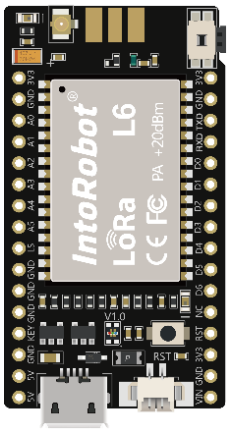
IntoRobot

Ant LoRa™ Datasheet



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Category

Chart Category

1 Overview

1.1 Product Description

IntoRobot-Ant (Ant, for short), designed by Shenzhen MOLMC Technology co., Ltd., is a kind of LoRa™ communication board, with the advantages of long distance, compact package and low power consumption. The board operates at the frequency range of Sub-1GHz, including 433MHz and 470MHz.

Ant is designed based on L6. L6 integrates the chip SX1276/1278 from Semtech, and its LoRa™ modulation mode is backward compatible with FSK and OOK. The LoRa™ spread spectrum modulation technology exhibits extremely high receive sensitivity and anti-jamming ability; the communication distance as well as the receive sensitivity is much larger than those of FSK and GFSK modulation modes. L6 integrates a high-performance data processing MCU, a 32-bit ARM Cortex-M3 chip STM32L151CB. The MCU supports 1.25DMOPS at 32MHz operating frequency, and the power consumption is lower than 0.28uA when standby.

Ant encrypts the wireless data with the AES128 technology, making the data transmission safe. The board supports 2 working modes including continuous and power-saving modes. The board's power consumption is as low as 93uA, and can work at the power-saving mode for a long time with one-time battery power supply. Ant utilizes the imported power supply chip with low dropout and high ripple rejection ratio; it supports 5V power supply and direct 3.7v battery power in. In addition, the IoT demos can be quickly established, because a test led light and an illumination sensor are integrated on the board.

Ant's development is compatible with Arduino programming and internally integrates IntoRobot platform, which means the programming work can be decreased dramatically so the product development cycle can also be reduced. The most creative ideas can be achieved when L6 is combined with IntoRobot and IntoRobot-APP.

1.2 Key Specification

- Transmission distance more than 10Km in open space;
- Radio frequency: 433/470 MHz;
- LoRa™ Modulation mode backward compatible with FSK and OOK;
- Receive sensitivity as low as -148dBm;
- RF output power: max 100mW (+20dBm)
- Power supply: 3.5~5.5V;
- Operating temperature: -40~+85℃;
- Plenty of interfaces: UART, SPI, I2C, ADC, DAC, USB, SWD;

- Support LoRaWan Class A, C;
- Support data encryption;

1.3 Product Applications

- Smart agriculture, forestry, animal husbandry and fishery;
- Smart logistics, e.g., cargo tracking, cold chain logistics, important assets monitoring;
- Smart city, e.g., smart metering, parking, street lighting, and fire alarms;
- Environment monitor, e.g., air quality monitoring (PM2.5, CO2, CO, and formaldehyde), forest fire monitoring, and water quality monitoring;
- Smart home and building, e.g., access control systems, security systems, and smoke alarms;
- Smart industry, e.g., industrial automation;
- Robotics and UAVs.

2 Hardware Specification

2.1 Specification Table

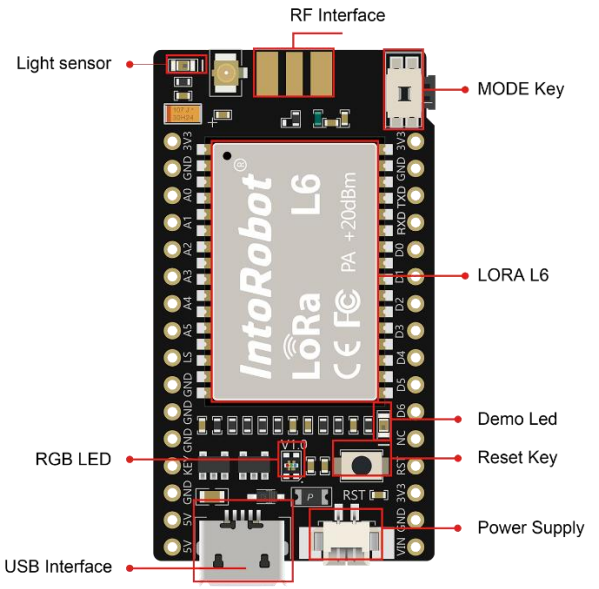
Chart 1: Specification Table

Product	IntoRobot Ant
Cloud Service	**IntoYun (www.intoyun.com)**
CPU	STM32L151CBU6A Cortex-M3 32bit，32MHz Flash: 128KB RAM: 32KB
Power Supply	3.5 ~ 5.5 V, typical 5V
Work Current	Transmission: Maximum current 140mA (20dBm)
	Receive: Maximum current 30mA
	Standby current 93uA
Radio Frequency	433MHz/470MHz
Modulation Mode	LoRa/FSK/OOK
Emission Power	2-20dBm
Receive Sensitivity	> -148dBm
Peripheral Interface	15 GPIO
	1 SPI
	2 UART
	1 I2C

	1 USB
	1 SWD
	1 Reset
	Power in pin 5V
	Antenna interface
Antenna Type	IPX/IPEX U.FL-R-SMT Antenna interface
Temperature	Operating Temperature -40°C - 85°C
	Storage Temperature -40°C - 125°C
	Humidity 10% - 90% Non-condensing
Panel Connection	Stamp Hole
Shield	Shield
Size	26.42mm(Width), 48.01mm(Length), 5.05mm(Height)

2.2 Pin Description

Chart 2: Block Diagram (Front View)



15 Groups GPIO、6 Group AD、7 Groups PWM、3 Group serial ports、
1 Group I2C、1 Group SPI

Chart 3: Pin Diagram

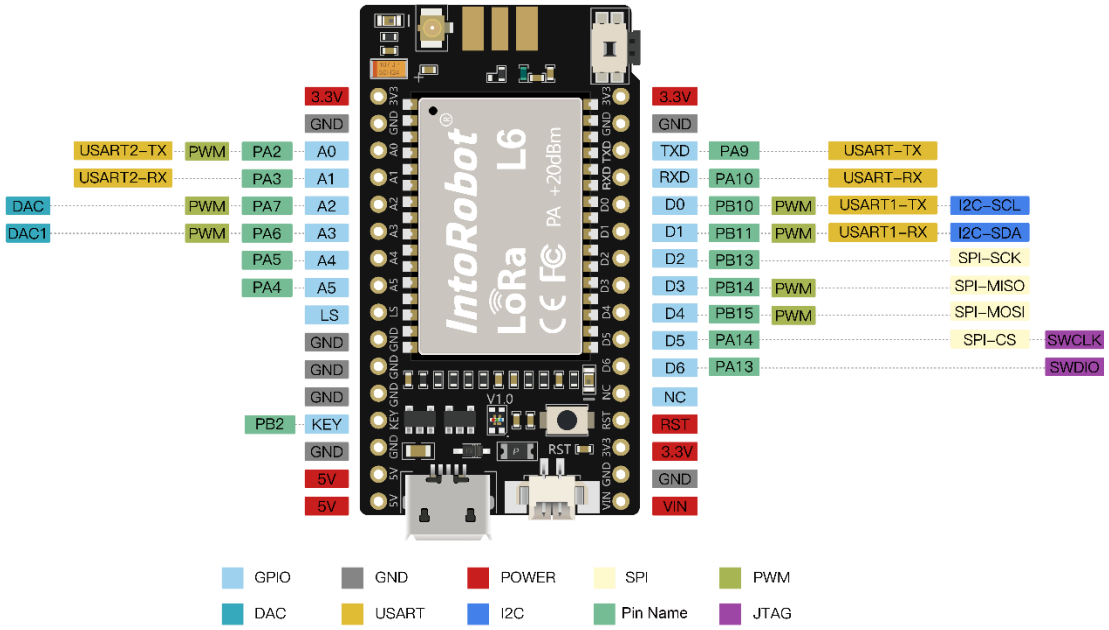


Chart 4: Pin Definition and Description

Pin	Name	Description
1	3V3	Power Out
2	GND	Ground
3	A0	USART2_TX/TIM2_CH3/ TIM9_CH1/ADC_IN2
4	A1	USART2_RX/TIM2_CH4/ ADC_IN3
5	A2	TIM3_CH2/ADC_IN7 (SPI1 Occupied by SX1278 in L6)
6	A3	TIM3_CH1/ADC_IN6 (SPI1 Occupied by SX1278 in L6)
7	A4	ADC_IN5/ DAC_OUT2 (SPI1 Occupied by SX1278 in L6)
8	A5	ADC_IN4/ DAC_OUT1 (SPI1 Occupied by SX1278 in L6)
9	LS	TIM3_CH1/ADC_IN6 (SPI1 Occupied by SX1278 in L6)
10	GND	Ground
11	GND	Ground
12	GND	Ground
13	KEY	PB2
14	GND	Ground
15	5V	Power Out
16	5V	Power Out
17	Vin	5V Power In

18	GND	Ground
19	3V3	3.3VPower Out
20	RST	Reset
21	NC	NC
22	D6	JTCK-SWCLK
23	D5	JTMS-SWDIO
24	D4	SPI2_MOSI/TIM11_CH1/ADC_IN21
25	D3	SPI2_MISO/TIM9_CH2/ADC_IN20
26	D2	SPI2_SCK/ADC_IN19
27	D1	I2C2_SDA/USART3_RX/ TIM2_CH4
28	D0	I2C2_SCL/USART3_TX/ TIM2_CH3
29	RXD	USART1_RX
30	TXD	USART1_TX
31	GND	Ground
32	3V3	3.3V Power Out

2.3 Electrical characteristics

2.3.1 Operating Environment

Chart 5: Recommended Operating Environment

Item	Label	Min	Typical	Max	Unit
Operating Tempererature	-	-40	20	85	℃
Storage Temperature	-	-40	20	125	℃
Power Supply	VDD	1.8	3.3	3.6	V
Operating Humidity	-	10%	-	90%	-

Test condition: IPC/JEDEC J-STD-020.

2.3.2 Digital Port Characteristics

Chart 6: Digital Port Characteristics

Label	Description	Condition	Min	Max	Unit
VIL	Input Level Logic Low	-	-	0.3VDD	V
VIH	Input Level Logic High	-	0.7VDD	-	V
VOL1	Output Level Logic Low	IIO=8mA	-	0.4	V

VOH1	Output Level Logic High	2.7V<VDD<3.6V	2.4	-	V
VOL2	Output Level Logic Low	IIO=4mA	-	0.45	V
VOH2	Output Level Logic High	1.65V<VDD<2.7V	VDD-0.45	-	V
VOL3	Output Level Logic Low	IIO=20mA	-	1.3	V
VOH3	Output Level Logic High	2.7V<VDD<3.6V	VDD-1.3	-	V

2.3.3 SPI Parameters

Chart 7: SPI Timing Parameters

Symbol	Parameter	Conditions	Min	Max(2)	Unit
f_{SCK} $1/t_{c(SCK)}$	SPI clock frequency	Master mode	-	16	MHz
		Slave mode	-	16	
		Slave transmitter	-	12(3)	
$t_{r(SCK)}$(2) $t_{f(SCK)}$(2)	SPI clock rise and fall time	Capacitive load: C = 30 pF	-	6	ns
DuCy(SCK)	SPI slave input clock duty cycle	Slave mode	30	70	%
$t_{su(NSS)}$	NSS setup time	Slave mode	$4t_{HCLK}$	-	ns
$t_{h(NSS)}$	NSS hold time	Slave mode	$2t_{HCLK}$	-	
$t_{w(SCKH)}$(2) $t_{w(SCKL)}$(2)	SCK high and low time	Master mode	$t_{SCK}/2-5$	$t_{SCK}/2+3$	
$t_{su(MI)}$(2)	Data input setup time	Master mode	5	-	
$t_{su(SI)}$(2)		Slave mode	6	-	
$t_{h(MI)}$(2)	Data input hold time	Master mode	5	-	
$t_{h(SI)}$(2)		Slave mode	5	-	
$t_{a(SO)}$(4)	Data output access time	Slave mode	0	$3t_{HCLK}$	
$t_{v(SO)}$(2)	Data output valid time	Slave mode	-	33	
$t_{v(MO)}$(2)	Data output valid time	Master mode	-	6.5	
$t_{h(SO)}$(2)	Data output hold time	Slave mode	17	-	
$t_{h(MO)}$(2)		Master mode	0.5	-	

2.3.4 I2C Interface

I2C interface is open drain, requiring external pull-up resister (4.7K Ω recommended).

Chart 8: I2C Interface Design Reference

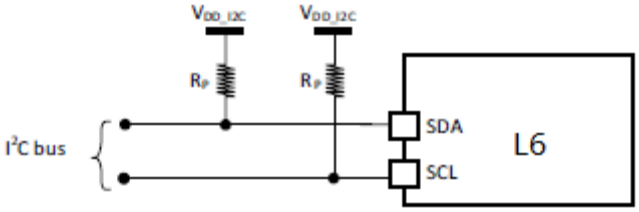
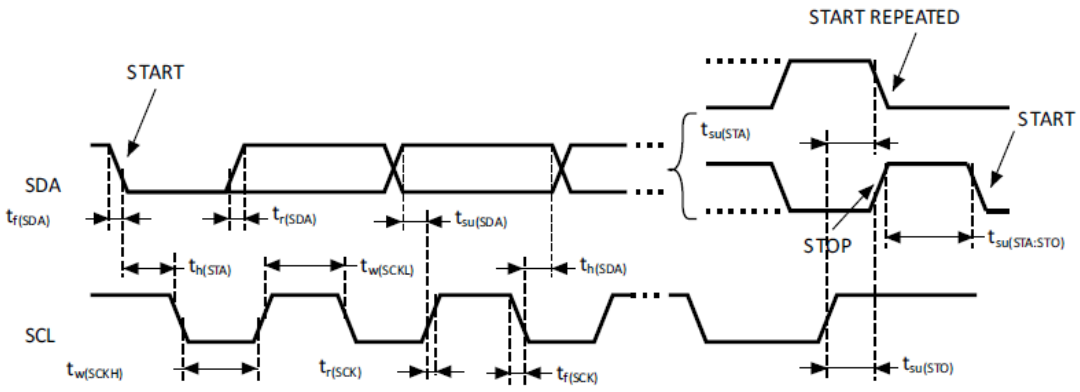


Chart 9: I2C Timing Parameters

Symbol	Parameter	Standard mode I²C(1)		Fast mode I²C(1)(2)		Unit
		Min	Max	Min	Max	
$t_{w(SCLL)}$	SCL clock low time	4.7	-	1.3	-	µs
$t_{w(SCLH)}$	SCL clock high time	4.0	-	0.6	-	
$t_{su(SDA)}$	SDA setup time	250	-	100	-	ns
$t_{h(SDA)}$	SDA data hold time	0	-	0	900(3)	
$t_{r(SDA)}$ $t_{r(SCL)}$	SDA and SCL rise time	-	1000	20 + 0.1C_b	300	
$t_{f(SDA)}$ $t_{f(SCL)}$	SDA and SCL fall time	-	300	-	300	
$t_{h(STA)}$	Start condition hold time	4.0	-	0.6	-	µs
$t_{su(STA)}$	Repeated Start condition setup time	4.7	-	0.6	-	
$t_{su(STO)}$	Stop condition setup time	4.0	-	0.6	-	µs
$t_{w(STO:STA)}$	Stop to Start condition time (bus free)	4.7	-	1.3	-	µs
C_b	Capacitive load for each bus line	-	400	-	400	pF

Chart 10: I2C Timing Chart



2.3.5 Reset

L6's pin NRST is already connected with a 0.1uF capacitor, and L6's MCU STM32L151CB is also weakly pulled-up with a resistor RPU (30-60KΩ).

Chart 11: NRST Interface Design

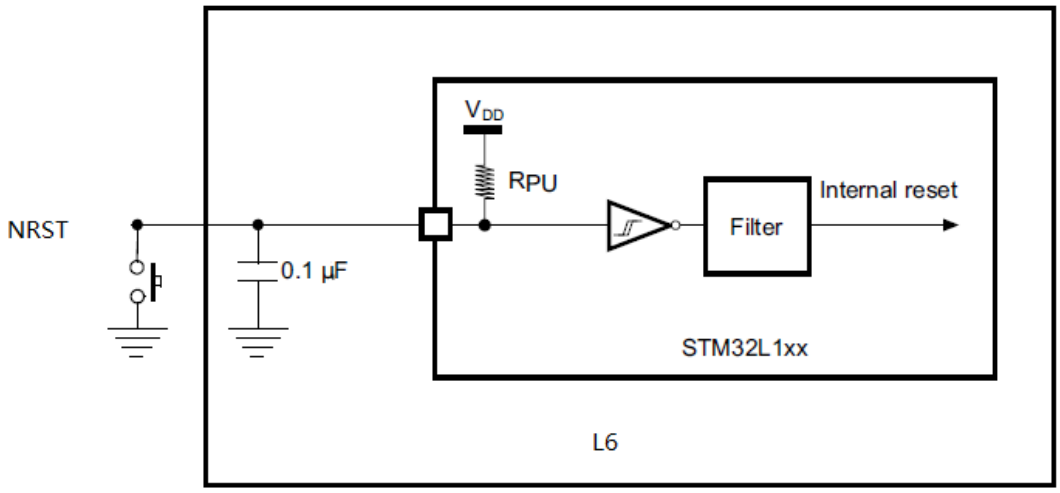


Chart 12: NRST Timing Parameters

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{IL(NRST)}$(1)	NRST input low level voltage	-	-	-	0.8	V
$V_{IH(NRST)}$(1)	NRST input high level voltage	-	1.4	-		
$V_{OL(NRST)}$(1)	NRST output low level voltage	I_{OL} = 2 mA 2.7 V < V_{DD} < 3.6 V	-	-	0.4	
		I_{OL} = 1.5 mA 1.65 V < V_{DD} < 2.7 V	-	-		
$V_{hys(NRST)}$(1)	NRST Schmitt trigger voltage hysteresis	-	-	10%V_{DD}(2)		mV
R_{PU}	Weak pull-up equivalent resistor(3)	V_{IN} = V_{SS}	30	45	60	kΩ
$V_{F(NRST)}$(1)	NRST input filtered pulse	-	-	-	50	ns
$V_{NF(NRST)}$(1)	NRST input not filtered pulse	-	350	-		ns

2.3.6 Clock

L6's MCU supports RTC, with crystal frequency 32.768KHz. The system clock is 12MHz.

2.4 Power Consumption

2.4.1 Operating Power Consumption

Chart 13: Operating Power Consumption

Modes	Min	Typical	Max	Unit
Sleep mode		5		mA
Normal		25		mA
Receive		30		mA
Transmission (5dBm)		70		mA
Wake-up (20dBm)		140		mA

Remark： T=25°C, VDD=3.3V.

2.5 RF Characteristics

2.5.1 RF Characteristics

Chart 14: RF Characteristics

Parameters	Min	Max	Unit
Sensitivity@433MHz	-148	—	dBm
Power Consumption@433MHz	2	20	dBm
Sensitivity@470MHz	-148	—	dBm
Power Consumption@470MHz	2	20	dBm

3 Mechanical Specification

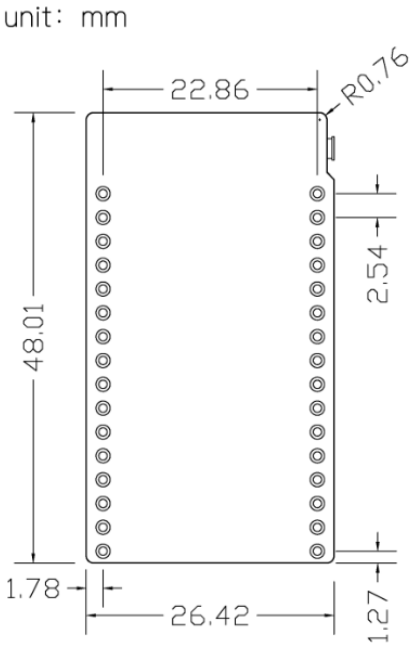
3.1 Module Weight

Chart 15: Module Weight

Module	Weight
IntoRobot-Ant	2.6 g

3.2 Module Size

Chart 16: Module Size (Front View) Unit mm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22.86
R0.76
2.54
48.01
1.78
26.42
1.27