BL28EU-001

OEM Manual and User Guide v 1.0

(to be used for certification)

FCC ID: LHJ-BL28EU001

Change History

Revision	Date	Change Description	Owner (s)
1.0	07-05-2018	Initial Release for certification, based off of HW Spec version 2.8	I. Shmagin

Terms and Acronyms

- CDMA Code Division Multiple Access
- DCM Data Connectivity Module
- DRX Discontinuous Reception
- ES Engineering Sample
- FDD Frequency Division Duplex
- GLONASS GLOBal'naya NAVigatsionnaya Sputnikovaya Sistema
- GNSS Global Navigation Satellite System
- GPIO General Purpose Input Output
- GSM Global System for Mobile
- HU Head Unit
- HSIC High Speed Inter-Chip
- LTE Long Term Evolution
- MP Mass Production
- NAD Network Access Device
- OEM Original Equipment Manufacturer
- PCB Printed Circuit Board
- PHY Physical Layer
- SIM Subscriber Identity Module
- TCU Telematics Control Unit
- TDD Time Division Duplex
- TSP Telematics Service Provider
- UMTS Universal Mobile Telecommunication System
- WCDMA Wideband Code Division Multiple Access

BL28EU-001 Module

The BL28EU-001 NAD is a proprietary modem module designed by Continental Automotive Systems, Inc. The modem will be integrated into Data Connectivity Modules (DCMs) or Head Units (HUs) designed and produced by Continental or by a 3rd party for use by automotive OEMs. DCMs will be installed into vehicles during the OEM's factory assembly process and will not be accessible without use of special tools. Primary use-cases are data-centric with data and voice connections to Telematics Service Providers (TSP).

1 Key Features

1.1 LTE CAT4 NAD Module

Air Interface Support

- LTE FDD/TDD: 3GPP Rel 10
- LTE FDD CAT4 (up to 150-Mbps UL/50-Mbps DL)
- UMTS: HSUPA CAT 6 (up to 5.76-Mbps), HSPA CAT14 (up to 21-Mbps), HSPA CAT24 (up to 42-Mbps)

2 Regulatory Compliance Notes

FCC:

This device complies with Part 15, Part 22(H), Part 24(E) and Part 27 of the FCC Rules. The FCC ID for this device is LHJ-BL28EU001. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.

2. This device must accept any interference received, including interference that may cause undesired operation.

3 Device Installation and User Manual

The BL28EU-001 module is a proprietary product designed and manufactured by Continental Automotive Systems, Inc. for integration into telematics control units manufactured by Continental Automotive Systems, Inc. for automotive OEMs.

i. The module is limited to installation ONLY in an integrated device manufactured by Continental Automotive Systems, Inc.

ii. During manufacturing process of the integrated device, the module is soldered onto the pcb of the integrated device.

iii. The integrated device must provide RF connectors to external antennas or RF traces to connect the BL28EU-001 modules to antennas inside the integrated device. The typical reference design for the RF trace layout, including pcb stack-up and trace length is described in Section 6 of this document.

iv. Automotive OEM is responsible for ensuring that the end-user has no manual instructions to remove or install module.

v. The module is limited to installation in mobile applications, according to Part 2.1091(b).

vi. No other operation configurations are allowed.

vii. Changes or modifications to this system by other than a facility authorized by Continental could void authorization to use this equipment.

viii. The module must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operate in conjunction with any other antenna or transmitter.

ix. The integrator is responsible for fulfilling FCC and IC requirements for the integrated device.

If Continental chooses to re-use modular approval, then the TCU shall be clearly labeled with an external label containing the integrated modem's FCC ID. For example, the label can include text "Contains device with FCC ID: LHJ-BL28EU001".

4 Antenna requirements for use with BL28EU-001 module:

- The module must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.
- The BL28EU-001 module is for use with external antennas ONLY.
- For all LTE/WCDMA operating bands the maximum antenna gain is 5 dBi including cable loss.
- The maximum gain of the antenna path (cable loss + antenna gain) shall not exceed the above mentioned values.
- This radio transmitter (FCC ID: LHJ-BL28EU001) has been approved by FCC and Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

5 Instructions to OEMs:

Continental must instruct the automotive OEM and provide them to include the following information into the car user's manual (i.e. for the DCM):

1. End-users must be provided with transmitter/antenna installation requirements and operating conditions for satisfying RF exposure compliance:
2. A separate section should clearly state "FCC RF Exposure requirements:"
3. Required operating conditions for end users.
4. The antenna used with this device must be installed to provide a separation distance of at least 20cm from all persons, and must not transmit simultaneously with any other transmitter, except in accordance with FCC multi-transmitter product procedures.
5. The Maximum ERP/EIRP and maximum antenna gain required for compliance with Parts 15, 22H, 24E, and 27.
6. Clear instructions describing the other party's responsibility to obtain station licensing.

6 Layout and Routing Recommendations

6.1 Module Specific

The pad spacing of 1mm should allow the placement of a 600um finished VIA between pads, while maintaining a 200um Via- to-trace or Via-pad spacing, to facilitate the breakout of inner row signals. The 1mm spacing is also large enough to route two 200um (8 mil) traces between pads.

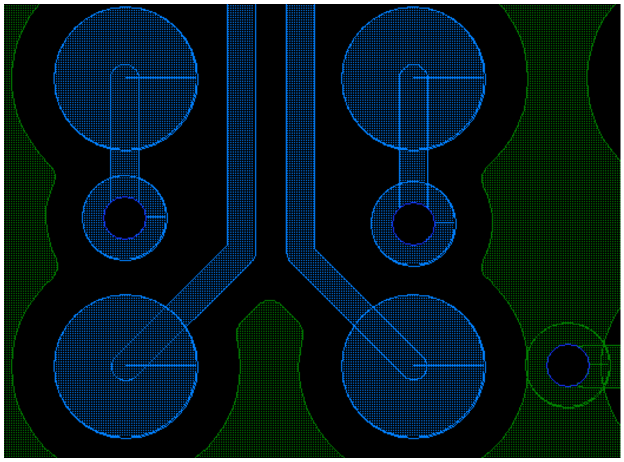

Figure 6-1 Vias placed between Pads

6.2 RF Traces for antennas

The NAD has three antenna pins.

- PRIMARY_ANT
- SECOND_ANT
- GNSS_ANT

The figure below shows the general breakout of the module:

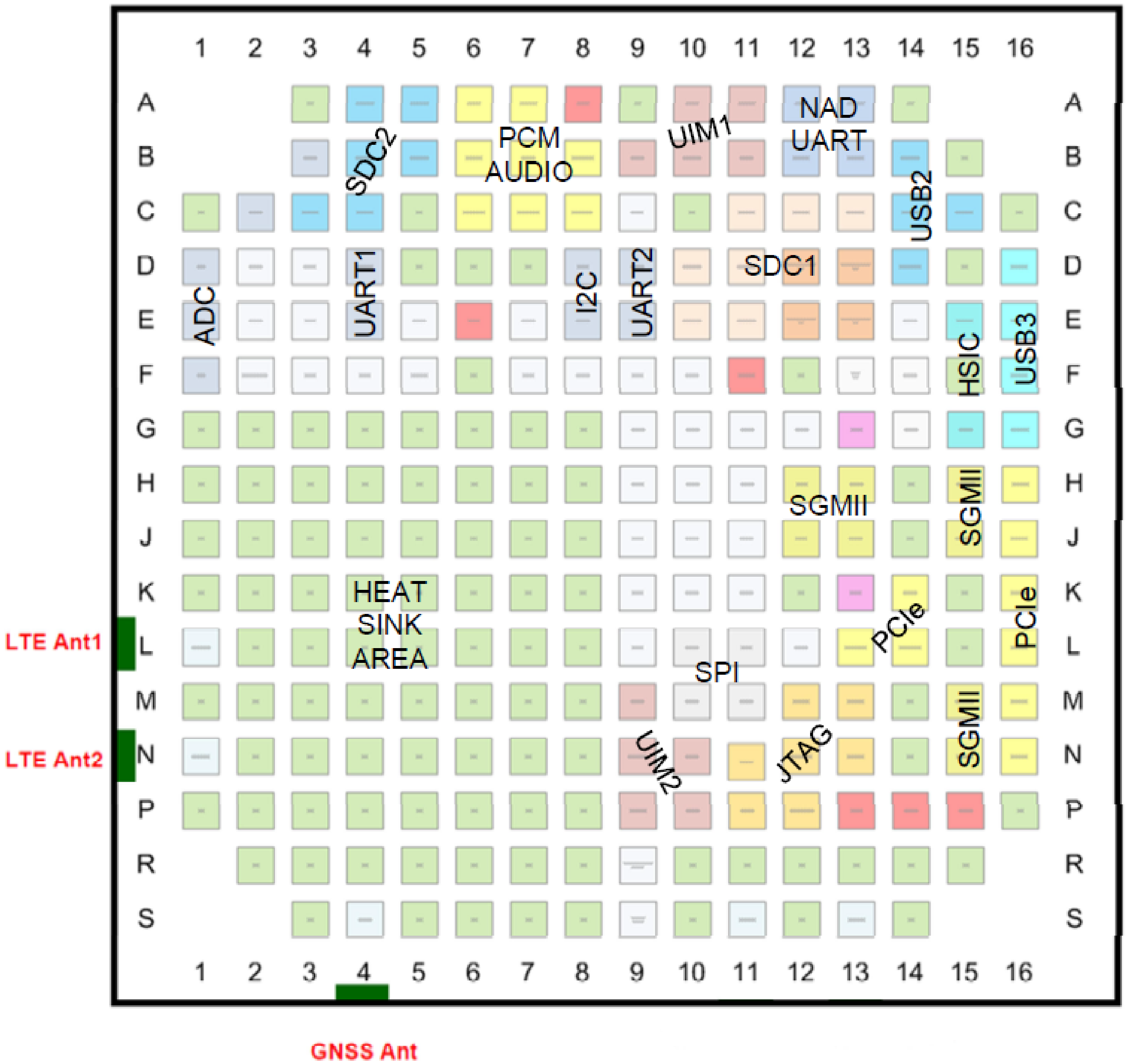

Figure 6-2: NAD Pin Breakout

The module should be oriented on the main board to minimize the length of the PRIMARY_LTE antenna pin (LTE Ant1). This 50ohm line should be as short as possible to the external RF connector or internal antenna feed point.

The RF traces from the NAD antenna pins on the main board can be stripline or microstrip. For the stripline approach, vias should be placed to the NAD EDGE SIDE of the pins as close as possible to the NAD antenna pads to minimize any impedance discontinuity (see figure 38). For the microstrip approach, the PCB insertion loss will be less but the short route under the NAD MUST BE TREATED AS STRIPLINE SO IT WILL BE NARROWER UNDER THE NAD THAN THE MICROSTRIP LINE.

The NAD has ground cleared out under the RF antenna routes as shown below:

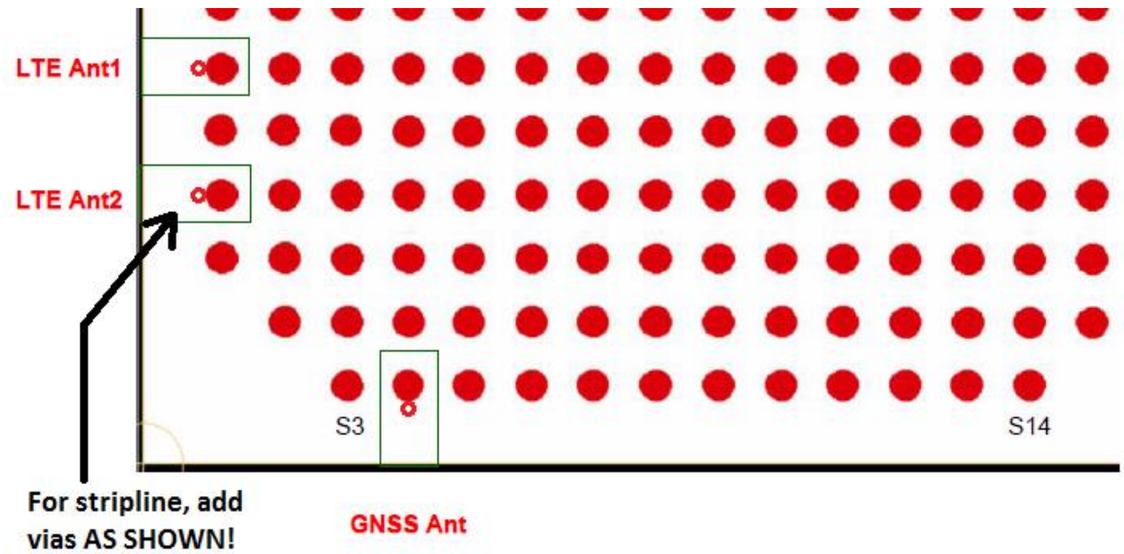

Figure 6-2: Antenna Pad Ground Cutout (Top View)

For routing microstrip lines UNDERNEATH the NAD on layer 1, these ground cutouts internal to the NAD need to be accounted for in the stripline calculation. The internal GND height and dielectric constant of the NAD board are shown below:

H = 19.3 mils (491 micron)
Dielectric Constant = 4.1

For example, consider the following stackup for a main PCB:

	Layer	Thickness in microns	Tolerance in microns	Thickness in mils
	Solder Mask	30 micron	+11 micron	1.17 mil
Plated 0.5oz Cu	ML1	49 micron	+/-10 micron	1.91 mil
7628 x 1+1080 x 1 Prepreg	DL1	253 micron	+/-38 micron	9.88 mil
1oz Cu	ML2	36 micron	+/-10 micron	1.41 mil
2116 x 2 Core	DL2	254 micron	+/-38 micron	9.92 mil
1oz Cu	ML3	36 micron	+/-10 micron	1.41 mil
2165 x 2 Prepreg	DL3	277 micron	+/-38 micron	10.82 mil
1oz Cu	ML4	36 micron	+/-10 micron	1.41 mil
2116 x 2 Core	DL4	254 micron	+/-38 micron	9.92 mil
1oz Cu	ML5	36 micron	+/-10 micron	1.41 mil
7628 x 1+1080 x 1 Prepreg	DL5	253 micron	+/-38 micron	9.88 mil
Plated 0.5oz Cu	ML6	49 micron	+/-10 micron	1.91 mil
	Solder Mask	30 micron	+11 micron	1.17 mil
	Total board thickness:	1593 micron	+272 mu / -250 mu	62.23 mil

Figure 6-3

Assume the main PCB above with a 6 layer stackup with ground cut away on layer 2 so the microstrip lines reference ground on layer 3. The dielectric thickness from L1 to L3 is 21.2 mils.

Using an online impedance calculator, the line width under the NAD for a 50 ohm line is 16.9mils (433micron) shown below:

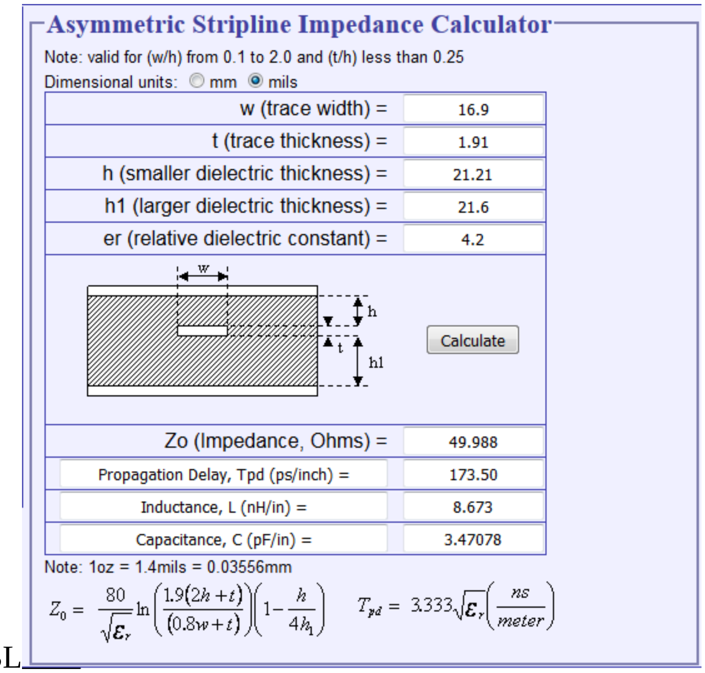

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Figure 6-4

The calculation for the microstrip line width outside the NAD is 37.7mils (967micron) shown below:

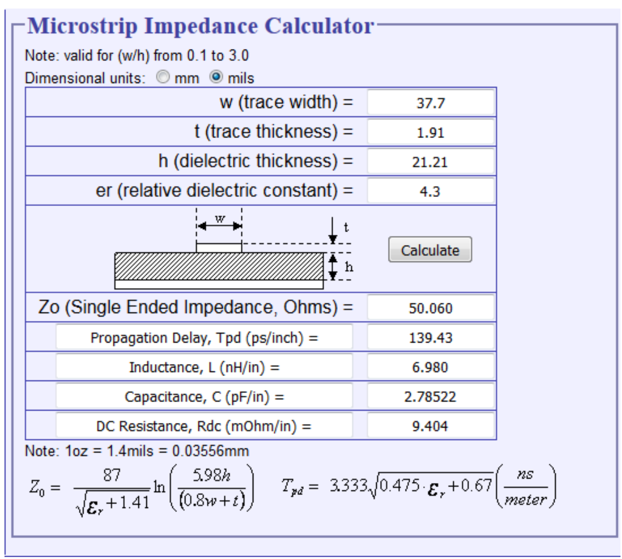

Figure 6-5

Due to the nature of the weave chosen for each PCB, the dielectric constant of the NAD board is 4.1 while the main board is 4.3. A dielectric constant of 4.2 was chosen in the stripline calculation, while 4.3 was used for the microstrip calculation.

Main board stack up may vary so these line widths may need to be recalculated. IT IS HIGHLY RECOMMENDED TO USE A SIMILAR STACKUP AS SHOWN IN FIGURE 39 WITH MICROSTRIP ROUTING AND GND CUTS ON LAYER 2 WITH GND REFERENCE ON LAYER 3. THERE SHOULD BE NO ROUTING ON L2 AND SOLID GND ON L3 UNDERNEATH THESE ANTENNA LINE MICROSTRIP TRACES.

The antenna traces need to routed STRAIGHT OUT OF THE NAD TO THE NEAREST NAD EDGE. The lines need to be tapered from 433micron to the 967micron width gradually but quickly.

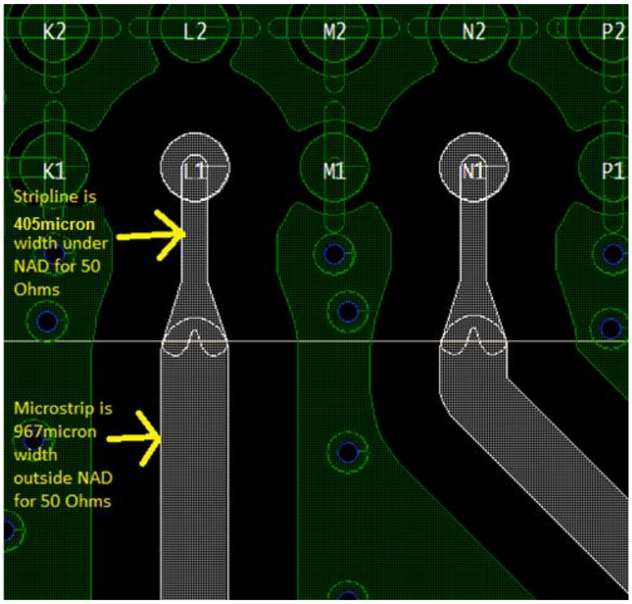

Figure 6-6

These line widths may vary depending on the stackup selected for the main board.

6.3 RF Antenna Layout Parameters

Type of Guidance	**Requirement**
Trace impedance	**50-Ohms ± 10% single-ended**
Total route length	**<100-mm**
Ground between signals	**> 3 x line width of ground trace between, stitched VIA to ground**
Spacing to other signals	**< 3:1**

- Signals should be routed along similar route path, but separated by ground trace.
- Trace impedances should match the table, either as microstrip or stripline.
- Total length for both signals should match the table.
- Spacing to ground or other signals on outside of bundled signals should match the table.