

ModBox-Front-End – The Latest Improvement

July, 2020 – Sales department

Underpinned by its unique in-house technologies, iXblue proposes the ModBox-FrontEnd turnkey system as an ideal solution for optical pulse shaping. The ModBox-FrontEnd offers the ultimate performance for the end user by integrating screened and selected components that are controlled by a dedicated software interface for intuitive control to provide reliable and stable operation.

Continuous product development is central to the company's activities. This focus on innovation has enabled the company to establish and maintain a leading position in the strategic laser market.

This Application Note introduces the latest ModBox-Front-End's updates. It concerns the optical amplifier and RF amplifier hardware updates, as well as new software features:

- improved output power and stability capabilities,
- improved hardware Pulse Shaping performances and new software features.

iXblue and the ModBox-FrontEnd: the ultimate performances

iXblue specializes in the design and production of fiber pigtailed electro-optic modulators and their matching components including microwave amplifiers, Mach-Zehnder modulator biasing electronic boards, as well as optical devices such as optical fibers and optical amplifiers.

By mastering all the building blocks of an efficient modulation system, iXblue is capable to offer complex optoelectronic modulation solutions based on proprietary designs. Our hardware is combined with an innovative and intuitive controllable human-machine interface and the ModBox-FrontEnd stands out as the solution of choice for premium performance and user-friendliness.

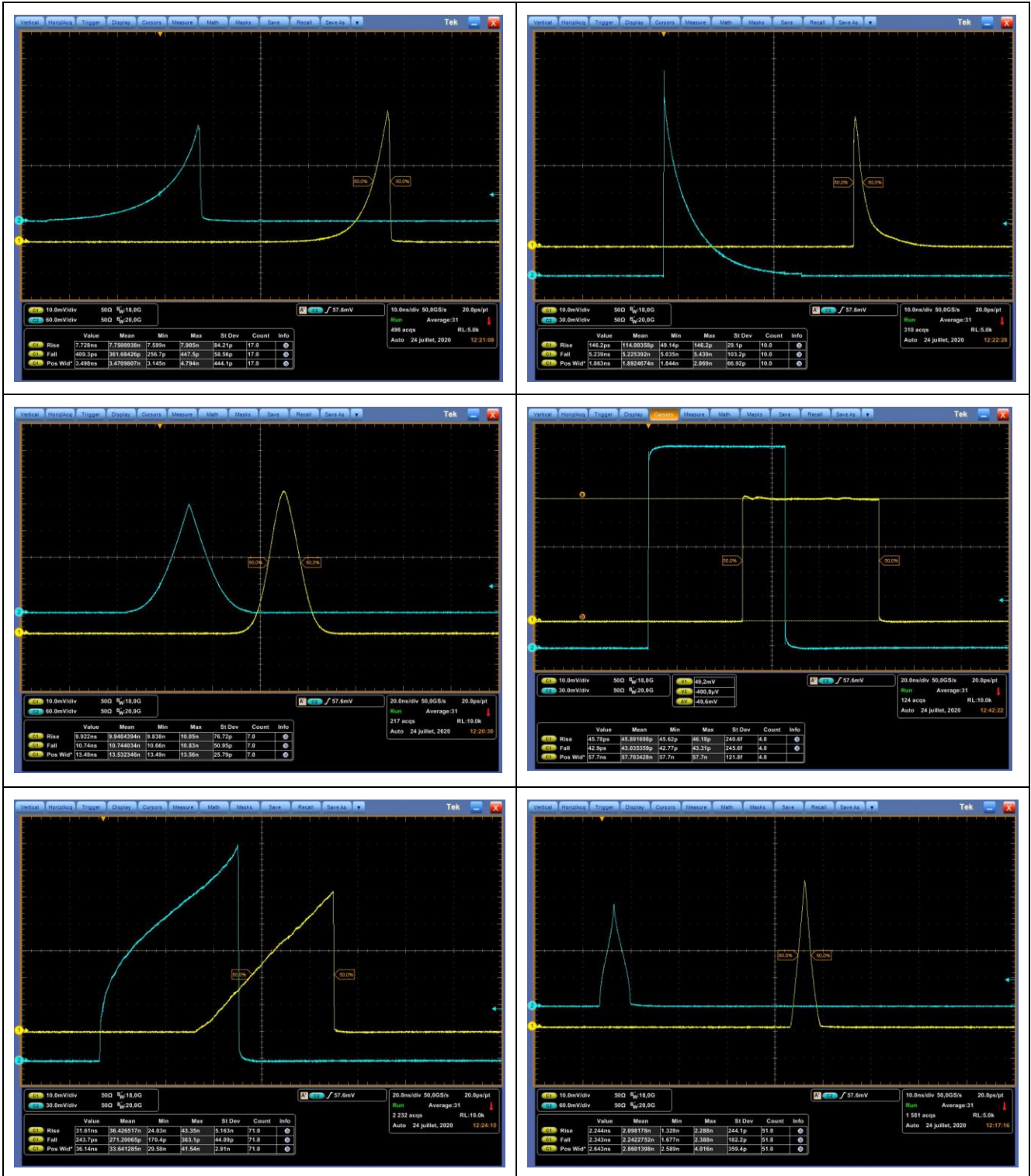
Pulse shaping capability enhanced by an improved linearity

The ability to shape the pulse temporally is of critical importance: the ModBox-FrontEnd will challenge the state of the art of temporal pulse shaping performance.

The Electrical Arbitrary Waveform Generator is now combined with a brand-new RF amplifier. Our proprietary RF amplifier design, especially developed for the ModBox-FrontEnd, uses the latest generation of monolithic microwave integrated circuitry, and features an exceptional linear behavior. The vertical resolution is improved. Also, the RF amplifier comes with a wider RF bandwidth allowing faster pulse rise and fall times

iXblue introduced a new hardware with a major driver's linearity improvement. This new RF amplifier is especially dedicated to low duty-cycle pulse train, it allows pulses width amplification from sub-nanosecond and now longer pulses to the microsecond range. Compared to its previous version, it is a higher linear and matching EOM driver: the over-shoots and undershoots have now been vanished and the ripple in the plateau been fully reduced. A recent ModBox-Front-End has been shipped to the LULI 2000, Palaiseau-France. Following the installation, Dr Loïc Meignein (LULI2000 Laser Chain Installation Manager) congratulated iXblue from the latest HW improvements: "this new RF amplifier is a major advancement on the optical pulse shaping capability for high power lasers".





Nanoseconds to few tens nanoseconds electrical (blue) and corresponding optical pulse responses (yellow)



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Few microseconds optical pulse responses

The EOM transfer function curve (sine response) is taken into consideration: into the ModBox software is registered the inversed EOM response. Thus, from the ModBox interfaces (GUI and tactile screen), or by downloading a txt file, user draws the wanted optical pulse waveform and the system generates in real time the exact and expected pulse waveform. From the above screen shots, the yellow curves are the optical pulse drawn by the user, and in blue the corresponding curves generated by the AWG. One can see the cleanness of the optical pulses.

Nota: ixblue is working on a new software algorithm to anticipate the distortion coming from afterwards amplifiers and passive components which are integrated into the optical laser chain. This new feature is expected to be released within 2020, at the latest 2021.

Pulse shaping capability enhanced by an innovative real-time interface

The ModBox embeds the last generation human-machine interface. It allows speedy downloads, pulse shape changes and updates. It also comes with a high capacity library for a large number of shapes to be registered. Finally, we would like to emphasize that waveforms can be changed “on the fly” without system interruption via an intuitive, real-time, easy to use, point-to-point precision graphic interface. Also, the waveform change will not cause dropped pulses or significant fluctuations in the output energy, other than the energy change caused by the adjustment itself. This is because only the EOM (which is associated to the AWG and waveform change) affects the optical output power level.



ixblue's Modbox offers new capability to draw waveforms directly from the View window using a mouse or the touchscreen (Although using a mouse would provide enhanced precision). The ModBox provides the capability to make live 'on the fly' adjustments to the pulse shape.



The video link provided below shows the real-time pulse shaping mode.

Video: [Real-time pulse shaping feature](#)

Maximum peak power from the ModBox system

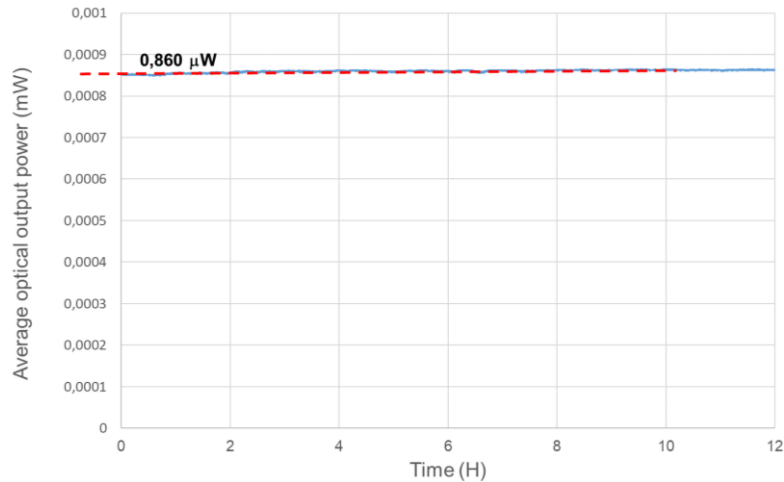
The ModBox-FrontEnd is based on a high-power amplifier combined with high optical power handling EOM modulator. This modulator is moreover screened and selected for its low insertion losses. During the components' assembly, a special care is also taken on the quality of the fibers splicing. We can therefore expect a minimized impact of the insertion loss on the optical power budget.

Because the amplifier and the optical modulator are still in their standard operating conditions, the limits of the system are not reached. Thus, the other system performances (power and energy stabilities for instance) and system reliability are not affected.

Indeed, the ModBox-FrontEnd outperforms the peak power minimum value of 600 mW peak (equivalent to 6 nJ @10 ns) and a typical 860 mW (equivalent to 8.6 nJ @10 ns) will be reached, without negatively affecting other parameters, can be proposed.

The new specifications related to the peak power and energy properties are provided in the table below.





Average output power for 10 ns @100 Hz pulses

The above figure provides the average power over time. The system stability shows indeed that it operates in a comfortable operating zone, and far from its damage threshold which may affect also the system lifetime.

An assumed long lifetime

iXblue Photonics is committed to providing more than ten years of quality assurance policy. Leveraging the benefits of our continuous improvements and most recent innovations, we guarantee the best services, and highly reliable products. iXblue performs a continuous quality audit of suppliers as well as a continuous quality evaluation of the ModBox-FrontEnd as a system. The expected lifetime of the systems is provided, and strategic components and sub-systems have been identified in order to safeguard some spare parts. For one of critical sub-system, soon to be obsolete, iXblue has committed to secure the availability by holding an additional replacement.

The heritage: from research to industry

The first Modbox-FrontEnd was created more than 8 years ago. Since the first unit shipped, iXblue has continuously improved its solution integrating higher performance hardware in a more compact design, adding new functionalities, and software features such as the real-time pulse design interface.

The ModBox-FrontEnd is a convenient and tailor-made solution from the market leader to meet customer distinct needs. The ModBox-FrontEnd is not a product: it is a carefully tuned turnkey solution dedicated to a specific High Energy or High-Power class laser. The ModBox-FrontEnd is used to seed high power amplifier chains to produce a master laser or an OPCPA pump laser. Applications range from scientific research and academic activities to industrial market needs. The ModBox-FrontEnd operates in many different fields such as particle acceleration, inertial confinement fusion, radiation therapy, X-ray generation, for sensor test applications, laser-driven shock compression for laser peening or dynamic compression. iXblue offers dedicated industrial grade Fibre Front End Seed Sources for all industries including R&D, Defense or production.

