R&S　2022 低軌道衛星與無線通訊線上研討會

Integrating Large Scale Active Antenna

大型積體天線之組裝

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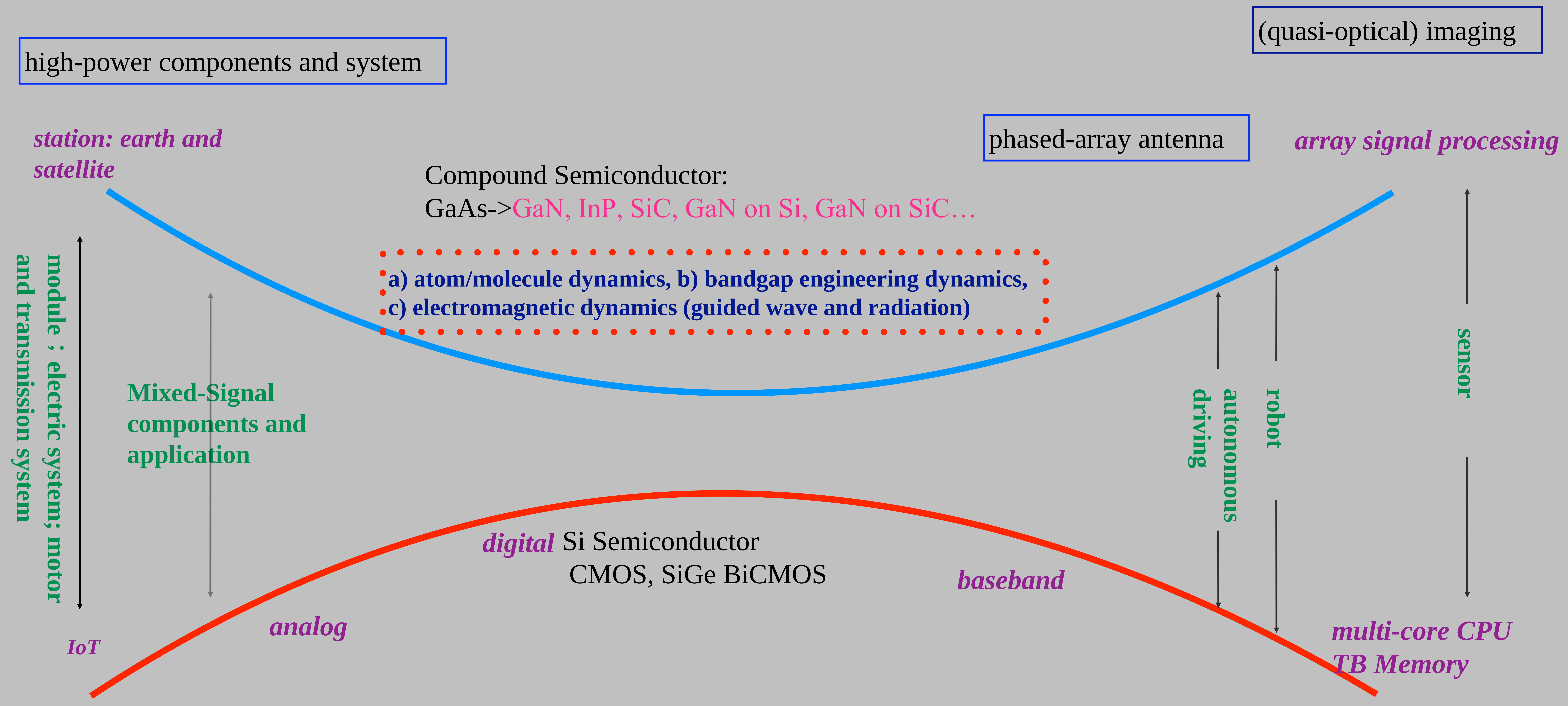
15:50-16:20　January 24, 2022

dedicate this presentation to professor 陳哲俊

Caption

on behalf of IEEE Taipei Life Member Affinity Group (LMAG) Join IEEE

congratulate all attendees on opportunity working on Taiwan space technology



high-power components and system
(quasi-optical) imaging
station: earth and satellite
phased-array antenna
array signal processing
Compound Semiconductor:
GaAs->GaN, InP, SiC, GaN on Si, GaN on SiC…
a) atom/molecule dynamics, b) bandgap engineering dynamics,
c) electromagnetic dynamics (guided wave and radiation)
module ; electric system; motor and transmission system
Mixed-Signal components and application
autonomous driving
robot
sensor
digital Si Semiconductor
CMOS, SiGe BiCMOS
baseband
analog
IoT
multi-core CPU
TB Memory

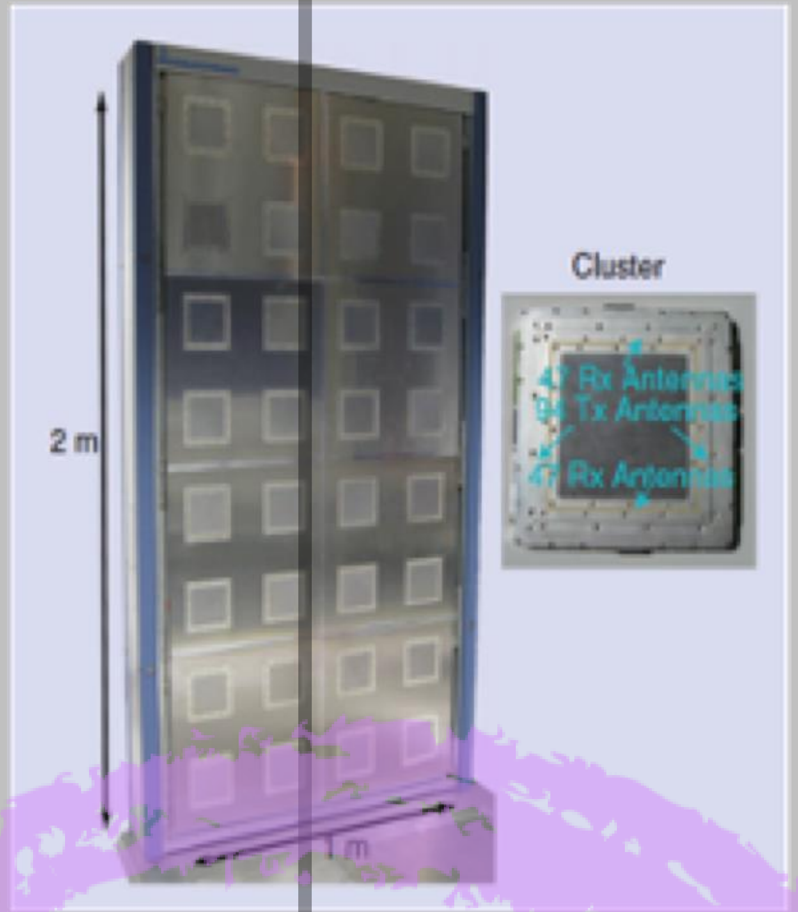
array integration _system perspective

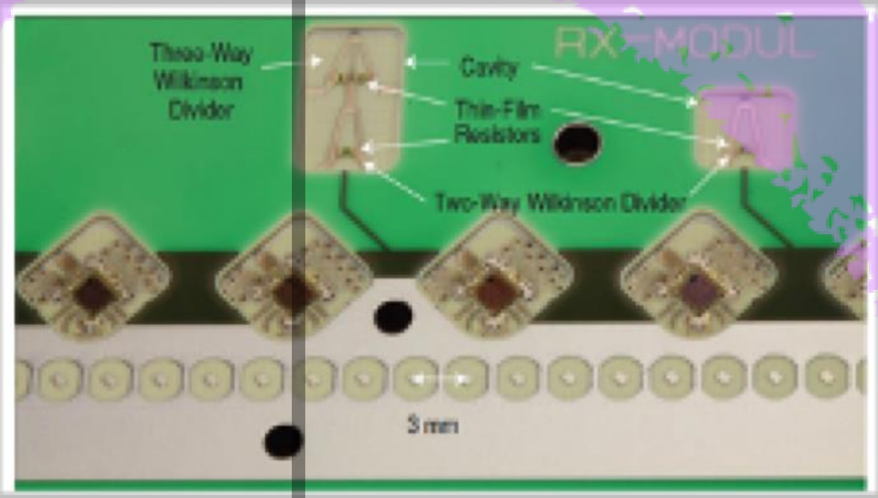
all digital

heat

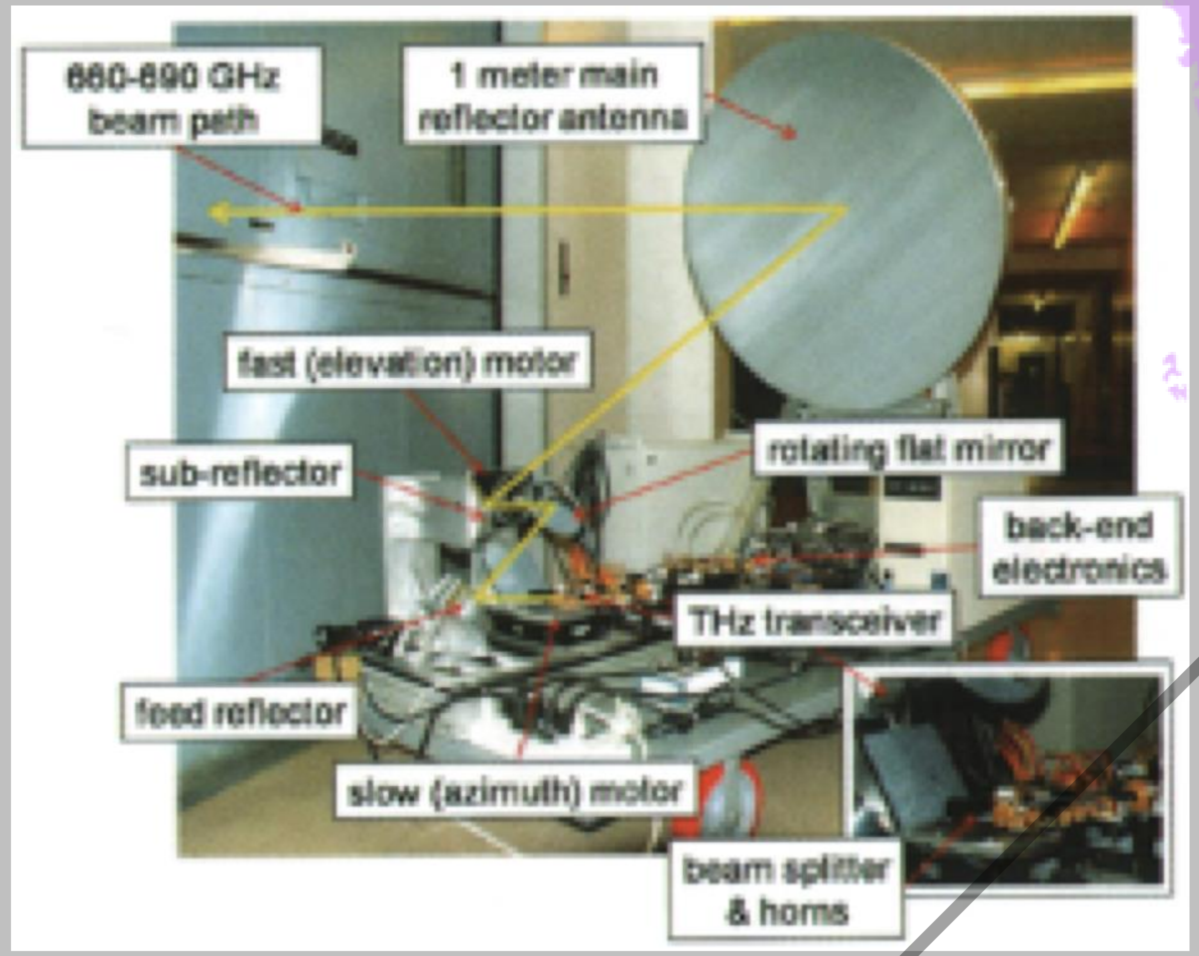
N-layer PCB integration

electronic scanning





mathematically equivalent



quasi-optics: reflector, lens

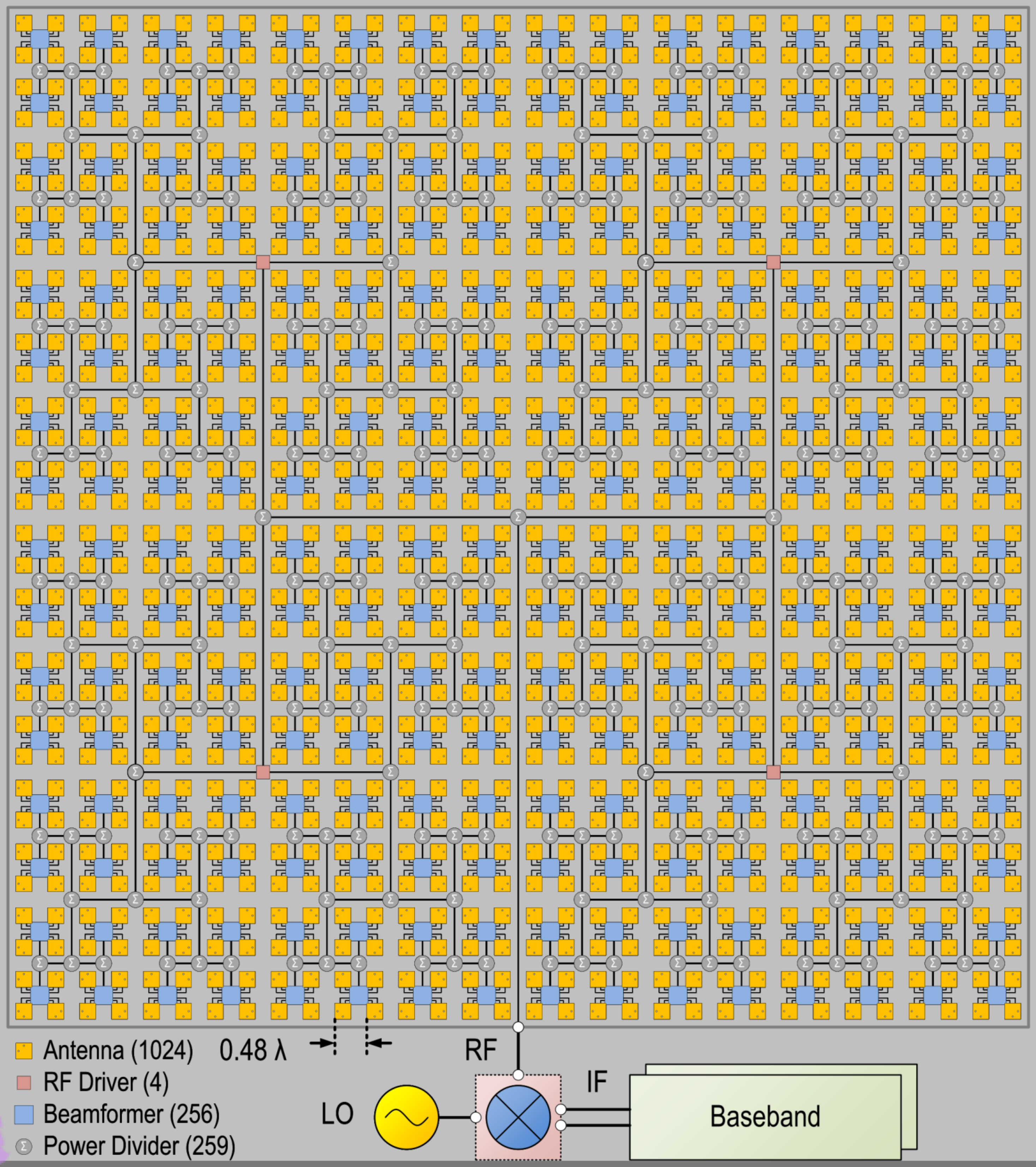
lens

heat

focal plane array

M-layer Si MEMS integration

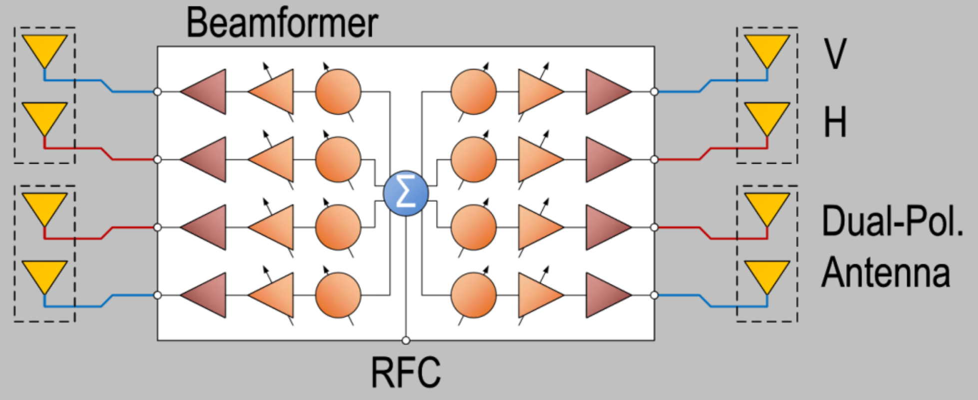
mechanical scanning



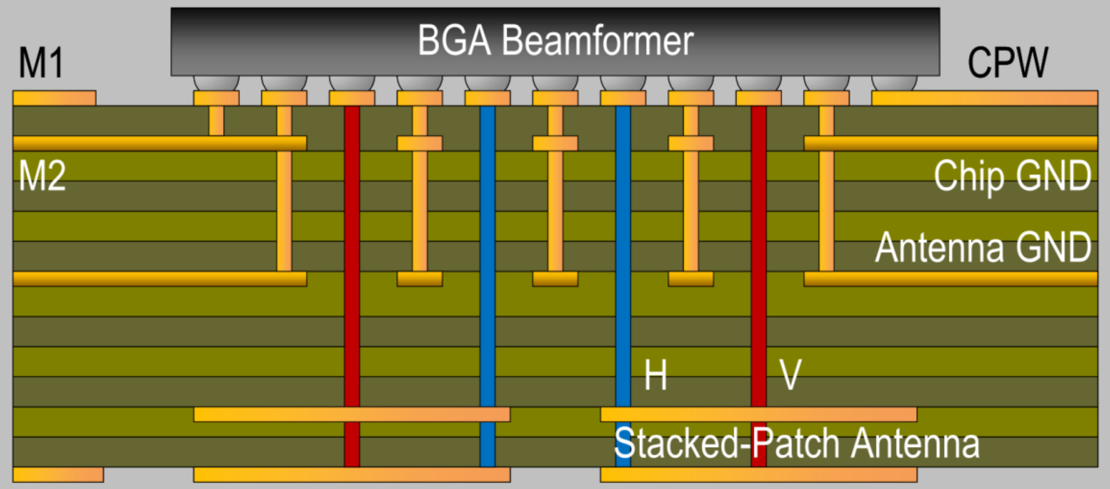
(a)

heat

hybrid RF



(b)



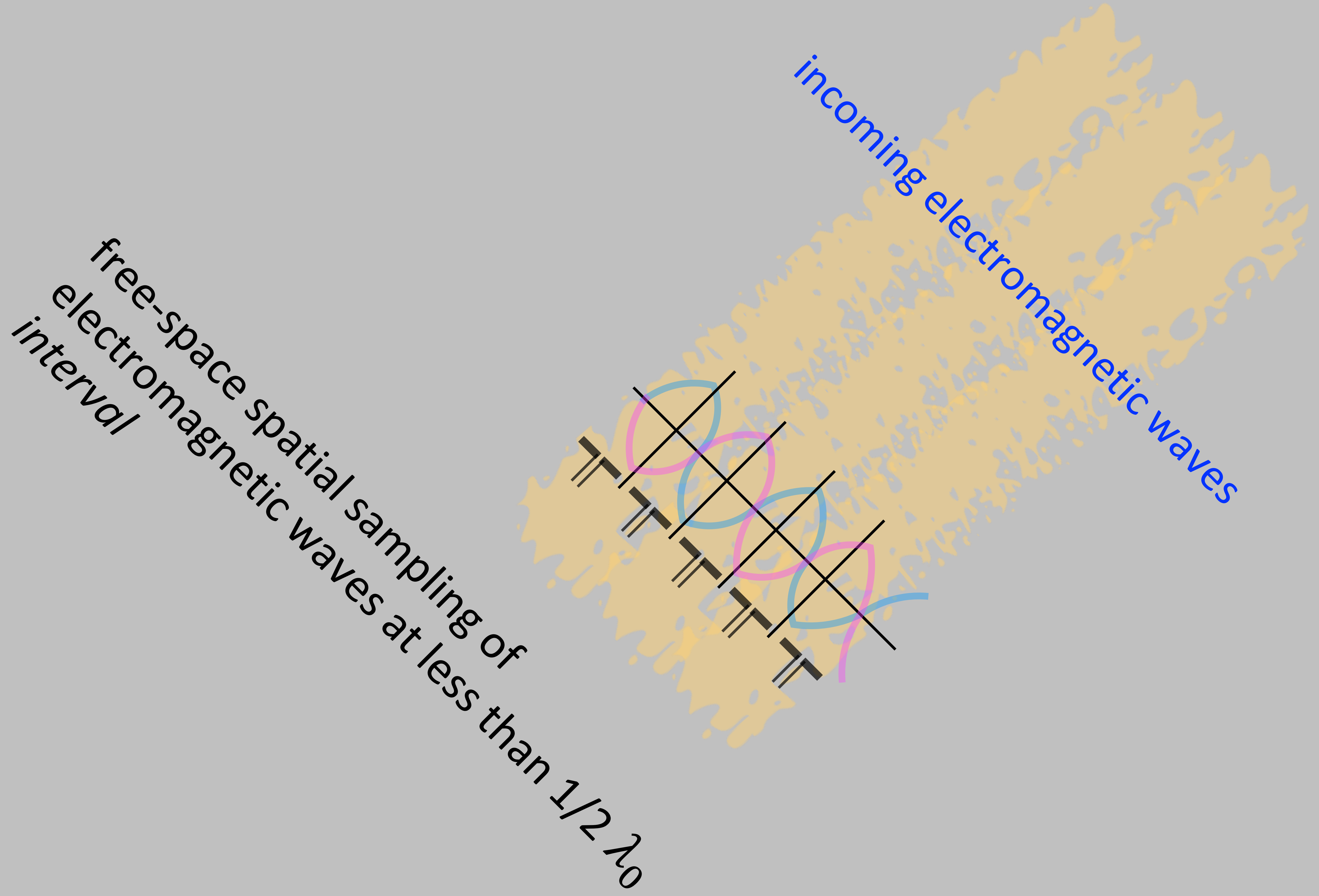
(c)

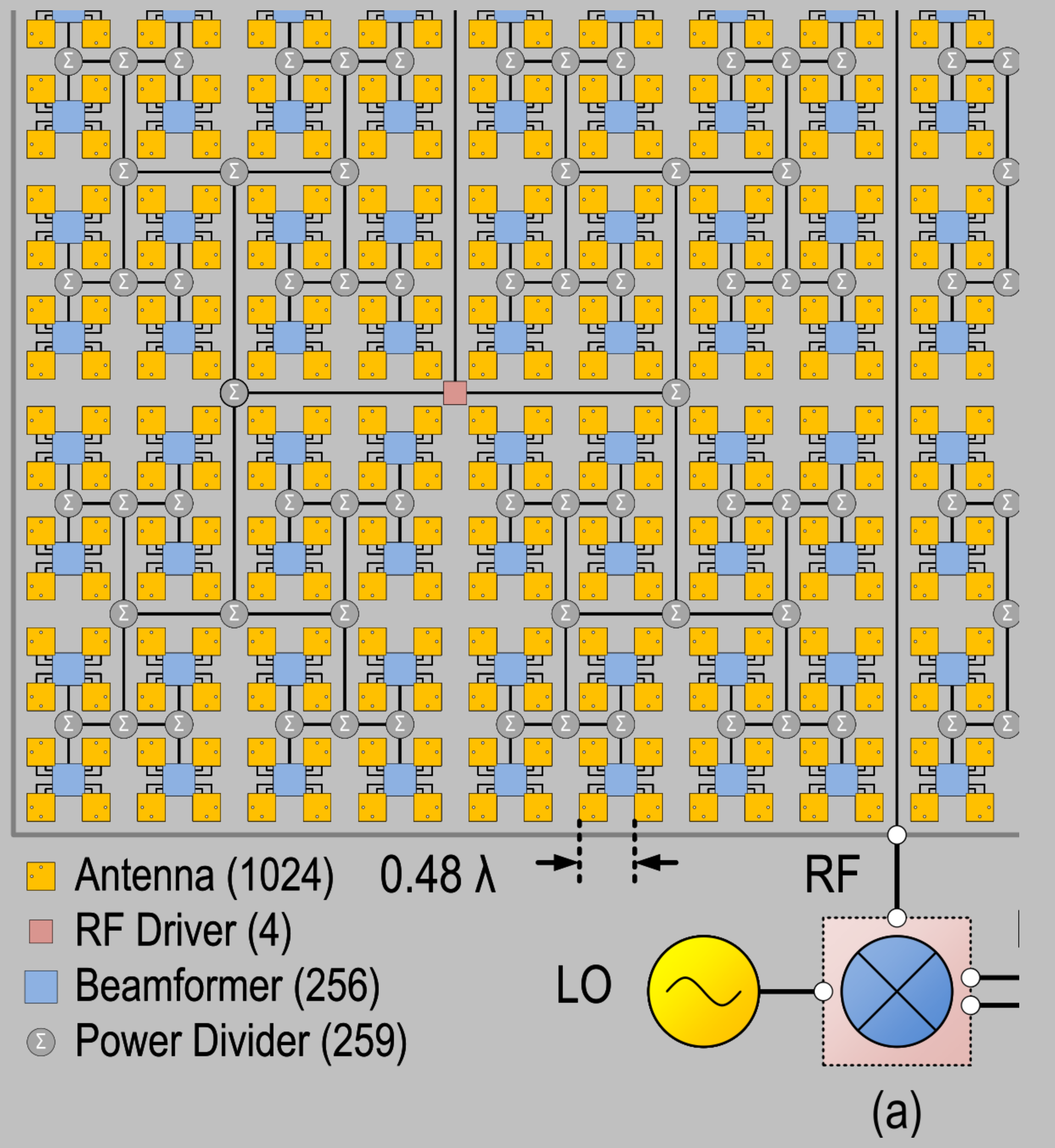
N-layer PCB integration

electronic scanning

array integration
_limit, risk, opportunity

1. Shannon Sampling Theorem





2. RF package or chip dimension (PA as an example)

19 Matching Products
(91 total)

ADD/REMOVE PARAMETERS

Reset All

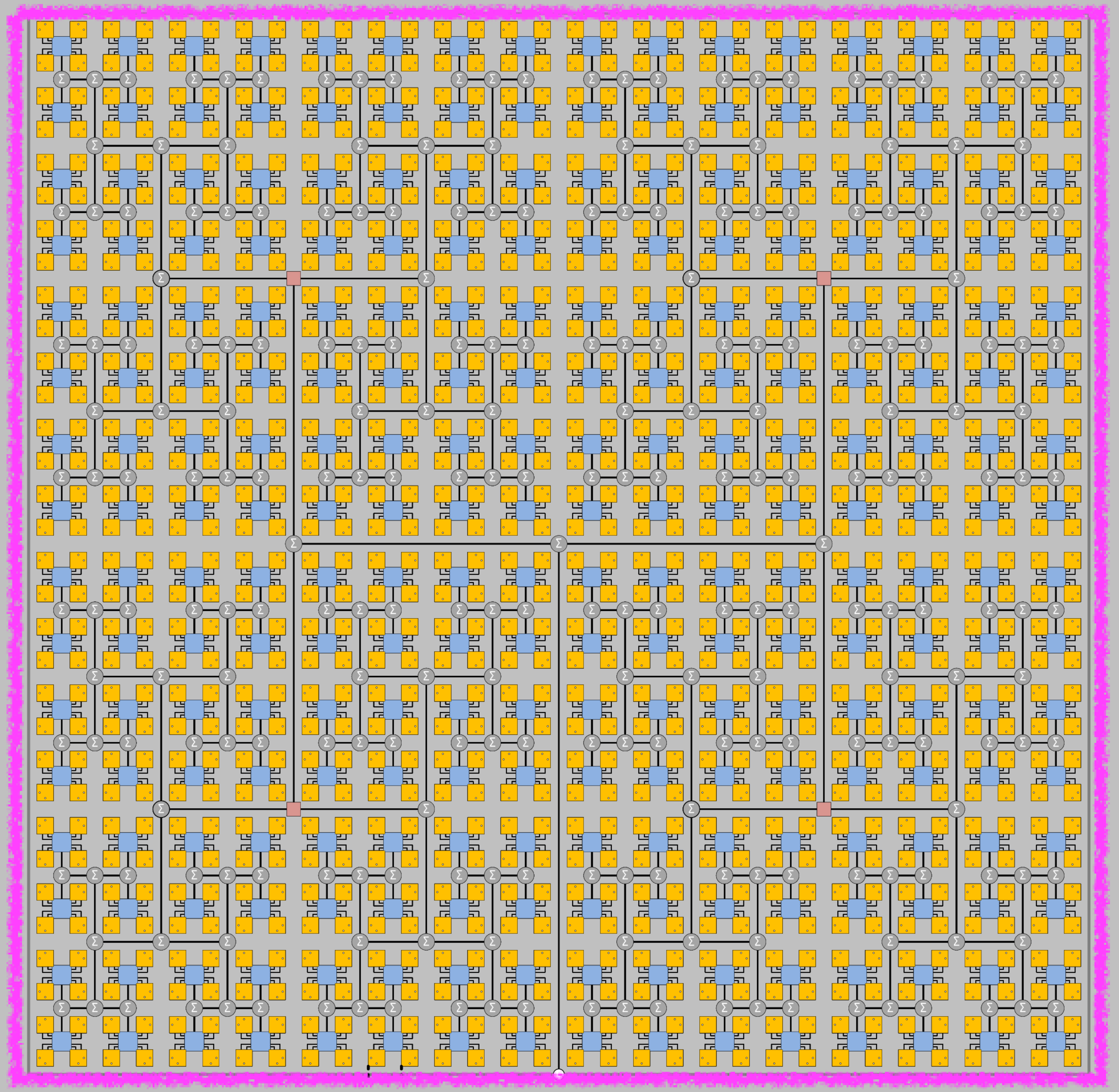
Compare | Parametric Filters

Part #	Description	Frequency Min GHz	Frequency Max GHz	Pout dBm	Psat dBm	Gain dB	PAE %	OIP3 dBm	Voltage V	Current mA	Package Type	Package mm
(filter range)		37.5 – 17	42.5 – 18	50 – 28	52 – 35	36.5 – 16, S21	62 – > 15	47 – 41	65 – -2.8 to 28	2,500 – 40 for final stage carrier	CP, ~~Cu Base~~, Die, ~~Flange~~, ~~Laminate~~, ~~overmold~~, ~~Overmold QFN~~, ~~OVM QFN~~, ~~QFN~~	~~1.8 x 1.8 x 0.10~~, ~~11.4 x 17.3 x 3~~, 15.2 x 15.2 x 3.5, ~~15.24 x 15.24 x 3.5~~, ~~2.4 x 1.8 x 0.10~~
QPA2211D	27.5 - 31 GHz, 14 Watt GaN Amplifier	27.5	31	41.5		17	34		22	280	Die	2.740 x 2.552 x 0.050
QPA2211T	27.5 - 31 GHz 14 Watt GaN Power Amplifier	27.5	31	41.5								
QPA2212D	27.5 - 31 GHz, 25 Watt GaN Power Amplifier	27.5	31		43.4							
QPA2212T	27.5 - 31 GHz 25 Watt GaN Power Amplifier	27.5	31		43.4							
QPA2226D	34 - 36 GHz 20 Watt GaN Amplifier	34	36	43								
QPA2229D	34 - 36 GHz, 13 Watt GaN Amplifier	34	36	41.2	41.2		15		28	50	Die	3.29 x 2.60 x 0.05
QPA2640D	20 - 40 GHz 8 Watt GaN Amplifier	20	40		39				18	2,040	Die	5.87 x 3.50 x 0.05
QPA4246D NEW	37.5 - 42.5 GHz 10 Watt GaN Amplifier	37.5	42.5		40	16, S21	17		24	270	Die	4.2 x 5.0 x 0.5
QPA4346D NEW	37.5 - 42.5 GHz 6 Watt GaN Amplifier	37.5	42.5		38	16, S21	20		24	140	Die	4.2 x 2.5 x 0.5
QPA4446D NEW	37.5 - 42.5 GHz 4 Watt GaN Amplifier	37.5	42.5		36	18, S21	25		24	70	Die	3.26 x 1.49 x 0.5
TGA2222	32 - 38 GHz 10 Watt GaN Amplifier	32	38	40	40	16	22		26			3.43 x 2.65 x 0.05
TGA4548	17 - 20 GHz 10 Watt GaN Power Amplifier	17	20	40		27	30		28	300		
TGA4548-SM	17 - 20 GHz 10 Watt GaN Power Amplifier	17	20	40		27	25		28	300		5.0 x 5.5 x 1.7

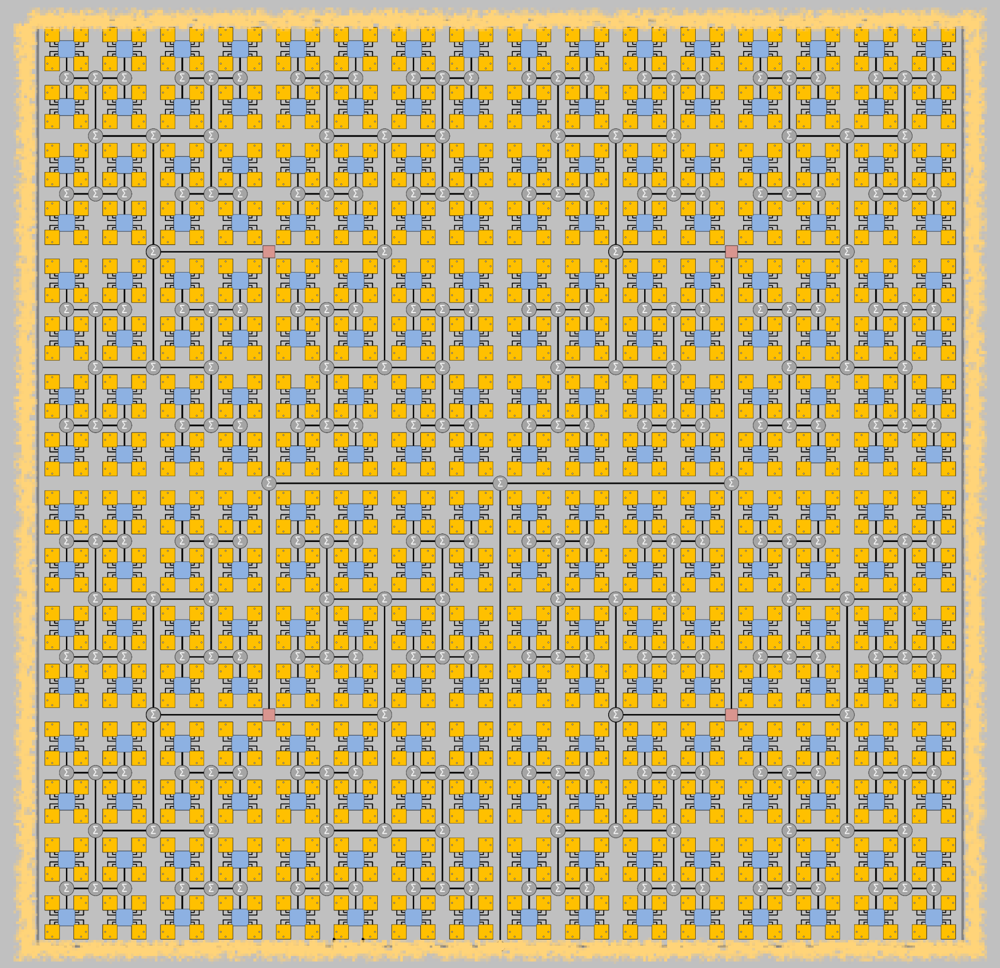
Caption

3. Bi-static to Monostatic

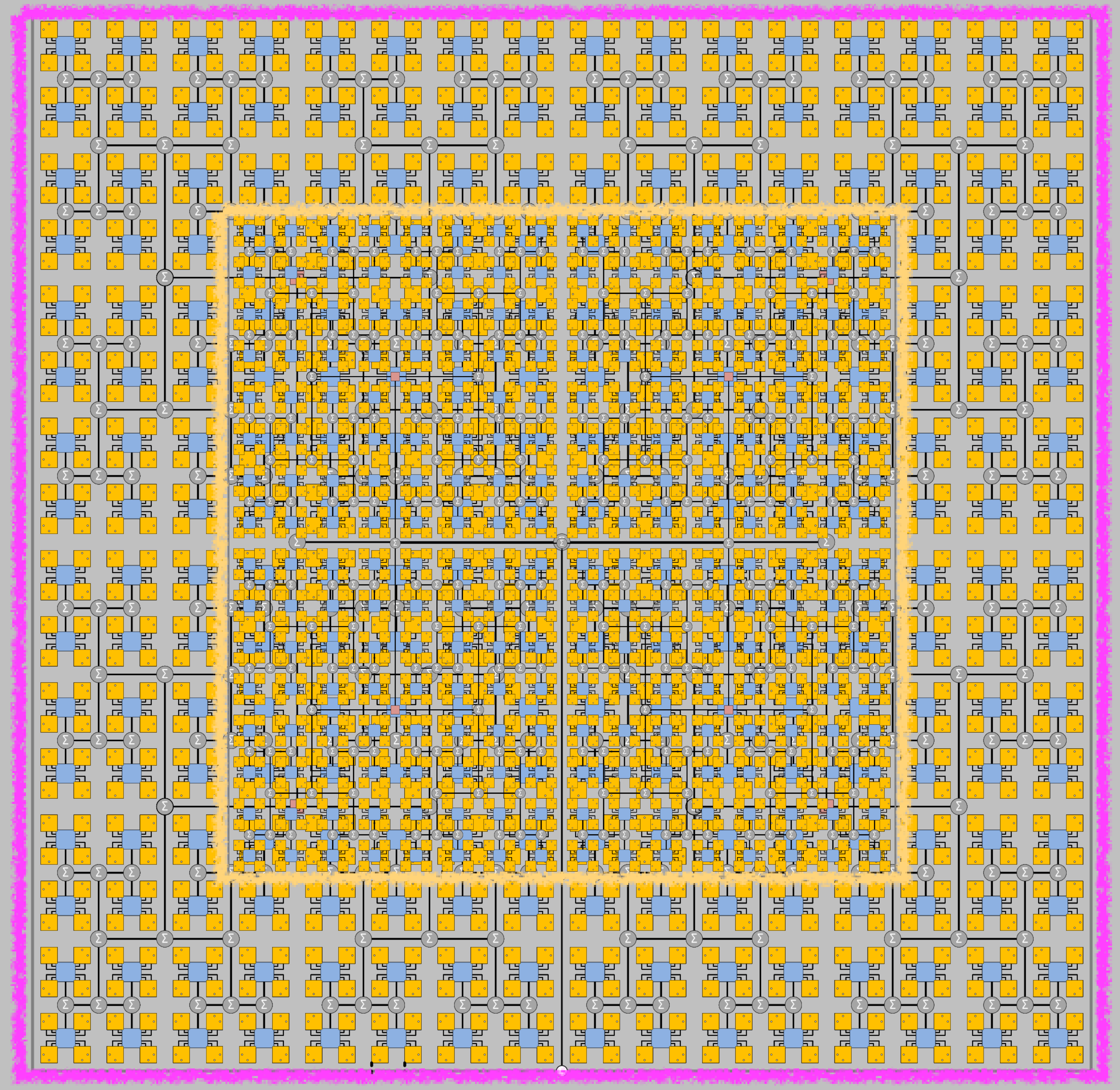
Rx



Tx



Bi-static



Monostatic

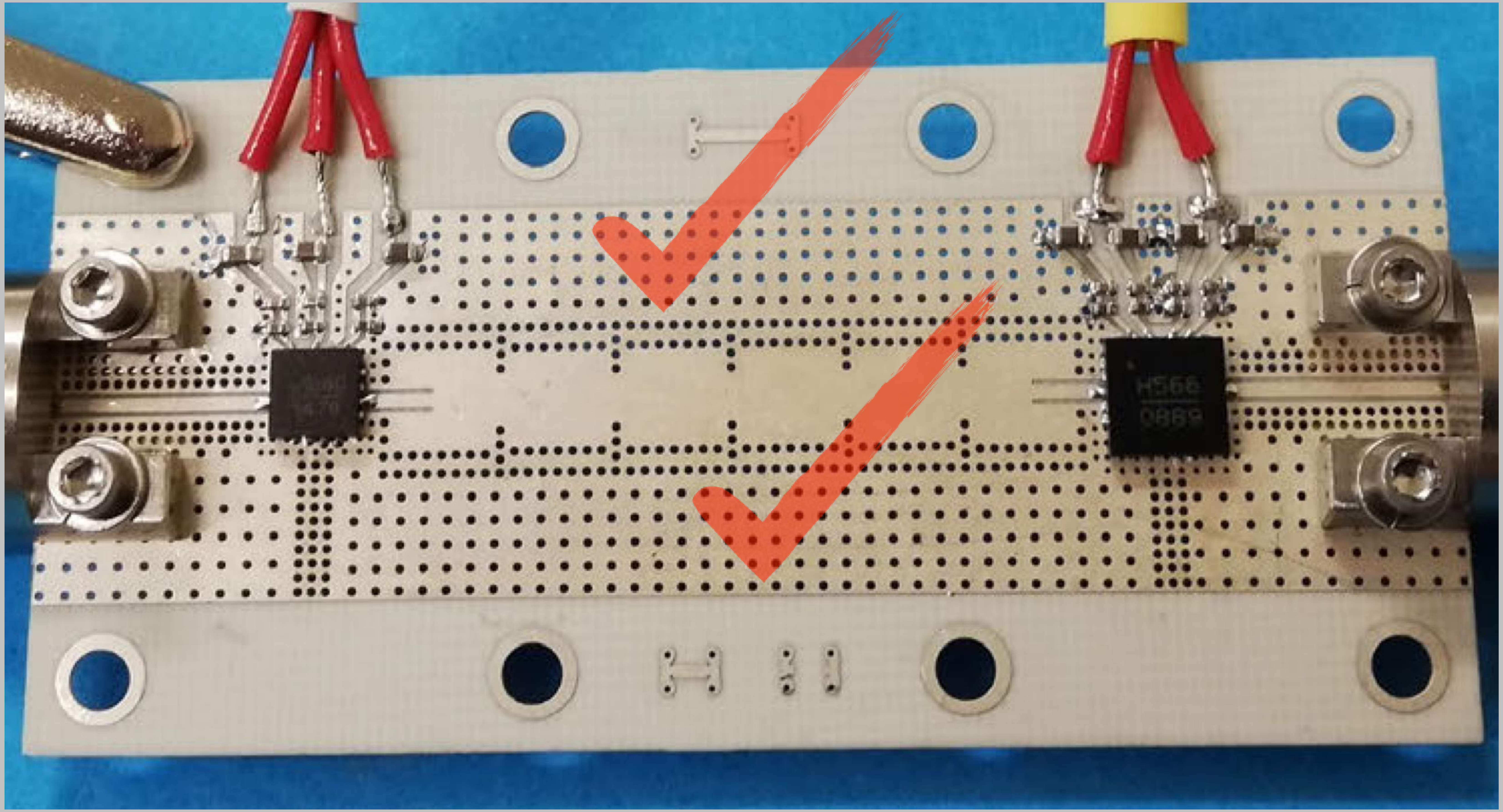
4. Heat Generation (only PA considered here)

All PAs in the table are valid for a satellite RF TX 1024-element array implementation, and we set EiRP of 66 dBm with zero ohmic loss; thus each antenna (6 dBi gain) radiates 1 Watt to account for total of radiated power at 1024 W.

At 30 % PAE, seemingly an impressive number from the table, implies the amount of approximately *2,389 Watts (1024 W/(1-0.7)) x 0.7) dissipated into heat, not mentioning losses stemming from interconnections and passive components, poor matching, drivers, LNAs, etc, really hot for the small area of 16 λ_0 by 16 λ_0 .*

5. Avoid excite undesirable modes

example: a Ka band receiver for inner satellite link: a LNA with an image-rejection filter



Conclusion

6. How to test thousands of RF components on board at every development stage?

Welcome aboard in pursuit of satellite communication system technology; it is immensely interesting, multi-disciplinary, multi-physics, and funs to meet challenges.

Road is narrow, gate is small, however.

Yet, the most precious moment for Formosans to enter frontier satellite business.