NAD6200 Network Access Device

Datasheet, Rev. 1.3

september, 2013

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Vorsitzender des Aufsichtsrates: Dr. Helmut Rothenberger **Ein Unternehmen der peiker Firmengruppe**

Revision History

Revision	Date	Chapter	Comment
1.0	13.5.2013	all	Release
1.1	17.7.2013	10	Insert chapter 10.2 Warning Statements
1.2	28.8.2013	10	Insert RF Exposure Warning and Notice
1.3	2.9.2013	10	Insert OEM responsibility to the FCC rules and regulations

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Index of abbreviations

3 GPP	3rd Generation Partnership Project
ADC	Analog – Digital – Converter
DAC	Digital – Analog - Converter
eCall	Emergency Call
Gb	Gigabit
GLONASS	Global Satellite navigation system
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GSBI	General Serial Bus Interface
GSM	Global System for Mobile Communications
HSDPA	High Speed Downlink Packet Access
HSIC	High Speed Inter – chip Interface
HSPA	High Speed Packet Access
HSUPA	High Speed Uplink Packet Access
HW	Hardware
IC	Integrated Circuit
I²C	Inter –Integrated Circuit
I²S	Inter-IC Sound Interface
LDO	Low Drop-Out
Mbit/s	Megabit per second
MPP	Multi Purpose PIN
NAD6200	Network Access Device
QCT	Qualcomm technology
PCM	Pulse Code Modulation
PCB	Printed Circuit Board
RF	Radio Frequency
SDIO	SD Input / Output

SMPS	Switched Mode Power Supply
SPDIF	Sony / Philips Digital Interface
SPI	Serial Peripheral Interface
SIM	Subscriber Identity Module
SSBI	Single – wired Serial Bus Interface
SW	Software
UART	Universal Asynchronous Receiver Transmitter
UIM	User Interface Module
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
WCDMA	Wideband Code Division Multiple Access
W-WAN	Wireless Wide Area Network

Abstract

Peiker NAD 6200

- Network Access Device
- ERA – GLONASS / eCall enabled

Automotive Grade by Design

- 10 – Layer design for best possible EMC and RF characteristics
- At the PA – Area and the Antenna Connector – Area is nothing assembled on bottom side
- Components integrated for antennas diagnostics
- Temperature sensors included for temperature management of some parameters

Automotive Grade by Application

A 500 MHz clocked ARM11 application processor is part of the MDM6200 chipset:

- It contains all mandatory application software for ERA-GLONASS / eCall support
- The complete emergency call procedure as specified in ETSI standards and the EGTS protocol are implemented
- Enables different license models for different UMTS data rates

Automotive Grade Characteristics

- Enhanced lifetime of the device (till 2020)
- GPS / GLONASS receiver and LNA integrated
- Operational temperature range -40°C to +85°C
- Shock resistance up to 200g

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1. Introduction

1.1. Scope

This document gives an overview about electrical, functional and mechanical details of the peiker NAD6200 module based on the Qualcomm chipset MDM6200 and PM 8028.

1.2. References

Table 1: References

Ref.	Name	Comment	Revision	Date
1	ASP-162345-02 (samtec)	Board to board connector 40-pole		
2	CLP-120-02-F-D-A-K-TR (samtec)	Mating connector		
3	4369.SMBA.1H10.009 (IMS Connector Systems GmbH)	FAKRA HF dual connector	d	10.09.2007
4	4408.SMBA.1H10.009 (IMS Connector Systems GmbH)	FAKRA HF single connector	b	30.01.2008

1.3. Audience

Information how integrate the NAD6200 module in other applications.

1.4. Contact information, support

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2. Overview of the NAD6200 – Module

This chapter gives a general overview of approvals, functionality and product variants of the NAD6200 module.

2.1. Key features

Table 2: Key features of NAD6200 - Module

Feature	
Processors	Application Processor: ARM1136 + L2 cache at 480 MHz Modem DSP: QDSP4000 processor at 147.5 MHz Application DSP: QDSP4000 processor at 162 MHz
Memory	512 Mb 16 bit DDR SDRAM 1 Gb NAND flash
GSM,GMSK,EDGE	GSM850,900 Class 4 (2W) GSM1800, 1900 Class 1 (1W) EDGE850, EDGE900 Class E2 (0.5W) EDGE1800, EDGE1900 Class E2 (0.4W) GPRS/EDGE Multi slot class 12 DTM Multi slot class 11
WCDMA, HSDPA, HSUPA	BC1, 2, 5, 6, 8 Class 3 (0.25W) HSDPA CAT 10 (14.4Mbps) HSUPA CAT 6 (5.76Mbps)
GNSS	GPS Glonass
Antenna functions/interface	Connector for one main antenna Connector for one backup antenna Optional connector for one GPS antenna Antenna diagnostics
Interfaces	USB2.0 HS UIM SPI I²C UART Digital Audio[1]
Data Communication	CSD analog (V.32/V.34) and digital (V110) with 2.4/4.8/9.6/14.4 kbit/s Packet switched data PPP-Stack SMS: - Point-to-Point MT and MO - Text and PDU mode (“binary-SMS”) - transmission of SMS alternatively over CSD and GPRS - Support of MO/MT SMS parallel to circuit switched (voice/data) - Packet switched data connections
Software	Firmware and application software independently updatable.
Power supply	Single power supply 3.8 V

[1] I²S

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Thermal functions	Operating Temperature: -40 °C to +85 °C[2]
Additional operations	DTMF after dialing DTMF configurable Multiple PDP contexts Echo Cancellation / Noise suppression VDA Class 2a fulfilled Speech codecs: - Half rate EFR - Full rate FR - Enhanced Full rate EFR - Adaptive Multi – Rate AMR

[2]: Automotive ambience fulfilled

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2.2. Product variants and Approvals

Table 3: Product variants

Variant	GSM – Quad Band	Band 1	Band 2	Band 5	Band 6[3]	Band 8	GPS & Glonass	GCF[4]	PTCRB[5]	MNO Approval	Country Approval
EU[6]	X	X				X		Yes	n/a	Vodafone	R&TTE
NA[7]	X		X	X				n/a	Yes	AT&T Rogers (in progress)	FCC FCC
China	X	X						Yes	n/a	China Unicom	SRRC, CCC, NAL
APAC[8]	X	X		X	X	X		??	n/a	Vodafone	In progress
EU[6] + GNSS	X	X				X	X	Yes	n/a	Vodafone	R&TTE
NA[7] + GNSS	X		X	X			X	n/a	Yes	AT&T Rogers (in progress)	FCC FCC
China + GNSS	X	X					X	Yes	n/a	China Unicom	SRRC, CCC, NAL
APAC[8] + GNSS	X	X		X	X	X	X	??	n/a	Vodafone	In progress

[3] : It is a part of Band 5.
[4] : Weblink to the Webpage of GCF: http://www.globalcertificationforum.org/
[5] : Weblink to the Webpage of PTCRB: http://www.ptcrb.org/
[6] : Germany, Benelux, Italy, Spain, France, Austria, Denmark, Czech Republic
[7] : USA, Canada
[8] : Japan, Singapore

3. Overview HW – Part

3.1. Block – Diagram

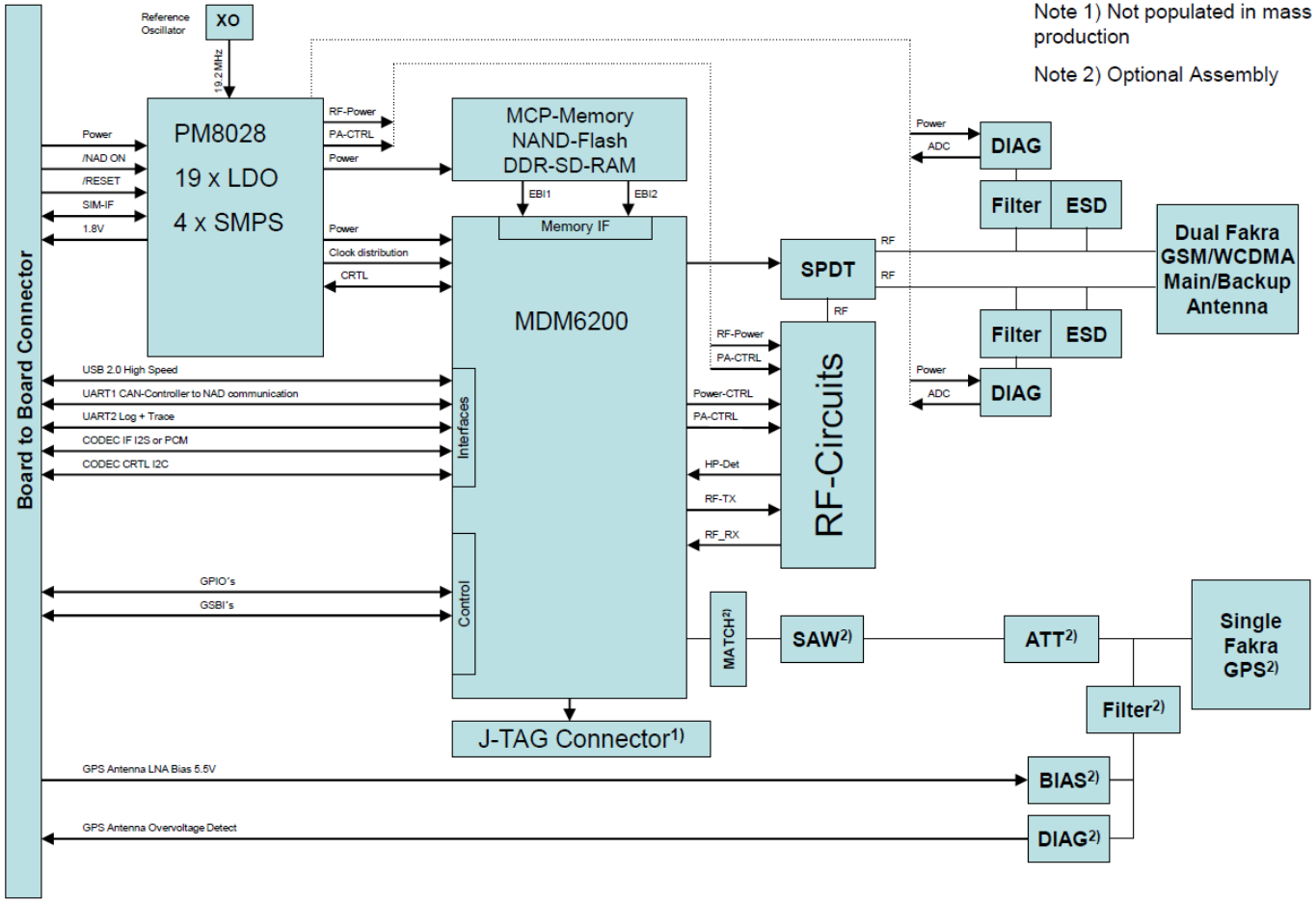


Figure 1: Block diagram of NAD6200 module

3.2. Pin description of the board to board connector

The following table describes the pin out of the board to board connector of the NAD6200 Module. For detailed information about the electrical characteristics of every Pin see chapter 3.3.2 Detailed Pin description.

Table 4: Pin description of the board to board connector

PIN	Signal	Direction related to NAD6200	Comment
1	VPH_PWR	Input Power	Main Power
2	GND	Input Power	Power GND
3	VPH_PWR	Input Power	Main Power
4	GND	Input Power	Power GND
5	VPH_PWR	Input Power	Main Power
6	GND	Input Power	Power GND
7	KPD_POWER	IN / active low	NAD6200 switch on input
8	VREG_MSME	Output Power	Output power
9	USIM_RST	Output	SIM – Card reset
10	USIM_CLK	Output	SIM – Card clock
11	VREG_USIM	Output Power	Output power to SIM – Card
12	USIM_DATA	IN/OUT	SIM – Card data
13	GPIO_73	I/O	GPIO
14	GPIO_69	I/O	GPIO
15	GPIO_32_GSBI_1_0	Output	4 - Pin – UART – Ready for receive 1
16	RES_IN	IN	Force a reset, shut down the PMIC
17	GPIO_35_GSBI_1_3	Output	4 - Pin - UART - TX 1
18	GPIO_33_GSBI_1_1	Input	4 - Pin - UART - clear to send 1
19	GPIO_30_GSBI_0_2	Input	2 - Pin - UART - RX 2
20	GPIO_34_GSBI_1_2	Input	4 - Pin - UART - RX 1
21	GPIO_47_GSBI_4_3	Output	I²S - Master Clock
22	GPIO_31_GSBI_0_3	Output	2 - Pin - UART - TX 2
23	USB_DP	IN/OUT	High – Speed USB Device for communication
24	USB_VBUS	Input Power	High – Speed USB Device for communication
25	USB_DM	IN/OUT	High – Speed USB Device for communication
26	GND_USB	Power	High – Speed USB Device for communication
27	GPIO_38_GSBI_2_2	Output	I²S - Master Clock
28	GPIO_37_GSBI_2_1	Output	I²S - word select
29	GPIO_36_GSBI_2_0	Output	I²S - clock
30	GPIO_39_GSBI_2_3	Input	I²S - data input
31	GPIO_42_GSBI_3_2	Input	2 – Pin – UART – RX 3
32	GPIO_43_GSBI_3_3	Output	2 – Pin – UART – TX 3
33	GPIO_40_GSBI_3_0	Output	I²C – seriel clock
34	GPIO_41_GSBI_3_1	IN/OUT	I²C – serial data

35	GPIO_17	Output	NAD-WAKEUP
36	GPIO_14	Output	Codec Reset
37	GPIO_46_GSBI_4_2	Output	I²S – data output
38	GPIO_9	Input	NAD-UPDATE
39	GPS_ANT_OVERVOLT	OUT / active low	Detection of GPS – Antenna short against + 12 V
40	EXT_5V5	Input Power	Power for inside GPS – Antenna LNA

Information about the pin connector and mating connector:

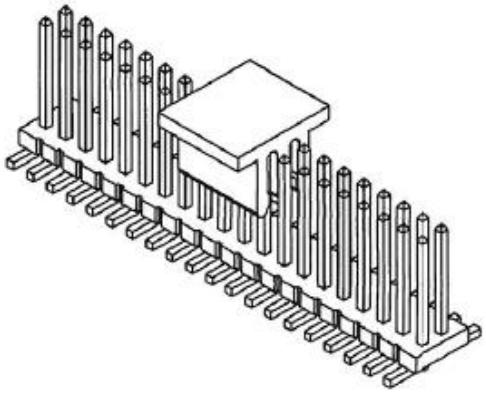
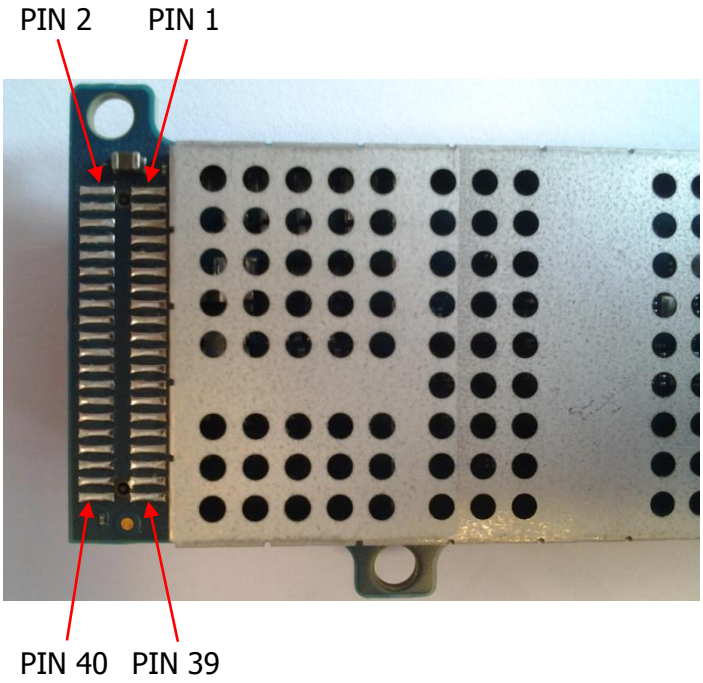


Figure 2: board to board pin connector

Figure 3: Mating connector

For detailed information about board to board pin connector see reference 1 and for mating connector see reference 2. Both are in the Table 1: References.



3.3. HW – Features

3.3.1. W-WAN connectivity

3.3.1.1. GSM/EDGE

- EGSM850,900 Class 4 (2W)
- GSM1800, 1900 Class 1 (1W)
- EDGE850, EDGE900 Class E2 (0.5W)
- EDGE1800, EDGE1900 Class E2 (0.4W)
- GPRS/EDGE Multi slot class 12
- DTM Multi slot class 11

3.3.1.2. UMTS/WCDMA

UMTS / WCDMA are the 3rd generation of mobile telecommunication standard worldwide. HSPA are only an extension of UMTS / WCDMA.

- WCDMA up to 384 kb/s at uplink/downlink
- UMTS to GSM handover for both voice and data
- HSPA:
  HSDPA: Downlink with at least 14.4. Mbit/s
  HSUPA: Uplink with at least 5.7 Mbit/s

Three different license configurations are realizable for Peiker NAD6200:

- UMTS Standard with Downlink Rate 384 kBit/s as license option (LDR)
- UMTS HSDPA with Downlink Rate 3.6 MBit/s as license option
- UMTS HSDPA+ with Downlink Rate 14.4 MBit/s as license option

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3.3.1.3. GNSS

GNSS is used for detection of the position and navigation. In the moment two systems are exist the American version GPS and the Russian version GLONASS.
The NAD6200 support GPS and GLONASS.

The MDM GNSS RF receiver performance is adequate to ensure compliance to the applicable standards.

3.3.1.3.1. GPS

Table 5: Features of the GPS

Feature	Value	Comment
Acquisition sensitivity – MSA Asynchronous A-GPS	-158 dBm	
Cold – start sensitivity	-145 dBm	
Tracking sensitivity Standalone or MSB	-161 dBm	
Accuracy in open sky	<2m CEP-50	Open sky, 1 Hz tracking
Standalone time to first fix (super hot/warm/cold/weak signal)	1s / 29s / 32s / 50s	

3.3.1.3.2. GLONASS

Table 6: Characteristics of GLONASS

Feature	Value		comment
Tracking sensitivity 98%	-155.3 dBm	-155.3 dBm	Probability of detection (Pdet) = 0.98 Probability of false alarm (Pfa) = $1e^{-3}$
Tracking sensitivity 98 % normalized to 2.5 dB NF	-158.2 dBm	-158.8 dBm	
Predicted Mission mode tracking sensitivity normalized to 2.5 dB NF, Pdet = 50%	-160.3 dBm	-160.9 dBm	

3.3.2. Detailed Pin description

3.3.2.1. Power Supply

The NAD6200 Module has 3 Pins (PIN 1, PIN 3 and PIN 5) for the Main Power Supply Voltage (VPH_PWR) and 3 Pins (PIN 2, PIN 4, PIN 6) for the Power Ground (GND).

3.3.2.1.1. Absolute maximum values

Voltage supply	3.4….4.2 V
Current supply	2.5 A @ peak
Temperature range	-40°C…+85°C

3.3.2.1.2. Nominal values

Table 7: nominal values of the NAD6200 - module

Parameter	Min	Typ	Max	Unit
Voltage supply	3.7	3.8	3.9	V
Current supply			2.5	A
Voltage drop @ GSM power burst (33 dBm) for an external voltage regulator			100	mV

3.3.2.2. KPD_Power

3.3.2.2.1. Description

This signal is used to switch on the NAD6200 module.
After the main power VPH_Power (3.8V) is applied to the NAD6200 module, the module will not start automatically. To start the power regulators of the module KPD_Power must be pulled against ground for at least 60 ms.
KPD_POWER input has an internal weak pull up against VPH_Power. Due to this fact it is recommended to pull the input against GND using an open drain or open collector circuit.
Because of EMC constraints it might be necessary to add an additional stronger pull up against the VPH_Power.
It is also possible to connect the KPD_Power input directly to Ground. In this case the module will start up immediately after VPH_Power turned on.

3.3.2.2.2. Electrical characteristics

Table 8: Electrical characteristics of KPD_Power

PIN	Parameter	Comment
7	KPD_POWER	Pull down with open Collector

3.3.2.3. RES_IN

3.3.2.3.1. Description

The reset input can be used either to switch off the module or to reset the module. In case that the module is already powered on and the KPD_Power is in pull up state this signal must be driven against ground for 250 ms to switch off the module. The module will remain switched off until the reset signal is released to pull up state and until there is no new KPD_Power on sequence.
In case of that the KPD_Power pin is connected directly to ground the internal regulators of the module will also switch off, but only for a few ms and then a new power on sequence starts automatically.
RES_IN input has an internal weak pull up against VREG_MSME (1.8V). Due to this fact it is recommended to pull the input against GND using an open drain or open collector circuit.
Because of EMC constraints it might be necessary to add an additional stronger pull up against the VREG_MSME (1.8V).

3.3.2.3.2. Electrical characteristics

Table 9: Electrical characteristics of RES_IN

PIN	Parameter	Comment
16	RES_IN	Pull down with open Collector

3.3.2.4. VREG_MSME

3.3.2.4.1. Description

VREG_MSME is provided by an internal regulator of the NAD6200 module. VREG_MSME can be used to source interface circuits like level shifters which are connected to the interfaces or GPIOs of the NAD6200 module.

The current drawn on VREG_MSME shall not exceed 30 mA. When using VREG_MSME it is recommended to decouple the signal with a combination of 1 µF and 22 pF directly at the board to board connector.

3.3.2.4.2. Electrical characteristics

Table 10: Electrical characteristics of VREG_MSME

PIN	Parameter	Min	Max	Unit	Comment
8	VREG_MSME		1.8	V	
			30	mA	

3.3.2.5. SIM Card

3.3.2.5.1. Description

The SIM interface of the NAD6200 module is compatible to 1.8 V and 3 V SIM Cards. Necessary voltage and level shifting is handled by NAD6200 module automatically. The SIM interface consists of the following signals:

- VREG_USIM: SIM Supply Voltage
- USIM_CLK: SIM clock signal
- USIM_DATA: SIM data signal
- USIM_RESET: SIM reset signal
- GPIO69: SIM Present Signal[9]

The data speed on the SIM interface is up to 4 Mbit. Hardware designer should take care of the length and routing of the SIM interface to prevent potential problems.

[9] : Software doesn´t support this feature at the moment.

3.3.2.5.2. Electrical characteristics

Table 11: Electrical characteristics of SIM Interface

PIN	Parameter	Min	Max	Unit	Comments
11	VREG_USIM		2.85 / 1.8	V	
			150	mA	
10	USIM_CLK		2.85 /1.8	V	
12	USIM_DATA		2.85 /1.8	V	Pull up 22 kΩ against VREG_USIM is required
9	USIM_RESET		2.85 /1.8	V	
14	SIM Present Signal – GPIO69		1.8	V	Is not supported yet

3.3.2.6. USB

3.3.2.6.1. Description

The NAD6200 module has one USB 2.0 high speed compliant interface with built-in PHY.

The USB Interface consists of 4 signals:
- USB_DP: USB Data Plus signal
- USB_DM: USB Data Minus signal
- USB_VBUS: USB Voltage Supply
- USB_GND: USB Ground

The NAD6200 module is configured as USB – Device on the NAD6200 PCB.
This Interface supports the following data rates:
- At low – speed: 1.5 Mbit/s
- At full – speed: 12 Mbit/s
- At high – speed: 480 Mbit/s

3.3.2.6.2. Electrical characteristics

Table 12: Electrical characteristics of USB Interface

PIN	Parameter	Min	Max	Unit	Comment
23	USB_DP		3.3	V	
25	USB_DM		3.3	V	
24	USB_VBUS	2	5.25	V	It is impossible to supply the module with USB_VBUS only.
			5	mA	
26	USB_GND				

If there is a requirement that the system must power the USB_VBUS while the module is not switched on, it is strictly recommended to limit the USB_VBUS current to the module by a serial resistor of 22 KΩ.

The Pin USB_VBUS must be supply a Minimum voltage about 2 V with the serial resistor.

3.3.2.7. GPIOs

3.3.2.7.1. Description

There are 21 GPIOs on the board to board connector of the NAD6200 module. Most of them are part of 5 GSBIs and are used for different interfaces (see Table 4 and the following chapters).

For dissenting configurations of the GPIOs/GSBIs please contact Peiker acustics GmbH & Co.KG

GPIOs and GSBIs share the same output pins and may not available when used as GSBI configuration.
The following GPIOs are not belonging to a GSBI bundle:
GPIO 9, 14, 69, 17, 73

The following GPIOs are belonging to a GSBI bundle:
GPIO 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 46, 47

Available signals on GSBI bundles at the board to board connector:

- GSBI0: GSBI0_2, GSBI0_3 (GPIO_30, 31)
- GSBI1: GSBI1_0, GSBI1_1, GSBI1_2, GSBI1_3 (GPIO_32, 33, 34, 35)
- GSBI2: GSBI2_0, GSBI2_1, GSBI2_2, GSBI2_3 (GPIO_36, 37, 38, 39)
- GSBI3: GSBI3_0, GSBI3_1, GSBI3_2, GSBI3_3 (GPIO_40, 41, 42, 43)
- GSBI4: GSBI4_2, GSBI4_3 (GPIO_46, 47)

For the standard configuration of the GSBIs see the following Figure 4.

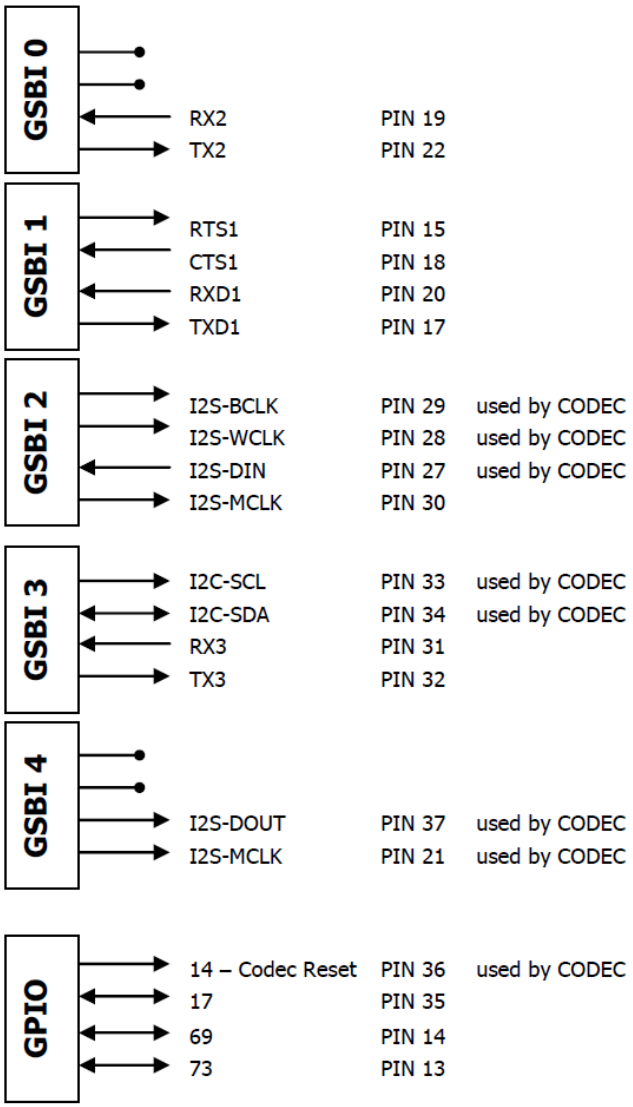

Figure 4: Pin description of GSBIs

For other configuration of the GSBIs please contact Peiker acustics GmbH & Co.KG.

3.3.2.7.2. Electrical characteristics

Table 13: Electrical characteristics of GPIOs

PIN	Parameter	Min	Max	Unit	Comment
13	GPIO_73		1.8	V	
14	GPIO_69 - SIM Present Signal		1.8	V	Not implemented yet. Pull down 1 kΩ against Ground
35	GPIO_17 – NAD-WAKEUP		1.8	V	
36	GPIO_14 – Codec reset		1.8	V	

38	GPIO_9 – NAD-UPDATE		1.8	V	Pull up 10 kΩ against 1.8 V

The following table is valid for all GPIOs and digital inputs and outputs.

Table 14: Definition of High - and Low - Level for digital inputs and outputs

Parameter		Min	Typ	Max	Unit
V_{IH}	High-level input voltage	0.65*1.8		1.8+0.3	V
V_{IL}	Low-level input voltage	-0.3		0.35*1.8	V
V_{SHYS}	Hysteresis voltage	100			mV
V_{OH}	High-level output voltage	1.8-0.45		1.8	V
V_{OL}	Low-level output voltage	0		0.45	V

3.3.2.8. UART

3.3.2.8.1. Description

The GPIOs 30, 31 and 42, 43 are configured as a 2 – Pin - UART and the GSBI1 are configured as a 4 – Pin - UART. It is used for the following applications:

- The UART 1 is used for the communication between the NAD6200 module and a CAN Controller
- The UART 2 is used for log and trace
- The UART 3 is used for test and debug of the NAD6200 module

3.3.2.8.2. Electrical characteristics

Table 15: Electrical characteristics of UART Interfaces

PIN	Parameter	Min	Max	Unit
19	UART – RX2		1.8	V
22	UART – TX2		1.8	V
31	UART – RX3		1.8	V
32	UART – TX3		1.8	V
15	UART – RFR1		1.8	V
17	UART – TX1		1.8	V
18	UART – CTS1		1.8	V
20	UART – RX1		1.8	V

3.3.2.9. I²C

3.3.2.9.1. Description

The I²C – Interface is used for the communication between the CODEC and NAD6200 Module.

3.3.2.9.2. Electrical characteristics

Table 16: Electrical characteristics of I²C

PIN	Parameter	Min	Max	Unit
33	Seriel clock		1.8	V
34	Seriel data		1.8	V

3.3.2.10. I²S

3.3.2.10.1. Description

The I²S interface is used to transfer serial digital audio to/from an external stereo DAC/ADC. This interface is a 3 – wire interface:
- Serial clock
- Word select
- Serial data

I²S supports all the Tx/Rx slave/master modes:
- Transmitter – master
- Transmitter – slave
- Receiver – master
- Receiver – slave

Master or slave is determined by the device driving the serial clock and word select. The transmitter sends data to the receiver.

Bidirectional I²S support is supported by configuring two of the five GSBI ports as I²S; one GSBI as transmitter and the second GSBI as receiver. Two options are possible:
- Option 1: MDM as master (transmitter or receiver) and slave (transmitter or receiver); external device as slave. The MDM transmitter and receiver cannot both be the master at the same time as there will be data contention.
- Option 2: Both MDM transmitter and receiver are slave; external device as master.

At the standard configuration the NAD6200 module is master and the Codec slave. For other configuration please contact Peiker acustics GmbH & Co.KG.

3.3.2.10.2. Electrical characteristics

Table 17: Electrical characteristics of I²S

PIN	Parameter	Min	Max	Unit
27 / 21	Master Clock		1.8	V
28	Word Select		1.8	V
29	Clock		1.8	V
30	Data input		1.8	V
37	Data output		1.8	V
36	GPIO_14 – codec reset		1.8	V

3.3.2.11. GPS Pins

3.3.2.11.1. Description

The PIN GPS_ANT_OVERVOLT and EXT_5V5 are reserved for use of the internal GPS of the NAD6200 module.
The PINs should be grounded when not used in the design.

3.3.2.11.2. Electrical characteristics

Table 18: Electrical characteristics of GPS Pins

PIN	Parameter	Min	Max	Unit	Comment
39	GPS_ANT_OVERVOLT	-	-	-	Open Collector, Pull up 47 kΩ against 3.3 V
40	EXT_5V5		5.5	V	
			100	mA	

3.3.3. Antenna

3.3.3.1. Antenna connector

The NAD6200 - module can be equipped with three antenna connectors. One connector is for the main antenna, second connector is for the backup antenna and third connector is for the GNSS antenna. See the following Figure 5: Antenna connectors.

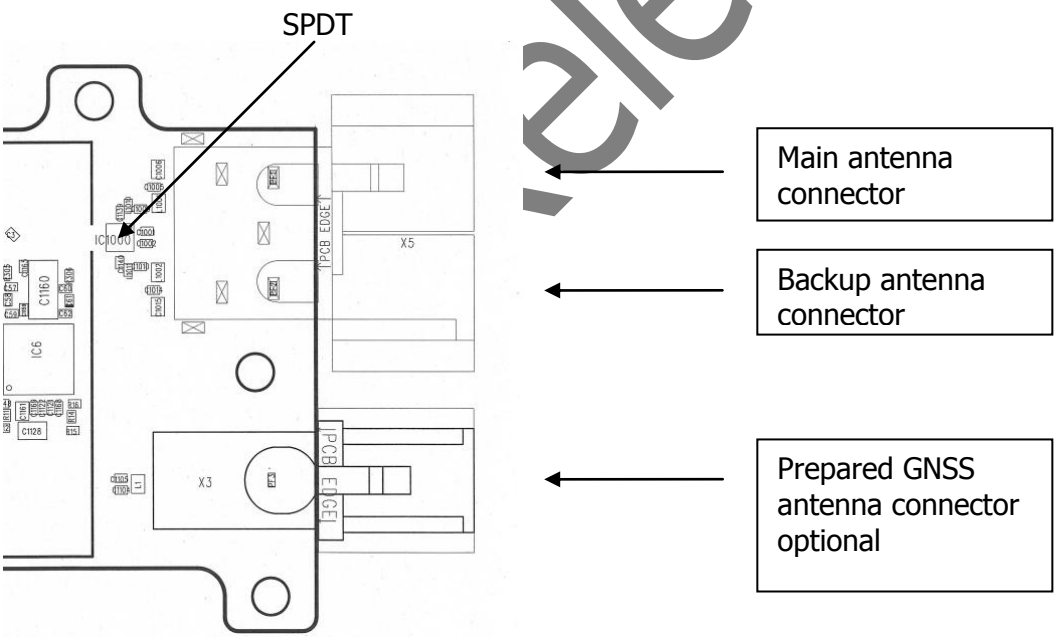

Figure 5: Antenna connectors

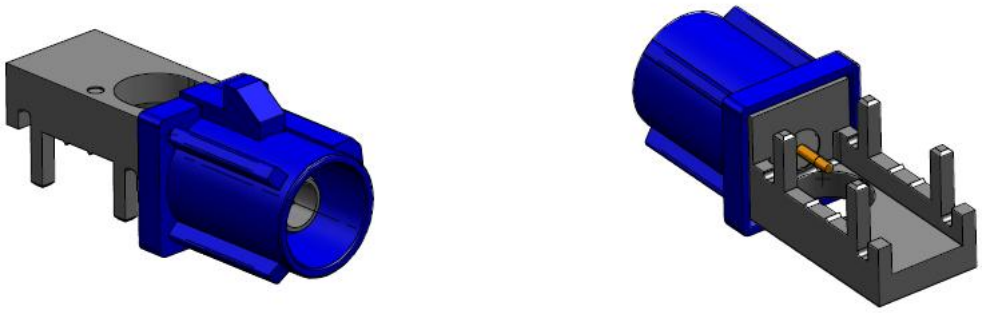

Figure 6: FAKRA HF Single connector

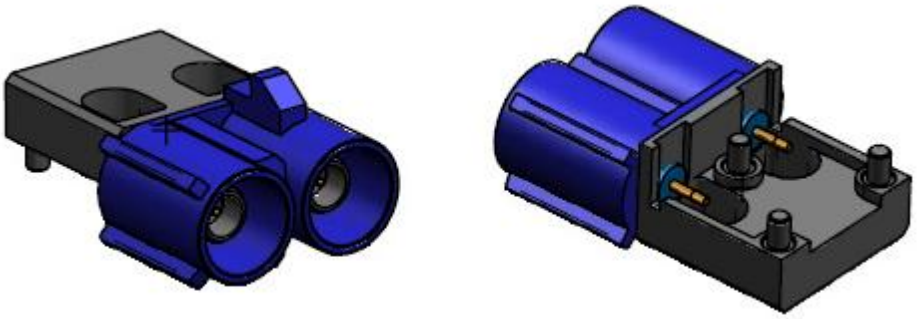

Figure 7: FAKRA HF Dual connector

For detailed information see the datasheet of those connectors. The device numbers of connectors see the reference 3 and 4 at the Table 1: References.

3.3.3.2. Antenna Switching

For switching between main and backup antenna a RF – switch SPDT is soldered on the PCB of the NAD6200 – module. The switch is controlled by two GPIO´s. The following Table 19 shows 4 switch combinations.

Table 19: switch combinations

GPIO_55	GPIO_56	Antenna	Comment
Low	Low	None	Whole transmission power would be reflected
Low	Hi	Main	Outside antenna connector
Hi	Low	Backup	Inside antenna connector
Hi	Hi	Both	Mismatching

The switching between different states must be synchronized with QCT software, because it is not allowed to switch between main and backup antenna during the GSM transmission pulse.
The state GPIO_55 = Hi and GPIO_56 = Hi is not allowed and have to avoid via software.

At the moment the main antenna is switched on by default. The main antenna is mapped to SMB connector close to outer dimension of the NAD6200 – module.

3.3.3.3. Antenna diagnostics

The diagnostic is supported for the main and backup antenna. The following states have to diagnose:
a) Antenna connected
b) No antenna connected
c) Antenna has a short-circuit against ground
d) Antenna has a short-cicuit against +Ubatt

The hardware is implemented for the diagnostic for both antenna on the PCB of the NAD6200 – module. This hardware is connected to the PM8028. Main antenna is connected to MPP_08 and backup antenna is connected to MPP_07.

The following expected voltage level is see at the ADC input with an external resistor R = 10 kOhm: (ADCref = 2.2 V)

For a) about 850 mV
For b) about 1150 mV
For c) about 390 mV
For d) about 1900 mV

3.3.4. Chipset MDM6200 + PM8028

The NAD Module included a Chipset from Qualcomm. This Chipset consist of the power manager PM8028 and mobile data modem MDM6200.

3.3.4.1. PM8028

The PMIC monitors and controls the power sources, detecting which sources are applied and verifying that they are within acceptable operational limits. Thermal conditions of the integrated pass transistor and its total current are monitored and reported to a state machine that coordinates PM operations.

Other input power management circuits provide VDD or VBAT voltage regulation, current monitoring and over – current protection, VDD collapse protection, under – voltage lockout protection, and automated recovery from sudden momentary power loss (SMPL).

On – chip voltage regulators generate 24 programmable output voltages using a combination of four switched – mode power supplies, 19 low – dropout linear regulators.

3.3.4.2. MDM6200

The MDM6200 is a mobile data modem IC. They have the following functions:

- *Baseband functions:*
  Processors
  Memory support
  Connectivity
  Air interfaces
  Internal BB functions
  Interfaces with other functions

General – purpose I/Os

- *RF functions:*
  RF transmitter (including supporting analog and LO circuits)
  RF receiver (including supporting analog and LO circuits)

3.3.5. Memory

The NAD6200 – module has one 1 Gb NAND Flash + 512 Mb Mobile DDR SDRAM memory.

For more detailed information about the memory device see the datasheet of K521H12ACI-B050.

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4. Application software

Tbd

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5. Antenna characteristics

5.1. Electrical characteristics for the Antenna

The end user is responsible to take care of the fulfillment of the "over the air performance" (OTA) of his end product.
OTA performance will be influenced mainly by the RF routing from the module to the antenna and antenna choice. If external switches or splitters are necessary signal attenuation and degradation has to be considered.
Regulatory requirements will give details on measurements and the corresponding limits.
As an example 3GPP requirements are found in TS34.114 (user equipment/mobile station Over The Air antenna performance; Conformance testing).

5.2. Electrical characteristics for the Bands

5.2.1. Frequencies

Table 20: Frequencies of supported WCDMA Bands for uplink

Band	Min	Typ	Max	Unit
WCDMA BC1	1920	-	1980	MHz
WCDMA BC2	1850	-	1910	MHz
WCDMA BC5	824	-	849	MHz
WCDMA BC8	880	-	915	MHz

Table 21: Frequencies of supported WCDMA Bands for downlink

Band	Min	Typ	Max	Unit
WCDMA BC1	2110	-	2170	MHz
WCDMA BC2	1930	-	1990	MHz
WCDMA BC5	869	-	894	MHz
WCDMA BC8	925	-	960	MHz

Table 22: Frequencies of supported GSM Bands (Uplink)

Band	Min	Typ	Max	Unit
GSM 850	824	-	849	MHz
GSM 900	876	-	915	MHz
GSM 1800	1710	-	1785	MHz
GSM 1900	1850	-	1910	MHz

Table 23: Frequencies of supported GSM Bands (Downlink)

Band	Min	Typ	Max	Unit
GSM 850	869	-	894	MHz
GSM 900	921	-	960	MHz
GSM 1800	1805	-	1880	MHz
GSM 1900	1930	-	1990	MHz

5.2.2. Power Consumption, Call

Table 24: Power Consumption @ TA = +25°C, VPH_PWR = 3.8 V, P = 23 dBm

Band	Condition	Min	Typ	Max	Unit
WCDMA BC1	REL 99	-	584	-	mA
WCDMA BC2		-	607	-	mA
WCDMA BC5		-	620	-	mA
WCDMA BC8		-	607	-	mA

Table 25: Power Consumption @ TA = +25°C, VPH_PWR = 3.8 V, P = 10 dBm

Band	Condition	Min	Typ	Max	Unit
WCDMA BC1	REL 99	-	192	-	mA
WCDMA BC2		-	196	-	mA
WCDMA BC5		-	184	-	mA
WCDMA BC8		-	297	-	mA

Table 26: Power Consumption @ TA = +25°C, VPH_PWR = 3.8 V, P = 0 dBm

Band	Condition	Min	Typ	Max	Unit
WCDMA BC1	REL 99	-	145	-	mA
WCDMA BC2		-	147	-	mA
WCDMA BC5		-	139	-	mA
WCDMA BC8		-	143	-	mA

Table 27: Power Consumption @ TA = +25°C, VPH_PWR = 3.8 V, Single Slot

Band	Condition	Min	Typ	Max	Unit
GSM 850	PCL = 5, P = 33 dBm	-	324	-	mA
	PCL = 19, P = 5 dBm	-	117	-	
GSM 900	PCL = 5, P = 33 dBm	-	332	-	mA
	PCL = 19 P = 5 dBm	-	118	-	
GSM 1800	PCL = 0 P = 30 dBm	-	223	-	mA
	PCL = 15 P = 0 dBm	-	117	-	
GSM 1900	PCL = 0 P = 30 dBm	-	223	-	mA
	PCL = 15 P = 0 dBm	-	117	-	

Table 28: Idle current for GSM and WCDMA

Parameter	Condition	Min	Typ	Max	Unit
Idle current	GSM 900, DRX = 5, V_{dd} = 3.8 V		2.7		mA

Idle current	WCDMA BC1, DRX = 8, V_{dd} = 3.8 V		2.2		mA

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6. Environmental Specification

6.1. General information

- Storage Temperature -40°C - +85°C
- Handling ESD – human body rating specified with max. 2 KV

6.2. Temperature Range

Table 29: Operating temperature range

Range		
Operating temp. range	-30°C … +70°C	3GPP spec. conform
Operating temp. range	-40°C … +85°C [10]	Operational Performance might slightly deviate from 3GPP spec.

[10]: Due to temperature specification of the chipset, the temperature of the power manager and the temperature of the modem chip shall not exceed +85°C.

7. Mechanical Specification

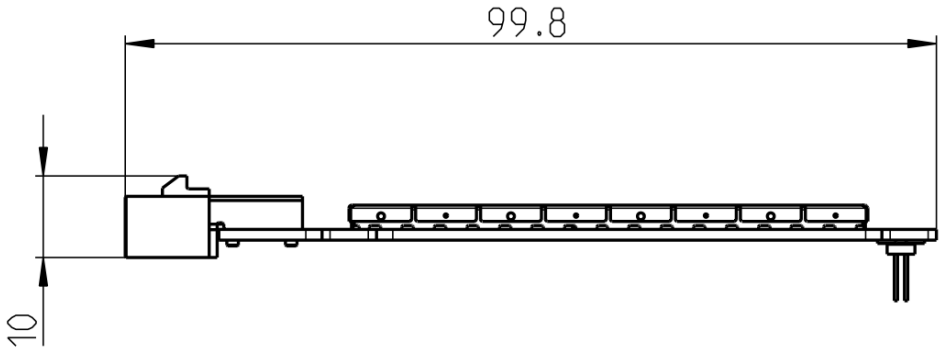

Figure 8: Mechanical dimensions of the NAD6200 module

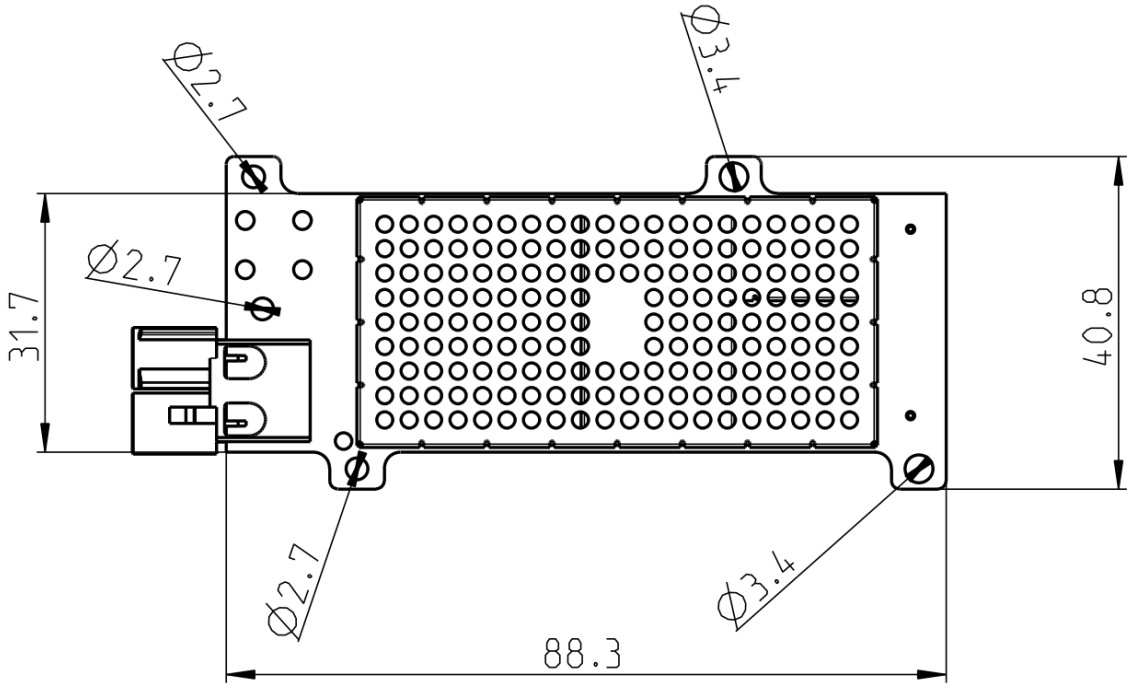

Figure 9: Mechanical dimensions of the NAD6200 module (top view)

8. Safety Recommendations according to EN60950-1

This device must be supplied by a limited power source according to EN 60950-1.
The clearance and creep age distances required by the end product must be withheld when the module is installed.
The cooling of the end product shall not negatively be influenced by the installation of the module.

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9. Evaluation Kit

For the NAD6200 – module there is an evaluation board available.

They have the following features:

- On beard 12 V DC power Supply or 3.8 V DC direct connected (unbuffered)
- USB 2.0 port type B
- SIM card tray
- 40 pin header connected to the board to board connector of the NAD6200 – module.
- 3 GSBI ports connected to DB9 or pin header.

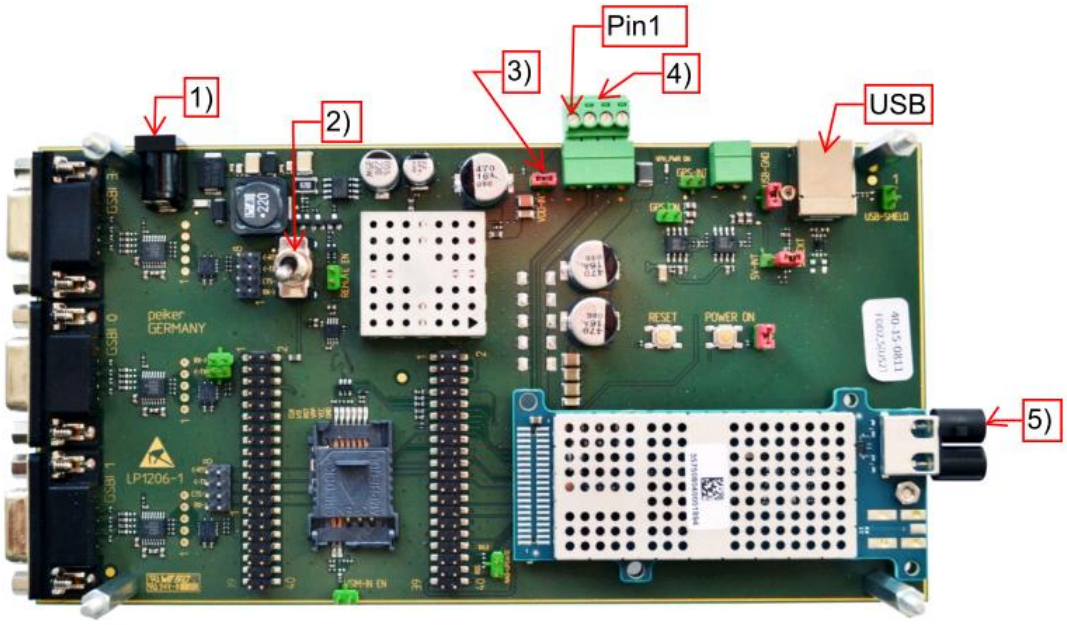

Figure 10: Evaluation Kit for NAD6200 module

Using the evaluation board with on board 3.8 V regulator:

- Connect between 11 and 14 V DC to power connector 1) by using delivered cable
- Power up on the board with switch 2)

Using the evaluation board with an external power supply:

- Remove Jumper 3)
- Switch 2) to off condition
- Connect external supply between 3.6 and 4.0 V DC to connector 4)
- Connector 4) Pin out: Pin 1: GND
  Pin 2: Sense GND
  Pin 3: Sense V+
  Pin 4: V+

Note: Make sure that the external power supply is not generating spikes or hazards higher than 4.2 V. NAD6200 module gets damaged when spikes or hazards are above 4.2 V.

RF Connector:

For RF measurements use main antenna connector 5)

AT Command interface:

The module supports standard AT command as listed in the chapter 10.1 AT Command list.
Commands are compliant to: 3GPP TS 27.007
3GPP TS 27.005

10. Appendix

10.1. AT Command list

Table 30: AT Command list with description

Command	Description	Comment
AT+CMGF	Message Format	
AT+CSCA	Service Centre Address	
AT+CMGS	Send Message	
AT+CGMI	Manufacturer Identification	
AT+CGMM	Request model identification	
AT+CGMR	Request revision identification	
AT+CGSN	Request product serial number	
AT+CIMI	Request international mobile subscriber identification	
AT+CMOD	Call mode	Only one Parameter is supported by the device.
AT+CHUP	Hang up call	
ATD	Initiate a CS or PS call or supplementary service	
ATA	Answer incoming CS call command	
ATH	Hang-up CS call command	
AT+CBST	Select bearer service type	
AT+CEER	Extended error report	
AT+CVHU	Voice hang-up control	
AT+CREG	Network registration	
AT+COPS	PLMN selection	
AT+CLCK	Facility lock	
AT+CPWD	Change password	
AT+CLIP	Calling line identification presentation	
AT+CLIR	Calling line identification restriction	
AT+CCWA	Call waiting	
AT+CHLD	Call related supplementary services	
AT+CUSD	Unstructured supplementary service data	
AT+CLCC	List current calls	
AT+CPOL	Preferred PLMN list	
AT+CPAS	Phone active status	
AT+CFUN	Set phone functionality	
AT+CPIN	Enter PIN	
AT+CSQ	Signal quality	
AT+CMER	Mobile termination event reporting	
AT+CSIM	Generic SIM access	
AT+CRSM	Restricted SIM access	
AT+CMEE	Report mobile termination error	
AT+CGDCONT	Define PDP context	
AT+CGEQREQ	Request 3G quality of service profile	
AT-CGATT	PS attach or detach	

Command	Description	Comment
AT+CGACT	PDP context activate or deactivate	
AT+CGPADDR	Show PDP address	
AT+CGSMS	Select service for MO SMS messages	
ATE	Character Echo ON/OFF	
AT+CSMS	Check Message Service support	
AT+CSMP	Set Text Mode Parameters	
AT+CSDH	Show Text Mode Parameters	
AT+CSCB	Select Cell Broadcast Message Types	
AT+CSAS	Save Settings	Only one Parameter is supported by the device.
AT+CRES	Restore Settings	Only one Parameter is supported by the device.
AT+CMGL	List messages	
AT+CNMA	New message acknowledgement	
AT+CMGC	Send Command	
AT+CMMS	More Messages to Send	
AT+ATV	DCE response format	
AT+ATX	Result code selection and call progress monitoring control	
AT+CNMI	New Message Indications to TE	
AT+CPMS	Preferred Message Storage	
AT+CMGW	Write Message to Memory	
AT+CMSS	Send Message from Storage	
AT+CMGD	Delete Messages	
AT+CNUM	Get MSISDN	
AT+CPBS	Select phonebook memory storage	
AT+CPBR	Read phonebook entries	
AT+CPBW	Write phonebook entry	

10.2. Warning Statements

FCC

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

(c) The provisions of paragraphs (a) and (b) of this section do not apply to digital devices exempted from the technical standards under the provisions of § 15.103.

(d) For systems incorporating several digital devices, the statement shown in paragraph (a) or (b) of this section needs to be contained only in the instruction manual for the main control unit.

(e) In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

OEM responsibility to the FCC rules and regulations

The US variant without GNSS of the NAD 6200 module is labeled with its own FCC ID Number and IC ID Number. If the FCC ID is not visible when the NAD6200 module is installed inside another device, then the host device must contain the FCC ID number with the statement such as the following: "Contains Transmitter Module FCC ID: QWY-PNADA or Contains FCC ID: QWY-PNADA".

The US variant with GNSS of the NAD 6200 module is labeled with its own FCC ID Number and IC ID Number. If the FCC ID is not visible when the NAD6200 module is installed inside another device, then the host device must contain the FCC ID number with the statement such as the following: "Contains Transmitter Module FCC ID: QWY-PNADB or Contains FCC ID: QWY-PNADB".

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by peiker acustic GmbH & Co. KG could void the user's authority to operate the equipment.

RF Exposure Warning:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minium distance 20 cm between the radiator and your body. This transmitter must not be co-located or Operating in conjunction with any other antenna or transmitter.

Notice:

The preceding statement must be included as a Caution statement in OEM product manuals in order to alert users of FCC RF Exposure compliance.

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IC Canada

This Class b digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe b est conforme à la norme NMB-003 du Canada.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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