RAK13005 Quick Start Guide

Prerequisite

What Do You Need?

Before going through each and every step on using the RAK13005 WisBlock module, make sure to prepare the necessary items listed below:

Hardware

- RAK13005 WisBlock LIN Module Controller/Master Mode
- RAK13005 WisBlock LIN Module Peripheral/Slave Mode 🗹
- Your choice of WisBlock Base ∠
- Your choice of WisBlock Core
- USB Cable
- Li-Ion/LiPo battery (optional)
- Solar charger (optional) 🗹
- External power source (5.5 V to 27 V)

Software

Arduino

- Download and install Arduino $\mathsf{IDE}\,\square$.
- To add the RAKwireless Core boards on your Arduino Boards Manager, install the RAKwireless Arduino BSP 🗹

Product Configuration

Block Diagram Hardware Setup

RAK13005 is a WisBlock LIN Module that extends the WisBlock system to be used on communication protocol called Local Interconnect Network (LIN). This communication is initiated by the automotive industry for the communication of in-vehicle devices on cars. Today, LIN is also used in other applications that require a robust communication line. For more information about the RAK13005, refer to the Datasheet.

Pin Definition



Figure 1: RAK13005 Pin Definition

LIN Peripheral and Controller Mode Hardware Configuration

RAK13005 supports both **Controller(master)** and **Peripheral(slave)** modes. The two modes uses the same RAK13005 circuit design and configuration is simply determined by an SMD resistor. The resistor location is shown in **Figure 2**.



Figure 2: RAK13005 LIN Mode Configuration

Assembling and Disassembling of WisBlock Modules Assembling

The RAK13005 module can be mounted on the IO slot of the WisBlock Base board, as shown in **Figure 3**. Also, always secure the connection of the WisBlock module by using the compatible screws.



Figure 3: RAK13005 mounting connection to WisBlock Base module

RAK13005 Connector Crimping Mechanism

The RAK13005 features a fast-crimping terminal connector to simplify and ensure the wiring process on the fields. The fast-crimping terminal can support cable with a width between 20 AWG to 24 AWG. The usual stripping length is around 6 to 7 mm.

As shown in **Figure 4**, during the crimping process, you should first press down and maintain the spring head of the crimping terminal firmly, then insert the stripped cable head into the corresponding connector's hole. Once inserted correctly, release the spring head, and the crimping process is completed.



Figure 4: RAK13005 Module Connector

Disassembling

The procedure in disassembling any type of WisBlock modules is the same.

1. First, remove the screws.



Figure 5: Removing screws from the WisBlock module

2. Once the screws are removed, check the silkscreen of the module to find the correct location where force can be applied.



Figure 6: Detaching silkscreen on the WisBlock module

3. Apply force to the module at the position of the connector, as shown in **Figure 7**, to detach the module from the baseboard.



Figure 7: Applying even forces on the proper location of a WisBlock module

📝 NOTE

If you will connect other modules to the remaining WisBlock Base slots, check on the WisBlock Pin Mapper Totol for possible conflicts.

Now, you can connect the battery (optional) and USB cable to start programming your WisBlock Core.

WARNING

- Battery can cause harm if not handled properly.
- Only 3.7-4.2 V Rechargeable LiPo batteries are supported. It is highly recommended not to use other types of batteries with the system unless you know what you are doing.
- If a non-rechargeable battery is used, it has to be unplugged first before connecting the USB cable to the USB port of the board to configure the device. Not doing so might damage the battery or cause a fire.
- Make sure the battery wires match the polarity on the RAK WisBlock Base Board. Not all batteries have the same wiring.
- Only 5 V solar panels are supported. Do not use 12 V solar panels. It will destroy the charging unit and eventually other electronic parts.

Software Configuration and Example

In this example, you will be using two RAK13005 Modules to demonstrate LIN functionality.

These are the quick links that go directly to the software guide for the specific WisBlock Core module you use:

- RAK13005 in RAK4631 WisBlock Core Guide
- RAK13005 in RAK11200 WisBlock Core Guide
- RAK13005 in RAK11310 WisBlock Core Guide

RAK13005 in RAK4631 WisBlock Core Guide

Arduino Setup

Figure 8 is an illustration on how to use two RAK13005 LIN modules for communication applications. One RAK13005 is configured as **Controller** and the other RAK13005 is configured as **Peripheral**. The SMD resistors that set the mode are highlighted in a yellow box.



Figure 8: Two RAK13005 Interconnection for Controller and Peripheral mode

- 1. Select the RAK4631 WisBlock Core.
- Install the RAKwireless Arduino BSP 🗹 to find the RAK4631 in the Arduino Boards Manager.

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			WisBlock Core RAK4601 Board		
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			WisBlock RAK11300 Board		
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Figure 9: Selecting RAK4631 as WisBlock Core

- 2. Next, install the **RAKwireless TLE7259** library using the Arduino Library manager.
- Select Sketch followed by Include Library then Manage Libraries .

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Figure 10: Open Arduino Library Manager

- Search for **RAKwireless TLE7259** on the Library Manager text box.
- Select the latest version of the library then click **Install** button.

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Figure 11: Look for RAKwireless TLE7259 LIN Bus Library

• After successful installation, close the Arduino Library window.

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Figure 12: RAKwireless TLE7259 LIN Bus Library Successfully Installed

- 3. Upload the RAK13005_linbus_master Controller sketch.
- Connect the first WisBlock with the RAK13005 module in **Controller** mode and select the RAK13005_linbus_master .

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Figure 13: Open the code for the RAK13005 Controller

• Select the port where RAK4631 WisBlock Core is connected.

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Figure 14: Select the Serial Port of RAK4631 for the RAK13005 LIN module in controller mode.

• Now, upload the RAK13005_linbus_master code to the WisBlock Core.

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Figure 15: Uploading RAK13005_linbus_master code



- Figure 16: Successful code Upload
- After the successful code upload, you can now open the Serial Monitor and see the Serial output.

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Figure 17: Serial Output of the RAK13005 Controller Mode

4. Upload the RAK13005_linbus_slaver **Peripheral** sketch.

• Connect the second WisBlock with the RAK13005 in Peripheral mode, then select RAK13005_linbus_slaver .

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SHT21-master > SHT21_Arduino-master > Sim800L Library Revised > Sim800L-master > Sim800L-master > Sodaq_HTS21 > Sodaq_SHT2x >			SharplR-master		
SHT21_Arduino-master > Sim800L Library Revised > Sim800I-master > Smattersynthing HTS221 > Sodaq_HTS221 > Sodaq_SHT2x >			SHT21-master >		
Sim800L Library Revised > Sim800L-master > SmatEverything HTS221 > Sodag_SHT2x > Sodag_SHT2x >			SHT21 Arduino-master		
Sim8001-master > SmatEverything HTS221 > Sodag_HTS221 > Sodag_SHT2x >			Sim800L Library Revised		
Smattverything HT5221 > Sodaq_HT5221 > Sodaq_SHT2x >			Sim800I-master >		
Sodaq, HTS221 > Sodaq, SHT2x >			SmartEverything HTS221		
Sodag,SHT2x >			Sodaq_HTS221 >		
Paral Face 10 M2020 6 DOE IN UT Paralamente - A			Sodaq_SHT2x >		
Sparkrun Eshisuse o Don Inio Breakout			SparkFun LSM303C 6 DOF IMU Breakout >		
SparkFun MAX3010x Pulse and Proximity Set			SparkFun MAX3010x Pulse and Proximity Ser		
SparkFun MPI3115A2 Altitude and Pressure?			SparkFun MPL3115A2 Altitude and Pressure?		
v			•		

Figure 18: Open the code for the RAK13005 Peripheral

• Select the port, which is the additional port from the previous port for the controller. You should see two ports in your Arduino IDE.

RAK13005_linbus	_slaver Arduino 1.8.13		- 0 × ,
File Edit Sketch To	ools Help		
	Auto Format	Ctrl+T	De la companya de la
	Archive Sketch		
RAK13005_lin	Fix Encoding & Reload		₩
/**	Manage Libraries	Ctrl+Shift+I	^
* GILLE KAKI	Serial Monitor	Ctrl+Shift+M	
* Øbrief lin	Serial Plotter	Ctrl+Shift+L	
* @version 0	WiFi101 / WiFiNINA Firmware Updater		
* @copyright	Pearsh "MisPlack Care PAK4621 Pearst"		
*/	Parties des "0.2.2.CetDavies -140.6.1.1"		
#include "li	Debug: "Level 0 (Release)"	<pre>#RAKwireless_TLE7259_LIN_Bus_library</pre>	
#if defined(_	Port: "COM13"	Serial ports	
#define BOA	Get Board Info	✓ COM13	
#elif defined	0	COM5	
#define BOA	Buro Bootloader		
#else	buill boottoader		
#define BOARD	"RAK11200 " //default board is	RAK11200	
<pre>int lin_tx =</pre>	21;		
#endif			
int lin_en = WB	_IO6; //internal pulldown, EN=0	is sleep mode, EN=1 is normal operation mode.	
int lin_wk = WB	_IO5; //low active		
// LIN Object	rial1 LIN VI lin en lin wk lir		
unsigned long b	aute = 9600;		
<pre>void setup()</pre>			
{	dr. OUT DUIT) .		
digitalWrite(lin wk.LOW);		
time_t timeou	t = millis();		
Serial.begin(115200);		
While (!Seria	1)		
if ((millis	() - timeout) < 5000)		
{			v.
	·		
1			WisBlock Core RAK4631 Board on COM13

Figure 19: Select the Serial Port of RAK4631 for the RAK13005 LIN module in peripheral mode.

• After ensuring the port matching the RAK13005 LIN Peripheral, you can now upload the RAK13005_linbus_slaver code.



Figure 20: Uploading the RAK13005_linbus_slaver code

NOTE

If you experience any error in compiling an example sketch, check the updated code for the RAK13005 WisBlock Core Module that can be found on the RAK13005 WisBlock Example Code Repository

- 5. Check Serial Monitor output.
- Check the Serial Monitor on the RAK13005 Peripheral device receiving the data coming from the RAK13005
 Controller device. You must have the external power supply connected to have successful transmissions.

RAK13005_linbus_slaver Arduino 1.8.13			– 0 ×
File Edit Sketch Tools Help			
			S
RAK13005_linbus_slaver			
/**			^
* @file RAK13005_linbus_slaver.ino			
* @author rakwireless.com			
* @brief linbus slaver receive example.			
* @version 0.1			
* gdate 2021-05-01			
*/ GCOPYFIGHT COPYFIGHT (C) 2021			1
<pre>#include "lin bus.h" //library: http://librarym</pre>	т 😳 СОМ13	- 🗆 X	
<pre>#if defined(_VARIANT_RAK4630_)</pre>	<u> </u>	Send	
#define BOARD "RAK4631 "	TEST RAK13005 receive data	^	
<pre>int lin_tx = 16;</pre>	The data[0] is 0		
<pre>#elif defined(_VARIANT_RAK11300_)</pre>	The data[1] is 1		
#define BOARD "RAKI1300 "	The data[2] is 2		
telse	The data[3] is 3		
#define BOARD "RAK11200 " //default board is RA	The data[4] 18 255		
<pre>int lin tx = 21;</pre>	The data[6] is 6		
∳endif	The data[7] is 100		
	TEST RAK13005 receive data		
<pre>int lin_en = WB_IO6; //internal pulldown, EN=0 is</pre>	¹ The data[0] is 0		
<pre>int lin_wk = WB_IO5; //low active</pre>	The data[1] is 1		
// LIN Object	The data[2] is 2		
unsigned long baute - 9600:	The data[3] is 3	~	
void setup()	The detailed to 755	Nuclear action local band	
1	Autoscroll Snow timestamp	Newline V 9600 Baud V Clear output	
<pre>pinMode(lin_wk,OUTPUT);</pre>			
digitalWrite(lin_wk,LOW);			
<pre>time_t timeout = millis();</pre>			
Serial.begin(115200);			
while (!Serial)			
i ((millin() - timeout) < 5000)			
delay/1001+			~
Javi as programmed			
FU upgrade took 3.2196409702301025s			^
<			>
17			WisBlock Core RAK4631 Board on COM13

Figure 21: Serial Output of the RAK13005 Peripheral Mode

RAK13005 in RAK11200 WisBlock Core Guide Arduino Setup

Figure 22 is an illustration on how to use two RAK13005 LIN modules for communication application. One RAK13005 is configured as **Controller** and the other RAK13005 is configured as **Peripheral**. The SMD resistors that set the mode are highlighted in a yellow box.



Figure 22: Two RAK13005 Interconnection for Controller and Peripheral mode

- 1. Select the RAK11200 WisBlock Core.
- Install RAKwireless Arduino BSP ☐ to find the RAK11300 in the Arduino Boards Manager.



Figure 23: Selecting RAK11200 as WisBlock Core

- 2. Next, install the **RAKwireless TLE7259** library using the Arduino Library manager.
- Select Sketch followed by Include Library then Manage Libraries .

<u>File</u> Edit	Sketch Tools Help			
00	Verify/Compile	Ctrl+R		
	Upload	Ctrl+U		
sketch	Upload Using Programme	r Ctrl+Shift+U		
void se	Export compiled Binary	Ctrl+Alt+S		^ ^
// pi	Show Sketch Folder	Ctrl+K		
3	Include Library		Δ	
model le	Add File		Manage Libraries Ctrl+Shift+I	
// pt	at your main code here, to	o run repeate	Add .ZIP Library	
1			Arduino libraries	
1			ArduinoHttpClient	
			Arduino_TensorFlowLite	
			Bridge	
			Esplora	
			Ethernet	
			Firmata	
			GSM	
			Keyboard	
			LiquidCrystal	
			Mouse	
			Robot Control	
			Robot IR Remote	
			Robot Motor	
			SD	
			SpacebrewYun	
			Stepper	
			Tumber	
			wiei	
			Contributed libraries	
			AES-library	×
			Accelerometer ADXL335	
			Accelerometer ADXL345	
			Adatruit BLE Services	
			Ŷ	

Figure 24: Open Arduino Library Manager

- Search for RAKwireless TLE7259 on Library Manager text box.
- Select the latest version then click Install button.

File Edit Sketch Tools Help		
		₽.
sketch_aug04a		■
<pre>void setup() {</pre>		^
// put your setup code here, to run once:		
1		
<pre>void loop() {</pre>		
<pre>// put your main code here, to run repeatedly:</pre>	S Library Manager X	
}	Type All V Topic All RAKwreless TLE7259	
	RAKwireless TLE7259 LIN Bus library	
	by RAKWireless RAKWireless library for the RAK13005 LIN bus module with the TLE7259 chip Build a LIN bus master or slave node with the	
	RAK13005 module from RAKWireless. Checkout the <u>WisBlock RAK13005</u> today!	
	More mito	
	v	
	Close	
		~
1		WisBlock Core RAK4831 Board on COM13

Figure 25: Look for RAKwireless TLE7259 LIN Bus Library

• After successful installation, close the Arduino Library window.

ile Edit Sketch Tools Help	
	Q.
sketh_aug04a	
void setup() { // put your setup code here, to run once: }	î
void loop() { // put your main code here, to run repeatedly:	
Type III v Topic III w NAWHeless TLE7259	

Figure 26: RAKwireless TLE7259 LIN Bus Library Successfully Installed

- 3. Upload the RAK13005_linbus_master Controller sketch.
- Open the RAK13005_linbus_master Controller sketch.
- Connect the first WisBlock with the RAK13005 module in Controller mode and select the RAK13005_linbus_master

sketch_aug04a Edit_Sketch	Arduino 1.8.13 Tools Help						-	0
New	Ctrl+N							
Open	Ctrl+O							
Open Recent	t >							
Sketchbook	· · · · · · · · · · · · · · · · · · ·							· · · ·
Examples	3	· 🔺						
Close	Ctrl+W	MCP3428_Arduino_Library >						
Save	Ctrl+S	MFRC522 >						
Save As	Ctrl+Shift+S	ModbusMaster >						
		MPU6050_tockn >						
Page Setup	Ctrl+Shift+P	OneWire >						
Print	Ctrl+P	PMS Library >						
Preferences	Ctrl+Comma	PubSubClient >						
		PZEM004T						
Quit	Ctrl+Q	RAKwireless TLE7259 LIN Bus library	LINBusCommunication	AK13005_linbus_master				
		RF24	LINBusControlLED	AK13005_linbus_slaver	.			
		SharpIR-master						
		SHT21-master >						
		SHT21_Arduino-master >						
		Sim800L Library Revised >						
		Sim800I-master >						
		SmartEverything HTS221 >						
		Sodaq_HTS221 >						
		Sodaq_SHT2x >						
		SparkFun LSM303C 6 DOF IMU Breakout >						
		SparkFun MAX3010x Pulse and Proximity Sensor Library						
		SparkFun MPL3115A2 Altitude and Pressure Sensor Breakout >						
		Streaming >						
		TheThingsNetwork >						
		ThingsBoard >						
		ThingSpeak >						
		Time						
		TinyGPS++ >						
		TinyGSM						
		TinyMPU6050 >						
		INCOMPATIBLE >						
		∇						

Figure 27: Open the code for the RAK13005 Controller

• Select the port where RAK11200 WisBlock Core is connected.

RAK13005_linbus	_master Arduino 1.8.13		- 0	×
RAK13005_lin	Auto Format Archive Sketch Fix Encoding & Reload	Ctd+T		₽ ▼
/** * @file RAK1 * @author ra * @brief lin	Manage Libraries Serial Monitor Serial Plotter	Ctrl+Shift+I Ctrl+Shift+M Ctrl+Shift+L		
* @version 0 * @date 2021 * @copyright */	WiFi101 / WiFiNINA Firmware Updater Board: "WisBlock Core RAK4631 Board"			
<pre>#include "li #if defined(_</pre>	Bootloader: "0.3.2 SoftDevice s140 6.1.1 Debug: "Level 0 (Release)" Port: "COM5"	* PAKwireless_TLF7259_LIN_Bus_library		
<pre>#define BOA int lin_tx #elif defined</pre>	Get Board Info Programmer			
<pre>#define BOA int lin_tx #else #define BOARD int lin_tx = : #endif</pre>	Burn Bootloader "RAK11200 " //default board i 21;	s Rak11200		
<pre>int lin_en = WB int lin_wk = WB // LIN Object lin_bus linl (Se unsigned long b uint16_t sendCor void setup()</pre>	_106; //internal pulldown, EN=0 _105; //low active rial1,LIN_V1, lin_en, lin_wk, li aute = 9600; uunt = 0;	is sleep mode, EN-1 is normal operation mode.		
<pre>{ pinMode(lin_w digitalWrite(time_t timeou Serial.begin(while (!Seria { if ((millis)); if (millis); } }</pre>	<pre>k,OUTPUT); lin_wk,HIGH); tt = millis(); lils200); l) () = timeout) < 5000)</pre>			
1				

Figure 28: Select the Serial Port of RAK11200 for the RAK13005 LIN module in controller mode.

• Now, upload the RAK13005_linbus_master code to the WisBlock Core.



Figure 29: Uploading RAK13005_linbus_master code

RAK13005_linbus_master Arduino 1.8.13	- 0	×	1
File Edit Sketch Tools Help			
		ø	
RAK13005_linbus_master			
/** * @file BAKL3005_linbus_master.ino * @author rakwireless.com * @brief linbus master send example. * @brief ol.1 * @date 2021-05-01 * @date 2021-05-01 * @dote 2021-05-01 */			
<pre>#if defined(_VARIANT_RAK4630_) #if define BOARD "RAK4630_" int lin_tx = 16; #if define BOARD "RAK11300 * int lin_tx = 0; #int lin_tx = 0; #int lin_tx = 21; #endif</pre>			
<pre>int lin_wt = WB_DOS; //Internal pulldown, EN=0 is sleep mode, EN=1 is normal operation mode. int lin_wt = WB_DOS; //Iow active // LIN Object lin_bus linl(Seriall,LIN_VI, lin_en, lin_wk, lin_tx); unsigned long baute = \$600; uintle_t sendCount = 0; void secup() { juinkode(lin_wk,GICH); digrialWrite(lin_wk,RICH); time_t timeout = millis(); Serial.begin(IIS200); while (!Serial) { if ((millis() - timeout) < 5000) / /</pre>		v	
Done uploading.		~	

Figure 30: Successful code Upload

• After the successful code upload, you can now open the Serial Monitor and check the Serial output.

RAK13005_linbus_master Arduino 1.8.13 File Edit Sketch Tools Help			- 0 ×
			P
RAK13005_linbus_master			
<pre>/** /** /** /** /** /** /** /** /** /**</pre>	COM5 0 1 2 3 255 5 6 100 The LIN bus Send count is 109 Send data is: 0 1 2 3 255 5 6 100 The LIN bus Send count is 110 Send data is: 0 1 2 3 255 5 6 100 The LIN bus Send count is 111 Send data is: 0 1 2 3 255 5 6 100 The LIN bus Send count is 111 Send data is: 0 1 2 3 255 5 6 100 The LIN bus Send count is 112 'Send data is: 0 1 2 3 255 5 6 100 The LIN bus Send count is 113 'Y Autoscrol Show timestamp Y Autoscrol Show timestamp	- C × Send V V Newtre V 9600 baud V Clear output	
Novem Reducing			

Figure 31: Serial Output of the RAK13005 Controller Mode

- 4. Upload the RAK13005_linbus_slaver **Peripheral** sketch.
- Connect the second WisBlock with the RAK13005 in Peripheral mode then select RAK13005_linbus_slaver .

File Edit Sketch Tools Help New Ctrl+N Open Ctrl+O	Q
New Ctrl+N Open Ctrl+O	ø
Open Ctrl+O	<u></u>
Open Recent >	Z
Sketchbook >	
Examples	
Close Ctrl+W MCP3428_Arduino_Library	
Save Ctrl+S MFRC522	
Save As Ctrl+Shift+S ModbusMaster >	
MPU6050_tockn >	
Page Setup Ctrl+Shift+P OneWire >	
Print Ctrl+P PMS Library >	
Preferences Ctrl+Comma PubSubClient >	
PZEM004T >	
Quit Ctrl+Q RAKwireless TLE7259 LIN Bus library LINBusCommunication 2 RAK13005 linbus master	
RF24 LINBusControlLED RAK13005_linbus_slaver	
SharpIR-master	
SHT21-master >	
SHT21_Arduino-master >	
Sim800L Library Revised >	
Sim8001-master >	
SmartEverything HTS221 >	
Sodaq_HTS221 >	
Sodaq_SHT2x >	
SparkFun LSM303C 6 DOF IMU Breakout >	
SparkFun MAX3010x Pulse and Proximity Sensor Library >	
SparkFun MPL3115A2 Altitude and Pressure Sensor Breakout >	
Streaming >	
TheThingsNetwork >	
ThingsBoard >	
ThingSpeak >	
Time >	
TinyGPS++ >	
TinyGSM >	
TinyMPU6050 >	
INCOMPATIBLE >	
∇	

Figure 32: Open the code for the RAK13005 Peripheral

• Select the port, which is the additional port from the previous port for the controller. You should see two ports in your Arduino IDE.

RAK13005_linbu	ıs_slaver Arduino 1.8.13		-	o x
File Edit Sketch	Tools Help			
	Auto Format	Ctrl+T		Ø
	Archive Sketch			
RAK13005_lin	Fix Encoding & Reload			
/**	Manage Libraries	Ctrl+Shift+I		· · · ·
* Gauthor ra	Serial Monitor	Ctrl+Shift+M		
* @brief lin	Serial Plotter	Ctrl+Shift+L		
* @version 0 * @date 2021	WiFi101 / WiFiNINA Firmware Updater			
* @copyright	Board: "WisCore RAK11200 Board"	>		
#include "li	Upload Speed: "921600"	> B	Bus library	
	Flash Frequency: "80MHz"	>		
<pre>#if defined(</pre>	Flash Mode: "QIO"	>		
int lin_tx	Partition Scheme: "Default 4MB with spiffs (1.2MB APP/1.5MB SPIFF	5)" >		
<pre>#elif defined</pre>	Core Debug Level: "None"	>		
#define BOA	Port: "COM13"	1	Serial ports	
#else	Get Board Info	×	COM13	
#define BOA	Programmer	2	COM5	
int lin_tx	Burn Bootloader			
<pre>int lin_en = W int lin_wk = W // LIN Object lin_bus lin[S unsigned long void setup() { pinMode (lin_ digitalWrice time t time time t time time fin[milli [</pre>	<pre>B_IO6; //internal pulldown, EN=0 is sleep mode, EN=1 i B_IO5; //low active eriali,LIN_VI, lin_en, lin_wk, lin_tx); baute = s600; wk;OUTBUT); (lin_wk,LOW); ut = millie(); (li1500); al) s() - timeout) < 5000) ni.</pre>	s normal operation	1 mode.	
4			With an IRAN AREA DO A THE ALL AND A REAL AND A	

Figure 33: Select the Serial Port of RAK11200 for the RAK13005 LIN module in Peripheral mode.

VOTE:

RAK11200 requires the BOOT0 pin to be configured properly before uploading. If not done properly, uploading the source code to RAK11200 will fail. Check the full details on the RAK11200 Quick Start Guide.

• After ensuring the port matching the RAK13005 LIN Peripheral, you can now upload the RAK13005_linbus_slaver code.



Figure 34: Uploading the RAK13005_linbus_slaver code

NOTE

If you experience any error in compiling an example sketch, check the updated code for the RAK13005 WisBlock Core Module that can be found on the RAK13005 WisBlock Example Code Repository

- 5. Check Serial Monitor output.
- Check the Serial Monitor on the RAK13005 Peripheral device receiving the data coming from the RAK13005
 Controller device. You must have the external power supply connected to have successful transmissions.

RAK13005_linbus_slaver Arduino 1.8.13		- 0 ×
Eile Edit Sketch Tools Help		Q
<pre>/** * Bile RAK13005_limbus_slaver.ino * Buthor redvireless.com * Burlef limbus slaver receive example. * Bversion 0.1 * Bdate 2021-05-01 * Bdoate 2021-05-01 * Bdoate 2021-05-01 * finclude "lim_bus.h" //library: http://librarym *if defined (DapKIMT_BAK1630_) # define BOADD "RAK1630_) # define BOADD "RAK1000" int lim_tx = 1; # define BOADD "RAK1100" int lim_tx = 0; # define BOADD "RAK1100" int lim_tx = 21; # define BOADD "RAK1100" int lim_tx = 21; # define BOADD "RAK1100" int lim_tx = 21; # define BOADD "RAK1100" int lim_tx = 0; # lim_tx = 10; # continue = % DioS; //low active // LIN Object lim_bus.html(serial).LIN_VI, lim_en, lim_wk, lim_tx) unsigned long baute = \$600; void setup() { pinMode(lim_wk.00TEUT); digitalWrite(lim_wk.00S); time_t timeout = millis(); Serial.begin(li5200; while (ISerial) { </pre>	COM13	
{ delay(100) -		•
Device programmed. DFU upgrade took 3.2196409702301025s		^ •
<		>
17		WisCore RAK11200 Board on COM13

Figure 35: Serial Output of the RAK13005 Peripheral Mode

RAK13005 in RAK11310 WisBlock Core Guide Arduino Setup

Figure 36 is an illustration on how to use two RAK13005 LIN modules for communication application. One RAK13005 is configured as **Controller** and the other RAK13005 is configured as **Peripheral**. The SMD resistors that set the mode are highlighted in a yellow box.



Figure 36: Two RAK13005 Interconnection for Controller and Peripheral mode

- 1. Select the RAK11300 WisBlock Core.
- Install the RAKwireless Arduino BSP ☐ to find the RAK11300 in the Arduino Boards Manager.

💿 Bli	nk Arduino	1.8.1	j						-	٥	×
File E	dit Sketch	lools	Help Auto Format	Ctrl+T							
			Archive Sketch								<u>19</u>
Blir	ık		Fix Encoding & Reload								•
1/	*		Manage Libraries	Ctrl+Shift+I							^
2	Blink		Serial Monitor	Ctrl+Shift+M							
3 4	Turns an		Serial Plotter	Ctrl+Shift+L	, repeatedly.						
5	Most Ard		WiFi101 / WiFiNINA Firmware Update	r	the UNO, MEGA and ZERO						
7	it is at		Board: "WisBlock RAK11300"	3	Boards Manager						
9	If you w		Port: "COM12 (WisBlock RAK11300)"	2	Arduino AVR Boards	>					
10	model, c		Get Board Info		Bouffalo Arduino Core	>					
11	https://		Programmer	,	ESP32 Arduino	>					
13	modified		Rurp Bootloader		ESP32 Arduino (in sketchbook)	>					
14	by Scott	110	sycrara		RAKwireless ESP32 Modules	>					
15	modified	2 S	ep 2016 Malupi		RAKwireless nRF Modules	>		7			
17	modified	8 St	2016		Rakwireless Raspberry Modules		WisBlock RAK11300				
18	by Colby	New	nan		STM32 boards groups (Board to be selected from Tools submenu 'Board part numbe	r') >					
19	-										
20	Inis exa	mpie	code is in the public domain	1.							
22	https://	www.a	arduino.cc/en/Tutorial/Builtl	nExamples/Bli	<u>ık</u>						
23 *	/										
24	(- h				at- td						
25 / 26 v	oid setup	() {	inccion runs once when you pr	ess reset or	Jower the board						
27	// initi	alize	e digital pin LED_BUILTIN as	an output.							
28	pinMode(LED_I	BUILTIN, OUTPUT);								
29 }											
31 /	/ the loo	ກ fui	oction runs over and over aga	in forever							
/	200,		ver age								~

Figure 37: Selecting RAK11300 as WisBlock Core

- 2. Next, install the **RAKwireless TLE7259** library using Arduino Library manager.
- Select Sketch followed by Include Library then Manage Libraries .



Figure 38: Open Arduino Library Manager

- Search for RAKwireless TLE7259 on Library Manager text box.
- Select the latest version of the library then click Install button.

Blink Arduino 1.8.15 File Edit Sketch Tools Help	– 0 ×
	₽
<pre>Bink 1 /* Bink 7 Urns an LED on for one second, the Kast Actuinos have an on-board LED is Lis attached to digital pin 13, be correct LED pin independent of if you sat to know that pin the of model, check the Technical Special be correct LED pin independent of is model, check the Technical Special be correct LED pin independent of be correct LED be been pin independent of be correct LED be been pin independent of be correct LED been pin independent of be c</pre>	
1	WisBlock RAK11300 on COM12

Figure 39: Look for RAKwireless TLE7259 LIN Bus Library

• After successful installation, close the Arduino Library window.

Slink Arduino 1.8.15	- Č		$\langle \neg \rangle$
File Edit Sketch Tools Help			
Blink		-	
			^
2 Blink			
3			
4 Turns an LED on for one second, the 🚳 Library Manager X			
o nos arutanos nave an on-board Leo Type (al V Tope All V RAKWYEless ILE/259)			
8 the correct LED pin independent of RAKwireless TLE7259 LIN Bus library			
9 If you want to know what pin the on by RAKWireless Version 1.0.2 INSTALLED			
10 model, check the Technical Specs of RAKWireless library for the RAKI3005 LID bus module with the TLF/259 chip Build a LIN bus master or slave node with the RAKI3005 LID bus module from RAKWireless. Check out the Wireless the Wireless Check out the Wireless out the Wireles			
11 https://www.arduino.cc/en/Main/Prod More info			
13 modified 8 May 2014			
15 molfied 2 Sen 2016			
16 by Arturo Guadalupi			
17 modified 8 Sep 2016			
18 by Colby Newman			
19			
20 This example code is in the public			
22 ILLDS://WWW.arguino.cc/en/iuUriai/			
24			
25 // the setup function runs once when			
26 void setup() {			
27 // initialize digital pin LED_BUILT			
28 pinMode(LED_BUILTIN, OUTPUT); Close			
29) 30			
31 // the loop function runs over and over again forever			
		_	*
1 Wa	Block RAK11300	on COM12	2

Figure 40: RAKwireless TLE7259 LIN Bus Library Successfully Installed

- 3. Upload the RAK13005_linbus_master Controller sketch.
- Connect the first WisBlock with the RAK13005 module in Controller mode and select the RAK13005_linbus_master .

Blink Arduir	no 1.8.15 h. Tools, Help					- 6	3 ×	(
New	Ctrl+N						Q	
Open Open Rece	ent >							
Sketchboo	k >							1
Examples	3	A						
Close	Ctrl+W	Temboo	repeatedly.					
Save	Ctrl+S	RETIRED	>					
Save As	Ctrl+Shift+S	Examples for WisBlock RAK11300	e UNO, MEGA and ZERO D BUILTIN is set to					
Page Setup	Ctrl+Shift+P	PDM	>					
Print	Ctrl+P	RAK WisBlock examples	> d to on your Arduino					
Preference	r Ctrl+Comma	Scheduler	>					
Preference	is cur+comma	ThreadDebug	>					
Quit	Ctrl+Q	Examples from Custom Libraries						
15 modifie	ed 2 Sep 2016	Adafruit BME680 Library	>					
16 by Artu	uro Guadalupi	Adafruit BuslO	>					
17 modifie 18 by Colb	ed 8 Sep 2016 ov Newman	Adafruit Circuit Playground	>					
19		Adafruit EPD	>					
20 This ex	kample code is	Adafruit FRAM I2C	>					
21		Adafruit GFX Library	>					
22 <u>nttps:/</u> 23 */	//www.arduino.c	Adafruit NeoPixel	>					
24		Adafruit SSD1306	>					
25 // the se	etup function r	Adafruit Unified Sensor	> er the board					
26 Void setu	up() { tialize digital	RAKwireless MQx library	>		7			1
28 pinMode	(LED_BUILTIN,	RAKwireless TLE7259 LIN Bus library	LINBusCommunication	RAK13005_linbus_master				
29 }		SparkFun ATECCX08a Arduino Library	LINBusControlLED	RAK13005_linbus_slaver				
30 31 // the lo	oop function ru	SX126x-Arduino	>		а 			
		U8g2	>					-
		INCOMPATIBLE	>					
		∇						
1					V	VisBlock RAK11300	on COM12	2

Figure 41: Open the code for the RAK13005 Controller

• Select the port where RAK11300 WisBlock Core is connected.

BAK[°] Documentation Center

RAK13005_linbus	s_master Arduino 1.8.15			-	٥	×
File Edit Sketch I	ools Help					_
	Auto Format	Ctrl+T				ø
	Archive Sketch					
RAK13005_lin	Fix Encoding & Reload				5	r.,
1 /**	Manage Libraries	Ctrl+Shift+I				
2 * @file R	Serial Monitor	Ctrl+Shift+M				
3 * @author	Serial Plotter	Ctrl+Shift+1				
4 * Oprier						
6 * @date 2	WiFi101 / WiFiNINA Firmware Updat	er				
7 * @copyri	Board: "WisBlock RAK11300"	>				
9 #include	Port: "COM12 (WisBlock RAK11300)"		Serial ports	Bus library		
10	Get Board Info		COM12 (WisBlock RAK11300)			
11 #if define						
12 #define	Programmer	>				
13 int lin	Burn Bootloader					
14 #elli dellim	OADD "DAK11300 "					
16 int lin ty	x = 0;					
17 #else						
18 #define BC	OARD "RAK11200 " //default bo	ard is RAK11200				
19 int lin_ts	x = 21;					
20 #endif						
21 22 int lin en -	UP TOG. //internal mulidaum	EN-0 is sleep	mode FN-1 is normal enough	ion made		
23 int lin wk =	= WB_106; //Internal pulldown,	EN=0 IS SIEED	mode, EN=I IS normal operat.	ion mode.		
24 // LIN Object	ct					
25 lin_bus lin1	l(Serial1,LIN_V1, lin_en, lin_w	<pre>k, lin_tx);</pre>				
26 unsigned lor	ng baute = 9600;					
27 uintl6_t ser	ndCount = 0;					
28 void setup())					
29 {	in the OUTDUT) .					
31 digitalWri	ite(lin wk.HIGH):					
	<u></u>					
1				WisBlock RAK1130	00 on COM	12

Figure 42: Select the Serial Port of RAK4631 for the RAK13005 LIN module in controller mode.

• Now, upload the RAK13005_linbus_master code to the WisBlock Core.

© RAK13005_linbus_master Arduino 1.8.15	- 0	×	٦
File Edit Sketch Tools Help			
		P	
RAK13005_linbus_master			
<pre>1 /** 2 * @file RAK1305_linbus_master.ino 3 * @author rakwireless.com 4 * @brief linbus master send example. 5 * @version 0.1 6 * @date 2021-05-01 7 * @copyright Copyright (c) 2021 7 * 9 finclude "lin_bus.h" //library: http://librarymanager/All#RAKwireless_TLE7255_LIN_Bus_library 1 1 fif defined(_VARIANT_RAK4631 * 1</pre>			
Si digitalwite(III_wk,nion);			ř
Done uploading.			
Sketch uses 16220 bytes (0%) of program storage space. Maximum is 16777216 bytes. Global variables use 43140 bytes (15%) of dynamic memory, leaving 227196 bytes for local variables. Maximum is 270336 bytes.			^
			~
	VISBIOCK RAK11300 or	n COM12	

Figure 43: Successful code upload

• After the successful code upload, you can now open the Serial Monitor and see the Serial output.

RAK13005_linbus_master Arduino 1.8.15 File Edit Sketch Tools Help		- 0	×	
			Ø	
RAK13005_linbus_master				
<pre>1 /** 2 * @file RAK13005_linbus_mass 3 * @author rakwireless.com 4 * @brief linbus master send 5 * @version 0.1 5 * @version 0.1 7 * @copyright Copyright (c) 8 */ 9 #include "lin_bus.h" //1 1 # fif defined (VARINT_RAK4631 " 13 int lin_tx = 16; 14 # felif defined (VARINT_RAK4631 " 15 #define BOARD "RAK1630 " 16 int lin_tx = 0; 17 #felee 18 #define BOARD "RAK11200 " 19 int lin_tx = 21; 20 #endif 21 21 int lin_en = WB_IO6; //inte; 21 int lin_tw = WB_IO5; //low 23 lin_bus linl(Serial1,LIN_VI; 24 (LIN Object 25 lin_bus linl(Serial1,LIN_VI; 26 unsigned long baute = 9600; 27 uintl6_t sendCount = 0; 28 void secup() 29 { 29 [20 pinMode(lin wk.OUTPUT); 21 kan base lint k.OUTPUT); 21 kan base lint</pre>	20M12 - □ × 1 2 3 255 5 6 100 LIN bus Send count is 43255 data is: 1 2 3 255 5 6 100 LIN bus Send count is 43256 data is: 1 2 3 255 5 6 100 LIN bus Send count is 43256 data is: 1 2 3 255 5 6 100 LIN bus Send count is 43257			
31 digitalWrite(lin_wk,HIGH);				~

Figure 44: Serial Output of the RAK13005 Controller Mode

- 4. Upload the RAK13005_linbus_slaver Peripheral sketch.
- Connect the second WisBlock with the RAK13005 in Peripheral mode then select RAK13005_linbus_slaver .

💿 F	AK13005_linbu	us_master Ardui	no 1.8.15			-	٥	×
File	Edit Sketch	Tools Help						
	New	Ctrl+N					, I.I.I.I.	Ω
	Open	Ctrl+O						
	Open Recent	,						
	Sketchbook	>						^
	Examples	3	▲					
	Close	Ctrl+W	Temboo >					
	Save	Ctrl+S	RETIRED					
	Save As	Ctrl+Shift+S	Examples for WisBlock RAK11300					
	Page Setup	Ctrl+Shift+P	PDM >					
	Print	Ctrl+P	RAK WisBlock examples	r/All#RAKwireless_TLE725	9_LIN_Bus_library			
			Scheduler >					
	Preferences	Ctrl+Comma	ThreadDebug >					
	Quit	Ctrl+Q	Examples from Custom Libraries					
15	#define H	BOARD "RAK113	Adafruit BME680 Library					
16	int lin_t	tx = 0;	Adafruit BusIO >					
17	<pre>#else</pre>		Adafruit Circuit Playground					
19	<pre>#define f int lin f</pre>	BOARD "RAKI12 tx = 21:	Adafruit EPD >	10				
20	#endif		Adafruit FRAM I2C					
21			Adafruit GFX Library					
22	int lin_en	= WB_IO6; /	Adafruit NeoPixel	b mode, EN=1 is normal op	eration mode.			
24	// LIN Obje	ect /	Adafruit SSD1306					
25	lin_bus lin	nl(Serial1,LI	Adafruit Unified Sensor					
26	unsigned lo	ong baute = 9	RAKwireless MQx library					
28	void setup	()	RAKwireless TLE7259 LIN Bus library	LINBusCommunication	RAK13005_linbus_master			
29	{		SparkFun ATECCX08a Arduino Libra	LINBusControlLED	RAK13005_linbus_slaver			
30	pinMode(lin_wk,OUTPUT	SX126x-Arduino					
31	digitalWi	rite(lin_wk, h	U8g2 >					~
			INCOMPATIBLE >					
			∇					
1						WisBlock RAK1	1300 on C(ом12

Figure 45: Open the code for the RAK13005 Peripheral

• Select the port, which is the additional port from the previous port for the controller. You should see two ports in your Arduino IDE.

RAK13005_linbus_slaver Arduino 1.8.13	- 1	J ×
Auto Format Ctrl+T		ø
Archive Sketch RAK13005_lin Fix Encoding & Reload		
/** Manage Libraries Ctrl+Shift+I		^
* Brile RAKL * Gauthor ra * Gbrief lin Serial Plotter Ctrl+Shift+L		
* @version 0 * @date 2021 WiFiNINA Firmware Updater		
* @copyright */ #include "11 Boatd: "WisBlock Core RAK4631 Board" #include "11 Bootloader: "0.3.2 SoftDevice s140 6.1.1" Dehum: "Level 0 (Release)"	> > FRANvireless_TLE7259_LIN_Bus_library >	
#if defined (Port: "COM13"	2 Serial ports	
int lin_tx Get Board Info	COM13	
<pre>#elif defined #define BOA</pre> Programmer	COMS	
int lin_tx Burn Bootloader		
<pre>#define BOARD "RAK11200 " //default board is RAK11200 int lin_tx = 21; fendif</pre>		
<pre>int lin_en = WB_IO6; //internal pulldown, EN=0 is sleep mo int lin_wk = WB_IO5; //low active // LIN Object lin_pus lini(Serial,LIN_VI, lin_en, lin_wk, lin_tx); unsigned long baute = 9600; wold setup()</pre>	de, EN⇒l is normal operation mode.	
<pre>{ pinMode(lin_wk,OUTPUT); digitalWrite(lin_wk,LOW); time t timeout = millis(); Serial.begin(ll5200); while((Serial)</pre>		
{ if ((millis() - timeout) < 5000) {		Ú.

Figure 46: Select the Serial Port of RAK11300 for the RAK13005 LIN module in peripheral mode.

• After ensuring the port matching the RAK13005 LIN Peripheral, you can now upload the

RAK13005_linbus_slaver code.

© RAK13005_linbus_slaver Arduino 1.8.15	٥	p	×
			Ø
RAK13005_linbus_slaver		F	2
<pre>1 /** 2 * #file EAK13005_linbus_slaver.ino 3 * # Quichor rakvireless.com 4 * BOrief linbus slaver receive example. 5 * @version 0.1 6 * #date 2021-05-01 7 * @copyright Copyright (c) 2021 */* 9 *// 9 *// 10 1 * file BOARD TRAK4630_) 1 * file BOARD TRAK4630_ 1 * file BOARD TRAK4630_ 1 * file BOARD TRAK4631 * 1 * file BOARD TRAK1300_ 1 * file BOARD TRAK1300_ 1 * file BOARD TRAK1300_ 1 * file BOARD TRAK1300_* 1 * file BOARD TRAK1300_* 1 * file BOARD TRAK1300_* 1 * file BOARD TRAK1200 * //default board is RAK11200 1 * file BOARD TRAK1200 * //default board is RAK11200 1 * file BOARD TRAK1300_* 1 * file BOARD TRAK1400_* 1 * file BOARD T</pre>			<
Compiling sketch			

Figure 47: Uploading the RAK13005_linbus_slaver code

📝 NOTE

If you experience any error in compiling an example sketch, check the updated code for the RAK13005 WisBlock Core Module that can be found on the RAK13005 WisBlock Example Code Repository

- 5. Check Serial Monitor output.
- Check the Serial Monitor on the RAK13005 Peripheral device receiving the data coming from the RAK13005 **Controller** device. You must have the external power supply connected to have successful transmissions.

RAK13005_linbus_slaver Arduino 1.8.13 File Edit Sketch Tools Help			- 0 ×
			Ø
<pre>RAK13005_linbus_slaver /** * @file RAK13005_linbus_slaver.ino * @author radvireless.com * @brief linbus slaver receive example. * @version 0.1 * @date 2021-05-01 * @dogine BOARD "RAK450_) #if define BOARD "RAK450_) #if define BOARD "RAK450_) #define BOARD "RAK450_) #define BOARD "RAK11300_) #define BOARD "RAK11300_) #define BOARD "RAK11300_' #define BOARD "RAK1130_' #define BOARD #define</pre>	COM13 TEST RAK13005 receive data The data[0] is 0 The data[1] is 1 The data[2] is 2 The data[3] is 3 The data[4] is 255 The data[6] is 6 The data[0] is 0 The data[1] is 1 The data[2] is 2 The data[2] is 2 The data[1] is 1 The data[2] is 2 The data[2] is 3 The data[2] is 4 The data[3] is 4 The data[4 The	- C × Send A Newline v 9600 baud v Clear output	
delav/1001+			~
Jevice programmed. DFU upgrade took 3.2196409702301025s			~
17			WisBlock Core RAK4831 Board on COM13

Figure 48: Serial Output of the RAK13005 Peripheral Mode

To extend the use of the RAKwireless TLE7259 LIN Bus library, check the TLE7259 Library methods \square .

Last Updated: 7/29/2022, 10:17:19 PM

RAK13005 WisBlock LIN Module Datasheet

Overview

Description

The RAK13005 is a **Local Interconnect Network** (LIN) transceiver module, used in automatic technologies that can be mounted on the IO slot of the WisBlock Base board. It is designed for in-vehicle networks using data transmission rates from 2.4 kBaud to 20 kBaud, and it uses the TLE7259-3 chip from Infineon.

This module offers safe communication over up to 40 m distance between the LIN bus nodes. Besides the use in an automotive environment, it can be implemented in home appliances and industrial automation. The LIN bus technology consists of Peripheral (Slave) and Controller (Master) Nodes which are both supported by RAK13005.

Features

Module specifications

- Single-wire LIN transceiver for transmission rates up to 20 kBaud
- Supports both Controller(Master) and Peripheral(Slave) modes
- Compliant to ISO 17987-4 and LIN Specification 2.2A
- Very low current consumption in sleep mode with wake-up functions
- Support 12 V and 24 V LIN bus power supply
- Digital I/O levels compatible with 3.3 V and 5 V microcontrollers
- Chipset: Infineon TLE7259-3
- Size
 - 25 x 35 mm

Specifications

Overview

Mounting

The RAK13005 module can be mounted on the IO Slot of a WisBlock Base board. Figure 1 shows the mounting mechanism of the RAK13005 on a WisBlock Base board, such as the RAK5005-O.



Figure 2: RAK13005 WisBlock LIN Module mounting

Hardware

The hardware specification is categorized into five parts. It shows the chipset of the module and the pinouts and its corresponding functions and diagrams. It also presents the parameters and their standard values in terms of electrical and mechanical.

Chipset

Vendor	Part number
Infineon	TLE7259-3

Pin Definition

The RAK13005 WisBlock LIN module module comprises a standard 40-pin WisConnector. The WisConnector allows the RAK13005 module to be mounted on a WisBlock Base board, such as RAK5005-O. The pin order of the connector and the pinout definition is shown in Figure 2.

NOTE:

- The UART related pins, 3V3, and GND are connected to this module.
- The IO6 pin is connected to LIN Enable input pin (EN).
- The IO5 pin is connected to MCU_WK pin.



Figure 3: RAK13005 WisBlock LIN Module Pinout Diagram

Electrical Characteristics Recommended Operating Conditions

Symbol	Description	Min.	Nom.	Max.	Unit
VS	Supply Voltage Range for Normal Operation	5.5	-	27	V
Тј	Junction Temperature	-40	-	85	°C
Isleep	Current Consumption at VS in Sleep Mode	-	5	12	uA

Mechanical Characteristic Board Dimensions

Figure 3 shows the dimensions and the mechanic drawing of the RAK13005 module.



Figure 4: RAK13005 WisBlock LIN Module Mechanic Drawing

WisConnector PCB Layout



Figure 5: WisConnector PCB Footprint and Recommendations

Schematic Diagram

Figure 5 shows the RAK13005 schematic.

- J2 is the LIN bus connector.
- J1 is the 40-pin WisConnector.
- **VS** is the LIN bus power supply pin.
- ${\bf EN}$ is the Enable input IO6 which is an active-high pin.
- $\ensuremath{\mathsf{WK}}$ is the Wake input which is an active-low pin.
- VIN range is 5.5 to 27 V.

NOTE:

The MCU_WK pin (IO5) is connected to the Q1 transistor, and the Q1 collector is connected to the WK pin. Q1 works as an inverter, thus in normal operation, set MCU_WK to the high level.



Figure 6: RAK13005 Schematic Diagram

NOTE:

- With **R5** soldered, the RAK13005 works as a LIN controller(master).
- With **R4** soldered, the RAK13005 works as a LIN peripheral(slave).



Figure 1: RAK13005 LIN Mode Configuration

Last Updated: 8/5/2022, 4:34:30 AM