

MAVLink driver for the REXYGEN system (the MAVLinkDrv module)

User guide

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Chapter 1

MAVLink for REXYGEN system

1.1 Introduction

This manual describes **MAVLinkDrv** - the driver for MAVLink communication within the REXYGEN system. The driver was developed by REX Controls.

The driver integrates the MAVLink communication protocol into the control algorithm in the REXYGEN system. It also allows routing of the mavlink protocol over UDP, TCP, or serial link. Such a functionality is performed, for example, by a mavlink-router on Intel Aero or MAVROS in the ROS system.

1.2 Basic concepts

The basic concept of the driver is simple: upon every tick of the driver, incoming packets are processed and routed in the context of the driver thread to corresponding function blocks. The processing of outgoing packets is performed from the context of execution of the respective blocks. If the application uses the routing function, all communication in the system is done with the driver's granularity. It is recommended to set the executive period to 1-5ms for correct function of the application as a "Companion computer".

All the functionality of the driver is accessed via function blocks of the RECV and SEND type. One RECV block (named `MAV_RECV_<command>`) and one SEND block (named `MAV_SEND_<command>`) are defined for each message.

No synchronization between blocks and the executive part of the driver is performed in the current version. Therefore, all receive blocks must be placed in tasks linked to the appropriate driver (ie using the *IOTASK* block). All higher logic is recommended to be implemented in subsystems.

The driver supports messages with scalar types. Character fields are converted to STRING of the appropriate length. Arrays of other types are converted to scalar numbered inputs/outputs. Blocks with non-character fields longer than 8 are not supported.

The documentation for MAVLink messages is available at <https://mavlink.io/en/messages/common.html>

1.2.1 Driver configuration

The driver configuration is stored in a *.rio* file in the *JSON* format. Configuration dialog is not available in current version. Configuration is used to define system ID and router settings. All other functionality is defined within function blocks. The following block shows a simple driver configuration.

```
{
  "SystemID" : 200,
  "ComponentID" : 1,
  "Endpoints" : [
    {
      "Type": "Serial",
      "Device": "/dev/ttyS1",
      "BaudRate": 921600
    },
    {
      "Type": "UDP",
      "Mode": "listen",
      "Address": "192.168.1.100",
      "Port": 14550
      "BindAddress": "0.0.0.0",
      "BindPort": 14550
    },
    {
      "Type": "TCP",
      "Mode": "connect",
      "Address": "192.168.1.200",
      "Port": 15550
    }
  ]
}
```

Main attributes

- **System ID** – defines application System ID,
- **Component ID** – defines application Component ID,
- **Endpoints** – defines the list of communication channels. The driver automatically routes packets between these channels. Supported channels are *Serial*, *UDP* a *TCP*.

Serial endpoint attributes

- **Device** – serial device pathname,
- **BaudRate** – serial device baud rate.

UDP endpoint attributes

- **Mode** – possible options: *listen* – listening on local port or *connect* – connecting to remote device. In *listen* mode, messages are received from all devices with any IP and port. In *connect* mode, only data from the device is received that is specified by *Address* and *Port*.
- **Address** – IP address of the remote device. If not specified or set to *0.0.0.0* in *listen* mode, the driver will send data to the first connected device.
- **Port** – The IP address of the remote device. If not specified or set to *0.0.0.0* in *listen* mode, the driver will send data to the first connected device.
- **BindAddress** – IP address of the local interface where communication will take place. It may be omitted or set to *0.0.0.0*, in which case all local interfaces will be used.
- **BindPort** – Local interface port. It can be omitted or set to *0*, in which case the appropriate local port is selected by the operating system.

For UDP endpoints, we recommend using only the *listen* mode, because the *connect* mode can cause problems if the opposite device is unavailable or closes the connection. In *listen* mode, it is also possible to operate communication via *broadcast*. For broadcasting, the local interface must be selected by setting the appropriate IP address using the *BindAddress* and *BindPort* parameters, and the *Address* parameter set the local broadcast address (eg 192.168.1.255).

TCP endpoint attributes

- **Mode** – possible options: *listen* – listening on local port or *connect* – connecting to remote device.
- **Address** – IP address of a local interface (0.0.0.0 for all) or IP address of a remote device ,
- **Port** – local port for listening or remote device port.

1.2.2 Receiving messages

Messages are received using MAV_RECV_<command> blocks. The basic interface of the block is as follows:

- **INHIBIT** – input, BOOL. Specifies whether to forward the received message. This must be set in advance, ie it is not possible to decide on routing based on message content.
- **VALID** – output, BOOL. Indicates the validity of the output data. Set to TRUE in case of valid data received before timeout elapsed (see the TimeoutMS parameter).

- **ACT** – output, BOOL. Set to TRUE only in the first tick after receiving new data.
- **Sequence** – output, INT. Sequence number from the header of the last received message frame - see the MAVLink documentation.
- **Timestamp** – output, INT. Timestamp of the last received data in the internal REXYGENformat, ie nanoseconds.
- **SrcSystemID** – parameter, SHORT. Specifies source node system ID (1 for UAV).
- **SrcComponentID** – parameter, SHORT. Specifies source node component ID (1 pro UAV).
- **TgtSystemID** – parameter, SHORT. Specifies target node system ID (-1 for not set or not included in the message, -2 for algorithm ID - see *SystemID* in driver configuration).
- **TgtComponentID** – parameter, SHORT. Specifies target node component ID (-1 for not set or not included in the message, -2 for algorithm ID - see *ComponentID* in driver configuration).
- **TimeoutMS** – parameter, LONG. maximum time between messages. If new data is not received in this interval, *VALID* is set to false. If set to 0, the timeout is not defined.

Other outputs are defined by the respective message and contain data from the last received message.

1.2.3 Sending messages

Messages are received using `MAV_SEND_<command>` blocks. The basic interface of the block is as follows:

- **RUN** – input, BOOL. Data is sent in a tick if this input is set to *True*.
- **SENT** – output, BOOL. Set to *True* if the RUN input is set and the data has been sent successfully.
- **TgtSystemID** – parameter, SHORT. Specifies the system ID of the destination node (it can be -1, ie “all” if it is not part of the message).
- **TgtComponentID** – parameter, SHORT. Specifies the component ID of the destination node (it can be -1, ie “uv” if it is not part of the message).

The other inputs are defined by the respective message and contain data for transmission.

1.3 Installation of driver on target device

1.3.1 Target device with OS Windows

A driver for the development tools (host) is included in the installer. The driver is not supported on a Windows target device.

1.3.2 Target device with OS linux

If the RexCore runtime software is installed on the target device, then it must be installed as described in *Getting Started with the Control REXYGEN* [1]. The installation includes all available drivers, including MAVLinkDrv.

Following command may be used from the terminal to install the driver separately:
`sudo apt-get install rex-mavlinkdrv`

Chapter 2

Integrating driver into the project

The driver is loaded into the project when the driver is added to the master file and the inputs and outputs are connected to the control algorithm and connected with the **EXEC** function block.

2.1 Přidání MAVLinkDrv ovladače

Two blocks has to be added to the main file to load the driver. The first of the blocks is of the **MODULE** type and must be connected to the **Modules** output of the **EXEC** block. The block has to be renamed to code **MAVLinkDrv**.

The second block is of the **TIODRV** type and must be linked to the **Drivers** output of the **EXEC** block in the main project file. The name of this block (**MAV**) must also be a prefix of all input and output signals provided by the driver followed by two underscores.

These parameters of the **IODRV** block have to be set:

- **module** – name of the module to which the driver is connected, in this case **MAVLinkDrv** - it is necessary to preserve the capitalization!
- **classname** – driver class, in this case **MAVLinkDrv**,
- **cfname** – name of driver configuration file, např. **mavlink.rio**,
- **factor** – defines the triggering period of the driver by multiplying the *tick* parameter of the **EXEC** block.

The above parameters of the **IODRV** block are configured in the **REXYGEN Studio** program.

Chapter 3

Licensing

Several parts of the driver are based on the mavlink-router code available at <https://github.com/intel/mavlink-router>. The code is licensed by Apache License Version 2.0.

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Version 2.0, January 2004

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Bibliography

- [1] REX Controls s.r.o.. *Getting started with REXYGEN*, 2020. [→](#).