



Maker Power™

Brick Controller ONE API

Overview

This document describes the Application Programming Interface (API) for both the USB and BTLE interfaces.

USB API (API Level 3)

The USB interface is a standard HID interface. The Brick Controller will negotiate the interface with the Operating System and provide the transport mechanism.

The commands are sent as packets in the following format:

Byte	Content	Description
1	0xFF	Header
2	0xFF	Header
3	0x\$\$	Command (see list)
4	0x\$\$	Packet Size
..	0x\$\$	Data
..	0x\$\$	Data
..	0x\$\$	Data
n	0xFE	End of Packet Marker

Header: The first two bytes are 0xFF and construct the header of the packet

Command: Single byte value of 0x01 – 0xFD (see command list)

Packet Size: Single byte value of 0x01 – 0x20 of how many bytes of data there are.

Data: Sequence of bytes as indicated in the packet size value.

EOP Marker: Single byte value of 0xFE to indicate the end of packet.

Note: The USB path will return string data that is outside of the packet format. These are generally Printf type strings indicating that certain commands have been completed. While every effort has been made to suppress these, we cannot guarantee we found them all.

USB Command List:

MotorControl	0x20
LEDControl	0x21
RetrieveScript	0x22
StoreScript	0x23
ScriptInit	0x24
StartScript	0x25
LED Flashing	0x26
LED Pulsing	0x27
FWUpdate	0xEC
Reserved	0xED
Reserved	0xEE
RestoreDefaults	0xEF
ACK	0xF0
NAK	0xF1
GetAPILevel	0xF3
GetFirmwareVer	0xF4
GetSerialNumber	0xF5
Reserved	0xF6
BoardID	0xF7
Reserved	0xFB
Reserved	0xFC
Reserved	0xFD
Reserved	0xFE
Reserved	0xFF

CAUTION

Using a reserved command may cause the device to lock up or become unusable. Do NOT use RESERVED commands.

Motor Control (0x20)

Command will set the new motor state. It is possible to change the state of all four motors simultaneously.

Tx Packet Size: 2

Rx packet Size: No returned data

Tx Data:

Byte	Description
1	Motor ID 0x00 – Byte 2 defines the motors affected 0x01 – Motor 1 0x02 – Motor 2 0x03 – Motor 3 0x04 – Motor 4
2	New Motor State as defined as follows:

Byte	Description
1	Motor ID 0x00 – Byte 2 defines the motors affected 0x01 – Motor 1 0x02 – Motor 2 0x03 – Motor 3 0x04 – Motor 4
2	New Motor State as defined as follows:

Bits	Description
D7	Motor 4 Power State 0 – OFF 1 – ON
D6	Motor 3 Power State 0 – OFF 1 – ON
D5	Motor 2 Power State 0 – OFF 1 – ON
D4	Motor 1 Power State 0 – OFF 1 – ON
D3	Motor 4 Direction 0 – Forward 1 – Reverse
D2	Motor 3 Direction 0 – Forward 1 – Reverse
D1	Motor 2 Direction 0 – Forward 1 – Reverse
D0	Motor 1 Direction 0 – Forward 1 – Reverse

RxData: No Rx data

LED Control (0x21)

Command will set the state of the LEDs. It is possible to change the state all four LEDs simultaneously.

Tx Packet Size: 2

Rx packet Size: no returned data

Tx Data:

Bits	Description
D15-D08	LED
	0x01 LED 1
	0x02 LED 2
	0x03 LED 3
	0x04 LED 4
D07-D00	LED State
	0x00 OFF
	0x01 ON

RxData: No Rx data

Retrieve Script (0x22)

Command will retrieve the script contained in the Brick Controller local memory. Scripts are a sequence of 32 bit (4 byte) values as described below.

Bits	Description
D31-D28	Command
D27-D16	12 bit number of absolute time in 0.1 sec intervals, 0-409.6 secs
D15-D00	data packet (see BTLE API for definition)

Tx Packet Size: 1

Rx packet Size: variable

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData: Is variable and will be sequence of packets, with each one containing one script command as described above. The last command is received when the Command value is either 0xF0 (stop command) or 0xFF (uninitialized local memory). The bytes are received in the following order:

Byte	Description
1	D31-D24
2	D23-D16
3	D15-D8
4	D7-D0

Store Script (0x23)

Command will store a sequence of the 32 bit (4 byte) values in the Brick Controller local memory. The script commands are sent one command at a time and the Brick Controller will acknowledge each command with a returned ACK packet (0xF0) to indicate that the next script command can be transmitted. It is up to you to place a stop command (0xF) as the last command. The total number of script commands that can be stored in local memory is 48.

Tx Packet Size: 4

Rx packet Size: 1

Tx Data: The bytes are sent in the following order:

Byte	Description
1	D31-D24
2	D23-D16
3	D15-D8
4	D7-D0

RxData: ACK Packet (0xF0) is received

Script Initialize (0x24)

Command will reset the script counter to zero.

Tx Packet Size: 1

Rx packet Size: 1

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData: ACK Packet (0xF0) is received

Start Script (0x25)

Command will reset the script counter to zero and start the script running located in internal memory running.

Tx Packet Size: 1

Rx packet Size: 1

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData: ACK Packet (0xF0) is received

Start Script (0x26)

Command will reset the script counter to zero and start the script running located in internal memory running.

Tx Packet Size: 1

Rx packet Size: 1

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData: ACK Packet (0xF0) is received

Start Script (0x25)

Command will reset the script counter to zero and start the script running located in internal memory running.

Tx Packet Size: 1

Rx packet Size: 1

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData: ACK Packet (0xF0) is received

Firmware Update (0xEC)

Command places the device in the Firmware update mode.

Tx Packet Size: 1

Rx packet Size: no returned data

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData: No Rx Data.

Restore Defaults (0xEF)

Command erases any locally updated calibration data and restores the factory default calibration data.

Tx Packet Size: 1

Rx packet Size: no returned data

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData: No Rx Data

ACK (0xF0)

This is a receive command only. When used indicates that a command was accepted and acted upon.

Tx Packet Size: N/A

Rx packet Size: 1

Tx Data: N/A

RxData: Byte value returned is dependent on the command the ACK is sent for.

NAK (0xF1)

This is a receive command only. When used indicates that a command was accepted, but failed.

Tx Packet Size: N/A

Rx packet Size: 1

Tx Data: N/A

RxData: Byte value returned is dependent on the command the NAK is sent for.

Get API Level (0xF3)

Command returns the API Level for both the USB interface and the BTLE interface.

Tx Packet Size: 1

Rx packet Size: 2

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData:

Byte	Description
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1	Byte value indicating the supported USB API Level. Valid values are 0x02.
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2	Byte value indicating the supported BTLE API Level. Valid values are 0x02.
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Get Firmware Version(0xF4)

Command returns the devices firmware version.

Tx Packet Size: 1

Rx packet Size: 2

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData:

Byte	Description
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1	Major version number
---	----------------------

2	Minor version number
---	----------------------

Get Serial Number (0xF5)

Command returns the Board serial number.

Tx Packet Size: 1

Rx packet Size: variable

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData: String containing the serial number.

Board ID (0xF7)

Command returns the Board ID and a string containing the Board Name, depending on whether it is connected to a Monitor Module or a Power Chassis.

Tx Packet Size: 1

Rx packet Size: variable

Tx Data: Any value between 0x01 and 0xEF, value is not used

RxData:

Connected to a Monitor Module will return 0x09 followed by the string "USB-BT Monitor"

Connected to a Power Chassis will return 0x0A followed by the sting "Power Chassis"

BTLE API (Level 3)

All communication across the BTLE link is through the MyMakerTools service and associated characteristics.

MyMakerTools Service UUID = `3425a5cc-a676-4362-9592-a88e132b8b52`

There are 4 characteristics that are used

Heartbeat UUID = `b67e3a3b-15c9-41b6-a9f2-fbf379418d12`

Control01 UUID = `f18e901a-f325-4dfd-8cdb-68506676dc08`

Control02 UUID = `9bac1d28-9fc1-4db0-97c4-896089ad26bb`

Control03 UUID = `39bb1bf9-17ec-41d2-b5e4-b78551b45740`

The BTLE device will connect with the Brick Controller device first through the MyMakerTools service. Once the connection is established, the BTLE device can query the characteristics and use as described below.

Heartbeat Characteristic

This characteristic establishes a heartbeat signal between the Brick Controller and the BTLE device. Additionally it may be used as a background channel to update some parameters as shown below.

The characteristic property is set to:

Notify

Read

Data Size 2 bytes.

To use the Heartbeat characteristic, the characteristic notification must be enabled through the BTLE programming mechanism you are using.

NOTE

Only the BTLE device you are using to control the Brick Controller can initiate this characteristic. The Brick Controller will not initiate this feature.

Once the notification is enabled, the Brick Controller will update the characteristic with a new heartbeat value at a 2 second interval. The value will alternate between 0x0035 and 0x0041. You may disable the Heartbeat by disabling the characteristic notification. Also if the connection between the Brick Controller and the BTLE device is broken or disabled by any means, the Heartbeat characteristic notification will be disabled and must be re-started on the next connection.

The following parameters are updated via this characteristic. In the two byte value that is sent bits D15-D8 are the command and D7-D0 are the payload value.

<u>D15-D8</u>	<u>Commands</u>
0x00	Heartbeat 0x35 – Heartbeat low value 0x41 – Heartbeat high value 0x55 – Brick Controller has gone to sleep
0x10	Reserved
0x11	Reserved
0x20	Reserved
0x21	Reserved

Control01 Characteristic

This characteristic is used to transfer the script between the brick controller and the Android application.

The characteristic property is set to:

Read

Write without response

Data Size 4 bytes.

The four bytes are considered a contiguous unsigned 32 bit value, with the upper byte being D31-D24 continuing down to the lower byte being D7-D0.

The script format is describe below. The 32 bit value is broken up into three parts, the command, a time stamp and the payload.

<u>Bits</u>	<u>Description</u>
D31-D28	Command
D27-D16	12 bit number of absolute time in 0.1 sec intervals, 0-409.6 secs
D15-D00	payload

To store scripts you would first send an Initialize Script (0x71) command via the Control02 Characteristic. The via this characteristic transfer the scripts until you are done. To Retrieve scripts, again send the Initialize Script command and then read this characteristic until the command is either 0xF0 (stop command) or 0xFF (uninitialized local memory).

<u>D31-D28</u>	<u>Commands</u>
0x8	Script Reset – jump to the beginning of the script
0x9	Motor/LED – basic on/off and forward/reverse for motor and on/off for LEDs
0xA	Wait – wait for and event to happen before proceeding
0xB	RESERVED
0xC	LED Flashing – different types of preprogrammed LED flashing
0xD	LED Pulsing – different types of preprogrammed LED pulsing
0xE	RESERVED
0xF	Stop – this is the last command executed, the script stops here

Script Reset(0x8)

Bits	Description
D31-D28	Command (0x8)
D27-D16	12 bit number of absolute time in 0.1 sec intervals, 0-409.6 secs
D15-D00	reserved (set to zero)

Motor/LED (0x9)

Bits	Description
D31-D28	Command (0x9)
D27-D16	12 bit number of absolute time in 0.1 sec intervals, 0-409.6 secs
D15-D14	LED4 State
	00 OFF
	01 ON
	10 Pulsing
	11 Flashing
D13-D12	LED3 State
	00 OFF
	01 ON
	10 Pulsing
	11 Flashing
D11-D10	LED2 State
	00 OFF
	01 ON
	10 Pulsing
	11 Flashing
D09-D08	LED1 State
	00 OFF
	01 ON
	10 Pulsing
	11 Flashing
D7	Motor 4 Power State
	0 – OFF
	1 – ON
D6	Motor 3 Power State
	0 – OFF
	1 – ON
D5	Motor 2 Power State
	0 – OFF
	1 – ON
D4	Motor 1 Power State
	0 – OFF
	1 – ON
D3	Motor 4 Direction
	0 – Forward
	1 – Reverse

D2	Motor 3 Direction
	0 – Forward
	1 – Reverse
D1	Motor 2 Direction
	0 – Forward
	1 – Reverse
D0	Motor 1 Direction
	0 – Forward
	1 – Reverse

Script Wait(0xA)

Bits	Description
D31-D28	Command (0xA)
D27-D16	12 bit number of absolute time in 0.1 sec intervals, 0-409.6 secs
D15-D12	reserved (set to zero)
D11-D08	set to 0x1
D07-D04	BT LED to use
	0x0001 Blue LED
	0x0010 Red LED
	0x0100 Green LED
D03-D00	Sesnor Input to use
	0x0001 Sensor 1
	0x0010 Sensor 2
	0x0100 Sensor 3

Script Stop(0xF)

Bits	Description
D31-D28	Command (0xF)
D27-D16	12 bit number of absolute time in 0.1 sec intervals, 0-409.6 secs
D15-D00	reserved (set to zero)

LEDs Flashing (0xC)

Bits	Description
D31-D28	Command (0x9)
D27-D16	12 bit number of absolute time in 0.1 sec intervals, 0-409.6 secs
D15-D12	LED4 Flash Style
	0000 OFF
	0001 Burst
	0010 Pulsing
	xxxx all others reserved
D11-D08	LED3 Flash Style
	0000 OFF
	0001 Burst
	0010 Pulsing
	xxxx all others reserved

D07-D04	LED2 Flash Style
	0000 OFF
	0001 Burst
	0010 Pulsing
	xxxx all others reserved
D03-D00	LED1 Flash Style
	0000 OFF
	0001 Burst
	0010 Pulsing
	xxxx all others reserved

LEDs Pulsing (0xD)

Bits	Description
D31-D28	Command (0x9)
D27-D16	12 bit number of absolute time in 0.1 sec intervals, 0-409.6 secs
D15-D08	Reserved (set to zero)
D07-D00	LED3 Pulse Style
	0001 0100 LED 3 normal Pulse style
	xxxx xxxx all others reserved

Control02 Characteristic

This characteristic is used to retrieve/set Brick Controller data, options and configuration. In order to set an option/configuration, write the 32 bit value to the characteristic. When retrieving data, you must first set the read pointer by writing to the characteristic and then immediately read the characteristic as many times as is necessary to retrieve the data. Once the read sequence is complete, the read pointer is set to zero unless otherwise noted below.

The characteristic property is set to:

Read

Write without response

Data size 4 bytes.

The four bytes are considered a contiguous unsigned 32 bit value, with the upper byte being D31-D24 continuing down to the lower byte being D7-D0. The upper bits define the command/data type and are defined as follows.

D31-D24	Write
0x65	Reserved
0x66	Set Heartbeat State
0x67	Get/Set Configuration
0x68	Get API version
0x69	Get/Set RN4020 LEDs
0x6A	Reserved
0x6B	Reserved
0x6C	Reserved

0x6D	Reset
0x6E	Reserved
0x6F	Factory Reset
0x70	Motor/LED
0x71	Initialize Script
0x72	Start Script
0x73	Halt Script
0x74	Set LED Flashing state
0x75	Set LED Pulsing state

D31-D24	Read
0x00	Complete
0x01	Continue
0x07	Configuration
0x08	API Version
0x09	Reserved
0x0A	Status
0x0B	Reserved
0x0C	Memory Dump
0x10	Sample Rate
0x11	Temperature Data
0x12	Reserved
0x13	Used FLASH

Set Heartbeat State (0x66)

Will override the heartbeat command from Heartbeat Characteristic. Default state is on. State cannot be read back and thus is a write only command.

Write Characteristic

Bits	Description
D31-D24	Command byte (0x66)
D23-D08	Reserved (set to all zeroes)
D07-D00	State
	0x00 OFF
	0x01 ON

Read Characteristic

No corresponding read data

Get/Set Configuration (0x67)

Will set the configuration or read the configuration. This is unimplemented in this version.

Write Characteristic

Bits	Description
D31-D24	Command byte (0x67)
D23	Get or Set Configuration
	0x0 Set Configuration

	0x1	Get Configuration
D22-D00	Reserved (set to all zeroes)	
Read Characteristic		
<u>Bits</u>	<u>Description</u>	
D31-D24	Command byte (0x07)	
D23-D00	undefined	

Get API Version (0x68)

Will retrieve the BTLE API version and the Hardware revision.

Write Characteristic

<u>Bits</u>	<u>Description</u>
D31-D24	Command byte (0x68)
D23-D00	Reserved (set to all zeroes)

Read Characteristic

<u>Bits</u>	<u>Description</u>
D31-D24	Command byte (0x08)
D23-D16	Hardware revision
D15-D08	PC-USB API version
D07-D00	BTLE API version

Set RN4020 LEDs (0x69)

Will override the default state of the LEDs of the RN4020. Once this is done, they will no longer indicate the status of the RN4020 (Blue LED) or the connection state (Green LED).

Write Characteristic

<u>Bits</u>	<u>Description</u>
D31-D24	Command byte (0x69)
D23-D08	Reserved (set to all zeroes)
D07	0x00
D06	Green LED Selection
	0x0 not selected
	0x1 selected
D05	Red LED Selection
	0x0 not selected
	0x1 selected
D04	Blue LED Selection
	0x0 not selected
	0x1 selected
D03	0x00
D02	Green LED State
	0x0 OFF
	0x1 ON
D01	Red LED State
	0x0 OFF
	0x1 ON

D00 Blue LED State
 0x0 OFF
 0x1 ON

Read Characteristic
 No corresponding read data

Get Status (0x6A)

Will retrieve the status on the next Read Characteristic.

Write Characteristic

Bits	Description
D31-D24	Command byte (0x6A)
D23-D00	Reserved (set to all zeroes)

Read Characteristic

Bits	Description
D31-D24	Command byte (0x0A)
D23-D00	all zeroes

Reset (0x6D)

Will execute a processor reset on the device.

Write Characteristic

Bits	Description
D31-D24	Command byte (0x6D)
D23-D00	Reserved (set to all zeroes)

Read Characteristic

No corresponding read data

Factory Reset (0x6F)

Will return the device to a factory new state and then cause a PIC reset.

Write Characteristic

Bits	Description
D31-D24	Command byte (0x6F)
D23-D00	Reserved (set to all zeroes)

Read Characteristic

No corresponding read data

Control03 Characteristic

This characteristic is reserved for future use.