

MAVLink driver for the REXYGEN system
(the MAVLinkDrv module)

User guide

REX Controls s.r.o.

Version 2.50.11
Plzeň (Pilsen), Czech Republic
2022-01-19

Contents

1	MAVLink for REXYGEN system	2
1.1	Introduction	2
1.2	Basic concepts	2
1.2.1	Driver configuration	3
1.2.2	Receiving messages	4
1.2.3	Sending messages	5
1.3	Installation of driver on target device	6
1.3.1	Target device with OS Windows	6
1.3.2	Target device with OS linux	6
2	Integrating driver into the project	7
2.1	Přidání MAVLinkDrv ovladače	7
3	Licensing	8
	Bibliography	11

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`,
- **cfgname** – 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.

Apache License

Version 2.0, January 2004

<http://www.apache.org/licenses/>

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object form, that is based on (or derived from) the Work and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship. For the purposes of this

License, Derivative Works shall not include works that remain separable from, or merely link (or bind by name) to the interfaces of, the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner or by an individual or Legal Entity authorized to submit on behalf of the copyright owner. For the purposes of this definition, "submitted" means any form of electronic, verbal, or written communication sent to the Licensor or its representatives, including but not limited to communication on electronic mailing lists, source code control systems, and issue tracking systems that are managed by, or on behalf of, the Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.

3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:

You must give any other recipients of the Work or Derivative Works a copy of this License; and You must cause any modified files to carry prominent notices stating that You changed the files; and You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute must include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works; or, within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The contents of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise, any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding the above, nothing herein shall supersede or modify the terms of any separate license agreement you may

have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade names, trademarks, service marks, or product names of the Licensor, except as required for reasonable and customary use in describing the origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special, incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

Bibliography

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