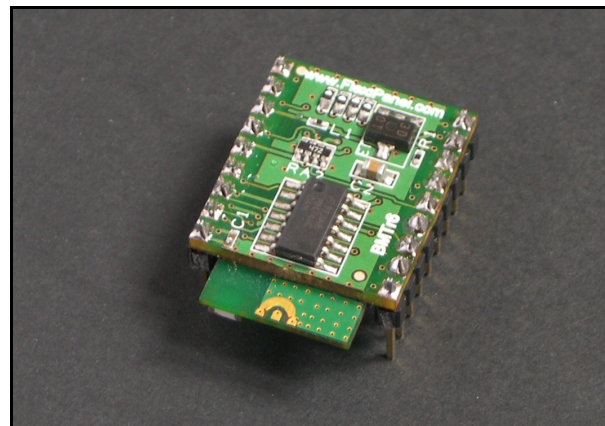
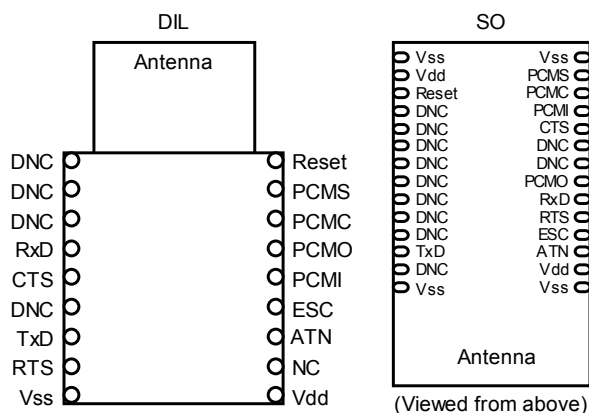




LinkMatik 2.0TM

Bluetooth 2.0 serial / audio transceiver with auto-connect modes and command interface



- Auto-Slave and Auto-Master configurations for no-host control, otherwise controlled with simple command set
- Connects with up to 4 slaves (command mode only)
- PCM audio profile (command mode only)
- Bluetooth 2.0 certified
- FCC / CE certified with integral antenna
- Maximum 570 kb/s data rate in serial mode
- End-to-end latency 8-15 ms
- Low power: ~25mA transmitting, 370µA sleep
- Authentication and encryption
- Device discovery
- Sniff, park and hold low power modes
- Hardware flow control or no flow control
- Bluetooth error correction layer
- Class I Bluetooth radio, 100m range
- 3.3-5V supply (DIL), or 3.3V supply (SO)
- Wide range of baud rates up to 2.7Mbaud (serial port only, not over-the-air)

Enquire about related products, including:

- Puck antenna for external mounting
- Parabolic dishes for directional gain
- Audio codec

Summary

LinkMatik 2.0 is a serial / PCM audio to Bluetooth data link. It can be controlled from a host controller using simple commands.

LinkMatik 2.0 can also operate without a host controller for point-to-point serial connections. Auto-Slave and Auto-Master modes allow LinkMatik 2.0 to operate a slave, master or wedded pair. LinkMatik is shipped in Auto-Slave mode.

The module can be interfaced to many standard Bluetooth devices, e.g. Laptop computers, PDA's, Mobile phones etc. PCM (Pulse Code Modulation) audio connections provide an audio interface when used with a suitable audio codec.

LinkMatik 2.0 replaces our earlier LinkMatik and BlueMatik products providing an enhanced feature set, faster data rates and substantially lower power.

Applications

- Direct access to PDA's, Laptops, Mobile Phones etc
- Wireless audio
- Cable replacement
- Process Control
- Robotics

Ordering Information

| Part No | Description |
|-----------------|---|
| LINKMATIK 2 DIL | Class I Bluetooth 2.0 transceiver 18pin Dual in Line package, 3.3V – 5V |
| LINKMATIK 2 SO | Class I Bluetooth 2.0 transceiver surface mount package, 3.3V |

Manufactured to ISO9001:2000



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Pin Connections

| Pin Name | Description |
|----------|---|
| ATN | Attention output: In Auto-Slave and Auto-Master modes, output is high if connected, low if unconnected. In command mode, output is high if serial data on RxD is from a remote device, low if a command mode response. (note 1) |
| ESC | Escape input: A low to high transition causes the module to revert to the mode where it accepts commands rather than transmits transparent data. (note 1) |
| CTS | Clear To Send: Flow control input to <i>LinkMatik 2.0</i> . When low, <i>LinkMatik 2.0</i> will output data on the TxD line. (note 1) |
| DNC | Do not connect |
| NC | Not connected |
| PCMC | 3.3V PCM audio clock. (note 2) |
| PCMI | 3.3V PCM audio input. (note 2) |
| PCMO | 3.3V PCM audio output. (note2) |
| PCMS | 3.3V PCM audio sync. (note 2) |
| Reset | Reset – Low to operate, high for at least 10ms to reset. (note 1, 3) |
| RTS | Flow control output from <i>LinkMatik 2.0</i> . When high, do not send data to <i>LinkMatik 2.0</i> . (note 1) |
| RxD | Serial data input to <i>LinkMatik 2.0</i> . (note 1) |
| TxD | Serial data output from <i>LinkMatik 2.0</i> . (note 1) |
| Vss | Power ground reference. |
| Vdd | 3.3V - 5V power supply (DIL version) 3.3V power supply (SO version) |

1. Vdd logic. Output highs are Vdd. Input high must not exceed Vdd.
2. 3.3V logic. Output highs are 3.3V. Input high must not exceed 3.3V.
3. DIL module has pull-down resistor and this pin may be left unconnected.

Power Connections

The DIL module contains all necessary power supply filtering components.

The SO module should have a 100nF decoupling capacitor placed between each of the two Vdd pins and their adjacent Vss pin, close to the module. In addition, a series inductor capable of choking 2.54GHz (approx 10nH) should be placed between the power supply and Vdd. The recommended part is muRata LQW15AN10NJ00.

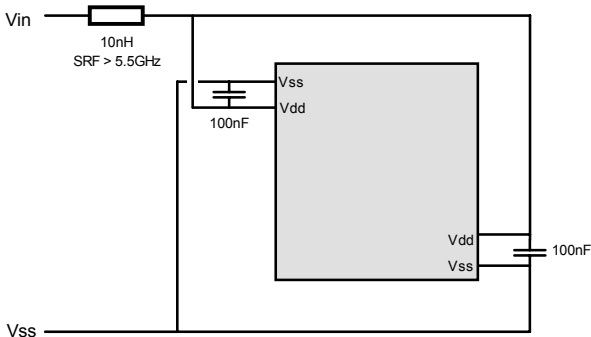


Figure 2. Power supply filtering

Radio Link / Antenna

The radio is a 2.4GHz Class I Bluetooth device with an integral antenna. To achieve 100m range, the corresponding Bluetooth device must also be Class I.

There should be no PCB copper or components within 2cm of the antenna.

Note that the use of an external antenna is not recommended due to coax losses and requirements for recertification.

If an external antenna is required because the product is to be housed in a metal enclosure, enquire about our puck antenna housings. These enclose the entire module and permit it to be externally mounted.

If an external antenna is required to achieve directional gain, enquire about our dish antenna housing. This encloses the entire module at the focus of a parabolic dish for directional operation.

Serial Connections

The serial data default baud rate is 9600 baud standard active low format with 8 data bits, no parity bit and 1 stop bit. Hardware flow control is

supported. If no flow control is required, RTS should be connected to CTS.

CTS and RTS can only be used for flow control. Since data is buffered inside the Bluetooth module, the RTS and CTS signals are locally generated and do not necessarily correspond to the state of the RTS and CTS lines at the other end of the link.

In Auto-Slave and Auto-Master modes, if no connection is indicated on the ATN output, any data on the RxD pin will be interpreted as a command. If the device connected to LinkMatik cannot suppress serial data when there is no connection, the ATN output should be used to clamp the RxD pin high when the device is not connected. An example clamping circuit is shown in figure 3a. (Simpler logic circuits would work, but this circuit uses of the same IC as fig 3b.)

To convert RxD and TxD and, if required, CTS and RTS, to RS232 levels, a level shifter such as a MAX232 may be used.

To convert the serial data lines RxD and TxD to RS485 signals, an RS485 transceiver such as a MAX 3082 may be used. This requires a device enable (DE) signal whenever the TxD output is active. A suitable monostable circuit to generate DE from TxD is shown in figure 3b.

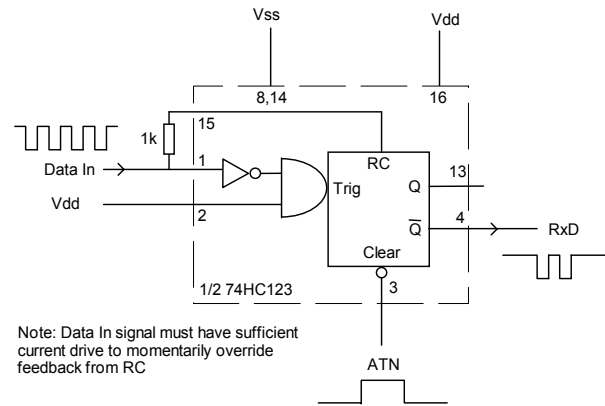
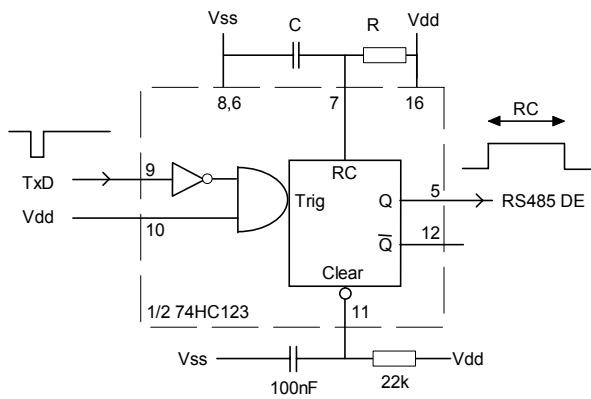


Figure 3a. RxD Clamping



$$\text{For } C = 100\text{nF} \quad R = \frac{250000}{\text{Baud}} \text{ (K}\Omega\text{)}$$

e.g. for 9600 baud, $R \sim 27\text{K}$

Figure 3b. RS485 driver enable

Operating Modes

There are three operating modes for LinkMatik 2.0:

- Auto-Slave Mode, where LinkMatik 2.0 allows other devices to connect to it.
- Auto-Master Mode, where LinkMatik 2.0 tries to connect to devices it is paired with.
- Command Mode, where LinkMatik accepts instructions from the host. Command mode is also used for:
 - Configuring Auto-Slave and Auto-Master settings such as baud rates
 - Audio modes
 - Connections to multiple devices

LinkMatik is shipped in Auto-Slave mode with the PIN code 0000 (four zeroes).

Auto-Slave Mode

In Auto-Slave mode, LinkMatik 2.0 waits for a remote device to discover and connect to it. No commands are required, and, unless configuration commands are sent, no responses are generated except data from the remote device.

The ESC input would normally be tied low in Auto-Slave mode unless configuration commands were to be sent to LinkMatik 2.0.

The ATN output indicates whether the module is in a connected state. The ATN output will be set high when a connection is complete and low when there is no connection. If data is sent while the ATN is low, it will be interpreted as a command.

Auto-Master Mode

In Auto-Master mode, LinkMatik 2.0 searches for any device it has in its list of paired devices and connects to the first one it finds. A slave and a master can thus be wedded and require no host control. No commands are required, and, unless configuration commands are sent, no responses are generated except data from the remote device.

The ESC input would normally be tied low in Auto-Master mode unless configuration commands were to be sent to LinkMatik 2.0.

The ATN output indicates whether the module is in a connected state. The ATN output will be set high when a connection is complete and low when there is no connection. If data is sent while the ATN is low, it will be interpreted as a command.

Command Mode

In Command mode, commands are sent to LinkMatik to control it. Only those commands required to configure Auto-Slave and Auto-Master modes are detailed in this document.

Refer to the LinkMatik 2.0 Command Reference DS389-1 for complete details about other commands available in command mode, including audio mode commands.

Configuration Commands

Sending Configuration Commands

To send commands for configuration purposes (as opposed to host control), connect LinkMatik to a serial terminal emulator such as Windows HyperTerminal. Commands should be terminated with carriage return and linefeed characters.

If required, FlexiPanel's Pixie Config Tool can be used to convert between USB and TTL serial signals in order to make the connections. If used to connect to the SO module, however, care should be taken to clamp the TxD maximum voltage to 3.3V using a circuit such as shown in figure 4. The tool has no flow control, so CTS is connected to RTS.

To ensure all commands take effect, reset LinkMatik 2.0.

To see a list of all current settings, send the following command:

```
SET
```

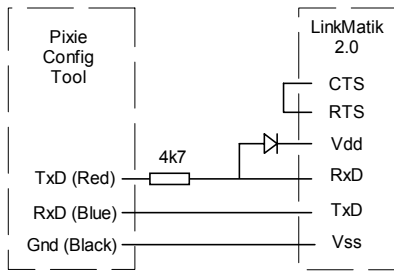


Figure 4 - Interfacing to Pixie Config Tool

Configuring Auto-Slave Mode

To configure LinkMatik for Auto-Slave mode, send the following commands:

```
SET CONTROL AUTOCALL
SET CONTROL ECHO 0
SET CONTROL CD 4 0
SET BT PAGEMODE 4 2000 1
```

Configuring Auto-Master Mode

The following commands are used to set up Auto-Master mode:

```
SET CONTROL AUTOCALL 1101
SET CONTROL ECHO 0
SET CONTROL CD 4 0
SET BT PAGEMODE 0 2000 1
```

In Auto-Master mode, LinkMatik searches for a device it is already paired with and connects to it. If more than one device is paired, LinkMatik will connect to the first paired device it detects and is able to connect to.

Therefore the LinkMatik must be paired with the devices it should connect to. You can do this by pairing from the remote device. Alternatively you can use commands to discover the remote device and pair with it. This is detailed in the Wedded Pairs section.

Setting the Baud Rate

```
Format: SET CONTROL BAUD RATE,8PS
Example: SET CONTROL 9600,8N1
Response: (none)
```

This command sets the RxD / TxD baud rate. *There must be no spaces between the arguments.* The baud rate change takes effect immediately. The baud rate must be changed with care. If you set it incorrectly by accident, you may no longer be able to communicate with LinkMatik.

Only 8 bit data is permitted, with or without parity; however, 7-bit data with odd or even parity may be transmitted as 8-bit, no parity. Note that baud rates below 9600 baud are somewhat inaccurate.

```
RATE 1200 = 1200 baud (+1.73% error)
      2400 = 2400 baud (+1.73% error)
      4800 = 4800 baud (+1.73% error)
      9600 = 9600 baud (-0.82% error)
      19200 = 9600 baud (+0.45% error)
      38400 = 38400 baud (-0.18% error)
      57600 = 57600 baud (+0.03% error)
      76800 = 76800 baud (+0.14% error)
      115200 = 115200 baud (+0.03% error)
      230400 = 230400 baud (+0.03% error)
      460800 = 460800 baud (-0.02% error)
      921600 = 921600 baud (0.00% error)
      1382400 = 1382400 baud (-0.01% error)
      1843200 = 1843200 baud (0.00% error)
      2765800 = 2765800 baud (0.00% error)
```

```
P N = no parity bit
  E = even parity bit
  O = odd parity bit

S 1 = one stop bit
  2 = 2 stop bits
```

Configuring the Bluetooth Name

```
Format: SET BT NAME DEVNAME
Example: SET BT NAME "Fred"
Response: (none)
```

This command sets the Bluetooth device name. The name can be up to 256 ASCII characters long, but not all remote devices will be able to display that many.

Configuring Bluetooth Device Class

```
Format: SET BT CLASS DEVCLS
Example: SET BT CLASS 522204
Response: (none)
```

This command sets the Bluetooth device class represented as a 6-digit hexadecimal (3-byte) number. Device classes are detailed in the section Bluetooth Device Classes.

Set PIN Code Security

```
Format: SET BT AUTH * [PIN]
Example: SET BT AUTH * 0000
Response: (none)
```

This command sets the PIN code security settings. If the optional PIN argument is specified, this becomes the pin code used to pair with other devices.

If the optional PIN argument is not specified, security and PIN codes are disabled. This is not recommended as some devices require PIN codes and connection will therefore not be possible.

The PIN code may be up to 16 characters long. Note that many mobile phones can only specify the digits 0-9 as PIN codes.

Wedded Pairs

To create a wedded pair, one device must be the master and the other the slave. Set the same PIN code on both devices. Then place the first device in Auto-Slave mode.

Place the second device in Auto-Master mode. It will have nothing paired with it initially. To set up its pair, use the *I* command to scan for the slave device.

Example: *I 8 N*

Response example:

```
INQUIRY_PARTIAL 01:23:45:67:89:AB DEVCLS
INQUIRY 1
INQUIRY BTADDR DEVCLS "" RSSI
NAME BTADDR DEVNAME
```

When the inquiry command is complete, connect to the Auto-Slave device using the *C* command, referring to the Bluetooth address reported in the *INQUIRY* response obtained during the scan.

Format: *C BTADDR 1101 RFC*

Example: *C 01:23:45:67:89:AB 1101 RFC*

Response: *CALL LINKID*
CONNECT LINKID RFCOMM

The devices will now be paired. When both devices power up, they will connect together automatically

Command Mode

To configure LinkMatik for Command / Data mode, send the following commands:

```
SET CONTROL AUTOCALL
SET CONTROL ECHO 4
SET CONTROL CD 4 1
SET BT PAGEMODE 3 2000 1
```

Migration from LinkMatik 1.0

Migration from LinkMatik 1.0 should be relatively straightforward. The following issues must be considered:

- The MSM pin is replaced with the ESC pin which should be kept low except to switch to command mode.
- ATN pin performs the same function as the earlier Status pin outputting high when the device is connected.

- Data should not be sent to LinkMatik when ATN is low; it will be interpreted as a command
- Connect / Sleep pin is no longer functional. Sleep mode can only be entered from command mode.
- Auto-Master Mode connects according to its list of paired devices rather than the name of the remote device.

Migration from BlueMatik 1.0

Migration from BlueMatik 1.0 is possible but will require modification of the motherboard and host firmware. The following issues must be considered:

- Pin-out substantially changed
- Command set substantially changed.

Bluetooth Device Classes

The 3-byte Bluetooth device class determines what the module claims to be when other Bluetooth devices ask it. It affects the icon that appears on other Bluetooth devices and may affect the device discovery function. In particular some mobile phones only look for certain sub classes, e.g. headsets.

The device class consists of three elements: the services available, the major device class and the minor device class. Any number of services can be indicated, but exactly one Major Class must be specified. The minor device class is an optional addition, defining a subset of the major device class.

Services and Major Device Class

The first two bytes of the device class contain the services information and the major device class. They are calculated by adding together as many service byte values that are required and one Major Device Class.

| Byte 1 | Byte 2 | Description | Data Type |
|--------|--------|----------------------------|--------------------|
| 0x00 | 0x20 | Limited discovery mode | Services |
| 0x01 | 0x00 | Positioning | |
| 0x02 | 0x00 | Network | |
| 0x04 | 0x00 | Rendering | |
| 0x08 | 0x00 | Capturing | |
| 0x10 | 0x00 | Object transfer | |
| 0x20 | 0x00 | Audio | |
| 0x40 | 0x00 | Telephony | |
| 0x80 | 0x00 | Information | |
| | | | |
| 0x00 | 0x01 | Computer | Device Major Class |
| 0x00 | 0x02 | Phone | |
| 0x00 | 0x03 | LAN | |
| 0x00 | 0x04 | AV | |
| 0x00 | 0x05 | Peripheral | |
| 0x00 | 0x06 | Imaging | |
| 0x00 | 0x1F | Uncategorized | |
| 0x00 | 0x00 | Miscellaneous Device Class | |

Minor device class

The last byte defines the minor device class and is optional. Its interpretation depends on the major device class specified as follows.

| Byte 3 | Computer Major Class | Phone Major Class | LAN Major Class | AV Major Class |
|--------|----------------------|-------------------|---------------------|---------------------|
| 0x00 | Other | Other | LAN 0% utilized | Other |
| 0x04 | Desktop | Cellphone | | Wearable headset |
| 0x08 | Server | Cordless phone | | Hands free device |
| 0x0C | Laptop | Smartphone | | |
| 0x10 | Handheld | Gateway / modem | | Microphone |
| 0x14 | Palm-sized | ISDN | | Loudspeaker |
| 0x18 | Wearable | | | Headphones |
| 0x1C | | | | Walkman |
| 0x20 | | | LAN 1-17% utilized | Car audio |
| 0x24 | | | | Set top box |
| 0x28 | | | | Hi-Fi |
| 0x2C | | | | VCR |
| 0x30 | | | | Video camera |
| 0x34 | | | | Camcorder |
| 0x38 | | | | Monitor |
| 0x3C | | | | Monitor with audio |
| 0x40 | | | LAN 17-33% utilized | Conferencing device |
| 0x48 | | | | Toy |
| 0x60 | | | LAN 33-50% utilized | |
| 0x80 | | | LAN 50-67% utilized | |
| 0xA0 | | | LAN 67-83% utilized | |
| 0xC0 | | | LAN 83-99% utilized | |
| 0xE0 | | | LAN 100% utilized | |

| Byte 3 | Peripheral Device Class <i>Add together one † value and one ‡ value</i> | Imaging Device Class <i>Add together as many values as apply</i> | Uncategorized / Miscellaneous Device Class |
|---------------|---|--|---|
| 0x00 | No keyboard or pointing device † | | Uncategorized / Miscellaneous |
| 0x00 | Other ‡ | | |
| 0x04 | Joystick | | |
| 0x08 | Gamepad ‡ | | |
| 0x0C | Remote control ‡ | | |
| 0x10 | Sensing device ‡ | Display | |
| 0x14 | Digitizer ‡ | | |
| 0x18 | Card reader‡ | | |
| 0x1C | | | |
| 0x20 | | Camera | |
| 0x40 | Keyboard but no pointing device † | Scanner | |
| 0x80 | Pointing device but no keyboard † | Printer | |
| 0xC0 | Keyboard and pointing device † | | |

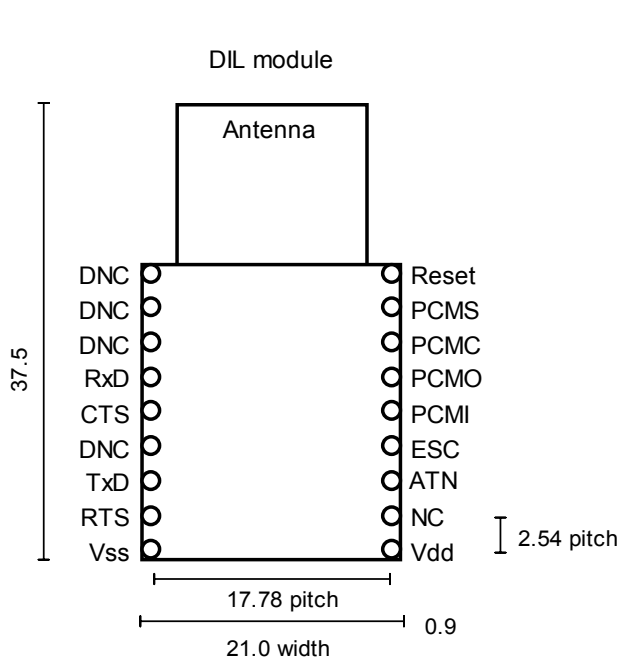
Example

A cellphone might have Object Transfer, Telephony, Network and Limited Discovery services. Its major class would be Phone and its minor class would be Cellphone. The calculation of the device class is as follows:

| Byte 1 | Byte 2 | Byte 3 | Notes |
|---------------|---------------|---------------|---|
| 10 | | | Object Transfer services |
| 40 | | | Telephony services |
| 02 | | | Network services |
| | 20 | | Limited Discovery services |
| | 02 | | Phone Major class |
| | | 04 | Cellphone minor class |
| 52 | 22 | 04 | Total = 522204 = Cellphone device class |

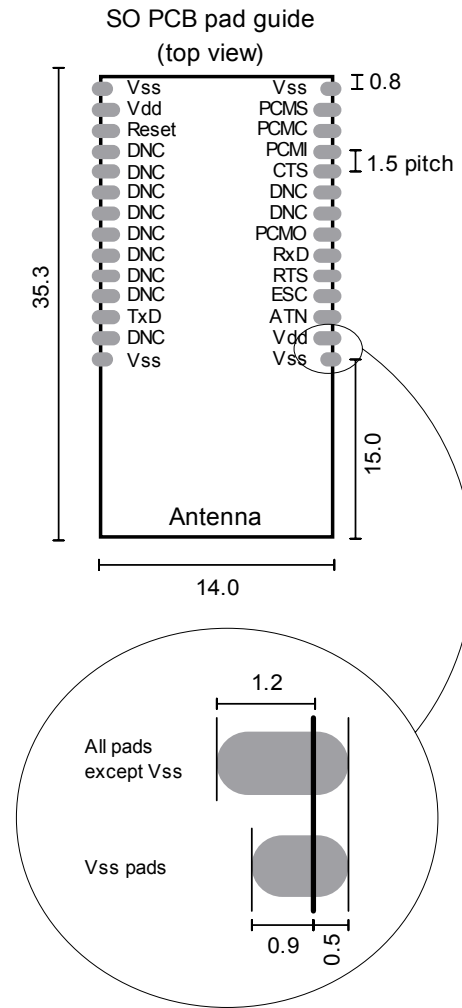
This device class is the default when shipped. All values shown are hexadecimal.

Mechanical Data



Pins are formed pin type,
 1mm dia hole required on PCB pad

All dimensions mm



Technical Specifications

| | |
|-----------------------------------|--|
| Max operating temperature | -40°C to +85 °C |
| Max storage temperature | -40°C to +105 °C |
| Dimensions L × W × H (DIL) | 37.5mm × 19.5mm × 6.5mm excluding pins |
| Dimensions L × W × H (SO Class I) | 35.5mm × 14mm × 2.3mm |

Electrical

| | |
|--|--|
| Supply Voltage (DIL) Vdd | 3.2V to 5.1V |
| Supply Voltage (SO) Vdd | 3.2V to 3.4V |
| Average current, Idle | 3mA |
| Average current, Idle, Deep Sleep on | 1.5mA |
| Average current, Idle, Deep Sleep on, not connectable, not visible | 370µA |
| Average current, during discovery and connecting | 55mA |
| Average current, connected as slave | 6.5mA |
| Average current, connected as master | 21.5mA |
| Average current, connected as slave, sniff mode | 3.7mA |
| Average current, connected as master, sniff mode | 4.85mA |
| Average current, connected as slave, park mode | 3.4mA |
| Average current, connected, transmitting | 22mA |
| Average current, connected, receiving | 33.4mA |
| Average current, connected, transmitting, sniff mode | 18.3mA |
| Average current, connected, receiving, sniff mode | 23.8mA |
| Max voltage on I/O pins (DIL) | -0.4V to 3.4V (PCM audio pins) -0.4V to Vdd+0.1V (other pins) |
| Max voltage on I/O pins (SO) | -0.4V to 3.4V |

Radio

| | |
|--|--------------------------|
| Max RF output power | Class I = 100mW = +20dBm |
| RF frequency range | 2402MHz to 2480MHz |
| RF channels | 79 |
| Frequency hopping | 1600 Hz |
| Range | 100m nominal |
| Communication latency, serial to serial via two LinkMatik 2.0 radios | 8ms to 15ms |

Bluetooth qualification & logos and trademarks

The radio has been pre-qualified and is listed in the Bluetooth Qualified Products as B03005. FlexiPanel Ltd is registered as an Adopter Member with the Bluetooth SIG, Inc. OEMs wishing to re-brand FlexiPanel Ltd Bluetooth products and use the Bluetooth Logos and trademarks must also register as Adopter Members. Membership is free, refer to www.bluetooth.org for details.

FCC and CE modular approval

The radio has 'modular approval' for USA and certain European countries, provided the existing integral antenna is used. The module indicates that it does not require further R&TTE certification. The exterior of the product should be marked as follows:

| |
|---|
| Contains Transmitter Module FCC ID: QOQWT11 |
|---|

Distributor Contact Details

LinkMatik 2.0 is assembled and distributed by agreement by RF Solutions Ltd:



R F Solutions Ltd
Unit 21, Cliffe Industrial Estate,
Lewes, E. Sussex, BN8 6JL, United Kingdom
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Manufacturer Contact Details

LinkMatik 2.0 was developed by FlexiPanel Ltd:



FlexiPanel

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