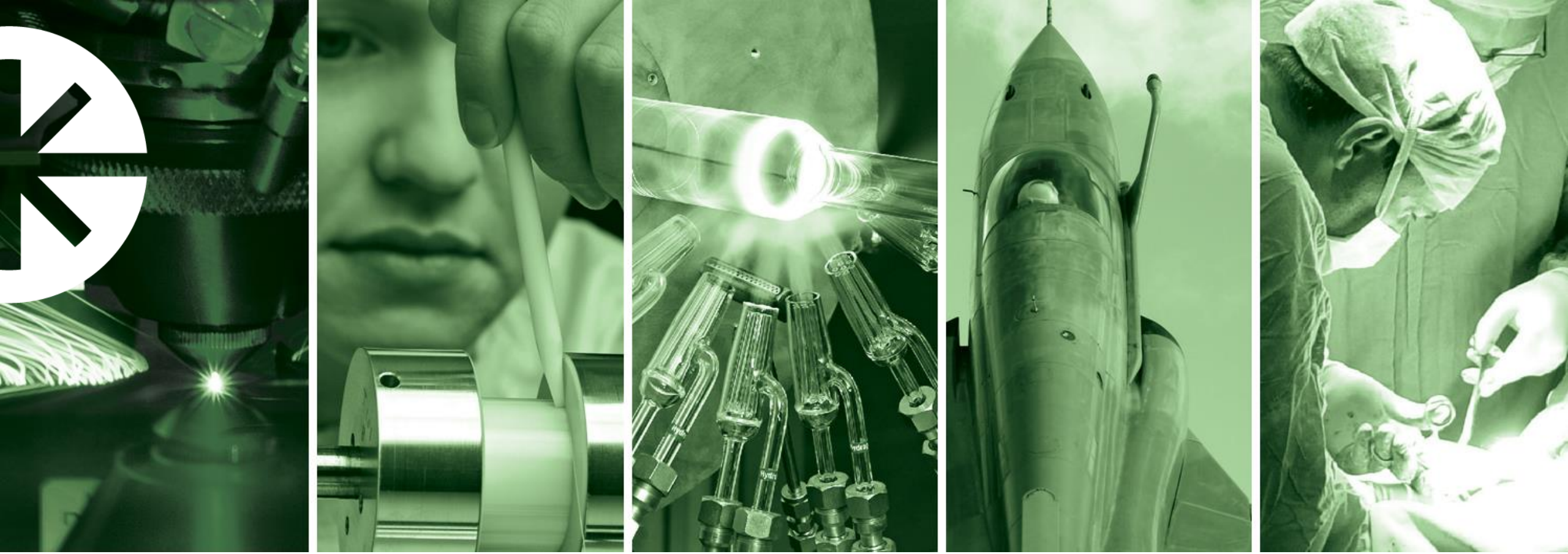


GEN X YDF OPTICAL FIBERS

New Product Introduction

August 2019

GEN X NPI PRESENTATION OUTLINE

- Coherent | Nufern is releasing a new product family based on Gen X glass design. The information in the following slides are meant to highlight the value proposition of these new products

Outline:

New Product Offering Overview

- LMA-YDF-14/250-HP-XM – Gen X
  - Comparative analysis against competitor offering
- LMA-YDF-20/400-HP-XM – Gen X
  - Comparative analysis with current YDF-20/400 Gen8
- LMA-YDF-20/400-HP-XM-**HI** – Gen X
  - Comparative analysis between Gen X and Gen X-HI
- LMA-YDF-25/250-HP-XM – Gen X
  - Comparative analysis against competitor offering

NEW PRODUCT OFFERING - OVERVIEW

Gen X Precision Matched Active LMA Double Clad Fiber

Coherent | Nufern's offering of GenX fibers is the newest series of Large Mode Area (LMA) double clad fibers, specifically tailored to enable power scaling of multi-kW -class fiber lasers and amplifiers.Offering superior photo-darkening (PD) performances with maintained and/or higher absorption, these fibers are optimized to benefit both CW and pulsed multi-kW systems. The 14/250 GenX design is ideal for efficient and reliable kW-class systems. The 20/400 GenX offers the same absorption with significantly lower PD than comparable products providing an optimized platform for high efficiency and high reliability multi-kW CW lasers. The 25/250 GenX product combines higher absorption and superior PD, ideal to enable multi-kW peak power scaling with reduced caivity length and nonlinearities.

Item Description	**LMA-YDF-14/250-HP-XM**	**LMA-YDF-20/400-HP-XM**	**LMA-YDF-25/250-HP-XM**	**LMA-YDF-20/400 HP-XM-HI**
Part Number	**1365438**	**1398875**	**1403834**	**Available September 2019**
Optical Specifications				
Operating Wavelength	1015 – 1115 nm	1015 – 1115 nm	1015 – 1115 nm	
Core NA	0.065 – 0.075	0.06 – 0.07	0.065 – 0.075	
First Cladding NA (5%)	0.46	0.46	0.46	
Core Attenuation	≤ 20 dB/km @1200nm	≤ 15 dB/km @1200 nm ≤ 30 dB/km @ 1300 nm	≤ 25 dB/km @1200nm	
Cladding Attenuation	≤ 15 dB/km @ 1095 nm	≤ 15 dB/km @ 1095 nm	≤ 15 dB/km @ 1095 nm	
Cladding Absorption	0.8 ± 0.1 dB/m @ 915 nm	0.40 ± 0.05 dB/m @ 915 nm	2.3 ± 0.3 dB/m @ 915 nm	
Slope Efficiency		≥ 70% @ 915 nm		
Geometrical & Mech Specifications				
Clad Diam (flat-to-flat)	250 ± 5 µm	400 ± 10 µm	250 ± 5 µm	
Core Diameter	14 ± 1 µm	20 ± 1.5 µm	25 ± 1.5 µm	
Core/Clad Offset	≤ 1 µm	≤ 2 µm	≤ 1.5 µm	
Coating Diameter	395 ± 15 µm	550 ± 15 µm	395 ± 15 µm	
Coating Material	Low Index Acrylate	Low Index Acrylate	Low Index Acrylate	
Proof Test Level	≥ 100 kpsi (0.7 GN/m²)	≥ 100 kpsi (0.7 GN/m²)	≥ 100 kpsi (0.7 GN/m²)	

HIGHLIGHT: *LMA-YDF-14/250-HP-XM*

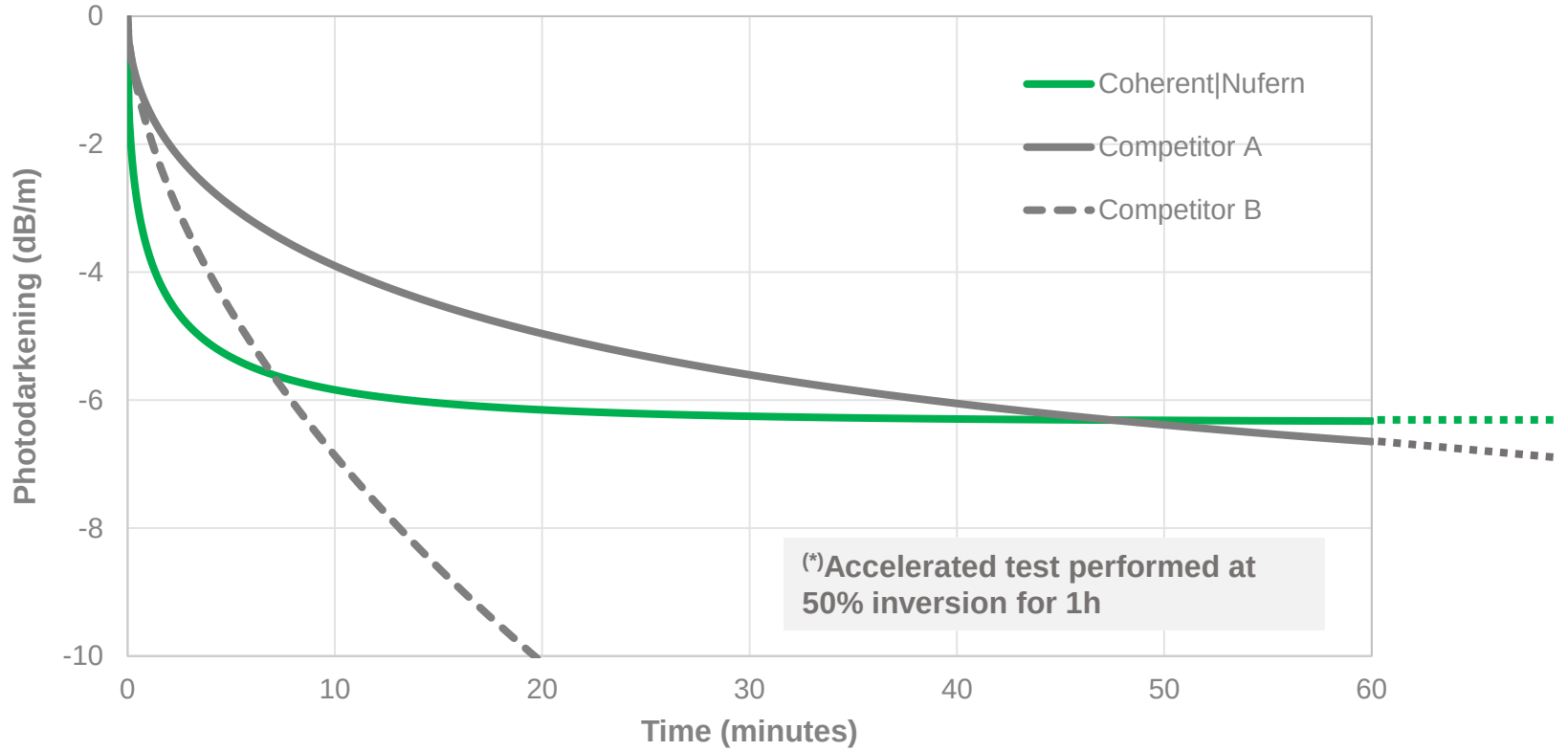
- Competitive Offering

Parameter	Coherent | Nufern	Competitor A
Core Attenuation @ 1200 nm	< 20 dB/km	≤ 15 dB/km
Cladding Attenuation @ 1095 nm	< 15 dB/km	n/a
Peak Cladding Absorption @ 915 nm	(0.8 ± 0.1) dB/m	(0.75 ± 0.1) dB/m*
Peak Cladding Absorption @ 976 nm	3.4 dB/m	3.25 dB/m
Core NA	0.070 ± 0.005	0.070 ± 0.005
Core Diameter	(14.0 ± 1.0) µm	(14.0 ± 1.0) µm
Cladding Diameter (Flat-to-Flat)	(250 ± 5) µm	(250 ± 5) µm
Core/Clad Offset	≤ 1.0 µm	≤ 1.0 µm
Coating Diameter	(395 ± 15) µm	(350 ± 15) µm

* Specified at 920 nm

HIGHLIGHT: *LMA-YDF-14/250-HP-XM*

- LMA-YDF-14/250-XM-HP has superior photodarkening performance while ensuring competitive cladding absorption

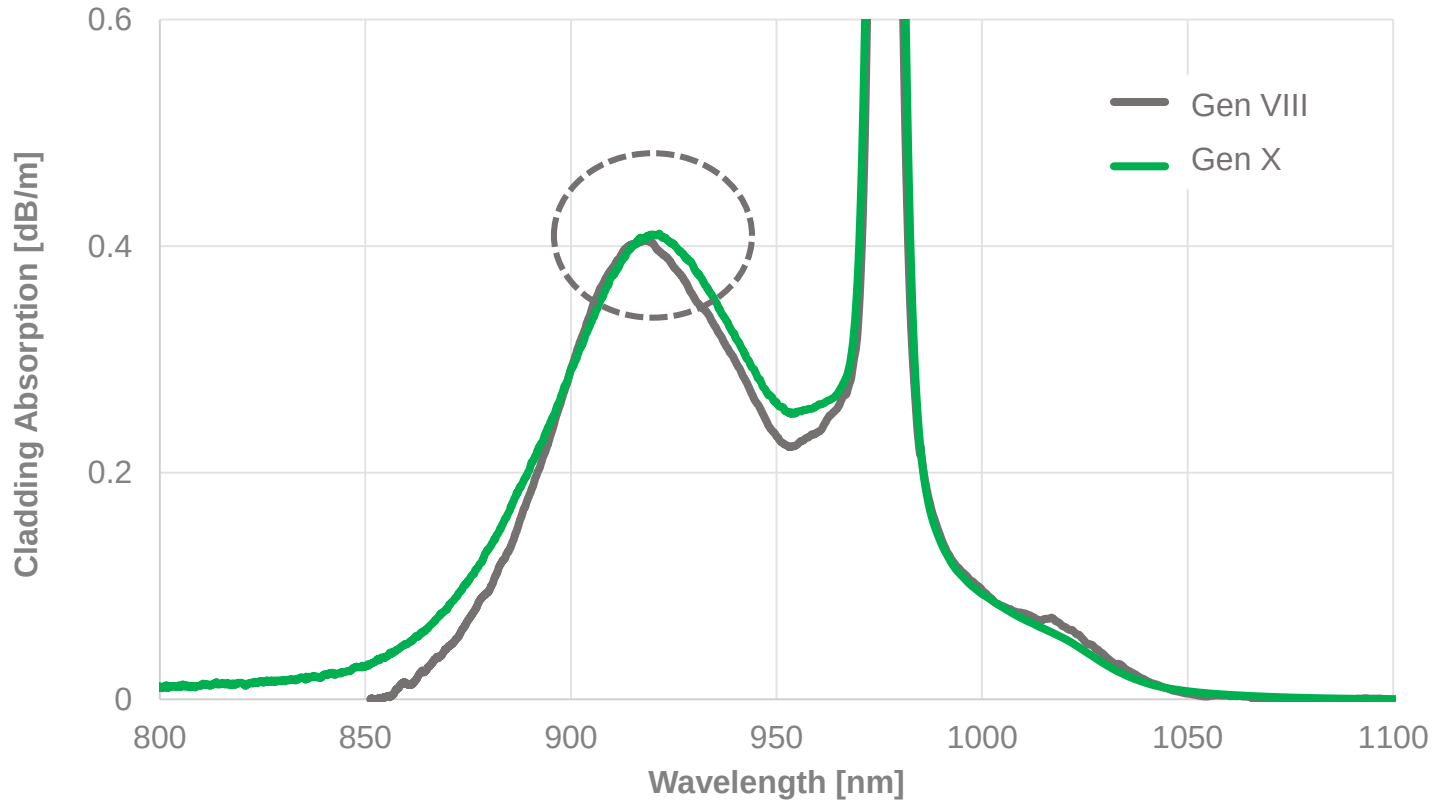


photodarkening saturates after 30 min(*)

- Photodarkening saturates two times faster than competition ensuring reliable operation and extended lifetime

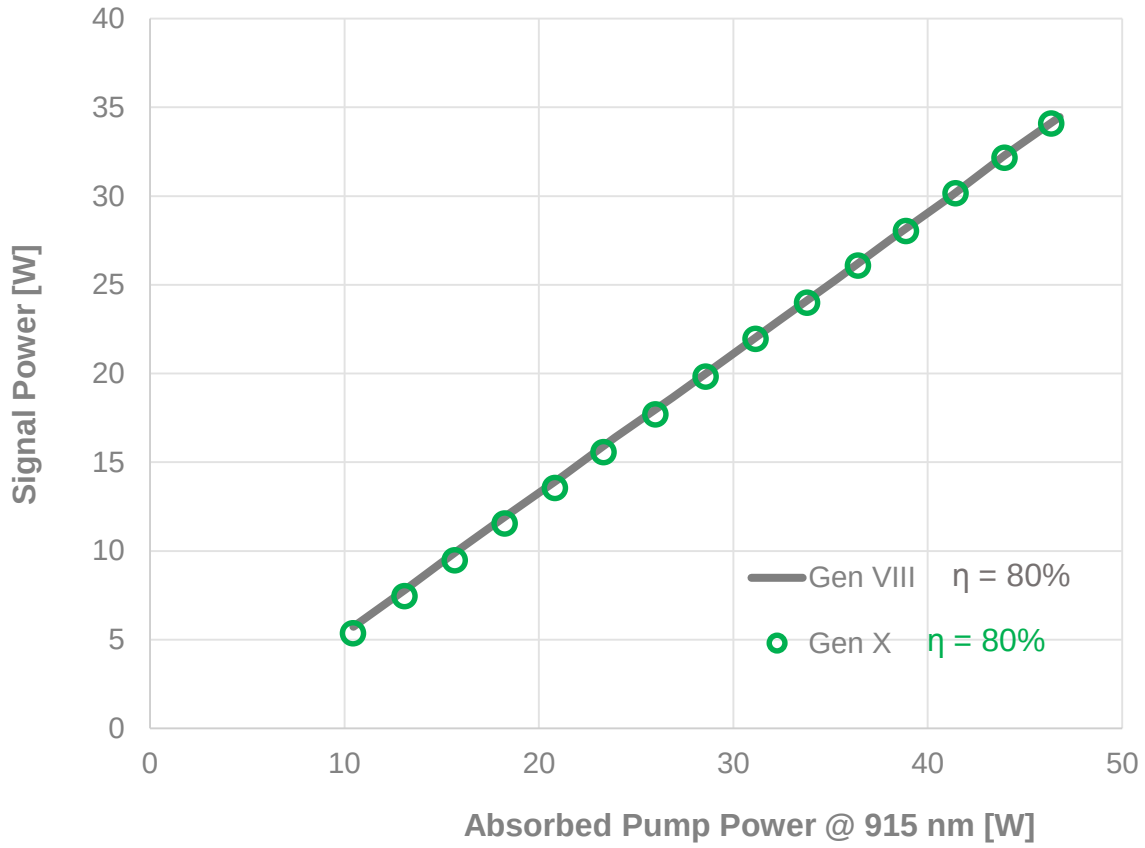
HIGHLIGHT: *LMA-YDF-20/400-HP-XM*

- LMA-YDF-20/400-HP-XM is designed as a drop-in replacement to LMA-YDF-20/400-HP Gen VIII fiber → Matched 915 nm absorption with 25% less Yb concentration
- The 976 nm / 915 nm absorption ratio is ~ 4x



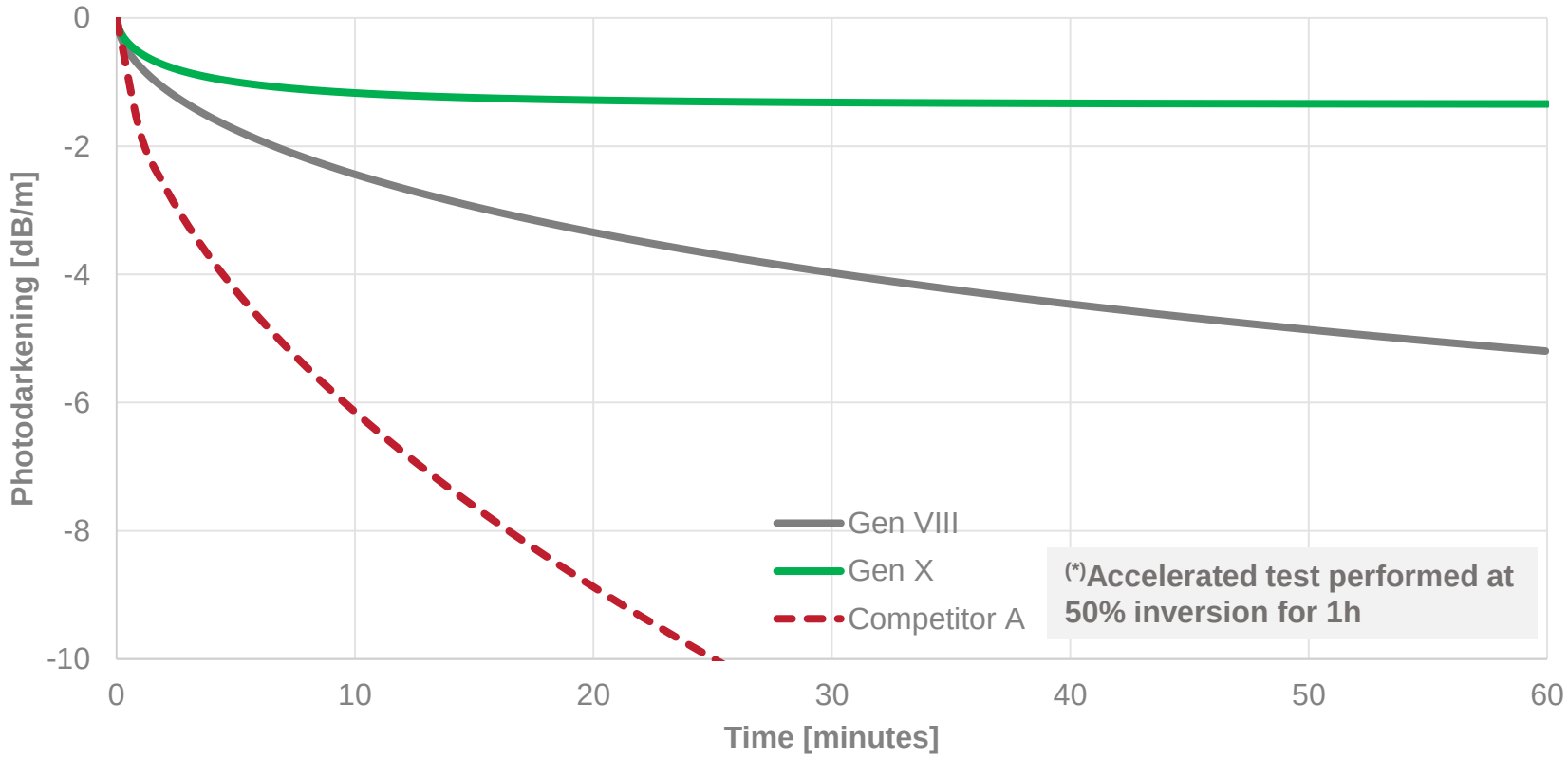
HIGHLIGHT: *LMA-YDF-20/400-HP-XM*

- LMA-YDF-20/400-HP-XM is designed as a drop-in replacement to LMA-YDF-20/400-HP Gen VIII fiber → Identical slope efficiencies are achieved



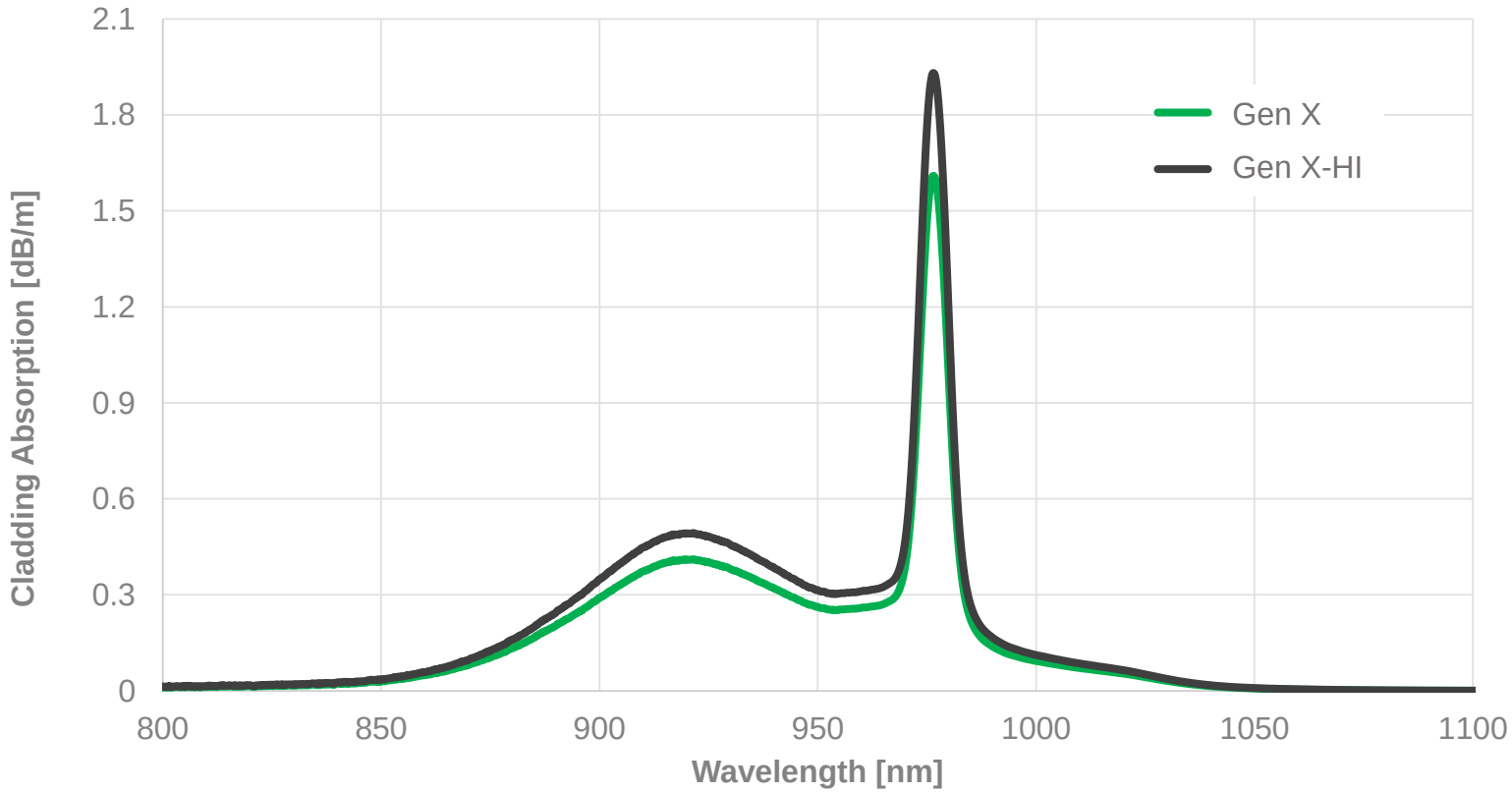
HIGHLIGHT: *LMA-YDF-20/400-HP-XM*

- Superior photodarkening performance compared to the competition for enhanced reliability and extended lifetime performance
- Approximately 2x lower photodarkening compared to Gen VIII product



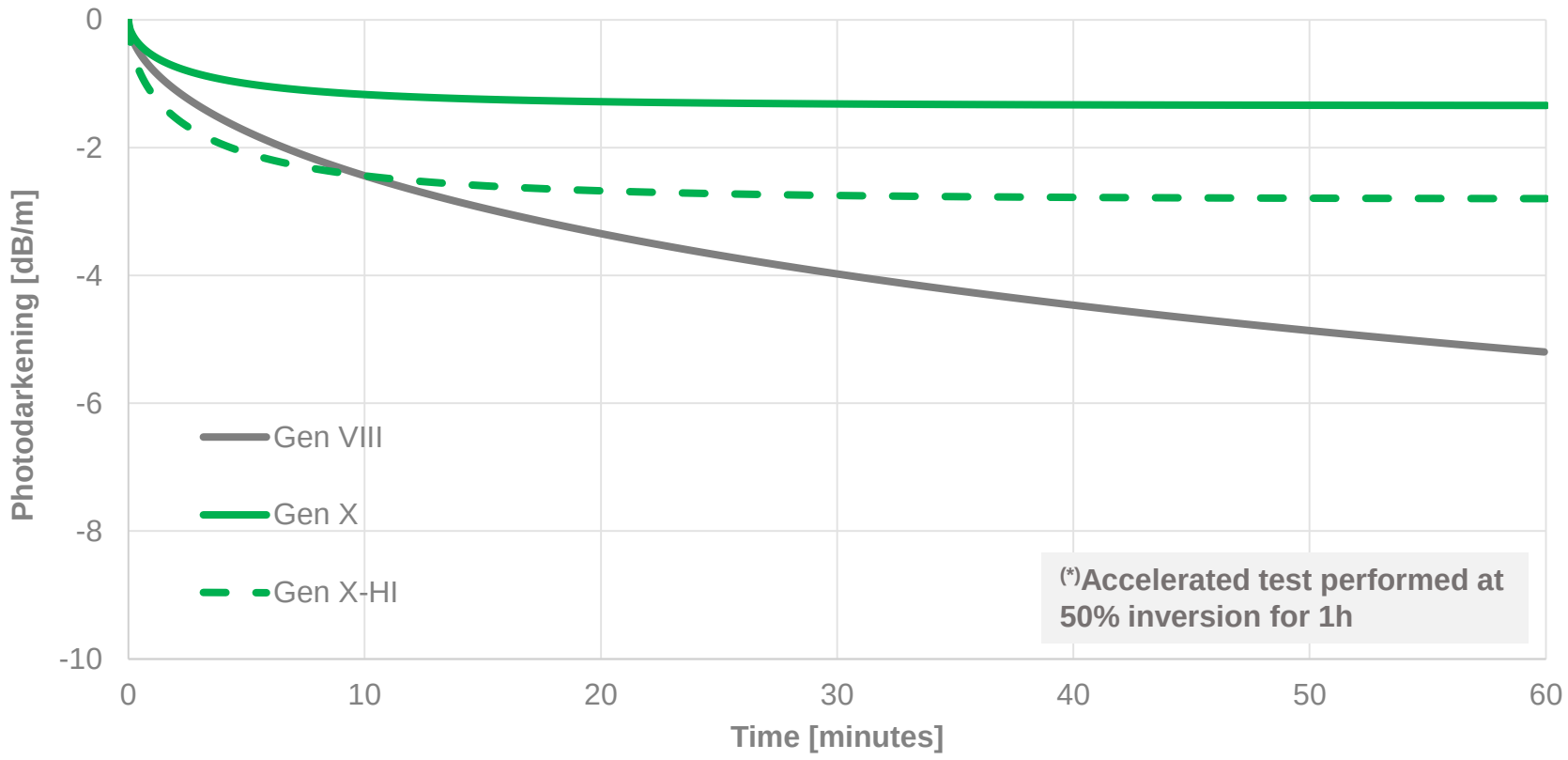
HIGHLIGHT: *LMA-YDF-20/400-HP-XM-HI*

- Gen X-HI offers a 20% higher cladding absorption compared to Gen X
- Gen X-HI enables reduced gain fiber lengths so as to mitigate SRS & SBS in high power applications



HIGHLIGHT: *LMA-YDF-20/400-HP-XM-HI*

- Gen X-HI combines 20% higher absorption with exceptional photodarkening performance for extended lifetime and reliability of power scaling applications



HIGHLIGHT: *LMA-YDF-25/250-HP-XM*

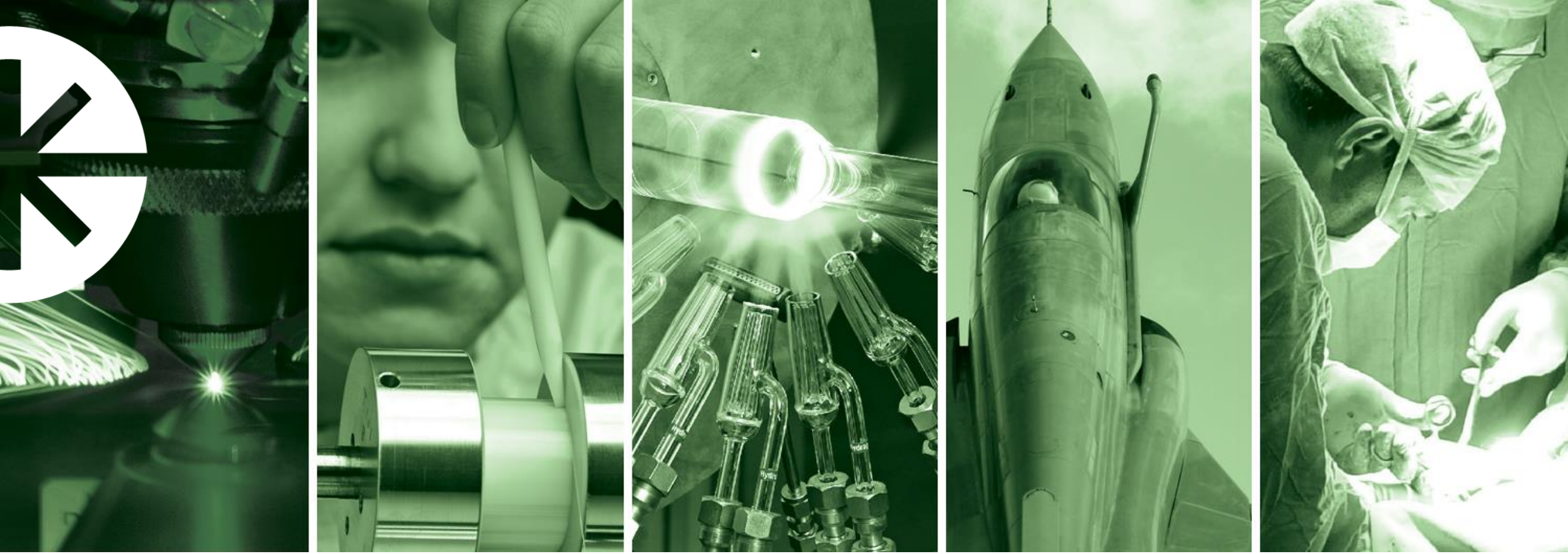
- Competitive Offer

Parameter	Coherent | Nufern	Competitor A
Core Attenuation @ 1200 nm	< 25 dB/km	≤ 25 dB/km
Cladding Attenuation @ 1095 nm	< 15 dB/km	n/a
Peak Cladding Absorption @ 915 nm	(2.3 ± 0.3) dB/m	(2.3 ± 0.3) dB/m *
Peak Cladding Absorption @ 976 nm	9.9 dB/m	9.9 dB/m
Core NA	0.070 ± 0.005	0.070 ± 0.005
Core Diameter	(25.0 ± 1.5) µm	(25.0 ± 1.5) µm
Cladding Diameter (Flat-to-Flat)	(250 ± 5) µm	(250 ± 5) µm
Coating Diameter	(395 ± 15) µm	(350 ± 15) µm

* Specified at 920 nm

GEN X YDF OPTICAL FIBER SUMMARY

- LMA-YDF-14/250-HP-XM
  - Superior PD performance with competitive cladding absorption
- LMA-YDF-20/400-HP-XM
  - Superior PD performance with Gen VIII absorption
- LMA-YDF-20/400-HP-XM-HI
  - 20% higher cladding absorption with exceptional PD performance
- LMA-YDF-25/250-HP-XM
  - Superior PD performance



THANK YOU!

July 2019