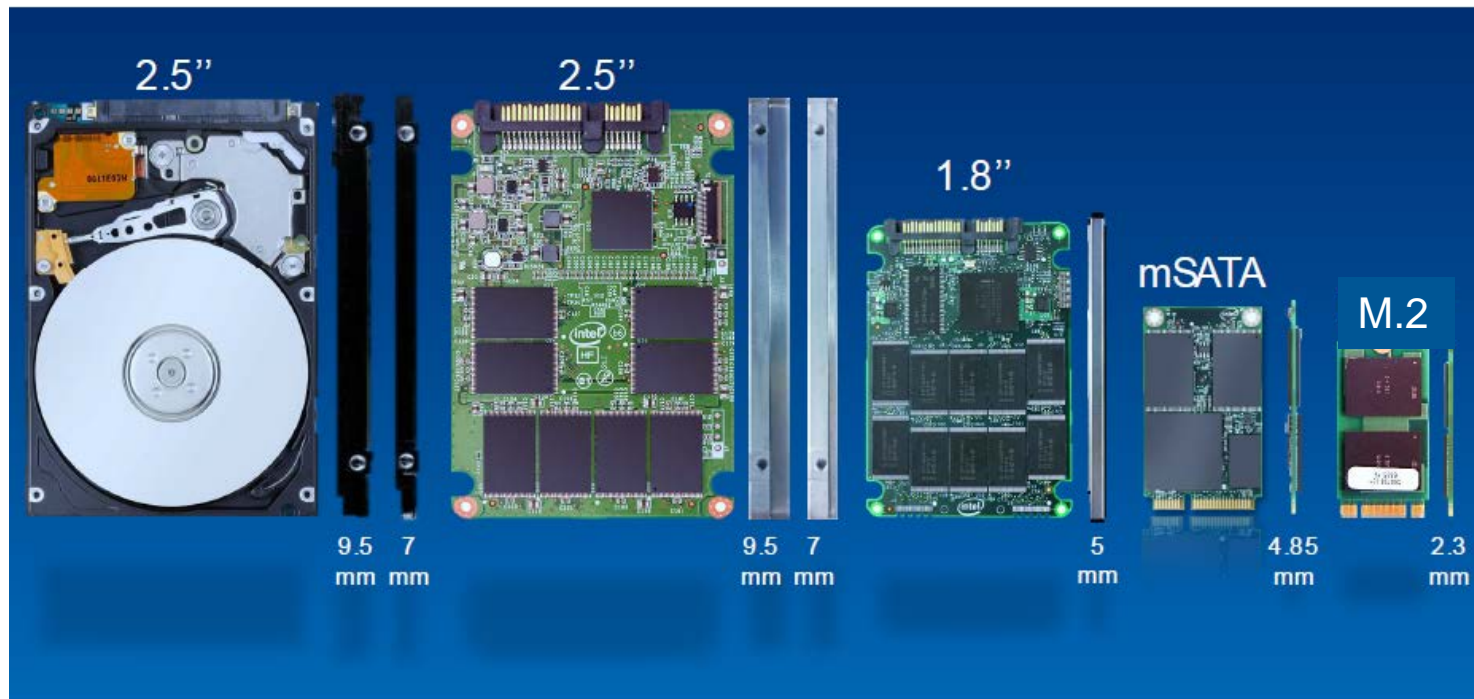


Amphenol M.2(NGFF) Connector Brochure

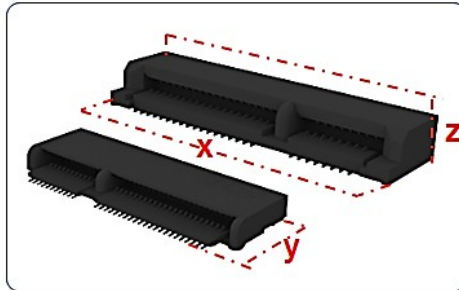
New Storage Form Factors Emerging



IDF2012
INTEL DEVELOPER FORUM

M.2(NGFF) Introduction

The M.2 form factor is used for Mobile Add-In cards. It is a natural transition from the Mini Card and Half Mini Card to a smaller form factor both in size and volume.



	Stack Height (z)	Card Centerline to PCB	Length (x)	Width (y)	Volume
MiniCard	4.0	2.1	9.09	29.9	1087
NGFF	2.25	1.08	8.7	21.9	426
Savings	1.75	1.02	0.39	8.0	659

Dimensions in mm

M.2 (NGFF) supports multiple functions.

Features

- Available in various heights
- 0.5mm pitch with 67 positions
- Designed for both single and double-sided modules
- Available in various keying options for module cards
- Support PCI Express 3.0, USB 3.0, & SATA 3.0

Benefits

- Wide product offering to meet customers design needs
- Save more than 20% PCB real estate compared to PCIe Minicard
- Reduces connector height by 15%
- Ensures proper mating with various module cards
- Supports higher data rates

Wireless Applications

- Wi-Fi
- WWAN (2G, 3G, 4G)
- Bluetooth (BT)
- WiGig
- GPS
- Solid State Storage Devices - SSDs
- Global Navigation Satellite Systems (GNSS)
- Near Field Communication (NFC)
- Hybrid Digital Radio (HDR)

Host Interfaces

- PCIe, PCIe LP
- SSIC
- USB (2.0, HS, 3.0)
- SDIO
- UART
- PCM/ I2S
- I2C
- SATA
- Display Port
- Future variants of the above



M.2(NGFF) Introduction

M.2 Connector Description:

- 75 positions (67 active lines with 8 positions dedicated to mechanical keying)
- Single and Dual Mechanical keying allows for multiple standards
- Two rows of contacts @ 0.50mm pitch; bottom row staggered 0.25mm from top row
- Supports multiple standard card widths (12mm, 16mm, 22mm and 30mm)
- Supports multiple standard card lengths (16mm, 26mm, 30mm, 38mm, 42mm, 60mm, 80mm and 110mm)

M.2 Module Description:

- M.2 specification standardizes multiple module sizes
 - Allows for Single- or Dual-sided Components on modules
 - Allows for Connectorized or Soldered-Down modules
- Will support multiple function add-in cards/modules
 - SATA or PCIe x2 fits “B” key for SSD, WWAN, other non-storage devices
 - PCIe x4 up to 4GB/s fitting “M” key modules for high performance SSD

M.2(NGFF) Application Fields



M.2 Modular Card Overview

Module Nomenclature

Sample type 2242-D2-B-M

Type XX XX - XX - X - X*

Width (mm)	Length (mm)	Component Max Ht (mm)	
		T Max**	B Max**
12	16	S1 1.2	0 [†]
16	26	S2 1.35	0 [†]
22	30	S3 1.5	0 [†]
30	38	D1 1.2	1.35
	42	D2 1.35	1.35
	60	D3 1.5	1.35
	80	D4 1.5	0.7
	110	D5 1.5	1.5

Key ID	Pin	Interface
A	8-15	PCIe x2 / USB / I2C / DP x4
B	12-19	PCIe x2 / SATA / USB / PCM / IUM / SSIC / UART-I2C
C	16-23	Reserved for Future Use
D	20-27	Reserved for Future Use
E	24-31	PCIe / USB / I2C-ME / SDIO / UART / PCM
F	28-35	Future Memory Interface (FMI)
G	39-46	Generic (Not used for M.2) [†]
H	43-50	Reserved for Future Use
J	47-54	Reserved for Future Use
K	51-58	Reserved for Future Use
L	55-62	Reserved for Future Use
M	59-66	PCIe x4 / SATA

What type of Cards & applications use key A, E, B, M?

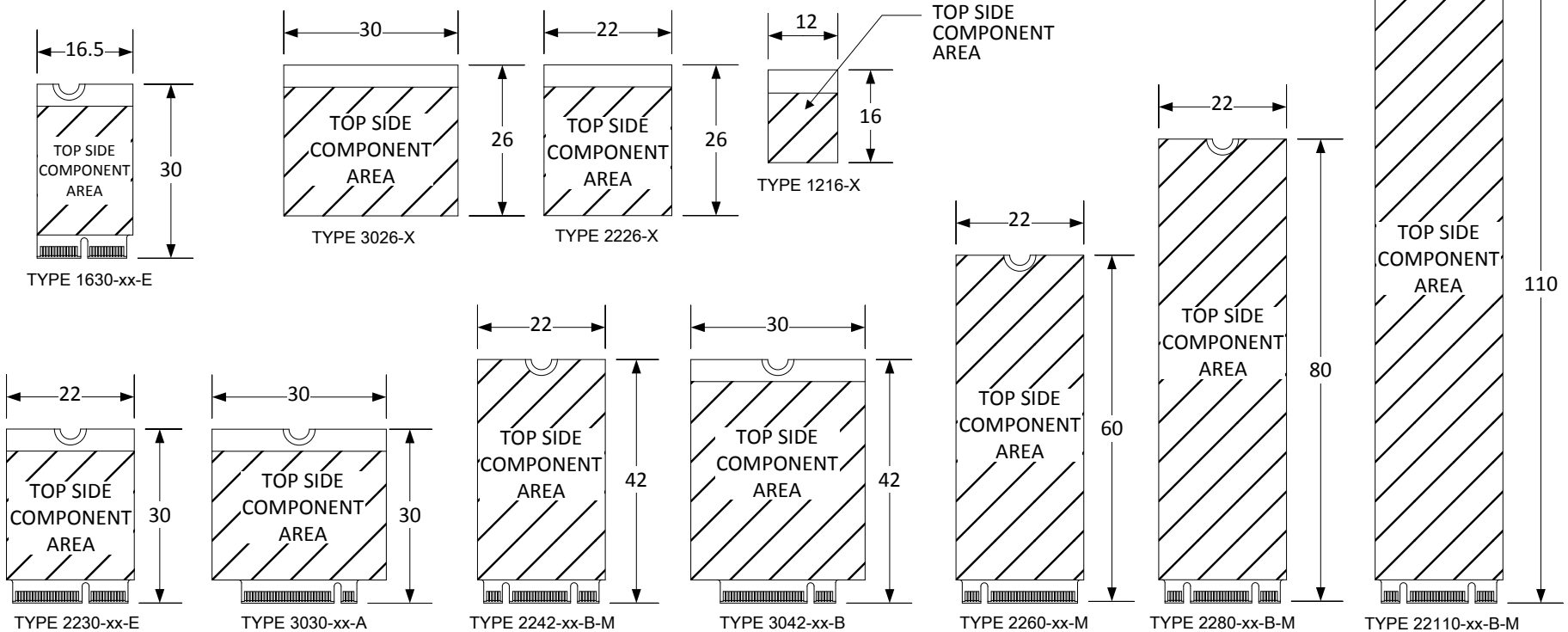
Key	Module Card Type	Application
A	1630, 2230, 3030	Wireless: Wi-Fi,BT, NFC, & or WiGig
E	1630, 2230, 3030,	Wireless: Wi-Fi,BT, NFC, & or GNSS
B	3042, 2230, 2242, 2260, 2280, 22110	WWAN+GNSS or SSD
M	2242, 2260, 2280, 22110	SSD, PCIe or SATA

Key G is designed for Non-M.2 compliant devices and future Memory interface.

M.2 Modular Card Overview



NOTE: KEY OPTION IS A REPRESENTATION ONLY AND DOES NOT PROHIBIT ADDITION OPTIONS



GENERAL TOLERANCE IS ± 0.15

M.2 (NGFF) – Keying Configurations

Preferred & Optional Module Configurations

	Soldered-down			Connectorized			
	Type	Preferred	Pinout Key	Connector Key	Type	Module Height Options	Module Key
Socket 1 Connectivity	1216	S1	E				
				A, E	1630	S1, D1, S3, D3, D4	A, E, A+E
	2226	S3	E	A, E	2230	S1, D1, S3, D3, D4	A, E, A+E
	3026	S3	A	A, E	3030	S1, D1, S3, D3, D4	A, E, A+E
Socket 2 WWAN/Other				B	3042	S1, D1, S3, D3, D4	B
Socket 2 SSD/Other				B	2230	S2, D2, S3, D3, D5	B+M
				B	2242	S2, D2, S3, D3, D5	B+M
				B	2260	S2, D2, S3, D3, D5	B+M
				B	2280	S2, D2, S3, D3, D5	B+M
				B	22110	S2, D2, S3, D3, D5	B+M
Socket 3 SSD Drive				M	2242	S2, D2, S3, D3, D5	M, B+M
				M	2260	S2, D2, S3, D3, D5	M, B+M
				M	2280	S2, , D2, S3, D3, D5	M, B+M
				M	22110	S2, D2, S3, D3, D5	M, B+M

Mechanical Key Assignment

Key ID	Pin Location	Key Definition
A	8-15	Connectivity Version A-DP
B	12-19	WWAN/SSD/Others Primary Key
C	16-23	Not Assigned
D	20-27	Not Assigned
E	24-31	Connectivity Version A-SD
F	28-35	Not Assigned
G	39-46	Future Memory Interface
H	43-50	Not Assigned
J	47-54	Not Assigned
K	51-58	Not Assigned
L	55-62	H S I Key for WWAN Solutions
M	59-66	SSD 4 Lane PCIe

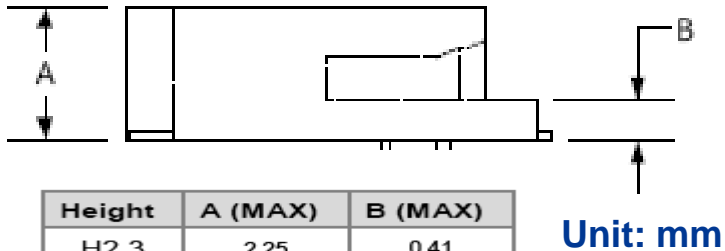
M.2(NGFF) Connector/ Module Supported Matrix

	Description	Component Height Descriptors							
		S1	S2	S3	D1	D2	D3	D4	D5
M1.8	Mid-plane Connector	✓	✓	✓	✓*	✓*	✓*	✓	✓
H2.3	Single-Sided (2.25 Max Ht.) Connector	✓	✓	✓					
H2.5	Single-Sided (2.45 Max Ht.) Connector	✓	✓	✓					
H2.8	Double-Sided (2.75 Max Ht.) Connector	✓	✓	✓				✓	
H3.2	Double-Sided (3.2 Max Ht.) Connector	✓	✓	✓	✓	✓	✓	✓	
H4.2	Double-Sided (4.2 Max Ht.)	✓	✓	✓	✓	✓	✓	✓	✓

Note: *System clearance will have to be evaluated.

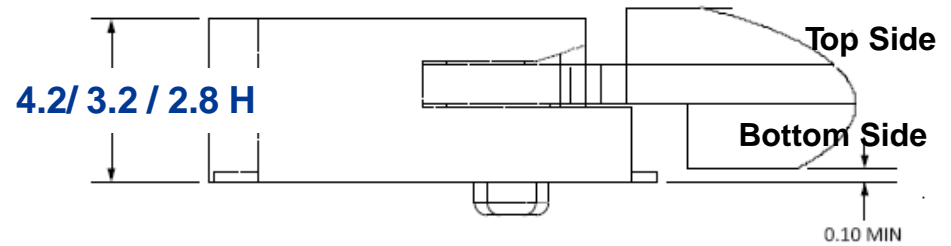
M.2 Module Card / Connector Height Recommendation

Top Side Connector Height

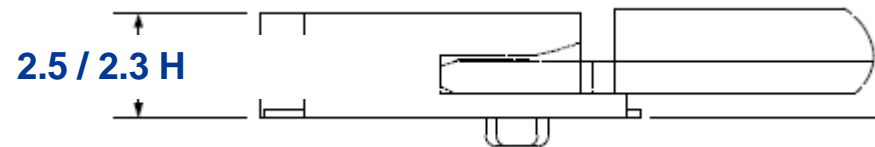


Height	A (MAX)	B (MAX)
H2.3	2.25	0.41
H2.5	2.45	0.61
H2.8	2.75	0.89
H3.2	3.20	1.54
H4.2	4.20	2.54

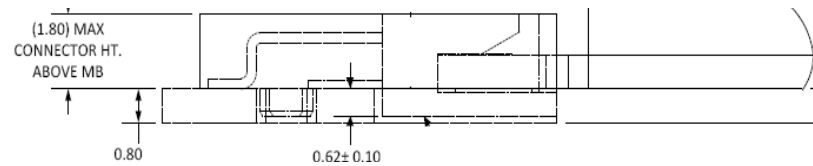
Double Sided Module



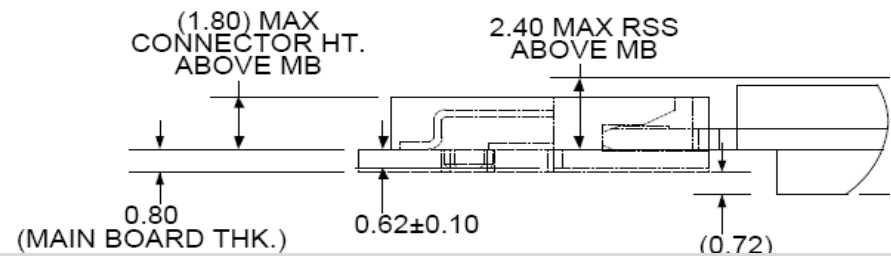
Single Sided Module



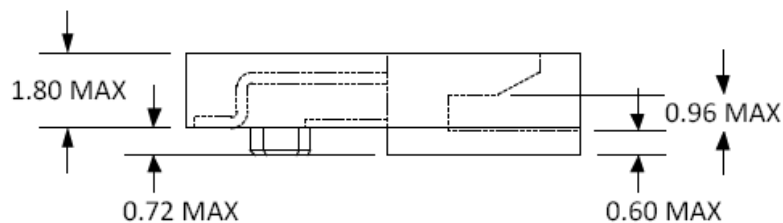
Mid Line Single Sided Module



Mid Line Double Sided Module



Mid Line Connector Height



M.2(NGFF) Connector Parametric Specifications

Connector Physical Requirements

Description	Requirement
Connector Housing	UL rated 94-V-0 Must be compatible with lead-free soldering process
Contact: Receptacle	Copper alloy with Gold Plating sufficient to meet all mechanical and environmental requirements
Contact Finish : Receptacle	Must be compatible with lead-free soldering process

M.2(NGFF) Connector Parametric Specifications

Connector Environmental Requirements

Test Conditions	Specification
Durability	EIA-364-9; <ul style="list-style-type: none">• Option 1 - 25 cycles,• Option 2 - 60 cycles. Upon completion of cycles the sample must meet all visual and electrical performance requirements.
Insertion Force	Insertion Force-25 N (2.04 KgF, 1 Newton = 1 Kg*m/s ²) maximum EIA-364-13, Method A
Shock	<ul style="list-style-type: none">• 250 G (Notebook) and 285 G (Tablet)• At 2 ms half sine• On all six (6) axis
Vibration	EIA-364-1000 Test group 3, EIA-364-28
Operating Temperature	-40°C to 80°C
Environmental Test Methodology	EIA-364-1000 Test Group 1, 2, 3, and 4
Useful Field Life	Three years

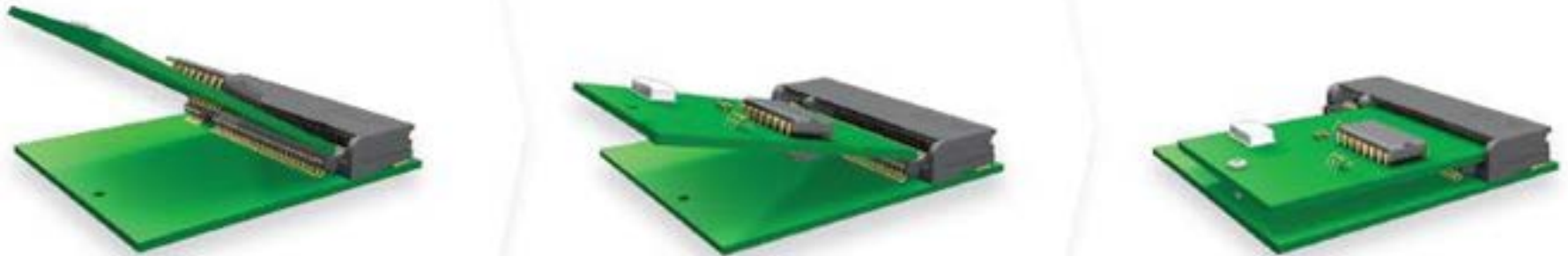
M.2(NGFF) Connector Parametric Specifications

Connector Electrical Requirements

Description	Requirement
Low Level Contact Resistance	EIA-364-23 <ul style="list-style-type: none">• 55 mΩ maximum (initial) per contact• 20 mΩ maximum change allowed
Insulation Resistance	EIA-364-21 <ul style="list-style-type: none">• >5 x 10⁸ Ω @ 500 V DC
Dielectric Withstanding Voltage	EIA-364-20 <ul style="list-style-type: none">• >300 V AC (RMS) @ Sea Level
Current Rating	<ul style="list-style-type: none">• 0.5 A/Power Contact (continuous)• The temperature rise above ambient shall not exceed 30°C.• The ambient condition is still air at 25°C.• EIA-364-70 Method 2
Voltage Rating	50 V AC per Contact

The connector meet RoHS and Halogen Free compliance.

M.2(NGFF) Connector Triple Insertion Module Method



Step 1: Move the module against the housing's chamber

Step 2: Rotate the module to 20 degrees and insert it until the bottom of the connector

Step 3: Rotate the module to horizontal position by hand

Step 4: Fix the module with a PCB screw to secure the module

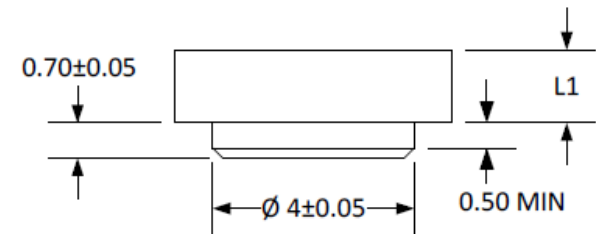
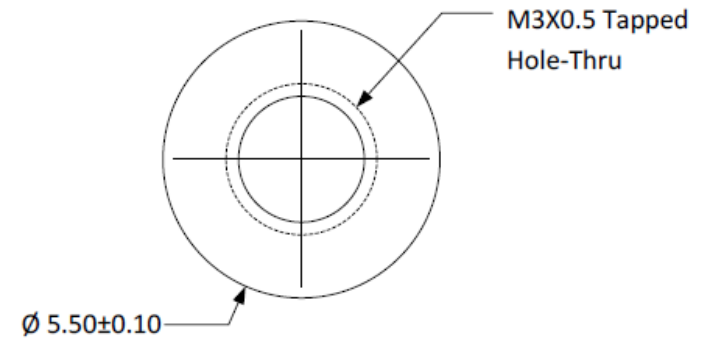
M.2(NGFF) Connector Module Fix

Stand-off

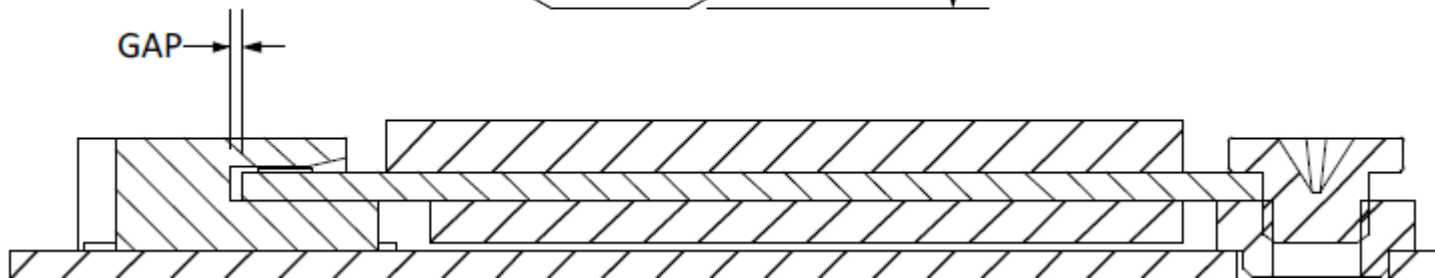
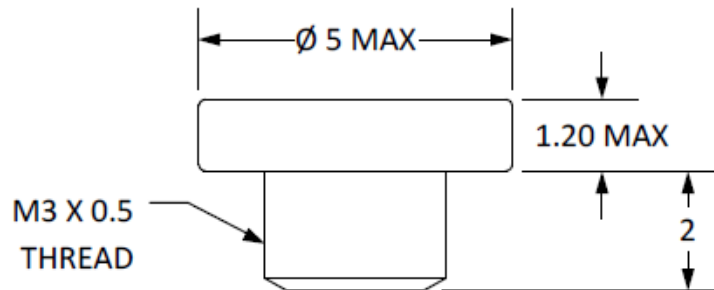
Connector Height Descriptor	L1	L2
H2.3	0.35 ± 0.03	
H2.5	0.55 ± 0.03	
H2.8	0.80 ± 0.03	0.80 ± 0.03
H3.2	1.45 ± 0.03	1.45 ± 0.03
H4.2	2.45 ± 0.03	2.45 ± 0.03

Notes:

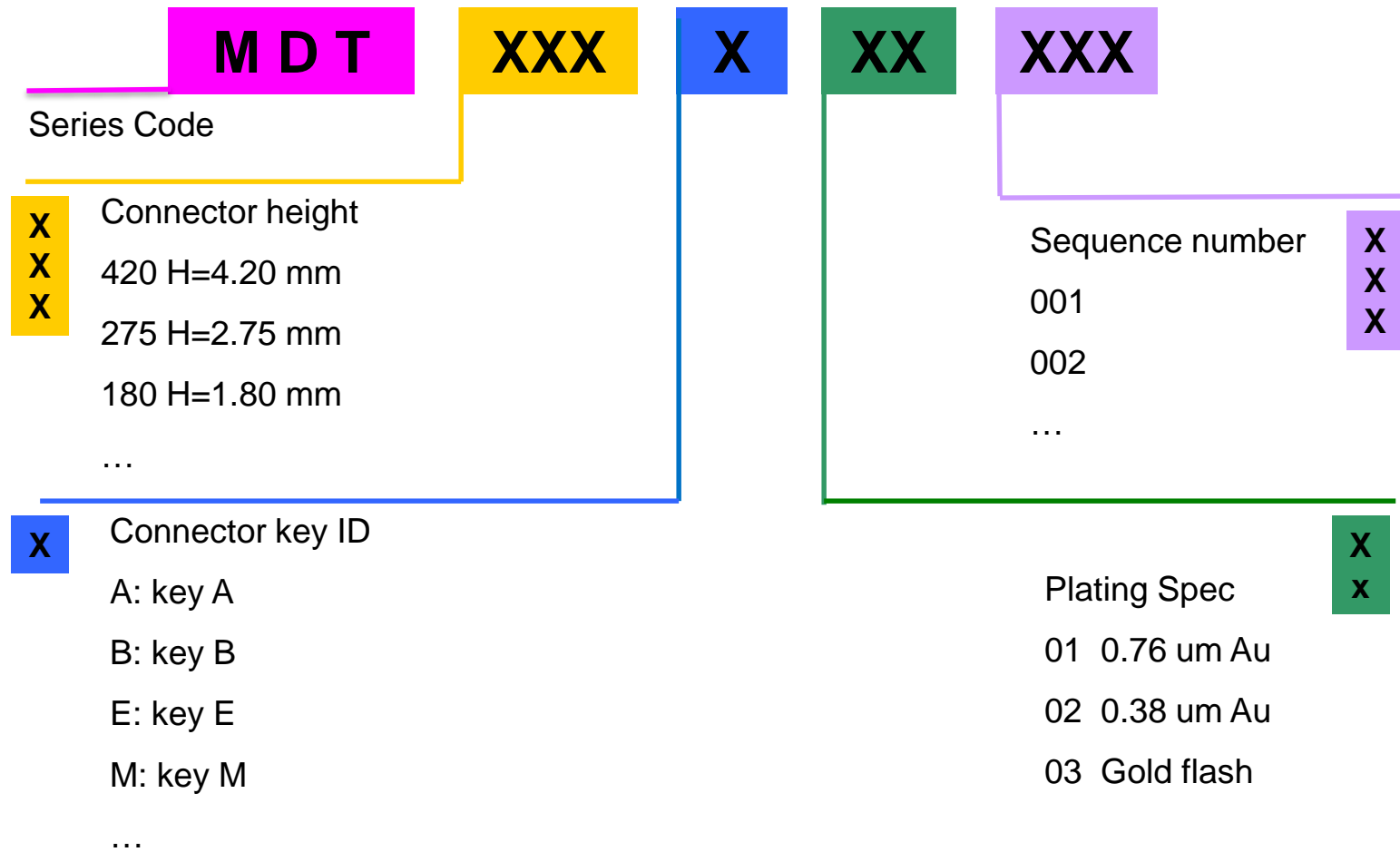
- Polyimide patch required for vacuum pick-up
- Minimum thermal conductivity of 50 W/(mK) or greater
- Material = Steel
- Finish = Matte tin, 1.2 microns minimum average
- Tape and reel



Screw



Amphenol M.2(NGFF) Connector P/N System



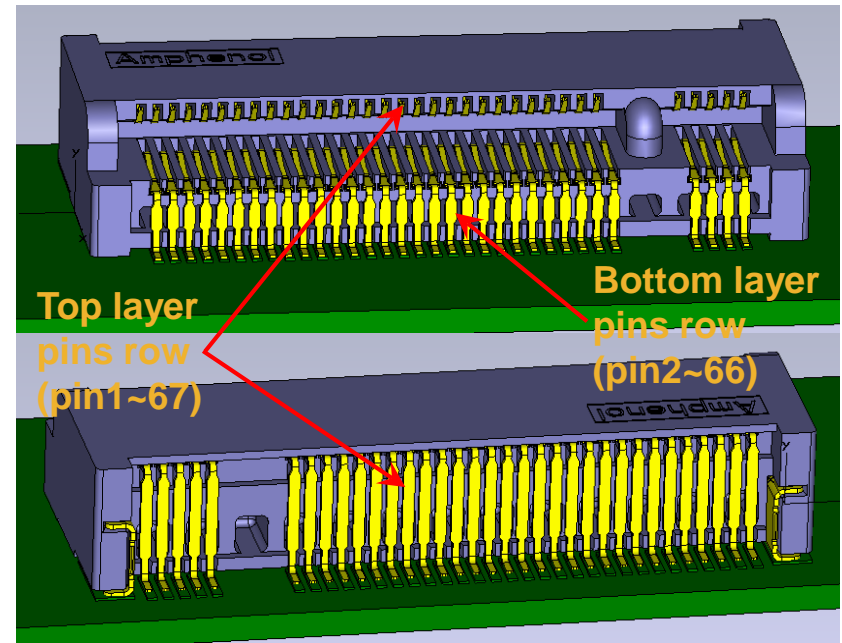
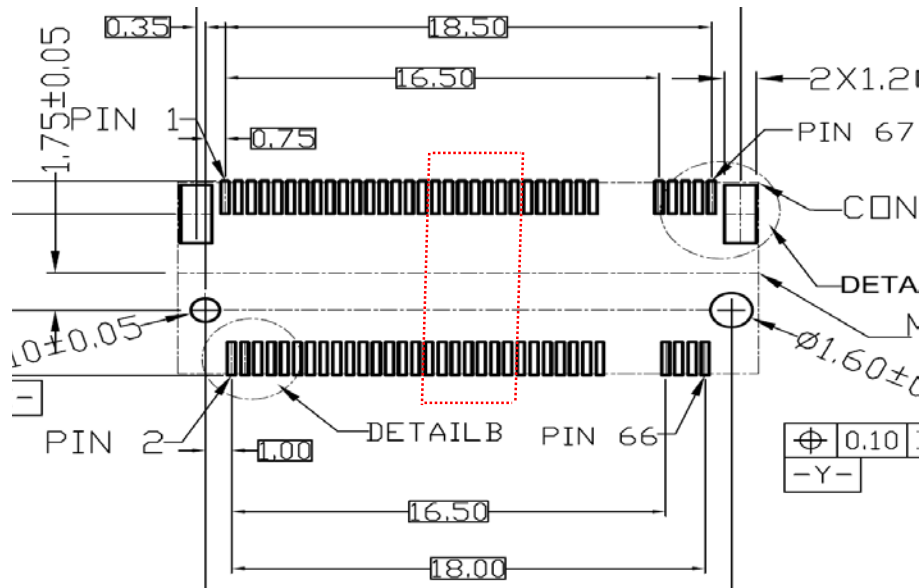
M.2(NGFF) Connector Signal Integrity Measurement Results

1: Introduction

- This technical bulletin presents measured electrical performance data on 67pin M.2 PCIe connector using frequency domain vector network analyzer (VNA) and time domain reflectometer (TDR) test equipment. Measured parameters include calibrated S-parameters and TDR reflections due to impedance mismatch.
- Measurement Setup
Freq domain test equipment: Agilent N5230C 4-port VNA
Freq domain test frequency range: 10MHz—20GHz (2000 points).
Time domain test equipment: Tektronix DSA8200 with 80E04 module.
Time domain test rise time: 50ps(20-80%).
- Measurement Calibration
method: TRL calibration to the end of PCB Microstrip(De-embedding).
The calibration helps to remove the test fixture effects.
Test results only included 67pin M.2 PCIe Connector with the footprint and few PCB trace(0.7mm).
- All S-parameter test results Re-normalized to 85ohm reference impedance.

M.2(NGFF) Connector Signal Integrity Measurement Results

2. High Speed Signal Assignment



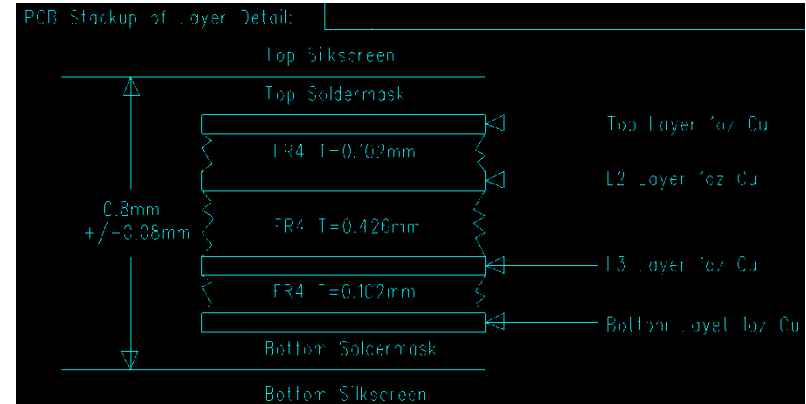
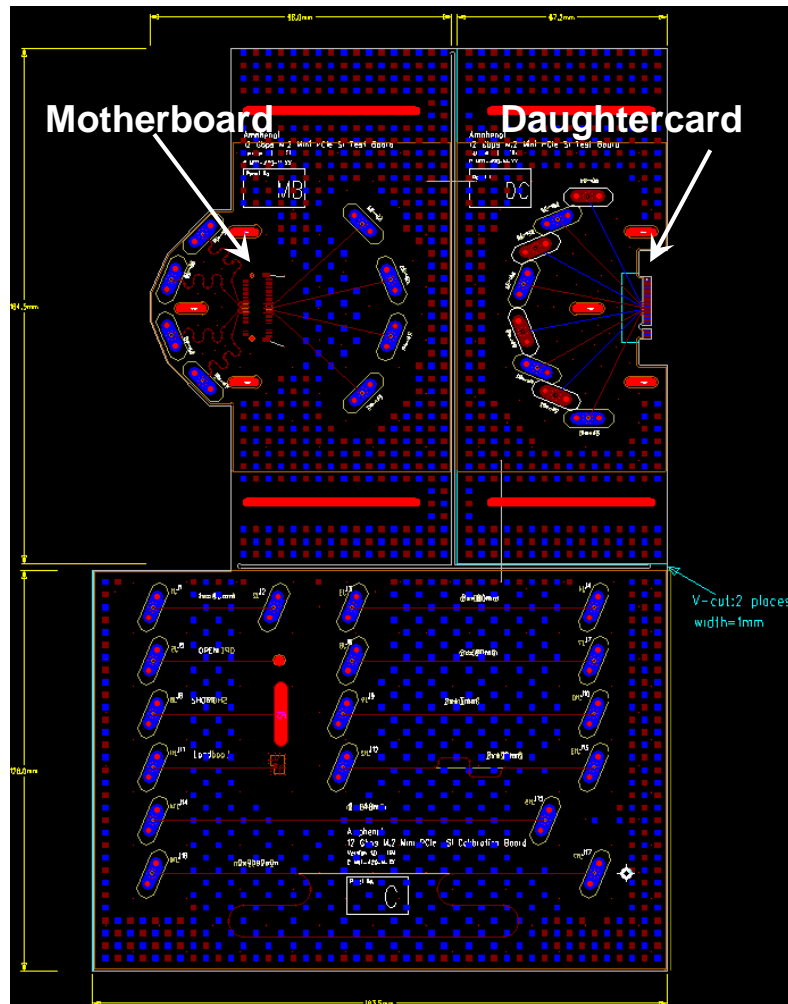
Top layer pins row



Bottom layer pins row

M.2(NGFF) Connector Signal Integrity Measurement Results

3. Test Fixture PCB Layout

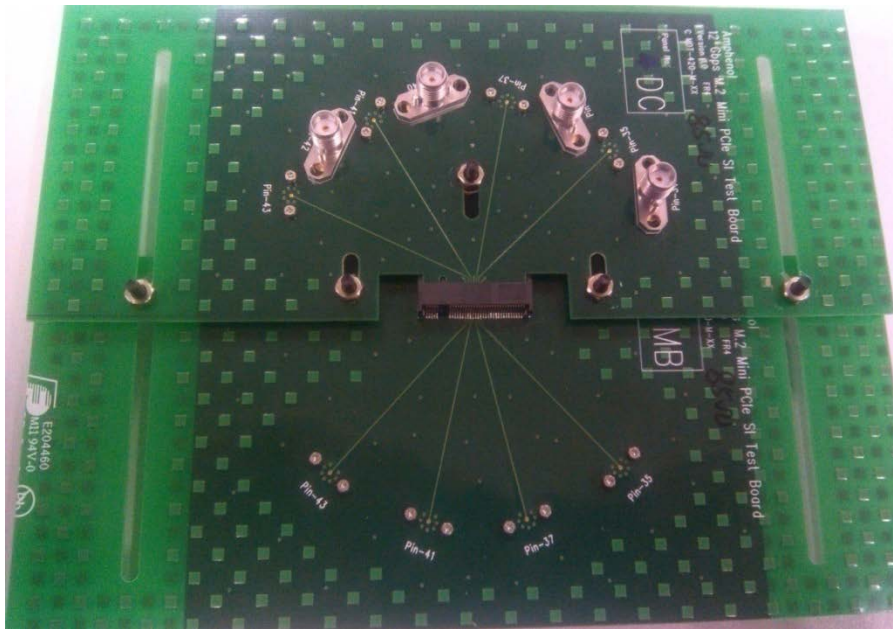


Notes:

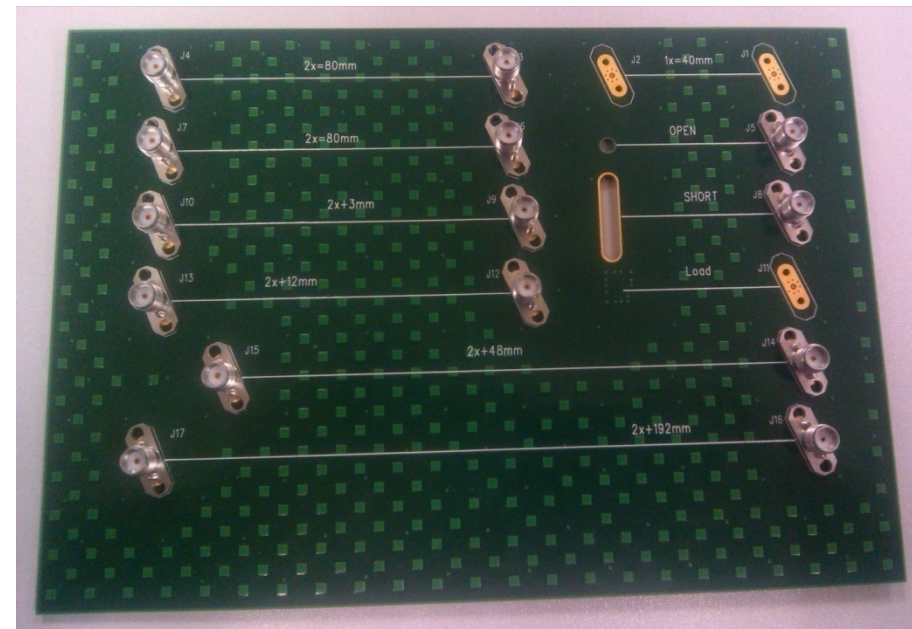
Microstrip length each is 40mm on both motherboard and daughtercard. Microstrip substrate material is FR4, the DK is 4.2 and DF is 0.02.

M.2(NGFF) Connector Signal Integrity Measurement Results

4. DUT



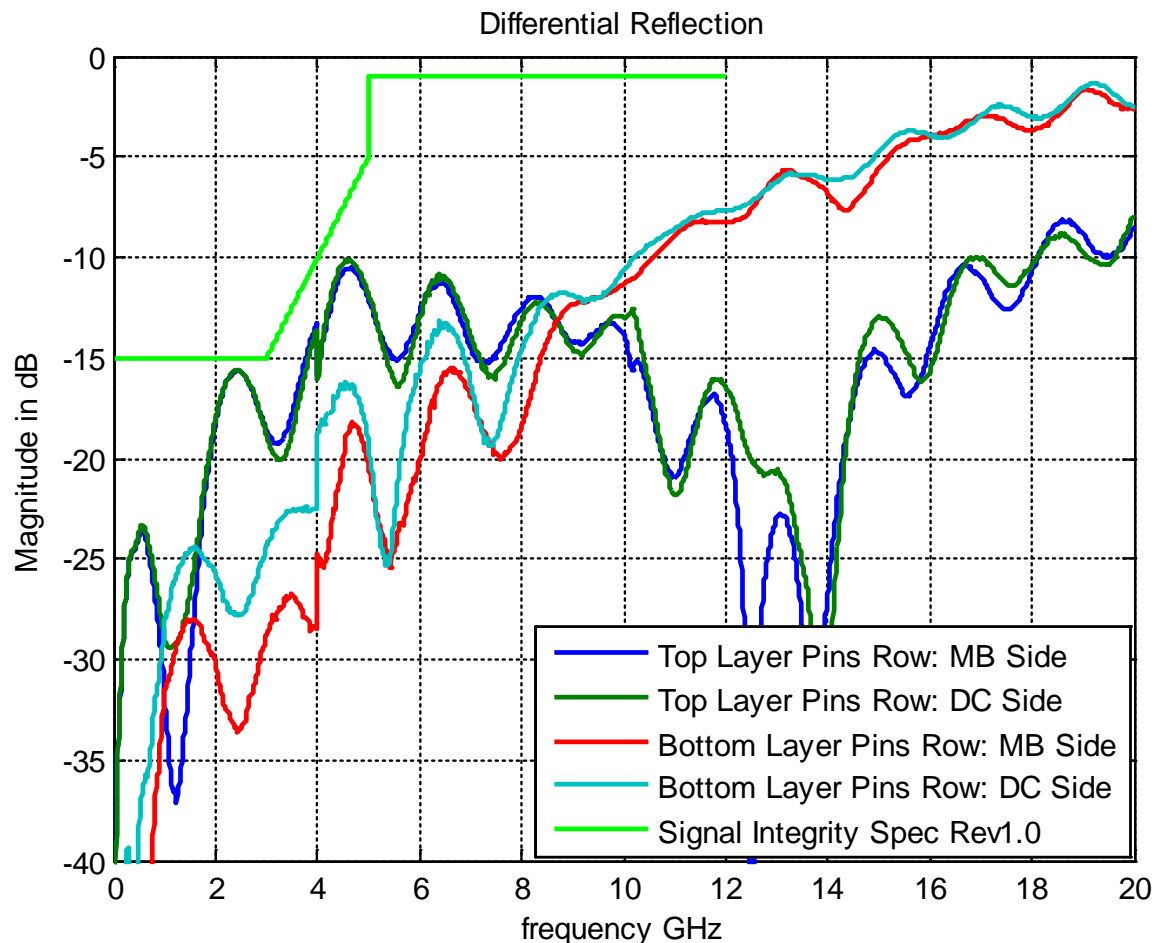
M.2 PCIe connector SI test fixture



Calibration Board for De-embedding

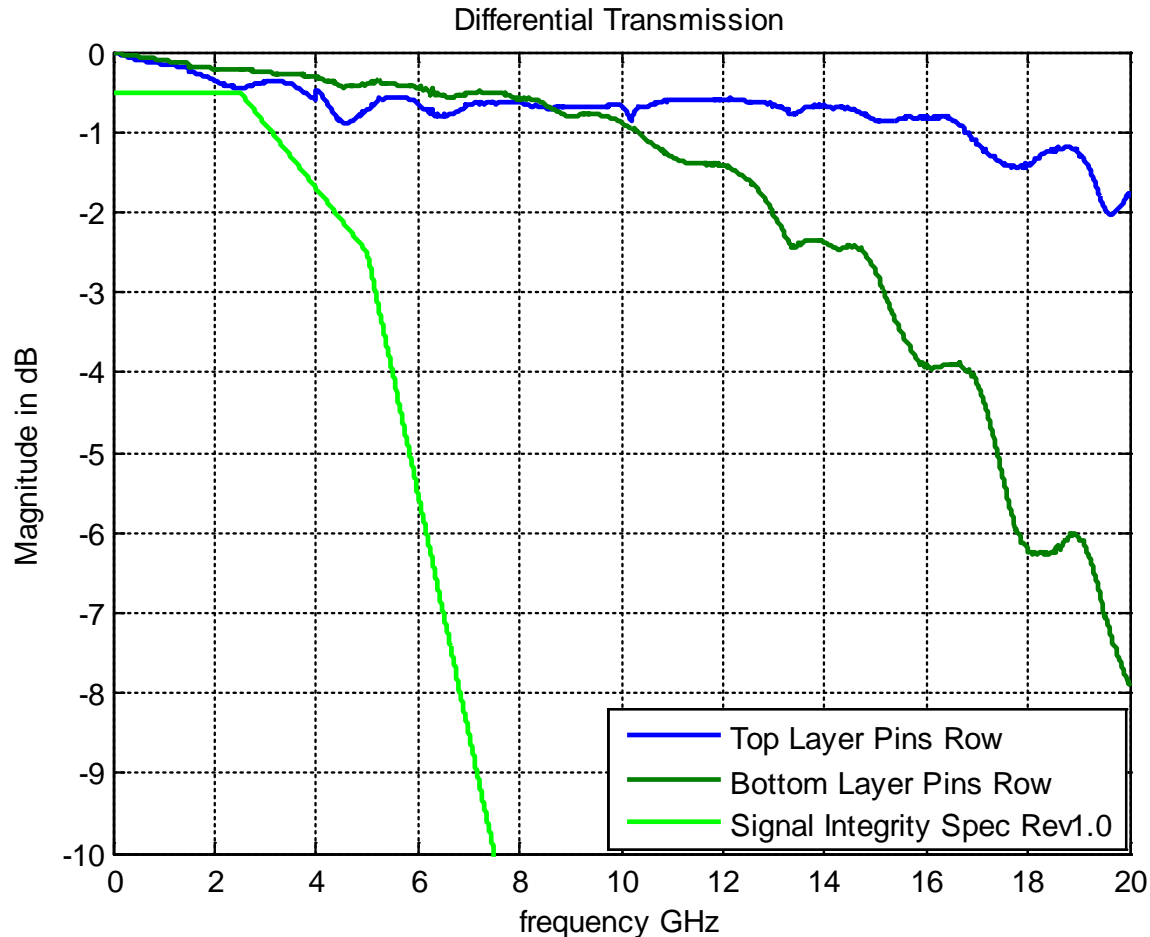
M.2(NGFF) Connector Signal Integrity Measurement Results

5. Differential Return Loss



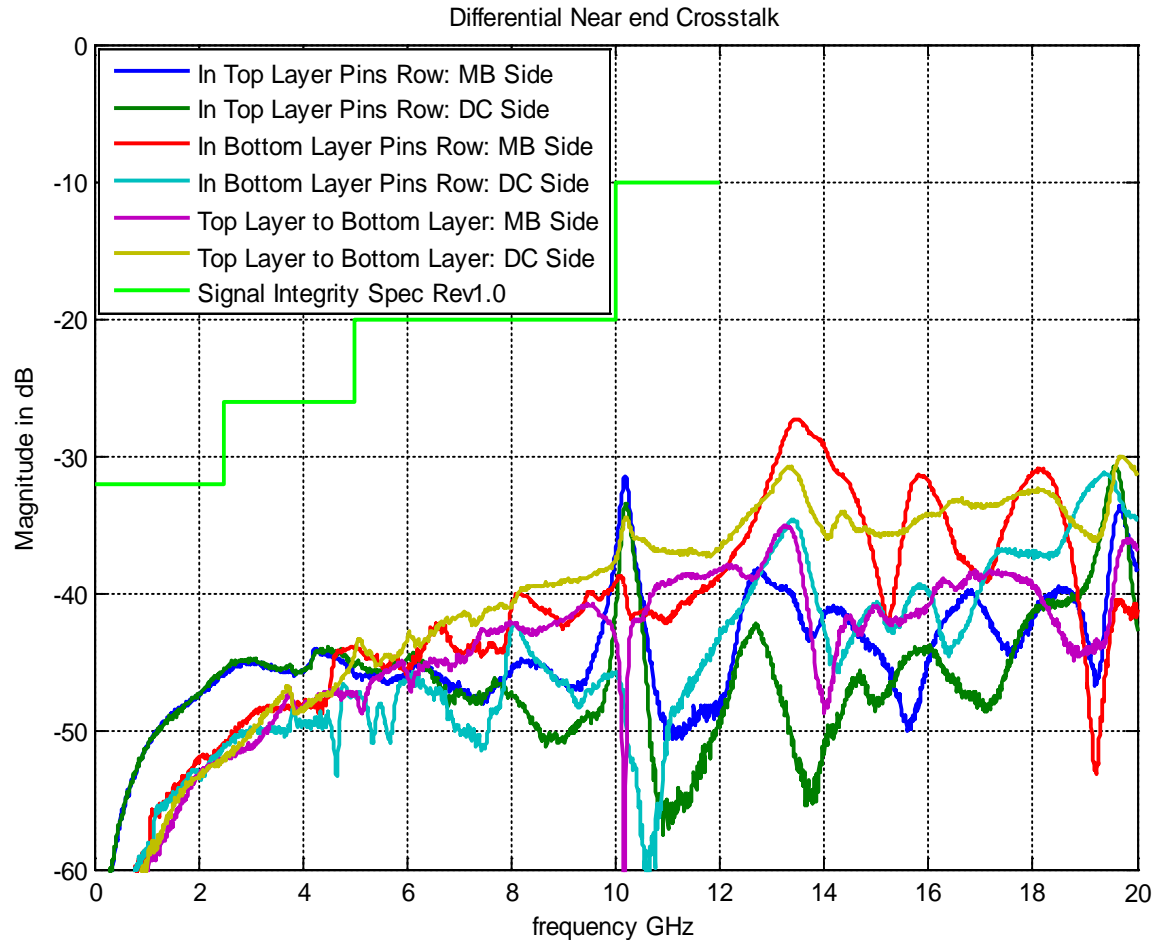
M.2(NGFF) Connector Signal Integrity Measurement Results

6. Differential Insertion Loss



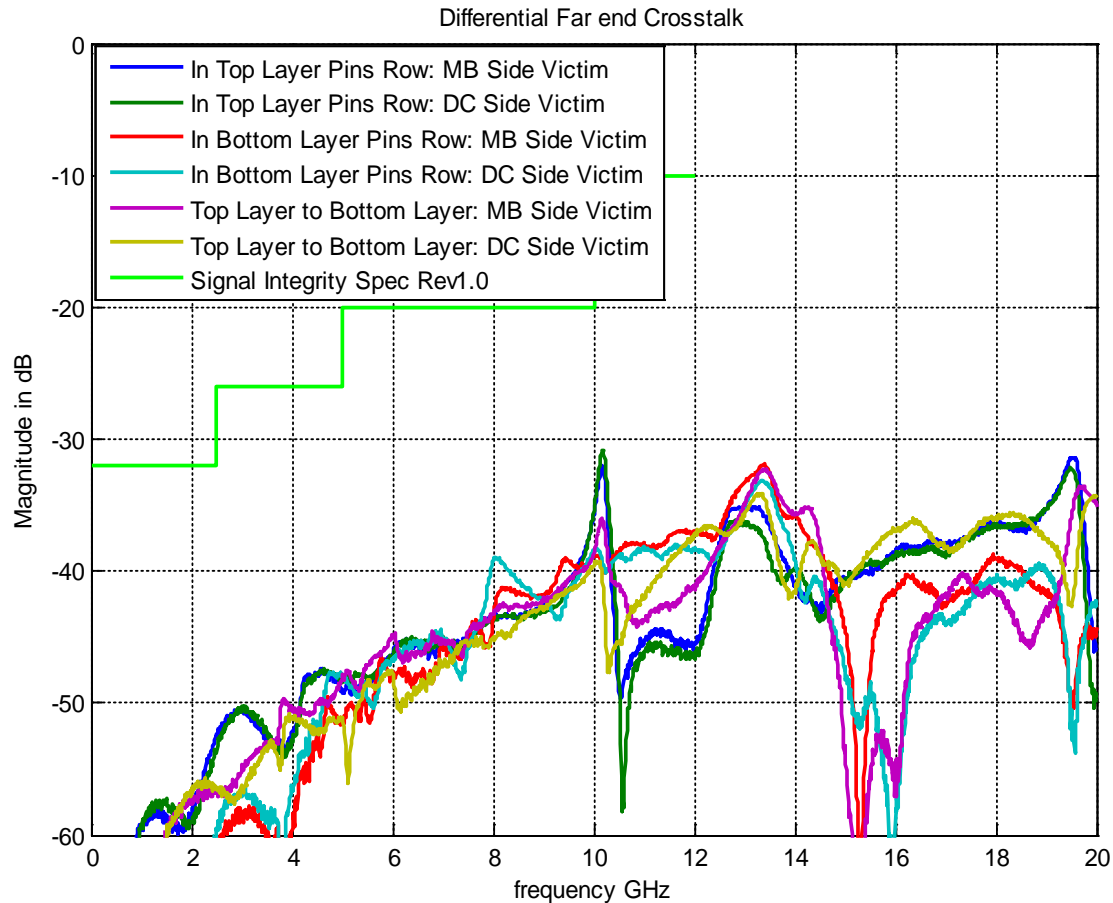
M.2(NGFF) Connector Signal Integrity Measurement Results

7. Differential NEXT



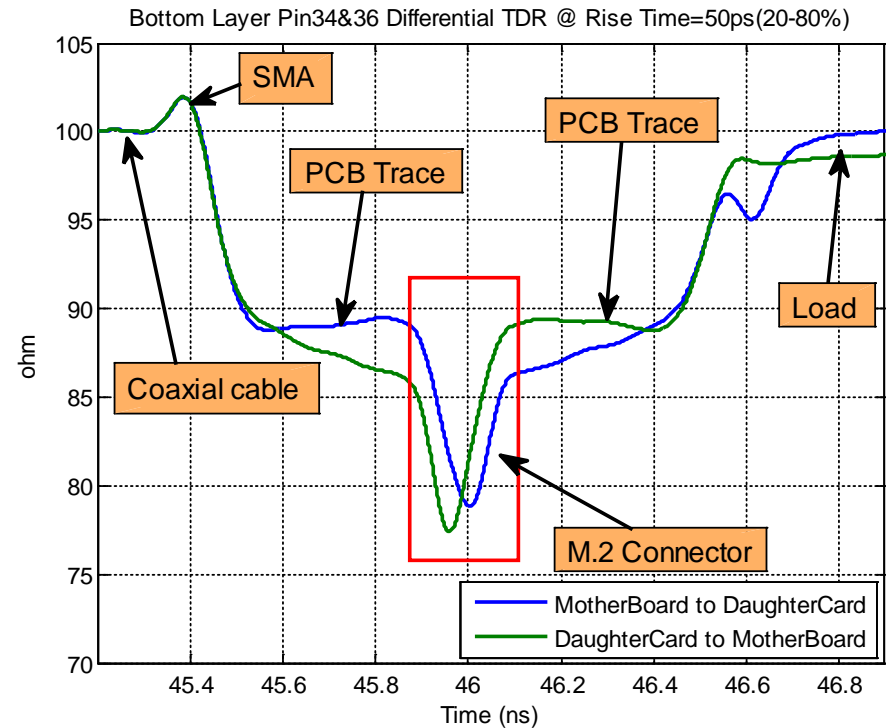
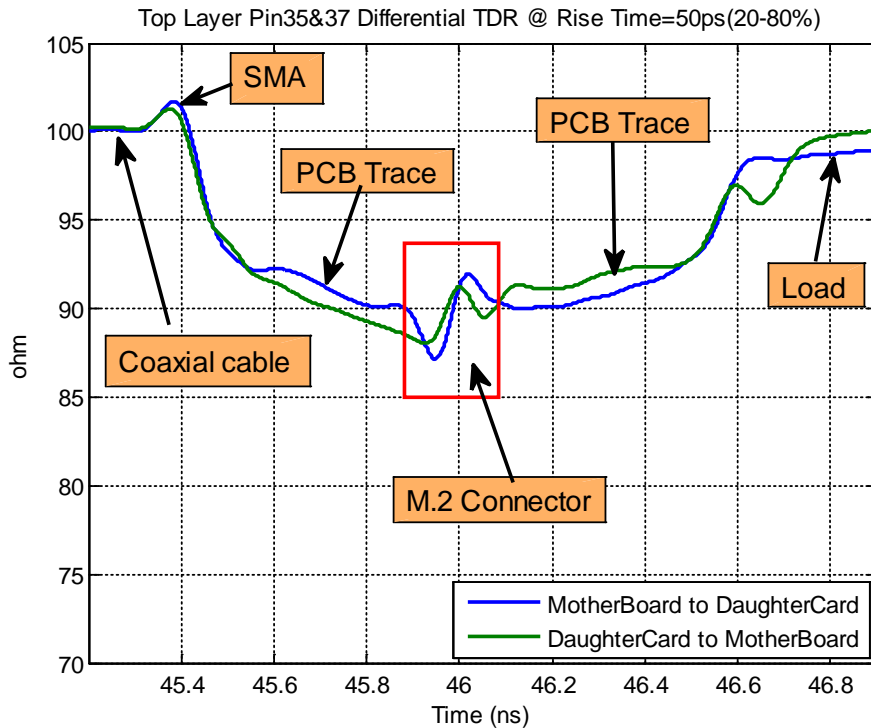
M.2(NGFF) Connector Signal Integrity Measurement Results

8. Differential FEXT



M.2(NGFF) Connector Signal Integrity Measurement Results

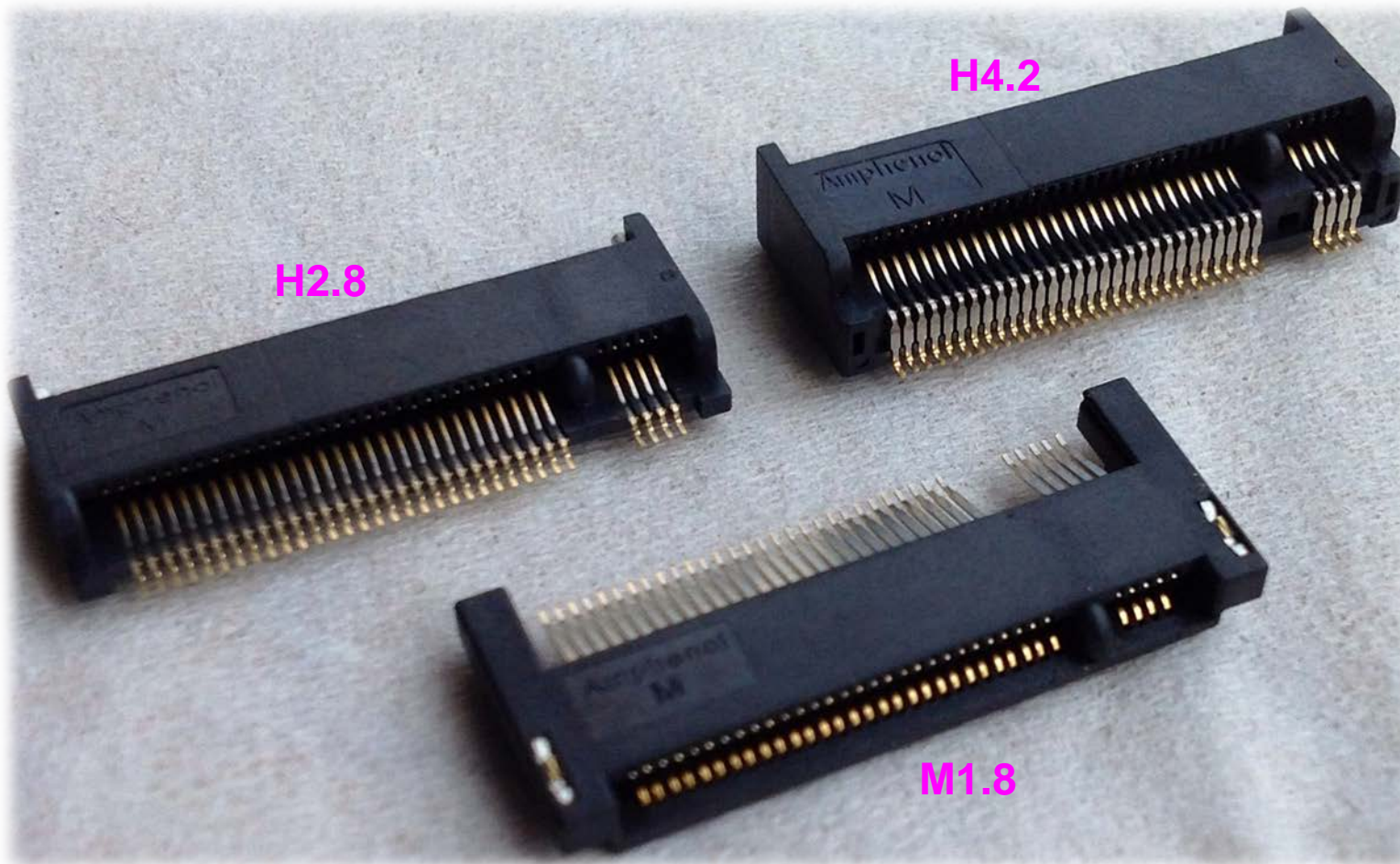
9. Differential Impedance



Impedance results met requirement of 85ohm connection system.

Amphenol M.2(NGFF) Connectors

M1.8, H2.8, H4.2 key ID A, B, E, M have been tooled up, drawings please refer to right side pdfs:

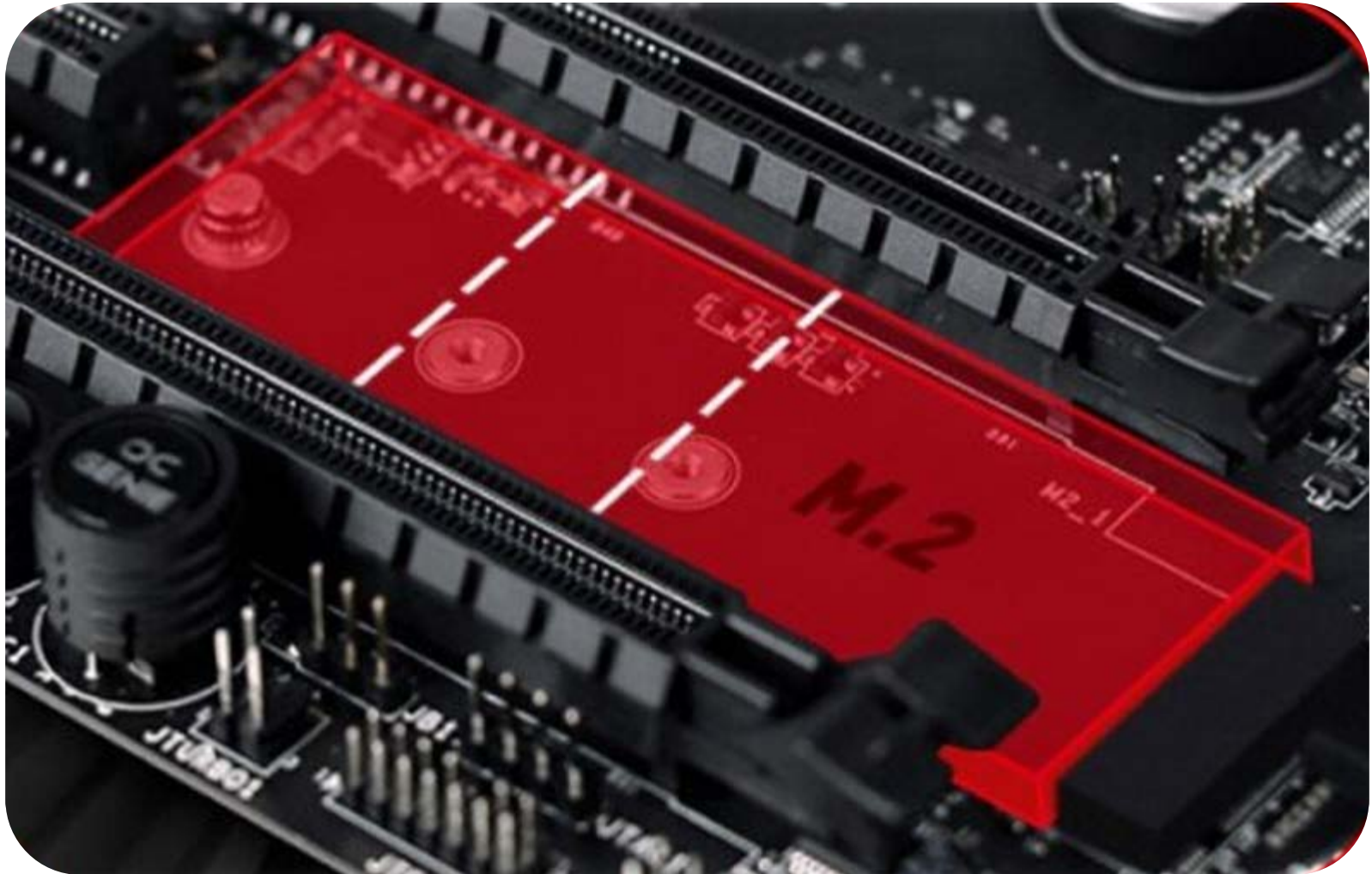


CMDT180-X-XX-001



CMDT-XXX-X-X
X-001

M.2(NGFF) Connectors in board

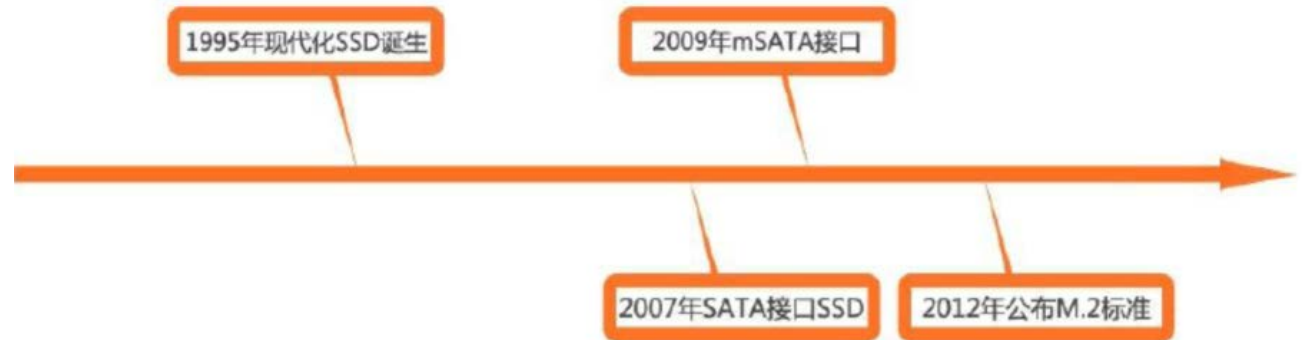
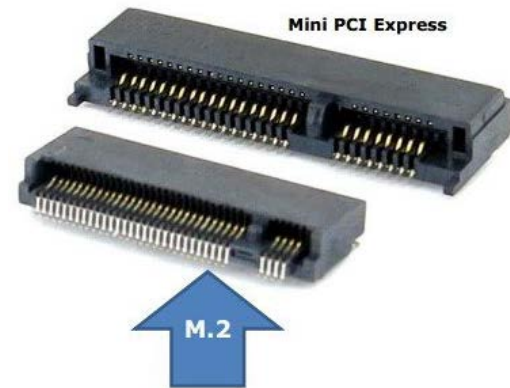


Amphenol M.2(NGFF) Connectors - Key applications

- M.2 key A connector is suitable for applications that use wireless connectivity including Wi-Fi, Bluetooth, NFC, and WiGig. Module card types include 1630, 2230 and 3030.
- M.2 key B connector is suitable for applications that use WWAN+GNSS or Solid State Storage Devices (SSD). Module card types include 3042, 2230, 2242, 2260, 2280 and 22110.
- M.2 key E connector is suitable for applications that use wireless connectivity including Wi-Fi, Bluetooth, NFC or GNSS. Module card types include 1630, 2230 and 3030.
- M.2 key M connector is suitable for applications that use Host I/Fs supported by either PCIe or SATA, or Solid State Storage Devices (SSD). Module card types include 2242, 2260, 2280



SSD Storage Interface Roadmap



M.2 is the future!

Amphenol



Now you're connected