Höcherl & Hackl
The electronic load

Application Note #21

Synchronizing Load Input Control With Electronic Loads of Different H&H Series Devices

When using several devices with multiple load channels, it is often important to control the load inputs of all devices as synchronously as possible (e.g. when testing automotive zone controllers). This application note describes various possibilities for connecting and controlling several devices.

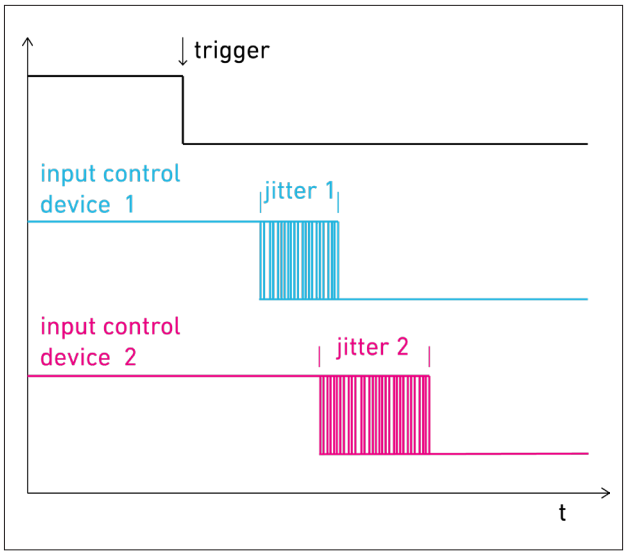

Fig. 1: Jitter at repeated load input switching at H&H devices of different series

Safety Instructions

Read the operating instructions of your equipment and especially the general safety instructions before starting operation!

1. Jitter and Delays

The time between the arrival of a command, a control signal or a trigger and its execution varies for each device, depending on the momentary internal controller state (see Fig. 1). This jitter is present in every device. It can be made visible by means of a long-term oscillogram with persistence (see Fig. 3ff).

Jitter cannot be eliminated, but further delay times between several devices can be minimized by choosing suitable control methods. Various methods are shown below.

2. Types of Load Input Control

The various types of input control have their pros and cons, which are explained in the following cases.

2.1 Wiring via I/O Port

Most of H&H's electronic loads have an I/O port for externally defining setpoints and states.

Wiring:
An external switching or control unit, e.g. a PLC, sets the nominal state for the load input by connecting its control output to the /INP_ON pin of the I/O ports of all electronic loads in the system.

Device configuration:
The external control signal for the load input must be enabled on all devices whose load input is to be controlled synchronously. To do this, the corresponding signal (input state) must be activated at the I/O port and the I/O port itself must be activated.

User Interface:
Main Menu -> Settings -> Basic Settings -> Ext. Control

SCPI Commands:

```
SETT:EXT:ENAB INP,1
SETT:EXT ON
```

Note:
These settings are volatile and will be reset to the default state after a restart or a reset. We recommend saving the device settings and having them loaded automatically when the device is switched on (see user manual "Save and Recall Device Settings").

Pros:

- High synchronicity and speed (typ. 200 µs)
- Little or no programming effort required
- Also possible in manual mode

Cons:

- External wiring required
- Only possible for devices with an I/O port
- Without an isolated I/O port, devices are galvanically connected

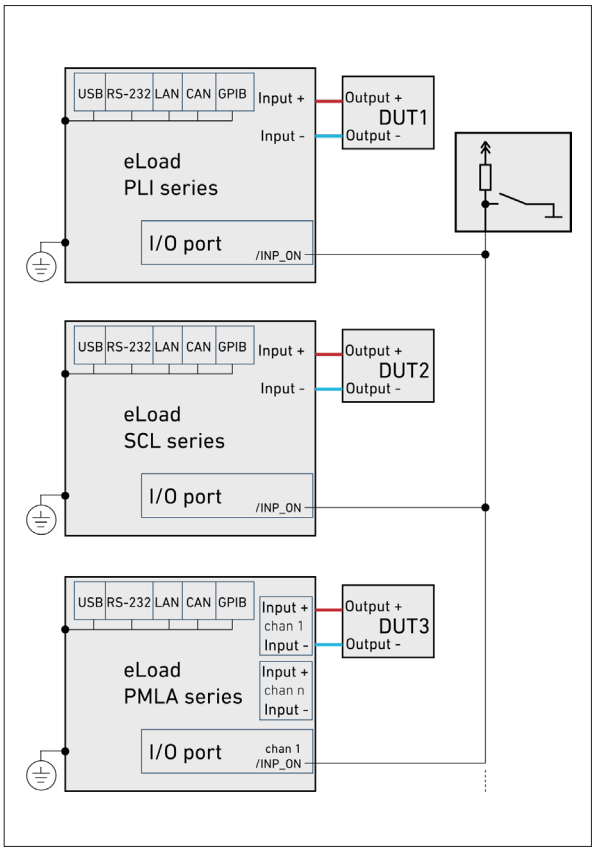

Fig. 2: Wiring via I/O port

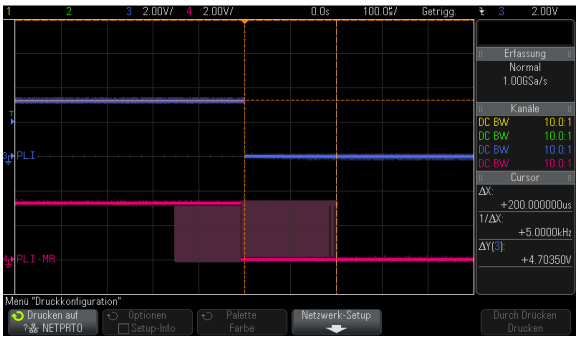

Fig. 3: Repeated switching of the load input on different PLI devices, control via /INP_ON line at I/O port

2.2 Control by Data Interface

Most of Höcherl and Hackl's electronic loads have a digital communication interface (LAN, USB, RS-232). To control the load inputs of several devices, the SCPI command INPut ON can be sent sequentially to the devices via the selected communication interface.

Pros:
- No wiring between devices necessary
- Also possible with devices without I/O port

Cons:
- Depending on the interface used, delays of several milliseconds may occur
- The delays are not deterministic
- Not possible in local mode

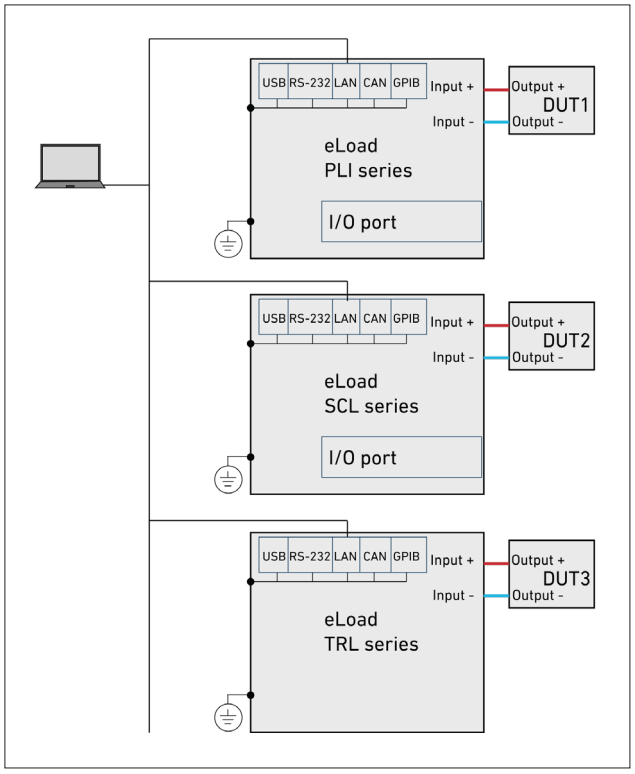

Fig. 4: Control by data interface

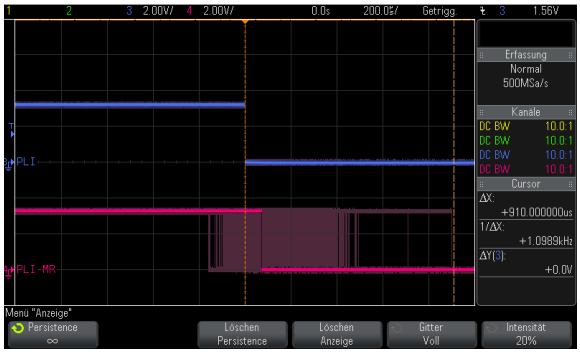

Fig. 5: Repeated input switching at different PLI devices. Control successively by command `INP ON` via LAN interface

2.3 Wiring by SyncroLink

SyncroLink uses the RS-232 interface physically. This must be configured accordingly in the first step.

User Interface:
Main Menu -> Configuration -> Communication -> RS-232 Configuration

SCPI Command:
`SYST:COMM:SER:MODE SLIN`

The setting takes effect after a restart and is non-volatile. The devices are connected using a special cable (see Fig. 9). There is one SyncroLink master and several SyncroLink slaves. The SyncroLink master generates the synchronization signal, the SyncroLink slaves receive it.
The use of the SyncroLink is similar to the use of a trigger signal. All devices must be initialized via one of the data interfaces (not RS-232).

Example for continuous initialization with triggered load input:

`SYST:SLIN ON`	activate SyncroLink
`INP:TRIG ON`	activate triggered load input state
`INIT:CONT ON`	initialize trigger system continuously

Only SyncroLink master:

`*TRG`	generate synchronization signal

The SyncroLink distributes the synchronization signal to all connected devices.

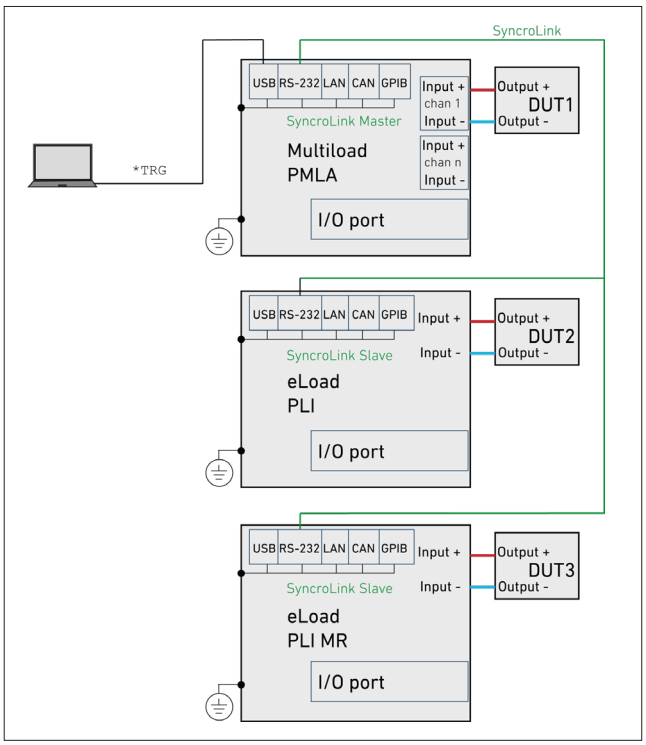

Fig. 6: Wiring by SyncroLink

Special case: mixed systems with PMLA

The PMLA multi-channel load series processes trigger signals differently to other H&H loads, which results in different propagation times. In mixed systems with PMLA devices, these delays can be compensated by programming a delay time of 450 µs for the PMLA devices. The actions of all devices are then only minimally shifted. See Fig. 6 and 7.

Command to all PMLA devices:
`SYST:SLIN:DEL 0.00045`

Fig. 7: Driving the load input of a PLI and a PMLA device without delay (long-term oscillogram with persistence)

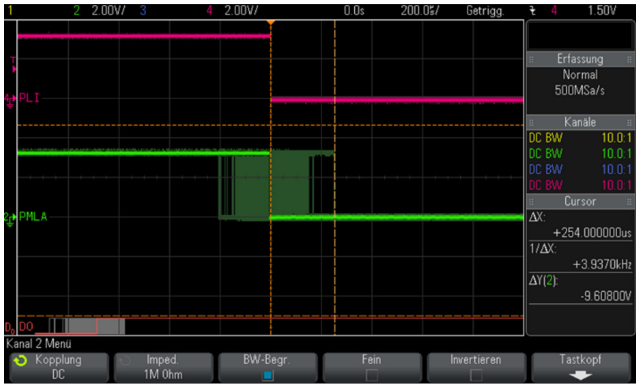

Fig. 8: Driving the load input of a PLI and a PMLA device with delay

Pros:
- High synchronicity (typ. < 300 µs)
- Deterministic behavior
- I/O port not necessary

Cons:
- Not possible in local operation
- External wiring necessary
- RS-232 not available as data interface

Pin assignment SyncroLink cable:

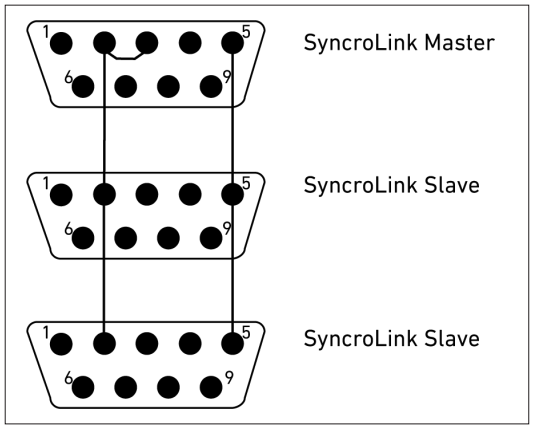

Fig. 9: SyncroLink cable wiring