THALES

Cinterion® 5G M.2 Data Card MV31-W

Hardware Interface Description

Version: 00.058
DocId: MV31-W_HID_v00.058

Document Name:	**5G M.2 Data Card MV31-W**
Version:	**00.058**
Date:	**2021-02-10**
DocId:	**MV31-W_HID_v00.058**
Status	**Public / Preliminary**
Supported products:	**FR1 Sub 6 variants (See Section 1.1)**

Contents

Tables

Figures

0 Document History

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.057a
New document: Cinterion® MV31-W Hardware Interface Description, Version **00.058**

Chapter	What is new
3.1	Changed Table 2 and Table 3 regarding to WAKE_ON_WWAN# signal
3.2.2.4	Revised chapter WAKE_ON_WWAN# signal is now supported

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.057
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.057a

Chapter	What is new
1.1	Revised Table 1 regarding eSIM information
2.1	Added PCB tolerance at maximum height and revised description of SIM and SIM interface
2.2	Revised Figure 3 regarding 2nd SIM Interface
3.1	Revised Table 2 regarding UIM_1 and Table 3 regarding MIPI interface
3.2.2.1	Revised chapter regarding control circuit
3.2.3.2	Revised chapter
3.2.7	Revised Design Guidelines and Figure 12
3.2.8	Added information that 2nd interface is reserved for future use
3.2.8.1	Changed sample ESD protection component to NUP4114 and added capacitors
5.5	Replaced baseband chip name by product name
5.8	Added Chapter for Mounting Advice

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.050
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.057

Chapter	What is new
2.1, 3.1	Changed maximum supply voltage to 4.8V
5.7	Revised Table 25 Summary of reliability test conditions
6.2	Revised Table 37 EN-DC Configurations

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.007
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.050

Chapter	What is new
Throughout document	Removed details about mmWave antenna connectors as mmWave bands are not supported with this product variant.
2	Revised Figure 1 and Figure 2 showing MV31-W top and bottom view.
3.1	Revised signal properties in Table 2.
3.2.5	Added resistor value to Figure 14.
4.1.1	Added GNSS frequencies.
5.2	Added max temperature for automatic thermal shutdown.
5.6	Revised ESD information.
6.1	Removed some comments supported CA configuration tables.

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.006
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.007

Chapter	What is new
5.4	Revised power supply ratings.
5.5	Added timing Sequence Requirement together with its subsections.
6, 6.1, 6.2	New Appendix with Supported CA Configurations and Supported EN-DC Configurations.

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.005
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.006

Chapter	What is new
2.1	Revised supported Bands.
2.1, 3.1, 5.4	Changed lowest supply voltage to 3.14V (Table 3).
3.1	Revised Table 2 column Pin Type.
3.2.6	Revised USB interface description.
4	Revised notes of Table 12.

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.004
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.005

Chapter	What is new
---	Removed information about FR2 bands.

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.003
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.004

Chapter	What is new
---	Removed information about mmWave Variants.
2.1	Revised supported bands.

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.002
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.003

Chapter	What is new
3	RESET# is not supported.
3.1	Added characteristics in Table 3 for mmWave_1P85.
3.2.3.1	Added Antenna Tuner example (Figure 10).
3.2.4, 3.2.5	Signal description improved.
4.1	Revised Table 13.
4.1.1	Revised Table 15.
5.3	Inserted new chapter Thermal Design Guidelines.

Preceding document: Cinterion® MV31-W Hardware Interface Description, Version 00.001
New document: Cinterion® MV31-W Hardware Interface Description, Version 00.002

Chapter	What is new
2.3	Added information about M.2 Application Connector.
2.3	Figure 6: Thermal Pad added.
3	WAKE_ON_WWAN# is not supported.
3	2nd PCI lane added for future use.
3	Change signal direction for signals mmWave_Enable_x in Table 2 and Table 3.
3.2.3	Revised signal description.

New document: Cinterion® MV31-W Hardware Interface Description, Version 00.001

Chapter	What is new
--	Initial document setup.

1 Introduction

This document[1] describes the hardware of the Cinterion® 5G M.2 Data Card MV31-W product. It helps you quickly retrieve interface specifications, electrical and mechanical details, and information on the requirements to be considered for integrating further components.

CAUTION: M.2 Add-in Card are not designed or intended to support Hot-Swap or Hot-Plug connections. Performing Hot-Swap or Hot-Plug may pose danger to the M.2 Add-in Card, to the system Platform, and to the person performing this act.

1.1 Ordering Information

Table 1: 5G Modem Card Variants

Product	Interface	Band Support	eSIM	Ordering information
MV31-W	USB	FR1 (Sub 6)	Yes	L30960-N6910-A100
MV31-W	USB	FR1 (Sub 6)	No	L30960-N6910-B100
MV31-W	PCIe®	FR1 (Sub 6)	Yes	L30960-N6920-A100
MV31-W	PCIe®	FR1 (Sub 6)	No	L30960-N6920-B100
Starter Kit 5G Data Card	USB	FR1 (Sub 6)		L30960-N6901-A100
Starter Kit 5G Data Card	PCIe®	FR1 (Sub 6)		L30960-N6902-A100

Where necessary a note is made to differentiate between the various product variants.

1.2 Related Documents

[1] MV31-W Release Note
[2] PCI Express® M.2 Specification, Revision 1.1, December 9, 2016, PCI-SIG
[3] PCI Express® Card Electromechanical Specification, Revision 1.1, March 28, 2005
[4] Universal Serial Bus Specification[2], Revision 2.0,April 27, 2000, USB.ORG
[5] Universal Serial Bus 3.2 Specification[2] September 22, 2017, USB 3.0 Promoter Group

1. The document is effective only if listed in the appropriate Release Notes as part of the technical documentation delivered with your Thales product.
2. The specification is available for download on http://www.usb.org/developers/docs/

1.3 Terms and Abbreviations

Abbreviation	Description
3FF	Third Form Factor
3GPP	3rd Generation Partnership Project
CE	Conformité Européene (European Conformity)
CSD	Circuit Switched Data
CTM	Cellular Text Telephone Modem
EN-DC	E-UTRAN New Radio Dual Connectivity
ETS	European Telecommunication Standard
FCC	Federal Communications Commission (U.S.)
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HSPA	High Speed Packet Access
HSDPA	High Speed Download Packet Access
I/O	Input/Output
IC	Integrated Circuit
IEC	International Electrotechnical Commission
ISO	International Standards Organization
ITU	International Telecommunications Union
LAA	Licensed Assisted Access
LED	Light Emitting Diode
Mbps	Mbits per second
MFF2	M2M UICC Form Factor 2
MMI	Man Machine Interface
MNO	Mobile Network Operator
MO	Mobile Originated
MT	Mobile Terminated
PBCCH	Packet Switched Broadcast Control Channel
PCI	Peripheral Component Interconnect (personal computer bus)
PDU	Protocol Data Unit
PIN	Personal Identification Number
PPP	Point-to-point protocol
R&TTE	Radio and Telecommunication Terminal Equipment
RF	Radio Frequency
RFFE	RF Front End
RLP	Radio Link Protocol

Abbreviation	Description
RoHS	Restriction of the use of certain hazardous substances in electrical and electronic equipment.
S4	Microsoft Windows power state for Hibernation.
S5	Microsoft Windows power state for Soft (power) Off.
SAR	Specific Absorption Rate
SIM	Subscriber Identification Module
SMS	Short Message Service
TTY	Text Telephone
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USSD	Unstructured Supplementary Service Data

2 Product Concept

Figure 1 shows the top view and Figure 2 the bottom view of 5G M.2 Data Card MV31-W.

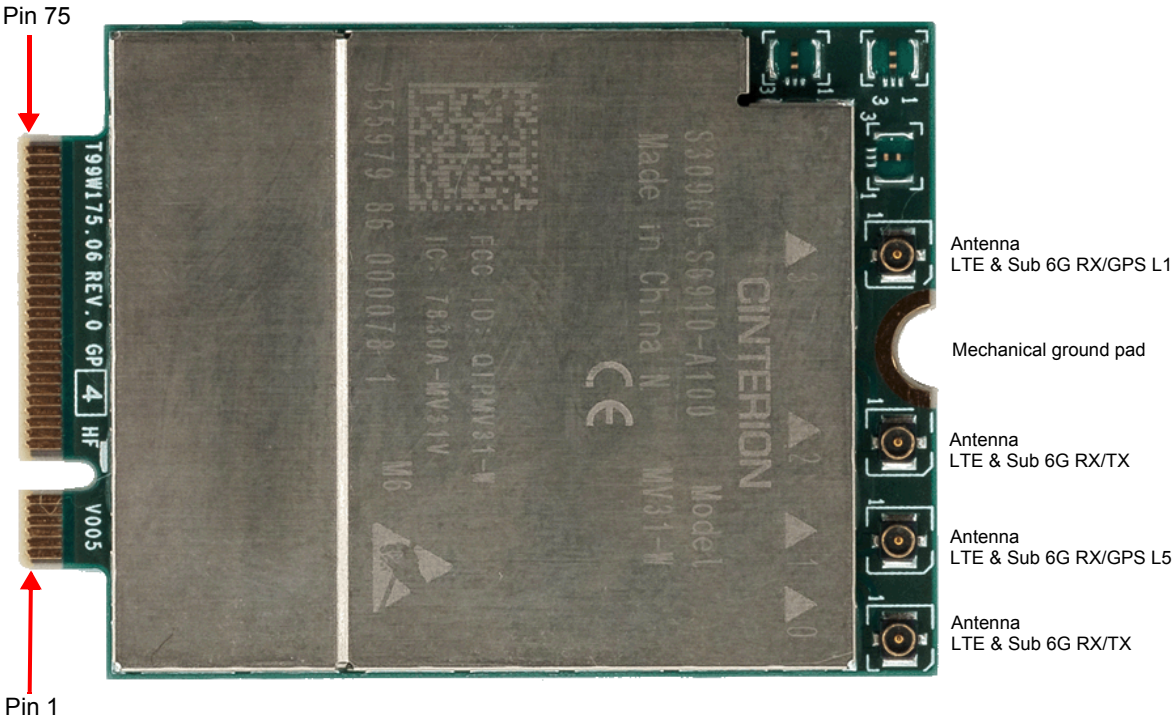


Figure 1: 5G M.2 Data Card MV31-W top view

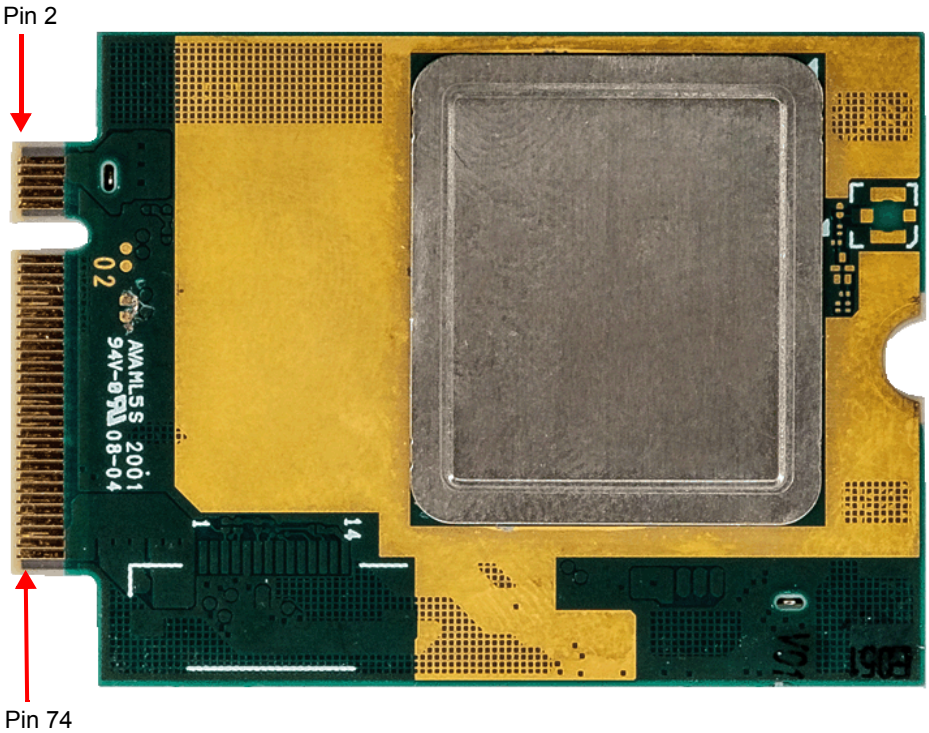


Figure 2: 5G M.2 Data Card MV31-W bottom view

2.1 Key Features at a Glance

Feature		Implementation
General		
5G	Bands	FR1 (Sub 6G): FDD: n1, n2, n3, n5, n7, n8, n12, n20, n28, n66, n71 TDD: n38, n41, n77, n78, n79
	Band combinations	For supported E-UTRAN New Radio Dual Connectivity (EN-DC) see Section 6.2
	4x4 MIMO	n1, n2, n3, n7, n66, n38, n41, n77, n78, n79
	Category	3GPP Rel 15
	Output Power	FR1 (Sub 6G): n41, n77, n78, n79: 26dBm +2/-3dB all other bands: 23dBm ±2dB
4G	Bands	FDD: B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B32, B66, B71 TDD: B34, B38, B39, B40, B41, B42, B48 LAA: B46 (DL only)
	Band combinations	For supported carrier aggregations (CA) see Section 6.1
	4x4 MIMO	B1, B2, B3, B4, B7, B25, B30, B66, B38, B40, B41, B42, B48
	RX Diversity	all LTE bands
	Category	UE Cat. 13 (UL: 150Mbps) + UE Cat. 20 (DL: 2Gbps); 7xDL CA, 3xUL CA (Intra-band), 5xDL CA+4X4 MIMO (Up to UE Cat20)
	Output Power	B41: 26dBm +2/-3dB all other bands: 23dBm ±2dB
3G	Bands	Bd.I, Bd.II, Bd.IV, Bd.V (Bd.VI, Bd.XIX), Bd.VIII, Bd.IX
	RX Diversity	all 3G bands
	Category	DC-HSPA+ – DL Cat. 24 (42Mbps) / UL Cat. 6 (11Mbps) HSUPA – UL 5.76Mbps Compressed mode (CM) supported according to 3GPP TS25.212
	Output Power	all bands: 24dBm +1.7/-3.7dB
GNSS		Dual-Frequency GNSS: GPS: L1; L5 GLONASS: G1 Beidou: B1 Galileo E1; E5a
SIM		Dual SIM with eSIM on board, Dual SIM Single Standby (DSSS)
Power supply		3.3V (typical, min. 3.14V,max. 4.8V)

Feature	Implementation
Temperature	Normal operation: -30°C to +70°C Extended operation: -40°C to +85°C Storage: -30°C to +85°C
Physical	Dimensions: 42 mm × 30 mm × 2.5 mm maximum height: 2.6 mm (add PCB tolerance=0.1mm) Weight: approx. 8 g
RoHS	All hardware components fully compliant with EU RoHS Directive
Interfaces	
Form factor	M.2 3042 S3 Key B
Application connector	PCI Express® M.2 Card system connector (75 pin golden finger, Key ID B)
USB	USB 2.0
	MV31-W USB only: USB 3.1 Gen.2 SuperSpeed (10Gbps) USB configuration supported: Windows(TM)10: MBIM, GNSS Linux: DIAG, MBIM/RmNet, Modem, NMEA
PCIe®	**MV31-W PCIe®only:** PCIe® configuration supported: Windows(TM)10: MBIM, GNSS Linux: DIAG, MBIM, Modem, NMEA
Driver	Windows(TM) 10: support both PCIe® and USB interfaces
UICC	Supported SIM/USIM cards: 3V, 1.8V External SIM card reader has to be connected via application connector.
Antenna	4 MHF4 type connectors for UMTS/LTE/5G (Sub 6G) main antenna and UMTS/LTE/5G (Sub G6) Diversity/MIMO antennas

2.2 System Overview

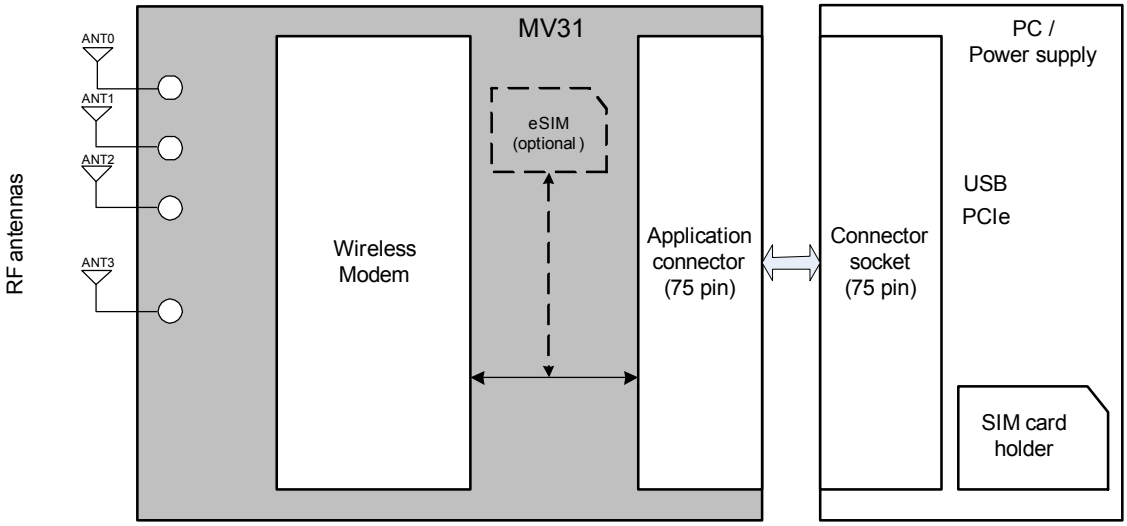


Figure 3: 5G M.2 Data Card MV31-W system overview

2.3 Mechanical Dimensions

The mechanical dimensions for PCI Express M.2 Cards with a 3042 form factor are specified in [2] and shown in Figure 4, Figure 5 and Figure 6.

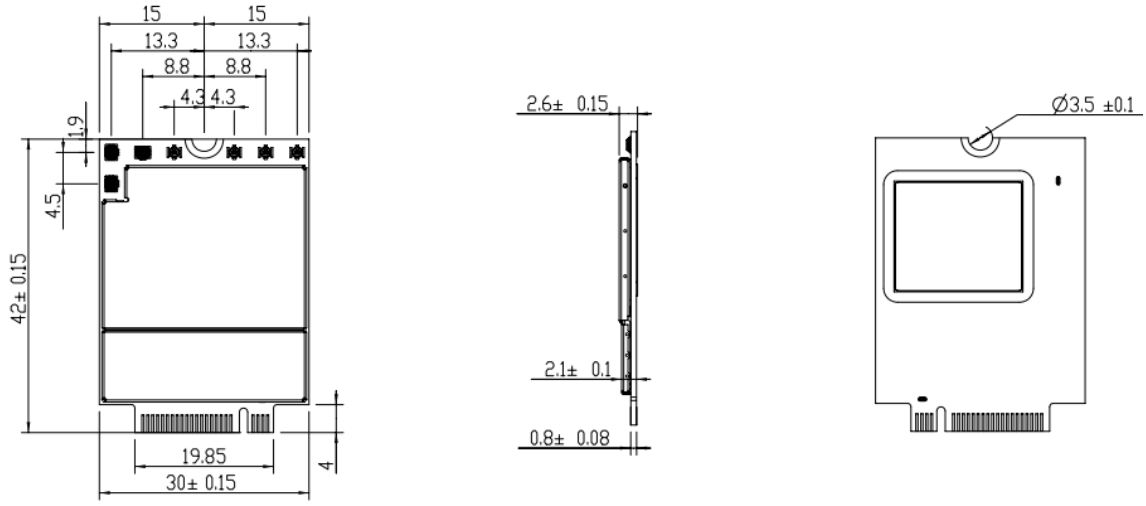


Figure 4: 5G M.2 Data Card MV31-W Dimensions

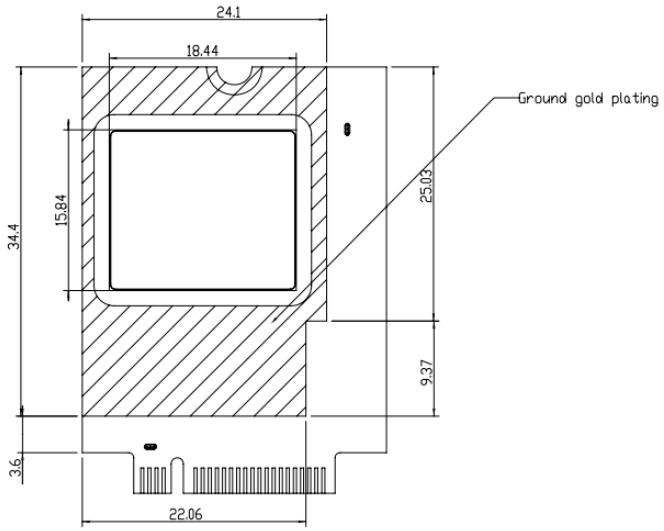


Figure 5: 5G M.2 Data Card MV31-W Ground area (with gold plating) on bottom side

For mounting the 5G M.2 Data Card a H2.3-S3 - Stack-up Top Mount Single-sided Add-in Card for 1.50 mm Maximum Component Height should be used.

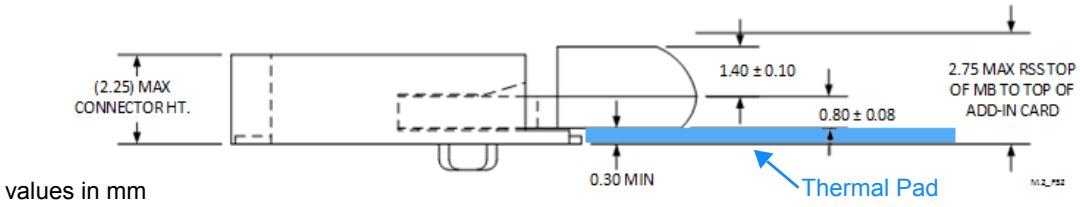


Figure 6: 5G M.2 Data Card MV31-W on application board (height) [2]

The area under the 5G M.2 Data Card on the Application Board should be free of components and signals.

3 Application Connector Interface

3.1 Pin Assignments and Electrical Description

Table 2 matches the 5G M.2 Data Card MV31-W pin assignments at the 75-pin application connector to the pin assignments specified in [2]. Table 3 lists electrical characteristics of the assigned and available pins at the application connector interface.

Table 2: Pin assignments

Pin No.	5G M.2 Data Card MV31-W pin name[1]	Comments	PIN Type
1	CONFIG_3	Add-in Card Configuration 3, Section 3.2.11	Output
3	GND		
5	GND		
7	USB+	USB Data, Section 3.2.6.1	
9	USB-		
11	GND		
Key ID B			
21	CONFIG_0	Add-in Card Configuration 0,Section 3.2.11	Output
23	WAKE_ON_WWAN#	Wake on WWAN, Section 3.2.2.4	Output 1.8V
25	DPR_1	Dynamic Power Reduction (SAR), Section 3.2.5	Input 1.8V
27	GND		
29	USB3.1-Tx-	USB 3.1 (USB Tx-), Section 3.2.6.2	Output
	PETn1	2nd PCIe® lane Tx-, Section 3.2.7	
31	USB3.1-Tx+	USB 3.1 (USB Tx+), Section 3.2.6.2	
	PETp1	2nd PCIe® lane Tx+, Section 3.2.7	
33	GND		
35	USB3.1-Rx-	USB 3.1 (USB Rx-), Section 3.2.6.2	Input
	PERn1	2nd PCIe® lane Rx-, Section 3.2.7	
37	USB3.1-Rx+	USB 3.1 (USB Rx+), Section 3.2.6.2	
	PERp1	2nd PCIe® lane Rx+, Section 3.2.7	
39	GND		
41	PETn0	1st PCIe® lane Tx+/-, Section 3.2.7	Output
43	PETp0		
45	GND		

Table 2: Pin assignments

Pin No.	5G M.2 Data Card MV31-W pin name[1]	Comments	PIN Type
47	PERn0	1st PCIe® lane Rx+/-, Section 3.2.7	Input
49	PERp0		
51	GND		
53	REFCLKn	PCIe® Reference Clock, Section 3.2.7	Input
55	REFCLKp		
57	GND		
59	mmWave_Enable_1	Reserved for mmWave product variant	Output 1.8V
61	mmWave_Enable_2	Reserved for mmWave product variant	Output 1.8V
63	mmWave_Enable_3	Reserved for mmWave product variant	Output 1.8V
65	mmWave_1P85	Reserved for mmWave product variant	Output 1.9V
67	RESET#	Asynchronous RESET, Section 3.2.2.2 (not supported by MV31-W)	Input 1.8V
69	CONFIG_1	Add-in Card Configuration 1, Section 3.2.11	Output
71	GND		
73	GND		
75	CONFIG_2	Add-in Card Configuration 2, Section 3.2.11	Output
2	3V3	Power supply 3.3V, Section 3.2.1	
4	3V3		
6	FULL_CARD_POWER_OFF#	Section 3.2.2.3	Input 3.3V
8	W_DISABLE1#	Disable WWAN on the Data Card, Section 3.2.2.1	Input 3.3V
10	LED_1#	Active low signal, Section 3.2.10	Output Open drain
Key ID B			
20			internal not connected
22	ANT_TUNER_CONFIG	Antenna tuner mode control, Section 3.2.3.2	Input 1.8V
24	ANT_TUNER_POWER	Antenna tuner power	Output 1.8V
26	W_DISABLE2#	disable GNSS on Data Card, Section 3.2.2.1	Input 3.3.V
28	DPR_2	Dynamic Power Reduction (SAR), Section 3.2.5	Input 1.8V

Table 2: Pin assignments

Pin No.	5G M.2 Data Card MV31-W pin name[1]	Comments	PIN Type
30	UIM_1_RESET	UIM_1 connect to external SIM socket, Section 3.2.8	Output
32	UIM_1_CLK		Output
34	UIM_1_DATA		Input/Output
36	UIM_1_PWR		Output
38	WLAN_Tx_EN	WLAN output to WWAN, Section 3.2.4	Input 1.8V
40	SIM DETECT_2	Reserve for future use, Section 3.2.8	Input 1.8V
42	UIM_2_DATA		Input/Output
44	UIM_2_CLK		Output
46	UIM_2_RESET		Output
48	UIM_2_PWR		Output
50	PERST#	PE-Reset, Section 3.2.7	Input 3.3V
52	CLKREQ#	Clock Request, Section 3.2.7	Input/Output 3.3V
54	PEWAKE#	PCIe® WAKE, Section 3.2.7	Input/Output Open Drain 3.3V
56	MIPI_DATA	For external tunable antenna (MIPI), Section 3.2.3	Input/Output 1.8V
58	MIPI_CLK		Output 1.8V
60	LAA_n79_Tx_EN	WWAN output to WLAN, Section 3.2.4	Output 1.8V
62	COEX_RXD	UART I/F for LTE / Wi-Fi coexistence, Section 3.2.4	Input 1.8V
64	COEX_TXD		Output 1.8V
66	SIM DETECT_1	SIM 1 detect, Section 3.2.8	Input 1.8V
68	GPIO	General Purpose I/O, Section 3.2.9	Input/Output 1.8V
70	3V3	Power supply 3.3V, Section 3.2.1	
72	3V3		
74	3V3		

1. Connected lines (various): ; Power Supply: ; Ground lines (GND): ;
PCIe® variant only ; USB 3.1 variant only
Not connected lines (nc): ; Do not connect, Reserved for future use

Table 3: Electrical description of connector interface pins

Function	Pin name	IO	Signal form and level	Comment
Power supply	3V3	I	$V_I$max = 4.8V $V_I$norm = 3.3V $V_I$min = 3.14V	
	GND		Ground	Application Ground
Control Signals	W_DISABLE1#	I	V_{IH}max = 3.36V V_{IH}min = 2.145V V_{IL}max = 1.155V	These signals disable the WWAN (W_DISABLE1#) and GNSS W_DISABLE2#) operation of the module. It is required to drive these lines low by an open drain or open collector driver connected to GND and external pull up to 3.3V with 10KΩ. Test point recommended.
	W_DISABLE2#	I		
	RESET#	I	--	Not supported.
	FULL_CARD_POWER_OFF#	I	V_{IH}max = 3.36V V_{IH}min =2.97V V_{IL}max = 1.0V	It's internally pulled down by 100kΩ resistor. 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO. Test point recommended.
	WAKE_ON_WWAN#	O	V_{IL}max = 0.8V V_{IH}min = 2.0V V_{IH}max = 3.8V V_{OL}max = 0.2V at I = 4mA V_{OH}min = TBD. at I = TBD. V_{OH}max = TBD.	Open Drain with external pull up. The given input rating is the maximum voltage that can be applied to this pad.
Tunable Antenna	MIPI_DATA	I/O	V_{IL}max = 0.54V V_{IH}min = 1.26V V_{IH}max = 2.1V V_{OL}max = 0.45V at I = TBD. V_{OH}min = 1.35V at I = TBD. V_{OH}max = 1.8V	If unused, terminate line by 50Ω.
	MIPI_CLK	O	V_{OL}max = 0.45V at I = TBD. V_{OH}min = 1.35V at I = TBD. V_{OH}max = 1.8V	If unused, terminate line by 50Ω.
	ANT_TUNER_CONFIG	I	V_{IL}max = 0.54V V_{IH}min = 1.26V V_{IH}max = 2.1V	
	ANT_TUNER_POWER	O	V_{OL}max = 0.012V at I = TBD. V_{OH}min = 1.504V at I = TBD. V_{OH}max = 2.0V.	

Table 3: Electrical description of connector interface pins

Function	Pin name	IO	Signal form and level	Comment
WWAN/ WiFi Coexis-tence Con-trol	LAA_n79_Tx_EN	O	V_{OL}max = 0.45V at I = TBD. V_{OH}min = 1.35V at I = TBD. V_{OH}max = 1.8V	
	COEX_RXD	I	V_{IL}max = 0.54V V_{IH}min = 1.26V V_{IH}max = 2.1V	For future use.
	COEX_TXD	O	V_{OL}max = 0.45V at I = TBD. V_{OH}min = 1.35V at I = TBD. V_{OH}max = 1.8V	For future use.
	WLAN_Tx_EN	I	V_{IL}max = 0.54V V_{IH}min = 1.26V V_{IH}max = 2.1V	
Dynamic Power Reduction	DPR_1 DPR_2	I	DPR_1: V_{IH}max = 1.89V V_{IH}min = 1.17V V_{IL}max = 0.63V DPR_2: V_{IL}max = 0.54V V_{IH}min = 1.26V V_{IH}max = 2.1V	It is required to drive this line low by an open drain or open collector driver connected to GND. If unused keep line open.
USB 2.0	USB_D-	I/O	Full and High speed differential lines according to USB 2.0 (refer to [4]).	Test point recommended. USB High Speed mode operation requires a differential impedance of 90Ω.
	USB_D+	I/O		
USB 3.1	USB3.1-Rx+ USB3.1-Rx-	I	SuperSpeed differential lines according to USB3.1 Gen2, 10Gbps (refer to [5])	USB SuperSpeed mode operation requires a differential impedance of 72Ω to 120Ω.
	USB3.1-Tx+ USB3.1-Tx-	O		

Table 3: Electrical description of connector interface pins

Function	Pin name	IO	Signal form and level	Comment
PCIe®	PERST#	I	RPU: 10K ohm V_{OH}max = NA V_{IH}max = 3.8V V_{IH}min = 2.0V V_{IL}max = 0.8V A Low will immediately reset the data card.	This line must be driven low by an open drain or open collector driver connected to GND as long as the module turns off. If unused keep line open. Test point recommended.
	CLKREQ#	I/O	V_{IL}max = 0.8V V_{IH}min = 2.0V V_{IH}max = 3.8V V_{OL}max = 0.2V at I = 4mA V_{OH}min = TBD. at I = TBD. V_{OH}max = TBD.	Open Drain with external pull up. The given input rating is the maximum voltage that can be applied to this pad.
	PEWAKE#	I/O	V_{IL}max = 0.8V V_{IH}min = 2.0V V_{IH}max = 3.8V V_{OL}max = 0.2V at I = 4mA V_{OH}min = TBD. at I = TBD. V_{OH}max = TBD.	Open Drain with external pull up. The given input rating is the maximum voltage that can be applied to this pad.
	PERp0, PERp1, PERn0, PERn1	I	PCIe® differential lines according to PCI Express® Card Electromechanical Specification	
	PETp0, PETp1, PETn0, PETn1	O	PCIe® differential lines according to PCI Express® Card Electromechanical Specification	
	REFCLKp/ REFCLKn	I	PCIe® differential lines according to PCI Express® Card Electromechanical Specification	
3V SIM card interfaces (2x)	UIM_1_RESET UIM_2_RESET	O	V_{OL}max = 0.59V at I = TBD. V_{OH}min = 2.36V at I = TBD. V_{OH}max = 2.95V	Maximum cable length or copper track should be not longer than 100mm to SIM card holder. If 2nd SIM interface not used, keep line open.
	UIM_1_DATA UIM_2_DATA	I/O	V_{IL}max = 0.59V V_{IL}min = -0.3V V_{IH}min = 2.065V V_{IH}max = 3.25V V_{OL}max = 0.4V. at I = TBD. V_{OH}min = 2.065V at I = TBD. V_{OH}max = 2.95V	
	UIM_1_CLK UIM_2_CLK	O	V_{OL}max = 0.59V at I = TBD. V_{OH}min = 2.065V at I = TBD. V_{OH}max = 2.95V	
	UIM_1_PWR UIM_2_PWR	O	$V_O$min = 2.7V $V_O$typ =2.95V $V_O$max = 3.05V $I_O$max = TBD.	

Table 3: Electrical description of connector interface pins

Function	Pin name	IO	Signal form and level	Comment
1.8V SIM card interface (2x)	UIM_1_RESET UIM_2_RESET	O	V_{OL}max = 0.36V at I = TBD. V_{OH}min = 1.44V at I = TBD. V_{OH}max = 1.8V	Maximum cable length or copper track should be not longer than 100mm to SIM card holder. If 2nd SIM interface not used, keep line open.
	UIM_1_DATA UIM_2_DATA	I/O	V_{IL}max = 0.36V V_{IL}min = -0.3V V_{IH}min = 1.26V V_{IH}max = 2.1V V_{OL}max = 0.3V at I = TBD. V_{OH}min = 1.26V at I = TBD. V_{OH}max = 1.8V	
	UIM_1_CLK UIM_2_CLK	O	V_{OL}max = 0.36V at I = TBD. V_{OH}min = 1.26V at I = TBD. V_{OH}max = 1.8V	
	UIM_1_PWR UIM_2_PWR	O	$V_O$min = 1.65V $V_O$typ =1.8V $V_O$max = 1.95V $I_O$max = TBD.	
SIM Detection	SIM_DETECT_1 SIM_DETECT_2	I	V_{IL}max = 0.54V V_{IH}min = 1.26V V_{IH}max = 2.1V	internal pull-up resistor
GPIO interface	GPIO	I/O	V_{IL}max = 0.54V V_{IH}min = 1.26V V_{IH}max = 2.1V I_{IH}PD = 1uA I_{IL}PU = -1uA I_{High-Z} = 1uA V_{OL}max = 0.45V at I = TBD. V_{OH}min = 1.35V at I = TBD. V_{OH}max = 1.8V	GPIO is reserved for future use. If unused keep lines open.
Status	LED_1#	O	V_{OL}max = 0.66V. at I = TBD. V_{OH}min = 2.64V. at I = 9~12 (sink current) V_{OH}max = 3.3V	Open Drain output
Add-in Card configuration pins	CONFIG_0..3		GND or NC (Not Connected/Floating) I = 0mA	The host must provide a pull up resistor for each of these signals to either 1.8 V or 3.3 V.

3.2 Characteristics

3.2.1 Power Supply and Ground

The 5G M.2 Data Card MV31-W uses the five 3V3 pins and 11 GND pins listed in Section 3.1. All pins have to be used in parallel.

3.2.2 Control Signals

3.2.2.1 W_DISABLE1#, W_DISABLE2# Signals

W_DISABLE1# controls the WWAN part of the data card. When this signal is driven low, the WWAN part is disabled.

W_DISABLE2# controls the GNSS part of the data card. When this signal is driven low, the GNSS part is disabled.

It is recommended to control W_DISABLE1# and W_DISABLE2# lines with an open collector transistor.

3.2.2.2 RESET#

Asynchronous RESET# pin (active low) is not supported by MV31-W.

3.2.2.3 FULL_CARD_POWER_OFF#

The MV31-W can be controlled to power on/off by the FULL_CARD_POWER_OFF# pin.

Table 4: FULL_CARD_POWER_OFF# States

Signal State	Data Card State
Low	Powers off
High	Powers on

3.2.2.4 WAKE_ON_WWAN#

The WAKE_ON_WWAN# signal is for power saving:
1. MV31-W always listening at very low power in idle mode
2. MV31-W will wake up mother board via WAKE_ON_WWAN# signal, when this feature is enabled by AT+WOWWAN_ENABLE=1 and the receiving SMS contains the password <pw>, which is set by AT+WOWWAN_PASSWORD=<pw>. For details refer to [2].
3. The platform will power on when triggered by the MV31-W.

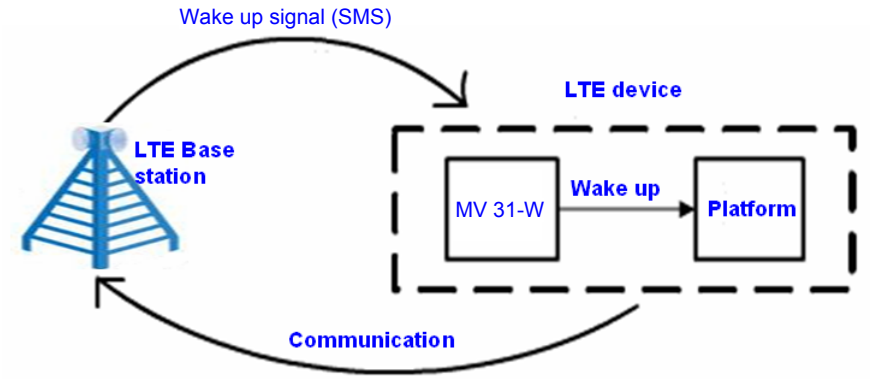


Figure 7: Wake-up scenario

The WAKE_ON_WWAN# signal is used to wake up the host. It is open drain and should be pulled up at the host side. When MV31-W needs to wake up the host, it will output a one second low pulse, shown in Figure 8.

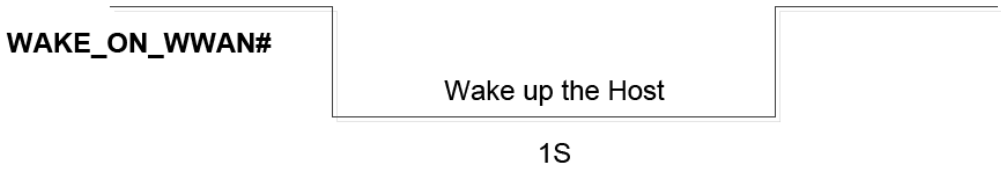


Figure 8: Wake-up signal

A typical connection in Platform/System shows Figure 9.

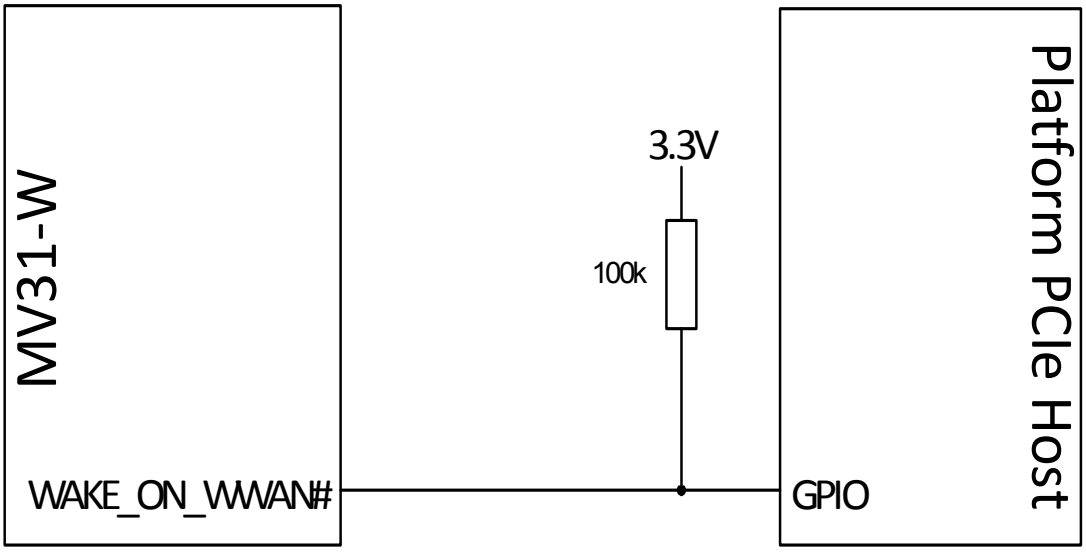


Figure 9: Typical Wake up schematic

3.2.3 Tunable Antenna Interface

3.2.3.1 Antenna Control

MV31-W provides a MIPI interface (MIPI_DATA/RFFE2_DATA and MIPI_CLK/RFFE2_CLK) for external antenna tuner application to allow the implementation of antenna tuner solutions, e.g. with QAT3555 antenna impedance tuner (see Figure 10).

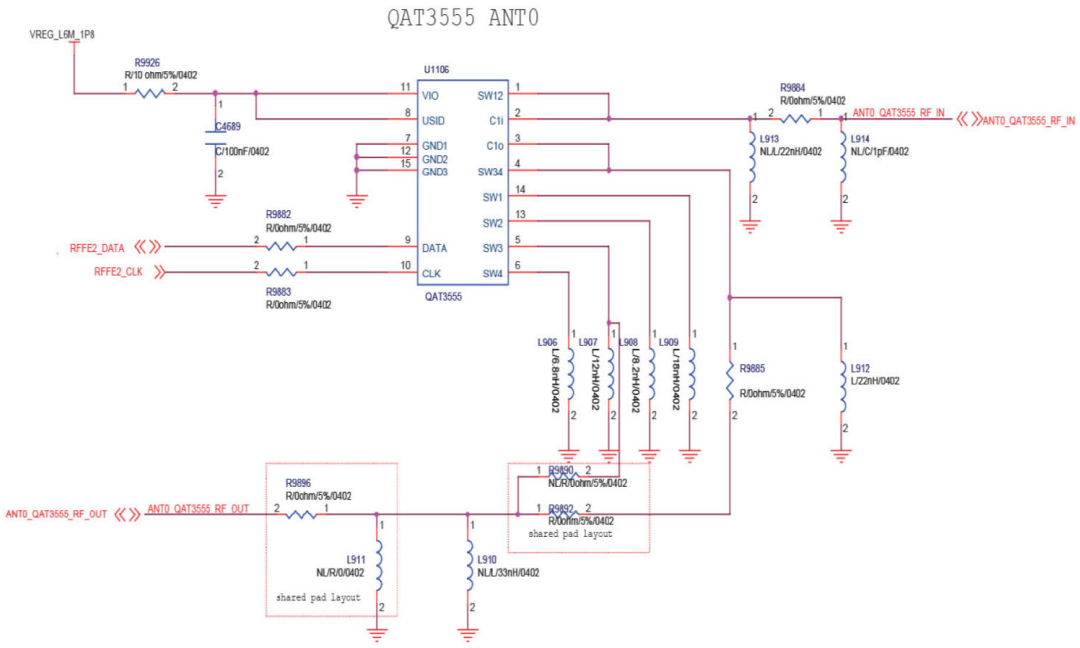


Figure 10: Sample Antenna Tuner with QAT3555 for one antenna path

3.2.3.2 ANT_TUNER_CONFIG

The ANT_TUNER_CONFIG pin of the MV31-W has the possibility to optimize the FR1 low band performance. The configuration is mainly for mobile devices with integrated antennas. Depending on the handling of the device the host controller can use this pin to trigger the 2 pre configuired modes.
Factors as the antennas, housing, size of the device, material and mobile handling e.g. tablet or notebook are influencing the performance.

Table 5: ANT_TUNER_CONFIG States

Signal State	Scenario
Low	For notebooks (Tuner Mode 0)
High	For tablets (Tuner Mode 1)

3.2.4 WWAN/WiFi Coexistence Control

The signals COEX_RXD, COEX_TXD, LAA_n79_Tx_EN and WLAN_Tx_EN are provided to allow the implementation of wireless coexistence solutions between the radio(s) on the M.2 Data Card and other off-card radio(s). These other radios can be located on another M.2 Card located in the same host platform or as alternate radio implementations.

Table 6: Coexistence Control between LAA and n79 with WiFi 5GHZ

Signal	Direction	Description
LAA_n79_Tx_EN	MV31-W to WLAN	Avoid n79 Tx impact 5GHz Wi-Fi Rx (While n79/LAA is in Tx mode, the WiFi 5G Rx mode is not working.)
WLAN_Tx_EN	WLAN to MV31-W	Avoid WLAN Tx impact n79/LAA Rx (While WiFi 5G is in Tx mode, the n79/LAA Rx mode is not working.)

The signals COEX_RXD, COEX_TXD are reserved for future use.

3.2.5 Dynamic Power Reduction

The optional DPR signals are used by M.2 Data Card to assist in meeting regulatory SAR (Specific Absorption Rate) requirements for RF exposure. The signal is provided by a host system proximity sensors to the M.2 Data Card to provide an input trigger causing a reduction in the radio transmit output power.

The required value of the power reduction will vary between different host systems and is left to the host platform OEM and card vendor to determine, along with the specific implementation details. The assertion and de-assertion of DPR is asynchronous to any system clock. All transients resulting from the proximity sensor need to be de-bounced by system circuitry.

Table 7: Dynamic Power Reduction States

Signal	Signal State	Definition
DPR_1	Low	Enable the SAR power back off
	High	Disable the SAR power back off
DPR_2	Low	Reserved for EN-DC multiple Tx requirement
	High	

DPR_1 can be implemented for 3G/4G/5G ANT Tx. DPR_2 can be implemented for 5G FR1 ANT Tx only in case DPR_1 is for 3G/4G ANT Tx.

It is recommended to control DPR_1 and DPR_2 lines with an open collector transistor or an open drain field-effect transistor.

3.2.6 USB Interface

The 5G M.2 Data Card MV31-W has 6 interface lines for USB (see Figure 11) and is acting as peripheral.

USB Design General Guidelines:
- Reserve choke on all the USB signals in platform for noise debug.
- Reserve 0.1uF capacitor on USB3.1 TX/Rx paths.
- Co-layout USB3 choke and 0.1uF capacitor on module side for noise debug

Notes: All the above components should be covered by shielding cover.

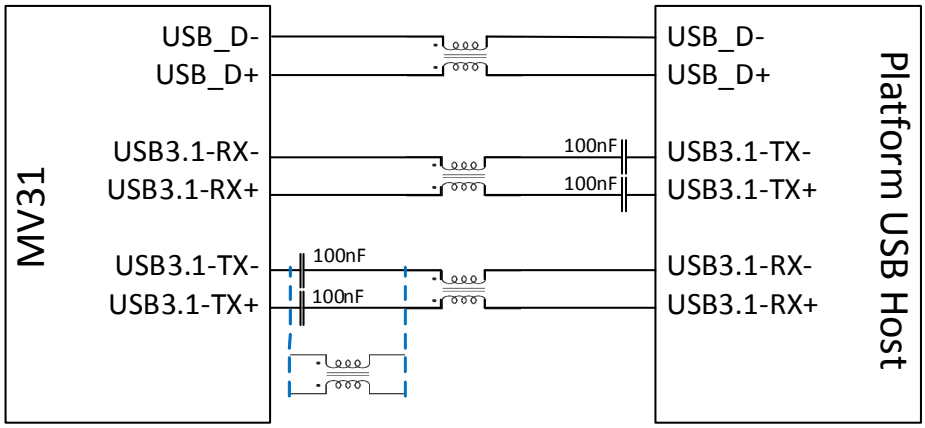


Figure 11: USB Interface

3.2.6.1 USB 2.0 Interface

The 5G M.2 Data Card MV31-W‘s USB interface (USB_D+, USB_D-) as part of the 75-pin application connector supports a USB 2.0 High Speed (480Mbit/s) device interface that is Full Speed (12Mbit/s) compliant. Because there is no separate voltage detection line available on the application connector, the 5G M.2 Data Card MV31-W reports as a self-powered device compliant with the [4].

3.2.6.2 USB 3.1 Gen 2 Interface

The USB 3.1 Gen 2 Interface s compliant to [5] and supports up to 10Gbit/s.

3.2.7 PCI Express® Interface

The PCI Express® Interface with a single lane is compliant to [3]. The second lane is reserved for future use.

PCIe® Design General Guidelines:

- All sensitive/high high-speed signals and circuits must be protected from PCIe® corruption, e.g. noisy signal, crosstalk and RF.
- Pay extra attention to crosstalk, ISI, and intra-lane skew and impedance discontinuities.
- Each trace needs to be adjacent to a ground plane.
- PCIe® PERx0 / PETx0 / REFCLK: 90 Ohm differential, +/ -10% trace impedance.
- AC coupling capacitor should be added in an application board: 220nF
  - Place 220nF capacitors on PCIe® PETx0 paths at module side (already included in MV31-W)
  - Place 220nF capacitors on PCIe® PETx0 paths at platform side.
- Reserve choke on all the PCIe® signals in platform for noise reduction
- Tx differential pair length matching < 0.5mm.
- Rx differential pair length matching < 0.5mm.

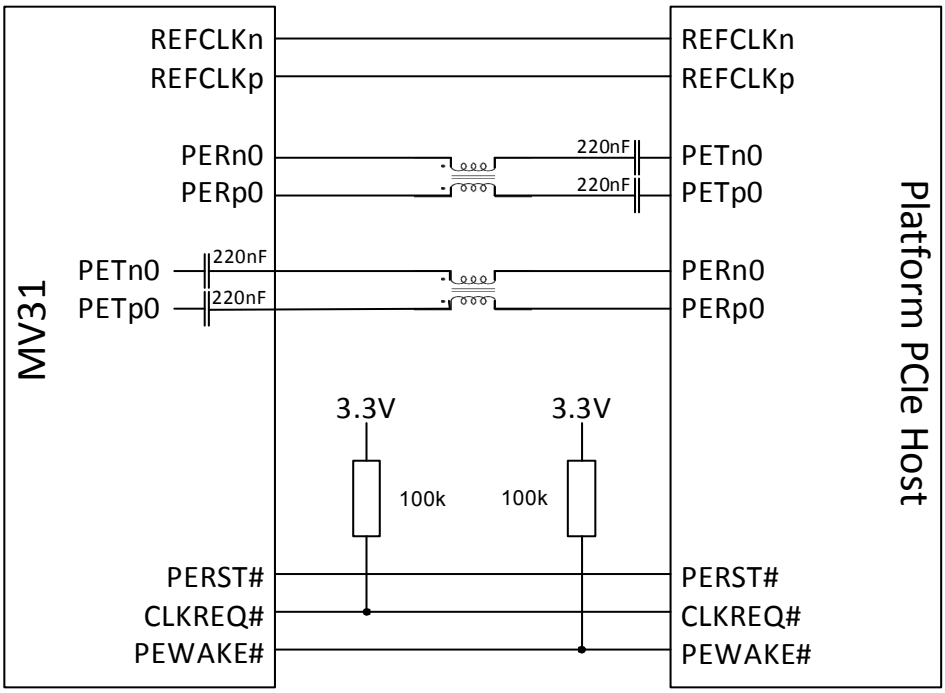


Figure 12: PCIe® Interface

3.2.7.1 PERST# Signal

The PERST# signal resets the 5G M.2 Data Card MV31-W. After releasing the PERST# line, i.e., with a change of the signal level from low to high, the module restarts.

It is recommended to control this PERST# line with an open collector transistor or an open drain field-effect transistor.

Caution: Use the PERST# signal only when, due to serious problems, the software is not responding for more than 5 seconds. Pulling the PERST# line causes the loss of all information stored in the volatile memory. Therefore, this procedure is intended only for use in case of emergency, e.g. if 5G M.2 Data Card MV31-W does not respond.

3.2.8 SIM/UICC Interface

The 5G M.2 Data Card MV31-W provides two SIM/UICC interfaces at the 75-pin application connector compliant to the ISO/IEC 7816-3 specification. The SIM interface are intended for 1.8V and 3V SIM cards in accordance with GSM 11.12 Phase 2.

The following table lists the pins available for both SIM/UICC interfaces. The second SIM interface is not available and the pins are reserved for future use.

Table 8: Signals of the SIM interface

Signal	Description
UIM_1_CLK UIM_2_CLK	SIM clock
UIM_1_PWR UIM_2_PWR	SIM supply voltage.
UIM_1_DATA UIM_2_DATA	Serial data line, input and output.
UIM_1_RESET UIM_2_RESET	SIM reset
SIM_DETECT_1 SIM_DETECT_2	SIM insertion detection (Low = no SIM inserted)

Note: No guarantee can be given, nor any liability accepted, if loss of data is encountered after removing the SIM card during operation. Also, no guarantee can be given for properly initializing any SIM card that the user inserts after having removed the SIM card during operation. In this case, the 5G M.2 Data Card MV31-W must be restarted.

The total cable length between the 5G M.2 Data Card MV31-W socket pads and the pads of an external SIM card holder must not exceed 100mm in order to meet the specifications of 3GPP TS 51.010-1 and to satisfy the requirements of EMC compliance (see Figure 3.2.8.1).

To avoid possible cross-talk from the UIM_x_CLK signal to the UIM_x_DATA signal, be careful that both lines are not placed closely next to each other. A useful approach is using a GND line to shield the UIM_x_DATA line from the UIM_x_CLK line.

3.2.8.1 ESD Protection for SIM Interfaces

For ESD protection of the SIM interfaces it is required to add ESD diodes to the interface lines of the first and second SIM interface as shown in the example given in Figure 13.

The example was designed to meet ESD protection according ETSI EN 301 489-1/7: Contact discharge: ± 4kV, air discharge: ± 8kV.

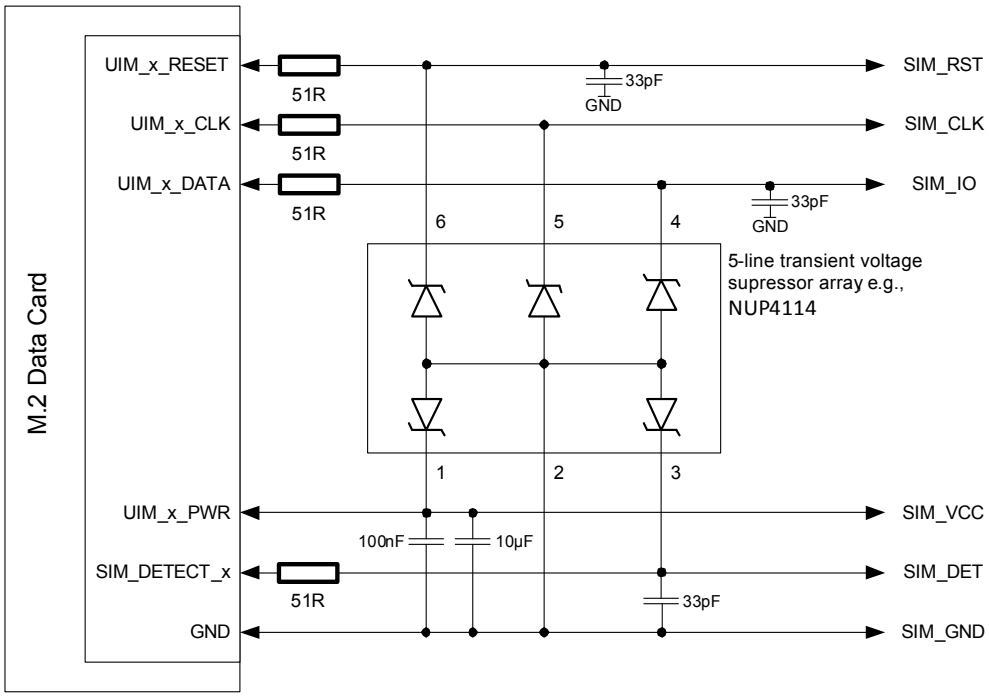


Figure 13: SIM interfaces - enhanced ESD protection

3.2.9 GPIO Interface

The GPIO is reserved for future use.

3.2.10 Status

The LED_1# signal is provided to enable wireless communication add-in cards to provide status indications to users via system provided indicators.

Table 9: Status States

Signal State	LED	Interpretation
Low	ON	Radio is capable of transmitting.
High	OFF	Radio is incapable of transmitting.

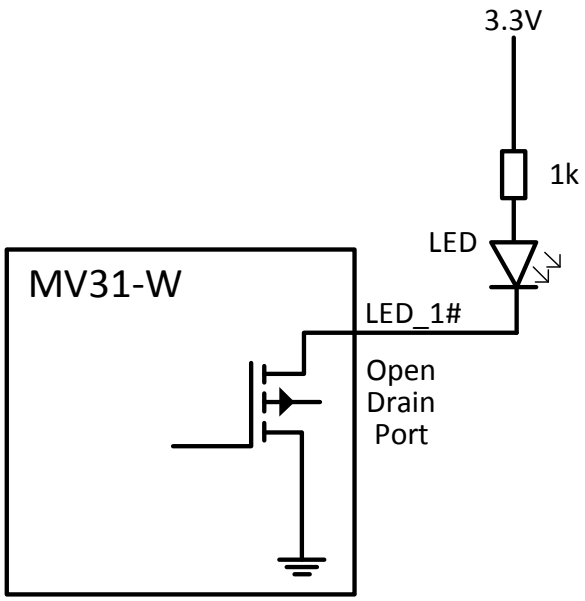


Figure 14: Sample Circuit for Status LED

Figure 14 show a sample circuit for the Status LED.

3.2.11 Add-in Card Configuration Pins

The CONFIG_x signals reports to the Host the communication interface (PCIe® or USB 3.1 Gen2) and the Port Configuration according to [2].

Table 10: Add-in Card Configuration

	Module configuration				**Module Type**	**Port Configura-tion**
Config	CONFIG_0	CONFIG_1	CONFIG_2	CONFIG_3		
State	NC	GND	GND	NC	WWAN PCIe®	2
	GND	GND	NC	NC	WWAN USB3.1 Gen1	2

The Port Configuration defines the signals on the GPIO0 to GPIO11 and provides the following signals in Port Configuration 2:

Table 11: GPIO Signals Mapping for Port Configuration 2

GPIO	**PIN**	**Signal**
GPIO_0	40	SIM_DETECT_2
GPIO_1	42	UIM_2_DATA
GPIO_2	44	UIM_2_CLK

Table 11: GPIO Signals Mapping for Port Configuration 2

GPIO	PIN	Signal
GPIO_3	46	UIM_2_RESET
GPIO_4	48	UIM_2_PWR
GPIO_5	20	no connected (RFU according to [2])
GPIO_6	22	ANT_TUNER_CONFIG (RFU according to [2])
GPIO_7	24	ANT_TUNER_POWER (RFU according to [2])
GPIO_8	28	DPR_2 (RFU according to [2])
GPIO_9	10	LED_1#
GPIO_10	26	W_DISABLE2#
GPIO_11	23	WAKE_ON_WWAN# (not supported by MV31-W)

4 Antenna Interface

MV31-W also provides connectivity for off board antennas. The antennas and their connection interface for this device satisfy the requirements specified in [2]. The antenna elements are typically integrated into the notebook/ultra book /tablet and connected to MV31-W via flexible RF coaxial cables. MV31-W provides four RF connectors (MHF4 type). The four RF connectors include for 5GNR Sub 6G & UMTS/LTE primary transmitter/receiver port, diversity receiver and 4x4 MIMO receiver port. For the location of the antenna connectors see Figure 1.

For LTE and 5GNR Sub 6G to ensure stable RF performance, customer must assemble adequate antenna according to the antenna specification.

Table 12: LTE& 5GNR Sub 6G antenna specifications

Parameter	Min.	Typ.	Max.	Unit	Notes
Cable loss			0.5	dB	Maximum loss to antenna
Impedance		50		Ohm	Antenna load impedance
VSWR			3:1		Maximum allowed VSWR of antenna
Isolation	20			dB	For all antenna each other

Note:
- Antenna peak gain limit as 2.5dBi for frequency <1.5GHz and 4dBi for frequency >1.5GHz of module level certification
- For Japan regional peak gain should be limited as 2.5dBi for frequency <1.5GHz and 3dBi for frequency >1.5GHz
- For Band 30 peak gain limit as 2.99dBi (meet FCC requirement)
- For Band 48 peak gain limit as 0.92dBi (meet FCC requirement)

4.1 Antenna Interface Specification

Measurement conditions: T_{amb}= 25°C, V_{3V3} = 3.3V.

Table 13: RF Antenna interface LTE/5G NR[1]

Conditions	Tx	PRx	DRx	PRX MIMO	DRX MIMO	Unit
LTE 2100 Band 1	23.3	-97	97.5	-97.5	-97.5	dBm
LTE 1900 Band 2	23.2	-97	-97	-97	-97.5	dBm
LTE 1800 Band 3	23.9	-97	-97	-97	-97.5	dBm
LTE AWS-1 Band 4	23.5	-97	-98	-97.5	-97	dBm
LTE 850 Band 5	23.2	-99.5	-101	-[2]	-[2]	dBm
LTE 2600 Band 7	23.4	-97	-97.5	-97	-96.6	dBm
LTE 900 Band 8	23.7	-99.5	-100.5	-[2]	-[2]	dBm
LTE 700 Band 12	23.5	-99.5	-100.5	-[2]	-[2]	dBm
LTE 700 Band 13	23.1	-100	-100	-[2]	-[2]	dBm
LTE 700 Band 14	23.4	-99.5	-100	-[2]	-[2]	dBm
LTE 700 Band 17	23.2	-100	-100	-[2]	-[2]	dBm
LTE 800 Band 18	23.9	-99.5	-100.5	-[2]	-[2]	dBm
LTE 800 Band 19	23.3	-99.5	-101	-[2]	-[2]	dBm
LTE 800 Band 20	23.9	-99.5	-100.5	-[2]	-[2]	dBm
LTE 1900 Band 25	23.7	-97	-96.5	-97.5	-97	dBm
LTE 800 Band 26	23.8	-99.5	-101	-[2]	-[2]	dBm
LTE 800 Band 28	23.0	-99.5	-99.5	-[2]	-[2]	dBm
LTE 700 Band 29	-	-99.5	-101	-[2]	-[2]	dBm
LTE 2300 Band 30	22.2	-96.5	-97	-97.5	-96.5	dBm
LTE 1500 Band 32	-	-98	-98	-[2]	-[2]	dBm
LTE 2000 Band 34	23.3	-97.5	-97.5	-[2]	-[2]	dBm
LTE 2600 Band 38	23.8	-98	-97	-96.5	-97	dBm
LTE 1900 Band 39	23.8	-97	-98	-[2]	-[2]	dBm
LTE 2500 Band 41	23.4	-97	-97	-97.5	-96.5	dBm
LTE 3500 Band 42	23.5	-98	-98	-97	-97.5	dBm
LTE 5200 Band 46	-	-97.5	-97	-[2]	-[2]	dBm
LTE 3500 Band 48	21.3	-98	-98	-97.5	-97	dBm
LTE AWS-3 Band 66	23.4	-97	-98	-98.5	-98	dBm
LTE 600 Band 71	23.3	-99.5	-102	-[2]	-[2]	dBm
5G NR 2100 Band n1	23.7	-92	-93	-93	-93	dBm
5G NR 1900 Band n2	23.5	-92	-92.5	-92	-92	dBm
5G NR 1800 Band n3	23.3	-92	-92	-92.5	-93	dBm
5G NR 850 Band n5	22.8	-93	-93	-[2]	-[2]	dBm
5G NR 2600 Band n7	23.4	-92.5	-93	-92	-93	dBm

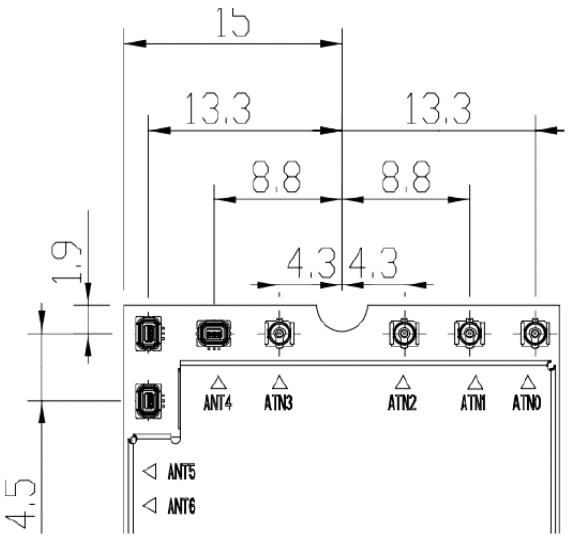
Table 13: RF Antenna interface LTE/5G NR[1]

Conditions	Tx	PRx	DRx	PRX MIMO	DRX MIMO	Unit
5G NR 900 Band n8	23.2	-93	-92.5	-[2]	-[2]	dBm
5G NR 800 Band n20	23.5	-93	-92.5	-[2]	-[2]	dBm
5G NR 700 Band n28	23.7	-92	-93	-[2]	-[2]	dBm
5G NR 2500 Band n41	23.6	-92	-93	-92	-93	dBm
5G NR 1700 Band n66	23.1	-93	-92.5	-92.5	-93	dBm
5G NR 600 Band n71	23.1	-92	-92.5	-[2]	-[2]	dBm
5G NR 3700 Band n77	23.1	-92	-93	-92	-93	dBm
5G NR 4700 Band n79	23.8	-90	-90	-90	-90	dBm

1. typically values, RX measured @10MHz bandwith, TX 1 RB@max
2. no 4x4 MIMO

Table 14: Antenna interfaces

Antenna port	TX.	RX.
ANT0	LTE: LB:B5,8,12,13,14,17,18,19,20,26,28,71 MHB:B1,2,3,4,7,25,30,34,38,39,40,41,66 5G Sub6G: LB:n5,8,12,20,28,71 MHB:n2,66	LTE: LB:B5,8,12,13,14,17,18,19,20,26,28,29,71 MHB:B1,2,3,4,7,25,30,32,34,38,39,40,41,66 UHB:B42,48; LAA: B46 5G Sub6G: LB:n5,8,12,20,28,71 MHB:n1,2,3,7,38,41,66 UHB:n77,78,79
ANT1		LTE: MHB:B1,2,3,4,7,30,38,41,66 UHB:B42,48 5G Sub6G: MHB:n1,2,3,7,38,41,66 UHB:n77,78,79
ANT2	LTE: MHB:B1,2,3,7,66 UHB:B42,48 5G Sub6G: MHB:n1,2,3,7,38,41,66 UHB:n77,78,79	LTE: MHB:B1,2,3,4,7,30,38,41,66 UHB:B42,48 5G Sub6G: MHB:n1,2,3,7,38,41,66 UHB:n77,78,79
ANT3		LTE: LB:B5,8,12,13,14,17,18,19,20,26,28,29,71 MHB:B1,2,3,4,7,25,30,32,34,38,39,40,41,66 UHB:B42,48; LAA: B46 5G Sub6G: LB:n5,8,12,20,28,71 MHB:n1,2,3,7,38,41,66 UHB:n77,78,79



Antenna	Interface
ANT0	LTE& Sub 6G Tx/Rx
ANT1	LTE& Sub 6G Rx/GPS L5
ANT2	LTE& Sub 6G Tx/Rx
ANT3	LTE& Sub 6G Rx/GPS L1
ANT4	mmWave IF_1
ANT5	mmWave IF_2
ANT6	mmWave IF_3

Figure 15: Antenna Interfaces

4.1.1 GNSS Interface Characteristics

Table 15: GNSS properties

Parameter	Conditions	Min.	Typical	Max.	Unit
Frequency	GPS L1 L5	 1574.4 1166.22	 1575.42 1176.45	 1576.4 1186.68	MHz
	GLONASS (G1)	1597.5	1601.7	1605.9	
	Beidou (B1)	1559.1	1561	1563.1	
	Galileo E1 E5a	 1573.4 1166.22	 1575.42 1176.45	 1577.5 11.86.68	
Horizontal accuracy	50% CEP, open sky		1.7	2	m
	90% CEP, open sky		1.9	5	m
Tracking Sensitivity	Open sky (passive antenna):		-159		dBm
Acquisition Sensitivity	Open sky (passive antenna):		-156		dBm
Time-to-First-Fix (TTFF) (indoor TTFF@-145dbm)	Hot		1.06	2	s
	Warm		23	20	s
	Cold		29	35	s

4.2 Antenna Interface Connector

4.2.1 UMTS/LTE & Sub 6G Antenna Connectors

Figure 16 and Figure 17 show the MHF4 type connectors for the UMTS/LTE & Sub 6G antennas.

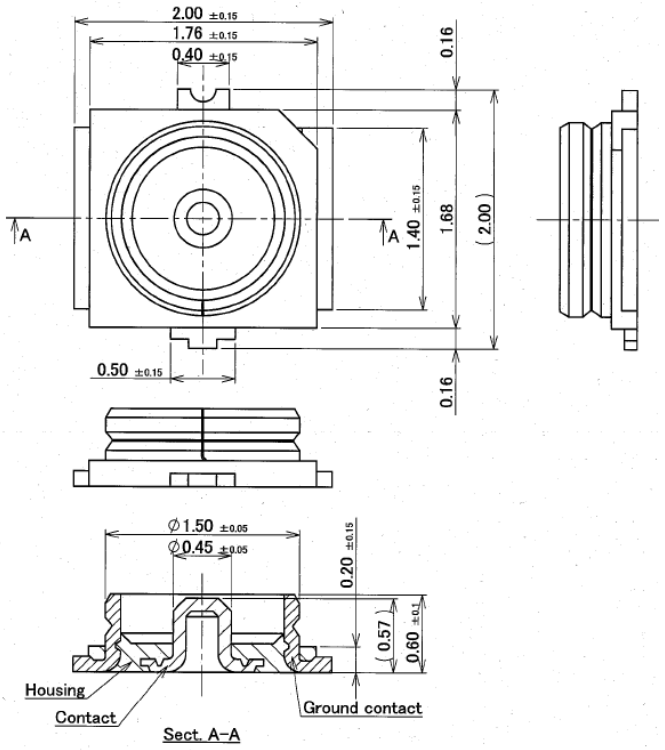


Figure 16: UMTS/LTE & Sub 6G Antenna Connector (male)

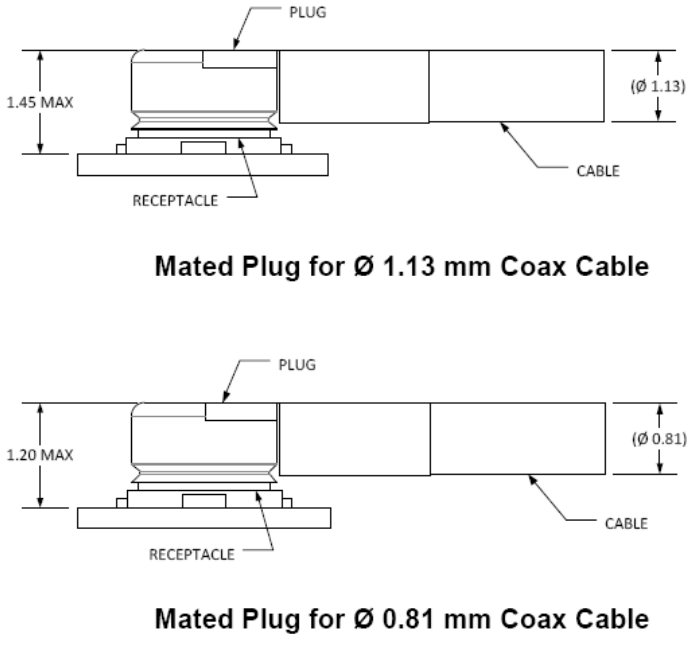


Figure 17: UMTS/LTE & Sub 6G Antenna Connector (mated plug)

5 Operation

5.1 Operating Modes

TBD.

5.2 Operating Temperatures

Table 16: Temperature characteristics

Parameter	Min	Typical	Max	Unit
Normal operation[1]	-30	25	+70	°C
Extended operation[1, 2]	-40 to -30		+70 to +85	°C
Automatic thermal shutdown[1, 3]	TBD.		+89	°C
Thermal resistance (R_{th})[4]		TBD.		K/W

1. Board temperature.
2. Extended operation allows normal mode data transmission for limited time until automatic thermal shutdown takes effect. Within the extended temperature range (outside the normal operating temperature range) the specified electrical characteristics may be in- or decreased.
3. Due to temperature measurement uncertainty, a tolerance of ±2°C on these switching thresholds may occur.
4. Thermal resistance (R_{th}) of the 5G M.2 Data Card MV31-W at the highest possible thermal power (P_{th}) dissipation, i.e., at the worst possible network conditions. Measured in still air with an air gap of at least 100mm between the 5G M.2 Data Card MV31-W and other objects.

Note: Within the specified operating temperature ranges the board temperature may vary to a great extent depending on operating mode, used frequency band, radio output power and current supply voltage. Note also the differences and dependencies that usually exist between board (PCB) temperature of the MV31-W and its ambient temperature.

5.3 Thermal Design Guidelines

The MV31-W m.2 card temperature rises because electrical energy is turned into heat. Depending on the application itself and housing different methods are recommend to allow the card operate under ideal conditions. The actual temperature of the board depends on different factors such as the radio technology e.g. 4G or 5G, but also on the used frequency bands with Sub6, and the output power.
The MV31-W has an optimized mechanical temperature design with a stepped EMI shielding which allows up to 19°C higher ambient temperature.
The MV31-W uses a 3 level throttling mechanisms based on pre-defined values which are for example limiting the TX power, fallback to LTE or dropping CA mode to allow even under high temperature conditions to perform E911 calls and to be operational.
The stepped EMI shielding improves the time up to 42% before the MV31-W throttling levels are starting.
The following chapter will give you a few recommended solutions which are mandatory for a full performance 5G operation of the MV31-W and the application.

5.3.1 Thermal Concept

The MV31-W stepped EMI shielding requires to be thermal coupled to the application PCB and in addition the shielding requires heat spreading too.
The total recommended height of the mounted MV31-W card with heat pipe requires at minimum 3.35mm where the MV31-W itself has a maximum thickness of 2.6+/-0.15mm (see Figure 18).
If the application allows more than 3.35mm it is recommended to use a copper plate with heat pipe over the complete module upper stepped EMI shielding (see Figure 19 and Figure 20).

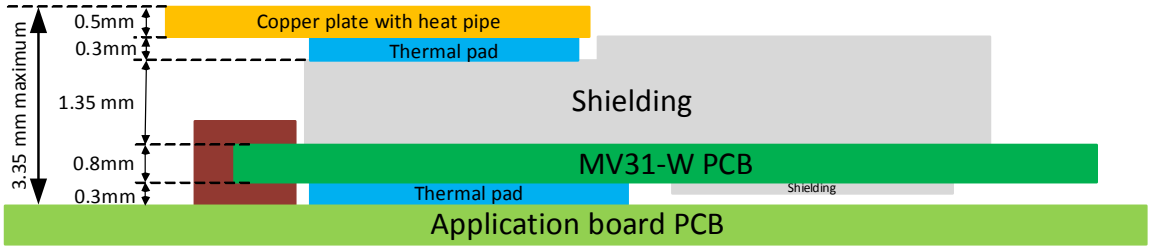


Figure 18: Option 1 - Mechanical setup for height restricted mounting

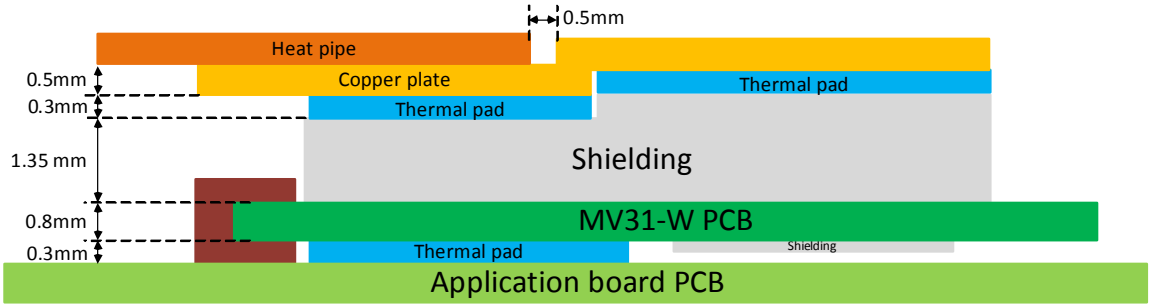


Figure 19: Option 2 - Mechanical setup without height restrictions

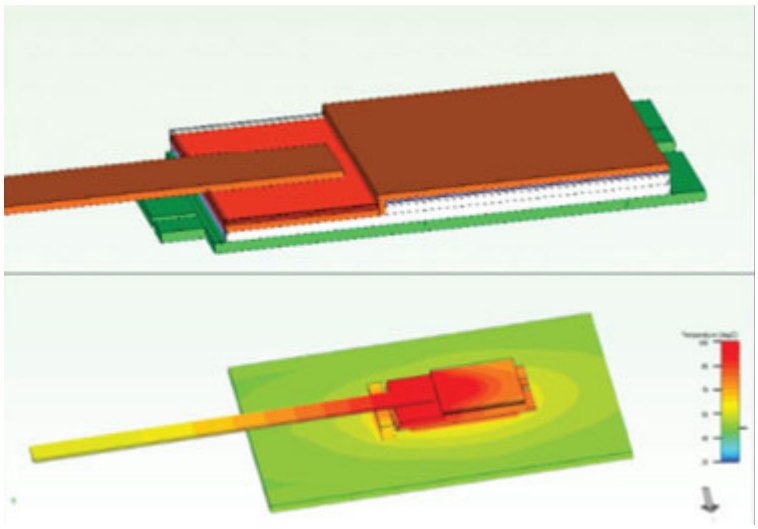


Figure 20: Option 2 - Thermal distribution

5.3.2 Thermal Solution

The thermal conductivity between the MV31-W and the copper plate or the application PCB requires a thermal gap pad with at least 6w/m*k. Depending on the mechanical setup the thickness of the thermal gap pad needs to be adjusted. The following picture shows a recommended setup.

5.3.2.1 Thermal heat spreading via the application PCB

To ensure an optimum heat spreading on the application PCB the application PCB should have below the MV31-W in each layer a copper plane. Each layer should be thermally coupled by a large amount of vias.
To optimize the heat spreading over on the bottom side of the application PCB a heat sink can be applied with a thermal conducting gap filler in between (see Figure 21).

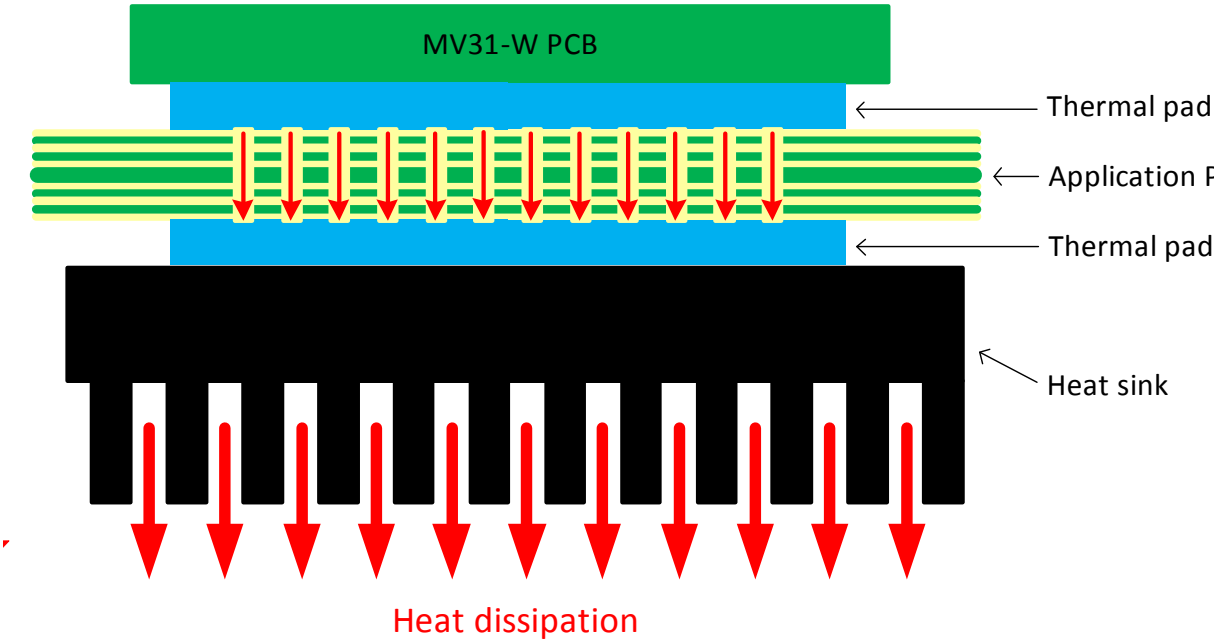


Figure 21: Heat sink below Application PCB

5.3.2.2 Thermal heat spreading over the stepped EMI shield

The thermal conducting via a gap filler is required on the stepped EMI shield. Depending on the application and used housing either a heat pipe or heat sink can be applied.
For operation with high ambient temperature or with high temperature within the housing a heat pipe is required.
For the heat sink/ coupling the housing or the heat pipe it is recommended to use the mechanical setup with fully conducting the stepped EMI shield (see Figure 19 and Figure 20).

5.4 Power Supply Ratings

The following tables provide sample power supply ratings for selected 4G/5G technologies including carrier aggregations (CA).

Table 17 lists selected LTE (4G) power supply ratings at various conditions.

Table 17: LTE current consumption ratings

	Description	Conditions			Typical rating	Unit
		Band	Tx power (dBm)	Channel		
I_{BATT+} [1]	Average LTE supply current Data transfer measured @minimum and @maximum Pout for low (L), mid (M) and high (H) band channels	Band 1	1dBm	18300 (M)	387	mA
			23.3dBm	18050 (L)	1079	
			23.4dBm	18300 (M)	883	
			23.1dBm	18550 (H)	1039	
		Band 2	1dBm	18900 (M)	388	mA
			23.5dBm	18650 (L)	942	
			23.3dBm	18900 (M)	949	
			23.3dBm	19150 (H)	837	
		Band 3	1dBm	19575 (M)	381	mA
			23.5dBm	19250 (L)	978	
			23.5dBm	19575 (M)	974	
			23.5dBm	19900 (H)	998	
		Band 4	1dBm	20175 (M)	380	mA
			23.3dBm	20000 (L)	991	
			23.4dBm	20175 (M)	763	
			23.4dBm	20350 (H)	1050	
		Band 5	1dBm	20525 (M)	320	mA
			23.5dBm	20450 (L)	655	
			23.6dBm	20525 (M)	635	
			23.6dBm	20600 (H)	625	
		Band 7	1dBm	21100 (M)	376	mA
			23.6dBm	20800 (L)	937	
			23.5dBm	21100 (M)	856	
			23.5dBm	21400 (H)	918	
		Band 8	1dBm	21625 (M)	320	mA
			23.7dBm	21500 (L)	720	
			23.6dBm	21625 (M)	706	
			23.6dBm	21750 (H)	699	

Table 17: LTE current consumption ratings

	Description	Conditions			Typical rating	Unit
		Band	Tx power (dBm)	Channel		
I_{BATT+}[1]	Average LTE supply current Data transfer measured @minimum and @maximum Pout for low (L), mid (M) and high (H) band channels	Band 12	1dBm	23095 (M)	314	mA
			23.4dBm	23060 (L)	581	
			23.3dBm	23095 (M)	591	
			23.4dBm	23130 (H)	599	
		Band 13	1dBm	23230 (M)	314	mA
			23.4dBm	23230 (M)	742	
		Band 14	1dBm	23330 (M)	311	mA
			23.4dBm	23330 (M)	596	
		Band 17	1dBm	23790 (M)	308	mA
			23.4dBm	23780 (L)	613	
			23.3dBm	23790 (M)	599	
			23.3dBm	23800 (H)	593	
		Band 18	1dBm	23925 (M)	337	mA
			23.4dBm	23900 (L)	670	
			23.4dBm	23925 (M)	648	
			23.4dBm	23950 (H)	652	
		Band 19	1dBm	24075 (M)	316	mA
			23.5dBm	24050 (L)	641	
			23.5dBm	24075 (M)	634	
			23.6 dBm	24100 (H)	613	
		Band 20	1dBm	24300 (M)	315	mA
			23.6dBm	24200 (L)	635	
			23.5dBm	24300 (M)	587	
			23.6dBm	24400 (H)	663	
		Band 25	1dBm	26365 (M)	376	mA
			23.4dBm	26090 (L)	1007	
			23.3dBm	26365 (M)	1007	
			23.3dBm	26640 (H)	938	
		Band 26	1dBm	26865 (M)	321	mA
			23.5dBm	26750 (L)	658	
			23.5dBm	26865 (M)	612	
			23.6dBm	26990 (H)	595	

Table 17: LTE current consumption ratings

	Description	Conditions			Typical rating	Unit
		Band	Tx power (dBm)	Channel		
I_{BATT+}[1]	Average LTE supply current Data transfer measured @minimum and @maximum Pout for low (L), mid (M) and high (H) band channels	Band 28	1dBm	27410 (M)	316	mA
			23.5dBm	27260 (L)	656	
			23.4dBm	27410 (M)	575	
			23.4dBm	27610 (H)	544	
		Band 30	1dBm	27710 (M)	397	mA
			22.2dBm	27710 (M)	953	
		Band 34	1dBm	36275 (M)	297	mA
			23.3dBm	36250 (L)	379	
			23.3dBm	36275 (M)	377	
			23.3dBm	36300 (H)	374	
		Band 38	1dBm	38000 (M)	347	mA
			23.7dBm	37800 (L)	495	
			23.6dBm	38000 (M)	499	
			23.7dBm	38200 (H)	535	
		Band 39	1dBm	38450 (M)	292	mA
			23.6dBm	38300 (L)	463	
			23.5dBm	38450 (M)	435	
			23.5dBm	38600 (H)	451	
		Band 40	1dBm	39150 (M)	332	mA
			23.6dBm	38700 (L)	498	
			23.5dBm	39150 (M)	467	
			23.8dBm	39600 (H)	466	
		Band 41	1dBm	40620 (M)	342	mA
			23.6dBm	39700 (L)	519	
			23.6dBm	40620 (M)	469	
			23.7dBm	41540 (H)	494	
		Band 42	1dBm	42590 (M)	310	mA
			23.2dBm	41640 (L)	551	
			23.3dBm	42590 (M)	535	
			23.1dBm	43540 (H)	509	
		Band 48	1dBm	55990 (M)	312	mA
			21dBm	55290 (L)	452	
			21dBm	55990 (M)	442	
			21dBm	56690 (H)	440	

Table 17: LTE current consumption ratings

	Description	Conditions			Typical rating	Unit
		Band	Tx power (dBm)	Channel		
I_{BATT+} [1]	Average LTE supply current Data transfer measured @minimum and @maximum Pout for low (L), mid (M) and high (H) band channels	Band 66	1dBm	132422 (M)	376	mA
			23.2dBm	132022 (L)	985	
			23.5dBm	132422 (M)	965	
			22.8dBm	132622 (H)	940	
		Band 71	1dBm	133297 (M)	321	mA
			23.4dBm	133172 (L)	620	
			23.3dBm	133297 (M)	557	
			23.2dBm	133422 (H)	596	

1. With an impedance of Z_{LOAD}=50Ω at the antenna pads. Measured at 25°C and 3.3V

Table 18 lists selected EN-DC (4G/5G) power supply ratings at various conditions.

Table 18: EN-DC current consumption ratings

	Description	Conditions			Typical rating	Unit
		EN-DC	Tx power (dBm)	Channel		
I_{BATT+} [1]	Average EN-DC (TDD) supply current Data transfer measured @minimum and @maximum Pout for mid (M) band channels and FR1 through-out=1950Mbps	DC_B3-n41	LTE=0dBm NR=0dBm	518598(M)	790	mA
			LTE=0dBm NR=22.9dBm		950	
			LTE=23dBm NR=17.3dBm		1570	
		DC_B3-n77	LTE=0dBm NR=0dBm	650000(M)	861	mA
			LTE=0dBm NR=23dBm		1017	
			LTE=23dBm NR=15.8dBm		1530	
		DC_B3-n78	LTE=0dBm NR=0dBm	636666(M)	875	mA
			LTE=0dBm NR=22.8dBm		1008	
			LTE=23dBm NR=16dBm		1550	
		DC_B3-n79	LTE=0dBm NR=0dBm	713990(M)	920	mA
			LTE=0dBm NR=23dBm		1060	
			LTE=23dBm NR=16dBm		1600	

Table 18: EN-DC current consumption ratings

	Description	Conditions			Typical rating	Unit
		EN-DC	Tx power (dBm)	Channel		
I_{BATT+} [1]	Average EN-DC (FDD) supply current Data transfer measured @minimum and @maximum Pout for mid (M) band channels and NR through-out=319Mbps	DC_B20-n3	LTE=0dBm NR=0dBm	349500(M)	410	mA
			LTE=0dBm NR=23dBm		1180	
			LTE=23dBm NR=17.5dBm		1040	
		DC_B5-n2	LTE=0dBm NR=0dBm	376000(M)	396	mA
			LTE=0dBm NR=23dBm		925	
			LTE=23dBm NR=16dBm		920	
		DC_B12-n7	LTE=0dBm NR=0dBm	507000(M)	418	mA
			LTE=0dBm NR=22dBm		830	
			LTE=23dBm NR=17.5dBm		980	
		DC_B12-n66	LTE=0dBm NR=0dBm	349000(M)	400	mA
			LTE=0dBm NR=23dBm		790	
			LTE=23dBm NR=16dBm		923	

1. With an impedance of Z_{LOAD}=50Ω at the antenna pads. Measured at 25°C and 3.3V

Table 19 lists selected LTE CA power supply ratings at various conditions.

Table 19: LTE CA current consumption ratings

	Description	Conditions				Typical rating	Unit
		CA combinations	Tx power (dBm)	Throughput			
				DL (Mbps)	UL (Mbps)		
I_{BATT+} [1]	2CA (4x4)	1A+3A	0	780	85	550	mA
			23			950	
	3CA (4x4)	1A+3A+7A	0	1170	85	713	mA
			23			1145	
	4CA (4x4)	1A+3C+7A	0	1560	85	740	mA
			23			1150	
	5CA (2x2)	1A+3A+7C+ 28A	0	965	85	658	mA
			23			1012	

1. With an impedance of Z_{LOAD}=50Ω at the antenna pads. Measured at 25°C and 3.3V

5.5 Timing Sequence Requirement

5.5.1 Power On Timing Requirement

- Requirements:
  - +3.3V power should be stable earlier than Full_Card_Power_Off
  - Compliance with PCI Express® Card Electromechanical Specification

Figure below shows the M.2 adapter power-up sequence for an adapter from the system power rail.

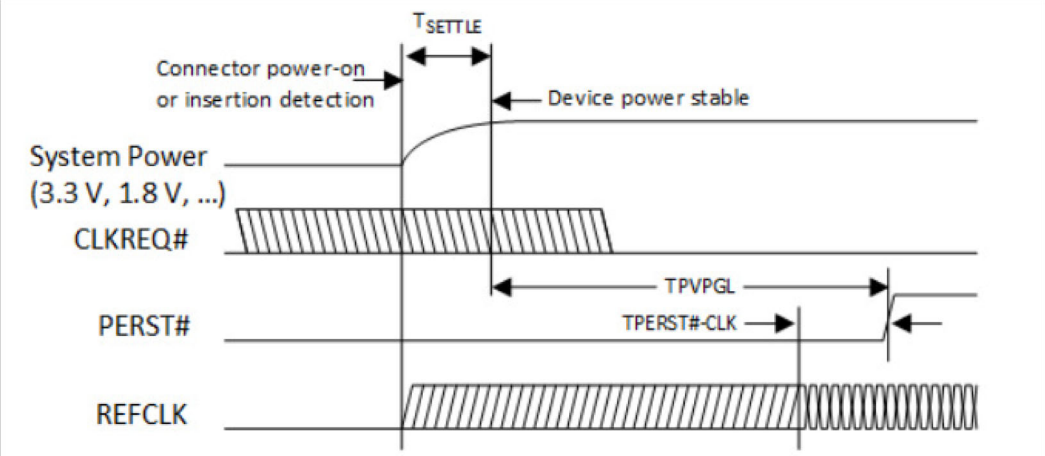


Figure 22: Power-up timing sequence

Tsettle is the time it takes all Power Rails to reach their minimum operating voltage (depending on System power rails). Power Valid is when all voltage supply rails have reached their respective Vmin.

Table 20: Power up timing information

Symbol	Parameter	Min	Max	Units
T_{PVPGL}	Power Valid to PERST# input inactive	Implementation specific: 50ms recommended		ms
$T_{PERS\#CLK}$	REFCLK stable before PERST# inactive	100		µs

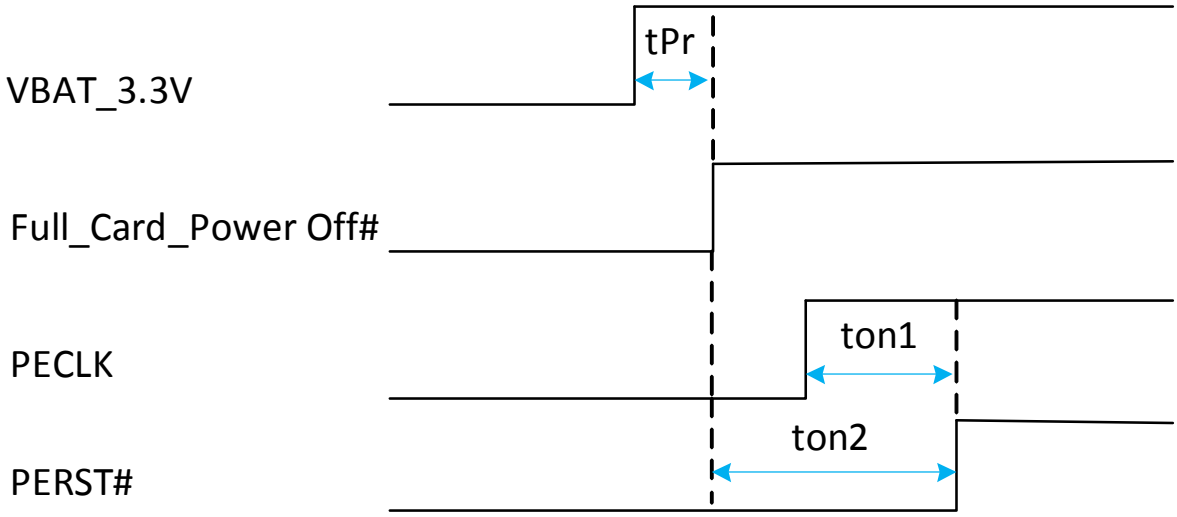


Figure 23: Power on timing diagram

Table 21: Power On information

Symbol	Typical value	Note
tPr	10ms	Keep 3.3V power supply before Full_Card_Power_Off# assert. There is no tPr if the power supply is always ready.
ton1	150µs	Keep PCIe_CLK stable before PERST# is inactive.
ton2	150ms	PERST# should be deasserted after a Full_Card_Power_Off#

5.5.2 Power Off Timing Requirement

- The platform should follow the requirement when the device power is Off by **M.2 PIN#6** and when Windows enters S4 and S5.
- Device Power Off by M.2 PIN#6 (Full_Card_Power_Off):
  - For Windows10: Platform performs M.2 PIN#6 power off after sending CID_MBIM_MSHOSTSHUTDOWN to MV31-W and receiving CID_MBIM_MSHOSTSHUTDOWN MBIM_COMMAND_DONE from MV31-W

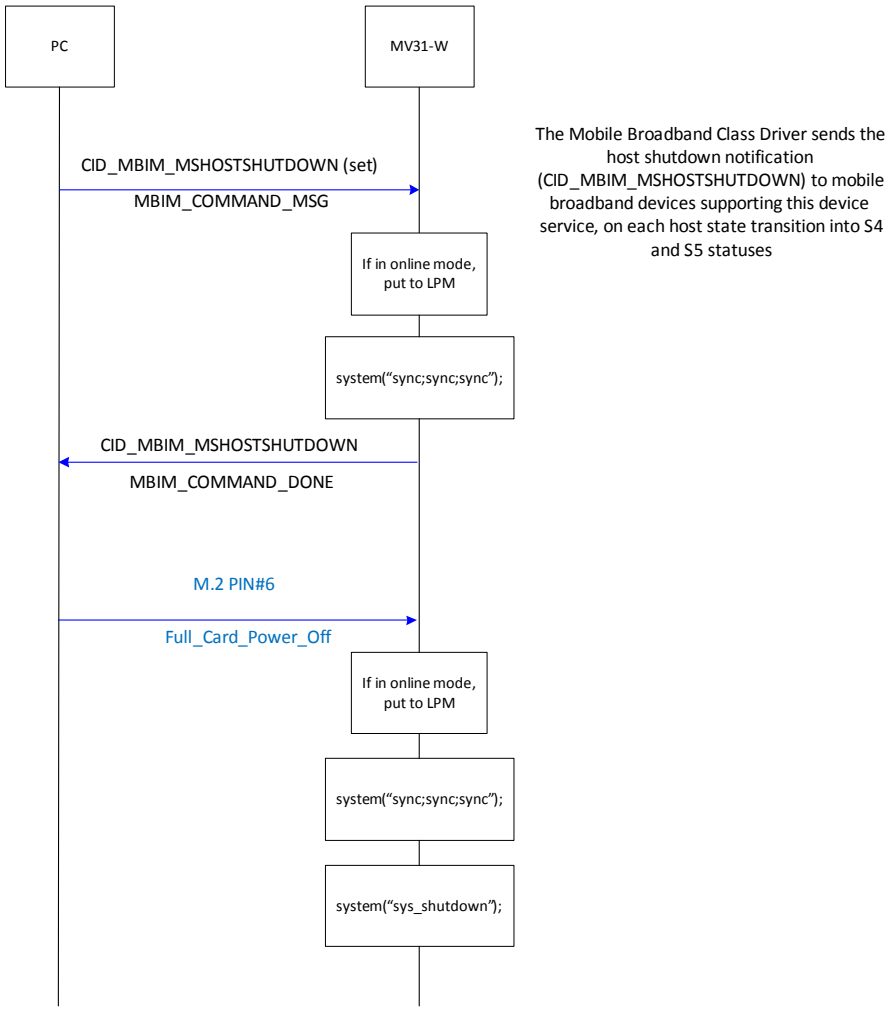


Figure 24: Device power off behavior for Windows 10

- For Linux: Estimate Software optimization with a minimum power off period.

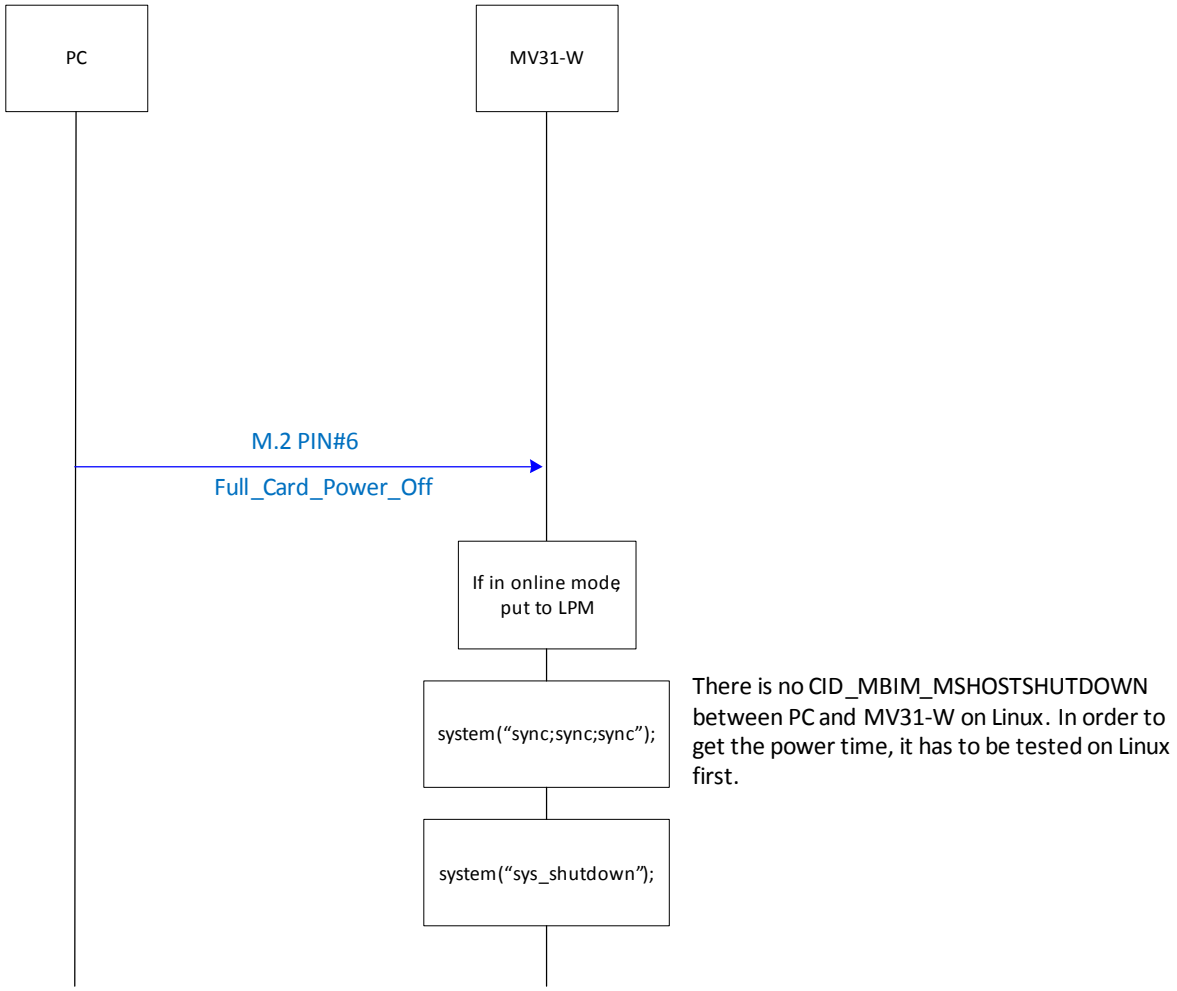


Figure 25: Device power off behavior for Linux

5.5.3 Power Off Timing

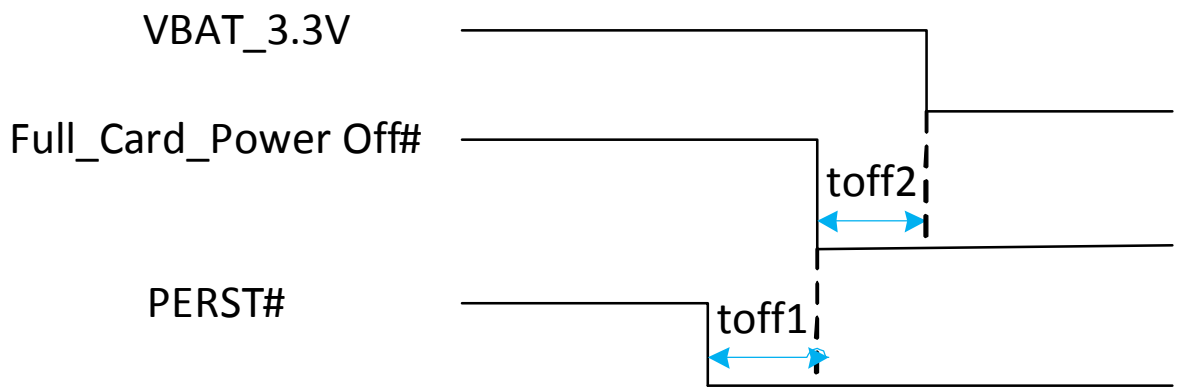


Figure 26: Power off diagram

Table 22: Power Off information

Symbol	Typical value	Note
toff1	400ms	PERST# should deasserted before Full_Card_Power_Off#
toff2	200ms	With MBIM driver installed, Full_Card_Power_Off# deasserted hold time
	3s	Without MBIM driver installed, Full_Card_Power_Off# deasserted hold time

5.5.4 Warm Boot Restart Timing

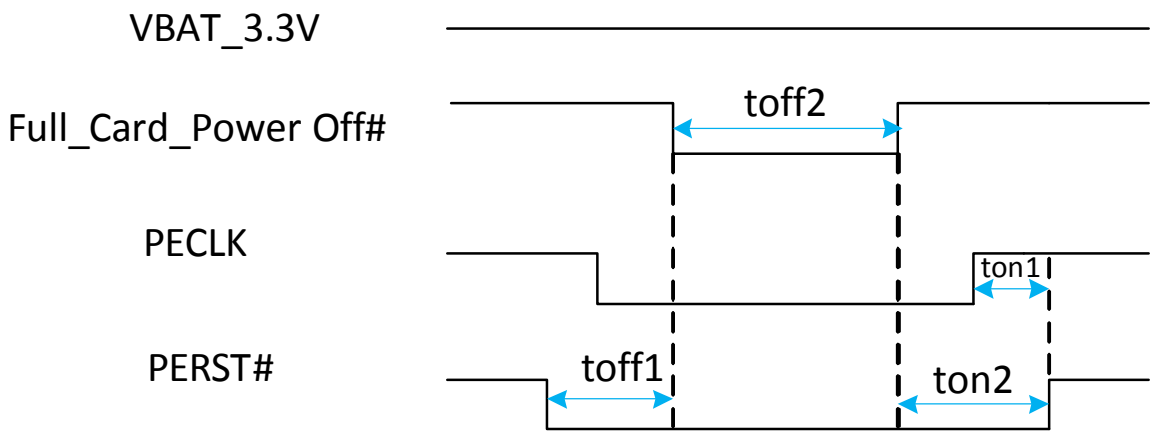


Figure 27: Warm boot restart diagram

Table 23: Warm boot restart information

Symbol	Typical value	Note
toff1	400ms	PERST# should deasserted before Full_Card_Power_Off#
toff2	500ms	With MBIM driver installed, Full_Card_Power_Off# deasserted hold time
	3s	Without MBIM driver installed, Full_Card_Power_Off# deasserted hold time
ton1	150µs	Keep PCIe_CLK stable before PERST# is inactive.
ton2	150ms	PERST# should be deasserted after a Full_Card_Power_Off#

5.5.5 Modem Standby Requirement

In order to perform a Modem Standby, the device MHI driver will query PCIe® root port capability via Microsoft(TM) API.
Currently, the bug driver supports D3cold but PCIe® supports root port as shown below:

```
[MhiHost] [PciSetPowerPolicy]W - Device DOESN'T support D3cold
[MhiHost] [PciSetPowerPolicy]W - GetIdleWakeInfo-Hibernate, status: 0xc0000002(STATUS_NOT_IMPLEMENTED)
[MhiHost] [PciSetPowerPolicy]Bus Driver DOES support D3cold
```

BIOS is needed to enable the PCIe® root port D3cold capability.

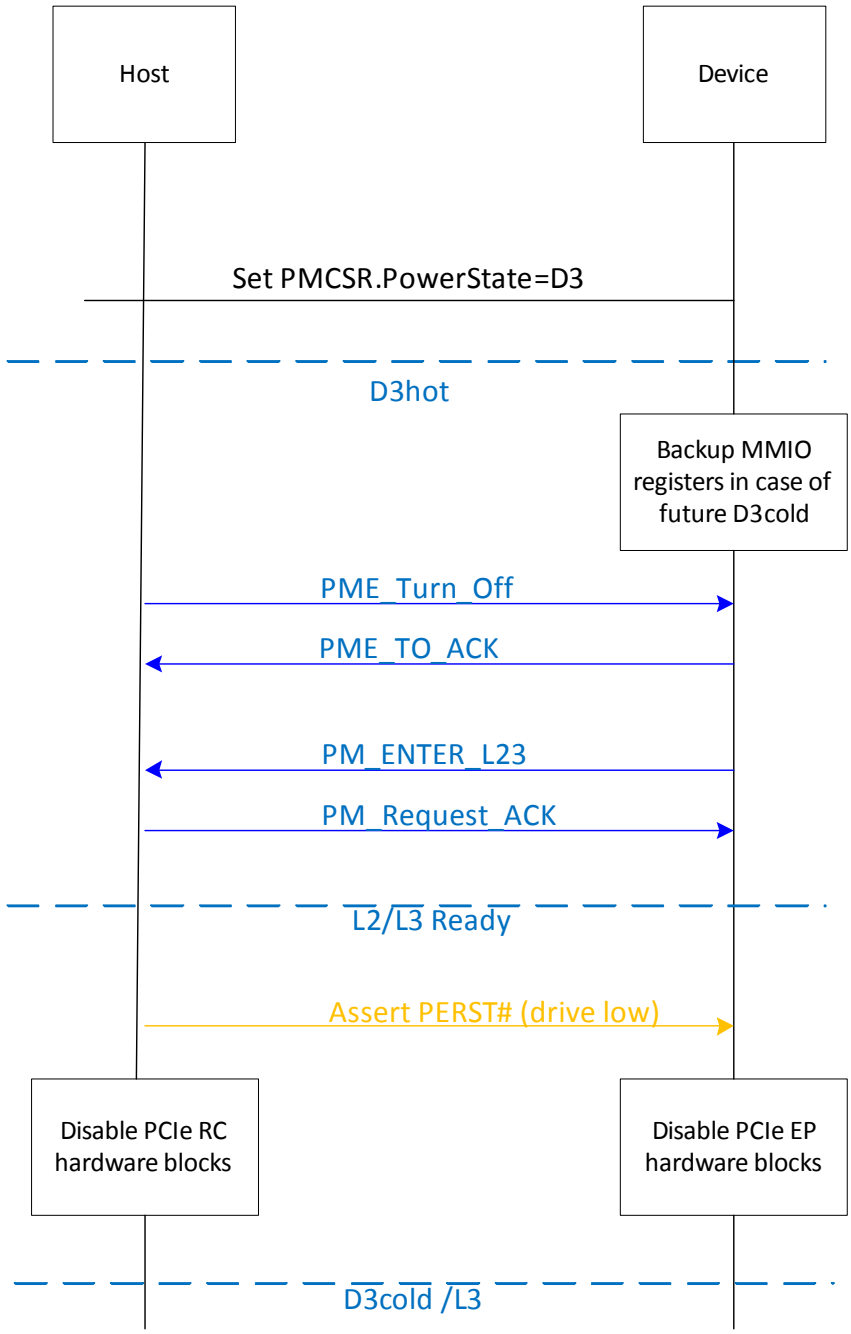


Figure 28: Modern Standby-D3cold Entry Flow

- The Host sets PMCSR in order to put device into D3hot state.
- The Host turns off PME.
- Device PM enters L2/L3
- The Host asserts PERST# (drive low)

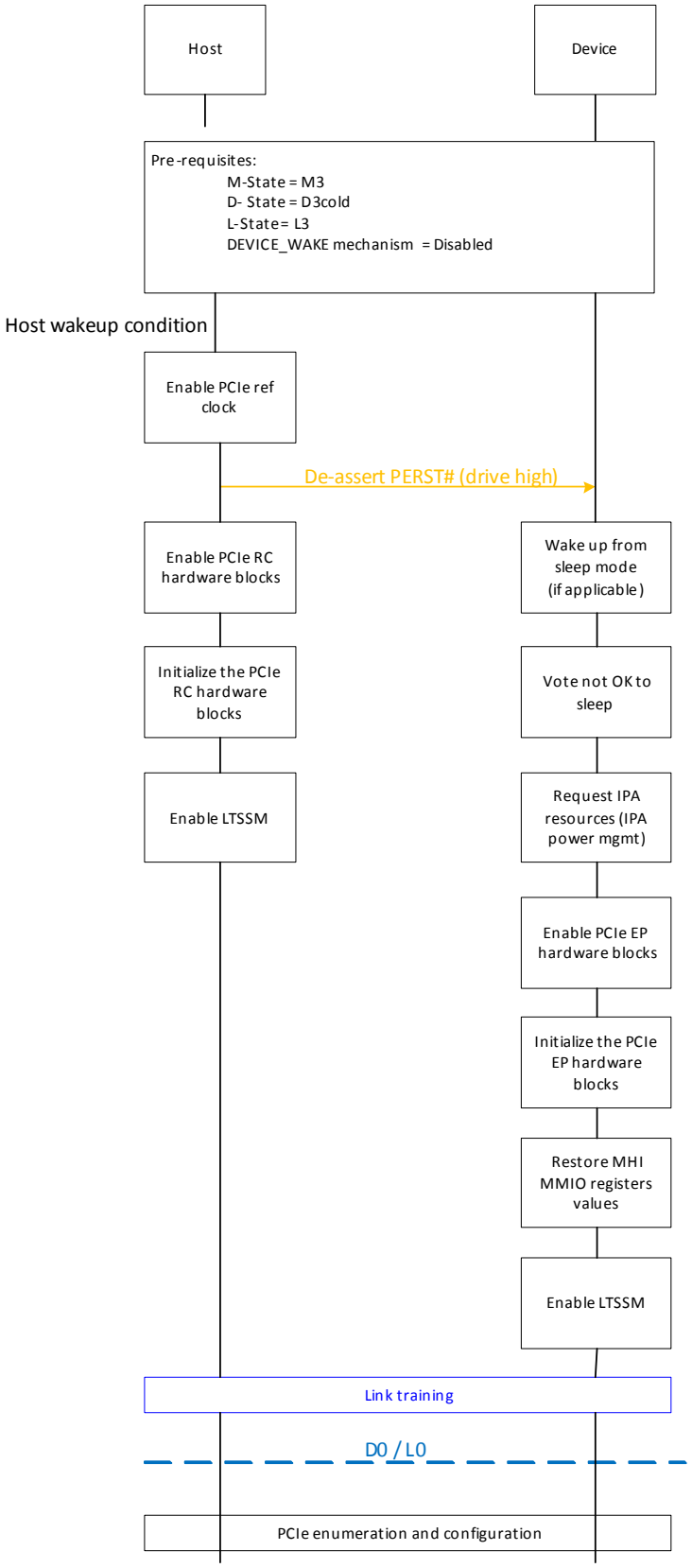


Figure 29: Modern Standby D3cold

- The Host enabled PCIe® reference clock and deasserts PERST# (drive high).

5.6 Electrostatic Discharge

The 5G M.2 Data Card MV31-W is not protected against Electrostatic Discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates a 5G M.2 Data Card MV31-W module.

The 5G M.2 Data Card's MV31-W module has been tested according to the following standards. Electrostatic values can be gathered from the following table.

Table 24: Electrostatic values

Specification/Requirements	Contact discharge	Air discharge
ETSI EN 301 489-1/7		
Application connector signals Antenna interface	± 4kV	± 8kV

Note: The values may vary with the individual application design. For example, it matters whether or not the application platform is grounded over external devices like a computer or other equipment.

5.7 Reliability Characteristics

The test conditions stated below are an extract of the complete test specifications.

Table 25: Summary of reliability test conditions

Type of test	Conditions	Standard
Shock Test (Non-operating)	Amplitude: 400G, Waveform: 1/2 sine, 2 msec duration, Repetition: 6 times / each axis	DIN IEC 60068-2-27
Vibration (Non Operatin) Sinusoidal	Amplitude: 3.0G peak to peak, Frequency: 5hz - 500hHz, Freq Sweep rate : 0.5 Octave/min,linear, Duration: 2hr/each axis	DIN IEC 60068-2-6
Vibration (Non Operatin) Random	3.0 G rms, Frequency Range : 10hz to 500hz, Duration: 1hr / each axis	DIN IEC 60068-2-36
Damp Cycle	High Temp:70°C, Low Temp = 25°C, Humidity: 95%, Duration: 12H+12H, Repetition: 6 times	DIN IEC 60068-2-30 Db
Thermal Shock	-40°C/85°C, 500 cycles Function check point interval 200, 500 cycles	DIN IEC 60068-2-14 Na
Drop Test	Height: 100cm, concrete or steel 6 drops (all surfaces)	DIN IEC 60068-2-31

5.8 Mounting Advice

Maximum force to the top shielding: 30 N
Maximum bending: 0,315 mm (0,75% of 42 mm)

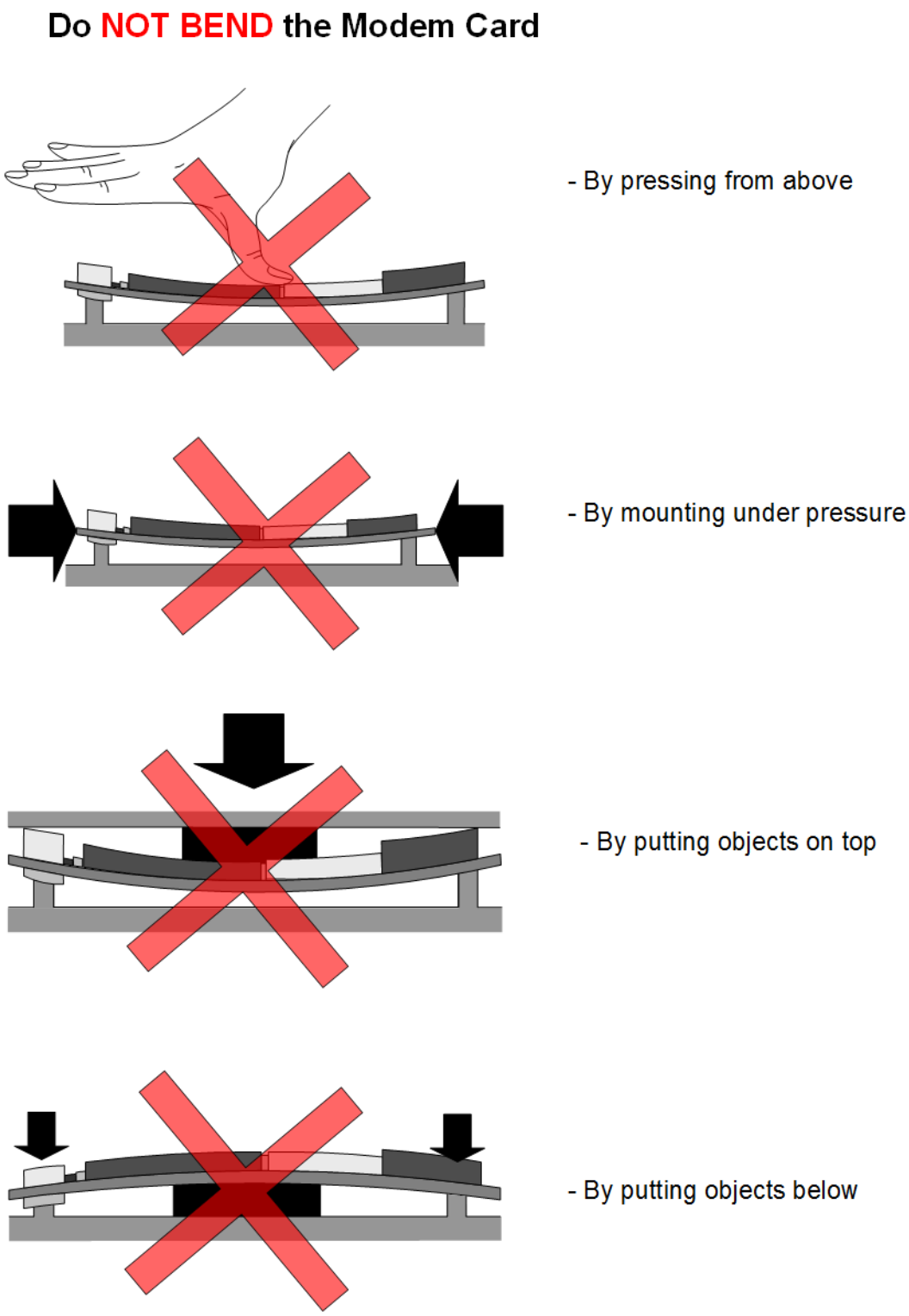


Figure 30: Mounting Advice

5.9 Approval Information

The 5G M.2 Data Card MV31-W has been type approved. The reference setup submitted to type approve the MV31-W consisted of the following components: MV31-W, PC as MMI, Power Supply.

Approval of mobile computing platforms containing 5G M.2 Data Card MV31-W can therefore be based on the existing module approval together with this document as appropriate technical documentation.

5.9.1 Directives and Standards (TBD.)

The 5G M.2 Data Card MV31-W is designed to comply with the directives and standards listed below.

Table 26: Directives

2014/53/EU	Directive of the European Parliament and of the council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/05/EC. The product is labeled with the CE conformity mark.
2002/95/EC (RoHS 1) 2011/65/EC (RoHS 2)	Directive of the European Parliament and of the Council of 27 January 2003 (and revised on 8 June 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

Table 27: Standards of North American type approval

CFR Title 47	Code of Federal Regulations, Part 22, Part 24 and Part 27; US Equipment Authorization FCC
OET Bulletin 65 (Edition 97-01)	Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields
NAPRD.03 V5.32	Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control PCS Type Certification Review board (PTCRB)
RSS132, RSS133, RSS139	Canadian Standard

Table 28: Standards of European type approval

3GPP TS 51.010-1	Digital cellular telecommunications system (Release 7); Mobile Station (MS) conformance specification;
ETSI EN 301 511 V12.5.1	Global System for Mobile communications (GSM); Mobile Stations (MS) equipment; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
GCF-CC V3.68.0	Global Certification Forum - Certification Criteria
Draft ETSI EN 301 489-01 V2.2.0	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU

Table 28: Standards of European type approval

Draft ETSI EN 301 489-52 V1.1.0	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication Mobile and portable (UE) radio and ancillary equipment; Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
ETSI EN 301 908-01 V11.1.1	IMT cellular networks; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 1: Introduction and common requirements
ETSI EN 301 908-02 V11.1.2	IMT cellular networks; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 2: CDMA Direct Spread (UTRA FDD) User Equipment (UE)
ETSI EN 301 908-13 V11.1.2	IMT cellular networks; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 13: Evolved Universal Terrestrial Radio Access (E-UTRA) User Equipment (UE)
EN 60950-1:2006/ A11:2009+A1:2010+A12:2011+A2:2013	Safety of information technology equipment

Table 29: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

Table 30: Standards of the Ministry of Information Industry of the People's Republic of China

SJ/T 11363-2006	"Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products" (2006-06).
SJ/T 11364-2006	"Marking for Control of Pollution Caused by Electronic Information Products" (2006-06).  According to the "Chinese Administration on the Control of Pollution caused by Electronic Information Products" (ACPEIP) the EPUP, i.e., Environmental Protection Use Period, of this product is 20 years as per the symbol shown here, unless otherwise marked. The EPUP is valid only as long as the product is operated within the operating limits described in the Thales Hardware Interface Description. Please see Table 31 for an overview of toxic or hazardous substances or elements that might be contained in product parts in concentrations above the limits defined by SJ/T 11363-2006.

Table 31: Toxic or hazardous substances or elements with defined concentration limits

部件名称 Name of the part	有毒有害物质或元素 Hazardous substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	O	O	O	O	O	O
电路模块 (Circuit Modules)	X	O	O	O	O	O
电缆及电缆组件 (Cables and Cable Assemblies)	O	O	O	O	O	O
塑料和聚合物部件 (Plastic and Polymeric parts)	O	O	O	O	O	O

O:
表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。
Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X:
表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。
Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part *might exceed* the limit requirement in SJ/T11363-2006.

5.10 Safety Precaution Notes

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any cellular terminal or mobile incorporating 5G M.2 Data Card MV31-W. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. Thales assumes no liability for customer's failure to comply with these precautions.

	When in a hospital or other health care facility, observe the restrictions on the use of mobiles. Switch the cellular terminal or mobile off, if instructed to do so by the guidelines posted in sensitive areas. Medical equipment may be sensitive to RF energy. The operation of cardiac pacemakers, other implanted medical equipment and hearing aids can be affected by interference from cellular terminals or mobiles placed close to the device. If in doubt about potential danger, contact the physician or the manufacturer of the device to verify that the equipment is properly shielded. Pacemaker patients are advised to keep their hand-held mobile away from the pacemaker, while it is on.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it cannot be switched on inadvertently. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communications systems. Failure to observe these instructions may lead to the suspension or denial of cellular services to the offender, legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. Remember that interference can occur if it is used close to TV sets, radios, computers or inadequately shielded equipment. Follow any special regulations and always switch off the cellular terminal or mobile wherever forbidden, or when you suspect that it may cause interference or danger.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for speakerphone operation. Before making a call with a hand-held terminal or mobile, park the vehicle. Speakerphones must be installed by qualified personnel. Faulty installation or operation can constitute a safety hazard.
	IMPORTANT! Cellular terminals or mobiles operate using radio signals and cellular networks. Because of this, connection cannot be guaranteed at all times under all conditions. Therefore, you should never rely solely upon any wireless device for essential communications, for example emergency calls. Remember, in order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency calls if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may need to deactivate those features before you can make an emergency call. Some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.

6 Appendix

6.1 Supported CA Configurations

The following tables lists the supported CA configurations (aka supported band combinations) for 2, 3, 4, 5, as well as 6&7 DL CA configurations of the 5G M.2 Data Card MV31-W product.

Table 32: Supported CA configurations (2 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_12A-12A			
CA_12A-25A		25A	
CA_12A-30A		30A	
CA_12A-46A			
CA_12A-66A		66A	
CA_12B			
CA_13A-46A			
CA_13A-48A		48A	
CA_13A-66A		66A	No plan to support interband UL CA
CA_14A-30A		30A	
CA_14A-66A		66A	
CA_18A-42A		42A	
CA_19A-42A		42A	
CA_1A-18A		1A	No plan to support interband UL CA
CA_1A-19A		1A	No plan to support interband UL CA
CA_1A-1A		1A, 1A-1A	
CA_1A-20A		1A	No plan to support interband UL CA
CA_1A-26A		1A	No plan to support interband UL CA
CA_1A-28A		1A	No plan to support interband UL CA
CA_1A-32A		1A	
CA_1A-38A		1A, 38A, 1A-38A	
CA_1A-3A		1A, 3A, 1A-3A	HW doesn't support MHB interband UL CA
CA_1A-40A		1A, 40A, 1A-40A	
CA_1A-41A	1A	1A, 41A, 1A-41A	
CA_1A-42A		1A, 42A, 1A-42A	No plan to support interband UL CA
CA_1A-46A		1A	
CA_1A-5A		1A	
CA_1A-7A		1A, 7A, 1A-7A	HW doesn't support MHB interband UL CA
CA_1A-8A		1A	No plan to support interband UL CA
CA_1C		1C	
CA_20A-32A			No plan to support B32 4*4MIMO
CA_20A-38A		38A	
CA_20A-40A		40A	
CA_20A-42A		42A	

Table 32: Supported CA configurations (2 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_25A-25A		25A, 25A-25A	
CA_25A-26A		25A	
CA_25A-41A	25A	25A, 41A, 25A-41A	
CA_25A-46A		25A	
CA_26A-41A		41A	
CA_26A-46A			
CA_28A-32A			
CA_28A-38A		38A	
CA_28A-40A		40A	
CA_28A-41A		41A	
CA_28A-42A		42A	
CA_28A-46A			
CA_28C			
CA_29A-30A		30A	
CA_29A-66A		66A	
CA_2A-12A		2A	No plan to support interband UL CA
CA_2A-13A		2A	No plan to support interband UL CA
CA_2A-14A		2A	
CA_2A-28A		2A	
CA_2A-29A		2A	
CA_2A-2A		2A, 2A-2A	
CA_2A-30A		2A, 30A, 2A-30A	
CA_2A-46A		2A	HW doesn't support B46 4*4MIMO
CA_2A-48A		2A, 48A, 2A-48A	
CA_2A-4A		2A, 4A, 2A-4A	HW doesn't support MHB interband UL CA
CA_2A-5A		2A	No plan to support interband UL CA
CA_2A-66A		2A, 66A, 2A-66A	HW doesn't support MHB interband UL CA
CA_2A-71A		2A	
CA_2A-7A		2A, 7A, 2A-7A	
CA_2C		2C	
CA_30A-66A		30A, 66A, 30A-66A	
CA_38A-40A		38A, 40A, 38A-40A	
CA_38C	38C	38C	
CA_39A-41A		39A, 41A, 39A-41A	
CA_39C	39C	39C	
CA_3A-18A		3A	
CA_3A-19A		3A	No plan to support interband UL CA
CA_3A-20A		3A	No plan to support interband UL CA
CA_3A-26A		3A	
CA_3A-28A		3A	No plan to support interband UL CA

Table 32: Supported CA configurations (2 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_3A-32A		3A	No plan to support B32 4*4MIMO
CA_3A-38A		3A, 38A, 3A-38A	
CA_3A-3A		3A, 3A-3A	
CA_3A-40A		3A, 40A, 3A-40A	
CA_3A-41A		3A, 41A, 3A-41A	
CA_3A-42A		3A, 42A, 3A-42A	No plan to support interband UL CA
CA_3A-46A		3A	
CA_3A-5A		3A	No plan to support interband UL CA
CA_3A-7A		3A, 7A, 3A-7A	
CA_3A-8A		3A	No plan to support interband UL CA
CA_3C	3C	3C	
CA_40A-40A		40A, 40A-40A	
CA_40A-41A		40A, 41A, 40A-41A	
CA_40A-42A		40A, 42A, 40A-42A	
CA_40C	40C	40C	
CA_41A-41A		41A, 41A-41A	
CA_41A-42A		41A, 42A, 41A-42A	No plan to support interband UL CA
CA_41A-46A		41A	
CA_41A-48A		41A, 48A, 41A-48A	
CA_41C	41C	41C	
CA_42A-42A		42A, 42A-42A	
CA_42C	42C	42C	
CA_46A-66A		66A	HW doesn't support B46 4*4MIMO
CA_46A-71A			
CA_48A-48A		48A, 48A-48A	
CA_48A-66A		48A, 66A, 48A-66A	
CA_48A-71A		48A	
CA_48C	48C	48C	
CA_4A-12A		4A	No plan to support interband UL CA
CA_4A-13A		4A	No plan to support interband UL CA
CA_4A-28A		4A	
CA_4A-29A		4A	
CA_4A-30A		4A, 30A, 4A-30A	
CA_4A-46A		4A	HW doesn't support B46 4*4MIMO
CA_4A-48A		4A, 48A, 4A-48A	
CA_4A-4A		4A, 4A-4A	
CA_4A-5A		4A	No plan to support interband UL CA
CA_4A-71A		4A	
CA_4A-7A		4A, 7A, 4A-7A	
CA_5A-25A		25A	

Table 32: Supported CA configurations (2 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_5A-30A		30A	
CA_5A-38A		38A	
CA_5A-40A		40A	
CA_5A-41A		41A	
CA_5A-46A			
CA_5A-48A		48A	
CA_5A-5A			
CA_5A-66A		66A	No plan to support interband UL CA
CA_5A-7A		7A	
CA_5B	5B		
CA_66A-66A		66A, 66A-66A	
CA_66A-71A		66A	
CA_66B	66B	66B	
CA_66C	66C	66C	
CA_7A-12A		7A	
CA_7A-20A		7A	No plan to support interband UL CA
CA_7A-28A		7A	No plan to support interband UL CA
CA_7A-32A		7A	
CA_7A-40A		7A, 40A, 7A-40A	
CA_7A-42A		7A, 42A, 7A-42A	
CA_7A-46A		7A	
CA_7A-66A		7A, 66A, 7A-66A	
CA_7A-7A		7A, 7A-7A	
CA_7A-8A		7A	
CA_7B		7B	
CA_7C	7C	7C	
CA_8A-32A			
CA_8A-38A		38A	
CA_8A-39A		39A	
CA_8A-40A		40A	
CA_8A-41A		41A	
CA_8A-42A		42A	
CA_8A-46A			
CA_8B	8B		
CA_4A-17A		4A	
CA_2A-17A		2A	
CA_7A-29A	7A	7A	
CA_46A-48A	48A		

Table 33: Supported CA configurations (3 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_1A-3A-41A	1A, 3A	1A, 3A, 41A, 1A-3A, 1A-41A, 3A-41A, 1A-3A-41A	
CA_1A-3A-5A		1A-3A	
CA_1A-41A-42A	1A, 42A	1A, 41A, 42A, 1A-41A, 1A-42A, 41A-42A, 1A-41A-42A	No plan to support interband UL CA
CA_1A-42C	42C	1A, 42C, 1A-42C	No plan to support interband UL CA
CA_1C-41A	1A	1C, 41A, 1C-41A	
CA_25A-25A-41A	25A	25A, 41A, 25A-25A, 25A-41A, 25A-25A-41A	
CA_25A-26A-41A	25A, 26A	25A, 41A, 25A-41A	
CA_3A-42C	42C	3A, 42C, 3A-42C	No plan to support interband UL CA
CA_3A-7A-32A	3A, 7A	3A, 7A, 3A-7A	
CA_41D	41C	41D	
CA_46C-66A	66A	66A	HW doesn't support B46 4*4MIMO
CA_48A-48A-66A		48A, 66A, 48A-66A, 48A-48A-66A	
CA_48A-66B		48A, 66B, 48A-66B	
CA_2A-48A-66A		2A, 48A, 66A, 2A-48A, 2A-66A, 48A-66A, 2A-48A-66A	
CA_46A-48A-66A	48A, 66A	66A	HW doesn't support B46_48 4*4MIMO
CA_48A-66B		48A, 66B, 48A-66B	
CA_7A-28A-38A		7A	
CA_7A-28A-40A		7A, 40A, 7A-40A	
CA_7A-7A-66A		7A-7A-66A	
CA_7A-7A-28A		7A-7A	
CA_3A-5A-41A		3A-41A	
CA_7A-7A-13A		7A-7A	
CA_7A-7A-29A	7A	7A-7A	
CA_7A-29A-66A	7A, 66A	7A-66A	
CA_7C-29A	7C	7C	
CA_7A-46A-66A	7A, 66A	7A-66A	
CA_1A-28A-40A			
CA_2A-46A-48A	2A, 48A	2A	HW doesn't support B46_48 4*4MIMO
CA_3A-28A-38A		3A	
CA_46C-48A	48A		HW doesn't support B46_48 4*4MIMO

Table 34: Supported CA configurations (4 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_1A-28A-42C	42C	42C	No plan to support interband UL CA
CA_1A-3A-41A-42A	1A, 3A, 42A	1A, 3A, 41A, 42A, 1A-3A, 1A-41A, 1A-42A, 3A-41A, 3A-42A, 41A-42A, 1A-3A-41A, 1A-3A-42A, 3A-41A-42A, 1A-3A-41A-42A	
CA_1A-3C-41A	1A, 3A	1A, 3C, 41A, 1A-3C, 1A-41A, 3C-41A, 1A-3C-41A	
CA_1C-3A-41A	1A, 3A	1C, 3A, 41A, 1C-3A, 1C-41A, 3A-41A, 1C-3A-41A	
CA_3A-41C-42A		3A, 41C, 42A, 3A-41C, 3A-42A, 41C-42A, 3A-41C-42A	No plan to support interband UL CA
CA_7A-28A-40C		7A, 40C, 7A-40C	
CA_1A-3C-38A		1A-3C	
CA_2A-12B-66A		2A-66A	
CA_2A-46A-48A-66A		2A-66A	HW doesn't support B48_46 4*4MIMO
CA_2A-46A-48C	2A, 48A	2A	HW doesn't support B48_46 4*4MIMO
CA_2A-46C-48A	2A, 48A	2A	HW doesn't support B48_46 4*4MIMO
CA_2A-7A-46C		2A-7A	
CA_2A-7A-7A-66A		2A, 7A, 66A, 2A-7A, 2A-66A, 7A-66A, 2A-7A-7A, 2A-7A-66A, 7A-7A-66A, 2A-7A-7A-66A	
CA_3A-8A-40C		3A	
CA_3C-28A-38A		3C	
CA_46A-48C-66A	48A, 66A	66A	HW doesn't support B48_46 4*4MIMO
CA_46A-48D	48A		HW doesn't support B48_46 4*4MIMO
CA_46C-48A-66A	48A, 66A	66A	HW doesn't support B48_46 4*4MIMO
CA_1A-7A-7A-28A		1A-7A-7A	
CA_3A-7A-7A-28A		3A-7A-7A	
CA_1A-28A-40C		1A-40C	
CA_2A-7C-66A		2A, 7C, 66A, 2A-7C, 7C-66A, 2A-7C-66A	
CA_2A-48A-66A-66A		2A-48A-66A-66A	
CA_3A-5A-40A-40A		3A-40A-40A	

Table 34: Supported CA configurations (4 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_7A-7A-66A-66A		7A, 66A, 7A-66A, 7A-7A, 7A-66A, 66A-66A, 7A-7A-66A, 7A-66A-66A, 7A-7A-66A-66A	
CA_2A-2A-7A-12A		2A-2A-7A	
CA_2A-7A-29A-66A	2A, 7A, 66A	2A-7A-66A	
CA_7A-7A-29A-66A	7A, 66A	7A-7A-66A	
CA_7C-29A-66A	7C, 66A	7C-66A	
CA_2A-7A-7A-13A		2A, 7A, 2A-7A, 7A-7A, 2A-7A-7A	
CA_46D-48A	48A		HW doesn't support B48_46 4*4MIMO

Table 35: Supported CA configurations (5 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_1A-3A-28A-42C	42C	1A, 3A, 42C, 1A-3A, 1A-42C, 3A-42C, 1A-3A-42C	No plan to support interband UL CA
CA_1A-3A-41A-42C	42C, 1A, 3A, 42A	1A, 3A, 41A, 42C, 1A-3A, 1A-41A, 1A-42C, 3A-41A, 3A-42C, 41A-42C, 1A-3A-41A, 1A-3A-42C, 3A-41A-42C, 1A-3A-41A-42C	
CA_1A-41C-42C	42C	1A, 41C, 42C, 1A-41C, 1A-42C, 41C-42C, 1A-41C-42C	
CA_3A-41C-42C	42C	3A, 41C, 42C, 3A-41C, 3A-42C, 3A-41C-42C, 41C-42C	No plan to support interband UL CA
CA_41C-41D	41C	41C, 41D, 41C-41D	
CA_1A-3A-3A-7C		1A-3A-3A-7C	
CA_1A-3A-28A-40C		1A, 3A, 40C, 1A-3A, 1A-40C, 3A-40C, 1A-3A-40C	
CA_5A-48A-48D		48A, 48D, 48A-48D	
CA_5A-48D-66A		48D, 66A, 48D-66A	
CA_1A-3A-42D	42C	1A, 3A, 42D, 1A-3A, 1A-42A, 1A-42D, 3A-42D, 1A-3A-42D	No plan to support interband UL CA
CA_1A-3A-46D		1A-3A	
CA_1A-3C-7A-28A		1A, 3C, 7A, 1A-3C, 1A-7A, 3C-7A, 1A-3C-7A	

Table 35: Supported CA configurations (5 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_1A-3C-7A-38A		1A-3C-7A	
CA_2A-12B-66A-66A		2A-66A-66A	
CA_2A-46A-48C-66A		2A-66A	HW doesn't support B46_48 4*4 MIMO
CA_2A-46A-48D	2A, 48A	2A	HW doesn't support B46_48 4*4 MIMO
CA_2A-46C-48A-66A		2A-66A	HW doesn't support B46_48 4*4 MIMO
CA_2A-46C-48C	2A, 48A	2A	HW doesn't support B46_48 4*4 MIMO
CA_2A-46D-48A	2A, 48A	2A	HW doesn't support B46_48 4*4 MIMO
CA_3A-7A-8A-40C		3A, 7A, 40C, 3A-7A, 3A-40C, 7A-40C, 3A-7A-40C	
CA_46A-48D-66A	48A, 66A	66A	HW doesn't support B46_48 4*4 MIMO
CA_46C-48C-66A	48A, 66A	66A	HW doesn't support B46_48 4*4 MIMO
CA_46C-48D	48A		HW doesn't support B46_48 4*4 MIMO
CA_46D-48A-66A	48A, 66A	66A	HW doesn't support B46_48 4*4 MIMO
CA_1A-3A-3A-7A-28A		1A-3A-3A-7A	
CA_1A-3A-7A-7A-28A		1A-3A-7A-7A	
CA_1A-3A-7C-20A		1A-3A-7C	
CA_1A-3A-3A-7A-8A		1A-3A-3A-7A	
CA_1A-3A-7A-7A-8A		1A-3A-7A-7A	
CA_2A-7C-66A-66A		2A, 7C, 66A, 2A-7C, 2A-66A, 7C-66A, 2A-7C-66A, 2A-66A-66A, 7C-66A-66A, 2A-7C-66A-66A	
CA_2A-7A-7A-29A-66A	2A, 7A, 66A	2A-7A-7A-66A	
CA_2A-7C-29A-66A	2A, 7C, 66A	2A-7C-66A	
CA_2A-7A-7A-66A-66A		2A, 7A, 66A, 2A-7A, 2A-66A, 7A-66A, 2A-7A-7A, 2A-7A-66A, 2A-66A-66A, 7A-66A-66A, 7A-7A-66A, 2A-7A-7A-66A, 2A-7A-66A-66A, 7A-7A-66A-66A, 2A-7A-7A-66A-66A	
CA_46E-48A	48A		HW doesn't support B46_48 4*4 MIMO

Table 36: Supported CA configurations (6 & 7 DL CA)

CA Configuration	Uplink CA	4x4 MIMO	Comments
CA_1A-3A-41C-42C	42C	1A, 3A, 41C, 42C, 1A-3A, 1A-41C, 1A-42C, 3A-41C, 3A-42C, 41C-42C, 1A-3A-41C, 1A-3A-42C	
CA_1A-3C-7C-28A		1A, 3C, 7C, 1A-3C, 1A-7C, 3C-7C	
CA_28A-41A-42C-42C	42C	41A, 42C, 41A-42C, 42C-42C	
CA_2A-46E-66A-66A		2A, 66A, 2A-66A, 66A-66A, 2A-66A-66A	
CA_2A-48E-66A		2A, 48E, 66A, 2A-66A	
CA_2A-7A-7A-46E		2A, 7A, 2A-7A, 7A-7A, 2A-7A-7A	
CA_3A-28A-41C-42C	41C, 42C	3A, 41C, 42C, 3A-41C , 3A-42C, 41C-42C	
CA_3A-28A-42C-42C	42C	42C, 3A-42C, 42C-42C	
CA_3A-41A-42C-42C	42C	41A, 42C, 3A-41A, 3A-42C, 41A-42C, 42C-42C, 3A-41A-42C	
CA_41C-42C-42C	41C, 42C	41C, 42C, 41C-42C, 42C-42C	
CA_3A-7C-46E		3A-7C	
CA_1A-3A-3A-7A-7A-8A		3A-3A-7A-7A	
CA_2A-5A-46D-66A-66A	2A, 5A, 66A	2A-66A-66A	
CA_2A-13A-46D-66A-66A	2A, 13A, 66A	2A-66A-66A	

6.2 Supported EN-DC Configurations

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_25A_n41A				n41A	25A	n41A	Don't support MHB+n41 4*4MIMO
DC_26A_n41A				n41A	26A	n41A	
DC_41A_n41A	41A			n41A	41A	n41A	
DC_41C_n41A	41C			n41A	41C	n41A	
DC_41D_n41A	41D			n41A	41C	n41A	
DC_1A_n78A	1A			n78A	1A	n78A	
DC_3A_n78A	3A			n78A	3A	n78A	
DC_7A_n78A	7A			n78A	7A	n78A	
DC_8A_n78A				n78A	8A	n78A	
DC_20A_n78A				n78A	20A	n78A	
DC_28A_n78A				n78A	28A	n78A	
DC_38A_n78A	38A			n78A	38A	n78A	
DC_1C_n78A	1C			n78A	1A	n78A	
DC_3C_n78A	3C			n78A	3C	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_7C_n78A	7C			n78A	7C	n78A	
DC_1A-3A_n78A	1A-3A			n78A	1A, 3A	n78A	
DC_1A-7A_n78A	1A-7A			n78A	1A, 7A	n78A	
DC_1A-8A_n78A	1A			n78A	1A, 8A	n78A	
DC_1A-20A_n78A	1A			n78A	1A, 20A	n78A	
DC_3A-3A_n78A	3A-3A			n78A	3A, 3A	n78A	
DC_3A-7A_n78A	3A-7A			n78A	3A, 7A	n78A	
DC_3A-8A_n78A	3A			n78A	3A, 8A	n78A	
DC_3A-20A_n78A	3A			n78A	3A, 20A	n78A	
DC_3A-28A_n78A	3A			n78A	3A, 28A	n78A	
DC_3A-38A_n78A	3A-38A			n78A	3A, 38A	n78A	
DC_7A-20A_n78A	7A			n78A	7A, 20A	n78A	
DC_7A-28A_n78A	7A			n78A	7A, 28A	n78A	
DC_8A-20A_n78A				n78A	8A, 20A	n78A	
DC_20A-38A_n78A	38A			n78A	20A, 38A	n78A	
DC_1A-3C_n78A	1A-3C			n78A	1A, 3C	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-7C_n78A	1A-7C			n78A	1A, 7C	n78A	
DC_3A-7C_n78A	3A-7C			n78A	3A, 7C	n78A	
DC_3C-7A_n78A	3C-7A			n78A	3C, 7A	n78A	
DC_3C-20A_n78A	3C			n78A	3C, 20A	n78A	
DC_1A-3A-7A_n78A	1A-3A-7A			n78A	1A, 3A, 7A	n78A	
DC_1A-3A-8A_n78A	1A-3A			n78A	1A, 3A, 8A	n78A	
DC_1A-3A-20A_n78A	1A-3A			n78A	1A, 3A, 20A	n78A	
DC_1A-3A-28A_n78A	1A-3A			n78A	1A, 3A, 28A	n78A	
DC_1A-7A-20A_n78A	1A-7A			n78A	1A, 7A, 20A	n78A	
DC_1A-8A-20A_n78A	1A			n78A	1A, 8A, 20A	n78A	
DC_3A-7A-20A_n78A	3A-7A			n78A	3A, 7A, 20A	n78A	
DC_3A-7A-28A_n78A	3A-7A			n78A	3A, 7A, 28A	n78A	
DC_3A-8A-20A_n78A	3A			n78A	3A, 8A, 20A	n78A	
DC_3C-7C_n78A	3C-7C			n78A	3C, 7C	n78A	
DC_1A-3A-7C_n78A	1A-3A-7C			n78A	1A, 3A, 7C	n78A	
DC_1A-3C-7A_n78A	1A-3C-7A			n78A	1A, 3C, 7A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-3C-20A_n78A	1A-3C			n78A	1A, 3C, 20A	n78A	
DC_3C-7A-20A_n78A	3C-7A			n78A	3C, 7A, 20A	n78A	
DC_1A-3A-7A-8A_n78A	1A-3A-7A			n78A	1A, 3A, 7A, 8A	n78A	
DC_1A-3A-7A-20A_n78A	1A-3A-7A			n78A	1A, 3A, 7A, 20A	n78A	
DC_1A-3A-7A-28A_n78A	1A-3A-7A			n78A	1A, 3A, 7A, 28A	n78A	
DC_1A-3C-7C_n78A	1A-3C-7C			n78A	1A, 3C, 7C	n78A	
DC_1A_n77A	1A			n77A	1A	n77A	
DC_1A_n78A	1A			n78A	1A	n78A	
DC_1A_n79A	1A			n79A	1A	n79A	
DC_3A_n77A	3A			n77A	3A	n77A	
DC_3A_n78A	3A			n78A	3A	n78A	
DC_3A_n79A	3A			n79A	3A	n79A	
DC_19A_n78A				n78A	19A	n78A	
DC_19A_n79A				n79A	19A	n79A	
DC_28A_n77A				n77A	28A	n77A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_41C_n77A	41C			n77A	41C	n77A	
DC_1A-3A_n77A	1A-3A			n77A	1A, 3A	n77A	
DC_1A-3A_n78A	1A-3A			n78A	1A, 3A	n78A	
DC_1A-3A_n79A	1A-3A			n79A	1A, 3A	n79A	
DC_1A-19A_n78A	1A			n78A	1A, 19A	n78A	
DC_1A-19A_n79A	1A			n79A	1A, 19A	n79A	
DC_1A-28A_n77A	1A			n77A	1A, 28A	n77A	
DC_1A-28A_n78A	1A			n78A	1A, 28A	n78A	
DC_1A-42A_n77A	1A-42A			n77A	1A	n77A	
DC_1A-42A_n78A	1A-42A			n78A	1A	n78A	
DC_3A-19A_n78A	3A			n78A	3A, 19A	n78A	
DC_3A-19A_n79A	3A			n79A	3A, 19A	n79A	
DC_3A-28A_n77A	3A			n77A	3A, 28A	n77A	
DC_3A-28A_n78A	3A			n78A	3A, 28A	n78A	
DC_3A-41A_n78A	3A-41A			n78A	3A, 41A	n78A	
DC_3A-42A_n77A	3A-42A			n77A	3A	n77A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_3A-42A_n78A	3A-42A			n78A	3A	n78A	
DC_19A-42A_n78A	42A			n78A	19A	n78A	
DC_28A-42A_n77A	42A			n77A	28A	n77A	
DC_41A-42A_n77A	41A-42A			n77A	41A	n77A	
DC_1A-42C_n77A	1A-42C			n77A	1A	n77A	
DC_1A-42C_n78A	1A-42C			n78A	1A	n78A	
DC_3A-42C_n77A	3A-42C			n77A	3A	n77A	
DC_3A-42C_n78A	3A-42C			n78A	3A	n78A	
DC_19A-42C_n78A	42C			n78A	19A	n78A	
DC_28A-42C_n77A	42C			n77A	28A	n77A	
DC_41A-42C_n77A	41A-42C			n77A	41A	n77A	
DC_41C-42A_n77A	41C-42A			n77A	41C	n77A	
DC_1A-3A-19A_n78A	1A-3A			n78A	1A, 3A, 19A	n78A	
DC_1A-3A-19A_n79A	1A-3A			n79A	1A, 3A, 19A	n79A	
DC_1A-3A-28A_n77A	1A-3A			n77A	1A, 3A, 28A	n77A	
DC_1A-3A-28A_n78A	1A-3A			n78A	1A, 3A, 28A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-3A-42A_n77A	1A-3A-42A			n77A	1A, 3A	n77A	
DC_1A-3A-42A_n78A	1A-3A-42A			n78A	1A, 3A	n78A	
DC_1A-19A-42A_n78A	1A-42A			n78A	1A, 19A	n78A	
DC_1A-28A-42A_n77A	1A-42A			n77A	1A, 28A	n77A	
DC_3A-19A-42A_n78A	3A-42A			n78A	3A, 19A	n78A	
DC_3A-28A-42A_n77A	3A-42A			n77A	3A, 28A	n77A	
DC_3A-42D_n78A	3A-42D			n78A	3A	n78A	
DC_41C-42C_n77A	41C-42C			n77A	41C	n77A	
DC_1A-3A-42C_n77A	1A-3A-42C			n77A	1A, 3A	n77A	
DC_1A-28A-42C_n77A	1A-42C			n77A	1A, 28A	n77A	
DC_3A-19A-42C_n78A	3A-42C			n78A	3A, 19A	n78A	
DC_3A-28A-42C_n77A	3A-42C			n77A	3A, 28A	n77A	
DC_1A-3A-19A-42A_n78A	1A-3A-42A			n78A	1A, 3A, 19A	n78A	
DC_1A-3A-28A-42A_n77A	1A-3A-42A			n77A	1A, 3A, 28A	n77A	
DC_1A-42E_n78A	1A-42E			n78A	1A	n78A	
DC_3A-42E_n78A	3A-42E			n78A	3A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-3A-19A-42C_n78A	1A-3A-42C			n78A	1A, 3A, 19A	n78A	
DC_1A-3A-28A-42C_n77A	1A-3A-42C			n77A	1A, 3A, 28A	n77A	
DC_5A_n78A				n78A	5A	n78A	
DC_1A-5A_n78A	1A			n78A	1A, 5A	n78A	
DC_3A-5A_n78A	3A			n78A	3A, 5A	n78A	
DC_5A-7A_n78A	7A			n78A	5A, 7A	n78A	
DC_7A-7A_n78A	7A-7A			n78A	7A	n78A	
DC_1A-5A-7A_n78A	1A-7A			n78A	1A, 5A, 7A	n78A	
DC_1A-7A-7A_n78A	1A-7A-7A			n78A	1A, 7A	n78A	
DC_3A-5A-7A_n78A	3A-7A			n78A	3A, 5A, 7A	n78A	
DC_3A-7A-7A_n78A	3A-7A-7A			n78A	3A, 7A	n78A	
DC_5A-7A-7A_n78A	7A-7A			n78A	5A, 7A	n78A	
DC_1A-3A-5A-7A_n78A	1A-3A-7A			n78A	1A, 3A, 5A, 7A	n78A	
DC_1A-3A-7A-7A_n78A	1A-3A-7A-7A			n78A	1A, 3A, 7A	n78A	
DC_1A-5A-7A-7A_n78A	1A-7A-7A			n78A	1A, 5A, 7A	n78A	
DC_3A-5A-7A-7A_n78A	3A-7A-7A			n78A	3A, 5A, 7A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-3A-5A-7A-7A_n78A	1A-3A-7A-7A			n78A	1A, 3A, 5A, 7A	n78A	
DC_3C-8A_n78A	3C			n78A	3C, 8A	n78A	
DC_1A-3C-8A_n78A	1A-3C			n78A	1A, 3C, 8A	n78A	
DC_1A-3A-5A_n78A	1A-3A			n78A	1A, 3A, 5A	n78A	
DC_7C-28A_n78A	7C			n78A	7C, 28A	n78A	
DC_1A-7A-28A_n78A	1A-7A			n78A	1A, 7A, 28A	n78A	
DC_3A-7C-28A_n78A	3A-7C			n78A	3A, 7C, 28A	n78A	
DC_2A-5A_n5A	2A				2A	n5A	
DC_2A-66A_n5A	2A-66A				2A, 66A	n5A	
DC_2A-5A-66A_n66A	2A-66A			n66A	5A	n66A	HW can't support two MHB tx work at same time except n41
DC_2A_n5A	2A				2A	n5A	Follow 80-PM475-650 Rev E moved
DC_30A_n5A	30A				30A	n5A	
DC_66A_n5A	66A				66A	n5A	
DC_5A_n66A				n66A	5A	n66A	
DC_12A_n66A				n66A	12A	n66A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-2A_n5A	2A-2A				2A, 2A	n5A	
DC_2A-12A_n5A	2A				2A	n5A	
DC_2A-30A_n5A	2A-30A				2A, 30A	n5A	
DC_12A-66A_n5A	66A				66A	n5A	
DC_30A-66A_n5A	30A-66A				30A, 66A	n5A	
DC_66A-66A_n5A	66A-66A				66A	n5A	
DC_2A-5A_n66A	2A			n66A	5A	n66A	HW can't support two MHB tx work at same time except n41
DC_2A-12A_n66A	2A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41
DC_5A-30A_n66A	30A			n66A	5A	n66A	HW can't support two MHB tx work at same time except n41
DC_5A-66A_n66A	66A			n66A	5A	n66A	
DC_12A-30A_n66A	30A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41
DC_12A-66A_n66A	66A			n66A	12A	n66A	
DC_2A-2A-30A_n5A	2A-2A-30A				2A, 30A	n5A	
DC_2A-2A-66A_n5A	2A-2A-66A				2A, 66A	n5A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-30A-66A_n5A	2A-30A-66A				2A, 30A, 66A	n5A	
DC_2A-66A-66A_n5A	2A-66A-66A				2A, 66A	n5A	
DC_30A-66A-66A_n5A	30A-66A-66A				30A, 66A	n5A	
DC_2A-2A-5A_n66A	2A-2A			n66A	5A	n66A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos
DC_2A-2A-12A_n66A	2A-2A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41
DC_2A-5A-30A_n66A	2A-30A			n66A	5A	n66A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos
DC_5A-30A-66A_n66A	30A-66A			n66A	5A	n66A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos
DC_12A-30A-66A_n66A	30A-66A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41
DC_2A-2A-5A-30A_n66A	2A-2A-30A			n66A	5A	n66A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-2A-5A-66A_n66A	2A-2A-66A			n66A	5A	n66A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos
DC_2A-2A-12A-30A_n66A	2A-2A-30A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41
DC_2A-2A-12A-66A_n66A	2A-2A-66A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41
DC_2A-2A-14A-30A_n66A	2A-2A-30A			n66A	14A	n66A	Follow QCT removed from B to C,Add in J
DC_2A-5A-30A-66A_n66A	2A-30A-66A			n66A	5A	n66A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos
DC_2A-12A-30A-66A_n66A	2A-30A-66A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41
DC_12A_n2A				n2A	12A	n2A	
DC_71A_n66A				n66A	71A	n66A	Follow QCT removed from B to C,And add in E
DC_2A_n71A	2A				2A	n71A	
DC_66A_n71A	66A				66A	n71A	
DC_66C_n71A	66C				66C	n71A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-12A_n2A	2A			n2A	12A	n2A	
DC_12A-66A_n2A	66A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_66A-71A_n66A	66A			n66A	71A	n66A	Follow QCT removed from B to C,And add in E
DC_2A-66A_n71A	2A-66A				2A, 66A	n71A	
DC_66A-66A_n71A	66A-66A				66A	n71A	Follow QCT removed from B to C,And add in E
DC_2A-12A-66A_n2A	2A-66A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_2A-12A-66A_n66A	2A-66A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41
DC_2A-66A-71A_n66A	2A-66A			n66A	71A	n66A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos
DC_20A_n1A				n1A	20A	n1A	
DC_3A-20A_n1A	3A			n1A	20A	n1A	HW can't support two MHB tx work at same time except n41
DC_7A-20A_n1A	7A			n1A	20A	n1A	HW can't support two MHB tx work at same time except n41

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_3A-7A-20A_n1A	3A-7A			n1A	20A	n1A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos
DC_20A_n3A				n3A	20A	n3A	
DC_1A-20A_n3A	1A			n3A	20A	n3A	HW can't support two MHB tx work at same time except n41
DC_7A-20A_n3A	7A			n3A	20A	n3A	HW can't support two MHB tx work at same time except n41
DC_1A-7A-20A_n3A	1A-7A			n3A	20A	n3A	Follow QCT removed from B to C,And add in E,Don't support LTE MHB+NR MHB UL combos
DC_3A_n8A	3A				3A	n8A	Follow QCT removed from B to C
DC_7A_n8A	7A				7A	n8A	Follow QCT removed from B to C
DC_1A-3A_n8A	1A-3A				1A, 3A	n8A	Follow QCT removed from B to C
DC_1A-7A_n8A	1A-7A				1A, 7A	n8A	Follow QCT removed from B to C
DC_3A-7A_n8A	3A-7A				3A, 7A	n8A	Follow QCT removed from B to C
DC_1A-3A-7A_n8A	1A-3A-7A				1A, 3A, 7A	n8A	Follow QCT removed from B to C
DC_1A_n28A	1A				1A	n28A	
DC_3A_n28A	3A				3A	n28A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_7A_n28A	7A				7A	n28A	
DC_3C_n28A	3C				3C	n28A	
DC_1A-3A_n28A	1A-3A				1A, 3A	n28A	
DC_1A-7A_n28A	1A-7A				1A, 7A	n28A	
DC_3A-7A_n28A	3A-7A				3A, 7A	n28A	
DC_1A-3A-7A_n28A	1A-3A-7A				1A, 3A, 7A	n28A	
DC_3A_n79A	3A			n79A	3A	n79A	
DC_3A_n41A				n41A	3A	n41A	Don't support MHB+n41 4*4MIMO
DC_8A_n41A				n41A	8A	n41A	
DC_39A_n41A				n41A	39A	n41A	Don't support MHB+n41 4*4MIMO
DC_39A_n79A	39A			n79A	39A	n79A	
DC_1A-3A-20A_n38A	1A-3A			n38A	20A	n38A	can't support MHB LTE NR tx at same time
DC_3C-28A_n78A	3C			n78A	3C, 28A	n78A	
DC_3C-7A-28A_n78A	3C-7A			n78A	3C, 7A, 28A	n78A	
DC_1A-3C-28A_n78A	1A-3C			n78A	1A, 3C, 28A	n78A	
DC_1A-7C-28A_n78A	1A-7C			n78A	1A, 7C, 28A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-3A-7C-28A_n78A	1A-3A-7C			n78A	1A, 3A, 7C, 28A	n78A	
DC_1A-3C-7A-28A_n78A	1A-3C-7A			n78A	1A, 3C, 7A, 28A	n78A	
DC_1A-3C-7C-28A_n78A	1A-3C, 1A-7C, 3C-7C			n78A	1A, 3A, 7A, 28A	n78A	
DC_1A_n5A	1A				1A	n5A	
DC_3A_n5A	3A				3A	n5A	
DC_3C_n5A	3C				3A	n5A	
DC_7A_n5A	7A				7A	n5A	
DC_7C_n5A	7C				7C	n5A	
DC_1A-3A_n5A	1A-3A				1A, 3A	n5A	
DC_1A-3C_n5A	1A-3C				1A, 3A	n5A	
DC_1A-7A_n5A	1A-7A				1A, 7A	n5A	
DC_1A-7C_n5A	1A-7C				1A, 7C	n5A	
DC_3A-7A_n5A	3A-7A				3A, 7A	n5A	
DC_3C-7A_n5A	3C-7A				3A, 7A	n5A	
DC_3A-7C_n5A	3A-7C				3A, 7C	n5A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_3C-7C_n5A	3C-7C				3A, 7A	n5A	
DC_1A-3C-7A_n5A	1A-3C-7A				1A, 3A, 7A	n5A	
DC_1A-3A-7C_n5A	1A-3A-7C				1A, 3A, 7C	n5A	
DC_1A-3C-7C_n5A	1A-3C-7C				1A, 3C, 7C	n5A	
DC_28A_n7A				n7A	28A	n7A	
DC_1A-28A_n7A	1A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_3A-28A_n7A	3A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_7A-28A_n7A	7A			n7A	28A	n7A	
DC_1A-3A-28A_n7A	1A-3A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-3C-28A_n7A	1A-3C			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-7A-28A_n7A	1A-7A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_3A-7A-28A_n7A	3A-7A			n7A	28A	n7A	can't support MHB LTE NR tx at same time

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_3C-7A-28A_n7A	3C-7A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-3A-7A-28A_n7A	1A-3A-7A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-3C-7A-28A_n7A	1A-3C-7A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_3A-40A_n78A	3A-40A			n78A	3A, 40A	n78A	
DC_28A_n40A				n40A	28A	n40A	
DC_1A-28A_n40A	1A			n40A	28A	n40A	Don't support MHB+MHB ENDC
DC_3A-28A_n40A	3A			n40A	28A	n40A	Don't support MHB+MHB ENDC
DC_1A-3A-28A_n40A	1A-3A			n40A	28A	n40A	Don't support MHB+MHB ENDC
DC_8A_n77A				n77A	8A	n77A	
DC_1A-8A_n77A	1A			n77A	1A, 8A	n77A	
DC_3A-8A_n77A	3A			n77A	3A, 8A	n77A	
DC_1A-3A-8A_n77A	1A-3A			n77A	1A, 3A, 8A	n77A	
DC_1A-3A-41C-42C_n78A	1A-3A-42C, 41C-42C			n78A	1A, 3A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-3A-41C-42A_n78A	1A-3A-42A, 3A-41C-42A, 1A-41C-42A			n78A	1A, 3A	n78A	
DC_1A-3A-41C_n78A	1A-3A-41C			n78A	1A, 3A	n78A	
DC_1A-3A-18A-42C_n78A	1A-3A, 1A-3A-42C, 1A-42C, 3A-42C			n78A	1A, 3A, 18A	n78A	
DC_1A-3A-18A-42A_n78A	1A-3A, 1A-3A-42A, 1A-42A, 3A-42A			n78A	1A, 3A, 18A	n78A	
DC_1A-3A-18A_n78A	1A-3A			n78A	1A, 3A, 18A	n78A	
DC_5A_n2A				n2A	5A	n2A	
DC_5A-66A_n5A	66A				66A	n5A	
DC_5A-30A_n2A	30A			n2A	5A	n2A	can't support MHB LTE NR tx at same time
DC_12A-30A_n2A	30A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_5A-66A_n2A	66A			n2A	5A	n2A	HW can't support two MHB tx work at same time except n41
DC_2A-5A_n2A	2A			n2A	5A	n2A	can't support MHB LTE NR tx at same time

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-5A-30A_n2A	2A-30A			n2A	5A	n2A	can't support MHB LTE NR tx at same time
DC_2A-12A-30A_n2A	2A-30A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_2A-5A-66A_n2A	2A-66A			n2A	5A	n2A	can't support MHB LTE NR tx at same time
DC_2A-5A-30A-66A_n2A	2A-30A-66A			n2A	5A	n2A	can't support MHB LTE NR tx at same time
DC_2A-12A-30A-66A_n2A	2A-30A-66A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_2A-5A-66A-66A_n2A	2A-66A-66A			n2A	5A	n2A	can't support MHB LTE NR tx at same time
DC_2A-12A-66A-66A_n2A	2A-66A-66A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_66A-66A-66A_n5A	66A-66A-66A				66A	n5A	
DC_2A-2A-5A_n5A	2A-2A				2A	n5A	
DC_2A-5A-66A_n5A	2A-66A				2A, 66A	n5A	
DC_5A-66A-66A_n5A	66A-66A				66A	n5A	
DC_2A-12A-30A_n66A	2A-30A			n66A	12A	n66A	HW can't support two MHB tx work at same time except n41

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_5A-30A-66A_n2A	30A-66A			n2A	5A	n2A	can't support MHB LTE NR tx at same time
DC_12A-30A-66A_n2A	30A-66A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_5A-66A-66A_n2A	66A-66A			n2A	5A	n2A	can't support MHB LTE NR tx at same time
DC_12A-66A-66A_n2A	66A-66A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_2A-2A-30A-66A_n5A	2A-2A-30A-66A				2A, 30A, 66A	n5A	
DC_2A-30A-66A-66A_n5A	2A-30A-66A-66A				2A, 30A, 66A	n5A	
DC_2A-2A-66A-66A_n5A	2A-2A-66A-66A				2A, 66A	n5A	
DC_30A-66A-66A-66A_n5A	30A-66A-66A-66A				30A, 66A	n5A	
DC_2A-2A-5A-66A_n5A	2A-2A-66A				2A, 66A	n5A	
DC_2A-5A-66A-66A_n5A	2A-66A-66A				2A, 66A	n5A	
DC_5A-30A-66A-66A_n2A	30A-66A-66A			n2A	5A	n2A	can't support MHB LTE NR tx at same time

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_12A-30A-66A-66A_n2A	30A-66A-66A			n2A	12A	n2A	HW can't support two MHB tx work at same time except n41
DC_13A_n66A				n66A	13A	n66A	
DC_13A_n2A				n2A	13A	n2A	
DC_48A_n5A	48A				48A	n5A	
DC_48A_n66A	48A			n66A	48A	n66A	
DC_2A-13A_n66A	2A			n66A	13A	n66A	HW can't support two MHB tx work at same time except n41
DC_13A-66A_n66A	66A			n66A	13A	n66A	
DC_13A-66A_n2A	66A			n2A	13A	n2A	HW can't support two MHB tx work at same time except n41
DC_2A-48A_n5A	2A-48A				2A, 48A	n5A	
DC_2A-46A_n5A	2A				2A	n5A	
DC_2A-48A_n66A	2A-48A			n66A	48A	n66A	HW can't support two MHB tx work at same time except n41
DC_13A-46A_n66A				n66A	13A	n66A	
DC_5A-46A_n66A				n66A	5A	n66A	
DC_46A-66A_n5A	66A				66A	n5A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-13A-66A_n66A	2A-66A			n66A	13A	n66A	HW can't support two MHB tx work at same time except n41
DC_5A-66A-66A_n66A	66A-66A			n66A	5A	n66A	
DC_2A-46A-48A_n5A	2A				2A	n5A	can't supportB48 4*4+B46 CA
DC_2A-46C_n5A	2A				2A	n5A	
DC_2A-46C-48A_n5A	2A				2A	n5A	can't supportB48 4*4+B46 CA
DC_2A-46D_n5A	2A				2A	n5A	
DC_2A-46D-48A_n5A	2A				2A	n5A	can't supportB48 4*4+B46 CA
DC_2A-46E_n5A	2A				2A	n5A	
DC_2A-46E-48A_n5A					2A	n5A	
DC_2A_n41A				n41A	2A	n41A	Don't support MHB+n41 4*4MIMO
DC_2C_n41A				n41A	2C	n41A	Don't support MHB+n41 4*4MIMO
DC_2A-66A_n41A				n41A	2A, 66A	n41A	Don't support MHB+n41 4*4MIMO
DC_2A_(n)71AA	2A				2A	n71A	
DC_66C_(n)71AA	66C				66C	n71A	
DC_66A_n41A				n41A	66A	n41A	Don't support MHB+n41 4*4MIMO
DC_2A-66C_n71A	2A-66C				2A, 66C	n71A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-66A_(n)71AA	2A-66A				2A, 66A	n71A	
DC_(n)41AA	41A			n41A	41A	n41A	
DC_(n)41CA	41C			n41A	41C	n41A	
DC_(n)41DA	41D			n41A	41C	n41A	
DC_8A_n1A				n1A	8A	n1A	
DC_3A-8A_n1A	3A			n1A	8A	n1A	HW can't support two MHB tx work at same time except n41
DC_7A-8A_n1A	7A			n1A	8A	n1A	HW can't support two MHB tx work at same time except n41
DC_3A-7A-8A_n1A	3A-7A			n1A	8A	n1A	HW can't support two MHB tx work at same time except n41
DC_8A_n3A				n3A	8A	n3A	
DC_1A-8A_n3A	1A			n3A	8A	n3A	HW can't support two MHB tx work at same time except n41
DC_3A_n20A	3A				3A	n20A	
DC_20A_n38A				n38A	20A	n38A	
DC_1A-20A_n38A	1A			n38A	20A	n38A	HW can't support two MHB tx work at same time except n41

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_3A-20A_n38A	3A			n38A	20A	n38A	HW can't support two MHB tx work at same time except n41
DC_18A_n77A				n77A	18A	n77A	
DC_18A_n78A				n78A	18A	n78A	
DC_41A_n79A	41A			n79A	41A	n79A	
DC_1A-18A_n77A	1A			n77A	1A, 18A	n77A	
DC_1A-18A_n78A	1A			n78A	1A, 18A	n78A	
DC_1A-41A_n77A	1A-41A			n77A	1A, 41A	n77A	
DC_1A-41A_n78A	1A-41A			n78A	1A	n78A	
DC_3A-18A_n77A	3A			n77A	3A, 18A	n77A	
DC_3A-18A_n78A	3A			n78A	3A, 18A	n78A	
DC_3A-41A_n77A	3A-41A			n77A	3A, 41A	n77A	
DC_18A-42A_n78A	42A			n78A	18A	n78A	
DC_18A-42A_n77A	42A			n77A	18A	n77A	
DC_1A-41C_n77A	1A-41C			n77A	1A, 41C	n77A	
DC_1A-41C_n78A	1A-41C			n78A	1A	n78A	
DC_3A-41C_n77A	3A-41C			n77A	3A, 41C	n77A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_3A-41C_n78A	3A-41C			n78A	3A	n78A	
DC_18A-42C_n77A	42C			n77A	18A	n77A	
DC_18A-42C_n78A	42C			n78A	18A	n78A	
DC_28A-41C_n77A	41C			n77A	28A	n77A	
DC_1A-3A-18A_n77A	1A-3A			n77A	1A, 3A, 18A	n77A	
DC_1A-3A-41A_n77A	1A-3A-41A			n77A	1A, 3A	n77A	
DC_1A-3A-41A_n78A	1A-3A-41A			n78A	1A, 3A	n78A	
DC_1A-41A-42A_n77A	1A-41A-42A			n77A	1A, 41A	n77A	
DC_1A-41A-42A_n78A	1A-41A-42A			n78A	1A	n78A	
DC_3A-41A-42A_n77A	3A-41A-42A			n77A	3A	n77A	
DC_3A-41A-42A_n78A	3A-41A-42A			n78A	3A	n78A	
DC_1A-42D_n78A	1A-42D			n78A	1A	n78A	
DC_1A-3A-41C_n77A	1A-3A-41C			n77A	1A, 3A	n77A	
DC_1A-3A-42C_n78A	1A-3A-42C			n78A	1A, 3A	n78A	
DC_1A-41A-42C_n77A	1A-41A-42C			n77A	1A, 41A	n77A	
DC_1A-41A-42C_n78A	1A-41A-42C			n78A	1A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-41C-42A_n77A	1A-41C-42A			n77A	1A, 41C	n77A	
DC_1A-41C-42A_n78A	1A-41C-42A			n78A	1A	n78A	
DC_3A-41A-42C_n77A	3A-41A-42C			n77A	3A	n77A	
DC_3A-41A-42C_n78A	3A-41A-42C			n78A	3A	n78A	
DC_3A-41C-42A_n77A	3A-41C-42A			n77A	3A	n77A	
DC_3A-41C-42A_n78A	3A-41C-42A			n78A	3A	n78A	
DC_1A-3A-42D_n78A	1A-3A-42D			n78A	1A, 3A	n78A	
DC_1A-41C-42C_n77A	1A-41C-42C			n77A	1A, 41C	n77A	
DC_1A-41C-42C_n78A	1A-41C-42C			n78A	1A	n78A	
DC_3A-41C-42C_n77A	3A-41C-42C			n77A	3A, 41C	n77A	
DC_3A-41C-42C_n78A	3A-41C-42C			n78A	3A	n78A	
DC_1A-3A-18A-42C_n77A	1A-3A-42C			n77A	1A, 3A, 18A	n77A	
DC_1A-3A-41A-42C_n77A	1A-3A-42C, 3A-41A-42C, 1A-41A-42C			n77A	1A, 3A	n77A	
DC_1A-3A-41A-42C_n78A	1A-3A-42C, 3A-41A-42C, 1A-41A-42C			n78A	1A, 3A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-3A-41C-42A_n77A	1A-3A-42A, 3A-41C-42A, 1A-41C-42A			n77A	1A, 3A	n77A	
DC_1A-3A-41C-42C_n77A	1A-3A-42C, 41C-42C			n77A	1A, 3A	n77A	
DC_1A-3A-18A-42A_n77A	1A-3A, 1A-3A-42A, 1A-42A, 3A-42A			n77A	1A, 3A, 18A	n77A	
DC_40A_n78A	40A			n78A	40A	n78A	
DC_40C_n78A	40C			n78A	40C	n78A	
DC_3A-3A-7A-7A_n78A	3A-3A-7A-7A			n78A	3A, 7A	n78A	
DC_66A_n78A	66A			n78A	66A	n78A	
DC_66A-66A_n78A	66A_66A			n78A	66A	n78A	
DC_7C-66A-66A_n78A	7C-66A-66A			n78A	7C, 66A	n78A	
DC_2A_n78A	2A			n78A	2A	n78A	
DC_7A_n71A	7A				7A	n71A	
DC_12A_n78A				n78A	12A	n78A	
DC_2A-7A_n71A	2A-7A				2A, 7A	n71A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-7A_n78A	2A-7A			n78A	2A, 7A	n78A	
DC_2A-66A_n78A	2A-66A			n78A	2A, 66A	n78A	
DC_7A-66A_n78A	7A-66A			n78A	7A, 66A	n78A	
DC_2A-7C_n78A	2A-7C			n78A	2A, 7C	n78A	
DC_7C-66A_n78A	7C-66A			n78A	7C, 66A	n78A	
DC_2A-7A-7A_n78A	2A-7A-7A			n78A	2A, 7A	n78A	
DC_2A-7A-66A_n78A	2A-7A-66A			n78A	2A, 7A, 66A	n78A	
DC_2A-66A-66A_n78A	2A-66A-66A			n78A	2A, 66A	n78A	
DC_7A-7A-66A_n78A	7A-7A-66A			n78A	7A, 66A	n78A	
DC_7A-66A-66A_n78A	7A-66A-66A			n78A	7A, 66A	n78A	
DC_2A-7C-66A_n78A	2A-7C-66A			n78A	2A, 7C, 66A	n78A	
DC_2A-7A-7A-13A_n66A	2A-7A-7A			n66A	13A	n66A	HW can't support two MHB tx work at same time except n41
DC_2A-7A-7A-66A_n78A	2A-7A-7A-66A			n78A	2A, 7A, 66A	n78A	
DC_2A-7A-66A-66A_n78A	2A-7A-66A-66A			n78A	2A, 7A, 66A	n78A	
DC_7A-7A-66A-66A_n78A	7A-7A-66A-66A			n78A	7A, 66A	n78A	
DC_2A-7C-66A-66A_n78A	2A-7C-66A-66A			n78A	2A, 7C, 66A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-7A-7A-66A-66A_n78A	2A-7A-7A-66A-66A			n78A	2A, 7A, 66A	n78A	
DC_5A_n7A				n7A	5A	n7A	
DC_12A_n7A				n7A	12A	n7A	
DC_3C-7C-28A_n78A	3C-7C			n78A	3C, 7C, 28A	n78A	
DC_66A_(n)71AA							
DC_41A_n78A	41A			n78A	41A	n78A	
DC_2A_n12A	2A				2A	n12A	
DC_66A_n12A	66A				66A	n12A	
DC_2A-66A_n12A	2A-66A				2A, 66A	n12A	
DC_2A-66C_(n)71AA	2A-66C				2A, 66C	n71A	
DC_28A_n3A				n3A	28A	n3A	
DC_20A_n7A				n7A	20A	n7A	
DC_3A-20A_n7A	3A			n7A	20A	n7A	can't support MHB LTE NR tx at same time
DC_1A_n8A	1A				1A	n8A	
DC_2A-7A-7A-66A_n5A	2A-66A-7A-7A				2A, 66A, 7A	n5A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_46C-66A_n5A	66A				66A	n5A	
DC_7A-13A_n66A	7A			n66A	13A	n66A	can't support MHB LTE NR tx at same time
DC_7A-7A_n5A	7A-7A				7A	n5A	
DC_2A-7A_n5A	2A-7A				2A, 7A	n5A	
DC_7A-66A_n5A	7A-66A				7A, 66A	n5A	
DC_2A-7C-13A_n66A	2A-7C			n66A	13A	n66A	can't support MHB LTE NR tx at same time
DC_48A-66A_n5A	48A-66A				48A, 66A	n5A	
DC_13A-48A_n66A	48A			n66A	13A, 48A	n66A	
DC_13A-48A_n2A	48A			n2A	13A, 48A	n2A	
DC_48B-66A_n5A	48B-66A				48B, 66A	n5A	
DC_13A-48B_n66A	48B			n66A	13A, 48B	n66A	
DC_13A-48B_n2A	48B			n2A	13A, 48B	n2A	
DC_48D-66A_n5A	48D-66A				48C, 66A	n5A	
DC_13A-48D_n66A	48D			n66A	13A, 48C	n66A	
DC_13A-48D_n2A	48D			n2A	13A, 48C	n2A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_48E-66A_n5A	48E-66A				48C, 66A	n5A	
DC_13A-48E_n66A	48E			n66A	13A, 48C	n66A	
DC_13A-48E_n2A	48E			n2A	13A, 48C	n2A	
DC_2A-2A-46D_n5A	2A-2A				2A	n5A	
DC_2A-46D-66A_n5A	2A-66A				2A, 66A	n5A	
DC_46D-66A_n5A	66A				66A	n5A	
DC_46D-66A-66A_n5A	66A-66A				66A	n5A	
DC_2A-46A_n71A	2A				2A	n71A	
DC_46A-66A_n71A	66A				66A	n71A	
DC_2A-46C_n71A	2A				2A	n71A	
DC_2A-46A-66A_n71A	2A-66A				2A, 66A	n71A	
DC_46C-66A_n71A	66A				66A	n71A	
DC_2A-46D_n71A	2A				2A	n71A	
DC_2A-46C-66A_n71A	2A-66A				2A, 66A	n71A	
DC_46D-66A_n71A	66A				66A	n71A	
DC_2A-46D-66A_n71A	2A-66A				2A, 66A	n71A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-46A_n41A				n41A	2A	n41A	can't support LTE MHB 4*4+n41
DC_46A-66A_n41A				n41A	66A	n41A	can't support LTE MHB 4*4+n41
DC_2A-46C_n41A				n41A	2A	n41A	can't support LTE MHB 4*4+n41
DC_2A-46A-66A_n41A				n41A	2A, 66A	n41A	can't support LTE MHB 4*4+n41
DC_46C-66A_n41A				n41A	66A	n41A	can't support LTE MHB 4*4+n41
DC_2A-46D_n41A				n41A	2A	n41A	can't support LTE MHB 4*4+n41
DC_2A-46C-66A_n41A				n41A	2A, 66A	n41A	can't support LTE MHB 4*4+n41
DC_46D-66A_n41A				n41A	66A	n41A	can't support LTE MHB 4*4+n41
DC_2A-46D-66A_n41A				n41A	2A, 66A	n41A	can't support LTE MHB 4*4+n41
DC_2A-2A-66A_n71A	2A-2A-66A				2A, 66A	n71A	
DC_2A-2A_n71A	2A-2A				2A	n71A	
DC_2C-66A_n71A	2C-66A				2C, 66A	n71A	
DC_2C_n71A	2C				2C	n71A	
DC_2A-2A-66A_n41A				n41A	2A, 66A	n41A	can't support LTE MHB 4*4+n41
DC_2A-2A_n41A				n41A	2A	n41A	can't support LTE MHB 4*4+n41
DC_2C-66A_n41A				n41A	2C, 66A	n41A	can't support LTE MHB 4*4+n41

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-1A-3A-28A_n7A	1A-1A-3A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-1A-3C-28A_n7A	1A-1A-3C			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-1A-7A-28A_n7A	1A-1A-7A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-1A-28A_n7A	1A-1A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-3A_n41A				n41A	1A, 3A	n41A	can't support LTE MHB 4*4+n41
DC_1A-3A-3A-28A_n7A	1A-3A-3A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_1A-3A-7C_n28A	1A-3A-7C				1A, 3A, 7C	n28A	
DC_1A-3C_n28A	1A-3C				1A, 3C	n28A	
DC_1A-3C-7A_n28A	1A-3C-7A				1A, 3C, 7A	n28A	
DC_1A-3C-7C_n28A	1A-3C-7C				1A, 3C, 7C	n28A	
DC_1A-7C_n28A	1A-7C				1A, 7C	n28A	
DC_3A-3A-7A-28A_n7A	3A-3A-7A			n7A	28A	n7A	can't support MHB LTE NR tx at same time

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_3A-3A-28A_n7A	3A-3A			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_3A-7C_n28A	3A-7C				3A, 7C	n28A	
DC_4A_n78A	4A			n78A	4A	n78A	
DC_3C-7A_n28A	3C-7A				3C, 7A	n28A	
DC_3C-7C_n28A	3C-7C				3C, 7C	n28A	
DC_3C-28A_n7A	3C			n7A	28A	n7A	can't support MHB LTE NR tx at same time
DC_7A-46A_n78A	7A				7A	n78A	Can't support B46_n78 4*4MIMO
DC_7A-46C_n78A	7A				7A	n78A	Can't support B46_n78 4*4MIMO
DC_7A-46D_n78A	7A				7A	n78A	Can't support B46_n78 4*4MIMO
DC_7A-46E_n78A	7A				7A	n78A	Can't support B46_n78 4*4MIMO
DC_7C_n28A	7C				7C	n28A	
DC_14A_n2A				n2A	14A	n2A	
DC_14A_n66A				n66A	14A	n66A	
DC_14A-66A_n2A	66A			n2A	14A	n2A	Don't support MHB+MHB ENDC
DC_2A-14A_n66A	2A			n66A	14A	n66A	Don't support MHB+MHB ENDC

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_14A-66A-66A_n2A	66A-66A			n2A	14A	n2A	Don't support MHB+MHB ENDC
DC_2A-2A-14A_n66A	2A-2A			n66A	14A	n66A	Don't support MHB+MHB ENDC
DC_5A-5A-66A-66A_n2A	66A-66A			n2A	5A	n2A	Don't support MHB+MHB ENDC
DC_46E-66A_n5A	66A				66A	n5A	
DC_1A-28A_n3A	1A			n3A	28A	n3A	Don't support MHB+MHB ENDC
DC_7A-28A_n3A	7A			n3A	28A	n3A	Don't support MHB+MHB ENDC
DC_1A-20A_n7A	1A			n7A	20A	n7A	Don't support MHB+MHB ENDC
DC_1A-3A-20A_n7A	1A-3A			n7A	20A	n7A	Don't support MHB+MHB ENDC
DC_1A_n20A	1A				1A	n20A	
DC_7A_n20A	7A				7A	n20A	
DC_3A-28A_n79A	3A			n79A	3A, 28A	n79A	
DC_2A-7A-13A_n66A	2A-7A			n66A	13A	n66A	Don't support MHB+MHB ENDC
DC_2A-7A-7A_n5A	2A-7A-7A				2A, 7A	n5A	
DC_7A-7A-66A_n5A	7A-7A-66A				7A, 66A	n5A	
DC_2A-7A-66A_n5A	2A-7A-66A				2A, 7A, 66A	n5A	
DC_2A-7C-66A_n5A	2A-7C-66A				2A, 7A, 66A	n5A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_41C_n78A	41C			n78A	41A	n78A	
DC_1A_n41A				n41A	1A	n41A	
DC_1A-8A_n79A	1A			n79A	1A, 8A	n79A	
DC_3A-8A_n79A	3A			n79A	3A, 8A	n79A	
DC_3A-41A_n79A	3A-41A			n79A	3A, 41A	n79A	
DC_7A-8A_n78A	7A			n78A	7A, 8A	n78A	
DC_8A_n79A				n79A	8A	n79A	
DC_28A_n79A				n79A	28A	n79A	
DC_28A-41A_n77A	41A			n77A	28A, 41A	n77A	
DC_28A-41A_n78A	41A			n78A	28A, 41A	n78A	
DC_28A-41A_n79A	41A			n79A	28A, 41A	n79A	
DC_41A_n77A	41A			n77A	41A	n77A	
DC_41C_n79A	41C			n79A	41A	n79A	
DC_7A-66A_n71A	7A-66A				7A, 66A	n71A	
DC_2A-7A-66A_n71A	2A-7A-66A				2A, 7A, 66A	n71A	
DC_7C-13A_n66A	7C			n66A	13A	n66A	Don't support MHB+MHB ENDC

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_7C-66A_n5A	7C-66A				7A, 66A	n5A	
DC_3A-3A-7A_n78A	3A-3A-7A			n78A	3A, 7A	n78A	
DC_5B_n66A				n66A	5A	n66A	
DC_5A-5A_n2A				n2A	5A	n2A	
DC_5B_n2A				n2A	5A	n2A	
DC_2A-5B_n66A	2A			n66A	5A	n66A	Don't support MHB+MHB ENDC
DC_5B-66A_n66A	66A			n66A	5A	n66A	
DC_5A-5A-66A_n2A	66A			n2A	5A	n2A	Don't support MHB+MHB ENDC
DC_2A-5B_n2A	2A			n2A	5A	n2A	
DC_5B-66A_n2A	66A			n2A	5A	n2A	Don't support MHB+MHB ENDC
DC_2A-5B-66A_n66A	2A-66A			n66A	5A	n66A	Don't support MHB+MHB ENDC
DC_5B-66A-66A_n66A	66A-66A			n66A	5A	n66A	
DC_2A-5B-66A_n2A	2A-66A			n2A	5A	n2A	Don't support MHB+MHB ENDC
DC_5B-66A-66A_n2A	66A-66A			n2A	5A	n2A	Don't support MHB+MHB ENDC
DC_2A-5B-66A-66A_n2A	2A-66A-66A			n2A	5A	n2A	Don't support MHB+MHB ENDC
DC_3A-7A-8A_n78A	3A-7A			n78A	3A, 7A, 8A	n78A	

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_1A-7A-8A_n78A	1A-7A			n78A	1A, 7A, 8A	n78A	
DC_1A-3A-8A_n79A	1A-3A			n79A	1A, 3A, 8A	n79A	
DC_1A-3A-7A_n5A	1A-3A-7A				1A, 3A, 7A	n5A	
DC_1A-19A-42C_n78A	1A-42C			n78A	1A, 19A	n78A	
DC_3C-20A_n1A	3C			n1A	20A	n1A	Don't support MHB+MHB ENDC
DC_3C-7A-20A_n1A	3C-7A			n1A	20A	n1A	Don't support MHB+MHB ENDC
DC_3C-7A-8A_n1A	3C-7A			n1A	8A	n1A	Don't support MHB+MHB ENDC
DC_3C-7C-20A_n1A	3C-7A			n1A	20A	n1A	Don't support MHB+MHB ENDC
DC_3C-8A_n1A	3C			n1A	8A	n1A	Don't support MHB+MHB ENDC
DC_2A-71A_n66A	2A			n66A	71A	n66A	Don't support MHB+MHB ENDC
DC_1A-28A_n79A	1A			n79A	1A, 28A	n79A	
DC_14A-30A_n2A	30A		30A	n2A	14A	n2A	Don't support MHB UL+MHB UL
DC_14A-30A_n66A	30A		30A	n66A	14A	n66A	Don't support MHB UL+MHB UL
DC_14A-30A-66A_n2A	30A-66A		30A, 66A	n2A	14A	n2A	Don't support MHB UL+MHB UL
DC_2A-14A-30A_n66A	2A-30A		2A, 30A	n66A	14A	n66A	Don't support MHB UL+MHB UL
DC_14A-30A-66A-66A_n2A	30A-66A-66A			n2A	14A	n2A	Don't support MHB UL+MHB UL

Table 37: Supported EN-DC configurations

EN-DC combination	Downlink				Uplink		Comment
	Sub, 6GHz 1/2 NR TDD <= 100MHz FDD <= 40MHz 4G DL 4x4 MIMO (20L)	Sub-6GHz (FR1) LTE Envelope		5G-NR DL 4x4 MIMO	SO (Single UL) UL Configuration		
		Sub-6GHz 3/4 NR 100MHz < TDD <= 160MHz 4G DL 4x4	Sub-6GHz Max NR 160MHz < TDD <= 200MHz 40MHz < FDD		4G UL	5G-NR UL	
DC_2A-66C-(n)71AA	2A-66C				2A, 66C	n71A	
DC_7A-8A_n3A	7A		7A	n3A	8A	n3A	Don't support MHB UL+MHB UL
DC_1A-7A-8A_n3A	1A-7A		1A, 7A	n3A	8A	n3A	Don't support MHB UL+MHB UL
DC_40A_n41A				n41A	40A	n41A	can't support LTE MHB 4*4+n41
DC_3A-7C-20A_n1A							
DC_13A-48C_n2A							
DC_48C-66A_n5A							

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