

Nomad Digital

R4600 GEN2 Communications Control Unit

User's Manual

Revision History

Revision	Change	Date
0.1	Initial version	Nov. 2, 2018

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1 NDL requirements

1.1 Power

Floating wide range DC input to support EN50155:2017 and ignition input to control system power plus initiate graceful operating system shutdown. The ignition control signal is to be referenced to input supply voltage as requested by NDL and is detailed in Section 2 Product Specifications. A flow diagram is shown under 6.2 power ignition control.

A TVS diode is fitted between the plus and minus power inputs, there are no voltage clamping devices between these inputs and the chassis. A standard 1000VAC voltage withstand test with shorted plus – minus is supported.

From EN 50155:2017:-

13.4.9.3 Voltage withstand test

Nominal battery voltage and/or I/O voltage	Test voltage
$72\text{ V DC} \leq V\text{ DC} < 125\text{ V DC}$ or from 50 to 90 V AC rms	1 000 V AC or 1 500 V DC

1.2 Expansion

The unit is equipped with four mPCIe slots, two m.2 slots from I/O board and one m.2 slot from the motherboard as detailed in Section 2.

Two m.2 slots from the modem area (Section 5.1 location M.2-1 & M.2-2) provide USB 3.0 signaling and one m.2 from the motherboard provides USB3.0 and SATA signaling for a storage device.

Two mPCIe slots with USB 3.0 signaling (Section 5.1 mPCIe-3 & mPCIe-4) will be configurable to support isolation of pins 22, 28 and 48 using dipswitches, this is to allow fitment of modems requiring these pins to be left open.

Two mPCIe slots with USB 2.0 and PCIe x1 signaling (Section 5.1 mPCIe-5 & mPCIe-6) will follow PCIe mini card spec V1.2.

The expansion slot pin outs have been designed to support mPCIe USB3.0 and M.2 USB3.0.

Installation of internal m.2 storage slot will require removal of the chassis covers. To help prevent damage to the screw head, a torx fitting will be used Torx type M3, F HEAD, L5 and their locations are shown in the chassis underside view under the mechanical drawings section.

Slot	Location	Signal
M.2	I/O board (AFM)	USB 3.0
M.2	I/O board (AFM)	USB 3.0
mPCIe	I/O board (AFM)	USB 3.0
mPCIe	I/O board (AFM)	USB 3.0
mPCIe	I/O board (AFM)	USB 2.0, PCIe x1
mPCIe	I/O board (AFM)	USB 2.0, PCIe x1
M.2	Motherboard (MB)	SATA, USB3.0

1.2.1 Pin-out of mini PCIe slots

Pin #	mPCIe slot 5 & 6 USB 2.0+PCIe x1	mPCIe slot 3 & 4 USB 3.0	Sierra MC7455 module	Telit LM960 module	Notes
Location	AFM	AFM	--	--	
1	MPCIE_5_WAKE_N	Module define	WAKE#	NC	
2	P3V3_SB_MPCIE_5	3V3	VCC	VBATT	
3	NC	NC	ANT_CTRL0/GPIO1	GPIO_01	
4	GND	GND	GND	GND	
5	NC	NC	ANT_CTRL1/GPIO2	GPIO_02	
6	P1V5_MPCIE_5	NC	NC	NC	
7	MPCIE_5_CLKREQ_N	NC	USIM2_RST	PCIE_CLKREQ_N*	*datasheet r7 Information – PCIe bus is currently NOT supported, PCI pins marked with * are for future use only
8	MODEM_SIM5_VSIM	SIM1_PWR	USIM_PWR	SIMVCC1	
9	GND	GND	GND	GND	
10	MODEM_SIM5_DAT	SIM1_DAT	USIM_DATA	SIMIO1	
11	MPCIE_5_CLK_R_N	Module define	VREF_1.8V	PCIE_REFCLK_M*	*datasheet r7 Information – PCIe bus is currently NOT supported, PCI pins marked with * are for future use only
12	MODEM_SIM5_CLK	SIM1_CLK	USIM_CLK	SIMCLK1	
13	MPCIE_5_CLK_R_P	NC	USIM2_PWR	PCIE_REFCLK_P*	*datasheet r7 Information – PCIe bus is currently NOT supported, PCI pins marked with * are for future use only
14	MODEM_SIM5_RST	SIM1_RST	USIM_RST	SIMRST1	
15	GND	GND	GND	GND	
16	NC	NC	NC	SIMVCC2	
17	NC	NC	USIM2_CLK	SIMCLK2	
18	GND	GND	GND	GND	
19	NC	NC	USIM2_DATA	SIMIO2	
20	MPCIE_5_W_DISABLE_L	W1_DISABLE_N(TP)	W_DISABLE#	W_DISABLE_N	
21	GND	GND	GND	GND	
22	MPCIE_5_PERST_N	DIP switch	SYSTEM_RESET#	PCIE_RESET_N*	*datasheet r7 Information – PCIe bus is currently NOT supported, PCI pins marked with * are for future use only
23	AFM_PCIE_RX1_N	U3P1_RXN	USB3.0_TX-	USB_SS_TX_M	
24	P3V3_SB_MPCIE_5	3V3	VCC	VBATT	
25	AFM_PCIE_RX1_P	U3P1_RXP	USB3.0_TX+	USB_SS_TX_P	
26	GND	GND	GND	GND	
27	GND	GND	GND	GND	
28	P1V5_MPCIE_5	DIP switch	NC	VREG_L6_1P8	DIP switch for P1.5V and NC options
29	GND	GND	GND	GND	
30	MPCIE_5_SMB_LS_CLK	NC	NC	I2C_SCL	
31	AFM_PCIE_TX1_N	U3P1_TXN	USB3.0_RX-	USB_SS_RX_M	
32	MPCIE_5_SMB_LS_DAT	NC	NC	I2C_SDA	
33	AFM_PCIE_TX1_P	U3P1_TXP	USB3.0_RX+	USB_SS_RX_P	
34	GND	GND	GND	GND	
35	GND	GND	GND	GND	
36	MPCIE_5_USB2_N	USB-N2_C	USB_D-	USB_D-	
37	GND	GND	GND	GND	
38	MPCIE_5_USB2_P	USB-P2_C	USB_D+	USB_D+	
39	P3V3_SB_MPCIE_5	3V3	VCC	VBATT	
40	GND	GND	GND	GND	
41	P3V3_SB_MPCIE_5	3V3	VCC	VBATT	
42	MPCIE_5_LED_WWAN_N	MPCIE_2_LED_WWAN_N	WAN_LED#	WAN_LED_N	
43	GND	GND	GND	GND	
44	NC	NC	ANT_CTRL2/GPIO3	GPIO_03	
45	NC	NC	NC	GPIO_05	
46	NC	NC	DPR/GPIO4	GPIO_04	
47	NC	NC	NC	GPIO_06	
48	P1V5_MPCIE_5	DIP switch	NC	SYSTEM_RESET_N	
49	NC	NC	NC	GPIO_07	
50	GND	GND	GND	GND	
51	NC	NC	NC	GPIO_08	
52	P3V3_SB_MPCIE_5	3V3	VCC	VBATT	

Remark: background in amber show the pin difference between MC7445 and LM960

Note : Pin 28 Dip Switch only present on Mass production units

1.2.2 Pin-out of M.2 slots

Pin#	M.2 slot 1&2 (for LN940)	M.2 Key B (for SATA)
Location	AFM	MB
1	NGFF_1_CONFIG3	NGFF_CONFIG3
2	P3V3_SB_MPCIE_1	P_+3V3_NGFF
3	GND	GND
4	P3V3_SB_MPCIE_1	P_+3V3_NGFF
5	GND	GND
6	NGFF_1_PWROFF_L	NGFF_PWROFF_L
7	NGFF_1_USB2_P	USB2_NGFF_DP
8	NGFF_1_W_DISABLE_L	NGFF_W_DISABLE_L
9	NGFF_1_USB2_N	USB2_NGFF_DN
10	NGFF_1_WWAN_LED	NC
11	GND	GND
12~19	SLOT KEY	SLOT KEY
20	NC	NC
21	NGFF_1_CONFIG0	NGFF_CONFIG0
22	NC	NC
23	NGFF_1_WAN_WAKE_L	NC
24	NC	NC
25	NGFF_1_DPR	NC
26	NGFF_1_GPS_DISABLE_L	NC
27	GND	GND
28	NC	NC
29	NGFF_1_USB3_R_RX_N	USB3_NGFF_RXN
30	NGFF_1_SIM1_RST	NC
31	NGFF_1_USB3_R_RX_P	USB3_NGFF_RXP
32	NGFF_1_SIM1_CLK	NC
33	GND	GND
34	NGFF_1_SIM1_DAT	NC
35	NGFF_1_USB3_C_TX_N	USB3_NGFF_TXN
36	MODEM_SIM1_VSIM	NC
37	NGFF_1_USB3_C_TX_P	USB3_NGFF_TXP
38	NC	NGFF_DEVSLP
39	GND	GND
40	NGFF_1_SIMDET2	NC

Pin#	M.2 slot 1&2 (for LN940)	M.2 Key B (for SATA)
Location	AFM	MB
41	NC	NGFF_SATA_RXP
42	NC	NC
43	NC	NGFF_SATA_RXN
44	NC	NC
45	GND	GND
46	NC	NC
47	NC	NGFF_SATA_TXN
48	NC	NC
49	NC	NGFF_SATA_TXP
50	NGFF_1_PERST_N	PLTRST_NGFF-L
51	GND	GND
52	NC	NGFF_CLK_REQ-L
53	NC	PCH_PCIE_CLK8_N
54	NGFF_1_PEWAKE_L	NGFF_PCIE_WAKE-L
55	NC	PCH_PCIE_CLK8_P
56	NC	NC
57	GND	GND
58~65	NC	NC
66	NGFF_1_SIMDET	NGFF_SIM_DET
67	NGFF_1_WAN_RESET_L	WWAN_RESET-L
68	NC	NGFF_SUSCLK
69	NGFF_1_CONFIG1	NGFF_CONFIG1
70	P3V3_SB_MPCIE_1	P_+3V3_NGFF
71	GND	GND
72	P3V3_SB_MPCIE_1	P_+3V3_NGFF
73	GND	GND
74	P3V3_SB_MPCIE_1	P_+3V3_NGFF
75	NGFF_1_CONFIG2	NGFF_CONFIG2

1.3 ECC Memory option

There is no current demand for ECC memory – however the main PCB has been designed to support ECC memory. If in the future ECC is required it may be possible to specify a suitable processor, chipset and memory to implement this feature.

Note: ECC CPU support list Intel Skylake CPU i3-6100TE

1.4 Software

The system will support Ubuntu 16.04.6 and Debian 10.0.0 operating systems. The operating system can be installed on either the m.2 2280 motherboard slot, cFast or removable 2.5" SSD device. As standard the



system will be supplied without storage media.

Expansion slots M.2-1, M.2-2 and mPCIe-3 to mPCIe-6 can be powered off or on using the built in PCA-9555 GPIO expander. The GPIO expander is controlled using i2c commands. By default expansion slots M.2-1, M.2-2 and mPCIe-3 to mPCIe-6 are powered on when the system power is on.

User defined LEDs labelled U1 to U8 are controlled using i2c commands to the built in PCA-9555 GPIO expander.

Watchdog facility can be either controlled directly using i2c commands or through the ADLINK SEMA tool.

2 Product Specifications

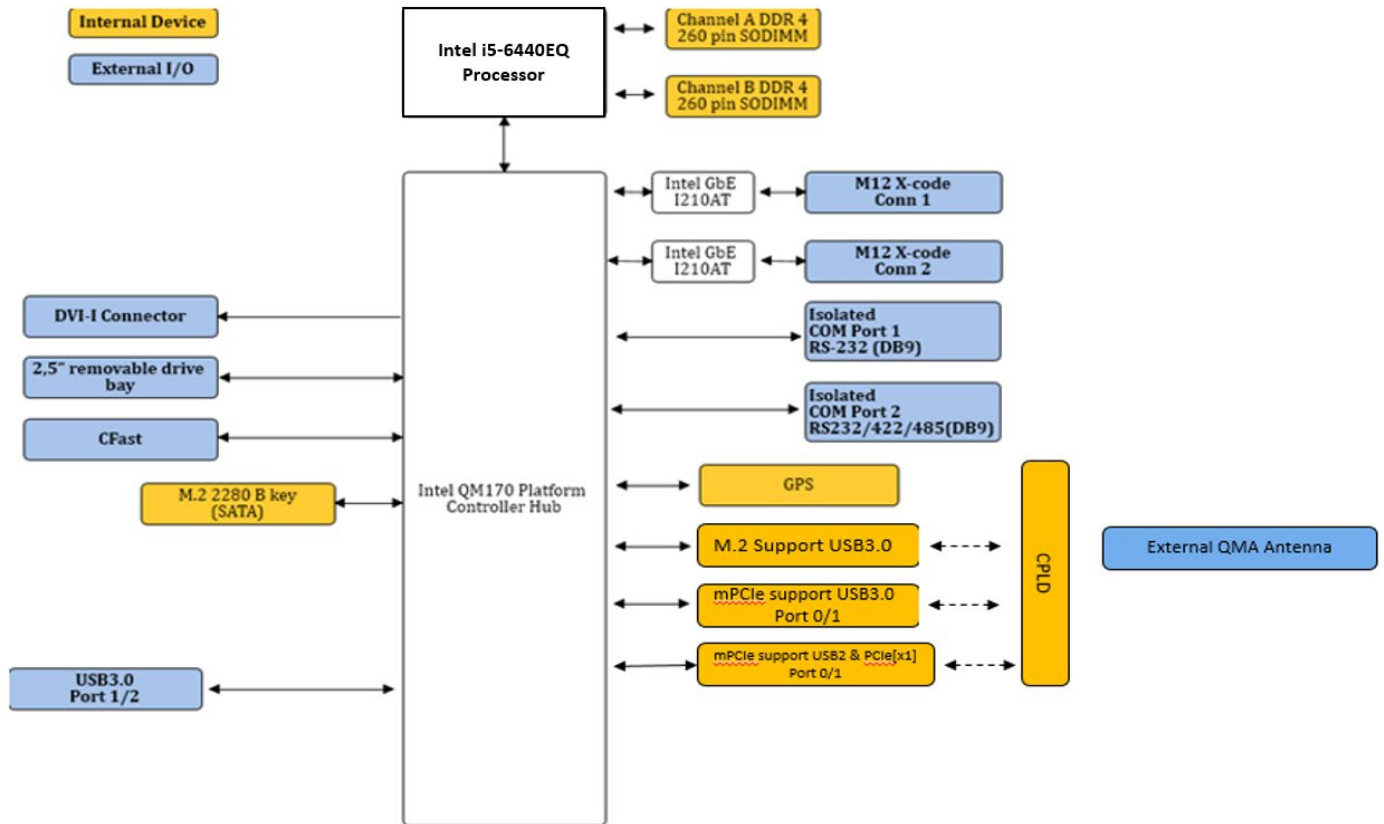
R4600 GEN2 ES2 system specifications

System	Processor	Intel® Core™ i5-6440EQ Processor, Base frequency 2.70GHz, Burst 3.4GHz																					
	Chipset	Intel QM170 Chipset																					
	Memory	Dual Channel DDR4 2133 8GB or 16GB by SODIMM (Up to 32GB)																					
	Storage	1 x 2.5” Removable drive bay 1 x accessible CFast socket 1 x Internal M.2 2280 Socket B key SATA & USB signalling(From MB)																					
	Display	1 x DVI-I for service with white plastic cover																					
	COM	1 x DB-9 RS232 port support console redirection 1 x DB-9 RS-485/422/232 port support auto redirection & auto flow control, RS-232/485/422 is selected by BIOS Both serial ports with 2kV isolation																					
	USB	2x type A USB 3.0 ports																					
	Ethernet	2 x X-coded M12 GbE ports with 2kV isolation																					
	Expansion Slot	2 x mPCIe Compliant to PCI Express® Mini Card Electromechanical Specification Revision 1.2 supporting USB2.0 & PCIe x1 Note : We will populate zero ohm links to pins 28 and 48 as standard on mini PCIe (USB2.0/PCIe)) which can be depopulated if required. 2 x mPCIe support USB 3.0 Note : We will populate dip switches to switch system reset and NC on pins 22 and 48. and we will populate dip switches to switch 1.5V and NC on pins 28, according to LM960 and MC7455 Pin definition <table><thead><tr><th>Pin</th><th>R4600 GEN2 ES2 mPCIe slot 3 & 4</th><th>Sierra MC7455</th><th>Telit LM960</th><th>Notes</th></tr></thead><tbody><tr><td>22</td><td>DIP switch</td><td>SYSTEM_RESET#</td><td>PCIE_RESET_N*</td><td rowspan="3">*r7 Information – PCIe bus is currently NOT supported, PCI pins marked with * are for future use only</td></tr><tr><td>28</td><td>DIP switch</td><td>NC</td><td>VREG_L6_1P8</td></tr><tr><td>48</td><td>DIP switch</td><td>NC</td><td>SYSTEM_RESET_N</td></tr></tbody></table> 2 x M.2 3042 Key B USB 3.0				Pin	R4600 GEN2 ES2 mPCIe slot 3 & 4	Sierra MC7455	Telit LM960	Notes	22	DIP switch	SYSTEM_RESET#	PCIE_RESET_N*	*r7 Information – PCIe bus is currently NOT supported, PCI pins marked with * are for future use only	28	DIP switch	NC	VREG_L6_1P8	48	DIP switch	NC	SYSTEM_RESET_N
	Pin	R4600 GEN2 ES2 mPCIe slot 3 & 4	Sierra MC7455	Telit LM960	Notes																		
	22	DIP switch	SYSTEM_RESET#	PCIE_RESET_N*	*r7 Information – PCIe bus is currently NOT supported, PCI pins marked with * are for future use only																		
	28	DIP switch	NC	VREG_L6_1P8																			
	48	DIP switch	NC	SYSTEM_RESET_N																			
	Indicator LED	1 x Standby, 1 x Storage, 1 x WDT, 8 x User defined																					
	Button	Front panel Power Button and Reset button																					
Mounting	Wall-mount kit																						
GND	M6 threaded stud for protective grounding																						
MTBF & Reliability	MTBF	15.1 Years																					
Power	Power input	+24/36/72/110VDC with M12 4-pin S code connector																					

		(16.8V to 137.5V, EN50155 compliant) -154V reverse polarity protection 161V(+2%) over-voltage protection A TVS diode is fitted between the plus and minus power inputs, there are no voltage clamping devices between these inputs and the chassis. A standard 1000VAC voltage withstand test with shorted plus – minus is supported.
	Ignition input	“Compare Vin_positive with Ignition, IF Ignition >70% of Vin_positive = System ON, IF Ignition <20% of Vin_positive = System OFF BIOS will provide Power off delay time option: 5,10,15 minutes. Input protected to same level as power input
	Compliance	Compliant to Interruptions of voltage supply according EN50155 SEC. 5.1.1.4 Class S2 (10ms) by capacitance
	Power Consumption	<80W with 100% CPU loading
Mechanical	Material	Extruded aluminum heatsink with chromate conversion coating cf. MIL-DTL-81706 B (conductive surface)
	Ingress Protection	IP41
	Dimensions	355 mm (W) x 204.5 mm (D) x 66mm(H)
	Net Weight	<7kg
Software	BIOS	AMI
	Watchdog	1~255 sec. system reset
	Operating System	Ubuntu 16.04.6, 64 bit Debian 10.0.0, 64 bit
Environment & Certification	Operating Temperature	-40°C ~ 70°C (EN50155 TX Class,+85C for 10mins)
	Storage Temperature	-40°C ~ +85°C
	Humidity operating	10% to 95% relative humidity (non-condensing)
	Humidity storage	5% to 95% relative humidity (non-condensing)
	EMC	EN50155:2017, EN50121-3-2:2016 EN50124-1:2006, EN61000-4-2:2009 EN61000-4-3:2006 + A1:2008 + A2:2010 EN61000-4-4:2012, EN61000-4-5:2014 EN61000-4-6:2014, EN55022:2006 + A2:2010

	Environmental	EN50155:2017, EN61373:2010 EN60068-2-1:2007, EN60068-2-2:2007 EN60068-2-27:2009, EN60068-2-30:2005, EN60068-2-64:2008 RoHS 2.0 & REACH
Safety	Fire Protection	Compliant to EN45545-2:2013+A1:2015 (HL 1-3)
	Rolling stock	BS EN 50155:2017
	Protection of system	Electrical isolation 2200VDC galvanic isolation of power input to output Power supply interface is floating (1500VDC)
Others	Others	No CMOS battery - RTC will not maintain date time information Torx screws for modem access area Pigtail kits to support standard fitment a. Pigtail Accessory kit 1 : 12x MHF4 Pigtail b. Pigtail Accessory kit 2 : 4x MHF4 Pigtail and 4x U.FL Pigtail Mounting bracket to customer dimensions – detailed in chassis top view drawing NDL 8192 range of MAC addresses to be programmed into NICs – NDL and ADLINK to define suitable MAC address format for receipt into production facility. Front Panel to include Customer logo in white PCBs conformal coated – type HumiSeal 1B73 Coating (AR) Acrylic.

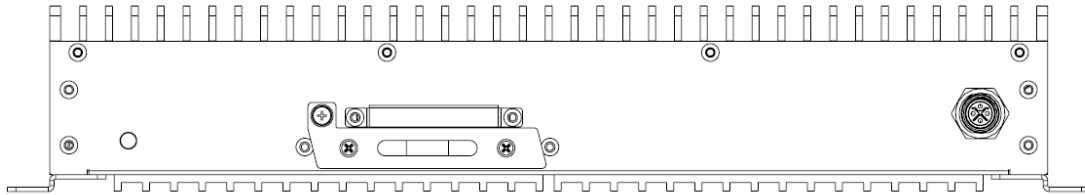
3 System Block Diagram



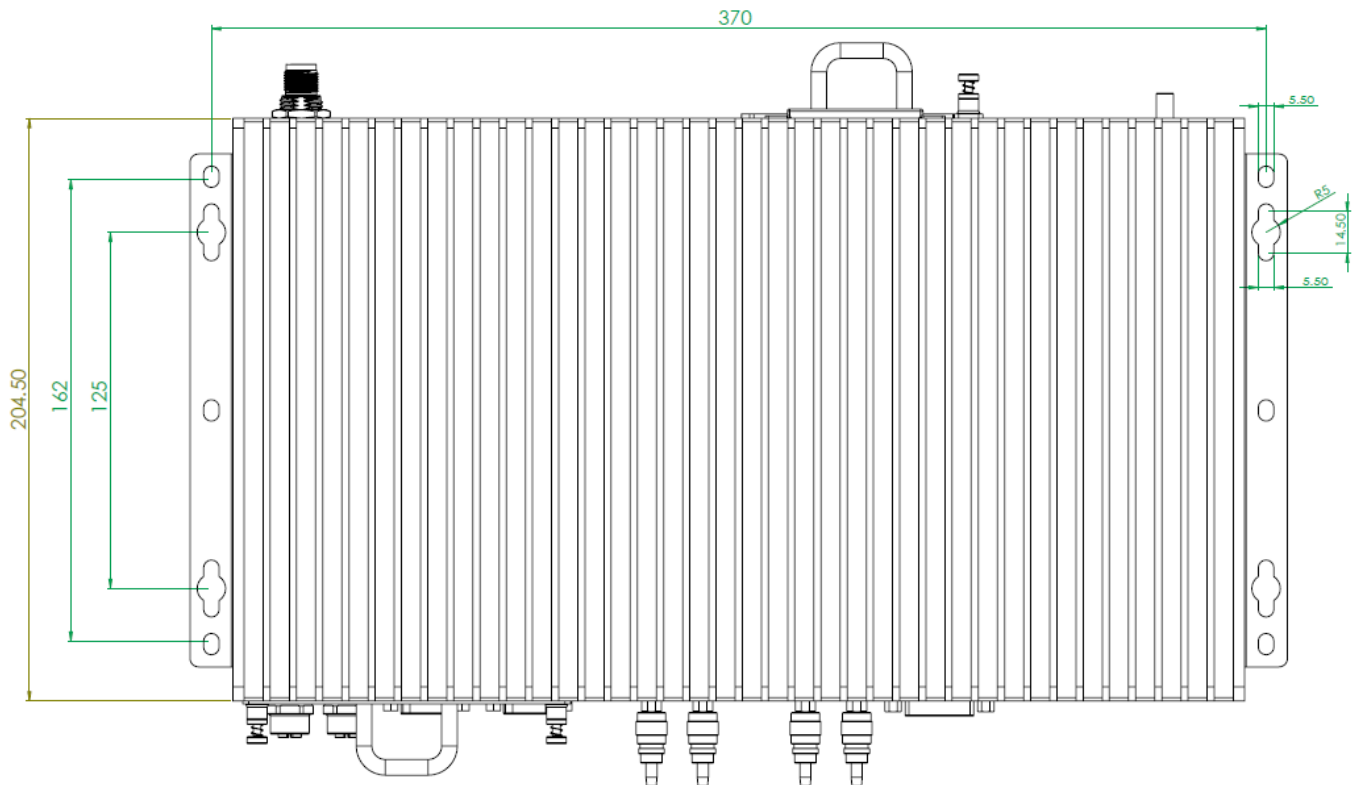
4 Mechanical Drawing reference

4.1 External chassis drawings and mounting plate

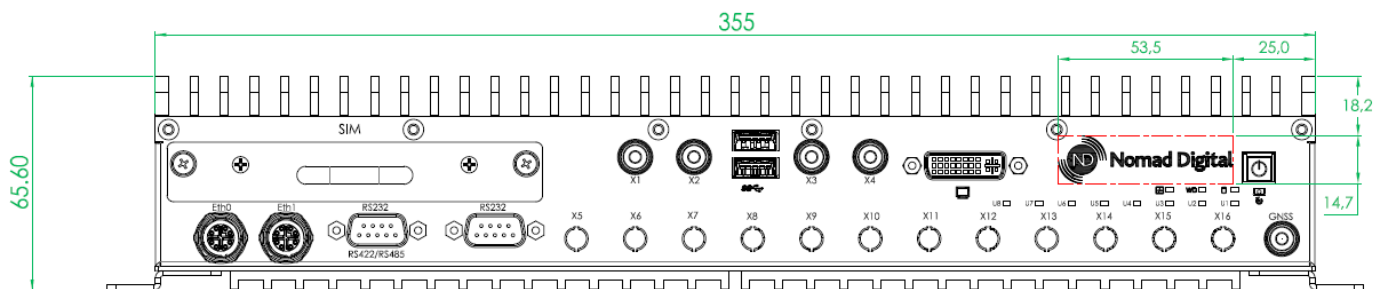
Chassis rear view



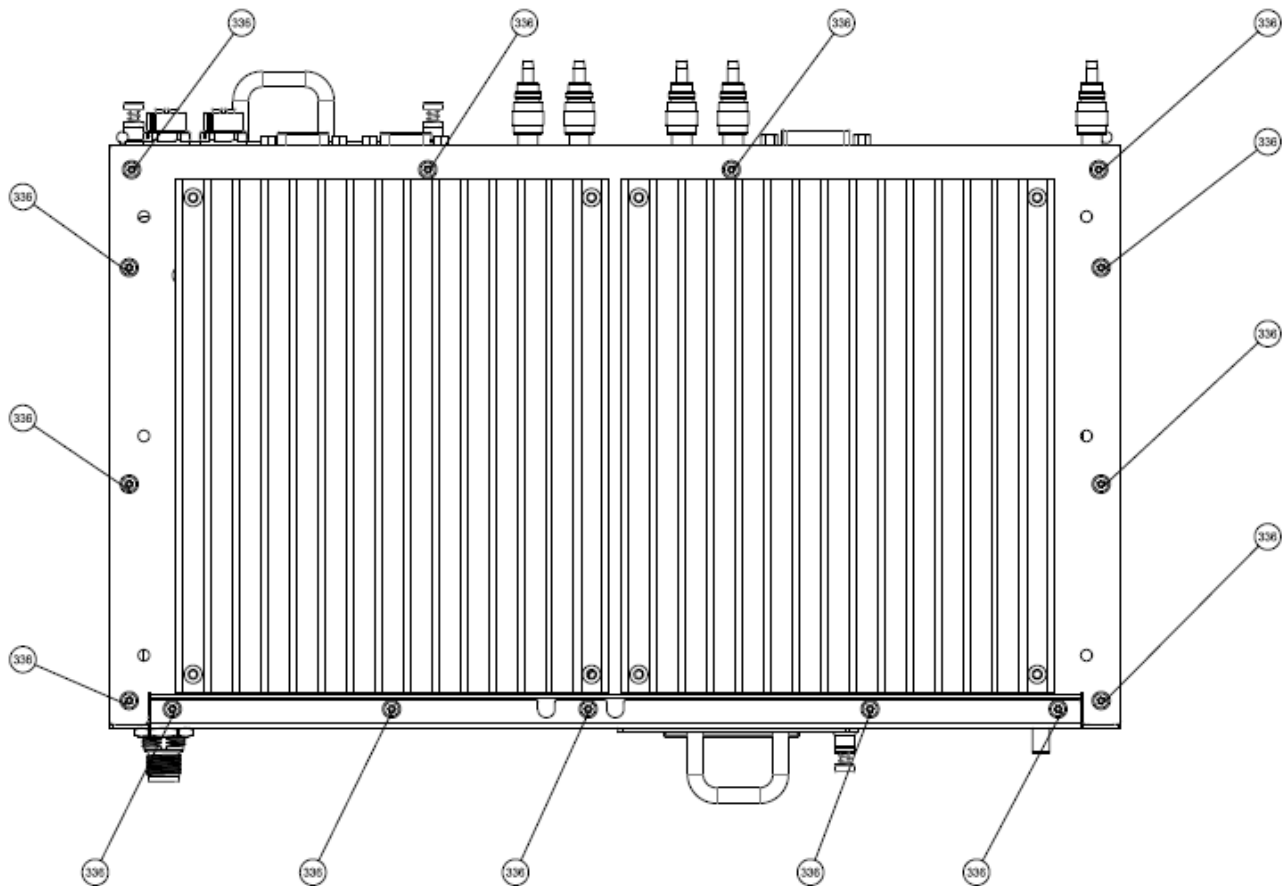
Chassis top view



Chassis front view

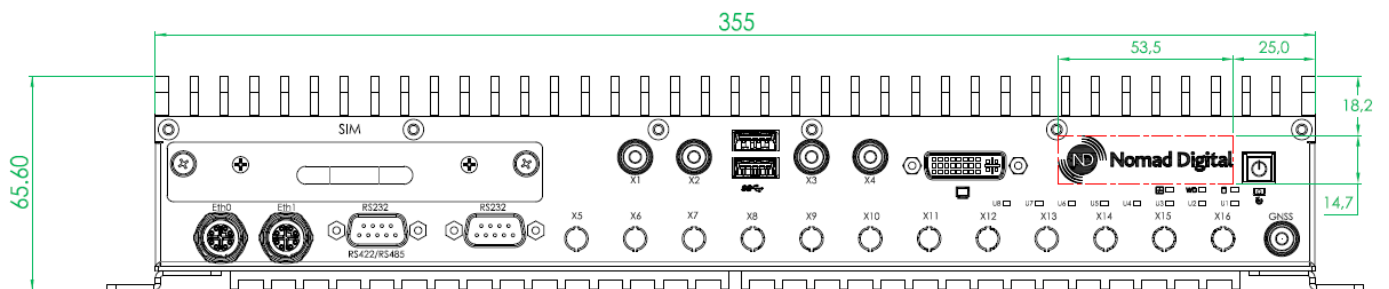


Torx screw location



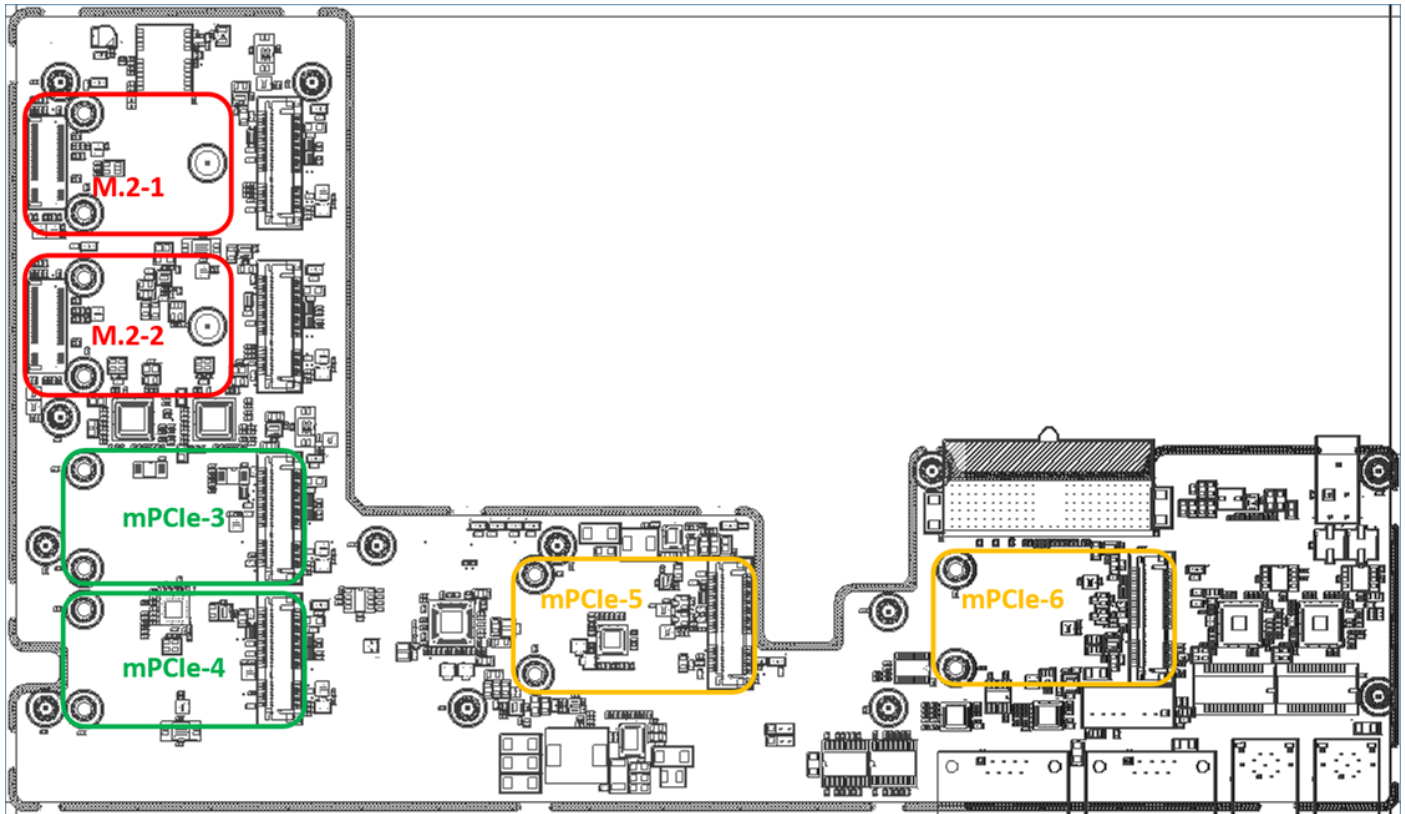
4.2 Front panel labelling

Front panel design with logo



5 Internal drawings and Warning statement

5.1 Drawing of M.2/mPCIe area and PCB designations



(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Acc. to FCC rule 15.21

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. 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.

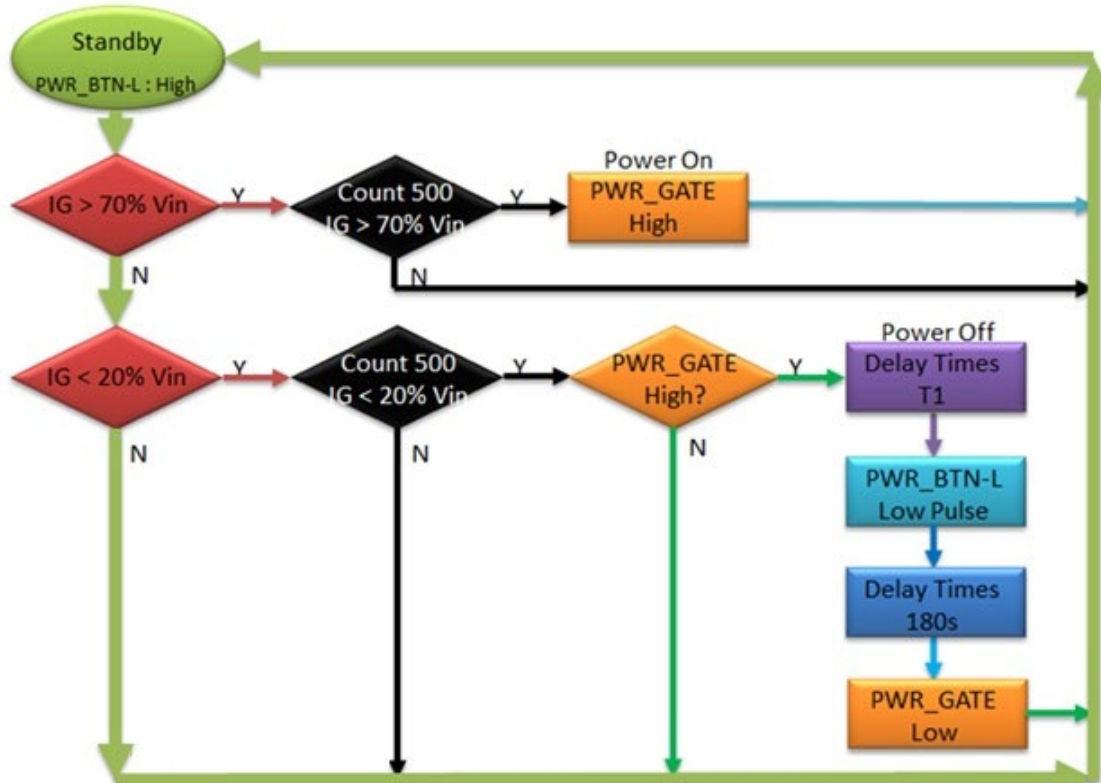
5.2 Suggested Pigtail routing

Optional Pigtail Accessory kit 1 P/N : 91-95261-000E	12x MHF4 Pigtail
Optional Pigtail Accessory kit 2 P/N : 91-95261-010E	4x MHF4 Pigtail and 4x U.FL Pigtail

	Silk screen	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
RF Kit1	MiniPCle No.	6	6	5	5	4	4	4	4	3	3	3	3	2	2	1	1	GNSS
	RF module por	Main	Aux	Main	Aux	Main0	Main1	Aux0	Aux1	Main0	Main1	Aux0	Aux1	Main	Aux	Main	Aux	
	MiniPCle/m.2	MiniPCle		MiniPCle		MiniPCle				MiniPCle				M.2		M.2		
	Silk screen	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
RF Kit2	MiniPCle No.	6	6	5	5					4	4	3	3	2	2	1	1	GNSS
	RF module por	Main	Aux	Main	Aux					Main	Aux	Main	Aux	Main	Aux	Main	Aux	
	MiniPCle/m.2	MiniPCle		MiniPCle						MiniPCle		MiniPCle		M.2		M.2		

6 Design Details

6.1 Power ignition control



Note :-

BIOS will provide Power off delay time option: 5,10,15 minutes.

7 Connector details and Pin out

7.1 External Connectors

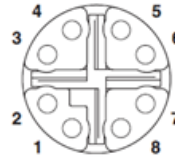
Main power and Ignition input

M12 S-coded, 4 pin male	Pin	Signal name
	1	Ignition
	2	Vin_positive
	3	Vin_negative
	4	Shield / PE

M12 LAN Port port (X-coded) from external cable side

	Pin↴	Signal Name↴
	1↴	LAN1_MDI_T_P0↴
	2↴	LAN1_MDI_T_N0↴
	3↴	LAN1_MDI_T_P1↴
	4↴	LAN1_MDI_T_N1↴
	5↴	LAN1_MDI_T_P3↴
	6↴	LAN1_MDI_T_N3↴
	7↴	LAN1_MDI_T_N2↴
	8↴	LAN1_MDI_T_P2↴

M12 LAN Port port (X-coded) from board side

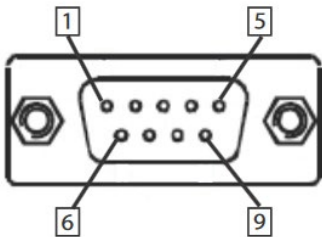
	Pin	Signal name
	1	MDI_T_P0
	2	MDI_T_N0
	3	MDI_T_P1
	4	MDI_T_N1
	5	MDI_T_P3
	6	MDI_T_N3
	7	MDI_T_N2
	8	MDI_T_P2

USB 3.0 Ports

USB 3.0 Type A connection - compatible with Super-Speed, Hi-Speed, full-speed and low-speed USB devices, with support for multiple boot devices, including USB flash, USB external HDD, and USB CD-ROM drives and boot priority and boot device configured in BIOS

7.2 External Connectors continued

COM port



Pin	RS-232	RS-422	RS-485
1	DCD#	TXD422-	485DATA-
2	RXD	TXD422+	485DATA+
3	TXD	RXD422+	N/S
4	DTR#	RXD422-	N/S
5	GND	N/S	N/S
6	DSR#	N/S	N/S
7	RTS#	N/S	N/S
8	CTS#	N/S	N/S
9	RI#	N/S	N/S

8 Additional data

Battery – not installed due to long term reliability concerns, system will lose date and time information when powered off, but will not show any error messages relating to a low or missing CMOS battery

USB Port Power – The USB ports provide power to support external USB devices, these are protected against overload with a self-recovering poly fuse.

DVI Port Power – The DVI port provides power output and this is protected against overload with a self-recovering poly fuse.

Important Safety Instructions

For user safety, please read and follow all **instructions**, **WARNINGS**, **CAUTIONS**, and **NOTES** marked in this manual and on the associated equipment before handling/operating the equipment.

- ❑ Read these safety instructions carefully.
- ❑ Keep this user's manual for future reference.
- ❑ Read the specifications section of this manual for detailed information on the operating environment of this equipment.
- ❑ When installing/mounting or uninstalling/removing equipment:
 - ❑ Turn off power and unplug any power cords/cables.
 - ❑ To avoid electrical shock and/or damage to equipment:
 - ❑ Keep equipment away from water or liquid sources;
 - ❑ Keep equipment away from high heat or high humidity;
 - ❑ Keep equipment properly ventilated (do not block or cover ventilation openings);
 - ❑ Make sure to use recommended voltage and power source settings;
 - ❑ Always install and operate equipment near an easily accessible electrical socket-outlet;
 - ❑ Secure the power cord (do not place any object on/over the power cord);
 - ❑ Only install/attach and operate equipment on stable surfaces and/or recommended mountings; and,
 - ❑ If the equipment will not be used for long periods of time, turn off and unplug the equipment from its power source.
- ❑ Never attempt to fix the equipment. Equipment should only be serviced by qualified personnel.
- ❑ A Lithium-type battery may be provided for uninterrupted, backup or emergency power.
- ❑ Equipment must be serviced by authorized technicians when:
 - ❑ The power cord or plug is damaged;
 - ❑ Liquid has penetrated the equipment;
 - ❑ It has been exposed to high humidity/moisture;
 - ❑ It is not functioning or does not function according to the user's manual;
 - ❑ It has been dropped and/or damaged; and/or,
 - ❑ It has an obvious sign of breakage.