



Flash Memory Summit

Next Generation Small Form Factor (NGSFF) SSD Proposal

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Agenda

- Background and Justification for NGSFF
- Key points of NGSFF proposal
- Form Factor, Pin Assignment, Connector
- NGSFF System Usage
- Summary



Background

- M.2 form factor has found success in the Value SSD segment with a compromise of premium features as it was initially targeted at PC Client segment,
 - E.g. Lacking considerations for serviceability (Hot-swap), dual-port support, higher capacity, power cycling support etc.
- U.2 form factor positioned for Enterprise SSD segment with Premium features
 - But, legacy U.2 (2.5inch) Form Factor originally designed to accommodate spinning disks - not dimensionally optimized for NAND component usage

M.2



U.2



- High capacity and small factor SSD with premium features are required to continue growth of small form factor SSD's in Enterprise and Data Center applications



Samsung's NGSFF Proposal

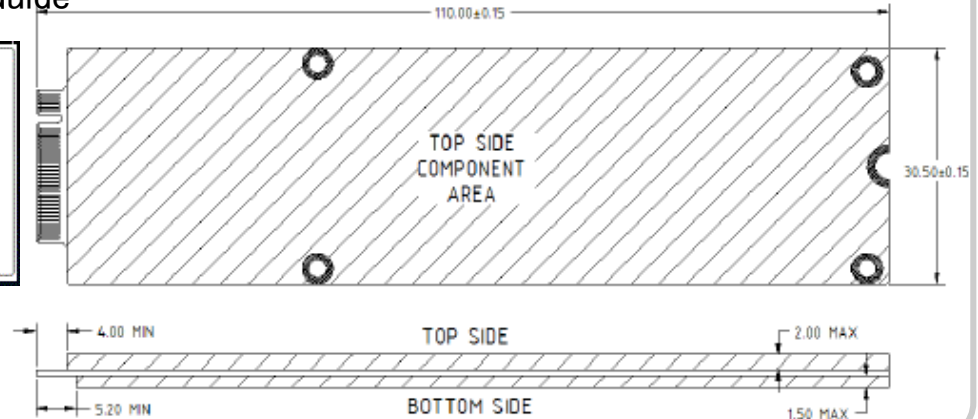
- Take the best qualities of U.2 and M.2, and make it better than both!
 - Maintain evolutionary compatibility with M.2 where possible
 - Height optimized for 1U servers (30.5 mm x 110 mm)
 - Add new features to enable improvement of system level RAS and configurability
- Advantage 1: SSD volume optimized for NAND component usage
 - M.2 (22 mm x 110 mm x 3.88 mm) = 9389.6 mm³;
 - NGSFF (30.5 mm x 110 mm x 4.38 mm) = 14694.9 mm³; 2~4X capacity relative to M.2
 - U.2 (69 mm x 100 mm x 7 mm) = 48300 mm³; 2~4X capacity relative to M.2
- Advantage 2: Some shared mechanical infrastructure with M.2
 - Common connector – assign new signals to reserved pins to enable new features
 - New Features: Dual Port options (2 port x 2 Lane, 1 port x 4 lane), 12V power, Power disable
- Advantage 3: Support front-side hot-swap capability for rackmount servers
 - Presence detect pins and 12V pre-charge pins assigned to the reserved-pins of M.2 pin-out
 - Hot-swap mating sequence defined
 - Front accessibility optimized: 1) Indicator LED's, 2) Lever, 3) Metal Guide



Form Factor / Size

Mechanical Outline Drawing (Bare Module Type, 4.38mmT)

- Size : [110 x 30.5mm, Max 4.38mmT](#)
- [Backward compatibility with M.2](#) (M-Key, SATA/PCIe)
: Card edge, PCB thickness(0.8mm) / length(110mm), Bottom side component height(Max. 1.5mmT)
- Added 4 Screw Holes for SSD tray and Metal Guide





Pin Assignment (1/2)

New signals assigned to 'N/C pins of M.2 connector' to support enterprise features in NGSFF

SATA

Pin	Signal	Signal	Pin
		GND	75
74	N/C	GND	73
72	N/C	GND	71
70	N/C	PEDET(GND-SATA)	69
68	SUSCLK(32kHz)	PRSENT1#	67
66	Module Key	Module Key	65
64	Module Key	Module Key	63
62	Module Key	Module Key	61
60	Module Key	Module Key	59
58	Reserved MFG_CLOCK	GND	57
56	Reserved MFG_DATA	N/C	55
54	N/C	N/C	53
52	N/C	GND	51
50	N/C	SATA-A+	49
48	N/C	SATA-A-	47
46	N/C	GND	45
44	ALERT#(O)(0/3.3V)	SATA-B-	43
42	SMB_DATA(I/O)(0/3.3V)	SATA-B+	41
40	SMB_CLK(I/O)(0/3.3V)	GND	39
38	DEVSIP_D/PWDIS	N/C	37
36	12V (Pre-Charge)	N/C	35
34	12V	GND	33
32	12V	N/C	31
30	12V	N/C	29
28	N/C	GND	27
26	GND	N/C	25
24	N/C	N/C	23
22	N/C	GND	21
20	GND	N/C	19
18	N/C	N/C	17
16	N/C	GND	15
14	N/C	N/C	13
12	3.3Vaux	N/C	11
10	DAS(DSS#)(I/O)	GND	9
8	NC	N/C	7
6	PRSENT2#	N/C	5
4	N/C	GND	3
2	N/C	GND	1

PCIe Single Port x4Lane

Pin	Signal	Signal	Pin
		GND	75
74	N/C	GND	73
72	N/C	GND	71
70	N/C	PEDET(NC-PCIe)	69
68	SUSCLK(32kHz)	PRSENT1#	67
66	Module Key	Module Key	65
64	Module Key	Module Key	63
62	Module Key	Module Key	61
60	Module Key	Module Key	59
58	Reserved MFG_CLOCK	GND	57
56	Reserved MFG_DATA	REFCLKp	55
54	REWAKE#	REFCLKn	53
52	CLKREQ#	GND	51
50	PERST#0	PERp0	49
48	N/C	PERn0	47
46	N/C	GND	45
44	ALERT#(O)(0/3.3V)	PETp0	43
42	SMB_DATA(I/O)(0/3.3V)	PETn0	41
40	SMB_CLK(I/O)(0/3.3V)	GND	39
38	N/C	PERp1	37
36	12V (Pre-Charge)	PERn1	35
34	12V	GND	33
32	12V	PETp1	31
30	12V	PETn1	29
28	PWDIS	GND	27
26	GND	PERp2	25
24	N/C	PERn2	23
22	N/C	GND	21
20	GND	PETp2	19
18	N/C	PETn2	17
16	N/C	GND	15
14	N/C	PERp3	13
12	3.3Vaux	PERn3	11
10	LED1#	GND	9
8	NC	PETp3	7
6	PRSENT2#	PETn3	5
4	N/C	GND	3
2	N/C	GND	1

PCIe Dual port x 2Lane

Pin	Signal	Signal	Pin
		GND	75
74	N/C	GND	73
72	N/C	GND	71
70	N/C	PEDET(NC-PCIe)	69
68	SUSCLK(32kHz)	PRSENT1#	67
66	Module Key	Module Key	65
64	Module Key	Module Key	63
62	Module Key	Module Key	61
60	Module Key	Module Key	59
58	Reserved MFG_CLOCK	GND	57
56	Reserved MFG_DATA	REFCLKp	55
54	REWAKE#	REFCLKn	53
52	CLKREQ#	GND	51
50	PERST#0	PERp0	49
48	PERST#1	PERn0	47
46	DualPortEn#	GND	45
44	ALERT#(O)(0/3.3V)	PETp0	43
42	SMB_DATA(I/O)(0/3.3V)	PETn0	41
40	SMB_CLK(I/O)(0/3.3V)	GND	39
38	N/C	PERp1	37
36	12V (Pre-Charge)	PERn1	35
34	12V	GND	33
32	12V	PETp1	31
30	12V	PETn1	29
28	PWDIS	GND	27
26	GND	PERp2	25
24	REFCLKp1	PERn2	23
22	REFCLKn1	GND	21
20	GND	PETp2	19
18	N/C	PETn2	17
16	N/C	GND	15
14	N/C	PERp3	13
12	3.3Vaux	PERn3	11
10	LED1#	GND	9
8	NC	PETp3	7
6	PRSENT2#	PETn3	5
4	N/C	GND	3
2	N/C	GND	1



Pin Assignment (2/2)

Interface Signals

Interface	Signal Name	I/O	Function	Voltage		
Power and Ground	12V (4Pins)	I	12V Source.	12V		
	GND (16Pins)		Return current path	0V		
	3.3Vaux	I	3.3V AUX Power (Optional)	3.3V		
PCIe	PERp0,PERn0/PETp0,PETn0 PERp1,PERn1/PETp1,PETn1 PERp2,PERn2/PETp2,PETn2 PERp3,PERn3/PETp3,PETn3	I/O	Refer to the PCI Express M.2 Specification			
	REFCLKp0/REFCLKn0 REFCLKp1/REFCLKn1	I				
	PERST#0 PERST#1	I				
	CLKREQ#	I/O				
	PEWAKE#/OBFF	I/O				
	DualPortEn#	I			Enable dual-link mode (Dual-port x 2Lane)	3.3V
	SATA	SATA-A+, SATA-A-/SATA-B+, SATA-B-			I/O	Refer to the Serial ATA Specification.
DEVSLP		I				
DAS/DSS#		I/O				
SSD Specific Signals	SUSCLK	I	Refer to the PCI Express M.2 Specification.			
	PEDET	O				
	Reserved for MFG_DATA					
	LED_1#	O				
	ALERT#	O				
	SMB_CLK	I/O			SMBus clock; Open Drain with pull up on platform	3.3V
	SMB_DATA	I/O			SMBus clock; Open Drain with pull up on platform	3.3V
	PWDIS	I			Power Disable Signal	3.3V
PRSNT1#/ PRSNT2#		Present Detect				

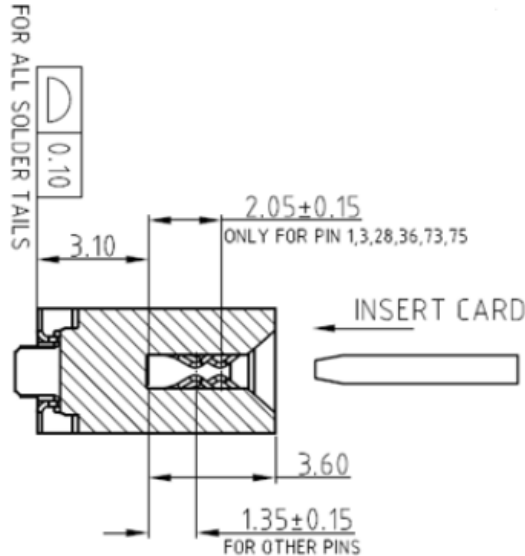
Power Supply

Power Rail	Max 16W
12V Voltage tolerance Supply Current	±8% 1.3A(max)
3.3Vaux Voltage tolerance Supply current	±8% 375mA(max)



Connector Illustration

- Mating Sequence: 1st Mating(GND/12V Pre-charge/PWDIS) → 2nd Mating(Signals/Power)
- Point of contact guide

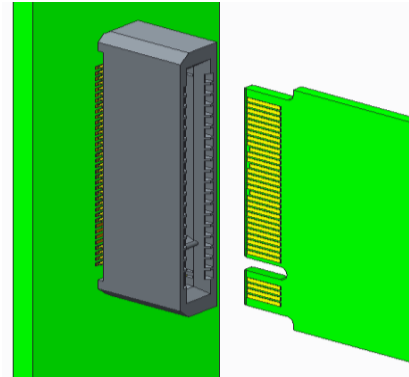
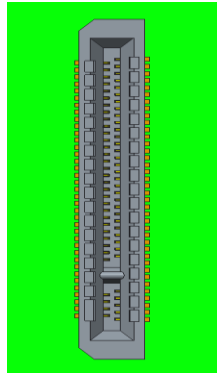


- The hot-plug and mechanical requirements yields staggered pin arrangements.
- Six pins (GNDs, 12V Pre-charge and PWDIS Pins) should be mated to Gold fingers earlier than signals and power pins.
- Pin numbers of earlier mated six pins are 1, 3, 73 and 75 at top-side and 28 and 36 at bottom-side

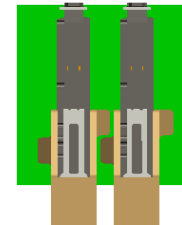
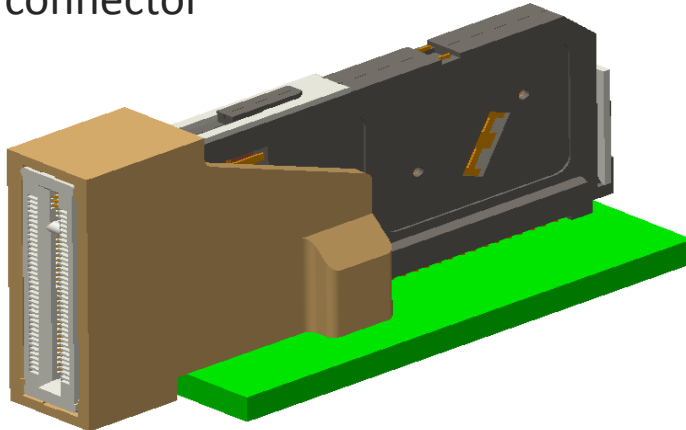


Connector Illustration 2

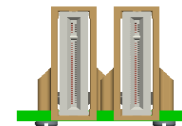
- Vertical connector



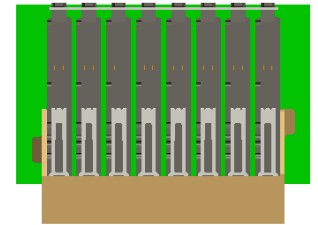
- Orthogonal connector



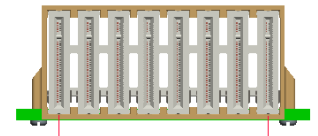
11.000



<Implement individually>
(Pitch : 11mm)



49.00



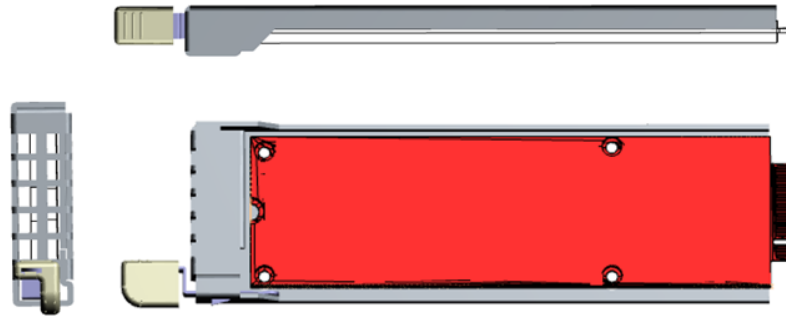
<Array>
(Pitch : 8mm)



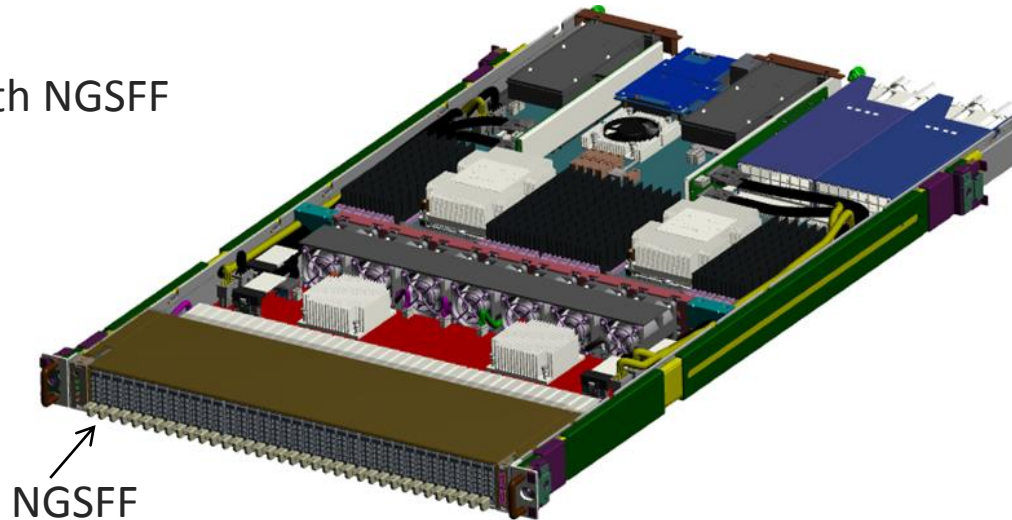
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NGSFF Usage

NGSFF with tray



Storage server with NGSFF





NGSFF Feature Summary

NGSFF evolved from M.2 for familiarity and compatibility reasons

1. Adoption of the M.2 card edge allows a NGSFF SSD to be inserted into existing M.2 connector.
2. SSD length (110mm) and the component height of bottom-side (Max.1.5mmT) for NGSFF are same as M.2
 - (**NGSFF form factor without metal guide and lever)
3. No-changes in M.2 power and signal pin-out. The new added signals and powers are assigned at reserved pin locations

Advantages when NGSFF form factor is utilized

1. With PCB width increase from 22mm to 30.5mm, max capacity increased by 2~4X
 - Greatly improving SSD and system storage capacity
2. Essential features for enterprise class SSD's such as dual-port and hot-swap are supported in the NGSFF specification
 - Improving system reliability, availability and serviceability
3. NGSFF is optimized for 1U Server deployment
 - Easy front side access - optimized (Metal Guide/Lever/Indicator LEDs) placements
4. Superior thermal characteristics compared to M.2