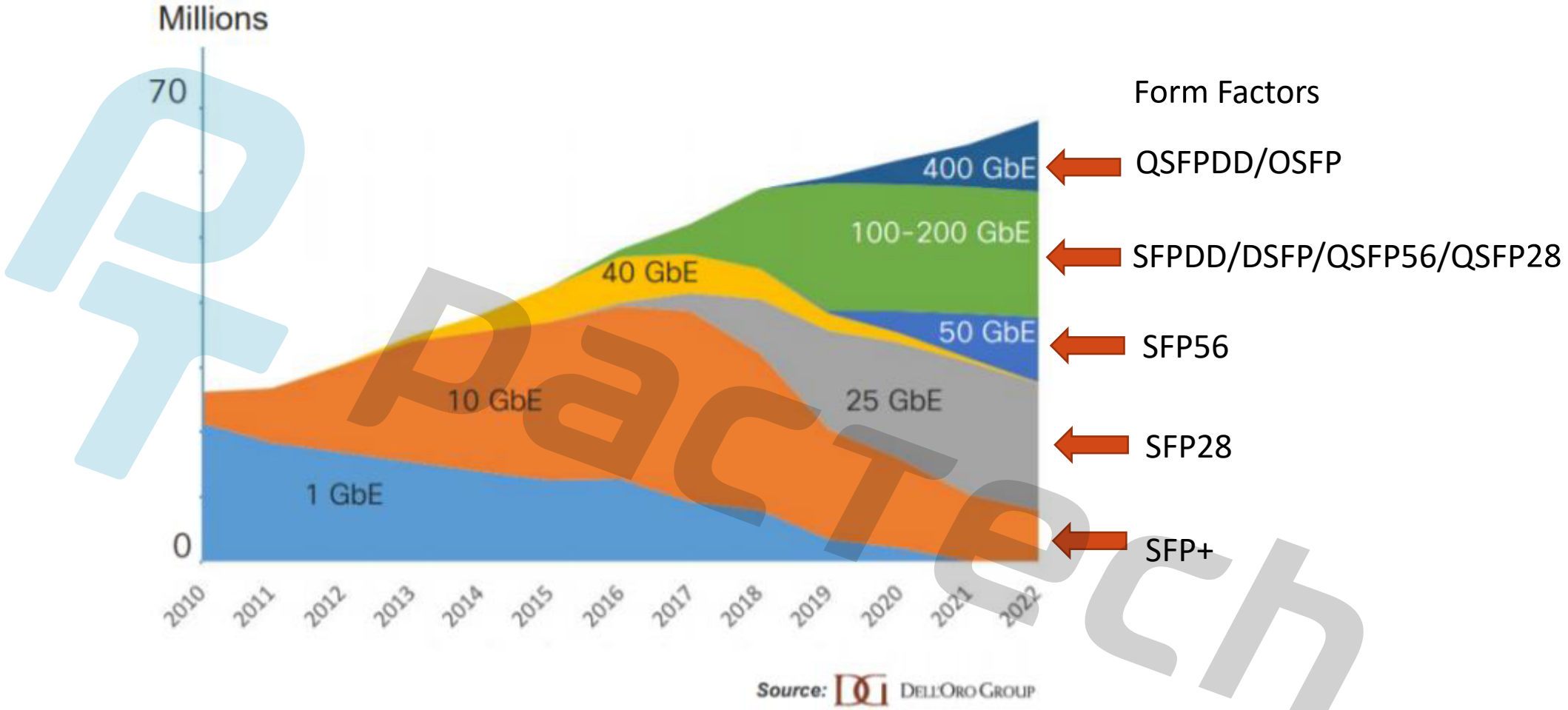
pactech

UNLOCKING THE COPPER POTENTIAL FOR 400G/800G

2021.06

ETHERNET PORTS DEPLOYMENT TREND

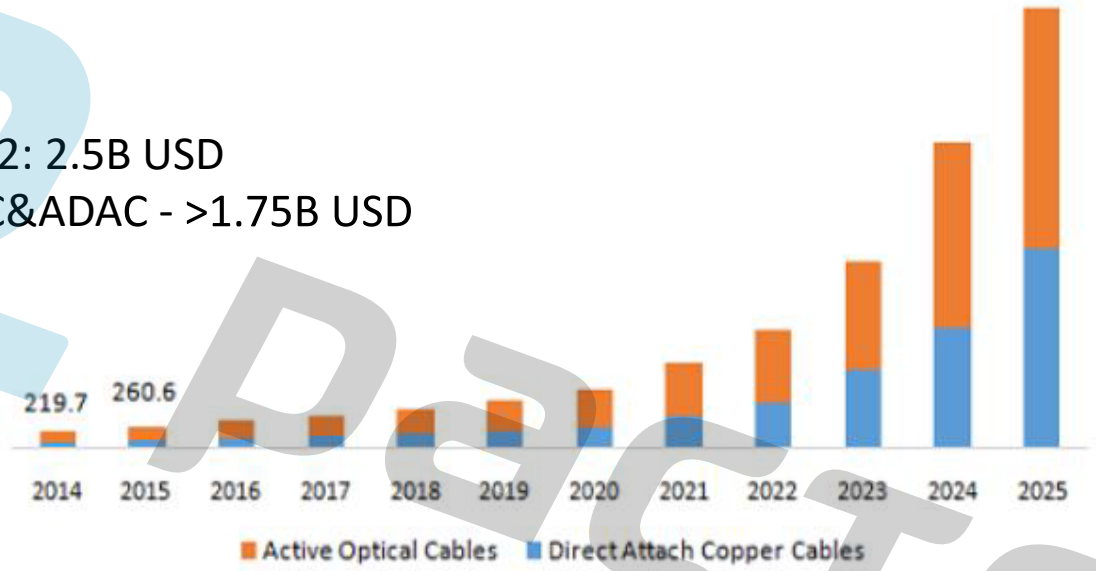


Total addressable market:

MARKET: DAC/ADAC & AOC

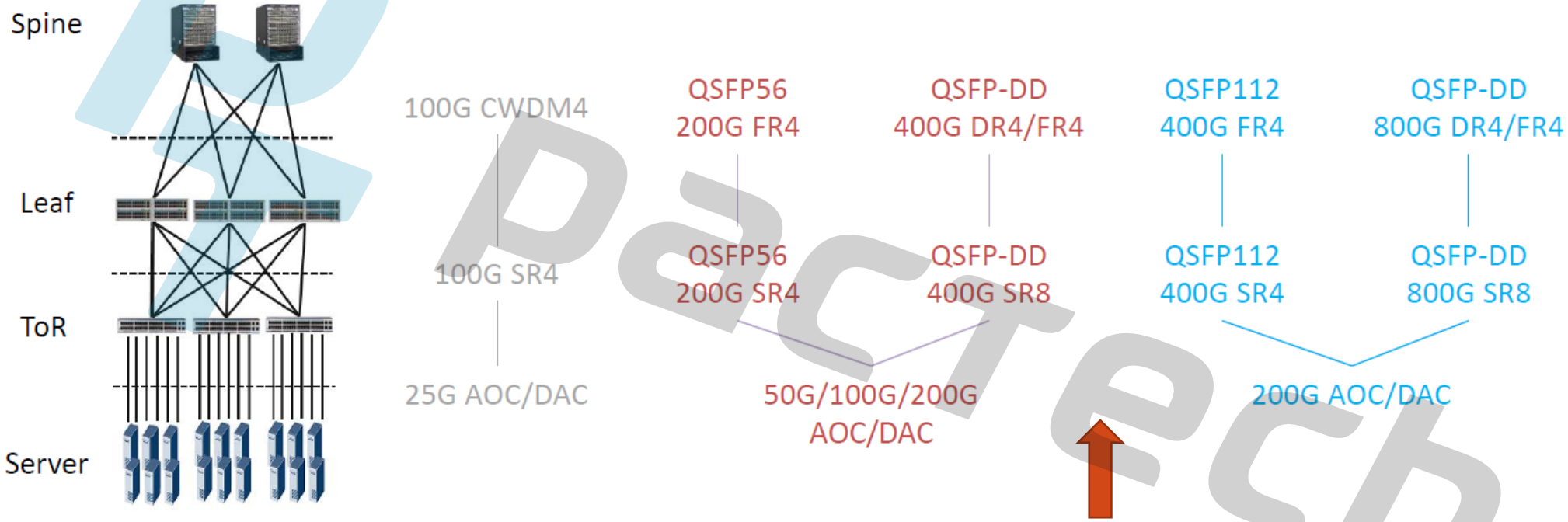
North America direct attach cable market size, by product type, 2014-2025 (USD Million)

2022: 2.5B USD
DAC&ADAC - >1.75B USD



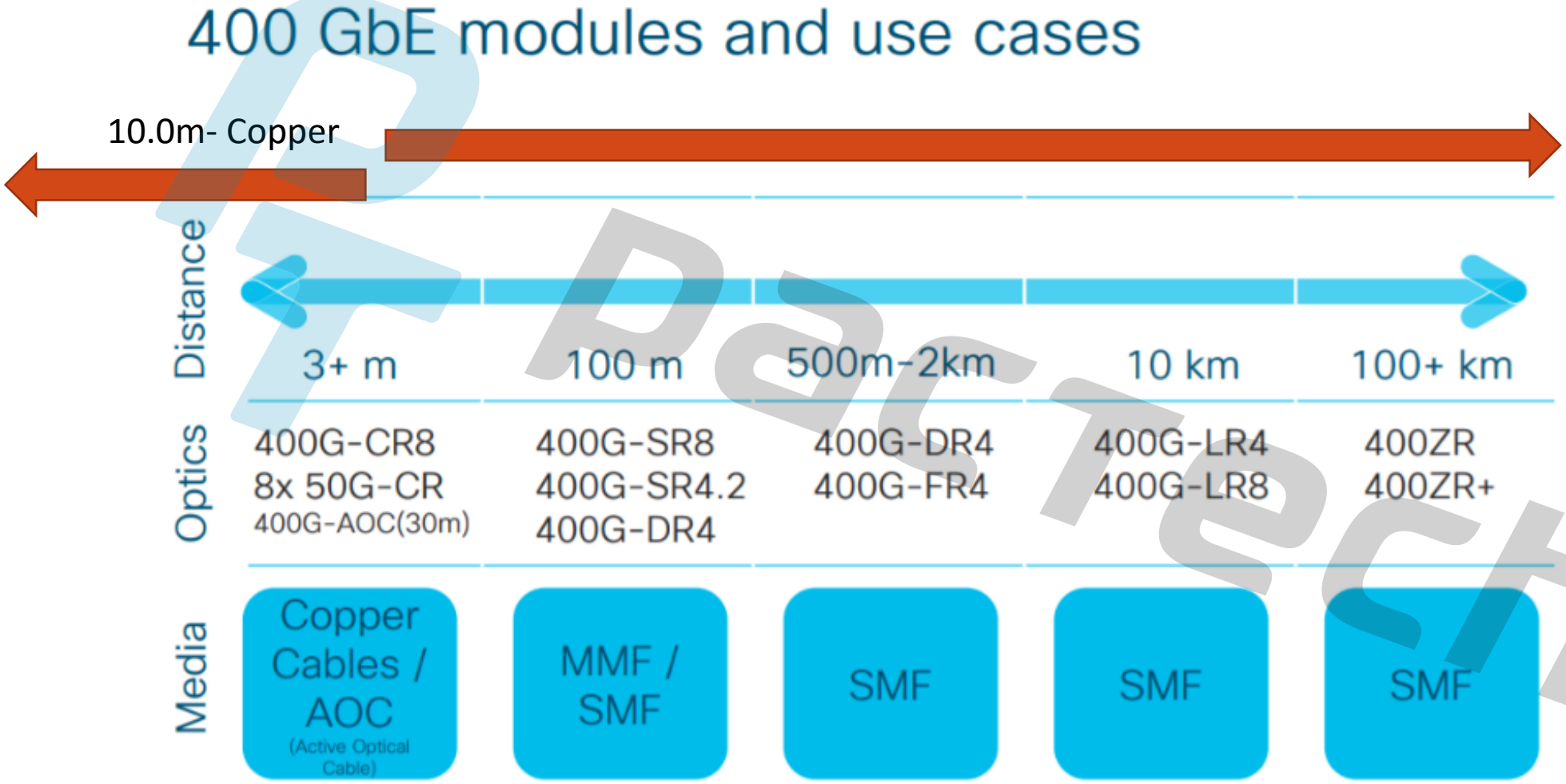
The global direct attach cable market size was accounted for USD 1.18 billion, in 2017. It is projected to ascend with a CAGR of 36.4% from 2018 to 2025.

DATA CENTER ARCHITECTURE OVERVIEW



Active Copper Cable Gains Attractions moving into 400G/800G to fill the gap of HPC/Enterprise

TYPICAL USE CASES FOR 400GBE



EMERGING FORM FACTORS OVERVIEW

Form Factor	MSA status	Standard	Pactech Part Number (XX=AWG, LLL=Meter)	Description
OSFP	Active	IEEE 802.3, Ethernet	R2-OSFP112-LB R2-OSFP8-AXX-LLL R2-OSFP4-AXX-LLL R2-O-4DS-AXX-LLL R2-O-4SD-AXX-LLL	800G OSFP Loopback 800G OSFP to OSFP 400G OSFP to OSFP 400G OSFP to 4xDSFP Breakout 400G OSFP to 4xSFPDD Breakout
QSFP-DD	Active	IEEE 802.3	R2-QDD4A-A28-500 R2-QDD4A4A28-500 R2-Q-4DS-AXX-LLL R2-Q-4SD-AXX-LLL R2-QDD4P4A28-LLL R2-QDDXY-AXX-LLL	400G QDD to QDD Active 400G QDD to 4xQSFP56 Active Breakout 400G QDD to 4xDSFP 400G QDD to 4xSFPDD 400G QDD to 4xQSFP56 400G QDD to QDD
SFP-DD	Active	IEEE 802.3	R2-SD56-AXX-LLL R2-SD-2-AXX-LLL	100G SFPDD56 to SFPDD56 100G SFPDD56 to 2xSFP56
DSFP	Active	IEEE 802.3	R2-DS56-AXX-LLL R2-DS-2-AXX-LLL	100G DSFP6 to DSFP56 100G DSFP56 to 2xSFP56
QSFP	Active	IEEE 802.3 InfiniBand, Fiber Channel	R2-Q56-AXX-LLL R2-Q56-2-AXX-LLL R2-Q56-4-AXX-LLL R2-Q28-AXX-LLL R2-Q28-2-AXX-LLL R2-Q28-4-AXX-LLL R2-Q-AXX-LLL R2-Q-4-AXX-LLL	200G QSFP56 to QSFP56 200G QSFP56 to 2xQSFP56 200G QSFP56 to 4xSFP56 100G QSFP28 to QSFP28 100G QSFP28 to 2xQSFP28 100G QSFP28 to 4xSFP28 40G QSFP to QSFP 40G QSFP to 4xSFP+
SFP		IEEE 802.3, InfiniBand, Fiber Channel	R2-LB-SFPxx R2-S56-AXX-LLL R2-S28-AXX-LLL R2-S-AXX-LLL	SFP+/SFP28/SFP56 Loopback 50G SFP56 to SFP56 25G SFP28 to SFP28 10G SFP+ to SFP+

COPPER & ACTIVE COPPER CONNECTIVITY

- Pros
  - Power consumption/heating
    - Passive copper: <0.001W/Gbps;
    - Active copper: < 0.01W/Gbps;
  - Latency
    - Passive copper: ~10's ps
    - Active copper: ~100's ps
  - Plug-n-play
    - Rough installation is allowed for field work
  - High-temperature stability and robustness
    - Both passive and active copper may work at high-temperature with little impactfor years

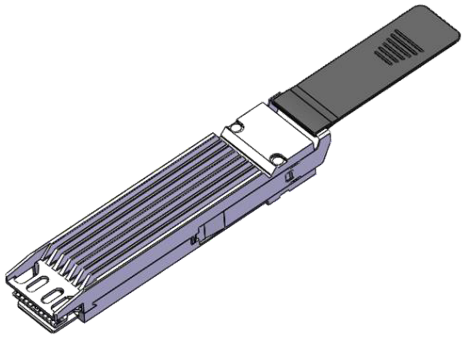
- Cons
  - Limited reach
    - Passive copper: 100G-5m max; 400G – 3m max
    - Active copper: 10m max for 400G
  - Limited flexibility
    - Cable bending is limited by materials and size;
  - Weight & shipping cost
    - Copper cable weight grows dramatically when the length increases;
  - Environmental impact
    - Use of copper, gold, Zinc, Silver etc.
    - Use of Plastics

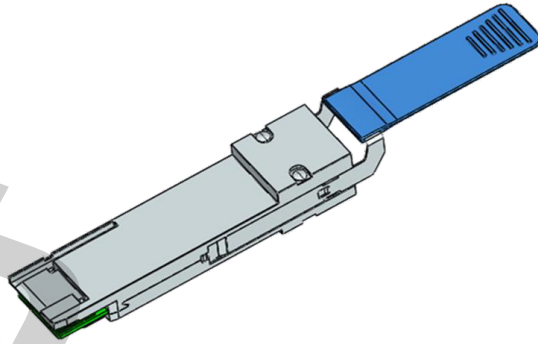
DAC VS. ADAC VS. AOC CONNECTIVITY

50G PAM4/Channel	DAC	ADAC	AOC / SR Modules
Max Distance (m)	3(4m Pactech)	10	100
Power consumption (W)	<0.01W/Channel	<0.5W/Channel	>2.5W/channel
Latency	10's picoseconds	100's picoseconds	10s nano-seconds
High-temperature Stability	Max operating temp > 85C	Max operating temp > 85C	Max operating temp: 70C
Operation cost(3 years)	1	5	25
Misc.	Plug-n-play	Plug-n-play	Customization may be required for tuning

DAC/ADAC 400G PORTFOLIO

- Industry's first total solution provider in
  - All form factors covering SFP/QSFP/DSFP/SFPDD/QDD/OSFP
  - Supporting 25G-800G aggregated data-rate
- 50G-400G PAM4 passive with extended reach
  - 3m for QDD/OSFP
  - 4.0m* for SFP56/QSFP56/SFPDD/DSFP
- Active DAC up to 10m
  - 25G-100G up to 10m in QSFP28
  - 50G-400G PAM4 up to 8.0m validated; **10m** in Q56/DSFP56/SFPDD*





PASSIVE DAC FEATURES

- Proprietary high-performance twinax technology enables industry's longest reach for passive
  - 4.0m for 50G PAM4, 1.0m longer than industry's standard practice
  - Increased flexibility using a co-extrusion technology
- Superior signal integrity and electrical performance
  - IEEE 802.3cd compliant
  - Channel Operating Margin (COM) 1.0dB higher than standard guaranteed;
  - BER<1E-5 with no FEC
  - 360 degree EMI shielding
  - Proprietary crosstalk noise mitigation technology
  - High-temperature performance stability: support stable low BER at 60+ Celcius
  - 100% in-line production signal integrity testing with data-tracking by S/N
- Enhanced reliability for worry-free field deployment
  - 500H 85°C&85%RH aging testing – 850K+ Hour MTBF
  - 1000H 85°C&85%RH aging solution available for Telecom/1.7million+ hour MTBF
  - 200 mating cycles guaranteed
- Customization available for
  - Labeling
  - Pull-tab color(MOQ required)
  - Cable color (MOQ required)
  - EEPROM including multi-vendor native compatible EEPROM

ACTIVE DAC FEATURES

- High-performance twinax technology
- Analog re-driver based solutions
- Industry's most cost/performance competitive in
  - Power consumption: <0.1W/channel; <1.0W/400G
  - Latency: latency at picoseconds
  - Plug-n-play: use as direct attached cable
  - Extended reach: up to 10m;
  - High-temperature performance stability: support stable low BER at 60+ Celcius
  - Low BER (< 1E-5 with no FEC)
  - In-line 100% SI testing for mass production with both BER & VNA
  - EEPROM coding: native Arista/Cisco Nexus/Juniper/MSA EERPOM available;
  - Compliance to IEEE 802.3cd
- Enhanced reliability as passive DAC
  - 500H 85°C&85%RH aging testing – 850K+ Hour MTBF
  - 200 mating cycles guaranteed

QSFP56-2xQSFP56 Active, 5m

ROADMAP

Released
- DAC
  - SFPDD/DSFP/QSFP56/SFP56/OSFP/QSFPDD – up to 3.5m
- Active DAC
  - DSFP/QSFP56/QSFPDD – up to 10.0m

In progress:
- DAC
  - OSFP112 800G/QDD112 800G
- Active DAC:
  - QDD112 800G/QSFP112 400G – up to 5m
  - SFP56 50G – up to 10m

Planned
- DAC
  - SFPDD112/DSFP112/QSFP112/SFP112– up to 2.0m
- Active DAC:
  - OSFP/SFPDD – up to 10.0m
  - QSFP112/DSFP112/SFP112 – up to 5.0m

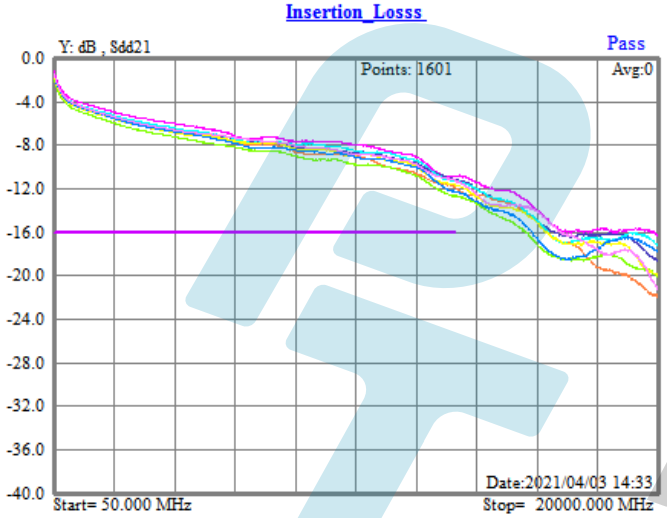
PACTECH 123210 OPERATION

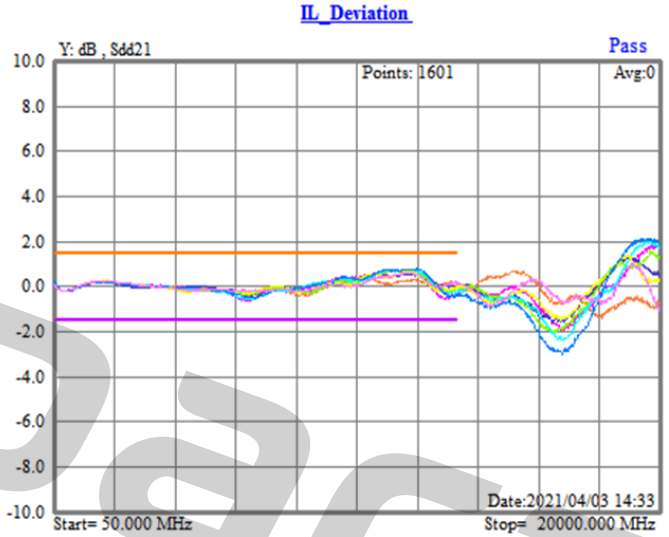
Transparency & Business Integrity

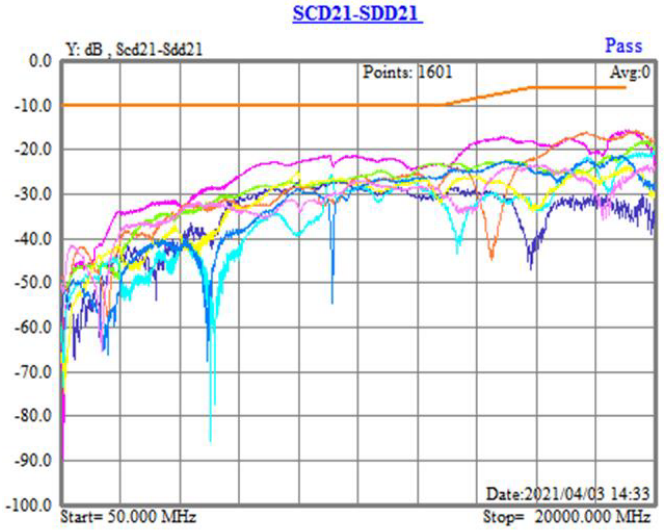
- **1 Day** – RFI Response– Yes/No
- **2 Day** –RFQ, Quote/Drawings;
- **3 Day** –Conceptual design
- **2 Weeks** - Engineering sample
- **1 Month** –Max Production lead-time
- **0 Defect** – EXW with required 100% in-line tests

APPENDIX: 7M ACTIVE DAC PERFORMANCE OVERVIEW

SI OVERVIEW - IL/ILD/MODE CONVERSION



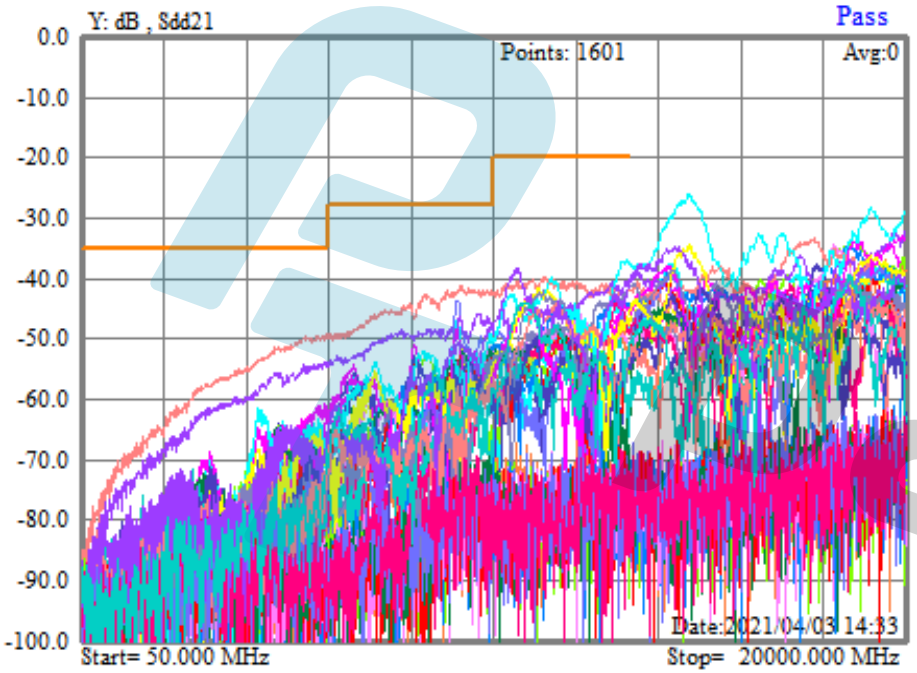




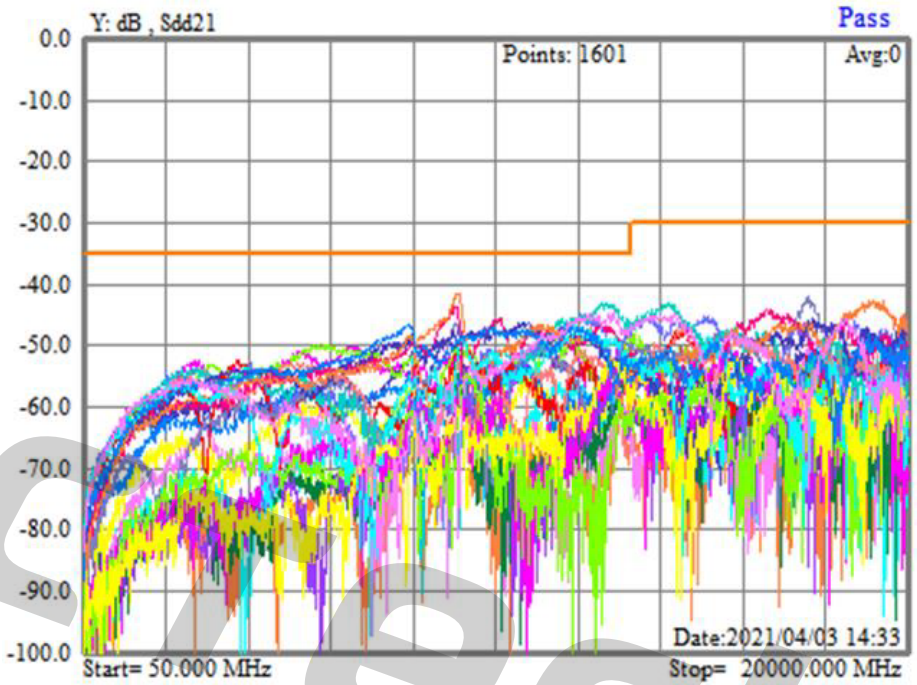
- Equalized IL target: -16dB vs. Standard 17.3dB;
  - Per-meter cable loss: 3.5db/m (28AWG)
  - Per-meter cable loss: 3.1dB/m(26AWG) for up to 10m
- IL production deviation target: +/-1.8dB
- Mode conversion: < -10dB

SI REPORTS - CROSSTALK

NEXT



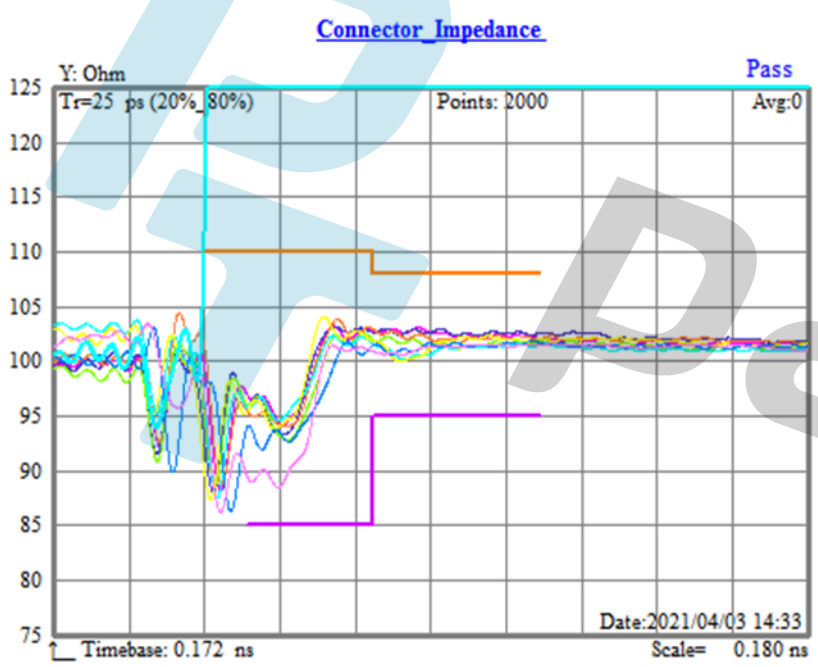
FEXT

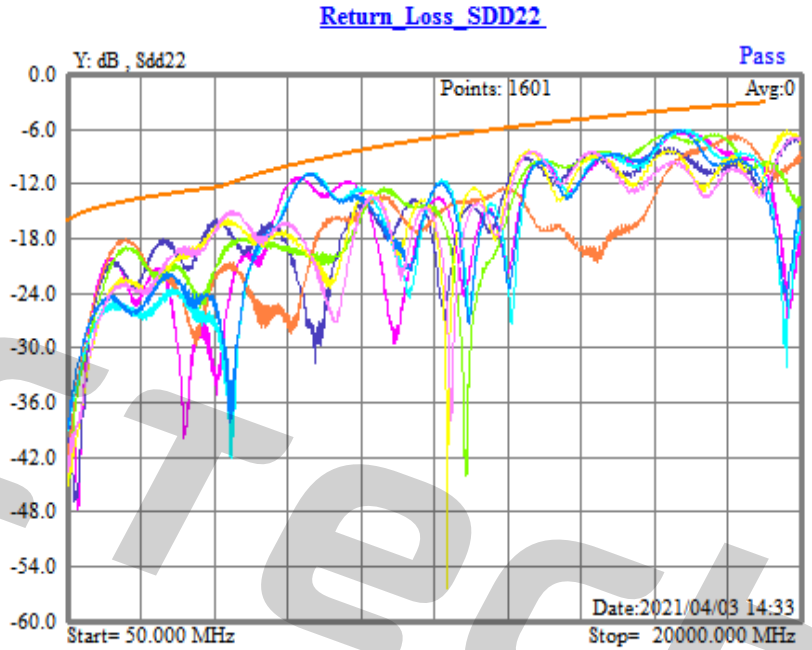


NEXT crosstalk mitigation techniques cancel the amplified noise generated by the active IC.

Production power sum of NEXT is set to be less than -35dB.

SI REPORTS - IMPEDANCE MANAGEMENT & RETURN LOSS





Managed impedance control to minimize the discountinuity in process, termination and designs while compensate the manufacturing variations in PCB/cable to reach <-10dB RL up to Nyquist frequency.

BER & COM

Testing	Standard Compliance	RX1	RX2	RX3	RX4
COM	3.0dB	5.15dB	4.53dB	4.75dB	5.12dB
Raw BER (1min)	2.4E-4	3.09E-6	1.37E-5	7.09E-6	4.01E-6
Raw BER (2min)	2.4E-4	3.19E-6	1.44E-5	7.27E-6	4.15E-6
Raw BER (24hours)	2.4E-4	3.13E-6	1.28E-5	7.12E-6	4.27E-6
Raw BER (+70C, 12 hours)	2.4E-4	3.69E-6	1.95E-5	7.71E-6	5.15E-6