High-performance FSK Wireless Receiver Module

SPECIFICATION

Model No.: DL-RXC2219A/B

Version: V2.0

Before using this module, please read this document carefully, and pay attention to the following important matters:

This module is an electrostatic sensitive product. Please operate it on an anti-static workbench during installation and testing.

The module uses an external antenna by default. The antenna can be a wire antenna or a standard UHF antenna. You can choose a specific antenna according to the actual situation. If the terminal product uses a metal shell, be sure to install the antenna outside the metal shell. Otherwise, the RF signal will be seriously attenuated, which will affect the effective distance.

Metal objects and wires should be kept away from the antenna as much as possible.

When installing the module, nearby objects should be kept at a sufficient safety distance from the module to prevent short circuit damage.

This module should be used in a dry environment. Please do not make any liquid substance come into this module.

Please use an independent voltage regulator circuit to supply power to this module, and avoid sharing with other circuits. The tolerance of the power supply should not be less than 5%.

Limitations:

This module is intended to be embedded in the customer's terminal product application, and does not provide a casing itself. It is not recommended that the customer directly resell this module as a final product without permission.

This series of modules are in accordance with commonly used international standards. If there is any special certification needed, we can adjust certain indicators according to your needs.

This module cannot be applied to life rescue, life-support systems, or any occasion where personal injury or life threatening may cause by equipment failure. Any organization or individual carrying out the above-mentioned applications shall bear all risks at their own.

We will not be responsible for any direct or indirect damage, injury or loss of profits caused by products that use this module.

Abbreviations

Abbreviations used in this data sheet are described below.

ADC	Analog to Digital Converter	**NP0**	Negative-Positive-Zero
AFC	Automatic-Frequency-Control	**NC**	Not Connected
AGC	Automatic Gain Control	**OOK**	On-Off Keying
AN	Application Notes	**PC**	Personal Computer
BER	Bit Error Rate	**PCB**	Printed Circuit Board
BOM	Bill of Materials	**PLL**	Phase Lock Loop
BSC	Basic Spacing between Centers	**PN9**	Pseudorandom Noise 9
BT	bandwidth-time product	**POR**	Power On Reset
BW	Bandwidth	**PUP**	Power Up
CRC	Cyclic Redundancy Check	**QFN**	Quad Flat No-lead
DC	Direct Current	**RESV**	Reserved
EEPROM	Electrically Erasable Programmable Read-Only	**RF**	Radio Frequency
	Memory	**RFPDK**	RF Products Development Kit
ESD	Electro-Static Discharge	**RoHS**	Restriction of Hazardous Substances
ESR	Equivalent Series Resistance	**RSSI**	Received Signal Strength Indicator
Ext	Extended	**Rx**	Receiving, Receiver
FIFO	First In First Out	**SAR**	Successive Approximation Register
FSK	Frequency-Shift Keying	**SMD**	Surface Mounted Devices
GFSK	Gauss frequency Shift Keying	**SPI**	Serial Port Interface
GPO	General Purpose Output	**SR**	Symbol Rate
HEX	Hexadecimal	**STBY**	Standby
IF	Intermediate Frequency	**TH**	Threshold
LNA	Low Noise Amplifier	**Tx**	Transmission, Transmitter
LO	Local Oscillator	**Typ**	Typical
LPOSC	Low Power Oscillator	**USB**	Universal Serial Bus
Max	Maximum	**VCO**	Voltage Controlled Oscillator
MCU	Microcontroller Unit	**WOR**	Wake-On Radio
Min	Minimum	**XOSC**	Crystal Oscillator
MOQ	Minimum Order Quantity	**XTAL/Xtal**	Crystal
NA	Not Applicable/Not Available		

The DL-RXC2219A/B is an ultra-low power, high performance, OOK and (G)FSK receiver 868 MHz wireless applications. includes a complete line of transmitters, receivers and transceivers. All features can be configured either by off-line EEPROM programming or on-line registers writing. The configuration file to be written, into the registers is generated by the smart RF PDK.

The DL-RXC2219A/B operates from a supply voltage of 1.8 V to 3.6V, when it is always on, it consumes only 5.7 mA current while achieving -109 dBm receiving sensitivity (FSK, 9.6 ksps symbol rate, 868.35 MHz), and only 60 nA sleep current for superior battery life. The device supports packet handling, 32-byte FIFO, Manchester decoding and data de-whitening for the received data processing. Besides the demodulated data and the sync clock, the device can also send out the power-on reset, the system clock, as well as 2 configurable interrupts for the external device. DL-RXC2219A/B receiver together with the DL-TXC2119A/B transmitter enables a powerful RF link.

1. Features:

- Embedded EEPROM, RoHS Compliant
- Very Easy Development with RFPDK. All Features Programmable
- Frequency: 868 MHz FSK, GFSK and OOK Demodulation Symbol Rate: 0.1 to 100 ksps
- Sensitivity: -109 dBm @ 9.6 ksps, FSK, 868M Hz
- 4-wire SPI Interface
- Direct, Buffer and Packet Mode Supported
- Configurable Data Handler and 32-Byte FIFO
- Manchester Decoding and Data De-Whitening
- Supply Voltage: 1.8 to 3.6 V
- Low Power Consumption: 5.7 mA Low Sleep Current
- 60 nA when Sleep Timer Off
- 440 nA when Sleep Timer on
- Module Size:15*12.5*1.8mm

2. Applications:

- Low-Cost Consumer Electronics Applications
- Home and Building Automation
- Infrared Receiver Replacements
- Industrial Monitoring and Controls
- Remote Automated Meter Reading
- Remote Lighting Control System
- Wireless Alarm and Security Systems
- Remote Keyless Entry (RKE)

3. Electrical Characteristics

VDD = 3.3 V, T_{OP} = 25 ℃, F_{RF} = 868.35 MHz, sensitivities are measured in receiving a PN9 sequence and matching to 50 Ω impedance, with the BER of 0.1%. All measurements are performed using the board DL-RXC2219A/B-EM V1.0, unless otherwise noted.

3.1 Recommended Operation Conditions

Table 2. Recommended Operation Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operation Voltage Supply	V_{DD}		1.8		3.6	V
Operation Temperature	T_{OP}		-40		85	℃
Supply Voltage Slew Rate			1			mV/us

3.2 Absolute Maximum Ratings

Table 3. Absolute Maximum Ratings[1]

Parameter	Symbol	Conditions	Min	Max	Unit
Supply Voltage	V_{DD}		-0.3	3.6	V
Interface Voltage	V_{IN}		-0.3	V_{DD} + 0.3	V
Junction Temperature	T_J		-40	125	℃
Storage Temperature	T_{STG}		-50	150	℃
Soldering Temperature	T_{SDR}	Lasts at least 30 seconds		255	℃
ESD Rating[2]		Human Body Model (HBM)	-2	2	kV
Latch-up Current		@ 85 ℃	-100	100	mA

Notes:

[1]. Stresses above those listed as "absolute maximum ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

[2]. The RFM219S is high-performance RF integrated circuits with VCON/P pins having an ESD rating < 2 kV HBM. Handling and assembly of this device should only be done at ESD-protected workstations.

Caution! ESD sensitive device. Precaution should be used when handling the device in order to prevent permanent damage.

3.3 Receiver Specifications

Table 4. Receiver Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Frequency Range	F_{RF}		300		960	MHz
Symbol Rate	SR	OOK demodulation	0.1		40	ksps
		(G)FSK demodulation	0.1		100	ksps
Deviation	F_{DEV}	(G)FSK	1		200	kHz
Bandwidth-Time Product	BT		-	0.5	-	-
OOK Sensitivity	$S_{315\text{-}OOK}$	315 MHz, SR = 1 ksps		-114		dBm
	$S_{433.92\text{-}OOK}$	433.92 MHz, SR = 1 ksps		-113		dBm
	$S_{868.35\text{-}OOK}$	868.35 MHz, SR = 1 ksps		-110		dBm
	$S_{915\text{-}OOK}$	915 MHz, SR = 1 ksps		-109		dBm
(G) FSK Sensitivity	$S_{315\text{-}FSK}$	315 MHz, SR = 9.6 ksps, F_{DEV} = 19.2 kHz		-112		dBm
	$S_{433.92\text{-}FSK}$	433.92 MHz, SR = 9.6 ksps, F_{DEV} = 19.2 kHz		-111		dBm
	$S_{868.35\text{-}FSK}$	868.35 MHz, SR = 9.6 ksps, F_{DEV} = 19.2 kHz		-109		dBm
	$S_{915\text{-}FSK}$	915 MHz, SR = 9.6 ksps, F_{DEV} = 19.2 kHz		-109		dBm
Saturation Input Signal Level	P_{LVL}			10		dBm
OOK Working Current	$I_{DD\text{-}OOK}$	315 MHz, OOK		3.5		mA
		433.92 MHz, OOK		3.8		mA
		868.35 MHz, OOK		5.2		mA
		915 MHz, OOK		5.4		mA
FSK Working Current	$I_{DD\text{-}FSK}$	315 MHz, FSK		4.0		mA
		433.92 MHz, FSK		4.3		mA
		868.35 MHz, FSK		5.7		mA
		915 MHz, FSK		5.9		mA
Sleep Current	I_{SLEEP}	When sleep timer is turned on		440		nA
		When sleep timer is turned off		60		nA
Frequency Resolution	F_{RES}			24.8		Hz
Frequency Synthesizer Settle Time	T_{LOCK}	From XOSC settled		150		us
Blocking Immunity	BI	SR = 1 ksps, ±1 MHz offset, CW interference		52		dB
		SR = 1 ksps, ±2 MHz offset, CW interference		74		dB
		SR = 1 ksps, ±10 MHz offset, CW interference		75		dB
Image Rejection Ratio	IMR	IF = 280 kHz		35		dB
Input 3rd Order Intercept Point	IIP3	Two tone test at 1 MHz and 2 MHz offset frequency. Maximum system gain settings		-25		dBm
Receiver Bandwidth	BW		50		500	kHz
Receiver Start-up Time	$T_{START\text{-}UP}$	From power up to receive, in Always Receive Mode		7.3		ms
Receiver Wake-up Time	$T_{WAKE\text{-}UP}$	From sleep to receive, in Duty-Cycle Receive Mode		0.61		ms

3.4 Crystal Oscillator

Table 5. Crystal Oscillator Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Crystal Frequency[1]	F_{XTAL}		26	26	26	MHz
Crystal Tolerance[2]				±20		ppm
Load Capacitance	C_{LOAD}		10	15	20	pF
Crystal ESR	Rm				60	Ω
XTAL Startup Time[3]	t_{XTAL}			400		us

Notes:

[1]. The RFM219S can directly work with external 26 MHz reference clock input to XIN pin (a coupling capacitor is required) with peak-to-peak amplitude of 0.3 to 0.7 V.

[2]. This is the total tolerance including (1) initial tolerance, (2) crystal loading, (3) aging, and (4) temperature dependence. The acceptable crystal tolerance depends on RF frequency and channel spacing/bandwidth.

[3]. This parameter is to a large degree crystal dependent.

3.5 LPOSC

Table 6. LPOSC Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Calibrated Frequency[1]	F_{LPOSC}			1		kHz
Frequency Accuracy		After calibration		1		%
Temperature Coefficient[2]				-0.02		%/°C
Supply Voltage Coefficient[3]				+0.5		%/V
Initial Calibration Time	$t_{LPOSC-CAL}$			4		ms

Notes:

[1]. The LPOSC is automatically calibrated to the crystal oscillator during the PUP state, and is periodically calibrated since then.

[2]. Frequency drifts when temperature changes after calibration.

[3]. Frequency drifts when supply voltage changes after calibration.

4. Pin Descriptions

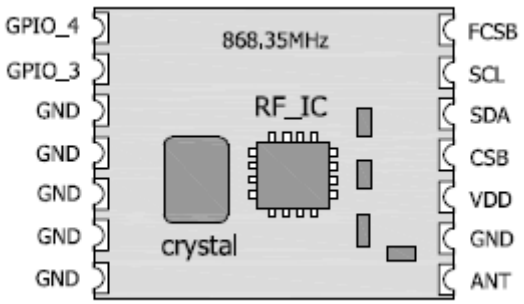


Figure 2. Pin Diagram

Table 7. Pin Descriptions

Pin Number	Name	I/O	Descriptions
1	ANT	I	RF signal input to the LNA
2	GND	I	Ground
3	VDD	I	Power supply input
4	CSB	I	3-wire SPI chip select input for EEPROM programming
5	SDA	I/O	3-wire SPI data input and output for EEPROM programming
6	SCL	I	3-wire SPI clock input for EEPROM programming
7	FCSB	I	
8	GPIO4(DATA)	O	Received data output
9	GPIO3	I/O	data output
10,11,12,13,14	GND	I	Ground

5. Typical Application Schematic

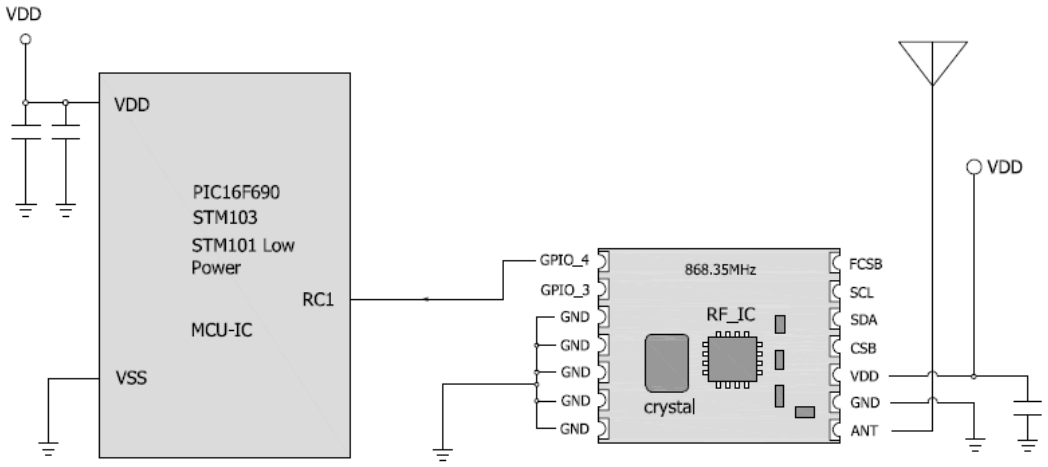


Figure 9: Typical Application Schematic

6. Functional Descriptions

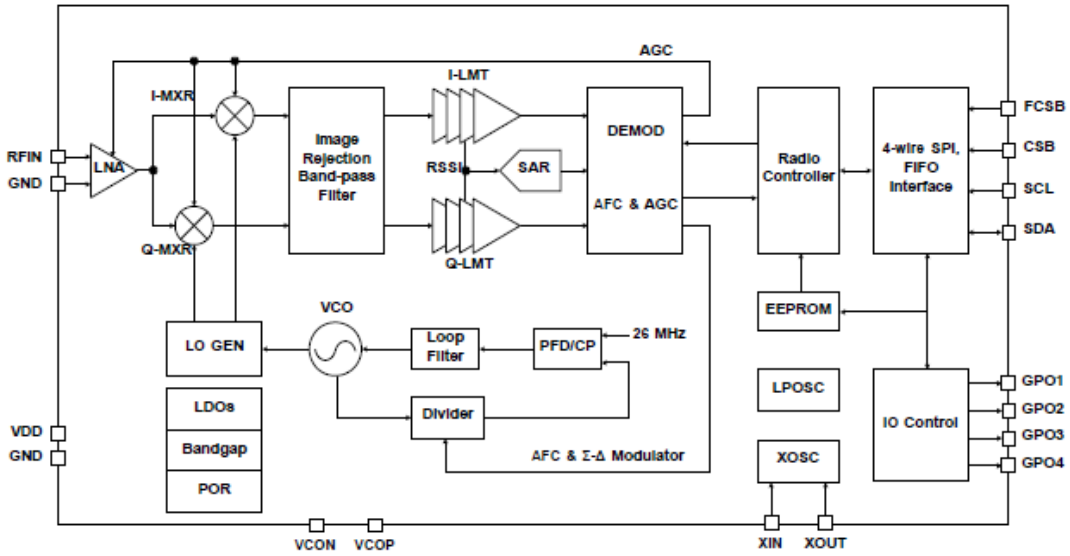
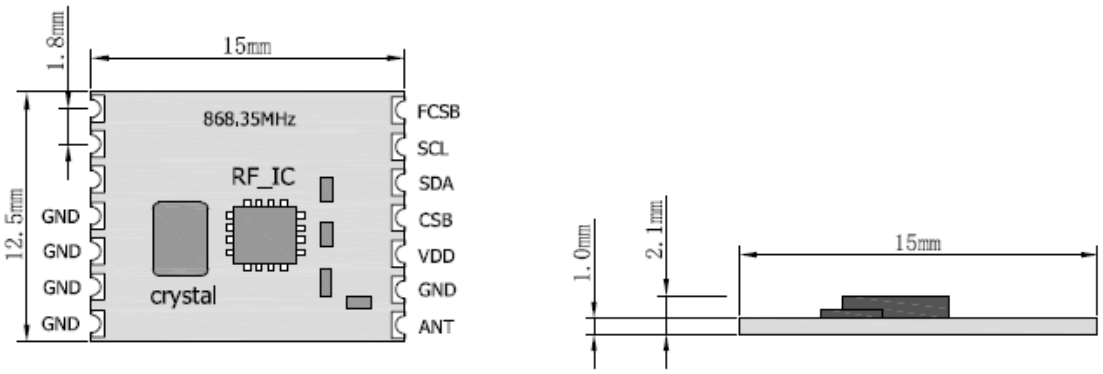


Figure 10. Functional Block Diagram

7. Package Outline



8. Typical Performance Characteristics

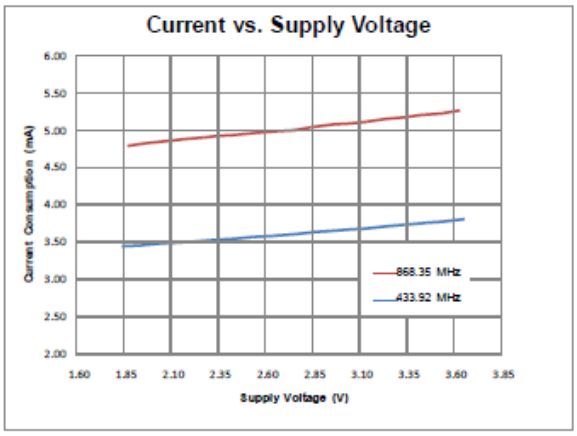


Figure 3. Current vs. Voltage, F_{RF} = 433.92 / 868.35 MHz, OOK, SR = 1 ksps

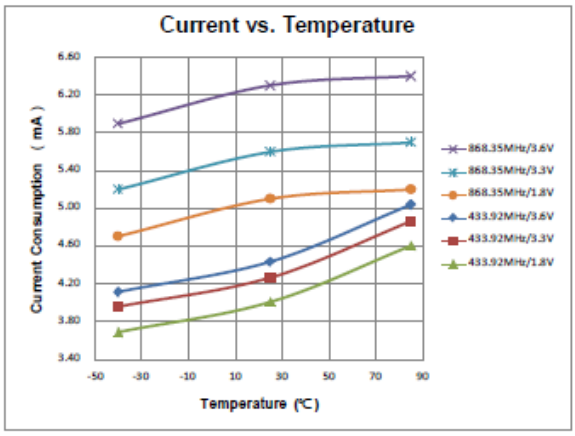


Figure 4. Current vs. Temperature, F_{RF} = 433.92 / 868.35 MHz, FSK, SR = 1 ksps

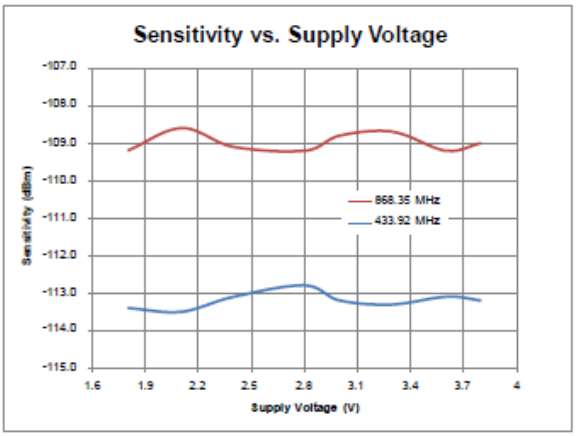


Figure 5. Sensitivity vs. Supply Voltage, SR = 1 ksps, OOK, BER = 0.1%

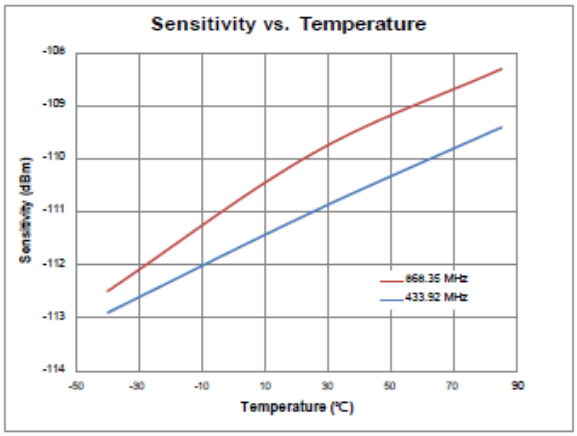


Figure 6. Sensitivity vs. Temperature, F_{RF} = 433.92 / 868.35 MHz, FSK, V_{DD} = 3.3 V, SR = 1 ksps, BER = 0.1%

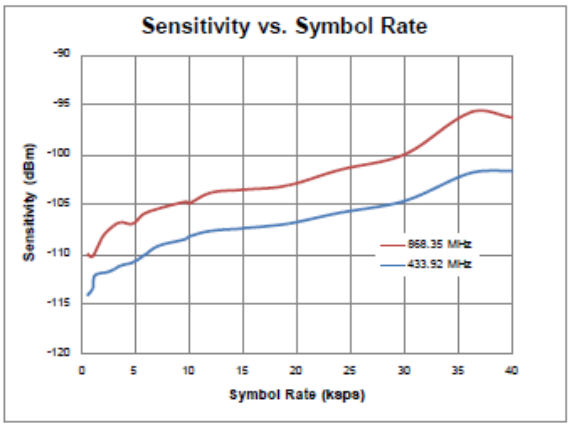


Figure 7. Sensitivity vs. SR, F_{RF} = 433.92 / 868.35 MHz, OOK, V_{DD} = 3.3 V, BER = 0.1%

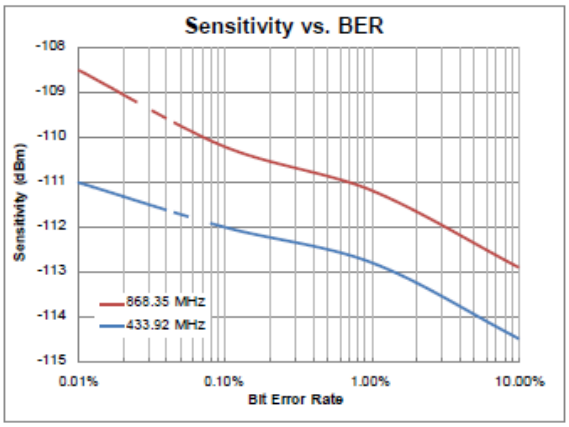


Figure 8. Sensitivity vs. BER, F_{RF} = 433.92 / 868.35 MHz, V_{DD} = 3.3 V, SR = 1 ksps

9. Problems in module application

Considering the complexity of data transmission over the air, the radio frequency modulation method of the data, and some inherent characteristics of electromagnetic waves, the following issues should be considered during the application process.

1. The electromagnetic interference of the application environment will affect the actual distance of the remote control. Electromagnetic wave interference is divided into mainboard power supply interference, TFT screen data cable interference, Flash data exchange interference; and airborne carrier frequency interference, noise interference, high-power signal source interference, etc.
2. Factors such as product size, internal space, and coating of the shell will cause the attenuation of the wireless signal, which will affect the remote-control distance. Usually the narrow internal space of the product is not conducive to the extension of the antenna. The outer shell should avoid metal or metal plating as much as possible.
3. To choose a proper antenna is very important. The antenna is an important part of the communication system, and its performance directly affects the indicators of the communication system. We must pay attention to its performance (antenna type, antenna electrical performance) when selecting the antenna. Please feel free to contact us for consultation or recommendation, if you need.

10. Contact us

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★ Data collection, Smart home, Internet of Things applications, Wireless remote control technology, Remote active RFID, Antennas ★

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