User Manuel

R4600-3AX

Communications Control Unit

Revision History

Revision	Change	Date
1.0	Released version	30-04-2024

Contents

1.1 Power

Floating wide range DC input to support EN50155:2021 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 3 Product Specifications. A flow diagram is shown under 7.2 power ignition control. The voltage tolerance is considered as 5% according to components tolerance. Further software calibration should be considered in the future products.

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 50155:2021:-

13.4.9.3 Voltage withstand test

Nominal battery voltage and/or I/O voltage	Test voltage
72 V DC ≤ V DC < 125 V DC or from 50 to 90 V AC rms	1 000 V AC or 1 500 V DC

Federal Communications Commission (FCC) Statement

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 15.19

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.

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.

FCC RF Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

1.2 Expansion

The unit is equipped with four m.2 slots from AFM board, two mPCIe slots from AFM board and one m.2 slot from the motherboard as detailed in Section 3.

Two m.2 slots from the modem area (Section 6.1 location m.2-1 to m.2-2) provide USB 3.2 Gen 1 5Gbps x1 signalling and PCIe x1 signalling.

Two m.2 slots from the modem area (Section 6.1 location m.2-3 to m.2-4) provide USB 3.2 Gen 1 5Gbps x1 signalling.

Two mPCIe slots with USB 2.0 and PCIe x1 signalling (Section 7.1 mPCIe-5 & mPCIe-6) will follow PCIe mini card spec V1.2. There are no DIP switch options for these slots. But the supported modules are not included in the product shipment. The customer has to buy and assemble them upon the individual applications.

One m.2 from the motherboard provides USB 3.2 Gen1 5Gbps x1 and SATA signalling for a storage device.

Slots m.2-1 to m.2-4 will be configurable to support three modem options as already specified by NDL. The supported modems are Sierra Wireless EM9191, Telit FN980, Telit FN990, Telit LN920 and SIMCom SIM8202G. But the supported modems are not included in the product shipment. The customer has to buy and assemble them upon the individual applications. Configuration will be controlled by DIP Switches inside the R4600-3A1 located on the AFM board.

Installation of modems and internal m.2 storage will require removal of the chassis covers. Torx fixings to be used Torx type M3, F HEAD, L5 locations are shown in the chassis underside view under the mechanical drawings section. All thermal pads fitted in the modem area should remain stuck in place when the bottom cover is removed.

Antenna locations X5 to X20 are not prepopulated by ADLINK but will have protective plastic covers installed.

Antenna locations X1 X2 X3 X4 and GNSS will be prepopulated by ADLINK at the time of manufacture with QMA by default. ADLINK will provide QLS connectors for the Sparklan WPEQ-405AX as a costed option.

NDL can bulk order pigtails of U.FL or MHF4 type depending on the modem configuration, for prepopulated pigtails U.FL or MHF4 should be specified at the time of order.

Since SIM replacement or exchange may occur on a more frequent basis than modem changes the SIM holders and eSIMs will be fitted to a removable “SIM Tray”, thus avoiding the need to completely open up

the chassis.

The system has been designed to support Infineon eSIMs and it is expected that NDL will free issue the parts required. This is due to the eSIM PCB footprint being available on the SIM tray PCB rather than a socket.

Slot	Location	Signal
m.2-1	I/O board (AFM)	USB 3.2 Gen 1 5G x1+ PCIe x1
m.2-2	I/O board (AFM)	USB 3.2 Gen 1 5G x1+ PCIe x1
m.2-3	I/O board (AFM)	USB 3.2 Gen 1 5G x1
m.2-4	I/O board (AFM)	USB 3.2 Gen 1 5G x1
mPCIe-5	I/O board (AFM)	USB 2.0, PCIe x1
mPCIe-6	I/O board (AFM)	USB 2.0, PCIe x1
m.2	Motherboard (MB)	SATA, USB 3.2 Gen 1 5G x1

1.3 Pin-out of mini PCIe slots mPCIe-5 & mPCIe-6

Pin	Function	Pin	Function
1	MPCIE_5_WAKE_N	34	GND
2	P3V3_SB_MPCIE_5	35	GND
3	NC	36	MPCIE_5_USB2_N
4	GND	37	GND
5	NC	38	MPCIE_5_USB2_P
6	P1V5_MPCIE_5	39	P3V3_SB_MPCIE_5
7	MPCIE_5_CLKREQ_N	40	GND
8	MODEM_SIM5_VSIM	41	P3V3_SB_MPCIE_5
9	GND	42	MPCIE_5_LED_WWAN_N
10	MODEM_SIM5_DAT	43	GND
11	MPCIE_5_CLK_R_N	44	NC
12	MODEM_SIM5_CLK	45	NC
13	MPCIE_5_CLK_R_P	46	NC
14	MODEM_SIM5_RST	47	NC
15	GND	48	P1V5_MPCIE_5
16	NC	49	NC
17	NC	50	GND
18	GND	51	NC
19	NC	52	P3V3_SB_MPCIE_5
20	MPCIE_5_W_DISABLE_L	53	GND
21	GND		
22	MPCIE_5_PERST_N		

23	AFM_PCIE_RX1_N		
24	P3V3_SB_MPCIE_5		
25	AFM_PCIE_RX1_P		
26	GND		
27	GND		
28	P1V5_MPCIE_5		
29	GND		
30	MPCIE_5_SMB_LS_CLK		
31	AFM_PCIE_TX1_N		
32	MPCIE_5_SMB_LS_DAT		
33	AFM_PCIE_TX1_P		
34	GND		
35	GND		

1.4 Pin-out of m.2 slots m.2-1 & m.2-2

Pin	AFM M.2-1 & M.2-2	DIP SW (M.2-1)	DIP SW (M.2-2)	(1) FN980	(2) EM9191	(3) SIM8202G
1	CONFIG3			CONFIG_3	CONFIG_3	CONFIG_3
2	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
3	GND			GND	GND	GND
4	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
5	GND			GND	GND	GND
6	DIP switch	SW23.4	SW24.4	FULL_CARD_POWER_OFF_N	Full_Card_Power_Off#	FULL_CARD_POWER_OFF#
7	DIP switch	SW23.3	SW24.3	USB_HS_DP	USB_D+	USB_D+
8	DIP switch	SW27.2	SW28.2	W_DISABLE_N	W_DISABLE#	W_DISABLE1#
9	DIP switch	SW23.3	SW24.3	USB_HS_DM	USB_D-	USB_D-
10	WWAN_LED			LED	WWAN_LED#	LED1#
11	GND			GND	GND	GND
12						
13						
14						
15				Key		
16						
17						
18						
19						
20	DIP switch	SW14.1	SW15.1	TGPIO_05	PCIE_DIS	I2S_CLK
21	CONFIG0			CONFIG_0	CONFIG_0	CONFIG_0
22	DIP switch	SW14.2	SW15.2	TGPIO_06	VBUS_SENSE	I2S_RX
23	WAN_WAKE_L			WAKE_ON_WAN	WAKE_ON _WAN#	WoWWAN#
24	N/C			TGPIO_07	VCC*	I2S_TX
25	DPR			TGPIO_02	DPR	DPR*
26	DIP switch	SW27.1	SW28.1	TGPIO_13	GPS_DISABLE#	W_DISABLE2#
27	GND			GND	GND	GND
28	DIP switch	SW14.4	SW15.4	TGPIO_08	PLA_S2#	I2S_WA
29	DIP switch	SW31.2	SW31.4	USB_SS_TX_M	USB3_TXM	USB3.1_Tx-
30	UIM_RESET			UIM1_RESET_N	UIM1_RESET	(U)SIM1_RESET
31	DIP switch	SW31.2	SW31.4	USB_SS_TX_P	USB3_TXP	USB3.1_Tx+
32	UIM_CLK			UIM1_CLK	UIM1_CLK	(U)SIM1_CLK
33	GND			GND	GND	GND
34	UIM_DATA			UIM1_DATA	UIM1_DATA	(U)SIM1_DATA
35	DIP switch	SW31.2	SW31.4	USB_SS_RX_M	USB3_RXM	USB3.1_Rx-
36	MODEM_SIM1_VSIM			UIM1_VCC	UIM1_PWR	(U)SIM1_PWR
37	DIP switch	SW31.2	SW31.4	USB_SS_RX_P	USB3_RXP	USB3.1_Rx+
38	N/C			TGPIO_12	VCC*	I2C_SCL
39	GND			GND	GND	GND
40	N/C			QTM0_PON	QTM0_PON	(U)SIM2_DET
41	DIP switch	SW31.1	SW31.3	PCIE_TX0_M	PCIE_TXM0	PETn0
42	N/C			QTM1_PON	QTM1_PON	(U)SIM2_DATA
43	DIP switch	SW31.1	SW31.3	PCIE_TX0_P	PCIE_TXP0	PETp0
44	N/C			QTM2_PON	QTM2_PON	(U)SIM2_CLK
45	GND			GND	GND	GND
46	N/C			QTM3_PON	QTM3_PON	(U)SIM2_RESET
47	DIP switch	SW31.1	SW31.3	PCIE_RX0_M	PCIE_RXM0	PERn0
48	N/C			VREG_S4E_1P904	QTM_IO_1.9V	(U)SIM2_PWR
49	DIP switch	SW31.1	SW31.3	PCIE_RX0_P	PCIE_RXP0	PERp0
50	PERST_N			PCIE_RESET_N	PCIE_PERST_N	PERST#
51	GND			GND	GND	GND
52	CLK_REQ_N			PCIE_CLKREQ_N	PCIE_CLKREQ_N	CLKREQ#
53	PCIE_REFCLKN			PCIE_REFCLK_M	PCIE_REFCLKM	REFCLKN
54	PEWAKE_L			PCIE_WAKE_N	PCIE_PEWAKE_N	PEWAKE#
55	PCIE_REFCLKP			PCIE_REFCLK_P	PCIE_REFCLKP	REFCLKP
56	N/C			I2C_SDA	N/C	ANTCTL3
57	GND			GND	GND	GND
58	N/C			I2C_SCL	N/C	ANTCTL 2
59	N/C			Reserved	ANT_CTRL0	ANTCTL0
60	N/C			TGPIO_11	Reserved	I2S_MCLK
61	N/C			RFFE0_DATA	ANT_CTRL1	ANTCTL1
62	N/C			TGPIO_03	Reserved	COEX2*
63	N/C			RFFE0_CLK	ANT_CTRL2	LAA_TX_EN*
64	N/C			TGPIO_04	Reserved	COEX1*
65	DIP switch	SW14.3	SW15.3	VDD_1P8_DIG_L6	ANT_CTRL3	WL_TX_EN*
66	SIMDET			UIM1_PRESENT	SIM1_DETECT	(U)SIM1_DET
67	DIP switch	SW23.1 & SW23.2	SW24.1 & SW24.2	SYS_RESIN_N	RESET#	RESET#
68	N/C			TGPIO_01	VCC*	I2C_SDA
69	CONFIG1			CONFIG_1	CONFIG_1	CONFIG_1
70	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
71	GND			GND	GND	GND
72	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
73	GND			GND	GND	GND
74	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
75	CONFIG2			CONFIG_2	CONFIG_2	CONFIG_2

1.5 Pin-out of m.2 slots m.2-3 & m.2-4

Pin	AFM M.2-3 & M.2-4	DIP SW (M.2-3)	DIP SW (M.2-4)	(1) FN980	(2) EM9191	(3) SIM8202G
1	CONFIG3			CONFIG_3	CONFIG_3	CONFIG_3
2	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
3	GND			GND	GND	GND
4	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
5	GND			GND	GND	GND
6	DIP switch	SW25.4	SW26.4	FULL_CARD_POWER_OFF_N	Full_Card_Power_Off#	FULL_CARD_POWER_OFF#
7	DIP switch	SW25.3	SW26.3	USB_HS_DP	USB_D+	USB_D+
8	DIP switch	SW29.2	SW30.2	W_DISABLE_N	W_DISABLE#	W_DISABLE1#
9	DIP switch	SW25.3	SW26.3	USB_HS_DM	USB_D-	USB_D-
10	WWAN_LED			LED	WWAN_LED#	LED1#
11	GND			GND	GND	GND
12	Key					
13						
14						
15						
16						
17						
18						
19						
20	DIP switch	SW16.1	SW17.1	TGPIO_05	PCIE_DIS	I2S_CLK
21	CONFIG0			CONFIG_0	CONFIG_0	CONFIG_0
22	DIP switch	SW16.2	SW17.2	TGPIO_06	VBUS_SENSE	I2S_RX
23	WAN_WAKE_L			WAKE_ON_WAN	WAKE_ON _WAN#	WoWWAN#
24	N/C			TGPIO_07	VCC*	I2S_TX
25	DPR			TGPIO_02	DPR	DPR*
26	DIP switch	SW29.1	SW30.1	TGPIO_13	GPS_DISABLE#	W_DISABLE2#
27	GND			GND	GND	GND
28	DIP switch	SW16.4	SW17.4	TGPIO_08	PLA_S2#	I2S_WA
29	USB3_RX_N			USB_SS_TX_M	USB3_TXM	USB3.1_Tx-
30	UIM_RESET			UIM1_RESET_N	UIM1_RESET	(U)SIM1_RESET
31	USB3_RX_P			USB_SS_TX_P	USB3_TXP	USB3.1_Tx+
32	UIM_CLK			UIM1_CLK	UIM1_CLK	(U)SIM1_CLK
33	GND			GND	GND	GND
34	UIM_DATA			UIM1_DATA	UIM1_DATA	(U)SIM1_DATA
35	USB3_TX_C_N			USB_SS_RX_M	USB3_RXM	USB3.1_Rx-
36	MODEM_SIM1_VSIM			UIM1_VCC	UIM1_PWR	(U)SIM1_PWR
37	USB3_TX_C_P			USB_SS_RX_P	USB3_RXP	USB3.1_Rx+
38	N/C			TGPIO_12	VCC*	I2C_SCL
39	GND			GND	GND	GND
40	N/C			QTM0_PON	QTM0_PON	(U)SIM2_DET
41	N/C			PCIE_TX0_M	PCIE_TXM0	PETn0
42	N/C			QTM1_PON	QTM1_PON	(U)SIM2_DATA
43	N/C			PCIE_TX0_P	PCIE_TXP0	PETp0
44	N/C			QTM2_PON	QTM2_PON	(U)SIM2_CLK
45	GND			GND	GND	GND
46	N/C			QTM3_PON	QTM3_PON	(U)SIM2_RESET
47	N/C			PCIE_RX0_M	PCIE_RXM0	PERn0
48	N/C			VREG_S4E_1P904	QTM_IO_1.9V	(U)SIM2_PWR
49	N/C			PCIE_RX0_P	PCIE_RXP0	PERp0
50	N/C			PCIE_RESET_N	PCIE_PERST_N	PERST#
51	GND			GND	GND	GND
52	N/C			PCIE_CLKREQ_N	PCIE_CLKREQ_N	CLKREQ#
53	N/C			PCIE_REFCLK_M	PCIE_REFCLKM	REFCLKN
54	N/C			PCIE_WAKE_N	PCIE_PEWAKE_N	PEWAKE#
55	N/C			PCIE_REFCLK_P	PCIE_REFCLKP	REFCLKP
56	N/C			I2C_SDA	N/C	ANTCTL3
57	GND			GND	GND	GND
58	N/C			I2C_SCL	N/C	ANTCTL 2
59	N/C			Reserved	ANT_CTRL0	ANTCTL0
60	N/C			TGPIO_11	Reserved	I2S_MCLK
61	N/C			RFFE0_DATA	ANT_CTRL1	ANTCTL1
62	N/C			TGPIO_03	Reserved	COEX2*
63	N/C			RFFE0_CLK	ANT_CTRL2	LAA_TX_EN*
64	N/C			TGPIO_04	Reserved	COEX1*
65	DIP switch	SW16.3	SW17.3	VDD_1P8_DIG_L6	ANT_CTRL3	WL_TX_EN*
66	SIMDET			UIM1_PRESENT	SIM1_DETECT	(U)SIM1_DET
67	DIP switch	SW25.1 & SW25.2	SW26.1 & SW26.2	SYS_RESIN_N	RESET#	RESET#
68	N/C			TGPIO_01	VCC*	I2C_SDA
69	CONFIG1			CONFIG_1	CONFIG_1	CONFIG_1
70	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
71	GND			GND	GND	GND
72	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
73	GND			GND	GND	GND
74	P3V3_SB_MPCIE_1			VPH_PWR	VCC	VBAT
75	CONFIG2			CONFIG_2	CONFIG_2	CONFIG_2

1.6 DIP Switch settings

DIP SW	M.2 slot #	FN980 (USB3)	FN980 (PCIe)	EM9191 (USB3)	EM9191 (PCIe)	SIM8202G-M2	EM7565 (USB3)	FN990 A28 (USB3)	FN990 A28 (PCIe)	FN990 A40 (USB3)	FN990 A40 (PCIe)	LN920 A12 (USB3)	Function description	Note
SW14.1	M.2-1 (PCIe/USB3)	On	Off	On	Off	Off	Off	On	N/A	On	Off	Off	EM9191 / FN980 interface select (On -> USB3 , Off -> PCIe)	FN980 interface switch enable by AT command (FW: 38.02.x01-8007)
SW14.2		Off	Off	On	Off	Off	Off	Off		Off	Off	Off	EM9191 USB detection	
SW14.3		On	On	Off	Off	Off	Off	On		On	On	Off	FN980 status indication	
SW14.4		Off	Off	On	On	Off	Off	Off		Off	Off	Off	EM9191 status indication	
SW23.1		On	On	Off	Off	Off	Off	On		On	On	On	FN980 module reset event	
SW23.2		Off	Off	On	On	On	On	Off		Off	Off	Off	EM9191 or SIM8202G module reset event	
SW23.3		Off	Off	Off	Off	Off	Off	Off		Off	Off	Off	USB2 function support (On -> Disable , Off -> Enable)	
SW23.4		On	Off	Off	Off	Off	Off	On		On	Off	On	FN980 reboot event	
SW27.1		Off	Off	Off	Off	On	Off	Off		Off	Off	Off	GPS_DIS	ON: GPS Disable, OFF: GPS Enable
SW27.2		Off	Off	Off	Off	On	Off	Off		Off	Off	Off	W_DISABLE_L	
SW31.1		On	On	Off	On	On	Off	On		On	On	Off	PCIe function support (On -> Enable , Off -> Disable)	
SW31.2		On	On	On	Off	On	On	On		On	On	On	USB3 function support (On -> Enable , Off -> Disable)	
SW15.1	M.2-2 (PCIe/USB3)	On	Off	On	Off	Off	Off	On	Off	On	N/A	Off	EM9191 / FN980 interface select (On -> USB3 , Off -> PCIe)	FN980 interface switch enable by AT command (FW: 38.02.x01-8007)
SW15.2		Off	Off	On	Off	Off	Off	Off	Off	Off		Off	EM9191 USB detection	
SW15.3		On	On	Off	Off	Off	Off	On	On	On		Off	FN980 status indication	
SW15.4		Off	Off	On	On	Off	Off	Off	Off	Off		Off	EM9191 status indication	
SW24.1		On	On	Off	Off	Off	Off	On	On	On		On	FN980 module reset event	
SW24.2		Off	Off	On	On	On	On	Off	Off	Off		Off	EM9191 or SIM8202G module reset event	
SW24.3		Off	Off	Off	Off	Off	Off	Off	Off	Off		Off	USB2 function support (On -> Disable , Off -> Enable)	
SW24.4		On	Off	Off	Off	Off	Off	On	Off	On		On	FN980 reboot event	
SW28.1		Off	Off	Off	Off	On	Off	Off	Off	Off		Off	GPS_DIS	ON: GPS Disable, OFF: GPS Enable
SW28.2		Off	Off	Off	Off	On	Off	Off	Off	Off		Off	W_DISABLE_L	
SW31.3		On	On	Off	On	On	Off	On	On	On		Off	PCIe function support (On -> Enable , Off -> Disable)	
SW31.4		On	On	On	Off	On	On	On	On	On		On	USB3 function support (On -> Enable , Off -> Disable)	

SW16.1	M.2-3 (USB)	On	N/A	On	N/A	Off	Off	On	N/A	On	N/A	Off	EM9191 / FN980 interface select (On -> USB3 , Off -> PCIe)	
SW16.2		Off		On		Off	Off	Off		Off		Off	EM9191 USB detection	
SW16.3		On		Off		Off	Off	On		On		Off	FN980 status indication	
SW16.4		Off		On		Off	Off	Off		Off		Off	EM9191 status indication	
SW25.1		On		Off		Off	Off	On		On		On	FN980 module reset event	
SW25.2		Off		On		On	On	Off		Off		Off	EM9191 or SIM8202G module reset event	
SW25.3		Off		Off		Off	Off	Off		Off		Off	USB2 function support (On -> Disable , Off -> Enable)	
SW25.4		On		Off		Off	Off	On		On		On	FN980 reboot event	
SW29.1		Off	Off	Off	Off	On	Off	Off		Off		Off	GPS_DIS	ON: GPS Disable, OFF: GPS Enable
SW29.2		Off	Off	Off	Off	On	Off	Off		Off		Off	W_DISABLE_L	
SW17.1	M.2-4 (USB)	On	N/A	On	N/A	Off	Off	On	N/A	On	N/A	Off	EM9191 / FN980 interface select (On -> USB3 , Off -> PCIe)	
SW17.2		Off		On		Off	Off	Off		Off		Off	EM9191 USB detection	
SW17.3		On		Off		Off	Off	On		On		Off	FN980 status indication	
SW17.4		Off		On		Off	Off	Off		Off		Off	EM9191 status indication	
SW26.1		On		Off		Off	Off	On		On		On	FN980 module reset event	
SW26.2		Off		On		On	On	Off		Off		Off	EM9191 or SIM8202G module reset event	
SW26.3		Off		Off		Off	Off	Off		Off		Off	USB2 function support (On -> Disable , Off -> Enable)	
SW26.4		On		Off		Off	Off	On		On		On	FN980 reboot event	
SW30.1		Off	Off	Off	Off	On	Off	Off		Off		Off	GPS_DIS	ON: GPS Disable, OFF: GPS Enable
SW30.2		Off	Off	Off	Off	On	Off	Off		Off		Off	W_DISABLE_L	

DIP SW	Slot #	PX1N	WLE600VXi	WLE3000H2/H5	WPEQ-405AX	WLE3000HX							Function description	Note
CN5 CN6	mPCIe	2-3	2-3	1-2	2-3	2-3							mPCIe pin 43 function 1-2: Power 2-3: Ground	1-2: WLE3000H2 & WLE3000H5 2-3: PX1N & WLE600VXi BA & WPEQ-405AX & WLE3000HX

*The modem PCIE interface is supported according to the PCIE driver availability provided by the modem vendor. During the product development phase, only the USB driver are ready so Adlink tests covers only the USB interface.

1.7 SIM switching and Modem Power

The unit has been designed to support multiple modems and SIM cards. Each modem can be switched to a different SIM path as per Section 7.1 SIM Farm Diagram.

1.8 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

1.9 Software

The system will support Debian version 10 and above operating system, this excludes modems and Wi-Fi modules as it is anticipated that Nomad will use their own software & drivers.
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.
An i2c command list and examples will be supplied to support software porting by NDL to control the SIM array.
Expansion slots m.2-1 to m.2-4 and mPCIe-5 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 to m.2-4 and mPCIe-5 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. The watchdog facility is also controlled using i2c commands.

2 Compliance testing

The R4600-3A1 will be tested in line with the ADLINK Certificate testing Plan V0.1 and Nomad BMS-RENG-TES-005. Any specialist hardware such as modems, co-axial cabling and antennas are to be provided on a loan basis by Nomad. Whilst modems and Wi-Fi modules will be installed and active for certain tests ADLINK will not be performing tests relating to intentional emitters. The addition of third party modems and Wi-Fi modules are purely intended to provide a worst case test scenario.

Configuration	Hardware to be used
1	All hardware installed as per table below (Items 1 to 12). Running basic ping tests on all network, modems and Wi-Fi ports
2	R4600-3A1 plus 1 modem plus CFast card selected from table below. Running a simple console test to system to check hardware OK plus 1 cycle of burn in test
3	R4600-3A1 plus 1 modem of each type table below. Plus items 8, 9, 10, 11 and 12 Running basic ping tests. Items 11 and 12 to be installed as required to match installed modems

ITEM	NOMAD PART NUMBER	R4600-3A1 Socket	DESCRIPTION
1	NMID 1054	NA	Box CCU. Wide input voltage range power supply unit for nominal voltages of 24V dc, 72V dc and 110V dc. Supports up to 4 internal WWAN modems and 2 Wi-Fi modules.
2	NMID 1058	m.2-1	5G Modem Telit FN990A40
3	TBD	m.2-2	5G Modem Telit FN990A28
4	NMID 1035	m.2-3	5G Modem Sierra Wireless - EM9191
5	TBD	m.2-4	4G Modem Telit LN920A12
6	TBD	mPCIe-5	Wi-Fi module WLE3000HX-i
7	TBD	mPCIe-6	Wi-Fi module WLE3000HX-i
8	TBD	CFAST	Innodisk DECFA-64GDK1EW1DF-N9301
9	TBD	m.2 MB	Innodisk M.2 (S80) 3MG2-P 1TB WT
10	TBD	2.5” SATA	Renice RIM01T-SX5A2-E
11		NA	Pigtail type 1 QMA jack to I-PEX)MHF I plug (quantity = 4) – for Wifi modules
12		NA	Pigtail type 2 QMA jack to MHF4L plug (quantity = 16) - 5G modems

Final test configuration is listed in chapter 2.3

2.1 EMC tests

1. Power supply tests Configuration 1
2. Insulation test Configuration 2
3. EMC emissions and immunity Configuration 1

2.2 Environmental tests

1.	Low temp storage	Configuration 3
2.	Cold start-up	Configuration 3
3.	Dry heat test	Configuration 1
4.	Damp heat cyclic	Configuration 1
5.	Salt mist 1	Leverage the R4600-2AX report
6.	Shock & Vibration	Configuration 3
7.	Enclosure IP	Leverage the R4600-2AX report
8.	Rapid temp changes	Configuration 1
9.	Inrush current	Configuration 1

2.3 Final test plan configuration

ITEM	NOMAD PART NUMBER	R4600 Slot	DESCRIPTION
1	NMID		R4600-3A1 Wide input voltage range power supply unit for nominal voltages of 24V dc, 72V dc and 110V dc.
2	NMID	m.2-1	Telit FN990A40
3	NMID	m.2-2	Telit FN990A28
4	NMID 1035	m.2-3	Sierra Wireless - EM9191
5	NMID	m.2-4	Telit LN920A12 (4G - CAT12 modem)
6	NMID	mPCIe-5	WLE3000HX-i
7	NMID	mPCIe-6	NA
8	NMID	m.2	Innodisk M.2 (S80) 3MG2-P 1TB WT
9	NMID	cFast	Innodisk DECFA-DECFA-64GDK1EW1DF-N9301
10	NMID	2.5”SSD	Renice RIM01T-SX5A2-E

3 Product Specifications

R4600-3AX 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 16GB or 32GB using SODIMMs
	Storage	1 x 2.5” Removable drive bay 1 x accessible CFast socket 1 x Internal M.2 2280 Socket B key SATA & USB3.2 Gen1 5G x1 signalling(From MB)
	Display	1 x DVI-I for service with white plastic cover and protected against overload with a self-recovering poly fuse.
	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 Both ports to include metal covers
	USB	2x type A USB 3.2 Gen1 x1 ports both ports to include plastic covers and protected against overload with a self-recovering poly fuse.
	Ethernet	2 x X-coded M12 10 GbE ports with 2kV isolation, ports with plastic covers NDL 8192 range of MAC addresses to be programmed into both NICs
	Expansion Slot	2 x mPCIe Compliant to PCI Express® Mini Card Electromechanical Specification Revision 1.2 supporting USB2.0 & PCIe x1 (mPCIe-5, mPCIe6) *Note :* *For mPCIe-5 to mPCIe-6 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.* *mPCIe-5 & mPCIe-6 will support modules up to 7W per module, internal temperature will be 20°C higher than external temperature.* 2 x m.2 (m.2-1 to m.2-2) supporting USB 3.2 Gen 1 5G x1 + PCIe x1 (Default support List : EM9191 FN980 SIM8202G) 2 x m.2 (m.2-3 to m.2-4) supporting USB 3.2 Gen 1 5G x1 (Default support List : EM9191 FN980 SIM8202G) *Note :* *For m.2-1 to m.2-4 We will populate dip switches for each slot as highlighted in red on the pinout tables. This will allow the use of any combination of the supported modems to be used. Similarly each m.2 slot will support 42 / 50 / 52 mm modems with a movable mounting point.* *The thermal design and thermal pads will be applied on both sides of the module.*

		1 x m.2 3042 Key B USB 3.2 Gen 1 5G x1 & SATA (mainboard for SSD)
	USIM array	12 x SIM holders on expansion carrier board 6 PCB footprint eUICC SIM, MFF2 type - Micro SIM (3FF, removable SIM Tray) - Multi SIM access function, any modem can access any SIM unit via CPLD control - SIM carrier board, connected to AFM pluggable connector
	Antenna	4x QMA (QLS option) connectors + 16x Antenna connector cut outs + 1x GNSS QMA connector Antenna positions X1, X2, X3, X4 will be preinstalled with U.FL Pigtails Antenna position GNSS will be preinstalled with a U.FL Pigtail Antenna positions X5 to X20 punched out with plastic covers
	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 or optional Rackmount kit
	GND	M6 threaded stainless steel stud with a min length of 16.5mm up to a max length of 20mm and lock nut for protective grounding
MTBF & Reliability	MTBF	15.1 Years minimum
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 Inrush current limited to 10 x nominal current for less than 1 mSec *Note : A TVS diode is fitted between the plus and minus power inputs, 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: 1, 4, 10, 15, 30 minutes. Input protected to same level as power input The voltage tolerance is considered as 5% according to components tolerance. Further software calibration should be considered in the future products.
	Compliance	EN50155 13.4.2 Supply variations (5.1.1.2) by leveraging the R4600-2AX report EN50155 14.4.3 Continuous voltage range (5.1.1.2) $0.7U_n$ & $1.25U_n$ by leveraging the R4600-2AX report EN50155 13.4.3 Supply fluctuations (5.1.1.3) EN50155 13.4.3 Supply interruptions (5.1.1.4) Class S2 EN50155 13.4.3 Supply changeover (5.1.3) Class C1 EN50155 13.4.3 Reverse Polarity (7.2.7) 1 minute (ADLINK TEST) EN50155 Inrush current limit (7.2.8) max 10x nominal input current for less than 1ms

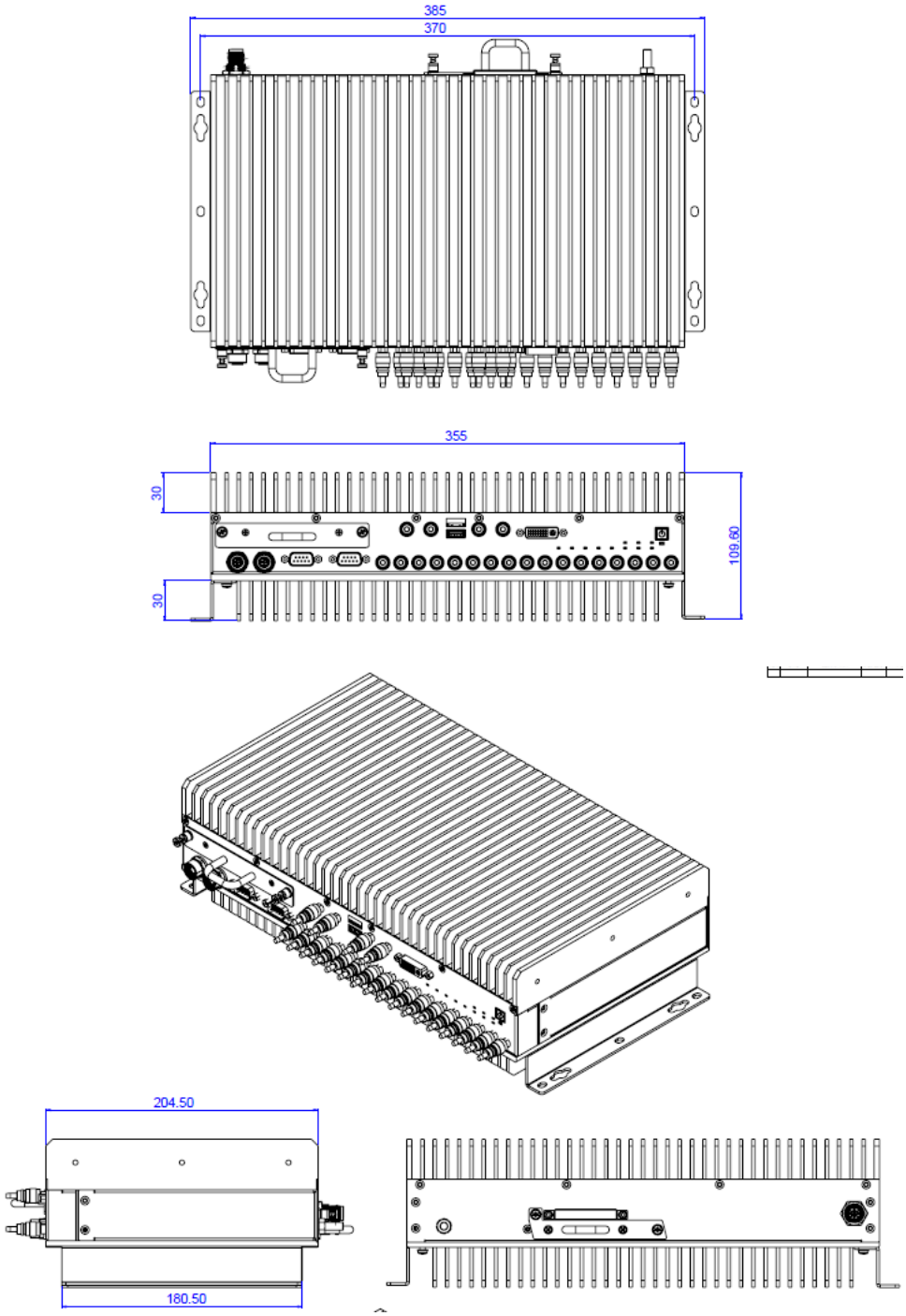
	Power Consumption	TBC W with 100% CPU loading
	Efficiency	≥78% @35°C
GNSS	Frequency bands	GPS/QZSS L1 C/A, GLONASS L10F BeiDou B1I, Galileo E1B/C SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN
	Module	Brand : Ublox P/N : NEO-M8N
Mechanical	Material	Extruded aluminium heatsink with chromate conversion coating cf. MIL-DTL-81706 B (conductive surface)
	Ingress Protection	EN60529 IP41 with optional Mylar cover kit *Note : All LEDS and Reset button will be covered by clear Mylar at time of manufacture*
	PCB Coating	All PCBs conformal coated both sides – HumiSeal 1B73 Coating (AR) Acrylic.
	Dimensions	355 mm (W) x 204.5 mm (D) x 76.4mm(H) (no greater than 86mm)
	Net Weight	6.615KG
Software	BIOS	AMI
	CMOS Battery	Optional – only required to support RTC, only date & time information will be lost muRata CR2032X Battery
	Watchdog	1~255 sec. system reset
	I2C command	SIM power control and SIM switching Via CPLD control
	Operating System	Debian 10.0.0, 64 bit and above *Note:* *ADLINK will support standard system functions but not 3rd party modems or Wi-Fi modules*
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)
	RED Directive 2014/53/EU	ETSI EN301 489-1 V2.2.3 *Note : This standard has not been tested to in its own right, but has been covered by extended EMC testing as instructed by NDL. ADLINK will not provide a certificate or compliance declaration to this standard.*
	EMC	EN50155:2021, EN 55032:2015 /A11:2020 EN 50155: 2021 Clause 4.3.6 EN 50121-1: 2021 EN 50121-3-2: 2016 Including EN 61000-4-2: 2009 **ESD** Criterion A EN 61000-4-3: 2006 + A1: 2008 +A2: 2010 **RS** Criterion A

		(Fill in the gaps 1-1.4GHz and 2.7-5.1GHz as per EN301 489-1) EN 61000-4-4: 2012 **EFT** Criterion A EN 61000-4-5: 2014 + A1: 2021 **Surge** Criterion A EN 61000-4-6: 2014 + AC: 2015 **CS** Criterion A EN50121-3-2:2016 13.4.8 Radio frequency interference susceptibility Table 4 performance criteria A - ETH0/1 1x Antenna port RS485 port EN55016-2-3 13.4.8 Radio frequency emmission test to 6GHz EN50121-3-2:2016 Conducted emission test Table 1 EN50121-3-2:2016 Radiated emission test FCC 47 CFR, Part 15, Subpart B, Class A *Note: Ferrite cores on DC input to be included as standard for FCC compliance* UKCA
	Environmental	EN50155: 2021 EN60068-2-1: 2007 Low temperature storage test -40°C EN50155: 2021 Low temperature start-up test -40°C EN50155: 2021 EN60068-2-2:2007, Cycle B Dry heat test +85°C 10 Minutes EN50155: 2021 EN60068-2-30:2005 Cyclic damp heat test EN60068-2-14: 2000 Rapid temperature variation test -25°C to +70°C EN60068-2-11 Salt mist (Test KA) EN60529 Edition 2.2: 2013 Enclosure protection test IP41 – *compliant with optional Mylar kit* EN50155 method EN61373:2010 Operational Shock 50m/s^2 Pulse 30 ms 6 axis (±X, ±Y, ±Z) Category 1 Class B Vibration PSD 1.01 m^2/s^3 all Axis Category 1 Class B Vertical Simulated long-life 5.72 m^2/s^3 Category 1 Class B IEC60068-2-6 Resonance search vibration test EN60068-2-27:2009, EN60068-2-64:2008 RoHS 2.0 & REACH
Safety	Insulation	EN 50155 13.4.9.2 Insulation measurement test, POWER/RS485/Eth0/Eth1 to chassis at 500Vdc. EN 50155 13.4.9.2 Insulation measurement test, POWER to All I/O port at 500Vdc. EN 50155 13.4.9.3 Voltage withstand test, RS485/Eth0/Eth1 to chassis at 500Vac. EN 50155 13.4.9.3 Voltage withstand test, POWER to chassis at 1,000Vac 50Hz EN 50155 13.4.9.3 Voltage withstand test, POWER to All I/O port at 1,000Vac 50Hz
	Fire Protection	Compliant to EN45545-2:2013+A1:2015 (HL 1-3) EL9 for PCB (R24 / R25) manufactured by ADLINK *Note : Adlink is not responsible for EN45545 for 5G modules and Wifi modules*

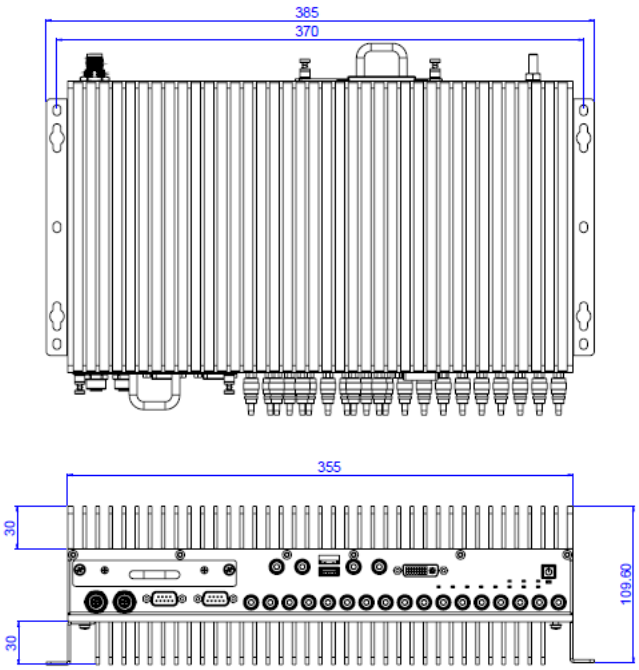
	Rolling stock	BS EN50155:2021
	CE LVD	EN 62368-1: 2014 +A11: 2021
	Protection of system	EN 50124-1:2021 Electrical isolation 2200VDC galvanic isolation of power input to output Power supply interface is floating (1500VDC) All antenna ports are ground referenced
Deliverables		MAC addresses for built in NICs will be printed on rear panel label and logged against chassis serial number at ADLINK A test report will be provided with each system in electronic format, to include system test and Railway Hi-POT test. Both reports to be uploaded to customer portal at time of shipping. The R4600-3A1 units are to be delivered in ESD packaging and all loose accessories to be packaged separately from main unit. Each unit to be packaged individually and labelled as detailed in the Packaging label section. 2.5” SSD Caddy – To include a metal bar at rear of caddy Infineon eSIMs will be free issued to ADLINK for installation on to the SIM tray PCB, this area is still under development at NDL.

4 Mechanical Drawing reference

4.1 External chassis drawings plus mounting plate rear, top and side



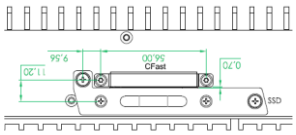
4.2 External chassis drawings plus mounting plate front and underside



Torx screw location

Torx screw location drawing to be added once design is finalised

Note: CFAST cover secured by Torx screws

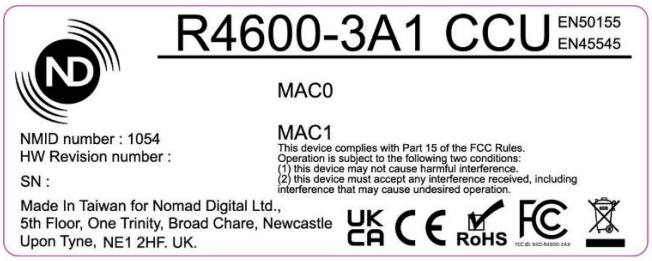


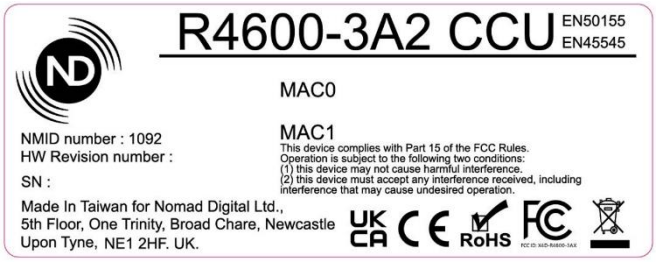
5 Labelling

Rear panel labelling

Front panel with logo

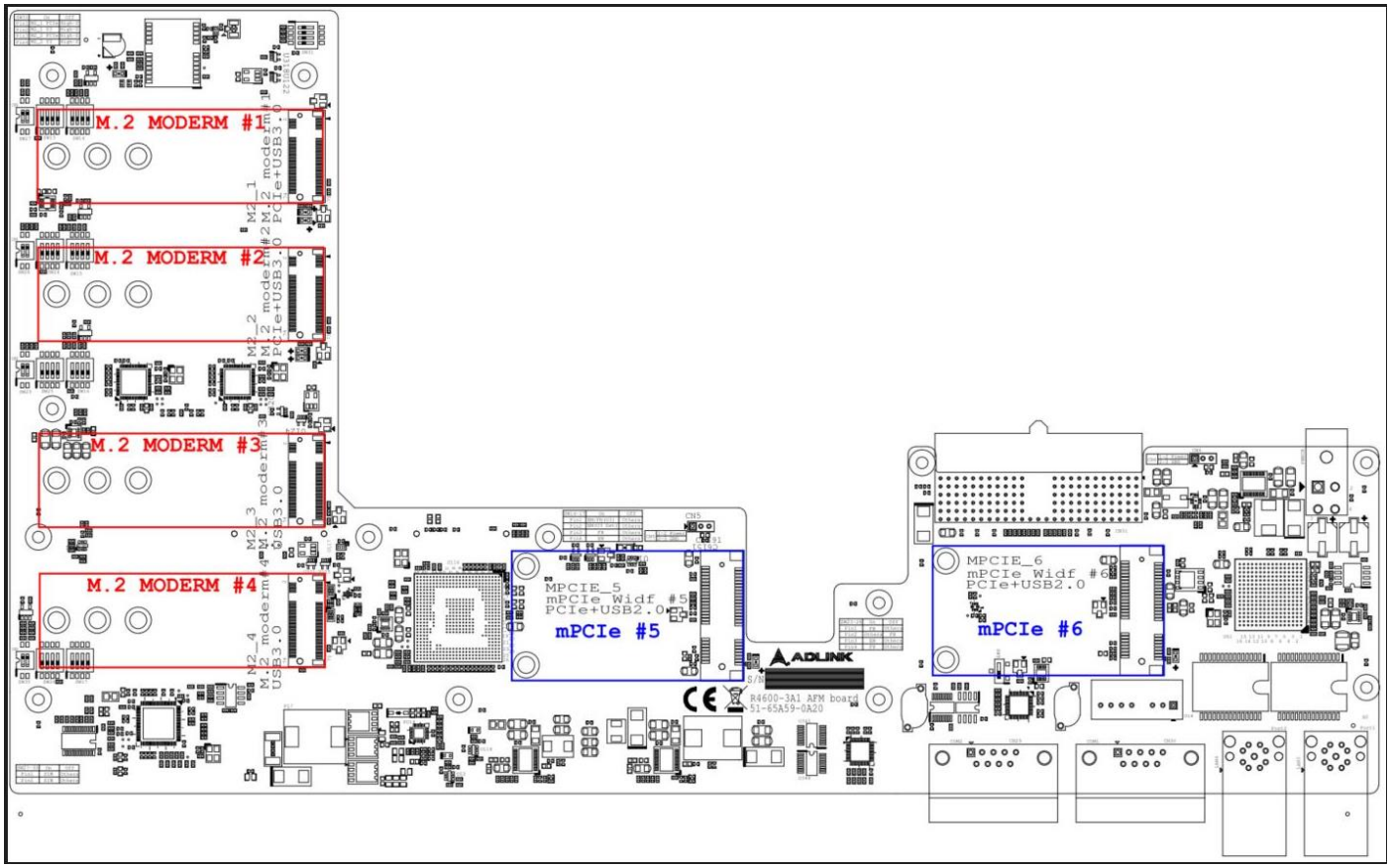
Rear Panel label detail





6 Internal Details

6.1 Drawing of modem area and PCB designations



PCB Print detail

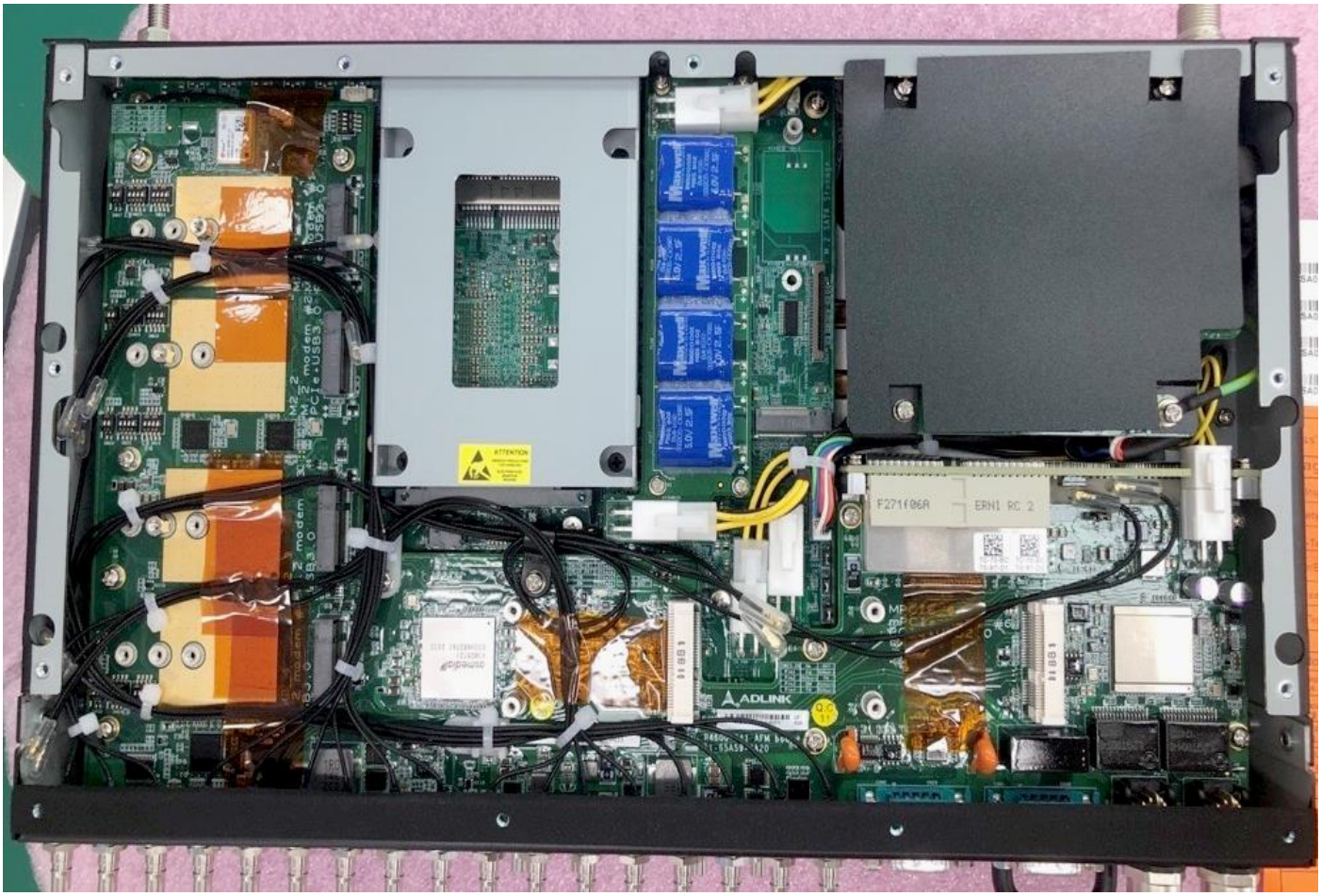
PCB silkscreen drawing to be added once design is finalised

6.2 Cable anchoring points for modems

Drawing of anchor points

Anchor points drawing to be added once design is finalised

Suggested cable routing


ADLINK

6.3 Internal ESD Labelling

ESD Label for modem area

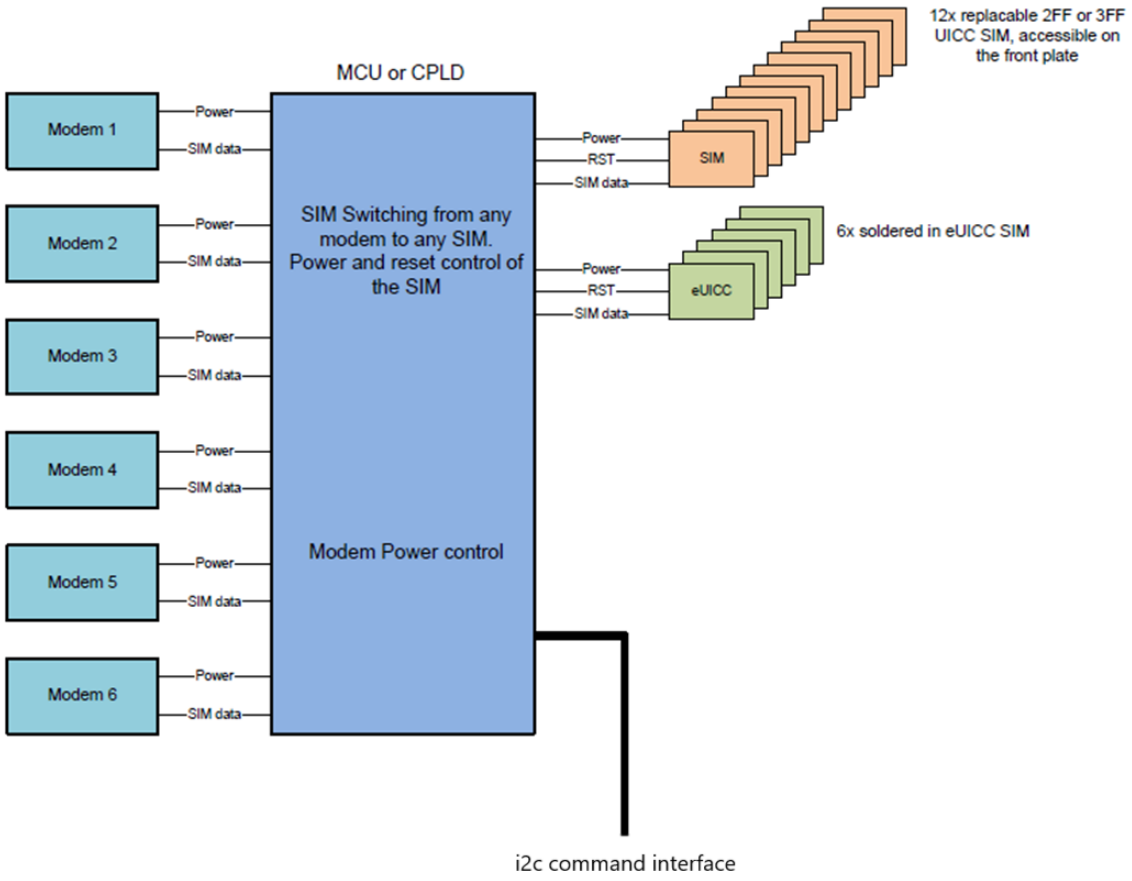
ESD Label fitted to SIM tray

Note: The current SIM tray supports MFF2 type eSIM only.

6.4 Suggested Pigtail routing

7 Design Details

7.1 SIM Farm Diagram



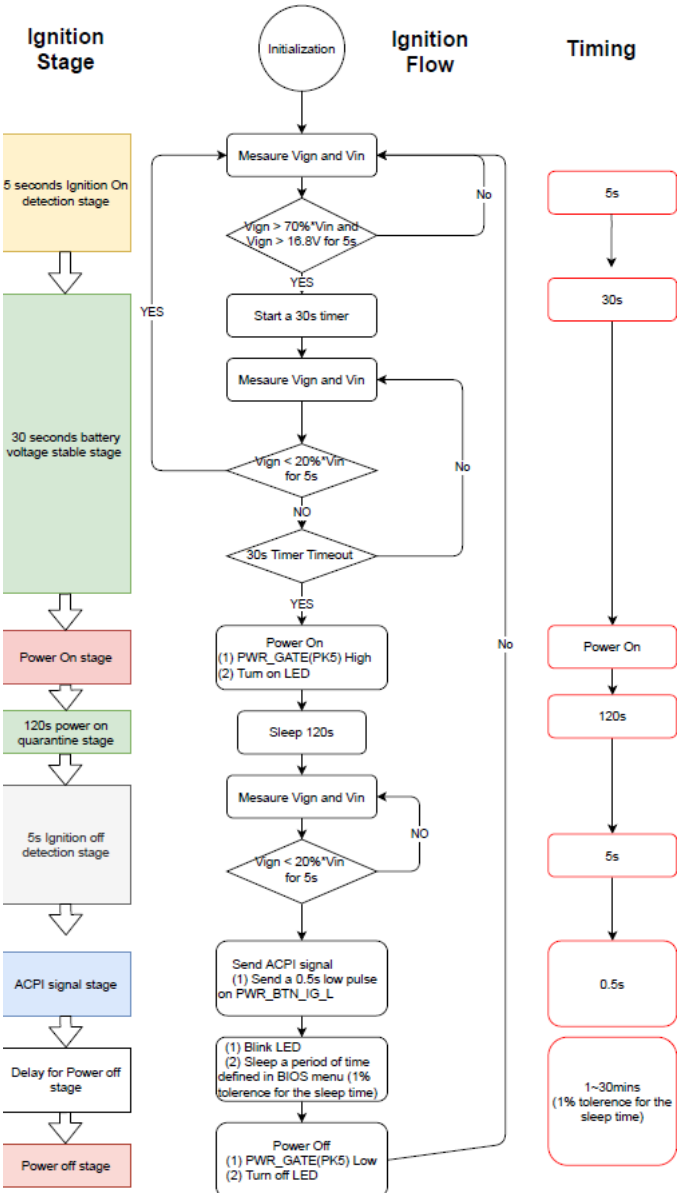
Note : Guidance for SIM Farm :

I2C is used to control the switches.

When Power is on, Reset is held on

When selecting the required SIM, release RESET, wait 600uS before talking to the SIM

7.2 Power ignition control



Note : BIOS will provide Power off delay time option: 1, 4,10,15,30 minutes. Flow diagram to be updated to match Firmware 1v5_4v1.

8 External Connector details and Pin out

8.1 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)

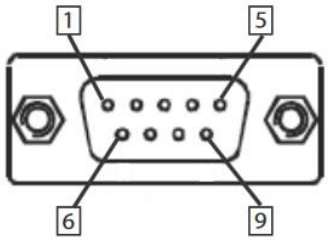
	Pin	Signal name
	1	MDI_T_P0
	2	MDI_T_N0
	3	MDI_T_P1
	4	MDI_T_N1
	5	MDI_T_P3
	6	MDI_T_N3
	7	MDI_T_N2
	8	MDI_T_P2

USB 3.2 Gen1 5G x1 Ports

USB 3.2 Gen 1 5G x1 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

8.2 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

9 Accessory Kit

9.1 Contents

QTY	Item	Description
2	Wall Bracket	Wall bracket
6	M4.0 Screw (P head,L6 with serrated washer, Nylok)	Screws to mount wall bracket to system
4	M2.5 Screw (P head, L8 with double washer)	mPCIe mounting screws
4	M2.5 Screw (P head, L6 with double washer)	M.2 mounting screws
2	mPCIe plastic bracket	Fixture bracket for mPCIe modems
4	m.2 plastic bracket	Fixture bracket for m.2 modems
4	M3.0 Countersunk screw (FLAT-HEAD,L4,BLACK, Nylok)	Screws to mount SSD into SSD caddy

The end of Document