FlexiPanel

BlueMatik™ AT Command User Guide

Contents

CONTENTS 1
INITIALIZATION 1
CONNECTION AS SLAVE 2
SEARCHING FOR DEVICES 2
CONNECTION AS MASTER 2
SECURITY 3
Authentication 3
Encryption 3
LOW POWER MODES 3
Hold mode 3
Sniff mode 3
Park mode 4
BLUETOOTH DEVICE CLASSES 5
Services and Major Device Class 5
Example 5
Minor device class 6

Initialization

To set up communication with BlueMatik, configure the host microcontroller as follows:

1. Set up I/O direction on host and set initial output values:

   - RxD is output from host, initially high
   - TxD is input from host
   - HUM is output from host, initially high
   - MUM is input to host
   - CTS is output from host, initially low or high depending on how you handle incoming data
   - RTS is input to host
   - Reset is output from host, initially high
   - On/Off is output from host, initially low

2. Initialize but disable host UART; settings 115.2k baud, 8N1.

3. Create incoming data buffers, one for AT responses and one for data. The longest AT response is the +BPRC response, which may contain up to 57 characters excluding <CR> (carriage return) and <LF> (linefeed) characters.

4. Set up incoming data handling by interrupts, or by polling (i.e. keeping the CTS line high until you are ready accept data and then take the line low). Monitor the MUM line to decide whether to put the data in the AT buffer (MUM = low) or data buffer.

5. All AT responses will be ASCII preceded and followed by <CR><LF> (i.e. "<CR>\n" in C, or the characters 0x0D 0x0A). The best way to handle this data is to ignore all <CR> characters and assume there is a complete response to process when a <LF> is received and the buffer is not empty. Empty the buffer after you have processed the message.

6. To initialize the module, set On/Off to high

7. Pulse Reset high for 10ms

8. Wait for TxD pin to go high

9. Enable UART

10. Wait for "+BINF" response from BlueMatik and read device name and Bluetooth address.

11. Wait for READY response from BlueMatik

12. If you need to switch baud rates, do so now with the "AT+BURT" and "AT+BURI" commands as indicated in the documentation. Wait for the "OK" response before switching baud rates. This is command only necessary once as the new setting is stored in ROM.

13. Initialize Serial Port Profile by sending the command "AT+BRSR=1,0<CR>". Wait for both the "OK" and "+BRSR" responses before continuing.

14. Set the Device Class if you wish by sending the command "AT+BSCD=aabbcc<CR>", where aabbcc is the hex device class. Wait for the "OK" response before continuing. Refer to the section below on Bluetooth device classes.

15. Add security if you wish by sending the command "AT+BSEC=1<CR>" for authentication, or "AT+BSEC=2<CR>" for authentication and encryption. Wait for the "OK" response before continuing. If add

security, you must implement the steps indicated in the *Security* section.

16. Enable Sniff and Hold low power modes by sending the command "AT+BWLP=7<CR>". Wait for the "OK" response before continuing.

17. Set device name if necessary by sending the command "AT+BNAM=NewName<CR>". Wait for the "OK" response before continuing. This is command only necessary once as the new setting is stored in ROM.

Connection as slave

To set up BlueMatik as a slave device, do as follows:

1. Throughout this section, ignore any modem status responses "+BMSC=...".

2. Enter slave mode by sending the command "AT+BSLV<CR>". Wait for the "OK" response before continuing.

3. When a remote device connects, BlueMatik sends "+BRFC=HHHH,HH,HHHHHH,x,x,x" in response. The remote device Bluetooth address will be indicated by the HHHH,HH,HHHHHH (leading zeroes on these hex values are suppressed).

4. To disconnect, send the message "AT+BDIS" message and wait for the "+BRFC=0,0,0,x,x,x" response before continuing. The module will no longer be in slave mode and if you wish to be ready to accept new connections, you must send the "AT+BSLV<CR>" command again.

5. If the master chooses to disconnect, BlueMatik sends a "+BRFC=0,0,0,x,x,x" response. The module will no longer be in slave mode and if you wish to be ready to accept new connections, you must send the "AT+BSLV<CR>" command again.

6. To come out of slave mode when you are not connected, send the message "AT+BCNL" message and wait for the "+BRFC=0,0,0,x,x,x" response before continuing.

Searching for devices

To use BlueMatik to search for discoverable devices:

1. Search for devices using the "AT+BINQ=0,0,A,A<CR>". The 0,0 indicate that all devices should be reported. The first A argument is the maximum number of responses (10 in decimal). The second is the inquiry time-span, (10 seconds).

2. Each located device will generate the response "+BINQ=HHHH,HH,HHHHHH, YYYYYY,DevName". The remote device Bluetooth address will be indicated by the HHHH,HH,HHHHHH (leading zeroes on these hex values are suppressed). YYYYYY is the remote device class of device.

3. Wait for the "AT+BINC:x" message to indicate the search is complete.

Connection as master

To use BlueMatik to connect to another device:

1. Throughout this section, ignore any modem status responses "+BMSC=...".

2. Attempt to connect by sending the command "AT+BMST=00,HHHH,HH,HHHHHH" where HHHH,HH,HHHHHH is the remote device Bluetooth address.

3. If connection is successful, you will receive a "+BRFC=HHHH,HH,HHHHHH, x,x,x" response.

4. If it is possible that connection may not be is successful, provide a timeout after the "AT+BMST" command. If you have not received a "+BRFC=..." response in that time, assume connection has failed and cancel the connection request by sending a "AT+BCNL" message. Wait for the "+BRFC=0,0,0,x,x,x" response before continuing.

5. To disconnect, send the message "AT+BDIS" message and wait for the "+BRFC=0,0,0,x,x,x" response before continuing.

6. If the slave chooses to disconnect, you will receive a "+BRFC=0,0,0,x,x,x" message.

Security

It is important to note that even if authorization or encryption are not enabled locally, the remote device may require one or both of them. Therefore the host should be capable of dealing with PIN codes and link keys as detailed below.

Authentication

Security settings should be set soon after initialization; the required commands are detailed in the section on initialization.

It is important to note that even if security is not enabled locally, the remote device may require it. Therefore the host should be capable of dealing with PIN codes and link keys as detailed below.

If authentication is enabled, an unknown device becomes trusted by exchanging PIN codes with the host. A trusted device exchanges a *Link Key* with the host. The Link Key would have been generated on a previous occasion where PIN codes were successfully exchanged. The link key exchanged relieves the user of having to enter a PIN code every time. BlueMatik can only store one link key, so it's really up to the host to store and manage link keys (i.e. paired devices).

When a device, slave or master, attempts to connect, you will receive a "+BLNK= HHHH,HH,HHHHHH" message. It is asking you if you have a link key for the device with Bluetooth address HHHH,HH,HHHHHH. If you have one (see the "+BPRC=..." point below), send message "+BLNK=H32H", where H32H is the 32-digit hex link key. Connection will then proceed with the "+BRFC=..." response as normal.

If you have no link key for the device, send the message "+BLNK=" in response to a "+BLNK=..." message. You will then receive a "+BPIN=HHHH,HH,HHHHHH" message requesting that you specify a pin number. In response, send the message "+BPIN=1234", where 1234 is your PIN code, up to 16 digits long. To reject a device completely, use the message "+BPIN=". Bear in mind that some devices can only enter the digits 0-9 for PIN codes.

If PIN codes are successfully exchanged, you will receive a "+BPRC=HHHH,HH, HHHHHH,H32H" message which tells you the link key for this device, which you can retain for future use. Connection will then proceed with the "+BRFC=..." response as normal.

Encryption

Encryption is transparent. You do not have to do anything other than send the "AT+BSEC=2<CR>" command as detailed in the section on initialization.

Low Power Modes

Hold mode

Hold mode is a power saving mode for the BlueMatik module while a connection is present. It is essentially notice given by one or other Bluetooth device that communication will be suspended for a negotiated *hold interval*. Once suspended, communication does not restart until the hold interval over.

To enter hold mode, use the AT+BEHM command. BlueMatik will automatically exit Hold mode at the end of the hold interval; to re-enter hold mode, issue the AT+BEHM command again. Appropriate +BCHM responses will be generated upon entry and exit of hold mode. The remote Bluetooth device may also request hold mode, which will also generate +BCHM responses.

To set the hold interval, use the AT+BSHP command as in the following example:

```
AT+BSHP=0200,0080
```

The first argument is the maximum negotiable hold interval; the second is the minimum negotiable hold interval. Both are four-digit hexadecimal numbers representing the time of the hold interval in units of 625µS. The actual interval negotiated is indicated by the +BCHM response.

The default minimum and maximum values are both 0x0100 i.e. 160ms which is designed to be hardly noticeable by a user.

Once set up, hold mode is transparent to the developer.

Sniff mode

Sniff mode is a power saving mode for the BlueMatik module while a connection is present. It is essentially an agreement that communication

can only resume in specific time slots. Once in sniff mode, a connection remains in sniff mode until either party decides to exit. Three time-period parameters, $T_{interval}$, $T_{attempt}$ and $T_{timeout}$, govern the sniff mode behavior as follows:

- Time is divided into sniff intervals of length $T_{interval}$.
- Communication may only resume in the first $T_{attempt}$ time units of the sniff interval.
- If communication does resume, it may continue right up to the end of the sniff interval. However, if resumed communication ceases at any time for longer than $T_{timeout}$ time units, communication must stay ceased until the start of the next sniff interval.

To enter sniff mode, use the `AT+BESM` command. To exit sniff mode, use the `AT+BXSM` command. Appropriate `+BCHM` responses will be generated upon entry and exit of hold mode. The remote Bluetooth device may also request hold mode, which will also generate `+BCHM` responses.

To set the sniff parameters, use the `AT+BSNP` command as in the following example:

```
AT+BSNP=0200,0080,0008,0008
```

The first argument is the maximum negotiable $T_{interval}$; the second is the minimum negotiable $T_{interval}$; the third is $T_{attempt}$; the fourth is $T_{timeout}$. All are four-digit hexadecimal numbers representing the time of the hold interval in units of 625µS.

As a rule of thumb, $T_{attempt}$ and $T_{timeout}$ may as well be equal and about 2% to 5% of $T_{interval}$. The default values are: minimum and maximum $T_{timeout}$ are both `0x0100`, *i.e.* 160ms; $T_{attempt}$ and $T_{timeout}$ are both `0x0008`, i.e. 5ms (3% of $T_{interval}$).

Once set up, sniff mode is transparent to the developer.

Park mode

A *Park* mode exists within the Bluetooth protocol, but it is not supported by BlueMatik.

Bluetooth Device Classes

The 3-byte Bluetooth device class, specified using the `AT+BSCD=aabbcc` command, 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. BlueMatik can be programmed to claim to be capable of any number of services, however 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 bitwise-ORing together as many services that are required and the one Device Major Class required.

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

Example

If BlueMatik is required to claim network and object transfer and information services, and appear as a peripheral then the device configuration bytes are:

Byte A	Byte B	
0x02 (0000 0010)	0x00 (0000 0000)	Network Services
0x10 (0001 0000)	0x00 (0000 0000)	Object transfer Services
0x80 (1000 0000)	0x00 (0000 0000)	Information Services
0x00 (0000 0000)	0x05 (0000 0101)	Peripheral Device Major Class

Resulting bytes (bitwise OR together the above)

Byte A	Byte B
0x92 1001 0010	0x05 0000 0101

Minor device class

The last byte defines the minor device class. Its interpretation depends on the major device class specified:

Byte C	Computer Major Class	Phone Major Class	LAN Major Class	AV Major Class
0x00	Other	Other	LAN 0% utilized	Other
0x04	Desktop	Cellphone (default)		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 C	***Peripheral Device Class*** *Bitwise-OR together one † value and one ‡ value*	***Imaging Device Class*** *Bitwise-OR together as many values as apply*	***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 †		