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1 Introduction

The Cinterion® LGA DevKit is designed as a generic development adapter for Cinterion® LGA modules. With the LGA DevKit it is no longer necessary to connect the Cinterion® evaluation modules to an adapter for test and development purposes.

One of the main advantages of the LGA DevKit is that thanks to the interruption possibilities via jumpers almost all signals can be directly traced or measured without any additional circuits.

The factory default jumper settings start the modules with a minimum of required operational connections. The benefit of this configuration is the possibility to use only those signals that are currently required in the development process.

The LGA DevKit may operate stand-alone without the need of any further tools or devices, or it can be used as a so called port extender, i.e., an adapter between a module and development boards like the DSB75 or the DSB-Mini.

The LGA DevKit is available in two variants:
- SM supports the all industrial platform modules
- L supports most of the industrial plus platform modules

Either one of the LGA DevKit variant (SM or L) needs to be ordered together with the LGA DevKit Socket, leaving the option to reuse the Socket for the other LGA DevKit variant.

1.1 Feature and Benefits

- LGA DevKit Socket supports four different module footprints for industrial/industrial plus modules:
  - With LGA DevKit SM: LGA106, LGA114, and LGA120
  - With LGA DevKit L: LGA156
- Future proof, ready for new, upcoming modules
- Improves the module inter-compatibility
- Stand-alone: Get the LGA module up and running without any additional tools or devices
- Supports DSB75/DSB-Mini as port extender
- UART via USB VCP, and/or native USB communication
- Direct module signal access with complete interrupt for deep level investigation
- Real module current consumption measurement, no additional leakage current
- Powered via USB or external devices (e.g., DSB75/DSB-Mini)
- Adjustable module supply level between 2.8...4.5V
- VEXT self-adjustment for level shifter reference level
- Interfaces also supported: SPS, SIM2, ASC1, Audio, GPIO, GNSS
- Error detection: Wrong or wrongly oriented modules, as well as module shorts preventing damages to LGA DevKit, LGA DevKit Socket and/or modules
- Clear & easy concept for usage and signaling
- Cost minimized: LGA DevKit Socket usable for both LGA DevKit versions (SM and L)
- QR code scanning leads users to all the information necessary for usage
2 Quickstart

Please complete the following steps to quickly get started with your LGA DevKit.

- Mount the LGA DevKit Socket onto the LGA DevKit (for details see Section 2.1).
- Insert the fixing frame and then the module into the Socket and close the retention lid by pressing it down and turning it clockwise.
- Connect the provided antenna to the SMA connector named "MAIN".
- Check that the jumpers are set to their default delivery positions.
- Connect your host PC to either the USB or the USB VCP connector (depending on the module). In case of USB VCP connections, install FT232R drivers.
- Set the switches PWR & ASC0 at the DevKit's lower right corner to "USB". Now, the green "PWR" LED lights up.
- Shortly press the ON button to start the module. Now, the white "ON" LED lights up.

The red "ERROR" LED may indicate issues that should be corrected. For details see Section 4.9.

Note: By scanning the QR code at the back of the LGA DevKit you will also find further information, videos and available drivers.

2.1 Mounting the LGA DevKit Socket

Before operating, the socket has to be mounted onto the LGA DevKit with 4 screws. Scanning the QR code on the DevKit's back and/or the quick start guide will lead you to the DevKit's web home where you find a short introduction and video on how to do this.

The white printing on the DevKit shows how the socket shall be orientated and mounted. You can quickly adapt to different module footprints by using dedicated fixing frames. All contacts have low-resistivity needles that can withstand a permanent DC current up to 1.7A per needle.

Note: The module's thermal encapsulation inside the Socket increases the thermal resistance (Rth). Thus, you need to be aware that the board temperature may rise quite quickly until automatic thermal shutdown takes effect, especially at higher environmental temperatures or high radio output power.
3 LGA DevKit Overview

3.1 Top and Bottom View

Figure 1: LGA DevKit top view

Figure 2: LGA DevKit top view
3.2 Block Diagram

Figure 3: LGA DevKit block diagram
4 LGA DevKit Interfaces

4.1 USB

The LGA DevKit comes with two USB interfaces supporting power supply and serial communication. You may choose to setup communication via a module's USB port and/or a module's UART (ASC0) port via FTDI232R VCP.

- Both USB ports can be used in parallel while power is sourced from both ports.
- The native USB power is isolated from the VCP USB power by a diode, meaning that the VCP USB power does not feedback to the native USB power, but vice versa. This should be taken into account when supplying the LGA DevKit from different USB power sources, depending on the voltage levels there could be a power feedback from native USB to VCP USB.
- In case of marginal USB power supply both USB ports should be used to improve power capabilities.

Note: The modem’s USB driver can be downloaded from the LGA DevKit's web page that can be reached by scanning the QR code.

4.2 SIM

On the LGA DevKit's bottom side you find a SIM card holder that is connected to the module's regular SIM interface lines, except for the CCIN line where the (default) jumper needs to be set for CCIN at the CONTROL pin headers (see Section 4.3). However, some modules come with an additional SIM interface. This can be accessed in conjunction with a DSB75/DSB-Mini (as port extender) to support dual SIMs - with the DSB75/DSB-Mini serving as the second SIM interface.

Some Cinterion® modules require additional components at the SIM interface, for instance pull-up resistors managed by the DevKit's control logic. These can be overridden by setting a switch on the DevKit's bottom side - see Figure 4. For modules requiring a CCIO pull up resistor this switch should be set to “CCIO PULLUP” (see Section 7.3).

Figure 4: SIM settings
4.3 Pin Headers

The pin headers at the head of the LGA DevKit's top side can be used to setup connections between modules and possible on board peripherals. Thus, pin headers having signal names at their left side only, namely the pin headers AUDIO, CONTROL, ASC0_A, ASC0_B, DAI, ASC1, GPIO, and PWR, can be bridged by jumpers. All of these pin headers have the module's signal name on their left side (orange box in Figure 5), whereas the right side corresponds to peripherals like level shifters or the DSB connector (green box in Figure 5).

- Placing a jumper connects a line through a level shifter to the associated pin at the 2x40 pin connector at the bottom of the LGA DevKit (and thus to a connected DSB75/DSB-Mini). See also Figure 3.
- Not placing a jumper leaves a module signal line open.

External periphery can also be connected to all accessible module signals directly. When connecting other external periphery to the pin headers pay attention not to violate the maximum module ratings.

![Figure 5: Pin headers](image_url)

4.3.1 Default Configuration

Figure 6 shows the factory default jumper and switch positioning.

![Figure 6: Default jumper and switch configuration](image_url)
4.4 ON Button: Module Start and Power Down

Pushing the ON button shortly (i.e., <0.5s), the LGA DevKit starts up and initially analyses the mounted module orientation and type. In case both are recognized and correct, the module is started using specific start pulses. The white LED indicates the modules VEXT state as high.

Picture TBD.

Also, it is possible to start up the module by toggling DTR on the DSB75/DSB-Mini RS232 connector.

Pushing the ON button for more than 2s shuts down the LGA DevKit's power supply, and the module's power supply is interrupted regardless of its current state.

4.5 RST Button: Module Reset

Pushing the RST button pulls down a module's EMERG-RST/OFF signal, thus forcing it into reset or off state depending on the module. Please note that this functionality is only available if the (default) jumper is set for EMERG_RST at the CONTROL pin headers (see Section 4.3).

4.6 ASC0 Switch: Module UART Interface Selection

The "ASC0" switch selects the module's UART communication interface either via USB VCP (FTDI232R) or via "RS232" D-Sub interface on the DSB75/DSB-Mini.

Changing this from "USB" to "RS232" during operation resets the FTDI VCP bridge in order to release the signal lines, thus leading to a USB VCP disconnect on the host PC side.

4.7 PWR Switch: Power Source Selection

The "PWR" switch selects the preferred power source, both sources can be connected at the same time, but do not supply the LGA DevKit in parallel.

When "USB" is set, both LGA DevKit USB ports will contribute to the overall power supply with a connected DSB75/DSB-Mini having to be powered separately. Setting "EXT", the power is supplied from the DSB75/DSB-Mini interface.

Please note that there is a dedicated power supply for the GPS antenna. To use this, the two pins at the GPS_PWR field will have to be soldered and connected by jumper.
4.8 Free Level Shifters

The LGA DevKit provides 8 free level shifters, with 4 placed & connected at the patch field on the bottom side, and 4 connected to the pin header "LEVELSHIFTER". The level shifters on the pin header are referenced to the module's Vext, and Vref that by default corresponds to 3V or to "REF IN" if connected (see Section 4.12.2).

These level shifters can be used to level shift signals that are not available at the DSB connector.

4.9 LEDs

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED</td>
<td>Blinking continuously: Module is inserted upside down, not powered, turn by 180°</td>
</tr>
<tr>
<td></td>
<td>Blinking 2 times: No module inserted</td>
</tr>
<tr>
<td></td>
<td>Blinking 3 times: A module not supported by footprint is inserted, not powered, change module.</td>
</tr>
<tr>
<td></td>
<td>Lighting: Overcurrent detected in module power pass, change module, restart LGA DevKit's power supply.</td>
</tr>
<tr>
<td>GREEN</td>
<td>Module TXD0 activity, low active</td>
</tr>
<tr>
<td>GREEN PWR</td>
<td>Sufficient power, but not switched on.</td>
</tr>
<tr>
<td>Amber</td>
<td>Module RXD0 activity, low active</td>
</tr>
<tr>
<td>Blue</td>
<td>Module state GPIO5 / LED (if a jumper is set for GPIO5 at the GPIO pin headers).</td>
</tr>
<tr>
<td>White ON</td>
<td>Module started, V180/300 is at high level (if the (default) jumper is set for VEXT at the CONTROL pin headers).</td>
</tr>
<tr>
<td>White USB</td>
<td>TX/RX activity on USB VCP</td>
</tr>
</tbody>
</table>

4.10 Patch Field

A small patch field is available at the LGA DevKit's bottom side. If required, you can add simple components (LED, Transistors etc.) here. All module signals, except USB and RF are accessible at the bottom through the labeled pads.

4 level shifters are accessible close to the patch field as well with the reference Vext and Vref. The Vref related level shifter connections can also be accessed via four additional pads at the left bottom side of the LGA DevKit where additional pins may be soldered.

Attention: You will lose your warranty if the patch field was soldered/used.

Figure 7: Patch field
4.11 RF Antenna

The LGA DevKit supports three antenna interfaces. The two SMA connectors "MAIN" and "DRX" can used for radio transmission. The GNSS interface is supported by an U.FL connector named "GPS".

All antenna interfaces have additional ESD protection implemented.

The LGA DevKit package includes a broad band high efficiency PCB antenna that can be used with the DevKit for all radio band combinations.

Figure 8: S11 MAIN antenna module RF pad and S21 MAIN antenna RF loss

Figure 9: Antenna S11
4.12 Power Supply

The LGA DevKit can be supplied through one or two USB ports that should be in the range of 5V +-5%, and/or externally by the DSB75/DSB-Mini. The modules supply level can be adjusted in the range between 2.8…4.8V by setting the variable resistor at the DevKit's top side. The DevKit power supply path is short protected with ~2A. In case of overcurrent the power path will be interrupted and the red LED lights up until the power has been reset.

As a recommendation the LGA DevKit should be supplied with 5V/1A over one or two USB ports. The onboard bypass capacitors should buffer enough energy to support short 2G peak currents up to 2.5A.

4.12.1 Supply Current Measurement

The LGA DevKit supports three methods to measure the current consumption of the inserted module.

- Measure the voltage across the on board 100 mOhm shunt resistor.
- Measure the current by a current meter.
- Power the module by an external power supply e.g. power analyzer.

All options require a jumper placed on the 4th "BB" and 5th "RF" row for connecting baseband and radio. Those two jumpers also allow to measure the current separately for the BB and RF path.

![Figure 10: Supply current measurements](image-url)
4.12.2 External Reference Supply

To drive/operate the LGA DevKit's interfaces at certain voltage levels, an external reference voltage may be connected. By default, i.e., without an external reference voltage connected, the interface operates at 3V to meet the DSB75/DSB-Mini requirements. But if it is required to operate the interface at another voltage, an external source in the range between 1.2V...5V can be connected to "REF IN" and "GND" as shown in Figure 11.

![External reference supply and pin header for free level shifter](image)

**Figure 11:** External reference supply and pin header for free level shifter
5  General Characteristics

5.1  Limits

The following table lists absolute maximum ratings for the LGA DevKit.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage on USB ports</td>
<td>-0.3</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Voltage on DSB port</td>
<td>-0.3</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Voltage on signal pin header, depending on used module</td>
<td>-0.3</td>
<td>2.1</td>
<td>V</td>
</tr>
<tr>
<td>Current signal pin header, depending on used module</td>
<td>-10</td>
<td>+10</td>
<td>mA</td>
</tr>
<tr>
<td>Voltage on external reference</td>
<td>-0.3</td>
<td>6</td>
<td>V</td>
</tr>
<tr>
<td>Socket single contact continues current</td>
<td></td>
<td>2</td>
<td>A</td>
</tr>
</tbody>
</table>

Note: Violation of these limits may cause permanent damage to the LGA DevKit.

5.2  Electrical Properties

The following table lists recommended operating conditions for the LGA DevKit.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended operating condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply voltage on USB port</td>
<td>4.75</td>
<td>5.25</td>
<td>V</td>
</tr>
<tr>
<td>Supply current capability on USB port</td>
<td>TBD.</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Supply voltage on DSB port</td>
<td>TBD.</td>
<td>TBD.</td>
<td></td>
</tr>
<tr>
<td>Electrical operating condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socket single contact resistance</td>
<td>80</td>
<td>120</td>
<td>mOhm</td>
</tr>
<tr>
<td>Environmental temperature</td>
<td>0</td>
<td>+30</td>
<td>°C</td>
</tr>
</tbody>
</table>
6 Operating DevKit on DSB75 and DSB-Mini

The LGA DevKit supports a 2x40pin connector at its bottom side, compatible to the DSB75/DSB-Mini. A DSB may be a port extender for an RS232 interface, a second SIM or an analog audio interface. When operating the LGA DevKit with a DSB the following settings can be adjusted.

- Use the "PWR" switch to select the power source. If you select "EXT", the DevKit expects the power on the DSB connector. If you select "USB", the DevKit is powered by its USB ports, and the DSB expects a separated power source.
- Use the "ASC0" switch to select the first UART. If you select "RS232", the modules ASC0 is conducted to the DSB and can be accessed on the D-SUB connector. If you select "USB" the UART can be accessed via USB VCP port. Note that the USB VCP bridge will be in reset state while "RS232" is activated. As a consequence the interface is de-enumerated on host side.

Please refer to Section 10.3 for a DSB-Mini patch needed to operate ASC0 on DSB-Mini.

6.1 Quick Start Operating LGA DevKit and DSB75

To operate the LGA DevKit with the DSB75 please complete the following steps:

- Mount the LGA DevKit onto the DSB75.
- Insert the module.
- Set "PWR" and "ASC0".
- Check if all jumpers are placed at the pin header: CONTROL, ASC0_A and PWR
- Connect the host PC to DSB75 via Sub-D.
- Connect power to DSB75 and if needed to the LGA DevKit.
- Press the ON button (or the DSB75 IGT button).

TBD.
7 Module Specific Configuration Settings

7.1 BGS2 Operation

BGS2 requires a reference voltage for the I/O domain at VDIG (pad 10 of the LGA106 footprint). Therefore please connect IO25 and VEXT via a jumper.

7.2 EHS5/6/8 Operation

Some early samples of EHS5/6/8 require the AUTO_ON circuit. For these samples please connect A_ON to GND or else the module will not start.

7.3 EMS31 Operation

EMS31-V requires a pull up resistor for the SIM interface. Please use the SIM switch setting mentioned in Section 4.2.

7.4 ENS22 Operation

With ENS22 the white ON LED blinks only very shortly, and about 3.5 seconds before the module actually start up.
8 Document Information

8.1 Revision History

Preceding document: "Cinterion® LGA DevKit User Guide" v01
New document: "Cinterion® LGA DevKit User Guide" v02

<table>
<thead>
<tr>
<th>Chapter</th>
<th>What is new</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Throughout document</td>
</tr>
</tbody>
</table>

New document: "Cinterion® LGA DevKit User Guide" v01

<table>
<thead>
<tr>
<th>Chapter</th>
<th>What is new</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>Initial setup</td>
</tr>
</tbody>
</table>

8.2 Related Documents

[1] Hardware Interface Description for your Gemalto M2M module
[2] AT Command Set for your Gemalto M2M module

To visit the Gemalto M2M website you can use the following link: http://www.gemalto.com/m2m
8.3 Safety Precaution Notes

The common safety precautions that apply to mobile phones must also be observed at all times when using this LGA DevKit. Failure to comply with these precautions violates safety standards. Gemalto M2M assumes no liability for customer’s failure to comply with these precautions.

The following is a non-extensive list of the mobile phone and LGA DevKit usage restrictions:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>![Symbol]</td>
<td>Pacemaker patients are advised to keep their hand-held mobile away from the pacemaker while it is on.</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>Mobile phones must be switched off before boarding an aircraft.</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>Mobile phones may not be operated in the presence of flammable gases or fumes</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>Interference can occur if mobile phones are used close to TV sets, radios, computers or inadequately shielded equipment</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>Do not use your mobile while driving a vehicle</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>You should never rely solely upon any wireless device for essential communications, for example for emergency calls</td>
</tr>
</tbody>
</table>

The power supply connected to the LGA DevKit shall be in compliance with the SELV requirements defined in EN 60950-1.

8.4 Regulatory Compliance Information

The Cinterion® LGA DevKit is intended for evaluation and development purposes only, and should therefore only be used in a (laboratory) test environment. The device is not CE approved, and has not been authorized as required by the rules of the FCC. All persons handling the Cinterion® LGA DevKit must be properly trained in electronics and observe good engineering practice standards.
The following packages are available for the LGA DevKits. Normally an LGA DevKit SM or L would be used with the LGA DevKit Socket SM/L:

- **Cinterion® LGA DevKit SM** (Ordering number: L30960-N0111-A100)
  - Base PCB for the industrial platform modules
  - USB and SMA cable
  - An ultra-wideband high efficiency antenna
  - A bag of jumpers ~25pcs
  - A quick start guide

- **Cinterion® LGA DevKit L** (Ordering number: L30960-N0112-A100)
  - Base PCB for the industrial plus platform modules
  - USB and SMA cable
  - An ultra-wideband high efficiency antenna
  - A bag of jumpers ~25pcs
  - A quick start guide

- **Cinterion® LGA DevKit Socket SM/L** (Ordering number: L30960-N0110-A100)
  - The needle socket fitting on both PCB versions SM and L
  - Screws, fixing frames, retention lid
10 Appendix

10.1 Placement

**Figure 14**: Top and bottom side placements
10.3 Errata/Troubleshooting

PCB B22 Antenna Matching
The LGA DevKit's PCB revision B22 - built in a smaller quantity - has a decreased RF matching that will be fixed in an upcoming version. The below figure shows the S11 DevKit’s MAIN antenna (left) and the S21 DevKit’s MAIN antenna RF path loss (right) of the PCB’s B22 revision.

Radio/Temperature Measurement
The LGA DevKit comes with minor limitations in terms of radio frequency and temperature evaluation because of a slightly increased RF path loss and module temperature encapsulation inside the LGA socket.

PCB22/23 with DSB-Mini as Expander Board - ON LED
When the DSB-Mini is used as port expander there is a current back feeding that results in an constant glowing ON LED on the LGA DevKit.

There is no impact in functionality. To fix this, place a 4k7 resistor from the ASC0 switch (upper pad) to V480 close to the patch field.
**PCB B22 Module Rotation Detecting Limited**
The LGA DevKit's PCB revision B22 - built in a smaller quantity - has a limited rotation detecting. If the DevKit is powered by native USB and the module is inserted upside down, the error detecting is limited and may allow drawing a limited current (max 20mA) into pad#11/212. The module may get damaged. This limitation will be fixed in an upcoming version.

**PCB B22 Footprint Detection Limited**
The LGA DevKit's PCB revision B22 - built in a smaller quantity - has a limited footprint detection. Modules with bold lettering "QUALCOMM" (e.g., EXS81) or wrongly positioned RohS symbol (e.g., ELS61/81) on the module’s bottom side, might be detected as a wrong footprint and will therefore not be powered-up. This limitation will be fixed in an upcoming version.

**PCB B22 Error LED/ TXD0 LED**
The LGA DevKit's PCB revision B22 has a softly glowing error LED. Also, when no module is inserted the TXD0 LED glows softly. This optical defect will be fixed in an upcoming version.

**PCB B22 Marking**
With the LGA DevKit's PCB revision B22 the following markings are swapped:
- DAT and CLK at the GPIO pin headers
- IO13 and VDLP at the FREE GPIOs pin headers

**EHS5/6/8**
Early samples of EHS5/6/8 require an additional circuit and pad to turn on the module. The so-called AUTO_ON pad can either be pad 79 (EHS5) or pad 72 (EHS6/8). These early samples are not be supported by the LGA DevKit.
About Gemalto

Since 1996, Gemalto has been pioneering groundbreaking M2M and IoT products that keep our customers on the leading edge of innovation.

We work closely with global mobile network operators to ensure that Cinterion® modules evolve in sync with wireless networks, providing a seamless migration path to protect your IoT technology investment.

Cinterion products integrate seamlessly with Gemalto identity modules, security solutions and licensing and monetization solutions, to streamline development timelines and provide cost efficiencies that improve the bottom line.

As an experienced software provider, we help customers manage connectivity, security and quality of service for the long lifecycle of IoT solutions.

For more information please visit www.gemalto.com/m2m, www.facebook.com/gemalto, or Follow@gemaltoIoT on Twitter.

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