RoboKit1
Interface Protocol Document

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1 INTRODUCTION

This is an interface document that details the format of messages that flow from the Host application to the RoboKit1 Board and vice versa. Messages directed from Host application to the Board are commands whereas the ones from a Board to the Host application can either be a response or an asynchronous message.

The messages are sent in a packet format defined in section 1.1 below:

1.1 DATA PACKET FORMAT

Header	Length	Msg Id	Payload data	Footer

Header: 2 Bytes

Indicates the beginning of a packet.

Value: 0x55AA

Length: 2 Bytes

Indicates the length Msg Id and the payload data.

MAX – 65536 Bytes

Msg Id: 1 Byte

Indicates the message Id, the message type can be either COMMAND, RESPONSE or ASYNC.

PAYLOAD DATA: Actual message body

Footer: 2 Bytes

Indicates End of the packet.

Value: 0xBEEF

Sample Packet format:

Header	Length	ID	Footer
0x55AA	0x01	0x01	0xBEEF

2 COMMAND AND RESPONSE DISSECTION

2.1 PROTOCOL VERSION

Protocol version determines the current version of the protocol software running on the RoboKit1 firmware.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_GET_PROTOCOL_VERSION	0x01	NA
Response	PKT_TYPE_RESP_GET_PROTOCOL_VERSION	0x81	1 Byte Version data

2.2 SOFT RESET

Soft reset facilitates the outside world to reset the sensors state at any intended point.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_SOFT_RESET	0x02	NA
Response	PKT_TYPE_RESP_SOFT_RESET	0x82	0 - Success

2.3 IQ STREAM

This includes providing an option for the end user to stream a raw(I & Q)Chirp data for post processing.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_ENABLE_IQSTREAM	0x06	1 – Enable 0 - Disable
Response	PKT_TYPE_RESP_ENABLE_IQSTREAM	0x86	0 - Success

2.4 ENABLE ASIC DATA

This command can be used to direct the firmware to stream only the processed Chirp data to include range, amplitude, and target detected.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_ENABLE_ASIC_DATA	0x09	1 – Enable 0 - Disable
Response	PKT_TYPE_RESP_ENABLE_ASIC_DATA	0x89	0 - Success

2.5 CHIRP MEASUREMENT START

While the Chirp specific IQ and ASIC commands enable the streaming process, the Chirp timer needs to be started and stopped to trigger or stop the measurement.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_START	0x07	1 – Enable
Response	PKT_TYPE_RESP_START	0x87	0 – Success

2.6 CHIRP MEASUREMENT STOP

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_STOP	0x08	0 - Disable
Response	PKT_TYPE_RESP_STOP	0x88	0 - Success

2.7 SENSOR ENABLEMENT

The commands below are related to IMU, Magnetometer, Temperature, and Pressure and help to enable/disable the sensor data traveling between the host and the device.

2.7.1 Enable IMU

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_ENABLE_IMU	0x0A	1 – Enable 0 - Disable
Response	PKT_TYPE_RESP_ENABLE_IMU	0x8A	0 - Success

2.7.2 Enable Magnetometer

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_ENABLE_MAG	0x50	1 – Enable 0 - Disable
Response	PKT_TYPE_RESP_ENABLE_MAG	0xd0	0 - Success

2.7.3 Enable Pressure sensor

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_ENABLE_PRES	0x51	1 – Enable 0 - Disable
Response	PKT_TYPE_RESP_ENABLE_PRES	0xd1	0 - Success

2.7.4 Enable Temperature Sensor

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_ENABLE_TEMP	0x52	1 – Enable 0 - Disable
Response	PKT_TYPE_RESP_ENABLE_TEMP	0xd2	0 - Success

2.8 SENSOR CONFIGURATION

The commands below are for setting and getting sensor configurations. Current ODR can be configured for all sensors and FSR can be configured for IMU.

2.8.1 Set sensor configuration

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_SET_SENSOR_CONFIG	0x57	Refer Table 1
Response	PKT_TYPE_RESP_SET_SENSOR_CONFIG	0xd7	0 - Success

2.8.2 Get sensor configuration

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_GET_SENSOR_CONFIG	0x58	Sensor_id config_param_id
Response	PKT_TYPE_RESP_GET_SENSOR_CONFIG	0xd8	Refer Table 1.

The payload/response use the structure with sensor id unique for each of the sensors.

Field Name	Bytes	Description
Sensor_id	4	ID for each of the sensors ICM – 0 Mag – 1 Temp – 2 IIM – 5 Chirp – 6 Pressure - 7
Config param ID	4	Sensor param to be configured 1 – ODR in us 2 - FSR
Config_param1	4	Value to set/get
Config_param2	4	Value to set/get

Table 1. Sensor Config Payload/Response

2.9 ENABLE AUDIO STREAMING

This command is used to trigger the transfer of mono audio data from the device to the host.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_ENABLE_AUDIO	0x53	1 – Enable 0 - Disable
Response	PKT_TYPE_RESP_ENABLE_AUDIO	0xd3	0 - Success

2.10 MOTOR CONTROL COMMANDS

The command below is used to issue commands to control motor, namely start, stop , turn left and turn right.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_CTRL_MOTOR	0x56	1 – Start motor 2 – Stop motor 3 – Turn left 4 – Turn right
Response	PKT_TYPE_RESP_CTRL_MOTOR	0xd6	0 - Success

2.11 GET VERSION & LABEL

Information related to the MCU firmware, Chirp algorithms, and Chirp firmware can be acquired on the host device using the command below. Necessary information is populated as part of the response packet.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_GET_VERSION	0x21	NA
Response	PKT_TYPE_RESP_GET_VERSION	0xA1	version_mcu_label, version_algo_label, version_chx01fw_label, mcu_version

2.12 SET THE NUMBER OF CHIRP SAMPLES

By default, the number of raw samples flowing from RoboKit1 to host is prefixed in the firmware. In case the end user wishes to modify the number of samples then this command can be used to set as per the requirement. Chirp port ID ranges from 0-8 and the MAX sample value is 130.

Packet Type	Packet Name	ID	Payload
Command	PKT_TYPE_CMD_SET_SAMPLE_RANGE	0x33	1 Byte – Chirp port ID 1 Byte – number of raw Samples
Response	PKT_TYPE_RESP_SET_SAMPLE_RANGE	0xB3	0 - Success

3 ASYNCHRONOUS PACKETS

These packets flow from the device to host based on the enable command sent by the host processor. As the name suggests these packets are asynchronous, and they continue to flow until the corresponding disable command is sent.

3.1 AUDIO DATA

PKT_TYPE_ASYNC_AUDIO_DATA – 0xF0				
Sl.No	**Field**	**Bytes**	**Units**	**Description**
1	Audio data	64	NA	Chunk of raw audio data

3.2 TEMPERATURE DATA

PKT_TYPE_ASYNC_TEMP_DATA – 0xF1				
Sl.No	**Field**	**Bytes**	**Units**	**Description**
1	Timestamp	8	µs	Timetag data
2	Temperature	4	°C	Temperature value in float

3.3 MAGNETOMETER DATA

PKT_TYPE_ASYNC_MAG_DATA – 0xF2				
Sl.No	**Field**	**Bytes**	**Units**	**Description**
1	Timestamp	8	µs	Timetag data
2	Mag value	12	µT(Micro Tesla)	Magnetic field value in X, Y, & Z axis

3.4 PRESSURE SENSOR DATA

PKT_TYPE_ASYNC_PRES_DATA – 0xF3				
Sl.No	**Field**	**Bytes**	**Units**	**Description**
1	Timestamp	8	µs	Timetag data
2	Pressure	4	mb	Pressure measured in millibar
3	Celsius	4	°C	Temp measured in Celsius
4	Height	4	m	Height in meters

3.5 IMU DATA

PKT_TYPE_ASYNC_IMU_DATA – 0xF9				
Sl.No	**Field**	**Bytes**	**Units**	**Description**
1	Timestamp	8	µs	Timetag data
2	Accel data	3*2	g	Q15 fixed point acceleration across X, Y, & Z axis in multiples of g (gravitational force). The sensitivity scale factor is 16. Example: Acceleration across Y axis in g = 9.8066 * (Accel_data[1] * 16)/ 2^15.
3	Gyro Data	3*2	dps	Q15 fixed point rotation in degrees per sec along X, Y, & Z axis. The sensitivity scale factor is 2000. Example: Rotation across z axis in dps = (Gyro_data[2]*2000)/ 2^15.

3.6 CHIRP DATA

PKT_TYPE_ASYNC_IQ_DATA – 0xFA				
Sl.No	**Field**	**Bytes**	**Units**	**Description**
1	rxsensor id	1	NA	Port ID of the Chirp sensor from where the data is read.
2	tx sensorid	1	NA	Port ID of the Chirp sensor responsible for transmitting the data.
3	Timestamp	8	µs	Timetag data
4	Data flag	1	NA	Data flag to determine if the payload has IQ data or ASIC data.
5	IQ data size	2	NA	Size of raw IQ data to be followed.
6	IQ data	Max 320	NA	Raw measurement data from chirp sensor.
5	targetdetected	4	NA	1 – Target detected 0 – Target not dected
6	range	4	1/32 mm	Distance between the sensor and the object.
7	amplitude	4		Target amplitude value

3.7 DEBUG MESSAGE

PKT_TYPE_ASYNC_DEBUG_MESSAGE – 0xFD				
Sl.No	**Field**	**Bytes**	**Units**	**Description**
1	Debug Message	X	NA	Variable length debug message flowing from device to host.

X – Variable length

4 REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
01/05/2022	1.0	Initial Draft
02/28/2022	1.1	Updated section 2.8

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