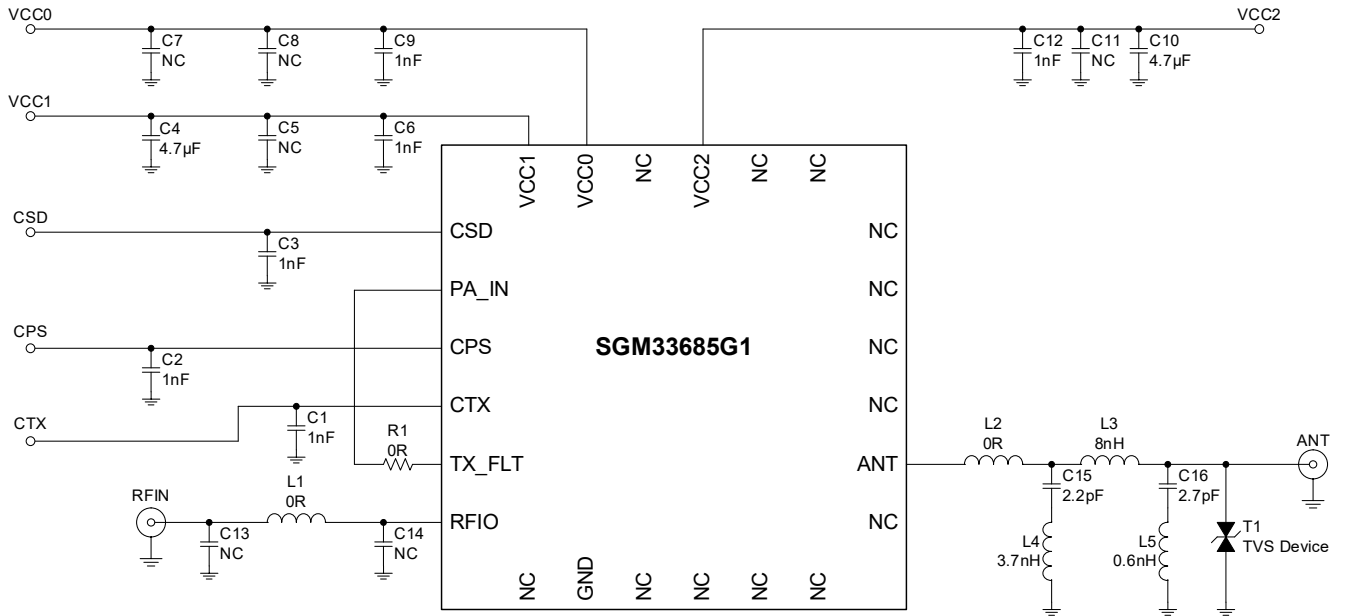


Figure 3. SGM33685G1 Typical Application Circuit

Table 1. Evaluation Board Bill of Material

COMPONENT	VALUE	DESCRIPTION
IC		SGM33685G1
C4, C10	4.7 μ F	De-Coupling Capacitor
C1, C2, C3, C6, C9, C12	1nF	De-Coupling Capacitor
R1, L1, L2	0R	Matching Resistor
L3	8nH	Matching Inductor
L4	3.7nH	Matching Inductor
L5	0.6nH	Matching Inductor
C15	2.2pF	Matching Capacitor
C16	2.7pF	Matching Capacitor
T1	$\pm$ 10kV	TVS Device

EVB BOARD LAYOUT

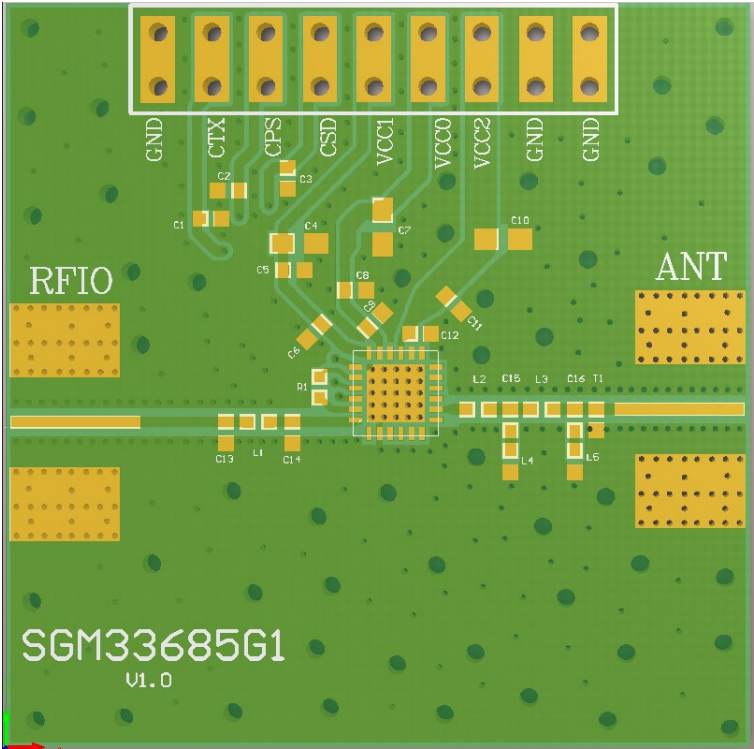


Figure 4. Evaluation Board Layout

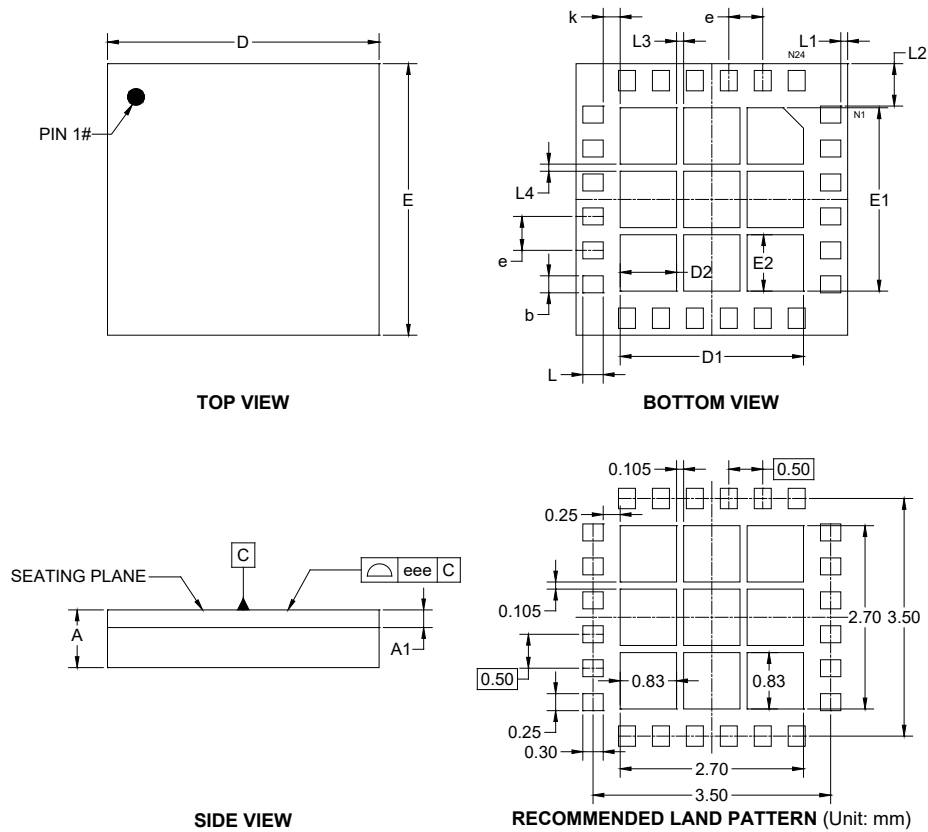
REVISION HISTORY

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

JULY 2025 – REV.A to REV.A.1	Page
Update Features, Absolute Maximum Ratings, Recommended Operating Conditions and Electrical Characteristics	1, 2, 4, 5, 6
Changes from Original to REV.A (JUNE 2025)	Page
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

TLGA-4×4-24L



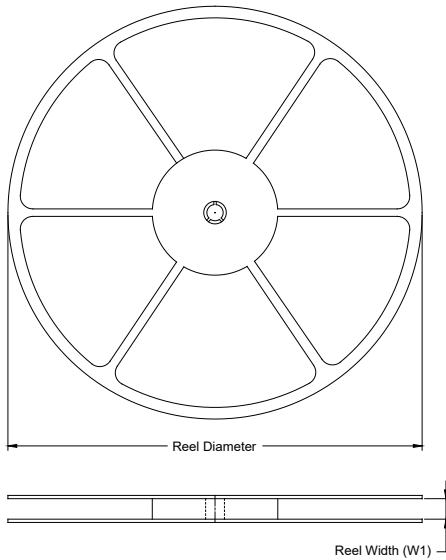
Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	0.800	-	0.900
A1	0.260 REF		
b	0.200	-	0.300
D	3.900	-	4.100
E	3.900	-	4.100
D1	2.600	-	2.800
D2	0.830 REF		
E1	2.600	-	2.800
E2	0.830 REF		
e	0.500 BSC		
k	0.250 REF		
L	0.250	-	0.350
L1	0.100 REF		
L2	0.625 REF		
L3	0.105 REF		
L4	0.105 REF		
eee	0.100		

NOTE: This drawing is subject to change without notice.

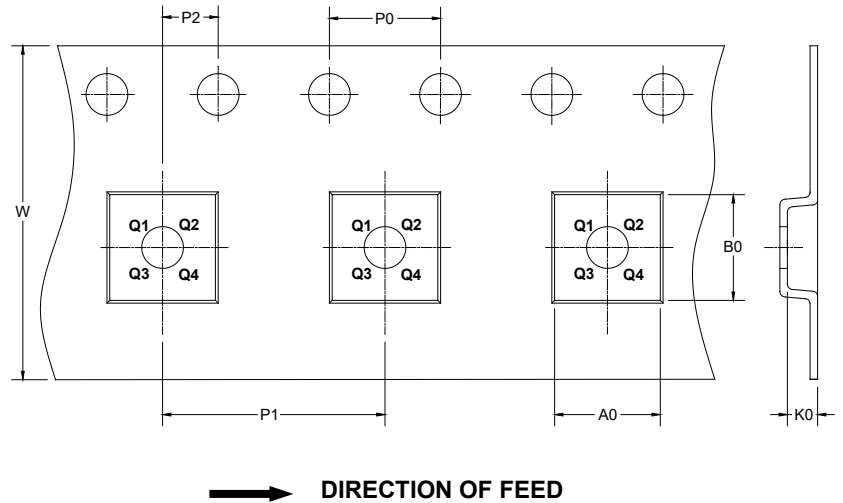
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

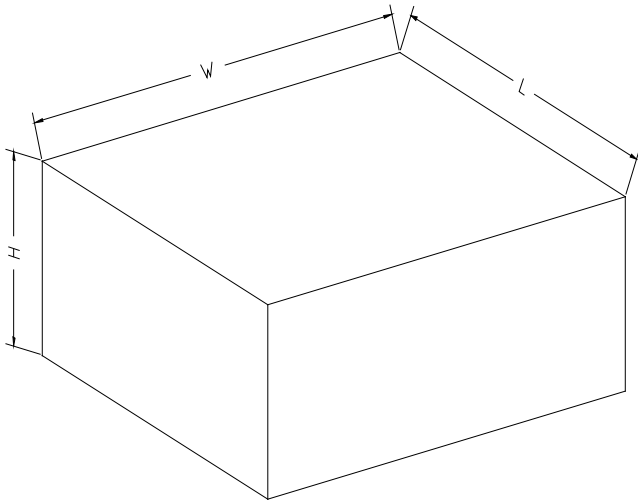
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TLGA-4×4-24L	13"	12.4	4.30	4.30	1.10	4.0	8.0	2.0	12.0	Q2

DD0001

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