# WP3 – Ultrafast Laser Frontend Development

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Work Package 3 - Overview

Objective: Develop ultrafast laser frontends for further amplification to a 500-W and 1-kW average power femtosecond laser

Organized in 3 tasks:

T3.1. A 50-W, 300-fs laser with >1MHz and spectrally tailored for injecting an Yb:YAG thin disk amplifier (AMP lead, USTUTT)

Primary signal

Secondary signal
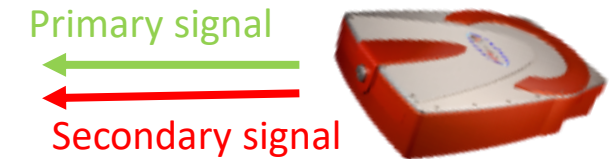
T3.2. A 200-W, ~500-fs laser at >1MHz (AMP lead, USTUTT, AMO)

T3.3. A high power capable user interface including high speed modulation of the amplified pulse train (AMP lead, USTUTT, C4L, AMO, BOSCH, XLIM, LASEA, GLO, E6)
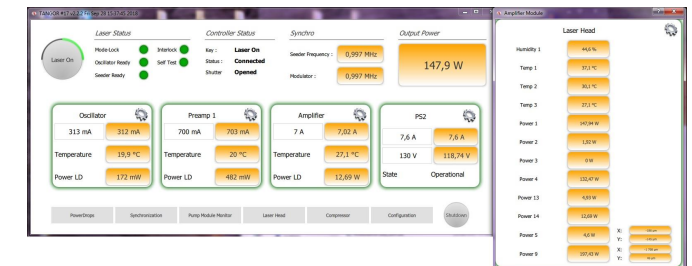
WP3 – Deliverables

| Deliverable title	Due date	Status
D3.1 50-W, 300-fs, >1-MHz laser for seeding an Yb:YAG amplifier (1)	M09 – October 2016	✔
D3.2 50-W, 300-fs, >1-MHz laser for seeding an Yb:YAG amplifier (2)	M09 – October 2016	✔
D3.3 200-W, sub-500-fs, >1-MHz laser (1)	M21 – October 2017	Submitted 05/07/2018
D3.4 200-W, sub-500-fs, >1-MHz laser (2)	M21 – October 2017	Submitted 06/07/2018

WP3 – Milestones

Milestone title	Due date	Status
MS7 Interface definition fixed	M08 – September 2016	✔
MS8 A 50W, 300fs at >1 MHz seed laser	M09 – October 2016	✔
MS16 System layout fixed	M12 – January 2017	✔
MS23 A 200W, sub-500fs, >1 MHz laser system	M21 – October 2017	✔

WP3 – Task 3.2: 200-W, ~500-fs laser >1MHz at 1030nm

- partners involved: AMP lead, USTUTT, AMO

- Achievements:
  - Hybrid fiber-seeded/crystal-amplifier architecture based on Tangor platform
  - >200W output power achieved from amplifier in late 2017
  - **BUT:** issue with long term stability revealed during stress testing
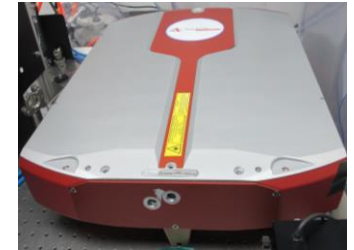
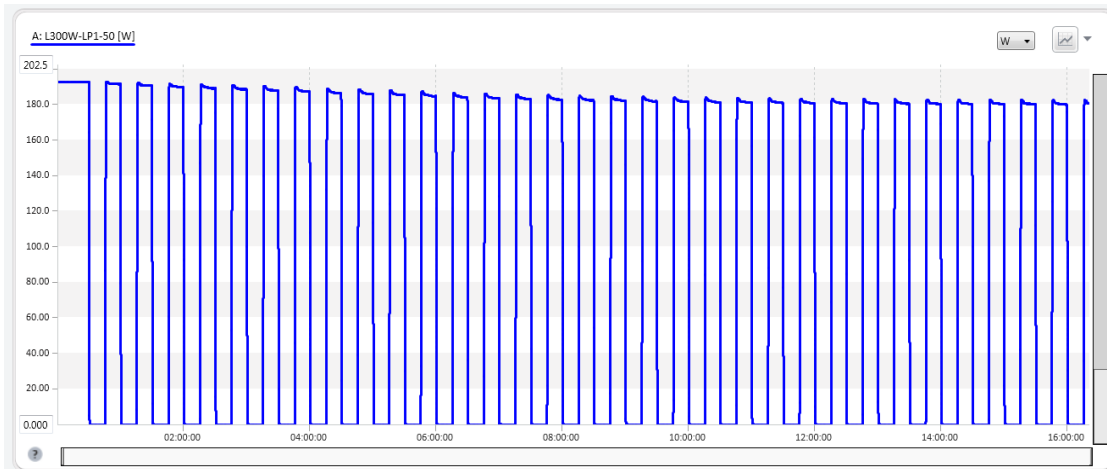=> Delay in prototype delivery / mitigation plan!
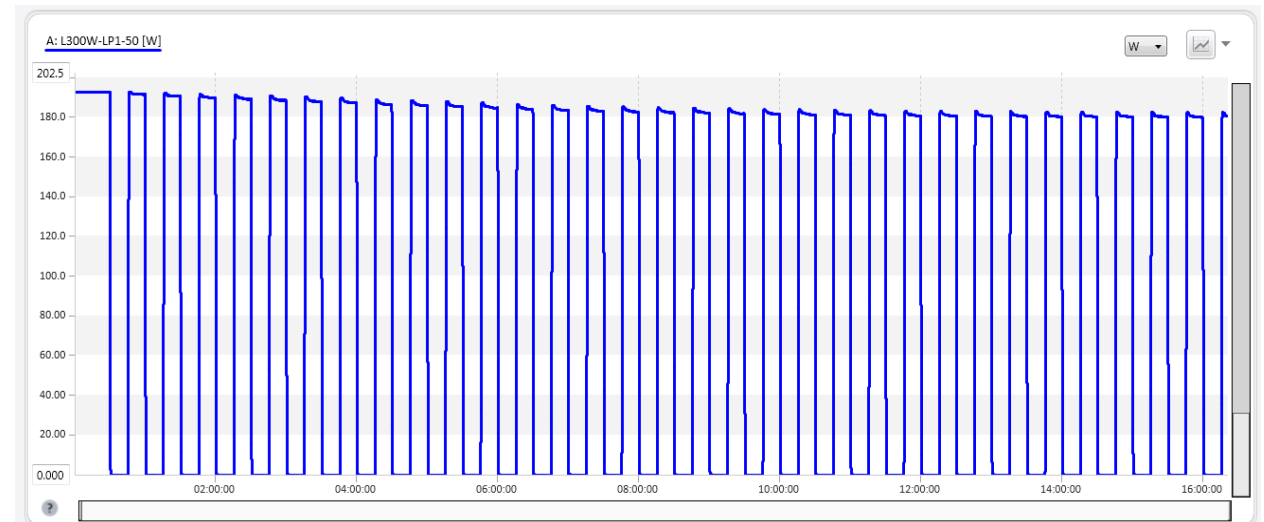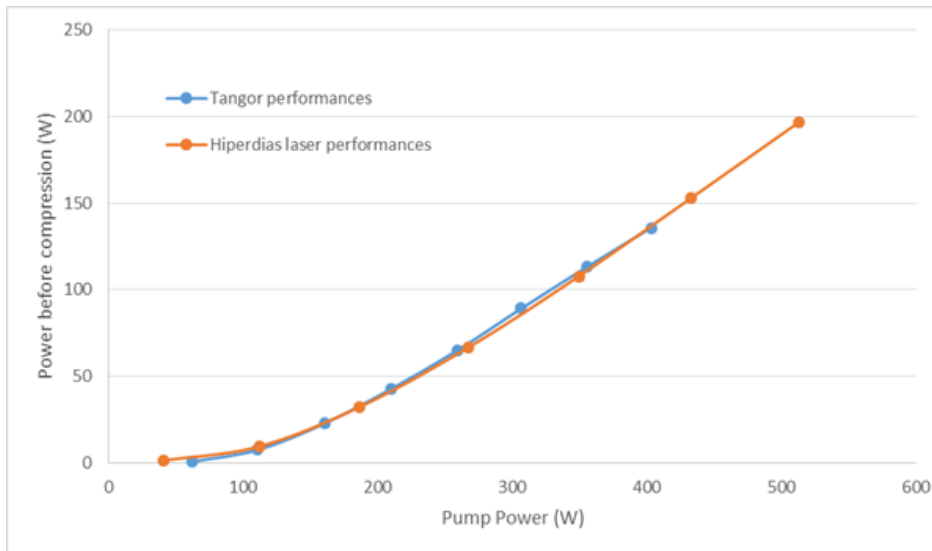
WP3 – Task 3.2: 200-W, ~500-fs laser >1MHz at 1030nm

- Ageing issue resolved:
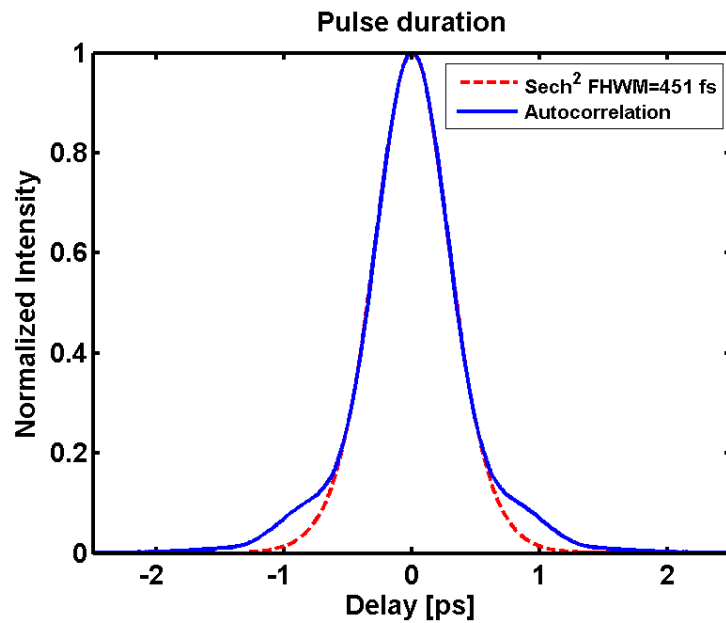
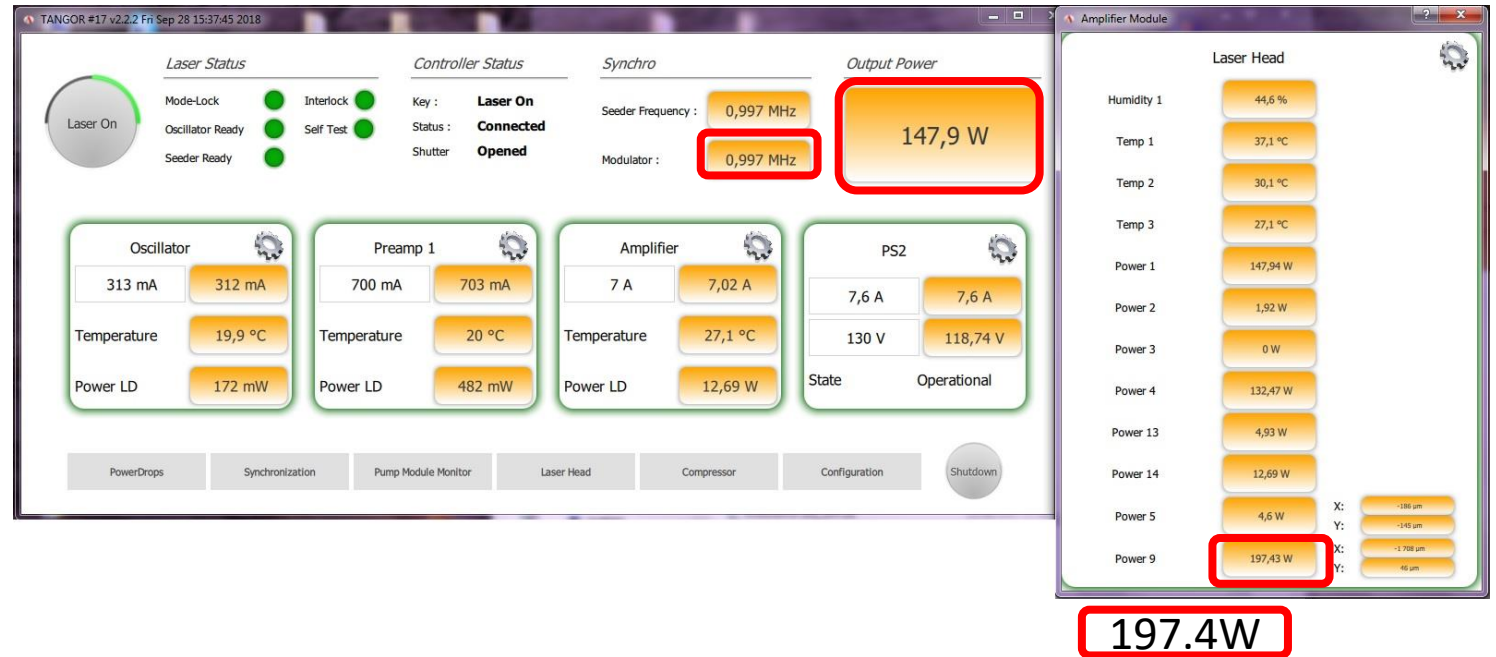Amplifier performance under ON/OFF cycling

before   after

WP3 – Task 3.2: 200-W, ~500-fs laser >1MHz at 1030nm

- Further laser performance:

450 fs @ 1MHz
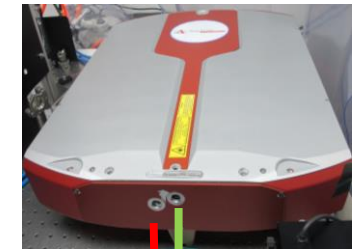
~200-W amplifier power, 150-W compressed

197.4W

WP3 – Task 3.3: A high power capable user interface including high speed modulation of the amplified pulse train

- partners involved: AMP lead, USTUTT, C4L, AMO, BOSCH, XLIM, LASEA, GLO, E6

- Major achievements:
  - Control interface based on Tangor platform
  - High speed modulation with external Trigger control of the pulse picker
  - Primary (1st order) and secondary (0th order) output signals of the ultrafast Frontend facilitate high speed modulation of the >500-W thin disk multipass amplifier of partner USTUTT
 - Variable compressed pulse duration from 450fs to 10ps

Secondary signal

Primary signal

3. Compressor adjustment table

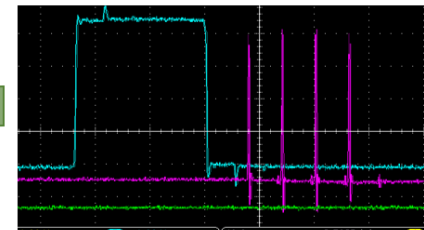|	1MHz	2MHz
min	4825	4524
800fs	5624	
1ps	6124	
2ps	7925	
5ps	11924	
10ps	19924	

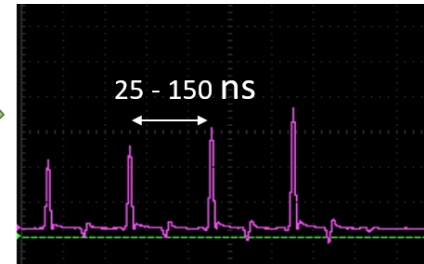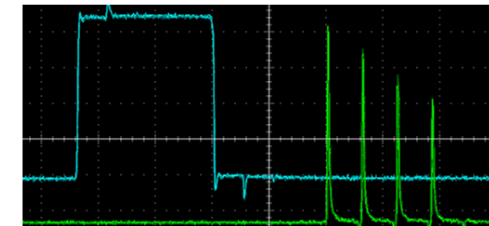# WP3 – Task 3.3: A high power capable user interface including high speed modulation of the amplified pulse train

- further achievements:
  - Burst mode operation

  - Sensors, parameter monitoring, Log-Files
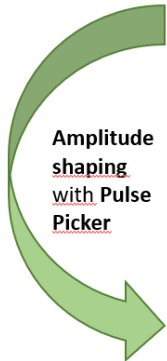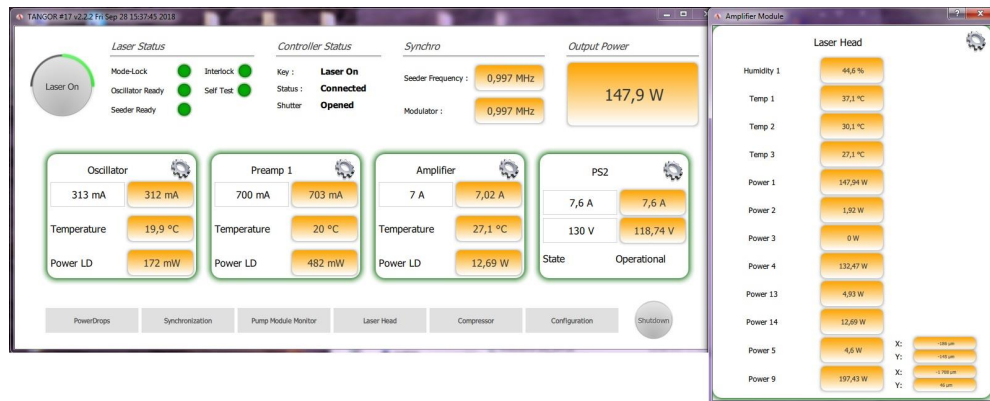
Before amplification

After amplification

Amplitude shaping with Pulse Picker

25 - 150 ns

« top hat » shaped bursts

200 - 300 µJ

WP3 - Conclusions

- Task 3.1 completed (no activities in this period)

- Task 3.2 and related deliverables were delayed because of technological difficulties encountered (now resolved)

  - Mitigation plan for the project:

    1. Delivery of an **additional** R&D Tangor prototype with ~100W average power **to C4L in Mai 2018**

    2. Optimization of prototype and **prototype delivery** to USTUTT in Oct 2018 (**scheduled for next week, 09/10/2018**)

- Task 3.3 on track

  - Concept implemented in demonstrator for USTUTT (primary and secondary signal output)

  - Support to partners (USTUTT, LASEA,…) for implementation to high power TD amplifier

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