

M.2 (NGFF) WWAN modem USB breakout board - Bug #4241

measure insertion loss for two alternatives of RF adapter on VNA up to 3GHz

10/22/2019 09:42 AM - mschramm

Status:	Resolved	Start date:	10/22/2019
Priority:	Normal	Due date:	
Assignee:	roh	% Done:	100%
Category:			
Target version:			
Spec Reference:			

Description

We want to know insertion loss for both alternatives we are thinking of for placing them on the NGFF breakout PCBA:

- the custom RF cable assembly w/ THT SMA jack (right angle,; don't solder this one, it can be tested self-supporting) and attached pigtail cable, and
- a similar combination w/ a short uFL<->MHF4 cable + THT SMA soldered (on the spare PCB where you already placed the MHF4 on).

For the first part, we don't yet have the MHF4 version but a uFL variant; so additional adapters are needed.

History

#1 - 10/23/2019 03:25 PM - roh

- File *sma-st-coupler.png* added
- File *sma-ufl-pigtail.png* added
- File *ngff-sma-180-amc-ufl-sma.png* added
- File *ngff-sma-180-hsc-ufl-sma.png* added
- File *ngff-sma-180-umc-ufl-sma.png* added
- Status changed from *New* to *Resolved*

#2 - 10/23/2019 03:26 PM - roh

- File *sma-ufl-pigtail_1.png* added
- File *sma-st-coupler_1.png* added

#3 - 10/23/2019 03:40 PM - roh

- % Done changed from *0* to *100*

results:

- the ufl pigtail performs best with a performance of 0.2-0.3dB insertion loss over the whole band.
- umc performs the worst with -13dB insertion loss at around 1.6GHz and -10dB at around 3GHz
- amc slopes down to -5dB at around 1GHz and slowly down to -9dB at 3GHz
- hsc also slopes down to -8dB at 3GHz, similar to amc, but with ~1dB better overall performance (less loss)

if we use mhf4 directly on the pcb - the 'hsc' connector seems the best of the batch. recommendation is using the pigtail due to massively better performance.

#4 - 10/23/2019 08:33 PM - laforge

Hi,

On Wed, Oct 23, 2019 at 03:40:24PM +0000, roh [REDMINE] wrote:

results:

- the ufl pigtail performs best with a performance of 0.2-0.3dB insertion loss over the whole band.
- umc performs the worst with -13dB insertion loss at around 1.6GHz and -10dB at around 3GHz
- amc slopes down to -5dB at around 1GHz and slowly down to -9dB at 3GHz
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5, 8, 9 or 13 dB loss are totally unacceptable. There must be something seriously wrong with either the test setup, or the adapters, cables or our PCB traces are anything but well-matched.

If we cannot improve the situation, the wire-to-SMA pigtail is the only acceptable option :/

#5 - 10/24/2019 01:31 PM - mschramm

The last two pictures show a gain: parts or all of the graph is in 1st quadrant of the graph (not exclusively in the fourth) which is clearly not possible.

The three product names of different brands all refer to the same mechanical plug solution, they should not expose these wide differences in measurements.

#6 - 10/24/2019 03:26 PM - roh

- File *ufl-ufl_cable.png* added
- File *sma-ufl-cable-ufl-sma.png* added
- File *sma-ufl-cable-ufl-sma.png* added

i think this is just a minor calibration error: * i was not redoing calib but loading a saved one * the calib was done on a used sma-sma coupler and sma calib kit, not with ufl or similar connectors

i did some traces on the minipci-e board for comparison (ufl to sma adapter onboard)

#7 - 10/24/2019 03:58 PM - mschramm

one image is uploaded twice - I think you wanted to upload another screencopy?

#8 - 10/24/2019 06:16 PM - roh

- File *deleted (sma-ufl-cable-ufl-sma.png)*

#9 - 10/24/2019 06:17 PM - roh

- File *ufl-cable-ufl-sma.png* added

#10 - 10/24/2019 06:17 PM - roh

sorry, this should fix it.

#11 - 10/25/2019 07:15 AM - laforge

- Status changed from *Resolved* to *In Progress*
- % Done changed from *100* to *60*

- did you double-check / re-confirm the situation with the improbable high loss of the converter involving the PCB trace? Like using another set of MHF4-to-UFL cables / ULF-to-SMA adapter or the like?
- i still have a hard time guessing what the file name of the graphs actually mean in terms of physical cable/adapter/connector comparison. Please explain the results, possibly by creating a small table with human-readable description of the setup next to every graph filename
- did you compare with the mPCIe breakout board trace as requested yesterday?

#12 - 10/25/2019 03:18 PM - roh

laforge wrote:

- did you double-check / re-confirm the situation with the improbable high loss of the converter involving the PCB trace? Like using another set of MHF4-to-UFL cables / ULF-to-SMA adapter or the like?

not yet - i am currently on that.

- i still have a hard time guessing what the file name of the graphs actually mean in terms of physical cable/adapter/connector comparison. Please explain the results, possibly by creating a small table with human-readable description of the setup next to every graph filename

i put a long description in the optional filedescription. but its only displayed on top of the page

```

ufl-ufl_cable.png          vna - sma-ufl adapter - ufl-ufl cable - ufl-sma adapter - vna 'only the ufl-ufl ca
ble (sma-ufl adaptes both sides)'
sma-ufl-cable-ufl-sma.png  vna - sma-mpcie-board - ufl-ufl cable - mpcie-board-sma - vna 'loop through mpcie-
board (connect ufl cable twice, use board as adapter on both ports)'
ufl-cable-ufl-sma.png      vna - sma-mpcie-board - ufl-ufl cable - ufl-sma adapter - vna 'one side sma-ufl ad
apter - other side mpci-e board'

```

i would expect the first having the best measurement results, the second the worst and the last should be most realistic and somewhere in the middle - which measurements confirm.

- did you compare with the mPCIe breakout board trace as requested yesterday?

thats what the last 3 graphs are all about.

#13 - 10/25/2019 04:22 PM - roh

- File umc2.png added
- File hsc2.png added
- File amc2.png added

these 3 graphs just show a different mh4-ufl cable being used

#14 - 10/25/2019 04:26 PM - roh

- File umc3.png added
- File hsc3.png added
- File amc3.png added
- File amc4.png added
- File hsc4.png added
- File umc4.png added

the next test was removing the esd protection diode, and the attenuation went away. these are the amc3/umc3/hsc3 graphs

still not ideal values, but all were better than -2dB now (see *4 graphs for better y scale)

#15 - 11/21/2019 02:21 PM - roh

- File ngff2_D5.png added
- File ngff2_D6.png added
- File ngff2_D7.png added
- Status changed from In Progress to Resolved
- % Done changed from 60 to 100

new testrun with new pcb and new diodes:

D5 = ESDAXLC6-1BT2 - digikey# 497-13413-1-ND
D6 = SESD0402X1BN-0010-098 - digikey# SESD0402X1BN-0010-098CT-ND
D7 = SESD0402X1BN-0015-096 - digikey# SESD0402X1BN-0015-096CT-ND

from the graphs i'd say we use the one selected for D5 in this case. the mh4 connector used was the 'cheapest one' of the tested ones. (could not see a proper difference inbetween the amc4/umc4/hsc4 graphs)

Files

sma-st-coupler.png	7.08 KB	10/23/2019	roh
sma-ufl-pigtail.png	7.04 KB	10/23/2019	roh
ngff-sma-180-amc-ufl-sma.png	7.35 KB	10/23/2019	roh
ngff-sma-180-hsc-ufl-sma.png	7.34 KB	10/23/2019	roh
ngff-sma-180-umc-ufl-sma.png	7.54 KB	10/23/2019	roh
sma-ufl-pigtail_1.png	7.14 KB	10/23/2019	roh
sma-st-coupler_1.png	7.03 KB	10/23/2019	roh
ufl-ufl_cable.png	5.97 KB	10/24/2019	roh

sma-ufi-cable-ufi-sma.png	6.56 KB	10/24/2019	roh
ufi-cable-ufi-sma.png	6.17 KB	10/24/2019	roh
umc2.png	7.71 KB	10/25/2019	roh
hsc2.png	7.74 KB	10/25/2019	roh
amc2.png	7.81 KB	10/25/2019	roh
umc3.png	7.3 KB	10/25/2019	roh
hsc3.png	7.32 KB	10/25/2019	roh
amc3.png	7.29 KB	10/25/2019	roh
amc4.png	7.98 KB	10/25/2019	roh
hsc4.png	7.99 KB	10/25/2019	roh
umc4.png	7.89 KB	10/25/2019	roh
ngff2_D6.png	8.14 KB	11/21/2019	roh
ngff2_D5.png	8.13 KB	11/21/2019	roh
ngff2_D7.png	8.14 KB	11/21/2019	roh