**PRELIMINARY**

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Maker PowerTM

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 afffected

 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 definiton)

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

1 Byte value indicating the supported USB API Level. Valid values are 0x02.

2 Byte value indicating the supported BTLE API Level. Valid values are 0x02.

**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

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 disable 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.

D15-D8 Commands

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.

Bits Description

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).

D31-D28 Commands

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 Flashhing – 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

Bits Description

D31-D24 Command byte (0x07)

D23-D00 undefined

*Get API Version (0x68)*

Will retrieve the BTLE API version and the Hardware revision.

Write Characteristic

Bits Description

D31-D24 Command byte (0x68)

D23-D00 Reserved (set to all zeroes)

Read Characteristic

Bits Description

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

Bits Description

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.