OEMSTAR Application Program Interface (API) User Guide

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Foreword

Scope

This document contains sufficient information on working with the Application Program Interface (API) to be able to develop applications for NovAtel’s OEMStar receivers. It does not provide specific details of the functions offered by the API, but rather information on building and loading applications. Details of the API functions can be found in the API header file.

Conventions

The conventions used throughout this document are:

< > Text displayed between < and > indicates a variable parameter.

[ ] Text displayed between [ and ] indicates an optional parameter

This is a notebox that contains important additional information.

In tables where no values are given, such fields should be assumed to be reserved for future use.

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| | Calgary, AB |
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Chapter 1  Introduction

1.1 Overview

The Application Program Interface (API) allows you to develop specialized C/C++ applications to further extend the functionality of your OEMStar receiver. By using the functions provided by the API, along with the commands and logs already provided by the OEMStar, a wide variety of applications can be created.

1.2 Features

The OEMStar API provides the following features:

- The ability to open physical ports on the receiver to interface with external devices
- Support for three virtual ports, allowing you to directly send commands to and receive logs from the receiver firmware
- Support for multiple tasks, with varying priority levels
- Message queuing functionality
- Support for semaphores and mutexes
- The ability to control many of the receiver’s general purpose input/output (GPIO) lines
- Access to receiver time
- Pulse-width modulation control (for receivers that support it)

Refer to the API header file for more information on the features provided by the API.

1.3 Requirements to Build and Run an Application

In addition to the items listed in the API Development Kit (see Section 1.4), the following is required to develop and run an application on an OEMStar receiver:

- A NovAtel supported compiler. Currently, Green Hills Software C/C++ compilers are supported. The Green Hills Software C/C++ compiler is available in the Green Hills Multi 2000 Integrated Development Environment.
- OEMStar receiver loaded with an API enabled software model (See Section 3.1 on page 19 for more information about setting up the receiver for loading an application.)
- PC with a serial port and a serial cable to load the application on to the receiver
- OEMStar Firmware Reference Manual

1.3.1 Firmware Compatibility

Firmware support for the API has been designed for backwards compatibility. For example, if the firmware loaded on to the receiver supports version 15 of the API, an application built using version 14 of the API will execute correctly. However, if the application uses a newer version of the API than
the firmware supports, the additional or updated functionality provided by the API may not be available.

A description of the changes made to the API since the last version can be found at the beginning of the API header file. To determine what version of the API your firmware supports, log the APPLICATIONSTATUS message, which is described further in Section 4.2 on page 23.

Compiler compatibility has been tested successfully up to Green Hills Multi V4.2.4. You must run OEMStar firmware version 1.100 or higher.

The API library and header files are named with the firmware version. For example: L6X010100RN0000.api.a.

1.4 Materials Provided

As part of the OEMStar API Development Kit, the following is provided:

- An OEMStar API library file (OEMStar_api.a)
- An OEMStar API header file (OEMStar_api.h)
- One sample project for the Greenhills Multi
- Two Windows command line utility programs, TOSREC and DATABLK, which format the executable for use with a NovAtel receiver
- NovAtel’s WinLoad utility for loading the application on to the receiver
2.1 Designing the Application

When designing an application for an OEMStar receiver, it is important to have an understanding of some of the key features of the API, which are explained in the sections below.

- Review the sample application provided with the API for more information on how to design your application to work with the receiver firmware.

2.1.1 Working with the Virtual Ports

When communicating through one of the physical or virtual ports, the application must be designed to either:

- Read all data sent to the port, or
- Configure the port to not transmit data and disable response generation

This is necessary because any incoming data will remain in a buffer until it is read and will not be automatically discarded if more data arrives, resulting in a build up of waiting data.

To disable transmission and response generation at the port, use the INTERFACEMODE command with the NONE mode for the txtype field and OFF for the responses field. Refer to the OEMStar Firmware Reference Manual for more information on this command.

2.1.2 Using the GPIOs

The OEMStar receiver provides LV-TTL general-purpose input/output (GPIO) signals that can be used by your application. The API header file provides more details on the functions available to control and read these GPIOs. The sections below indicate which GPIOs are provided and Section A.1 on page 26 gives the electrical specifications for those GPIOs.

2.1.2.1 OEMStar

The following GPIO pins available on the OEMStar:

- GPIO0
- GPIO1
- GPIO3
- PV (output only)

See Pin-Outs on page 27 for additional information.
2.1.2.2 FlexPak-G2 with OEMStar

There are two GPIO pins available on the FlexPak-G2 with OEMStar:

- PV
- GPIO1

The OEMStar Installation and Operation User Manual provides the location of this pin and details of internal pull-up or pull-down resistors. The electrical specifications for this pin are given in Table 7 on page 26.

Note: For OEMStar, Pin 5 = PV line and Pin 6 = GPIO1 line.

2.1.3 Input Parameters

There are two methods that can be used to pass parameters to an application, as discussed in the following sections.

2.1.3.1 Command-Line Entry

The application can be designed to accept a single unsigned, 32-bit parameter, which is then entered as part of the command string for starting the application. This parameter could be used, for example, to set the output serial port used by the application.

For more information about entering a parameter when starting the application, see Section 3.3.1 on page 21.

See Section 2.1.4 for a note about the use of command-line entry input parameters with auto-start applications.

2.1.3.2 DATABLK Entry

Alternately, the <SNKey> field, set when the DATABLK utility is run on the executable, can be used to store an input parameter, which would then be read from the VERSION log by the application.

For more information about the <SNKey> field, see Section 2.2.3.1 on page 15. Section 4.3 on page 25 provides more information about where the field is stored in the VERSION log.

2.1.4 Auto-Start Applications

An application loaded on to an OEMStar receiver can be set to automatically start whenever the receiver is powered up. This option is set using the <ComponentEnum #> field of the DATABLK utility, which is described in Section 2.2.3 on page 15.
When an application is configured to automatically start, the input parameter is fixed as 0, the priority is set to 1, and the stack size is 10,000. See Section 3.3 on page 21 for more information.

2.2 Building the Application

Building the application in a format that can be loaded on to a receiver is a three step process:

1. Build the application using one of the supported compilers.
2. Convert the binary executable to S-records.
3. Add the S-records necessary for loading the application.

Each of these steps is discussed in the sections that follow.

2.2.1 Building the Application Using a Supported Compiler

2.2.1.1 Project Configuration

With the Greenhills version 4.2.4 compiler, use the build file provided with the sample application as a template. This build file has the necessary settings for a variety of options, including the application format and target, which should not be altered. However, the following can be changed to customize the project, either by directly editing the file or using the interface provided by the compiler.

- The name of the output file
- The files included in the project

2.2.2 Converting Binary to S-Records

When loading the application on to the receiver, the S-record format, which is described in Section 2.2.2.1, is used. Therefore, once the application has been built, the resulting binary ELF file must be converted to S-record format. The TOSREC utility is provided to complete this conversion.

2.2.2.1 S-Records

The S-record format is an industry standard for encoding programs or data files in a printable form that allows for ease of transfer between devices.

An S-record is an ASCII character string consisting of five fields, in the format shown below.

<type><length><address><data...><checksum>

The S-record fields all use hexadecimal format, except for the <type> field. The fields are described in Table 1 below.
Table 1: S-Record Fields

<table>
<thead>
<tr>
<th>Field</th>
<th>Length (Characters)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;type&gt;</td>
<td>2</td>
<td>The type of S-record, as described by Table 2.</td>
</tr>
<tr>
<td>&lt;length&gt;</td>
<td>2</td>
<td>The number of character pairs in the record, excluding the &lt;type&gt; and &lt;length&gt; fields.</td>
</tr>
<tr>
<td>&lt;address&gt;</td>
<td>4, 6, or 8</td>
<td>The 2, 3, or 4-byte address at which to load the contents of the data field in memory.</td>
</tr>
<tr>
<td>&lt;data&gt;</td>
<td>variable</td>
<td>Executable code or memory-loadable data.</td>
</tr>
<tr>
<td>&lt;checksum&gt;</td>
<td>2</td>
<td>The least significant byte of the one’s complement of the sum of the values represented by the length, the address, and the data fields.</td>
</tr>
</tbody>
</table>

There are 3 types of S-records used for OEMStar applications, as shown in Table 2 below.

Table 2: S-Record Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>Header record. Used by WinLoad to determine how to load the application as described in Section 2.2.3.2 on page 17</td>
</tr>
<tr>
<td>S3</td>
<td>Data record</td>
</tr>
<tr>
<td>S7</td>
<td>End-of-file record</td>
</tr>
</tbody>
</table>

Typically, each S-record file consists of one or more header records, followed by one or more data records, concluded with a single end-of-file record.

2.2.2.2 Using TOSREC

The TOSREC utility is a Windows command line program. To run the application, enter the following in a command window:

    tosrec <infile>

where <infile> is the name of the file to be converted. The name of the S-record file to be generated can be specified using the following option trigger:

    -o <outfile>

where <outfile> is the name of the output file.

Examples of command strings to run the utility are given below.

    tosrec input.elf
    tosrec input.elf -o output.hex
2.2.3 Adding Information for Loading the Application

The WinLoad utility, which is used to load the application onto the receiver, reads information from the input file in order to determine how the application should be loaded. This information is included in a special set of S-records placed at the beginning of the file. Once the application data has been converted to an S-record format, the DATABLK utility is used to add these necessary records.

2.2.3.1 Using DATABLK

The DATABLK utility is a Windows command line program. To run the application, enter the following string in a command window.

```
datablk <In SREC File> <Out SREC File> <Compress> <Block #> <ComponentEnum #> <Name> <Version> <SNKey> <Platform> [Compile Date] [Compile Time]
```

Each of the parameters are described in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Valid Values</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;In SREC File&gt;</td>
<td>Any</td>
<td>File name of input file.</td>
</tr>
<tr>
<td>&lt;Out SREC File&gt;</td>
<td>Any</td>
<td>File name of output file.</td>
</tr>
<tr>
<td>&lt;Compress&gt;</td>
<td>Compress or Raw</td>
<td>Specifies whether or not the data will be compressed.</td>
</tr>
<tr>
<td>&lt;Block #&gt;</td>
<td>0</td>
<td>The data block in memory in which the application will be loaded into.</td>
</tr>
<tr>
<td>&lt;ComponentEnum #&gt;</td>
<td>1 or 5</td>
<td>The type of application, where 1 specifies a standard user application and 5 specifies an auto-starting user application.</td>
</tr>
<tr>
<td>&lt;Name&gt;</td>
<td>14 non-null characters or less</td>
<td>A string indicating the name of the application</td>
</tr>
<tr>
<td>&lt;Version&gt;</td>
<td>14 non-null characters or less</td>
<td>A string indicating the version of the application.</td>
</tr>
<tr>
<td>&lt;SNKey&gt;</td>
<td>14 non-null characters or less</td>
<td>A string indicating the serial number or key for the application. Can also be used to set an application parameter. See Section 2.1.3.2 on page 12 for more details.</td>
</tr>
<tr>
<td>&lt;Platform&gt;</td>
<td>14 non-null characters or less</td>
<td>A string of comma separated platforms the application is targeting. For OEMStar, valid options are M6XV1G and M6XV1.</td>
</tr>
</tbody>
</table>
An example command string to run the utility is given below.

    datablk input.hex output.hex raw 2 1 SampleApp 1.00 1234 M6XV1G

See Section 4.3 on page 25 for more information about how the values entered for the DATALNK parameters are used in the receiver logs.
2.2.3.2 Records Used By WinLoad

`DATABLK` adds three header records that are required by the `WinLoad` utility when loading the application. The records provide the following information to `WinLoad`:

- The target platform of the OEMStar receiver (M6XV1 and/or M6V1G)
- The version of the application
- In which data block to load the application (block 0)

2.2.4 Automating Utility Execution

The Greenhills Multi development environment supports execution of specified programs after compilation. This feature can be used to automate execution of TOSREC and `DATABLK`. By doing so, the binary executable will automatically be converted to S-records and the necessary records for loading will be added. The resultant executable can be loaded directly onto the receiver without further manipulation. Please see below if you are developing with Greenhills Multi.

To automate this, with the project open in `Multi`, select `Set Options...` from the `Edit` menu.
Expand the **Advance** option under the **Option Categories** on the left side of the window.

Click on **Advanced Project Options** under the **Option Categories** on the left side of the window.

On the right side of the window, under **Build Options in Category**, double-click on **Commands to Execute After Associated Command**.

In the **Commands to Execute After Associated Command** box, enter the command strings to run the utilities.

Press **OK** to save the changes.

The next time the application is built, the utilities will automatically be executed as specified.
Chapter 3  Loading and Controlling the Application

Once the application has been built and converted to S-record format, with the necessary S-records added, the application can be loaded on to the receiver.

A Windows-based utility named WinLoad has been created to assist with loading the firmware.

3.1 Setting up the Receiver

In order to load and run an application, the receiver must have:

- A model with the API option enabled, and
- Version L6X010101RN0000 or higher of firmware loaded

The following sections provide information on how to determine if your receiver meets these criteria and how to update it if it does not.

3.1.1 Determining the Current Model and Firmware Version

To determine the current model and firmware version of the receiver, read the VERSION log. To do so, send the following command to the receiver.

```
LOG VERSION
```

Read the output provided, specifically the 1st and 4th fields after the word GPSCARD. The first field provides the model and the fourth field indicates the version of firmware loaded on the receiver. In the example below, the model is “LXGMTSA” and the firmware version field shows “L6X010101RN0000”.

```
<VERSION COM1 0 68.0 UNKNOWN 0 5.263 004c0000 3681 6576
< 2
< GPSCARD "LXGMTSA" "BHD09320088" "M6XV1G-4.00-TT" "L6X010101RN0000" "L6XD10004DBG004"
"2011/Mar/02" "12:15:16"
< DB_USERAPP "datalogdisplay" "0" "0" "1.000" "1202/Feb/01" "13:50:42"
```

GPS card field  Model field  Firmware version field

In this example, the model field ends with an “A” and the firmware version field reads “L6X010101RN0000” therefore, an application can be loaded on to the receiver. If an update to the firmware and/or model is needed, instructions are provided in Section 3.1.2 and Section 3.1.3.
3.1.2  Updating the Firmware

To update the firmware to a version that supports the API, obtain the following from NovAtel Customer Support.

- The firmware update file, with version 1.100 or higher
- An update authorization code

*WinLoad* is also required to load the firmware on to the receiver and is included with the API package. Follow the procedure given in the *HowTo.txt* file provided with the update file to upgrade the firmware.

3.1.3  Authorizing a Model with the API Option

To authorize a model with the API option enabled, contact NovAtel Customer Support to obtain the necessary authorization code and use the `AUTH` command to add the code to the receiver. Refer to the *OEMStar Firmware Reference Manual* for more information on this command.

3.2  Loading the Application

Once the receiver is set up with the necessary model and firmware version, the application can be loaded into non-volatile memory on the receiver using release 102 or higher of the *WinLoad* utility. This utility is provided as part of the API package or can be obtained from NovAtel Customer Support.

By reading the S-records added using the *DATABLK* utility, *WinLoad* automatically knows where and how to place the application in memory so it does not interfere with the operation of the main receiver firmware. Therefore, loading the application can be done using the same method as that used when loading GPS firmware, with the following exceptions:

- The application *HEX* file should be selected, rather than a standard firmware *HEX* file.
- An authorization code is not needed and, therefore, you will not be prompted for one.

For more information on using *WinLoad* to load the application, follow the procedure given in the *OEMStar Installation and Operation User Manual*, making adjustments for the selection of the application file, rather than the firmware file, and the absent authorization code prompt.

* Only one application can be loaded on to the receiver at any one time. However, functions are provided to allow for multiple tasks running within the application. Please see the provided library files for more information.
3.3 Controlling the Application

The operation of the application can be controlled by using the APPLICATION command as discussed below.

3.3.1 Starting the Application

Once the application has been loaded on to the receiver, enter the following command string to start the application.

```
application start <parameter> <priority> <stack>
```

The values that can be entered when starting an application are described in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Valid Values</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;parameter&gt;</td>
<td>Any ulong value</td>
<td>Optional field to specify an input parameter for the application. If a value is not specified, the default of 0 is used.</td>
</tr>
<tr>
<td>&lt;priority&gt;</td>
<td>Any long value from 0 to 16</td>
<td>Optional field to specify the priority of the application in relation to system tasks. See the API header file for details. In order to specify the priority, a value must be entered for the &lt;parameter&gt; field as well. If a value is not specified, the default of 1 is used.</td>
</tr>
<tr>
<td>&lt;stack&gt;</td>
<td>Any long value from 200 to 20000</td>
<td>Optional field to specify the size of the stack to be used by the application in bytes. In order to specify the stack size, a value must be entered for both the &lt;parameter&gt; and &lt;priority&gt; fields as well. If a value is not specified, the default of 10000 is used.</td>
</tr>
</tbody>
</table>

3.3.1.1 Auto-Start Applications

If 5 was entered for the <ComponentEnum #> field when running the DATABLK utility, the application will be set to auto-start. Therefore, when the receiver is first powered, the application will begin running.

An alternate method for setting an application to automatically start is by using the SAVECONFIG command after the application has been started. When this is done, the application will automatically start whenever the receiver is powered up as long as the saved receiver configuration is present in memory. However, as soon as the FRESET command is issued, the configuration will be lost and the application will not automatically start. When an application is configured to auto-start using the method described in Section 2.1.4 on page 12, it will not be affected by the state of the receiver configuration.
3.3.2 **Stopping the Application**

To stop the application, enter the following command.

```
application stop
```

This command can be used to stop either standard or auto-start applications.

3.3.3 **Removing the Application**

To remove the application from non-volatile memory, enter the following command.

```
application remove
```

⚠️ The application is not recoverable when removed from non-volatile memory, so be sure to use this command with care.
Chapter 4  Additional Information

The following sections provide additional information that may be useful when working with OEMStar applications.

4.1  Determining the Version of the Loaded Application

When an application is loaded on the receiver, the VERSION log provides information about the application. When an application is loaded, an additional entry is displayed in the VERSION log, with the type field showing DB_USERAPP for a standard application or DB_USERAPPAUTO for an auto-start application. All the parameters given in that entry apply to the application loaded on to the receiver. An example of the log with a DB_USERAPP entry is shown below.

<VERSION COM1 0 68.0 UNKNOWN 0 5.263 004c0000 3681 6576 8 < 2 < GPSCARD "LXGMSTA" "BHD09320088" "M6XV1G-4.00-TT" "L6X010101RN0000" "L6XD10004DBG004" "2011/Mar/02" "12:15:06" < DB_USERAPP "datalogdisplay" "0" "" "1.000" "" "2012/Feb/01" "13:50:42"

For information on how to capture the VERSION log or the fields it contains, refer to the OEMStar Firmware Reference Manual. Section 4.3 on page 25 provides information on how some of the VERSION log fields are set by the DATABLK utility.

4.2  Logging the Application Status

A log has been created to capture the details of any application loaded on to the receiver. The details of this log follow. All formats and standard fields, such as the header, are explained further in the OEMStar Firmware Reference Manual. Many of the fields are set to values entered for use by the DATABLK utility, as described in Section 4.3 on page 25.

☆ The time indicated in the log header is the time when the application status was last changed, for example, the time when the application was started or stopped.
## APPLICATIONSTATUS  API Application Status Information

Log Type: Asynch  
Message ID: 520

<table>
<thead>
<tr>
<th>Field</th>
<th>Field Type</th>
<th>Data Description</th>
<th>Format</th>
<th>Binary Bytes</th>
<th>Binary Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>header</td>
<td>Log header</td>
<td>H</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>api version</td>
<td>The version of the API that the currently loaded firmware supports</td>
<td>Ulong</td>
<td>4</td>
<td>H</td>
</tr>
<tr>
<td>3</td>
<td>running</td>
<td>Flag indicating whether the application is currently running, where 0 = FALSE 1 = TRUE</td>
<td>Enum</td>
<td>4</td>
<td>H+4</td>
</tr>
<tr>
<td>4</td>
<td>base address</td>
<td>The base address in RAM the application is running from Valid only when the application is running</td>
<td>Ulong</td>
<td>4</td>
<td>H+8</td>
</tr>
<tr>
<td>5</td>
<td>size</td>
<td>The number of bytes in RAM the application is using Valid only when the application is running</td>
<td>Ulong</td>
<td>4</td>
<td>H+12</td>
</tr>
<tr>
<td>6</td>
<td>name</td>
<td>The name of the application</td>
<td>Char[16]</td>
<td>16</td>
<td>H+16</td>
</tr>
<tr>
<td>7</td>
<td>version</td>
<td>The version of the application</td>
<td>Char[16]</td>
<td>16</td>
<td>H+32</td>
</tr>
<tr>
<td>8</td>
<td>compile date</td>
<td>The date the application was compiled In the format yyyy/mm/dd, where mm is three letters for the month (eg. JAN)</td>
<td>Char[12]</td>
<td>12</td>
<td>H+48</td>
</tr>
<tr>
<td>9</td>
<td>compile time</td>
<td>The time the application was compiled In the format hh:mm:ss</td>
<td>Char[12]</td>
<td>12</td>
<td>H+60</td>
</tr>
<tr>
<td>10</td>
<td>xxxx</td>
<td>32-bit CRC (ASCII and Binary only)</td>
<td>Hex</td>
<td>4</td>
<td>H+72</td>
</tr>
<tr>
<td>11</td>
<td>[CR][LF]</td>
<td>Sentence terminator (ASCII only)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Recommended Input:**

```
LOG APPLICATIONSTATUSA
```

**ASCII Example:**

```
#APPLICATIONSTATUSUSA,COM1,0.75.0,UNKNOWN,0,1.814,004c0000,3314,6576;1,FALSE,0000 0000,00000000,"datalogdisplay","1.000","2012/Feb/01","13:50:42"*3eb207f8
```
4.3 DATABLK Parameters Used in Logs

Many of the fields captured in the APPLICATIONSTATUS log and the DB_USERAPP or DB_USERAPPAUTO entry of the VERSION log are set to the values entered for parameters used by the DATABLK utility. The table below provides a list of these parameters and the matching log fields. For more information about the DATABLK utility, see Section 2.2.3.1 on page 15.

<table>
<thead>
<tr>
<th>DATABLK Parameter</th>
<th>Matching Log Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;Name&gt;</td>
<td>model</td>
</tr>
<tr>
<td>&lt;SNKey&gt;</td>
<td>psn</td>
</tr>
<tr>
<td>&lt;Version&gt;</td>
<td>sw version</td>
</tr>
<tr>
<td>&lt;Compile Date&gt;</td>
<td>comp date</td>
</tr>
<tr>
<td>&lt;Compile Time&gt;</td>
<td>comp time</td>
</tr>
</tbody>
</table>

Table 5: DATABLK Parameters Used in Logs

4.4 Determining the Version of WinLoad

To load an application on to the receiver, release 102 or higher of WinLoad must be used. To determine the version of WinLoad you currently have, run the application and select About... from the Help menu.

The version is shown in the Loader Version field in the About dialog box.
## Appendix A  Technical Specifications

### A.1 GPIO Electrical Specifications

#### A.1.1 OEMStar

**Table 6: OEMStar GPIO Electrical Specifications**

<table>
<thead>
<tr>
<th>Low</th>
<th>Voltage</th>
<th>Current</th>
<th>High</th>
<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>$0 &lt; V_{IL} &lt; 0.8$ VDC</td>
<td>$I_{IL} = -0.1$ mA</td>
<td>Output</td>
<td>$V_{OL} &lt; 0.4$ VDC</td>
<td>$I_{OLMAX} = 8$ mA</td>
</tr>
<tr>
<td></td>
<td>$2.0 &lt; V_{IH} &lt; 3.6$ VDC</td>
<td>$I_{IH} \sim 0$ mA</td>
<td></td>
<td>$V_{OH} &gt; 2.7$ VDC</td>
<td>$I_{OHMAX} = -8$ mA</td>
</tr>
</tbody>
</table>

#### A.1.2 FlexPak-G2 with OEMStar

**Table 7: FlexPak-G2 with OEMStar GPIO Electrical Specifications**

<table>
<thead>
<tr>
<th>Low</th>
<th>Voltage</th>
<th>Current</th>
<th>High</th>
<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>$0 &lt; V_{IL} &lt; 0.8$ VDC</td>
<td>$I_{IL} = -0.1$ mA</td>
<td>Output</td>
<td>$V_{OL} &lt; 0.4$ VDC</td>
<td>$I_{OLMAX} = 8$ mA</td>
</tr>
<tr>
<td></td>
<td>$2.0 &lt; V_{IH} &lt; 3.6$ VDC</td>
<td>$I_{IH} \sim 0$ mA</td>
<td></td>
<td>$V_{OH} &gt; 2.7$ VDC</td>
<td>$I_{OHMAX} = -8$ mA</td>
</tr>
</tbody>
</table>
A.1.3 Pin-Outs

![Top-view of 20-Pin Connector on the OEMStar](image)

**Figure 1: Top-view of 20-Pin Connector on the OEMStar**

<table>
<thead>
<tr>
<th>Signal</th>
<th>Behavior</th>
<th>Descriptions</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPIO0</td>
<td>Input / Output</td>
<td>User-configurable I/O pin</td>
<td>7</td>
</tr>
<tr>
<td>GPIO1</td>
<td>Input / Output</td>
<td>User-configurable I/O pin</td>
<td>8</td>
</tr>
<tr>
<td>GPIO3</td>
<td>Input / Output</td>
<td>User-configurable I/O pin</td>
<td>17</td>
</tr>
<tr>
<td>PV</td>
<td>Output</td>
<td>Output shows a good solution, or valid GPS position, when high</td>
<td>20</td>
</tr>
</tbody>
</table>

a. The VIN and LNA_PWR inputs are protected against damage or latch-up due to ESD by bi-directional Transient Voltage Suppressor (TVS) devices. GPIO lines are protected by unidirectional TVS devices and series resistors.
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