LB5377

AISG Integrated Transceiver

1. FEATURES

- Wide input dynamic for receiver, ranging from −15dBm to +5dBm in 50Ω
- Transmitter output level variable from +7dBm to +12dBm
- Output emission profile compliant with AISG
- Output with AutoDirection
- Handle bus arbitration in tower-mounted equipment without microcontrollers
- All AISG data rates supported:
  - 9.6kbps
  - 38.4kbps
  - 115.2kbps
- AISG-compliant bandpass filter centered around 2.176MHz
- Voltage supply from 3.0V to 5.5V
- Independent logic supply
- 3mm × 3mm QFN-16 package

2. APPLICATIONS

- Base Stations
- Tower Equipment

3. DESCRIPTION

The LB5377 is a fully integrated transceiver compliant with AISG.

Its receiver provides a 20dB typical dynamic range and integrates a bandpass filter operating in the 2.176MHz frequency with a narrow 200kHz bandwidth.

Its transmitter integrates a bandpass filter compliant with the AISG spectrum emission profile. The transmitter can modulate OOK signals up to 115.2kbps. With external resistors, the output power can vary from +7dBm to +12dBm to compensate for loss in the external circuitry and cabling. A direction output is also available to help with the RS-485 bus arbitration in tower-mounted equipment. Regarding the package, the LB5377 adopts a small, 3mm × 3mm 16-pin QFN and is rated. See **Table 1** for the order information.

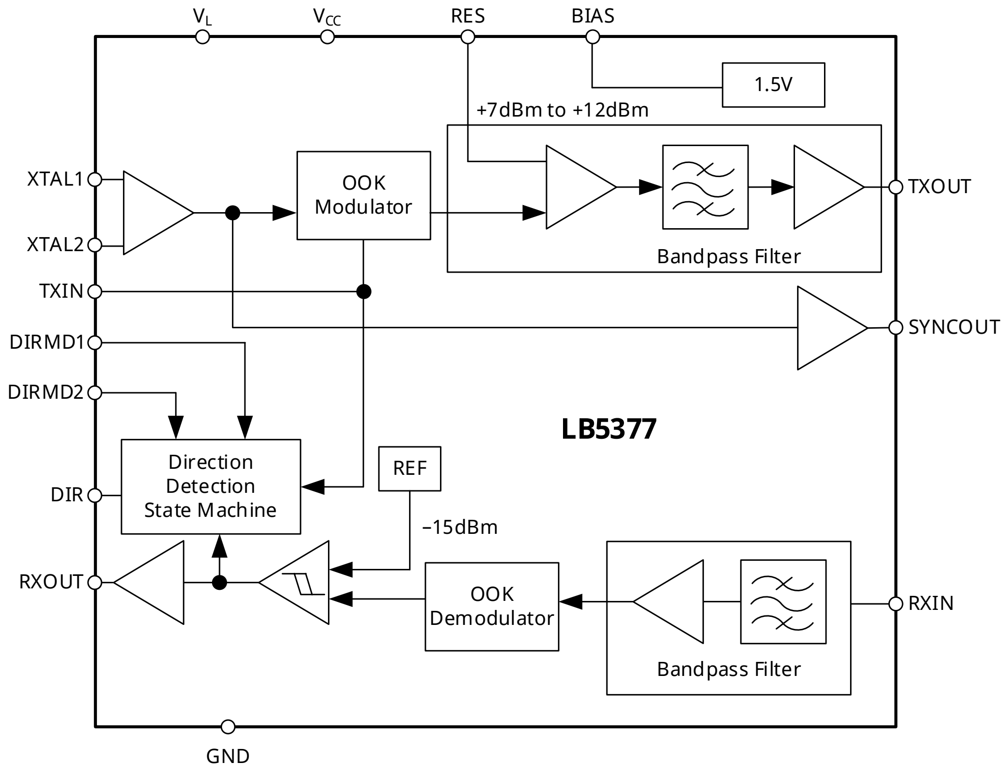


Table 1 lists the order information.

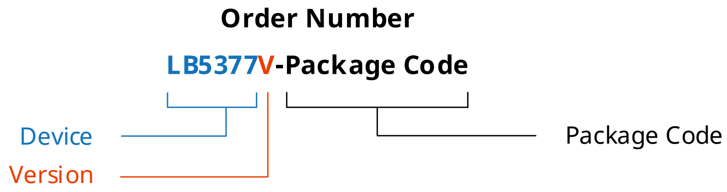
Table 1. Order Information

ORDER NUMBER	PART NUMBER	PACKAGE	MARKING	OPERATING TEMP (°C)	PACKAGE OPTION
LB5377AQFN16[(1)]	LB5377	QFN-16	LB5377A	–40-120	T/R-5000

Devices can be ordered via the following two ways:

1. Place orders directly on our website (www.analogysemi.com), or;
2. Contact our sales team by mailing to sales@analogysemi.com.

Note:



4. PIN CONFIGURATION AND FUNCTIONS

Figure 1 illustrates the pin configuration.

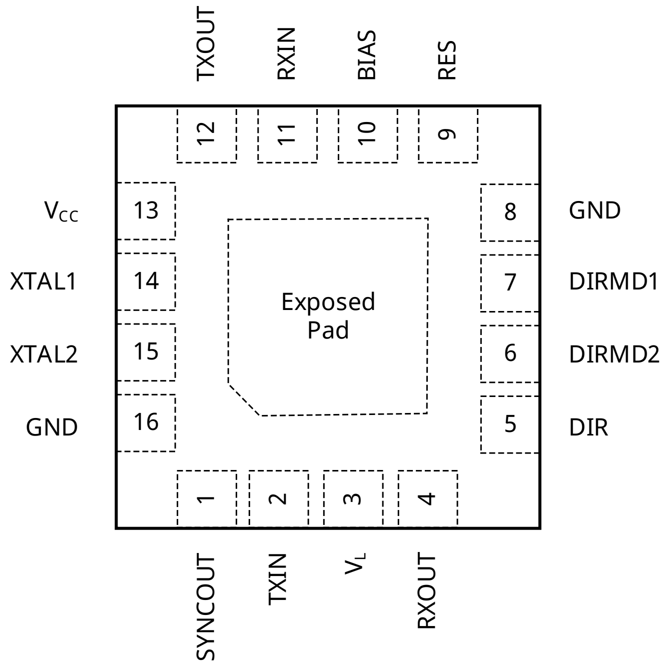


Figure 1. Pin Configuration

Table 2 lists the pin functions.

Table 2. Pin Functions

POSITION	NAME	TYPE	DESCRIPTION
1	SYNCOUT	Digital Output	Open-drain sync output that outputs the 8.704MHz clock to synchronize other devices.
2	TXIN	Digital Input	Digital signal input
3	V_L	Power Supply	Logic supply voltage
4	RXOUT	Digital Output	Digital signal output
5	DIR	Digital Output	Direction output asserted high when the data stream is seen at the receiver (RXIN).
6	DIRMD2	Digital Input	Duration mode select input 2, internally pulled down
7	DIRMD1	Digital Input	Duration mode select input 1, internally pulled down
8, 16	GND	Power Supply	Ground
9	RES	Power Supply	External resistors' connection to set the output power level
10	BIAS	Analog Output	Output bias reference used with RES to set the output power level. Decouple BIAS with 1μF to GND.
11	RXIN	Analog Input	OOK-modulated input signal
12	TXOUT	Analog Output	OOK-modulated output signal
13	V_{CC}	Power Supply	Analog supply voltage
14	XTAL1	Input/Output	External crystal input terminal. Feed with 8.704MHz (±30ppm) input clock for external synchronization.
15	XTAL2	Input/Output	External crystal input terminal. Connect to GND for external synchronization.
EP	EP	---	Exposed Pad. Connect EP to GND for thermal dissipation enhancement.

5. SPECIFICATIONS

5.1 ABSOLUTE MAXIMUM RATINGS

Table 3 lists the absolute maximum ratings of the LB5377.

Table 3. Absolute Maximum Ratings

PARAMETER	DESCRIPTION	MIN	MAX	UNITS
Voltage	V_{CC} to GND	–0.3	6	V
	V_L to GND	–0.3	6	V
	TXOUT, BIAS to GND	–0.3	V_{CC} + 0.3	V
	RXIN, XTAL1, XTAL2, SYNCOUT, RES to GND	–0.3	6	V
	TXIN, RXOUT, DIR, DIRMD1, DIRMD2 to GND	–0.3	V_L + 0.3	V
Current	Output short-circuit current TXOUT, SYNCOUT to V_{CC} or GND	Continuous		
	ALL other pins max in/out current	–20	20	mA
	Continuous power dissipation (T_A = 70°C) QFN-16 (derate 17.5mW/°C)		1013	mW
Temperature	Operating ambient, T_A	–40	120	°C
	Junction, T_J		125	°C
	Storage, T_{stg}	–65	150	°C
	Lead (soldering, 10s)		300	°C
	Soldering (reflow)		260	°C

Note: Stresses beyond those listed under **Table 3** may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under **Table 5**. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

5.2 ESD RATINGS

Table 4 lists the ESD ratings of the LB5377.

Table 4. ESD Ratings

PARAMETER	SYMBOL	DESCRIPTION	VALUE	UNITS
Electrostatic Discharge	$V_{(ESD)}$	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±8000	V
		Charged-device model (CDM), per JEDEC specification JESD22-C101[2]	±2000	

Note 1: The JEDEC document JEP155 indicates that 500V HBM allows safe manufacturing with a standard ESD control process.
Note 2: The JEDEC document JEP157 indicates that 250V CDM allows safe manufacturing with a standard ESD control process.

5.3 RECOMMENDED OPERATING CONDITIONS

Table 5 lists the recommended operating conditions for the LB5377.

Table 5. Recommended Operating Conditions

PARAMETER		SYMBOL	MIN	NOM	MAX	UNITS
Analog Supply Voltage		V_{CC}	3		5.5	V
Logic Supply Voltage		V_L	1.6		5.5	V
Input Signal Amplitude at RXIN		$V_{I(pp)}$			1.12	V_{p-p}
High-Level Input Voltage	TXIN, DIRSET1, DIRSET2	V_{IH}	70%V_L		V_L	V
	XTAL1, XTAL2		70%V_{CC}		V_{CC}	
Low-Level Input Voltage	TXIN, DIRSET1, DIRSET2	V_{IL}	0		30%V_L	V
	XTAL1, XTAL2		0		30%V_{CC}	
Data Signaling Rate		$1/t_{UI}$	9.6		115	kbps
Oscillator Frequency		F_{OSC}	−30ppm	8.704	30ppm	MHz
Load Impedance between TXOUT to RXIN		Z_{LOAD}		50		Ω
Load Impedance between RXIN and GND at f_C (Channel)				50		Ω
Bias Resistor between BIAS and RES		R1		4.1		kΩ
Bias Resistor between RES and GND		R2		10		kΩ
Pullup Resistor between SYNCOUT and V_{CC}		R_{SYNC}		1		kΩ
Voltage at RES Pin		V_{RES}	0.7		1.5	V
Coupling Capacitance between RXIN and Coax (Channel)		C_C		220		nF
Capacitance between BIAS and GND		C_{BIAS}		1		μF
Operating Free-Air Temperature		T_A	−40		120	°C
Junction Temperature		T_J	−40		125	°C

5.4 THERMAL INFORMATION

Table 6 lists the thermal information for the LB5377.

Table 6. Thermal Information

PARAMETER	SYMBOL	QFN-16	UNITS
Junction-to-Ambient Thermal Resistance	$R_{\theta JA}$	64	°C/W
Junction-to-Case (Top) Thermal Resistance	$R_{\theta JC(top)}$	54	°C/W
Junction-to-Board Thermal Resistance	$R_{\theta JB}$	28	°C/W
Junction-to-Top Characterization Parameter	ψ_{JT}	1	°C/W
Junction-to-Board Characterization Parameter	ψ_{JB}	26.5	°C/W
Junction-to-Case (Bottom) Thermal Resistance	$R_{\theta JC(bot)}$	6.5	°C/W

5.5 ELECTRICAL CHARACTERISTICS

Table 7 lists the electrical characteristics of the LB5377. V_{CC} = 5V, V_L = 3.3V, TXOUT connected with 50Ω to RXIN, 4.1kΩ resistor between BIAS and RES, 10kΩ resistor between RES and GND, 1kΩ resistor between SYNCOUT and V_{CC}, T_A = T_{MIN} to T_{MAX}, XTAL frequency 8.704MHz ± 30ppm. Typical values are at T_A = 25°C, unless otherwise specified.(1)

Table 7. Electrical Characteristics

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS						
Supply Voltage	V_{CC}		3.0		5.5	V
Supply Current	I_{CC}	9.6kbps, 38.4kbps, 115.2kbps		24.5	35	mA
		DIRMD1 = H, DIRMD2 = H (standby)		9.5	17	mA
Logic Supply Voltage	V_L		1.6		5.5	V
Logic Supply Current	I_L	V_{TXIN} = 3.3V		5.3	300	μA
Receiver Power-Supply Rejection Ratio	PSRR_RX	3.0V ≤ V_{CC} ≤ 5.5V, V_{TXIN} = 3.3V(2)	45	60		dB
Output Power-Supply Rejection Ratio	PSRR_TX	3.0V ≤ V_{CC} ≤ 5.5V, V_{TXIN} = 3.3V(3)	45	55		dB
LOGIC INPUTS AND OUTPUTS						
Logic-Input High Threshold Voltage	V_{IH}	DIRMD1, DIRMD2, TXIN	0.7 × V_L			V
Logic-Input Low Threshold Voltage	V_{IL}	DIRMD1, DIRMD2, TXIN			0.3 × V_L	V
Logic-Output High Threshold Voltage	V_{OH}	RXOUT, DIR source 3.3mA	0.9 × V_L			V
Logic-Output Low Threshold Voltage	V_{OL}	RXOUT, DIR sink 3.3mA			0.1 × V_L	V
Input Leakage Current	I_{IH}, I_{IL}	TXIN shorted to GND or V_L	−5		1	μA
		DIRMD1, DIRMD2: Shorted to GND	−1			μA
		DIRMD1, DIRMD2: Shorted to VL			50	μA
SYNC INPUT (XTAL1) AND OUTPUT (SYNCOUT)						
Input High Threshold Voltage	V_{XTAL1_IH}		0.7 × V_{CC}			V
Input Low Threshold Voltage	V_{XTAL1_IL}				0.3 × V_{CC}	V
Input High Leakage Current	I_{XTAL1_IH}				15	μA
Input Low Leakage Current	I_{XTAL1_IL}		−15			μA
Output Low Voltage	$V_{SYNCOUT\_OL}$	SYNCOUT sink 3.3mA			0.4	V
RECEIVER FILTER						
Passband	f_{PB_L}, f_{PB_H}	Input amplitude 1.12V_{P-P} (the input carrier is recognized.)	1.1		4.17	MHz
Extra Carrier Receiver Immunity	f_{IM1_L}, f_{IM1_H}	2.176MHz carrier amplitude (112.4mV_{P-P} ± 3dB), extra carrier amplitude 0.8V_{P-P}, V_{DIRMD1} = V_{DIRMD2} = 0V (9.6kbps)	1.1		4.17	MHz
RECEIVER						
Input Voltage Range	V_{IN}	V_{CC} = 3.0V to 5.5V, f_{RXIN} = 2.176MHz			1.12	V_{P-P}
Equivalent Input Power Range	P_{IN}	V_{CC} = 3.0V to 5.5V, f_{RXIN} = 2.176MHz			5	dBm
Input Impedance(4)	Z_{IN}	f_{RXIN} = 2.176MHz	11	21		kΩ
Threshold Voltage Range	V_{TH}	f_{RXIN} = 2.176MHz	−18	−15	−12	dBm
			79.6	112.4	158.8	mV_{P-P}

 Public

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
TRANSMITTER						
Output Frequency	f_O			2.176		MHz
Output Frequency Variation(5)	Δf_O				±100	ppm
Output On Level at TXOUT(6)	V_{OUT}	V_{RES} = 1.5V (maximum)	11.1	12		dBm
			2.24	2.52		V_{P-P}
		V_{RES} = 0.7V (minimum)		5.38	6.28	dBm
				1.17	1.30	V_{P-P}
Output Emission Profile(7)			Conforms to the AISG Spectrum Emissions Mask 3GPP TS 37.461			
Output Impedance	Z_{OUT}	DC		0.03		Ω
		f_{SW} = 10MHz		3.5		
Amplifier Gain Bandwidth	GBW			27		MHz
TXOUT Short-Circuit Protection	I_{SC}	Shorted to GND or V_{CC}, guaranteed over V_{CC} range			±280	mA
Peak-to-peak Voltage at Coax Out	VO_{PP}	V_{RES} = 1.5V	5	6		dBm
		V_{RES} = 0.7V		−0.6	0.3	
Off-State Output Voltage(4)(8)	VO_{FF}	At TXOUT			1	mV_{P-P}
		At coax out			−60	dBm
SWITCHING CHARACTERISTICS						
Receiver Propagation Delay	t_{RX}	RXIN to RXOUT, V_{DIRMD1} = V_{DIRMD2} = 0V		8.9	11	μs
		RXIN to RXOUT, V_{DIRMD1} = 3.3V, V_{DIRMD2} = 0V (38.4kbps), V_{DIRMD1} = 0V, V_{DIRMD2} = 3.3V (115.2kbps)		5.5	11	
Receiver Output Rise and Fall Time	t_R, t_F	10% to 90%, R_L = 1kΩ, C_L = 10pF		20		ns
Transmitter Propagation Delay	t_{TX}	TXIN to TXOUT (at 9.6kbps, 38.4kbps, 115.2kbps)			5	μs
DIR to RXOUT Delay(9)	$t_{DIR, SKEW}$		270			ns
Direction Duration High	$t_{DIR, HIGH}$	V_{DIRMD1} = V_{DIRMD2} = 0V (9.6kbps)		1667		μs
		V_{DIRMD1} = 3.3V, V_{DIRMD2} = 0V (38.4kbps)		417		
		V_{DIRMD1} = 0V, V_{DIRMD2} = 3.3V (115.2kbps)		137		
Receiver Output Data Duty-Cycle Variation	ΔDC	RXIN fed by an OOK 2.176MHz sinusoidal signal with 50% duty cycle(10); RXIN = 0dBm		±2	±10	%
		RXIN fed by an OOK 2.176MHz sinusoidal signal with 50% duty cycle(10); RXIN = −10dBm		±2	±10	
Standby Disable Delay	T_{dis}	300mV_{P-P} at 2.176MHz on RXIN		2		ms
Standby Enable Delay	T_{en}	300mV_{P-P} at 2.176MHz on RXIN		2		

Note 1: All devices are 100% production tested at T_A = 25°C. Specifications over temperature limits are guaranteed by design.
Note 2: Defined as $\Delta V_{RXIN}/\Delta V_{CC}$ at DC.
Note 3: Defined as $\Delta V_{TXOUT}/\Delta V_{CC}$ at DC.
Note 4: Specifications are guaranteed by design, not production tested.
Note 5: Output frequency variation determined by external crystal tolerance.
Note 6: For external resistor values, refer to the **TRANSMISSION OUTPUT POWER** section.
Note 7: Guaranteed by design with a recommended 470pF capacitor between RXIN and ground. Measurements above 150MHz are determined by setup.
Note 8: Under typical operating conditions, P_o ≤ 5dBm, and V_{CC} noise is 600kHz/−35dBm.
Note 9: See **Figure 20**.
Note 10: ±2μs envelope rise/fall.

5.6 TYPICAL CHARACTERISTICS

V_{CC} = 5V, V_L = 3.3V, TXOUT connected with 50Ω to RXIN, 4.1kΩ resistor between BIAS and RES, 10kΩ resistor between RES and GND, 1kΩ resistor between SYNCOUT and V_{CC}, XTAL frequency 8.704MHz ± 30ppm. T_A = 25°C, unless otherwise specified.

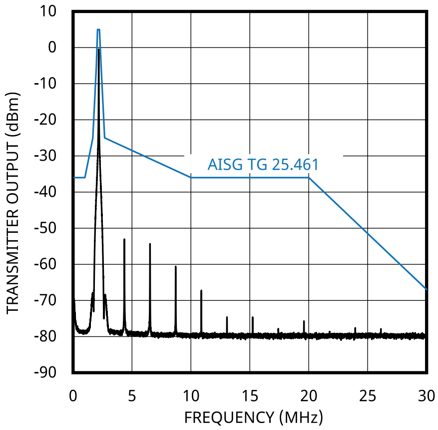


Figure 2. Low Frequency Emissions Spectrum with 9.6kbps Signaling Rate

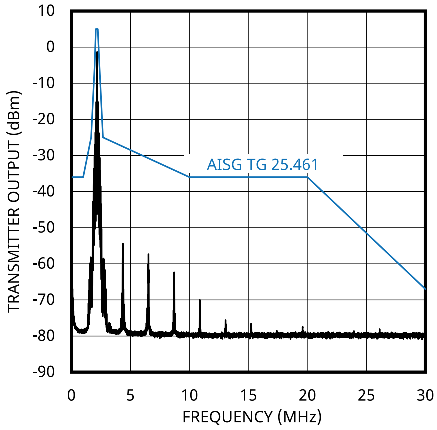


Figure 3. Low Frequency Emissions Spectrum with 38.4kbps Signaling Rate

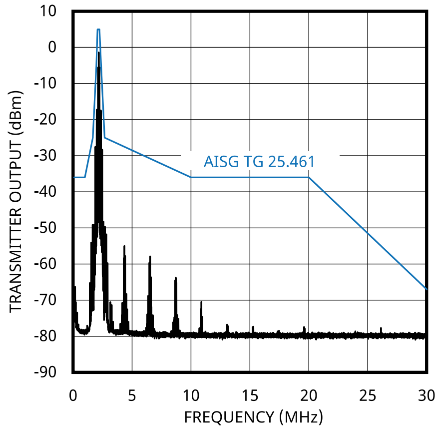


Figure 4. Low Frequency Emissions Spectrum with 115.2kbps Signaling Rate

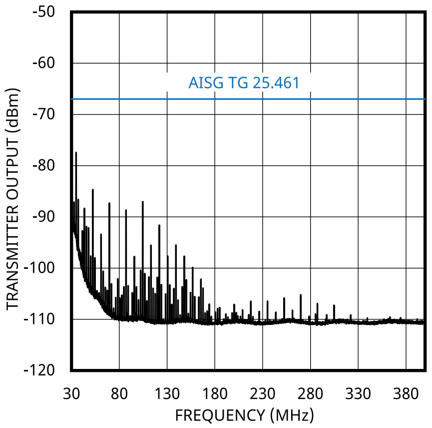


Figure 5. High Frequency Emissions Spectrum with 9.6kbps Signaling Rate

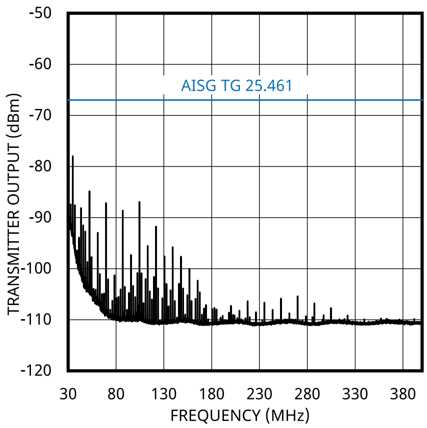


Figure 6. High Frequency Emissions Spectrum with 38.4kbps Signaling Rate

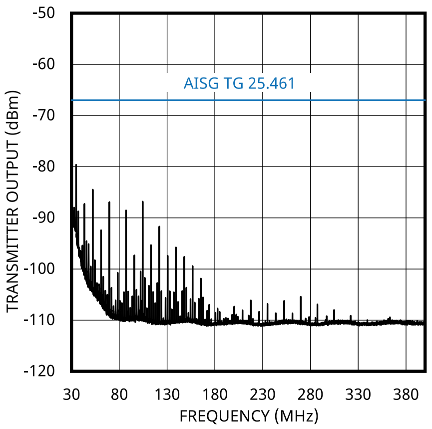


Figure 7. High Frequency Emissions Spectrum with 115.2kbps Signaling Rate

5.7 TYPICAL CHARACTERISTICS (CONTINUED)

V_{CC} = 5V, V_L = 3.3V, TXOUT connected with 50Ω to RXIN, 4.1kΩ resistor between BIAS and RES, 10kΩ resistor between RES and GND, 1kΩ resistor between SYNCOUT and V_{CC}, XTAL frequency 8.704MHz ± 30ppm. T_A = 25°C, unless otherwise specified.

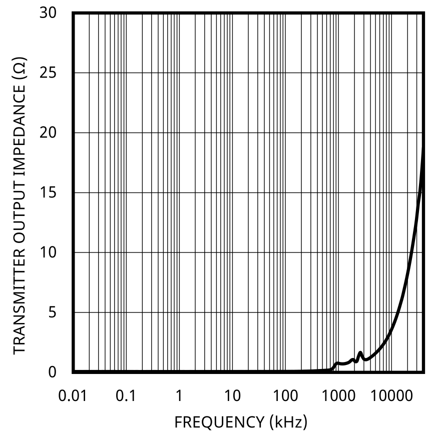


Figure 8. Transmitter Output Impedance vs. Frequency

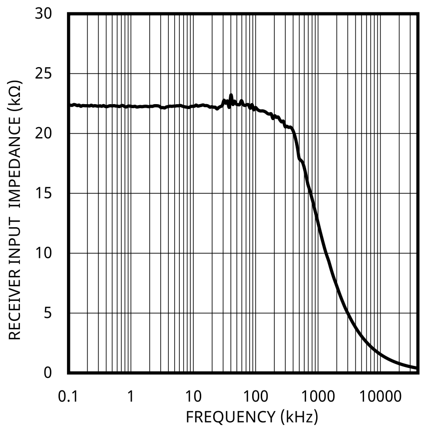


Figure 9. Receiver Input Impedance vs. Frequency

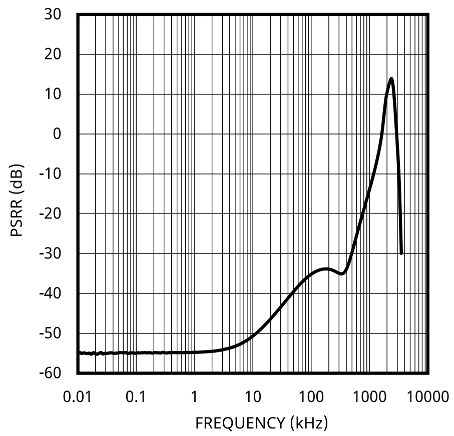


Figure 10. PSRR vs. Frequency

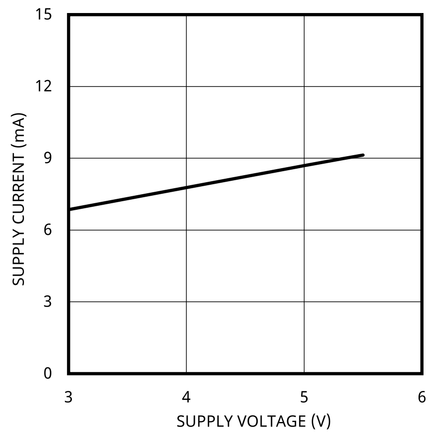


Figure 11. Supply Current vs. Supply Voltage in Standby Mode

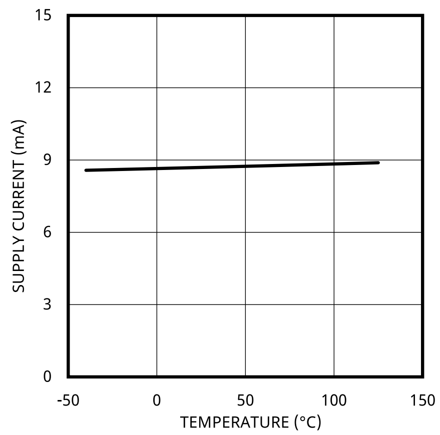


Figure 12. Supply Current vs. Temperature in Standby Mode

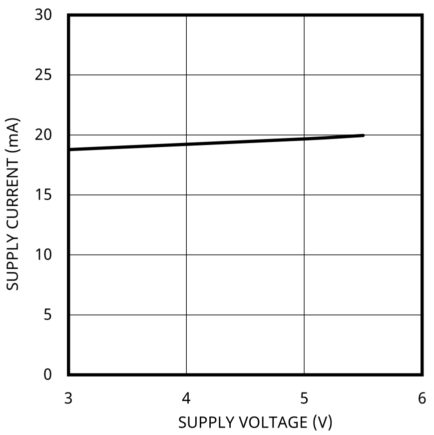


Figure 13. Supply Current vs. Supply Voltage while Being Transmitted

5.8 TYPICAL CHARACTERISTICS (CONTINUED)

V_{CC} = 5V, V_L = 3.3V, TXOUT connected with 50Ω to RXIN, 4.1kΩ resistor between BIAS and RES, 10kΩ resistor between RES and GND, 1kΩ resistor between SYNCOUT and V_{CC}, XTAL frequency 8.704MHz ± 30ppm. T_A = 25°C, unless otherwise specified.

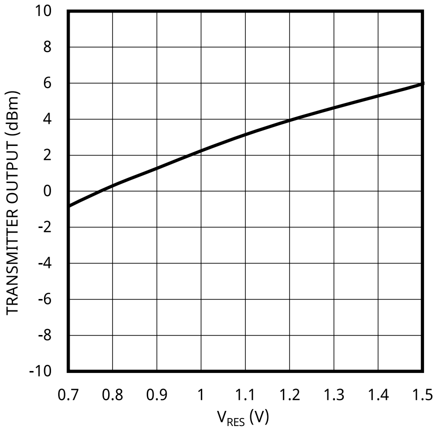


Figure 14. Transmitter Output vs. V_{RES}

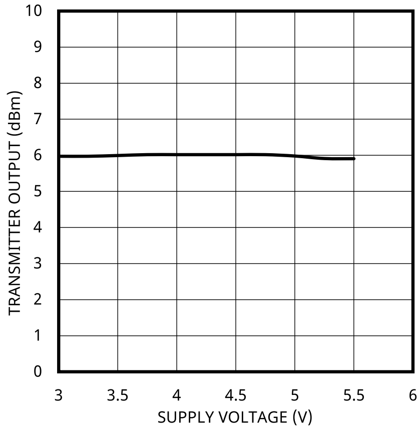


Figure 15. Transmitter Output Power vs. Supply Voltage

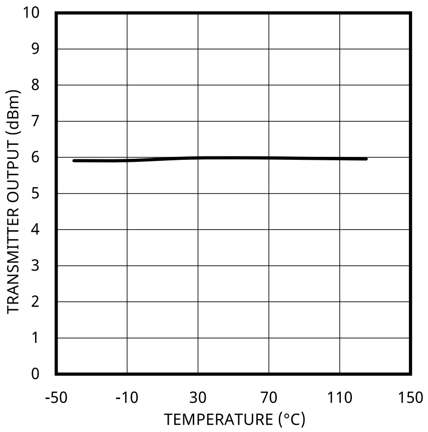


Figure 16. Transmitter Output Power vs. Temperature

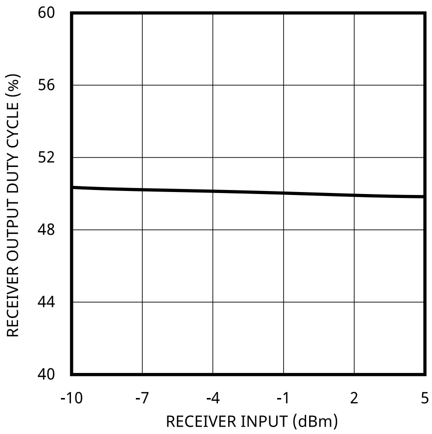


Figure 17. Receiver Duty with 9.6kbps vs. Signaling Rate

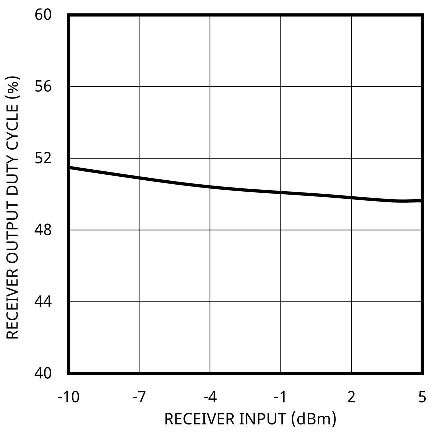


Figure 18. Receiver Duty with 38.4kbps vs. Signaling Rate

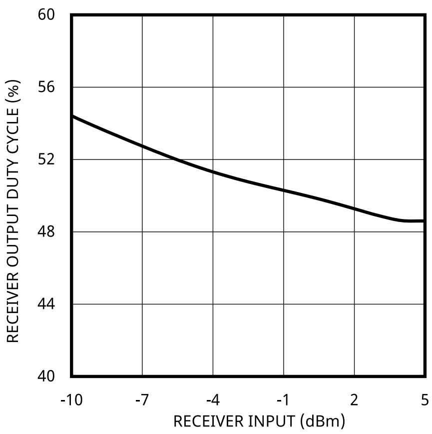


Figure 19. Receiver Duty with 115.2kbps vs. Signaling Rate

5.9 TYPICAL CHARACTERISTICS (CONTINUED)

V_{CC} = 5V, V_L = 3.3V, TXOUT connected with 50Ω to RXIN, 4.1kΩ resistor between BIAS and RES, 10kΩ resistor between RES and GND, 1kΩ resistor between SYNCOUT and V_{CC}, XTAL frequency 8.704MHz ± 30ppm. T_A = 25°C, unless otherwise specified.

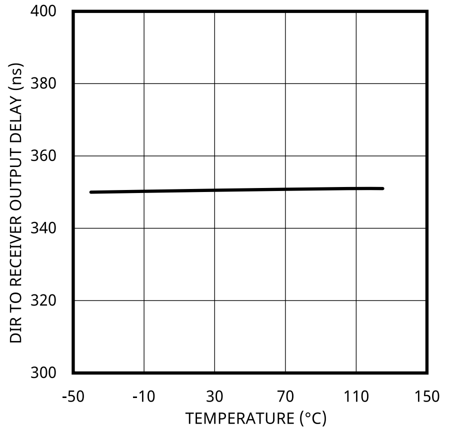


Figure 20. DIR to Receiver Output Delay vs. Temperature

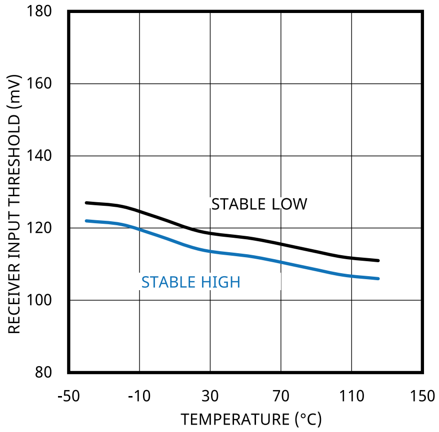


Figure 21. Receiver Input Threshold vs. Temperature

6. DETAILED DESCRIPTION

6.1 OVERVIEW

The LB5377 is a fully integrated transceiver compliant with AISG. There is an OOK modulator, a bandpass filter compliant with the AISG spectrum emission profile, and an output amplifier in the LB5377 transmitter. With external resistors, the output power can vary from +7dBm to +12dBm (+1dBm to +6dBm at the feeder cable) to compensate for loss in the external circuitry and cabling. By applying an external 8.704MHz crystal to the OOK internal modulator through the XTAL1 and XTAL2 pins, the OOK carrier can be generated. When connecting XTAL2 to ground, an external clock source at the same frequency can also be applied to XTAL1.

A bandpass filter with narrow 200kHz bandwidth is included in the LB5377 receiver. It operates around the 2.176MHz center frequency. Furthermore, the LB5377 receiver integrates an OOK demodulator and a comparator that reconstruct the digital signal. The minimum typical sensitivity of the receiver is –15dBm as per the AISG standard.

The LB5377 also provides a direction output for the RS-485 bus arbitration in tower-mounted equipment.

6.2 DIRECTION OUTPUT

The LB5377 direction output pin (DIR) can be used to determine the direction of the data flow. For example, when the tower acts as a slave in the AISG protocol, the base is the master and it controls the data flow by performing the bus arbitration. With the DIR pin, the equipment in the tower can avoid any involvement in the bus arbitration. See **Figure 26** for an example of using the LB5377 in the tower together with the RS-485 transceiver.

The output DIR drives the DE (driver output enable) and RE (receiver output enable) of the RS-485 transceiver. The DIR pin is asserted high whenever the data flows from RXIN to RXOUT. When the LB5377 is located in the tower, the data flow is sent from the base (master) to the tower (slave). Conversely, when the data flows from TXIN to TXOUT, the DIR pin is asserted low. In spite of that, the LB5377 internal state machine can sense both the TXIN and RXIN lines, recognize the correct data flow, and prevent the DIR from being asserted high.

Figure 22 and **Figure 23** show the timing diagrams of the DIR functionality. When the data flows from RXIN to RXOUT, DIR remains high for 16 bit-times after the last logic-level low bit within the 8-bit protocol data. This complies with the AISG specification—the RS-485 transmitter stops driving the bus within 20 bit-times after the last stop bit is sent. The input pins DIRMD2 and DIRMD1 define the duration of the bit time. See **Table 8**.

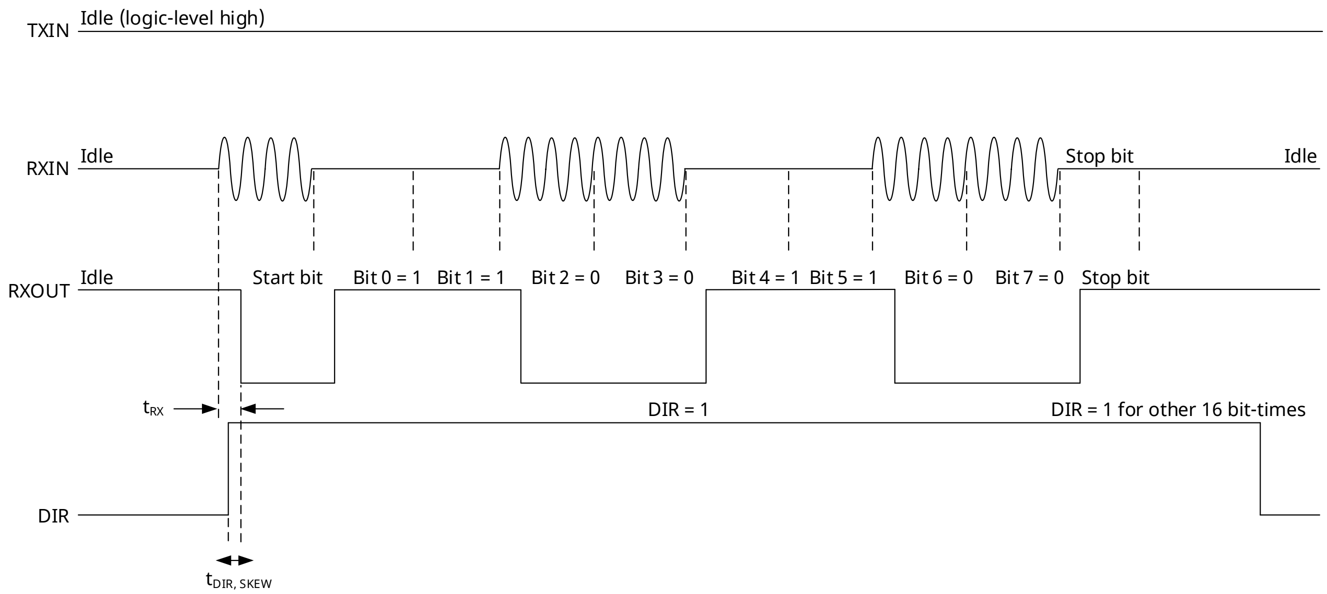


Figure 22. Data Flow from Base to Tower (LB5377 in the Tower)

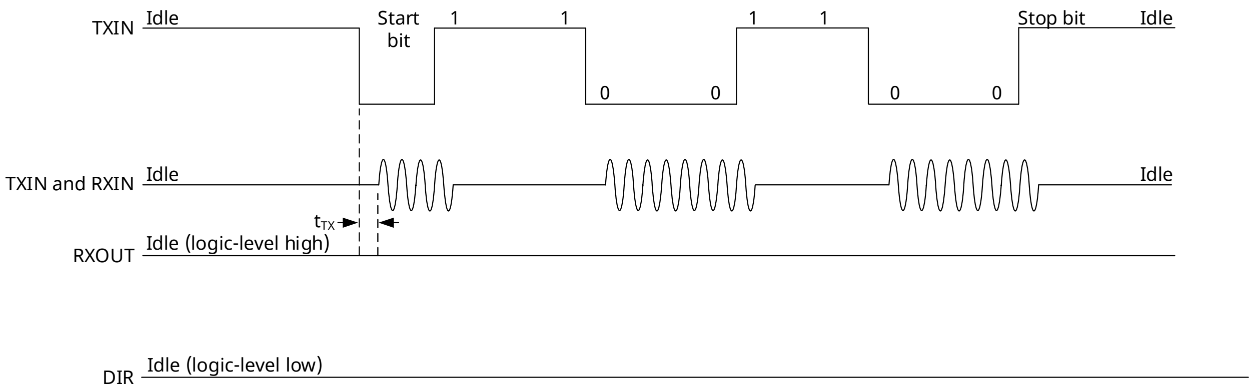


Figure 23. Data Flow from Tower to Base (LB5377 in the Tower)

Table 8 provides information about the bit-time duration selector.

Table 8. Bit-Time Duration Selector

DIRMD2	DIRMD1	AISG DATA RATE (kbps)	UNITY BIT TIME (μs)
0	0	9.6	104.16
0	1	38.4	26.04
1	0	115.2	8.68
1	1	Standy	Standy

7. APPLICATION AND IMPLEMENTATION

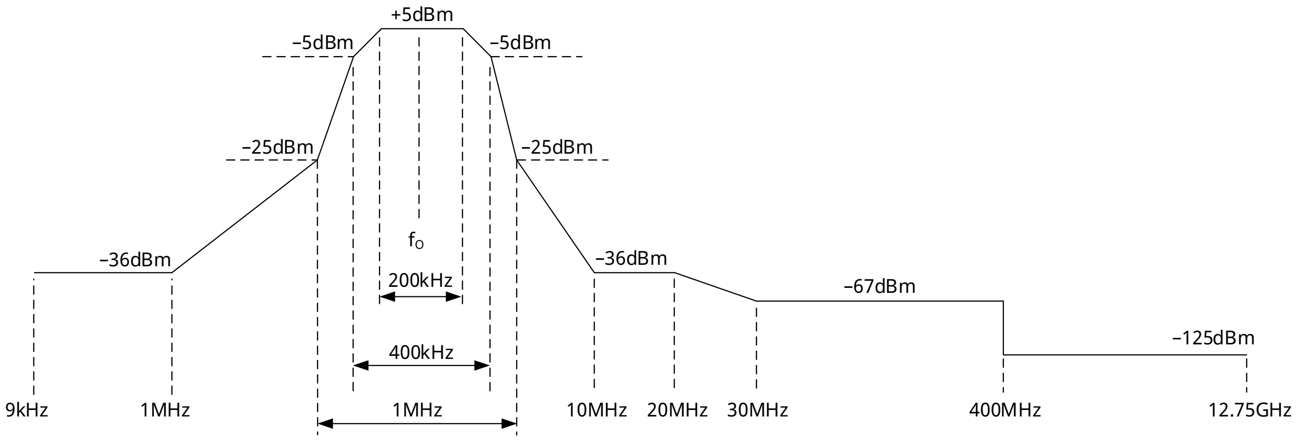
NOTE

The information provided in this section is not part of the AnalogySemi component specification. Hence, AnalogySemi does not warrant its completeness or accuracy. Customers are responsible for determining suitability of components and system functionality for their applications. Validation and testing should be performed prior to design implementation.

7.1 APPLICATION INFORMATION

7.1.1 EMISSION OUTPUT PROFILE

In the AISG standard, the maximum spectrum emission is defined for all the OOK modulating devices. See **Figure 24** for such a spectrum.



Note: Spectrum emission with 50% duty-cycle OOK, in compliant with AISG TS 25.461.

Figure 24. Modem Spectrum Emission Mask Conforming to AISG Standard

The LB5377 is compliant with the AISG standard. It is recommended to connect an external 470pF capacitor between RXIN and ground for compliance above 25MHz (see **Figure 25** and **Figure 26**).

7.1.2 EXTERNAL TERMINATION AND AC-COUPLING TO FEEDER CABLE

The LB5377 transceiver can operate with an external 50Ω termination. The termination is connected serially between TXOUT and the feeder cable. It acts as series termination for the transmitting path (data flow from TXIN to TXOUT) and acts as parallel termination for data received from RXIN.

The transmitter output is biased at 1.5V to maximize the power-supply rejection ratio and minimize the emission. The device is recommended to be AC-coupled to the feeder cable through an external RF filter or a series 100nF capacitor.

7.1.3 TRANSMISSION OUTPUT POWER

The LB5377 output level at TXOUT can be set by connecting two external resistors at the RES and BIAS pins, as shown in **Figure 25** and **Figure 26**. The maximum voltage at TXOUT is $2.52V_{P-P}$. When the feeder cable is terminated into a 50Ω impedance, the external filter is lossless at 2.176MHz, and a series 50Ω termination is being used as in **Figure 25** and **Figure 26**, the output level of $2.52V_{P-P}$ corresponds to +6dBm at the feeder cable.

The TXOUT voltage level can be different based on the following equations:

$$V_{TXOUT}\ (V_{P-P}) = (2.52V_{P-P} \times V_{RES}\ (V))\ /\ 1.5V$$

$$V_{RES}\ (V) = 1.5V \times R2\ /\ (R1 + R2)$$

$$V_{TXOUT}\ (V_{P-P}) = 2.52V_{P-P} \times R2\ /\ (R1 + R2)$$

For maximum voltage level of $2.52V_{P-P}$, use 0Ω R1. The voltage at the RES pin must be between 0.84V and 1.5V so that the minimum voltage level at TXOUT is approximately 1.41V and corresponds to +1dBm at the feeder cable. A 1μF capacitor is recommended to be connected between the BIAS pin and ground.

According to the AISG standard, the nominal power level at the feeder cable should be +3dBm. To meet this requirement, use 4.1kΩ R1 and 10kΩ R2 that provide $1.78V_{P-P}$ at TXOUT.

The LB5377 can provide up to $2.52V_{P-P}$ to compensate for potential loss within the external filter, cable, connections, and termination.

7.1.4 RECEIVER-INPUT RANGE AND THRESHOLD

At RXIN, the maximum OOK input power into the 50Ω external termination is +5dBm, which corresponds to $1.12V_{P-P}$ for a single-tone signal at 2.176MHz.

As conformed to the AISG standard, the internal threshold of the LB5377 is −15dBm ($112.4mV_{P-P}$) with ±3dB accuracy. This threshold sets the minimum input signal level for recognizing the presence of the OOK carrier (level logic-low).

Assume a corner case where the 2.176MHz OOK signal present at the RXIN pin is at the minimum level of −15dBm ± 3dB. Any other adjacent carrier with power up to +5dBm must be below 1.1MHz or above 4.5MHz to avoid the saturation of the receiver input stage.

7.1.5 EXTERNAL CLOCK

The LB5377 integrates an AISG-compliant transceiver. The transceiver works with an external crystal at 4 × the 2.176MHz frequency, or 8.704MHz. To meet the AISG standard of ±100ppm frequency stability, a crystal is needed. It is recommended to connect a crystal with ±30ppm and two 40pF (±10% tolerance) capacitors to ground, as shown in **Figure 25** and **Figure 26**. The capacitors do not affect the oscillation frequency.

For multiple LB5377, they can share the same crystal. By means of the SYNCOUT pin, one LB5377 acts as the master and provides the 8.704MHz clock signal to the slave device(s). Connect XTAL2 to ground when configuring a device as the slave. The external clock from the master device feeds the XTAL1 pin of the slave device through a series 10kΩ resistor.

Connect a 1kΩ pullup resistor to V_{CC} from the SYNCOUT pin of the master device.

7.2 TYPICAL APPLICATION

This section gives typical examples for using the LB5377 in various situations.

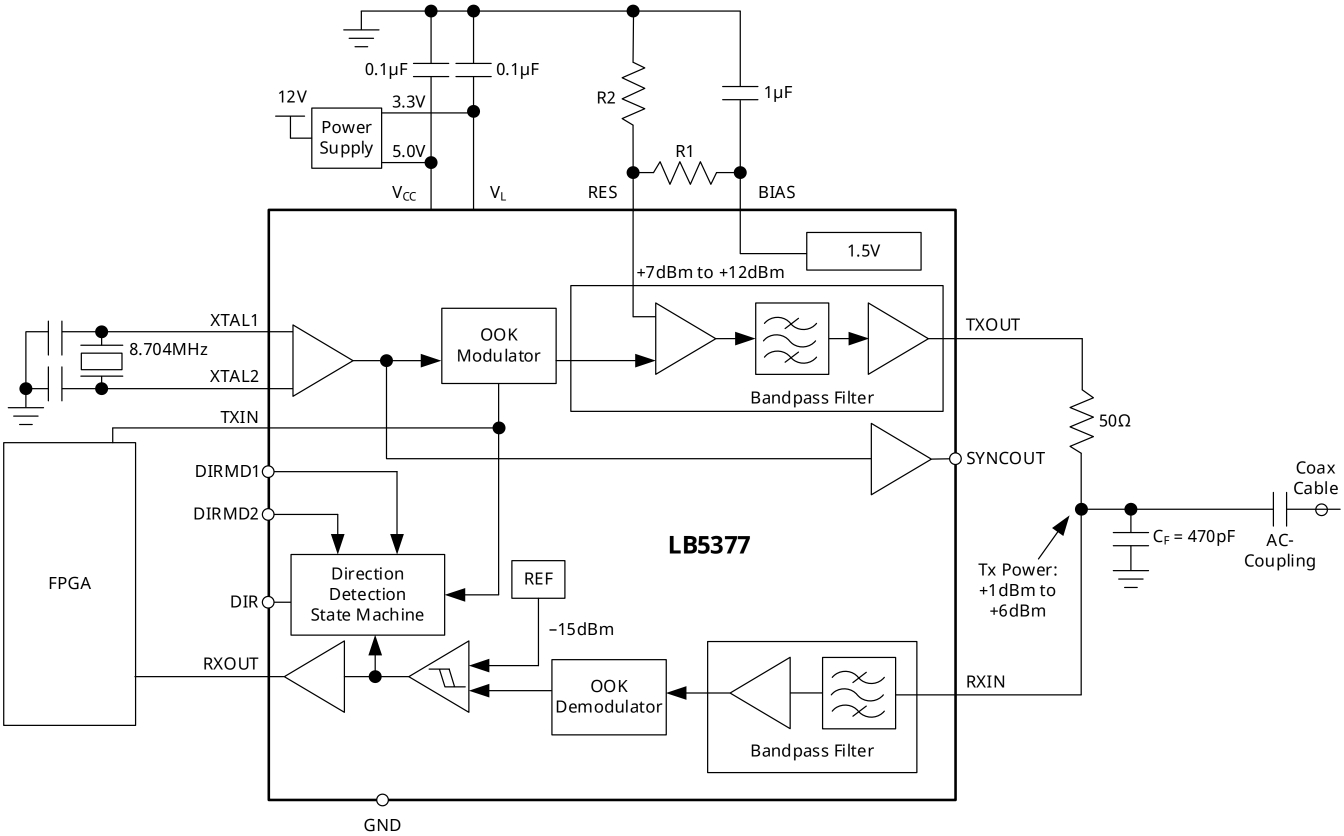


Figure 25. Typical Example (Connectivity at the Base)

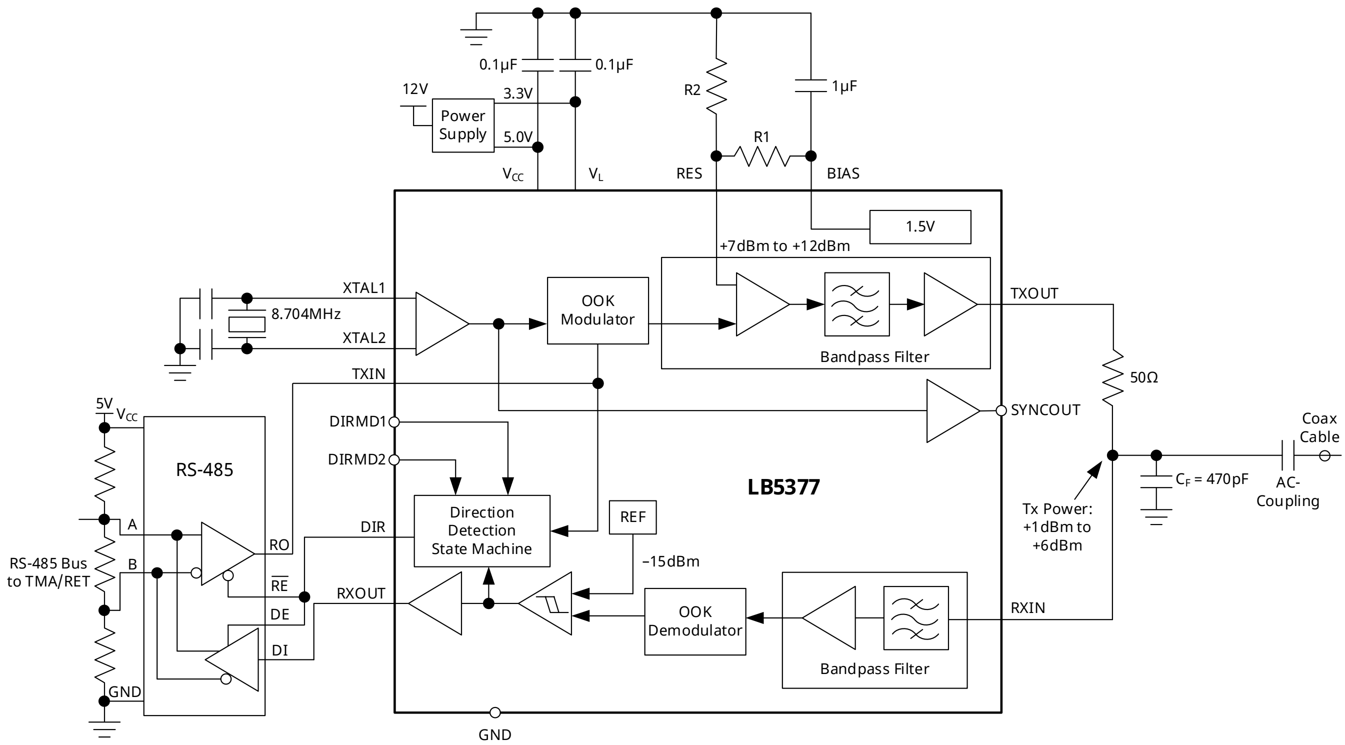


Figure 26. Typical Example (Connectivity at the Tower)

8. PACKAGE INFORMATION

The LB5377 is available in the 3mm × 3mm QFN-16 (P0.50T0.75) package. **Figure 27** shows the package view.

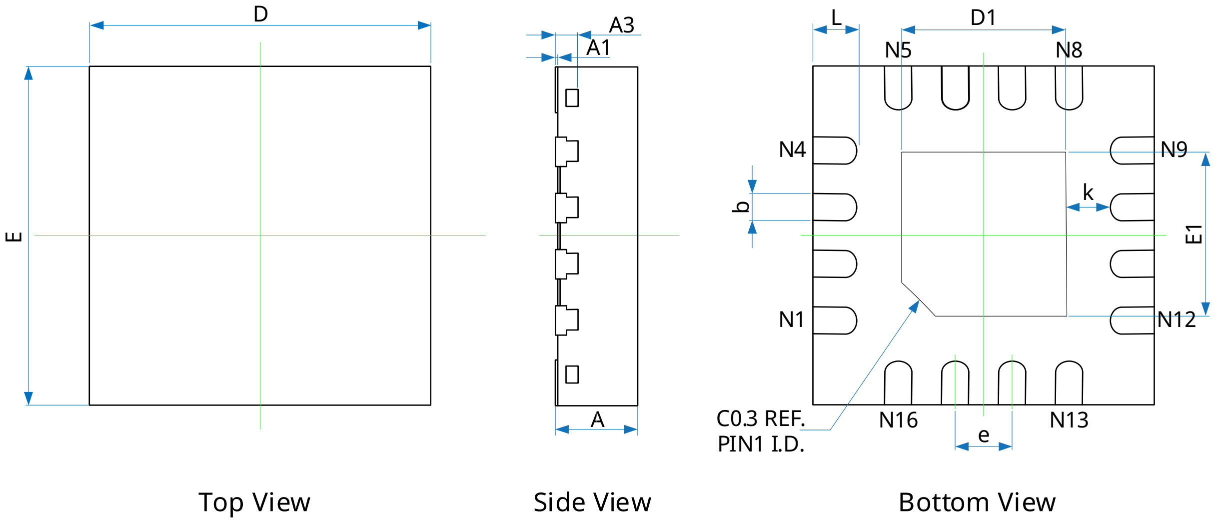


Figure 27. Package View

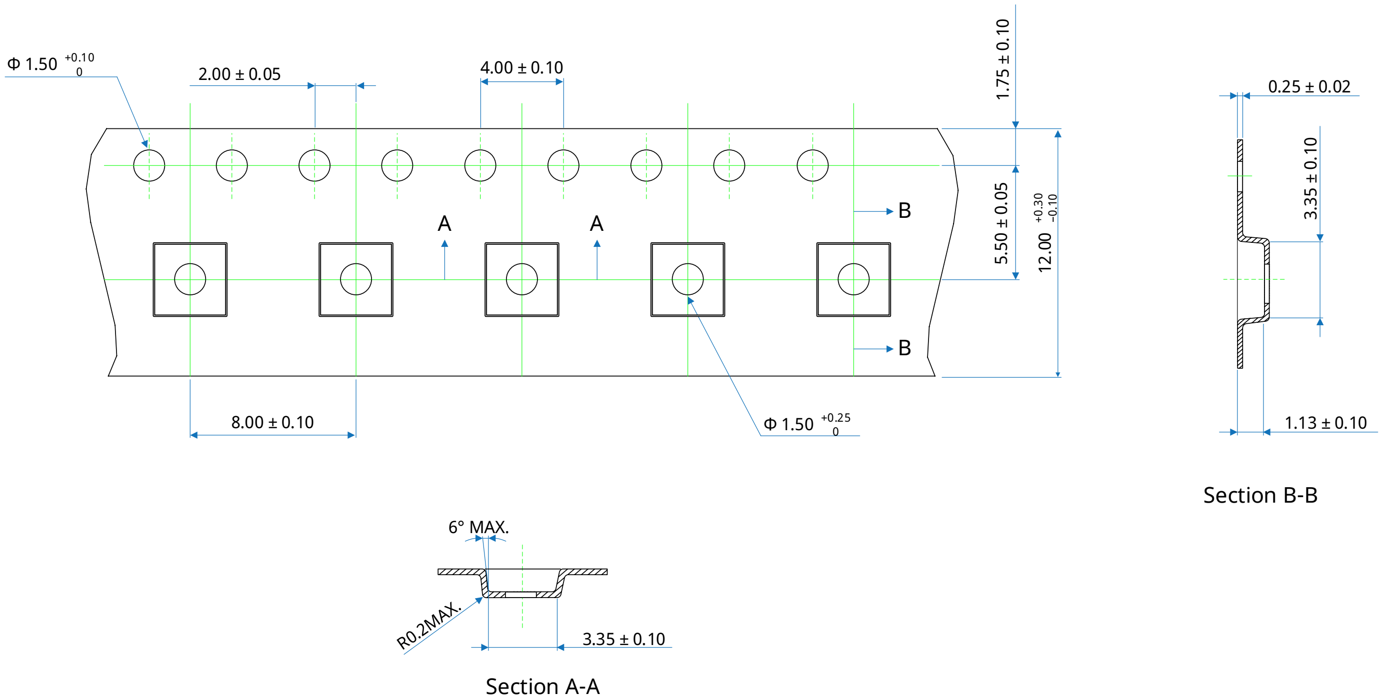
Table 9 provides detailed information about the dimensions.

Table 9. Dimensions

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
A3	0.203REF.		0.008REF.	
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
D1	1.350	1.550	0.053	0.061
E1	1.350	1.550	0.053	0.061
k	0.375REF.		0.015REF.	
b	0.200	0.300	0.008	0.012
e	0.500BSC.		0.020BSC.	
L	0.300	0.500	0.012	0.020

9. TAPE AND REEL INFORMATION

Figure 28 illustrates the carrier tape (model: IC-ZD-11, width = 12mm, pitch = 8mm).



Notes:
1. Cover tape width: 9.50 ± 0.10.
2. Cumulative tolerance of 10 sprocket hole pitch: ±0.20 (max).
3. Camber: not to exceed 1mm in 100mm.
4. Mold#: QFN (3x3).
5. All dimensions: mm.
6. Direction of view:

Figure 28. Carrier Tape Drawing

Table 10 provides information about tape and reel.

Table 10. Tape and Reel Information

PACKAGE TYPE	REEL	QTY/REEL	REEL/ INNER BOX	INNER BOX/ CARTON	QTY/CARTON	INNER BOX SIZE (MM)	CARTON SIZE (MM)
QFNWB3*3 (T0.75)	13'' D = 330mm	5000	1	8	40000	358*340*50	430*380*390

Figure 29 shows the product loading orientation—pin 1 is assigned on the upper left corner.

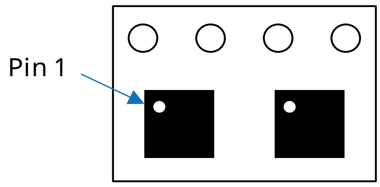


Figure 29. Product Loading Orientation

 Public

REVISION HISTORY

REVISION	DATE	DESCRIPTION
Rev A	17 November 2021	Rev A release.