DEWETRON'S ANALOG OUTPUT MODULES

TRION3-18X0-MULTI-AOUT-8 & TRION3-AOUT-8

DEWETRON

THE MEASURABLE DIFFERENCE.

- > Analog data output
- > Signal conditioning
- > Function generator
- > Customized waveform patterns
- > Data file replay
- > Highspeed versus high-resolution mode

FURTHER INFORMATION?

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INTRODUCTION

In 2013, DEWETRON introduced the first data acquisition module of its TRION series. The major difference to the other data acquisition approaches was the functional scope of TRION. TRION modules provided the signal conditioning path, the filtering, and the AD conversion (ADC) on one single board. Conventional data acquisition systems consisted of two separate hardware boards: one for the analog signal conditioning and one for the ADC. This approach with only one single data acquisition board provides many advantages, such as a very small form factor including a high channel density, lower error rate as well as easier and faster calibration as it is sufficient to calibrate the data acquisition board itself instead of the entire data acquisition system.

In 2018, DEWETRON released the first module of its TRION3 series with a PXI express interface for data transmisson instead of the PXI interface of TRION modules. Therefore, the difference between the two series is a significantly higher data transmission rate of the TRION3 series provided by the PXI express interface. A PXI interface reaches a data throughput of up to 90 MB/s, whereas the PXI express interface has a data throughput rate of 400 MB/s.

In 2021, DEWETRON introduced the first analog output modules for the TRION3 series – the TRION3-AOUT-8 and the TRION3-18x0-MULTI-AOUT-8 module. Although DEWETRON offered different analog output boards in the past, these modules are the first analog output boards of the TRION/TRION3 series developed by DEWETRON itself. This whitepaper will introduce you to DEWETRON's world of analog outputs and give an overview of the possibilities and applications to use the TRION3-AOUT-8 or the TRION3-18x0-MULTI-AOUT-8 module – Enjoy reading!

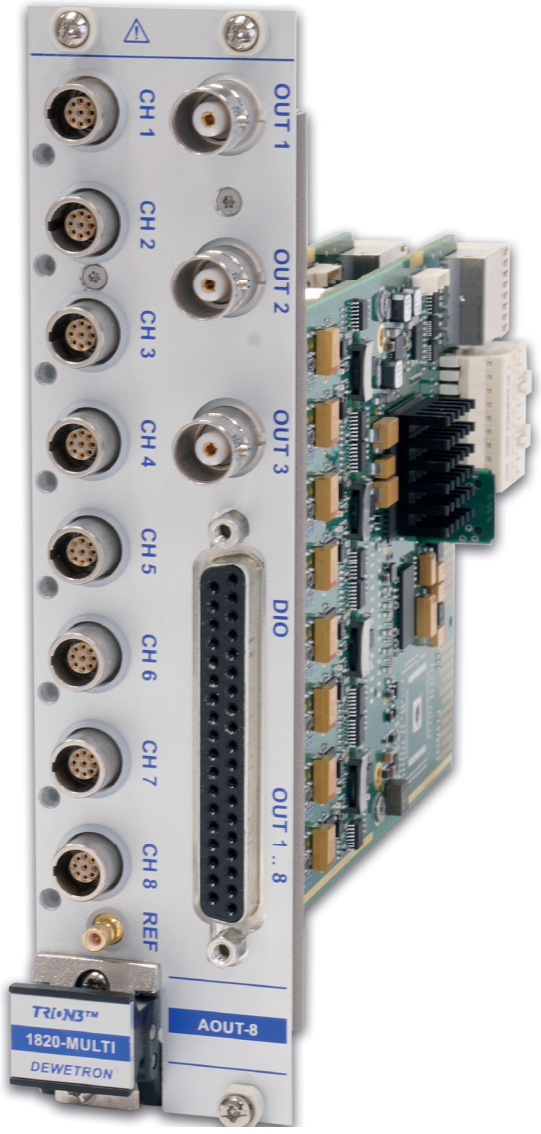

Figure 1: TRION3-1820-MULTI-AOUT-8 module

FUNCTIONAL OVERVIEW

DEWETRON offers two versions of the analog output module. On the one hand, the TRION3-AOUT-8 module (see Figure 2) is available as a pure analog out module with eight analog output channels for the operating modes *Constant Output*, *Function Generator,* or *File Replay*. The different modes will be introduced in the next section OUTPUT MODES.

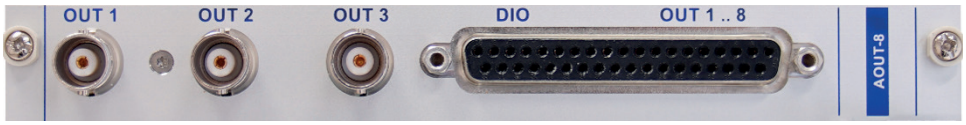

Figure 2: DEWETRON's TRION3-AOUT-8 module

On the other hand, DEWETRON offers the analog output module as an add-on for the TRION3-1820-MULTI-8-L0B and the TRION3-1850-MULTI-8-L0B module (click here to get to DEWETRON's website). This combination is called TRION3-18x0-MULTI-AOUT-8 (see Figure 3) and provides a *Monitor Output* and a *Math Output* function in addition to the operating modes of the TRION3-AOUT-8 board.

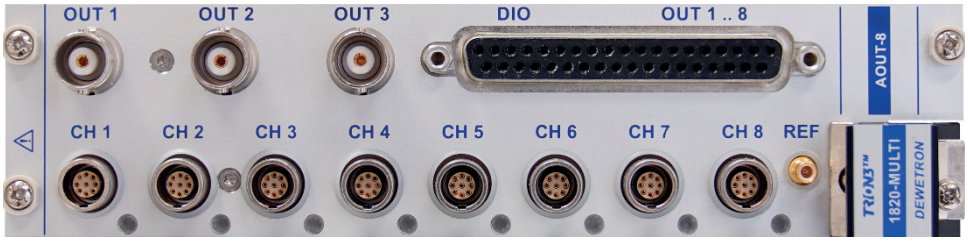

Figure 3: DEWETRON's TRION3-1820-MULTI-AOUT-8 module

The output channels of the new analog output module have the same specifications for both, the standalone (TRION3-AOUT-8) and the add-on for TRION3-18x0-MULTI (TRION3-18x0-MULTI-AOUT-8). Both modules offer eight analog output channels available on a D-SUB37 connector. For better accessibility, the first three channels are also available on BNC connectors while the others are only available on the D-SUB connector to keep the signal conditioning module small. 12 digital inputs and six digital outputs are additionally part of the feature set. The modules provide two different ADC modes differing in their output rate, resolution, and latency (see Table 1).

DAC MODE	HIGHSPEED MODE	HIGH-RESOLUTION MODE
UPDATE RATE	2.5 MS/s	500 kS/s
DAC RESOLUTION	16-bit	32-bit
LATENCY	<5 µs	<100 µs
BANDWIDTH	600 kHz	70 kHz

Table 1: Highspeed mode versus high-resolution mode

If required, the DAC mode cannot only be changed board-wise but also channel-wise as each channel is sampled with a separate DAC. The output signal can either be a voltage signal within the range from -10 V to +10 V or also a current signal from -30 mA to +30 mA. Different signal ranges are provided as symmetrical (i.e. -5 V … +5 V) or asymmetrical signal outputs (i.e. 0 … 5V). Moreover, the output signal range can also be selected channel-wise. Detailed specifications can be found in the datasheet which is available on DEWETRON's website (click here to get to DEWETRON's website).
Data transmission between the data acquisition system and the board is ensured over a PXI express interface. DEWETRON highlights the use of a PXI express interface with the name TRION3 (instead of TRION which uses PXI interfaces). The high-speed DEWE3 series supports DEWETRON's TRION3 series. This means all data acquisition systems of the DEWE3 series (e.g. DEWE3-RM16, DEWE3-PA8, etc.) support the new analog output boards. However, the modules are not supported by DEWE2 data acquisition systems such as the DEWE2-M13.

OUTPUT MODES

MONITOR OUTPUT

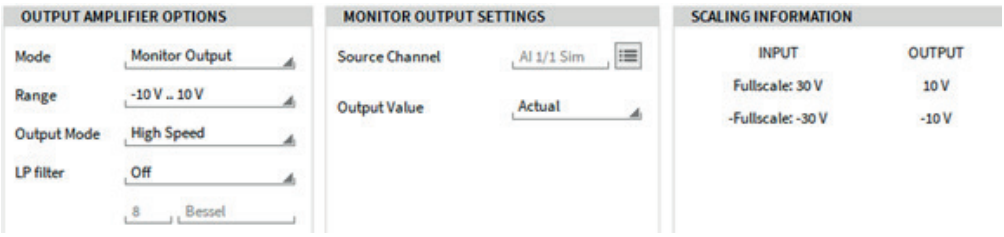

Figure 4: *Monitor Output* mode – software settings

The *Monitor Output* mode (see Figure 4) is intended to output the conditioned signal of one analog input of the TRION3-18x0-MULTI-AOUT-8 board. The typical use-cases are signal conditioning applications or redundant data acquisition applications. In this example of redundant data acquisition applications the data acquisition system including the TRION3-18x0-MULTI-AOUT-8 module serves as the main data acquisition system. The TRION3-18x0-MULTI-AOUT-8 board provides all input signals as scaled analog output signals which can be forwarded to a second data acquisition system ensuring redundant data storage. In case the data acquisition fails within one system, data is still available on the second system (see Figure 5).

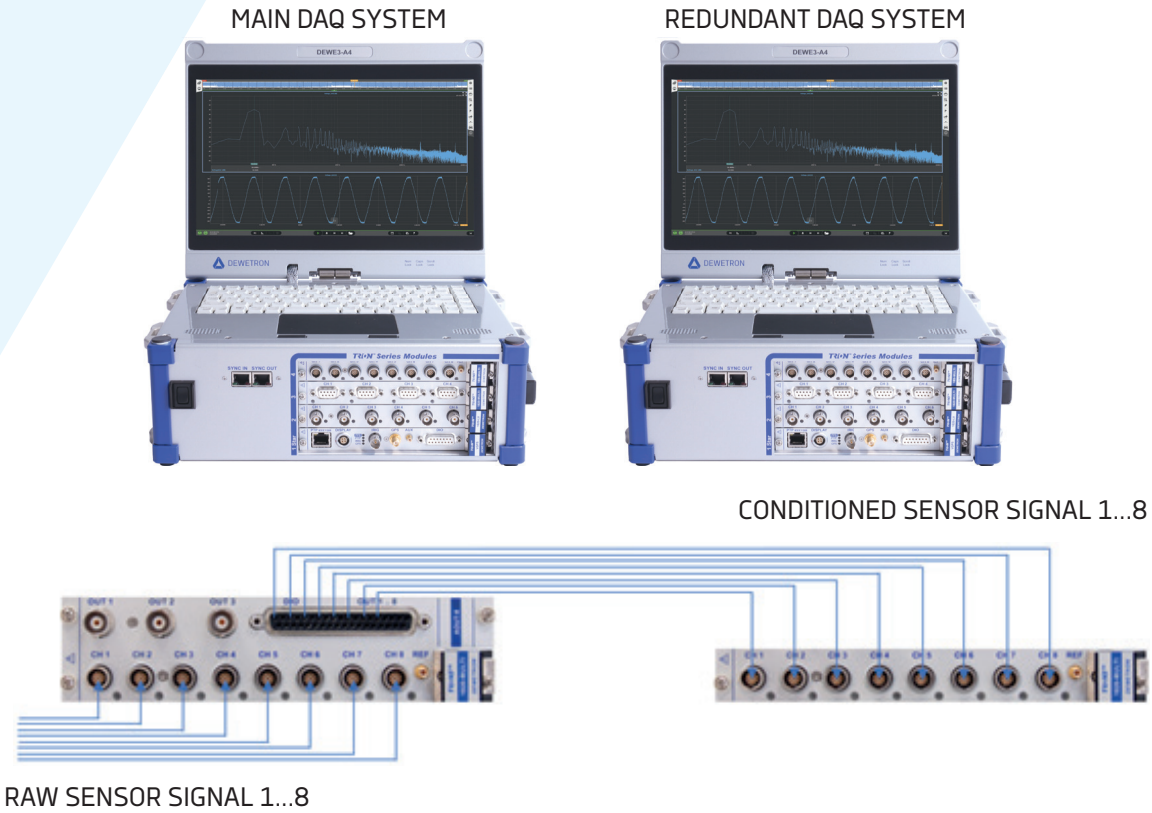

Figure 5: Redundant data acquisition system

The input channel assignment can be freely defined channel-wise. The conditioned signal can be either output as voltage (-10 V … +10 V max.) or current signal (-30 mA … +30 mA max.). Depending on the application, either a high resolution or a low latency can have a priority. In general, the low latency times (see Table 1) can be ensured as the conditioned signal is directly picked up from the FPGA and is not processed through the PC before the DAC.
The channel's output value can either be the actual input signal value as well as a linear or quadratic average with moving or fixed window with selectable window size. Thus, statistical signal values can be output as well. The input channel's signal range is always scaled to the maximum possible output channel range as can be seen in the example in Figure 4.

MATH OUTPUT

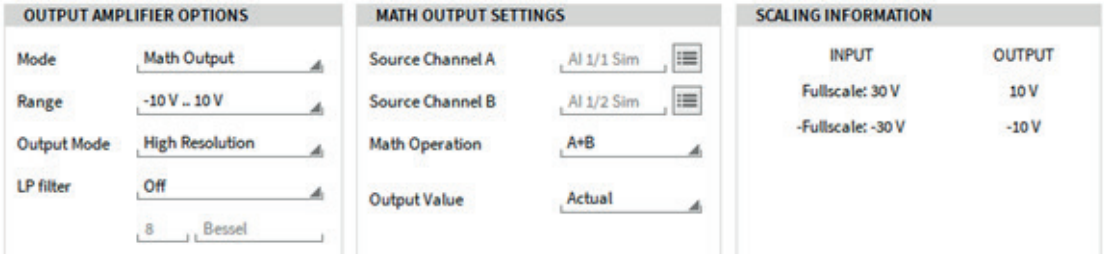

Figure 6: *Math Output* mode - software settings

The *Math Output* mode (see Figure 6) can be used to output the mathematical sum, difference, or product of two analog input channels of the TRION3-18x0-MULTI-AOUT-8 board. The result of the mathematical operation will be scaled to the output range of the output channel and can either be a voltage or a current signal.
Typical use-cases are applications where the mathematical combination of two signals is fed back to a controller for regulation purposes. Minimum latency times can be ensured as well because the mathematical operations are done on the FPGA of the TRION3-18x0-MULTI-AOUT-8 board and forwarded to the DAC directly afterward. The result of the mathematical operation which is output can either be an actual value as well as a linear or quadratic average with moving or fixed window and selectable window size.

CONSTANT OUTPUT

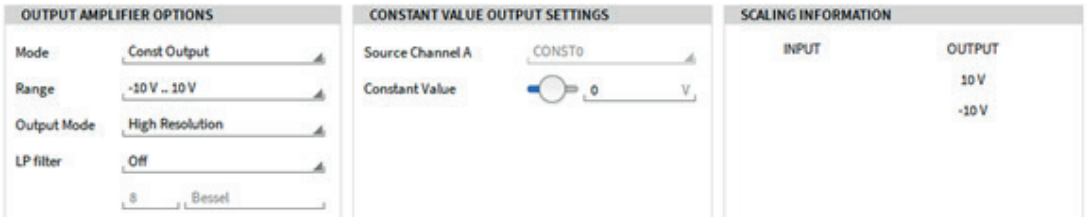

Figure 7: *Constant Output* mode - software settings

The *Constant Output* mode (Figure 7) can be used to output a static signal. The output can either be a voltage signal from -10 V to +10 V or a current signal from -30 mA to +30 mA. The signal could i.e. be forwarded to a testbed that requires a static signal as a reference.

FUNCTION GENERATOR

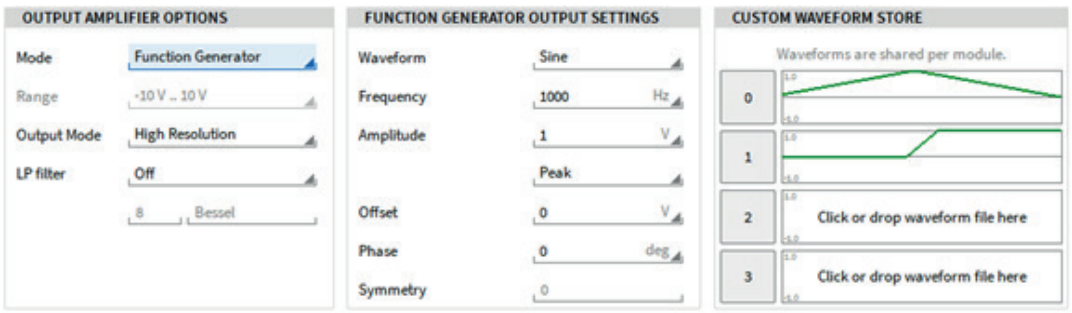

Figure 8: *Function Generator* mode - software settings

The fourth output mode (see Figure 8) is the *Function Generator* mode. This mode can be used to output either predefined waveforms or customized signal patterns. The predefined waveforms contain sine, triangular and rectangular signals with definable frequency, amplitude, DC offset, phase shift, and signal symmetry. As an add-on, customized waveform patterns can be output as well. The customized pattern can be defined in a csv-file that is loaded to the channel afterward.
The advantage here is again that both the predefined and the customized waveforms are rendered on the board's FPGA and do not occupy any CPU resources of the DAQ system. The customized waveforms are directly stored on the board's FPGA. Up to four different waveform patterns can be loaded on one board. The selection of voltage or milliampere proportional signal amplitudes is supported here as well.

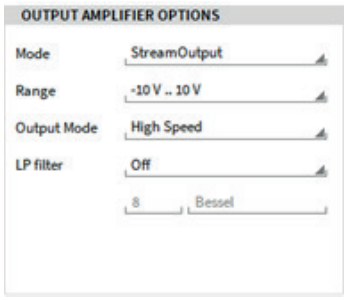

Figure 9: *Stream Output* mode - channel settings

Finally, the analog output modules offer a *Stream Output* mode (see Figure 9) to replay previously recorded data files. An output channel instrument (see Figure 10) was designed to load a data file in the current OXYGEN session and to assign synchronous channels from the data file such as analog channels or formulas to the analog output channels for replaying them. The output signal can again be a voltage or current signal and the scaling from input to output can be edited by the user. This mode supports replaying the entire file as well as selecting and replaying only a certain section while the playback can be looped.

One use-case among others is the following. It is often required to record the acceleration while the VUT is driving on a real track. The VUT can be a car that is driving on a public road or special test track or a train that is driving on a public track. The acceleration data measured during the test shall be output to a shaker to simulate the road profile in the lab. For this application, the input channels of the TRION3-18x0-MULTI-AOUT-8 board can be used to record the data during the test while its output channels will be used in the lab to forward the data to the shaker or testbed.

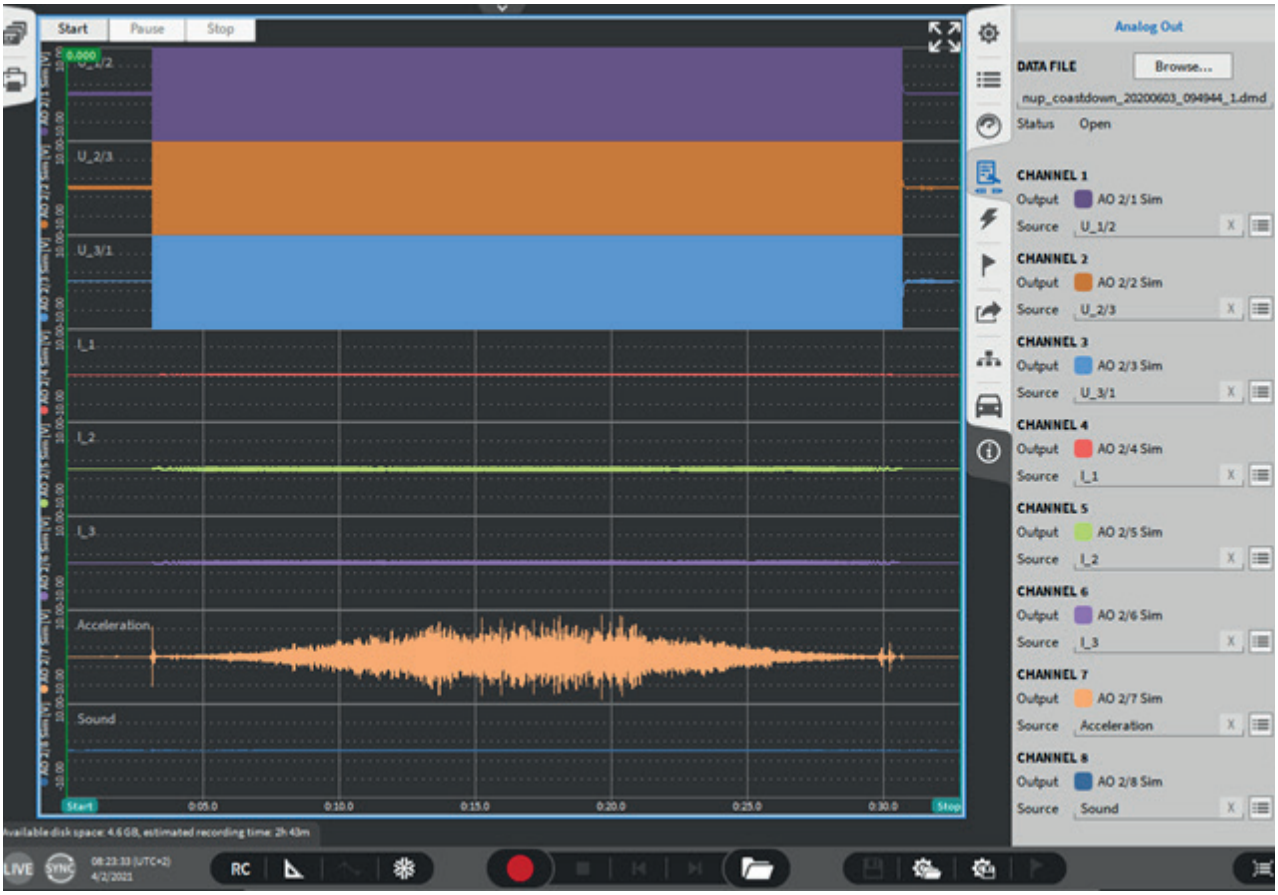

Figure 10: File replay user instrument

SUMMARY

Both, the TRION3-18x0-MULTI-AOUT-8 and the TRION3-AOUT-8 module provide a lot of benefits and use-cases for your tests and measurements. If you have specific questions about the capabilities related to your application or feedback regarding additional functionalities or features, feel free to get in touch with us. We are glad to receive any feedback you might want to share with us!

Figure 11: DEWE3-PA8 power analyzer with several modules, including a TRION3-1820-MULTI-AOUT-8 module

THE EXPERT

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Rafael Ludwig studied electrical engineering as well as audio engineering at the University of Music and Performing Arts Graz and the Graz University of Technology. During his master's studies, he specialized in acoustics and audio recording. After graduating, he worked as an acoustics engineer in the R&D department of a mechanical engineering company before he joined DEWETRON in 2017. At DEWETRON, he is a product application engineer for automotive, e-mobility, and power applications as well as for general test and measurement solutions.

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