Remote IO Control Protocol

Document Version: R3.1.1

RIOC messages can be transferred between RIOC units over CAN-Bus, UART (serial) or WebSocket.

Remote IO Control over CAN-Bus

For each data frame transferred between RIOC units, both the address and message are packaged in an extended CAN datagram. The source address and destination address occupy 16 bits in CAN EID. The rest 2 bits in CAN EID and 11 bits in CAN SID are reserved in RIOC protocol presently. And, the RIOC message is filled in an 8-byte payload of the CAN datagram. In other words, the length of any RIOC message must be 8 bytes (or less than 8 bytes).

<EID15~EID8>	source unit address
<EID7~EID0>	destination unit address
	(master unit: 0, slave unit: 1~254, broadcast: 255)
<DATA0>	RIOC class
<DATA1>	command (byte7 marks transmission direction)
<DATA2>	channel
<DATA3>	parameter
<DATA4>	parameter
<DATA5>	parameter
<DATA6>	parameter
<DATA7>	parameter

Remote IO Control over UART
14 bytes in each serial data frame

0x5A	leading character
0x00	data frame version
<ADD_S >	source unit address
<ADD_D >	destination unit address
<DATA0>	RIOC class
<DATA1>	command
<DATA2>	channel
<DATA3>	parameter
<DATA4>	parameter
<DATA5>	parameter
<DATA6>	parameter
<DATA7>	parameter
<CRC>	checksum
0xA5	ending character

Remote IO Control over WebSocket (Text Mode)

22 ASCII characters in each web socket text message

(each field below is a double-digit hex number with two characters)

"00"	data frame version
<ADD_S >	source unit address
<ADD_D >	destination unit address
<DATA0>	RIOC class
<DATA1>	command
<DATA2>	channel
<DATA3>	parameter
<DATA4>	parameter
<DATA5>	parameter
<DATA6>	parameter
<DATA7>	parameter

Protocol for RIOC Objects

With the RIOC messaging protocol, a set of remote-controllable objects is defined. The hardware developers can follow RIOC logical object definitions and make RIOC-compatible devices.

General IO
- Digital In

SETUP	01 00 \<pin\> \<mode\> \<filter\> \<sample_interval_H[1]\> \<sample_interval_L[1]\>
(rsp)	01 80 \<pin\> \<ok\>
READ	01 01 \<pin\>
(rsp)	01 81 \<pin\> \<value\>
SET_NOTIFICATION	
	01 02 \<pin\> \<enable_notification\>
(rsp)	01 82 \<pin\> \<enable_notification \>
(notify)	01 83 \<pin\> \<value\>

[1] microseconds

- Digital Out

SETUP	02 00 \<pin\> \<mode\>
(rsp)	02 80 \<pin\> \<ok\>
WRITE	02 01 \<pin\> \<value\>
(rsp*)	02 81 \<pin\> \<value\>
~~SET_PWM~~	~~02 02 \<pin\> \<pwm_period\>~~
~~(rsp)~~	~~02 82 \<pin\> \<pwm_period\>~~
WRITE_PWM	02 03 \<pin\> \<pwm_value\>
(rsp*)	02 83 \<pin\> \<pwm_value\>
PULSE	02 04 \<pin\> \<value\> \<pw_H[1]\> \<pw_M[1]\> \<pw_L[1]\>
(rsp*)	02 84 \<pin\> \<value\> \<pw_H[1]\> \<pw_M[1]\> \<pw_L[1]\>
READ	02 05 \<pin\>
(rsp)	02 85 \<pin\> \<value\>
READ_PWM	02 06 \<pin\>
(rsp*)	02 86 \<pin\> \<pwm_value\>

[1] microseconds

- Analog In

SETUP	03 00 \<pin\> \<mode\> \<filter\> \<sample_interval_H[1]\> \<sample_interval_L[1]\>
(rsp)	03 80 \<pin\> \<ok\>
READ	03 01 \<pin\>
(rsp)	03 81 \<pin\> \<value_H\> \<value_L\>

SET_NOTIFICATION
                03 02 <pin> <enable_notification> <interval_H[2]> <interval_L[2]> <significant_bits[3]>
(rsp)   03 82 <pin> <enable_notification> <interval_H[2]> <interval_L[2]> <significant_bits[3]>
(notify)   03 83 <pin> <value_H> <value_L>

[1] microseconds
[2] milliseconds
[3] 0 or 1~16bits

- Analog Out
        SETUP   04 00 <pin> <mode>
        (rsp)   04 80 <pin> <ok>

        WRITE   04 01 <pin> <value_H> <value_L>
        (rsp*)   04 81 <pin> <value_H> <value_L>

        READ   04 02 <pin>
        (rsp)   04 82 <pin> <value_H> <value_L>

- UART Serial
        SETUP   05 00 <port> <baud_H> <baud_M> <baud_L> <config[1]>
        (rsp)   05 80 <port> <ok>

        SEND   05 01 <port> <length> <byte1> <byte2> <byte3> <byte4>
        (receive)   05 82 <port> <length> <byte1> <byte2> <byte3> <byte4>

[1]
5N1=0x00, 6N1=0x02, 7N1=0x04, 8N1=0x06, 5N2=0x08, 6N2=0x0A, 7N2=0x0C, 8N2=0x0E,
5E1=0x20, 6E1=0x22, 7E1=0x24, 8E1=0x26, 5E2=0x28, 6E2=0x2A, 7E2=0x2C, 8E2=0x2E,
5O1=0x30, 6O1=0x32, 7O1=0x34, 8O1=0x36, 5O2=0x38, 6O2=0x3A, 7O2=0x3C, 8O2=0x3E

- Multiple Digital In
        SETUP   06 00 <pin> <number[1]> <mode>
        (rsp)   06 80 <pin> <ok>

        READ   06 01 <pin>
        (rsp)   06 81 <pin> <value_bits1> <value_bits2> <value_bits3> <value_bits4>

        SET_ NOTIFICATION
                    06 02 <pin> <enable_notification> <interval_H[2]> <interval_L[2]>
        (rsp)   06 82 <pin> <enable_notification> <interval_H[2]> <interval_L[2]>
        (notify)   06 83 <pin> <value_bits1> <value_bits2> <value_bits3> <value_bits4>

[1] 1~32 pins for digital in
[2] milliseconds

- Multiple Digital Out
        SETUP   07 00 <pin> <number[1]> <mode>
        (rsp)   07 80 <pin> <ok>

        WRITE   07 01 <pin> <value_bits1> <value_bits2> <value_bits3> <value_bits4>
        (rsp*)   07 81 <pin> <value_bits1> <value_bits2> <value_bits3> <value_bits4>

        READ   07 02 <pin>
        (rsp)   07 82 <pin> <value_bits1> <value_bits2> <value_bits3> <value_bits4>

Motion

- DC Motor (2 Lines)

SETUP	11 00 <pin1[1]> <pin2[1]> <mode[1]>
(rsp)	11 80 <pin1> <ok>
RUN	11 01 <pin1> <dir> <power>
(rsp*)	11 81 <pin1> <dir> <power>
READ	11 02 <pin1>
(rsp)	11 82 <pin1> <dir> <power>

[1] pin1, pin2 are connected to motor v+/v- for mode 0; pin1, pin 2 are connected to motor PWM and DIR for mode 1.

- Stepper (4 Lines or PUL+DIR)

SETUP	12 00 <pin1[1]> <pin2[1]> <pin3> <pin4> <mode[1]>
(rsp)	12 80 <pin1> <ok>
STEP	12 01 <pin1> <dir> <steps_H> <steps_L>
(rsp*)	12 81 <pin1> <dir> <steps_H> <steps_L>
GOTO	12 02 <pin1> <pos_sign> <pos_H> <pos_M> <pos_L>
(rsp*)	12 82 <pin1> <pos_sign> <pos_H> <pos_M> <pos_L>
STOP	12 03 <pin1>
(rsp*)	12 83 <pin1>
SET_SPEED	12 04 <pin1> <speed_H[2]> <speed_L[2]>
(rsp*)	12 84 <pin1> <speed_H[2]> <speed_L[2]>
GET_SPEED	12 05 <pin1>
(rsp)	12 85 <pin1> <speed_H[1]> <speed_L[1]>
SET_POSITION	12 06 <pin1> <pos_sign> <pos_H> <pos_M> <pos_L>
(rsp*)	12 86 <pin1> < pos_sign> < pos_H> < pos_M> < pos_L>
GET_POSITION	12 07 <pin1>
(rsp)	12 87 <pin1> <pos_sign> <pos_H> <pos_M> <pos_L>

[1] pin1, pin2, pin3, pin4 are connected to stepper A+, A-, B+, B- for mode 0; pin1, pin 2 are connected to stepper PUL and DIR for mode 1.
[2] steps per second

- Servo (Rudder)

SETUP	13 00 <pin> <mode>
(rsp)	13 80 <pin> <ok>
SET_ANGLE	13 01 <pin> <angle[1]>
(rsp*)	13 81 <pin> <angle[1]>
GET_ANGLE	13 02 <pin>
(rsp)	13 82 <pin> <angle[1]>

```
SET_ENABLE   13 03 <pin> <enable>
(rsp*)        13 83 <pin> <enable>

GET_ENABLE   13 04 <pin>
(rsp)         13 84 <pin> <enable>
```

[1] 0 ~ 180 degrees

Sensor
- Encoder (A/B signals)
```
SETUP        21 00 <pin1> <pin2> <mode> <sample_interval_H[1]> <sample_interval_L[1]>
(rsp)         21 80 <pin1> <ok>

READ         21 01 <pin1>
(rsp)         21 81 <pin1> <value_sign> <value_H> <value_M> <value_L>

SET_ NOTIFICATION
              21 02 <pin1> <enable_notification> <interval_H[2]>  <interval_L[2]> <significant_bits[3]>
(rsp)         21 82 <pin1> <enable_notification> <interval_H[2]>  <interval_L[2]> <significant_bits[3]>
(notify)      21 83 <pin1> <value_sign> <value_H> <value_M> <value_L>

WRITE        21 04 <pin1> <value_sign> <value_H> <value_M> <value_L>
(rsp*)        21 84 <pin1> <value_sign> <value_H> <value_M> <value_L>

SET_RANGE_LOWER
              21 05 <pin1> <value_sign> <value_H> <value_M> <value_L>
(rsp*)        21 85 <pin1> <value_sign> <value_H> <value_M> <value_L>

SET_RANGE_UPPER
              21 06 <pin1> <value_sign> <value_H> <value_M> <value_L>
(rsp*)        21 86 <pin1> <value_sign> <value_H> <value_M> <value_L>
```

[1] microseconds
[2] milliseconds
[3] 0 or 1~24bits

- Ultrasonic Ranger
```
SETUP        22 00 <pin1> <pin2> <mode>
(rsp)         22 80 <pin1> <ok>

RANGE        22 01 <pin1>
(rsp)         22 81 <pin1> <value_H1[1]> <value_L[1]>
```

[1] cm

- Thermometer
```
SETUP        23 00 <pin1> <mode>
(rsp)         23 80 <pin1> <ok>

MEASURE      23 01 <pin1>
(rsp)         23 81 <pin1> <temp_H[1]> < temp_L[1]>  <humidity_H[2]> < humidity_L[2]>
```

[1] temperature / kelvins x 10
[2] humidity / 0 ~ 1000 mapped to 0 ~ 100.0%

Sound
- Tone (Frequency)

SETUP	31 00 <pin> <mode>
(rsp)	31 80 <pin> <ok>
PLAY	31 01 <pin> <frequency_H> <frequency_L> <duration_H[1]*> <duration_L[1]*>
(rsp*)	31 81 <pin> <frequency_H> <frequency_L> <duration_H[1]*> <duration_L[1]*>
STOP	31 02 <pin>
(rsp*)	31 82 <pin>

[1] milliseconds

Light
- RGB LED Strip (WS2812)

SETUP	41 00 <pin> <mode> <led_count_H> <led_count_L>
(rsp)	41 80 <pin> <ok>
SHOW_RGB	41 01 <pin> <led_id_H> <led_id_L> <red> <green> <blue>
(rsp*)	41 81 <pin> <led_id_H> <led_id_L> <red> <green> <blue>
SET_RGB	41 02 <pin> <led_id_H> <led_id_L> <red> <green> <blue>
(rsp*)	41 82 <pin> <led_id_H> <led_id_L> <red> <green> <blue>
SHOW	41 03 <pin>
(rsp*)	41 83 <pin>
GET_RGB	41 04 <pin>
(rsp)	41 84 <pin> <led_id_H> <led_id_L> <red> <green> <blue>

Communication
- IR Transmitter

SETUP	51 00 <pin> <mode>
(rsp)	51 80 <pin> <ok>
SEND	51 01 <pin> <format> <byte1> <byte2> <byte3> <byte4>
(rsp*)	51 81 <pin> <format> <byte1> <byte2> <byte3> <byte4>

- IR Receiver

SETUP	52 00 <pin> <mode>
(rsp)	52 80 <pin> <ok>
(receive)	52 81 <pin> <format> <byte1> <byte2> <byte3> <byte4>

User Object
- User Channel

SETUP	E1 00 <channel> <mode>

```
(rsp)              E1 80 <channel> <ok>

READ               E1 01 <channel>
(rsp)              E1 81 <channel> <value_1> <value_2> <value_3> <value_4>

SET_ NOTIFICATION
                   E1 02 <channel> <enable_notification>
(rsp)              E1 82 <channel> <enable_notification>
(notify)           E1 83 <channel> <value_1> <value_2> <value_3> <value_4>

WRITE              E1 04 <channel> <value_1> <value_2> <value_3> <value_4>
(rsp*)             E1 84 <channel> <value_1> <value_2> <value_3> <value_4>
```

Universal Commands for All Objects
- Silence Mode (no response for * marked items)
```
        SET_SILENCE <object> 70 <pin/port> <silent>
        (rsp)              <object> F0 <pin/port> <silent>
```

System Reserved Control for Units
- Unit Control
```
        (start)     00 8f <ver_1> <ver_2> <desc_1> < desc_2> < desc_3> < desc_4>

        RESET       00 01
        (rsp!)      0 81 <ver_1> <ver_2> <desc_1> < desc_2> < desc_3> < desc_4>

        VERSION     00 02
        (rsp)       00 82 <ver_1> <ver_2> <desc_1> < desc_2> < desc_3> < desc_4>

        SET_ID      00 03 <unit_id>
        (rsp)       00 83 <unit_id>

        SYNC_BEGIN  00 04
        (rsp)       00 84

        SYNC_END    00 05
        (rsp)       00 85

        SLEEP       00 06 <duration_H[1]> <duration_L[1]> <rspMode [2]>
        (rsp)       00 86 <duration_H[1]> <duration_L[1]>

        SET_SILENCE 00 07 <silent>
        (rsp)       00 87 <silent>
```

[1] milliseconds
[2] mode 0 = no response, mode 1 = response before sleep, mode 2 = response after sleep, mode 3 = response for both

System Reserved Control for App
- App Control
```
        SIGN_IN     00 00 <app_sign>
        (rsp)       00 80 <connection_count>
```