DEWETRON

OXYGEN TRAINING
> SYNCHRONIZATION

SYNCHRONIZATION – WHY?

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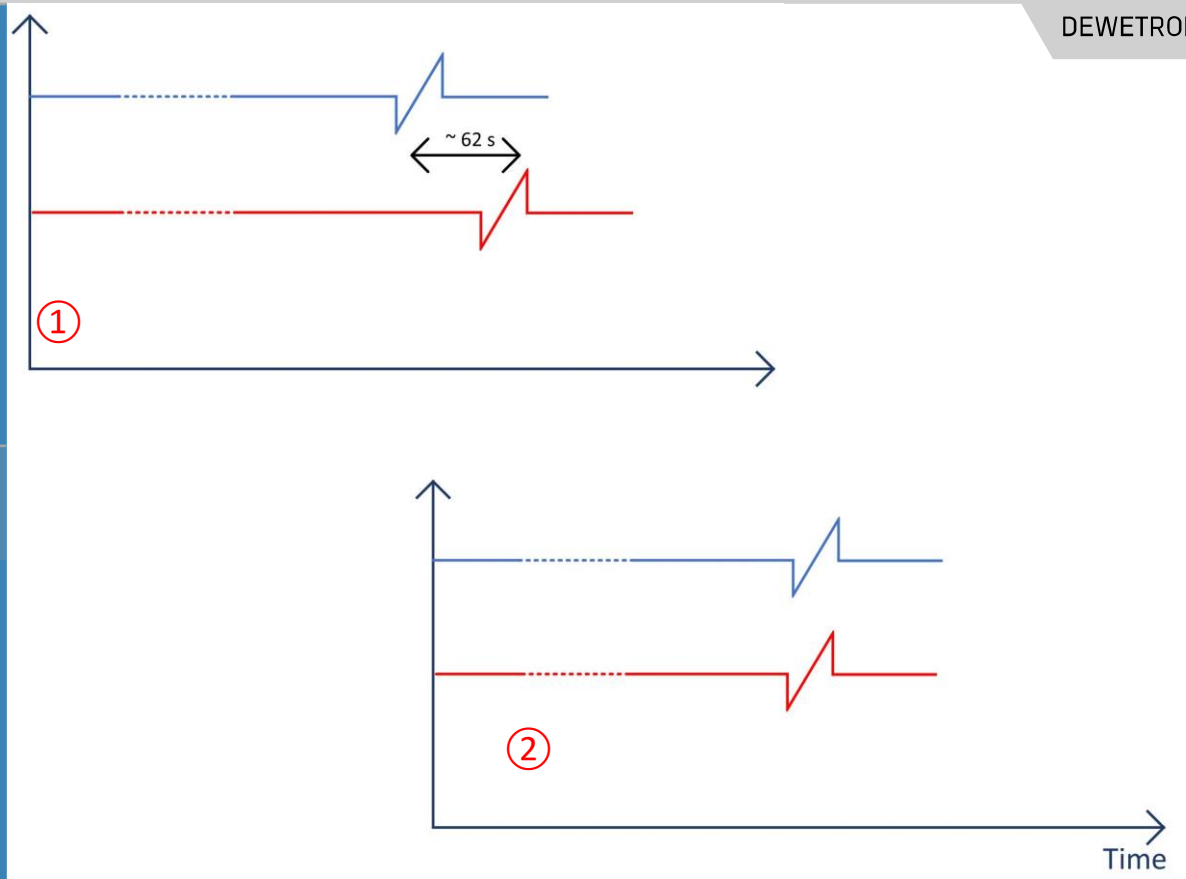
① No Synchronization:
- System A has a timing error of +39ppm
- System B has a timing error of +15ppm
- Both systems start data recording at the same time
- After one month of continuous recording, there is a time shift of ~62 seconds between both systems:

$30_{days} * 24_{hours} * 3600_{sec} * (0.000039_{ppm} - 0.000015_{ppm}) = 62.2$ sec

② Synchronization avoids this problem
- If system A is the SYNC master and system B is synced as slave to it, both systems will run with an error of 39 ppm
- The difference will be 0 ppm even after one month



SYNCHRONIZATION – TYPE OVERVIEW

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Depending on the chassis controller or TRION board which is mounted to the first (Star) slot of the system, different external synchronization signals can be applied to the system.
The table on the right provides an overview about the supported external synchronization sources for chassis controller and TRION modules.

	INPUT SYNCHRONIZATION SIGNAL										
	PTP / IEEE 1588	GNSS				PPS		IRIG			
		GPS	Galileo	BeiDou	GLONASS	Rising Edge	Falling Edge	A DC	B DC	A AC	B AC
Chassis Controller	✓	✓	x	✓	✓	✓	✓	✓	✓	x	x
TRION-BASE	x	x	x	x	x	✓	x	x	✓	x	x
TRION-TIMING	✓[1]	✓	✓	✓	✓	✓	✓[1]	✓	✓	✓	✓
TRION-VGPS	✓[2]	✓	x	x	✓	✓	✓[2]	✓	✓	✓	✓
	OUTPUT SYNCHRONIZATION SIGNAL										
Chassis Controller	✓	x	x	x	x	✓	x	x	✓	x	x
TRION-BASE	x	x	x	x	x	x	x	x	x	x	x
TRION-TIMING	✓[1]	x	x	x	x	x	x	x	✓[1]	x	x
TRION-VGPS	✓[2]	x	x	x	x	x	x	x	✓[2]	x	x

[1] TRION-TIMING-V3 required [2] TRION-VGPS-V3 required

SYNCHRONIZATION recommendations

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*) For mixed sample rate or mixed TRION module configurations, the sample period of the slower sampling card must be added to the sync accuracy.
**) These values are recommended maximum distances and might vary due to used cables.

Synchronization type	Typical synchronization accuracy*	Absolute time	Distance**	Cable Type	Recommended for
GPS	±100 ns	✓	-	-	Highest distance; cable connection is impossible
PTP / IEEE1588 Via master or switch	±50 ns	✓	1 km	RJ45 or fibre optic	Medium distance, sync with 3rd party hardware
PTP / IEEE1588 connected via standard Ethernet switch	25 µs	✓	1 km	RJ45 or fibre optic	Only for sample rates up to 10 kS/s
TRION Sync	±60 ns +5 ns/m	☒	100 m	RJ45 CAT VI	Medium distance; low jitter; DEWE chassis
PPS	±60 ns +5 ns/m	☒	10 m	RG58	Low distance
PPS out	500 ns	☒	10 m	RG58	Low distance; clocking 3rd party devices
IRIG-B TTL	100 ns	✓	50 m	RG58	Medium distance; use with existing IRIG installation
IRIG-A/B DC; AC	Slave-Slave ±2 µs Master-Slave ±20 µs	✓	300 m	RG58	Medium distance; use with existing IRIG installation
Frequency Out (TTL)	500 ns	☒	10 m	RG58	E.g. camera trigger

SYNCHRONIZATION – TYPE OVERVIEW

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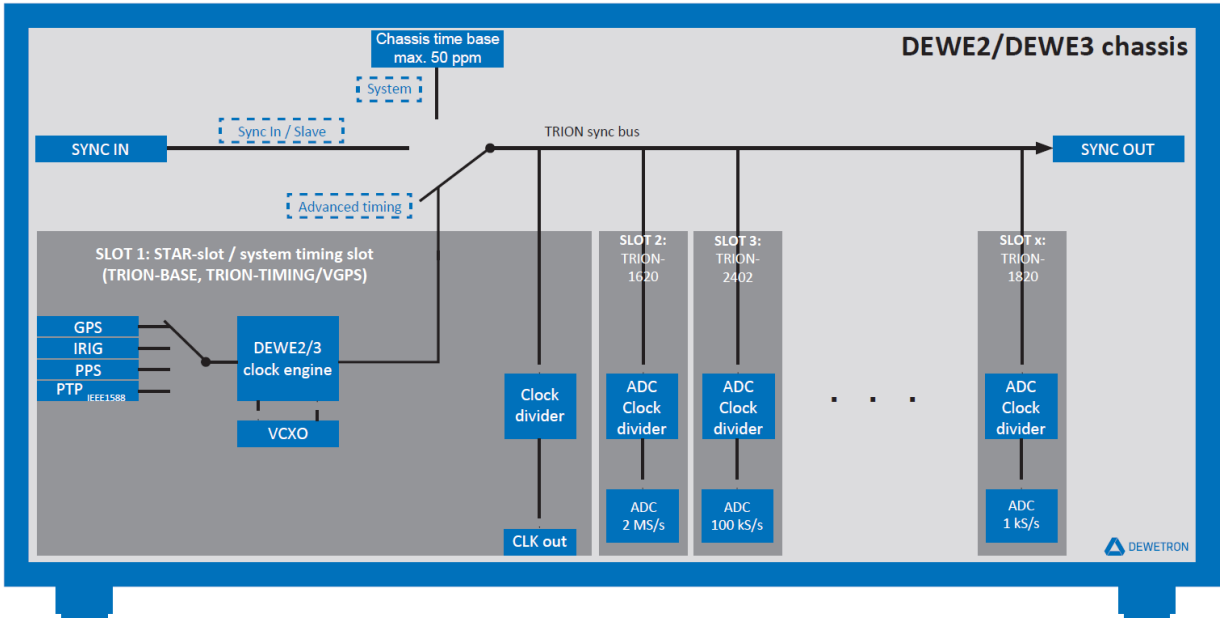
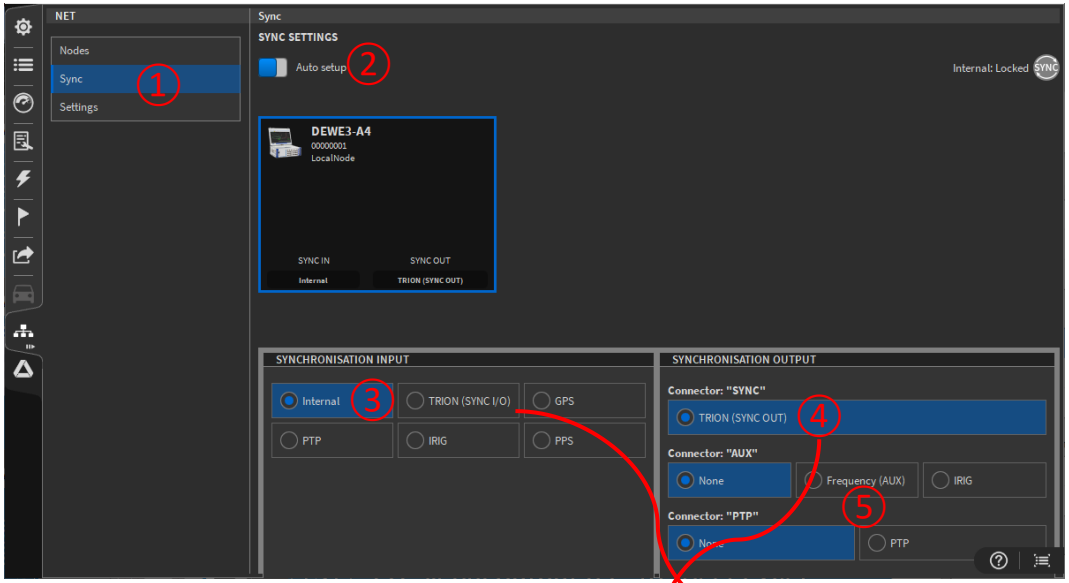
All DEWE2 systems have internally the same clock structure, independent on the amount of slots. The heart of it is the TRION Sync Bus that is connected to every slot of the chassis.
The Timing Source for the bus can be the internal time base of the chassis or another DEWE2 System by using the Sync In connector. In case a Timing board is installed in the first Slot (Star * Slot), the TRION Sync Bus can be synchronized to almost every external time source. All cards generate their AD clocks out of the TRION Sync Bus signals separately. That allows different Sample rates settings at board level while still being precisely synchronized

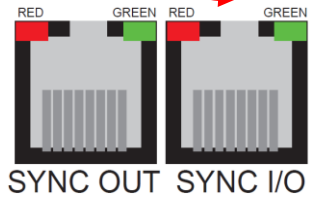


OXYGEN - SYNC SETUP

①	Open The *System Settings* and navigate to *Sync* tab
②	Uncheck the *Auto Setup* to edit the *Synchronization Input* (③) settings
③	Select the proper Synchronization source (selection depending on availability and TRION board in first slot)
④	Sync signal is output via TRION-SYNC-OUT connector (always enabled)
⑤	TTL signal output (i.e. to trigger GigE cameras) (availability depending on TRION board in first slot)



Auto Setup denotes *TRION (SYNC I/O)* as source if signal connected to *SYNC I/O* plug and *Internal* otherwise



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OXYGEN - SYNC OPTIONS OF DIFFERENT SYNC SOURCES

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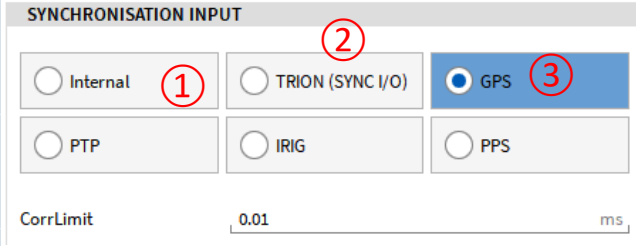
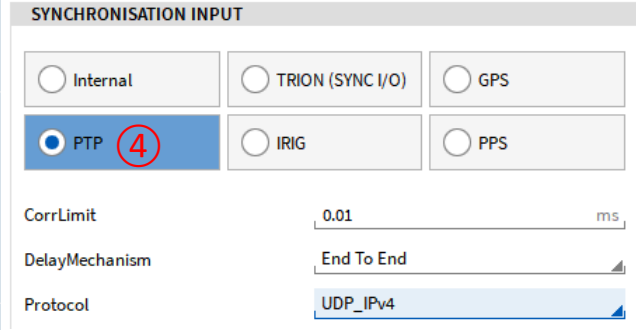
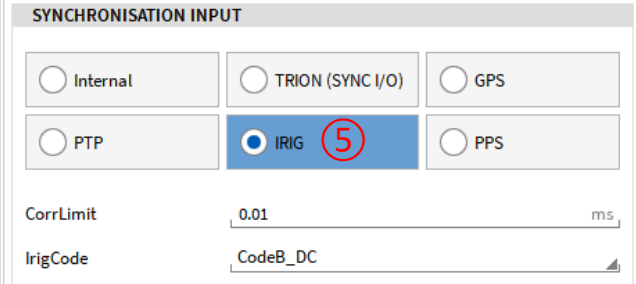
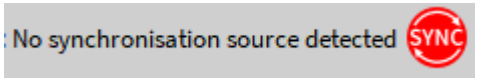
①	*Internal* → No further options
②	*SYNC I/O* → No further options
③	*GPS* → Specify a correction limit between 10 ns and 500 ms
④	*PTP* → Specify a correction limit between 10 ns and 500 ms, Specify the proper delay mechanism and protocol type
⑤	*IRIG*→ Specify a correction limit between 10 ns and 500 ms and the proper IRIG code
⑥	*PPS*→ Specify a correction limit between 10 ns and 500 ms and optionally invert received signal







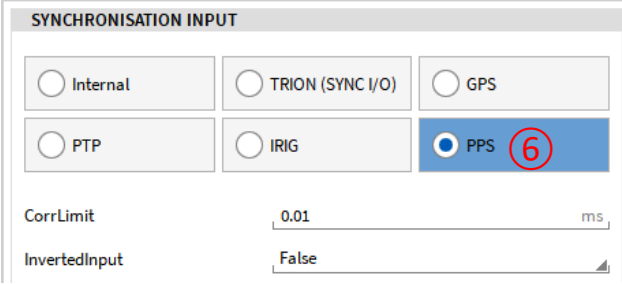
→ Locked when *Internal* is used



→ NO correct sync signal received by HW

→ Sync signal received but not synchronized yet

→ Sync signal received and sync'd



SYNCHRONIZATION – SYNC LOST DURING RECORDING

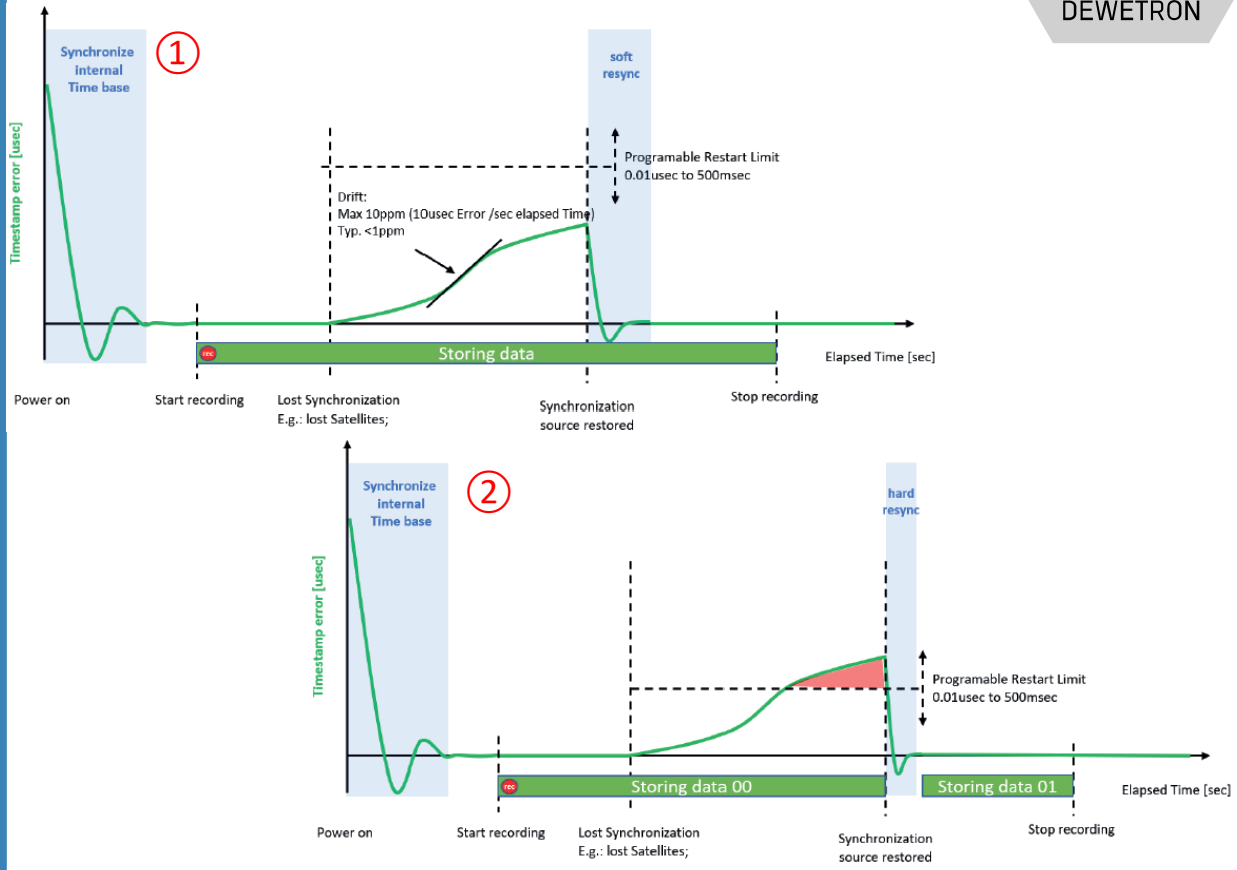
The TRION-TIMING-V3 is designed for continuously measuring data, even if the external time base source is temporary not available. Especially in GPS mode that could easily happen. In that case the TRION-TIMING-V3 generates a notifying event and continues measuring on its internal time base. This internal time base has been adjusted to the external reference while the sync was stable.

That minimizes the drift in free-run mode. (Typically far below 1 ppm). Only when the environmental conditions change dramatically during a longer non-synced period of time, it might go up to a maximum of 10 ppm.

When the synchronization has established again the TRION-TIMING checks if the internal time base error is still below the pre-programmed restart limit.

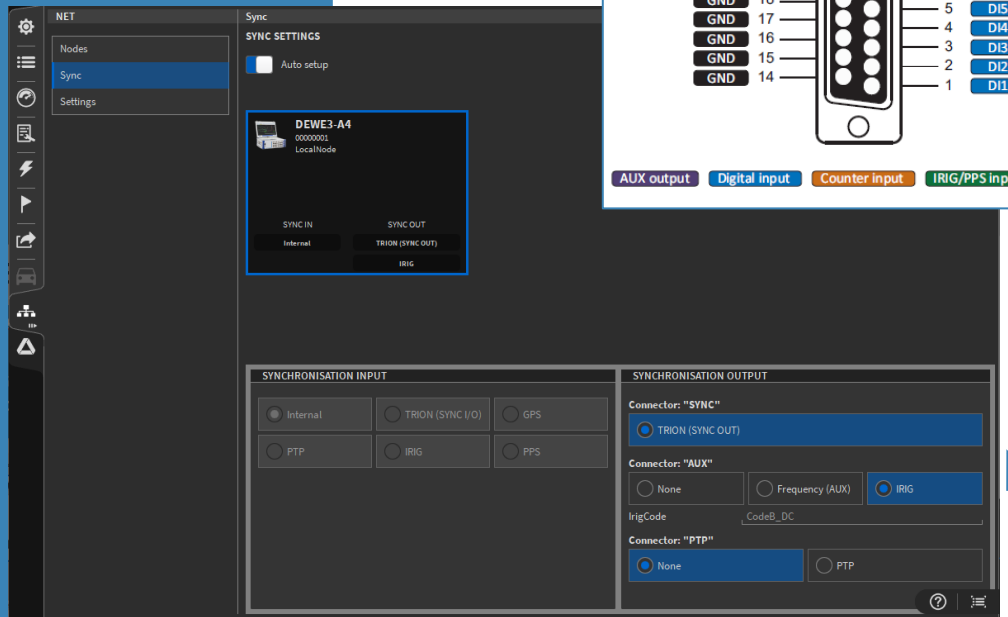
> ① If yes, it starts resyncing by slightly changing the time-base until the time stamps matches again exactly. That prevents from gaps in the data file due to resync. That might take a while because the maximum readjusting speed is 100 ppm.

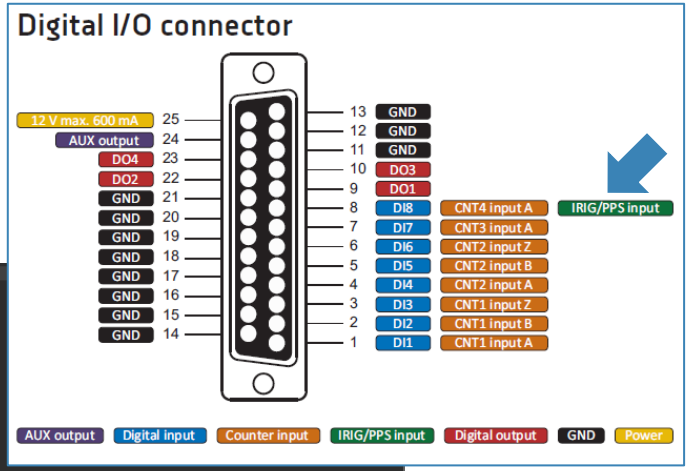
> ② If for some reason a hard resync is needed the restart limit could be set to a low value. In that case the datafile will be interrupted.

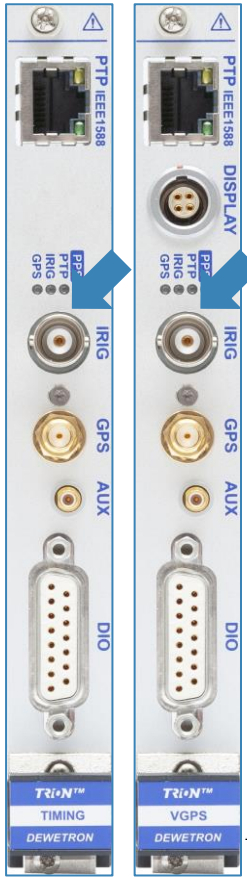


IRIG MASTER

- Option to output IRIG B DC signal
- TRION-TIMING-V3, -VGPS-V3 or Chassis Controller required







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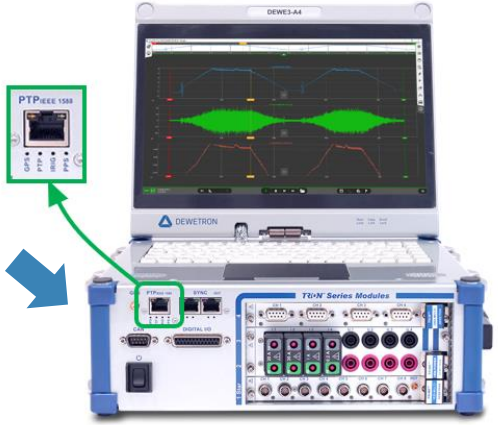
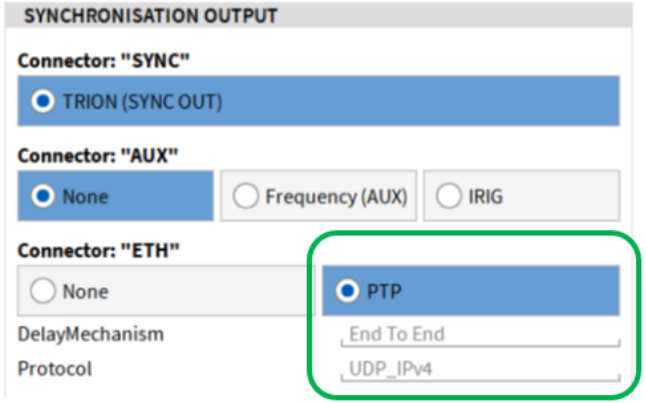
PTP MASTER

- Option to output PTP IEEE1588 signal
- Option available for chassis controller
- License option: no hardware changes necessary to activate PTP Master Out option





Option available when licensed

PPS-OUTPUT

	PPS-Output via Chassis ControllerOption available for chassis controller
①	Must be configured in the Sync Setup
②	PPS signal available on AUX output with a Duty Cycle: 2%

SYNCHRONISATION OUTPUT

Connector: "SYNC"

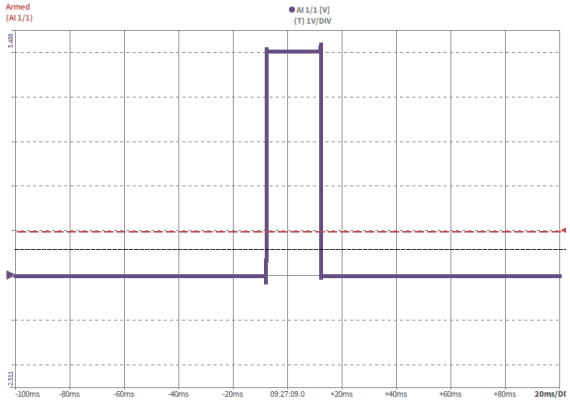
- (•) TRION (SYNC OUT)

Connector: "AUX"

- ( ) None
- (•) PPS ①
- ( ) Frequency (AUX)
- ( ) IRIG

Connector: "PTP"

- (•) None
- ( ) PTP



Digital I/O connector