BioStim

BioStim Controller
&
Computer Interface

User's Manual

SUPERTECH

The parts of the BioStim universal biological stimulator system

The **BioStim** system is divided into two functional parts. The time parameters are generated by the fully digital **BioStim Controller**, and the analogue voltage and current sources are implemented in the **End-stage**s. The parts of the system are manufactured as independent equipments. On one hand it results a more flexible and variable system, because the similar parts (e.g. the **End-stage**s) are compatible, and they can be changed easily. On the other hand the divided system meets the special experimental requirements much better, because the analogue **End-stage**s can be located close to the biological objects in the shielded environment, but the digital **BioStim Controller**, can be placed anywhere else. **BioStim Computer Interface** is an alternate of the **BioStim Controller** in special cases. You can find detailed descriptions about each elements of the **BioStim** system in the appropriate manuals.

BioStim Controller

BioStim Controller is a dual-processor system. There are two independent RISC microcontrollers built into one cage. One of them, the **Repetition Cycle and Gate Controller** can be used to generate the periodical repetition trigger events, or it can be used as a gate generator to enable, or disable the output pulse sequence. The other microcontroller is the **Pulse Pattern Generator**. It is used to generate the different output pulse sequences (as listed below).

The accuracy of the time parameters in **BioStim Controller** are guaranteed by internal crystal pacers. All the programmed time parameters are stored in built-in nonvolatile memories. They hold the previously used values during switched off periods. Easy programming operations are carried out in menu system, with 4-button keypads. The displays of the microcontrollers are 4 x 20, and 2 x 16 character alphanumeric models with backlight to provide good visibility.

BioStim Controller (together with one of the **End-stage**s) can be used as a stand-alone stimulator, but both of its microcontrollers have got bi-directional digital control capabilities: Start Input, Gate Input, and Synchron Output. These TTL-compatible control bits offer a huge versatility in the different applications. **BioStim Controller** can be started externally (with rising edges at Start Inputs) from another equipment (for instance a PC), or it can be the master synchron generator (if the external equipments are triggered from its Synchron Outputs), as well.

BioStim Controller has got nonvolatile memories to store all parameters of the functions. If you use the equipment in a fixed application, you should program it one time only. If you switch the **BioStim Controller** on, it checks, which function was used last time. After it the parameters used by the actual function are checked. If the parameters have got valid values preset, the last used function will be started automatically.

BioStim Computer Interface

There is an alternate equipment, **BioStim Computer Interface** in our choice to substitute the **BioStim Controller** in that cases, when a computer software is used to generate the sequence of the stimulating pulses. **BioStim Computer Interface** has got a universal connector to connect any of **End-stage**s of Supertech, a power supply unit to supply the **End-stage**, and two TTL-compatible digital input connectors. Its TTL inputs are configured in logical OR function internally. The TTL standard describes the voltage, and load specifications of the inputs, and outputs of a logic system, what is supplied from 5V. Nowadays most of the microcontrollers, and logic systems use 3.3V of supply voltage internally. The inputs of the **BioStim Computer Interface** accept the logic levels of the 3.3V, non-standard-TTL systems correctly, with optimal noise margins, too. Basically **BioStim Computer Interface** realizes the **DC via Control** function (see later in this description) of **BioStim Controller**. If a sophisticated software is used, it is not necessary to install the **BioStim Controller**, it is enough to use the **BioStim Computer Interface**. The disadvantage of this arrangement is, that a fast computer, and an appropriate software is always necessary to be used. An independent, universal, stand-alone stimulator can be formed only by using of the **BioStim Controller**.

Programming conventions, and definition of terms in connection with the BioStim Controller

The functions are categorized in two groups. The first group contains the 'single' functions. 'Single' functions are initiated by the START event. After a START event they generate their sequence one time only (an example is Single Burst). The other category is the group of the 'repetitive' functions. They repeat their sequence periodically based on an internal crystal pacer (an example is Continual Bursts).

A subcategory of the 'single' functions is the group of the 'delayed' functions. They are the same as their appropriate 'single' equivalents, but a programmable delay is occurring at the beginning of the sequence before the first Output pulse.

START event means a keypress on START button, or a TTL rising edge appearing on Start input. The two source of Start event can be used together or independently any time (they are in logical OR relation).

You can clear all stored parameters if you press and hold F button down, while **BioStim Controller** is switched on. During programming actions the equipment checks the validity of the actual value. If you try to accept (with F button) a number out of range, the software will not allow it. If more than one parameters are incoherent, you will be asked to correct them.

UP and DOWN button is used to navigate in menus, and to modify parameter values up or down, respectively. F button is used to select a menu item, or accept a parameter value. Furthermore, F button is used to cancel a function if it is running. If

you cancel a function with F button, you will get an access to Function Choice menu. START button is used to start the sequence of pulses, if a 'single' or a 'delayed' function is selected actually. The 'repetitive' functions can be interrupted temporarily with START button (and they can be restarted again with it).

The operating modes of the Repetition Cycle and Gate Controller in BioStim Controller equipment

Repetition Cycle:

This function can be used to generate periodical repetitive trigger events in such cases, when the **BioStim Controller** is the master synchron generator of the data acquisition process (in such cases, if the external data acquisition equipment, such as a PC is triggered from its Synchron Output). In this function the Synchron output of the **Repetition Cycle and Gate Controller** provides repetitive Start events for the **Pulse Pattern Generator,** on which any of the 'single' patterns should be selected. To use the Repetition Cycle function the Synchron Output of the **Repetition Cycle and Gate Controller** should be connected to the Start input of the **Pulse Pattern Generator** with the appropriate switch at the back side of the **BioStim Controller**. The repetition cycle time (Tc) can be set from 80 ms - 60 sec, with 10 ms of resolution. A wide (50 ms) Synchron pulse is generated at the beginning of every Repetition Cycles. These Synchron pulses are the synchron pulses of the whole time sequence, if the Repetition Cycle function is used, and a 'single' pattern is initiated on the **Pulse Pattern Generator.** The **Repetition Cycle and Gate Controller** has got its own TTL-compatible Output, which is independent from the Output of the **Pulse Pattern Generator.** The Output pulse of the **Repetition Cycle and Gate Controller** (0.1 - 24.9 milliseconds in width, with 0.1 ms of resolution) can be used for any other controlling task (for instance muting the input of the preamplifier for a programmed period before appearing, and during the stimulating pulse at the Output of the **End-stage**), if it would be necessary.

Gate Generator:

This function can be used to generate a programmed enabling period for the Gated Continual function of the **Pulse Pattern Generator**. To use the Gate Generator function the TTL-compatible Output of the **Repetition Cycle and Gate Controller** should be connected to the Gate Input of the **Pulse Pattern Generator** with an external cable at the back side of the **BioStim Controller**. This combination of functions can be used to produce very long bursts of pulses. The duration of the burst is defined by the **Repetition Cycle and Gate Controller.** The timing data of the pulses, and the pauses should be programmed at the **Pulse Pattern Generator** in its Gated Continual function. The gate time (Tg) can be set from 80 ms - 60 sec, with 10 ms of resolution. A wide (50 ms) Synchron pulse is generated at the beginning of every Gate periods. These synchron pulses are accessible at the Synchron Output of the **Repetition Cycle and Gate Controller**.

The operating modes of the Pulse Pattern Generator in BioStim Controller equipment

The actually realized 12 operating modes are presented in the Appendix. They have got a graphical interpretation to explain them in fine details. In a few cases there are more than one function with which a paradigm can be carried out. You should always consider, which function is the best one to your special task.

Further development

Until now we have developed many different operating modes for **BioStim Controller**, as it is listed above. In spite of this, if you can not find the appropriate function for your special task in our actual choice, and this function seems to be interesting for other our customers, we will develop a special operating mode especially for you. It is our method, how we improve the features of our equipment. We collect all the notices and feedbacks of our customers, and we implement their (may be your) knowledge into the features of **BioStim**.

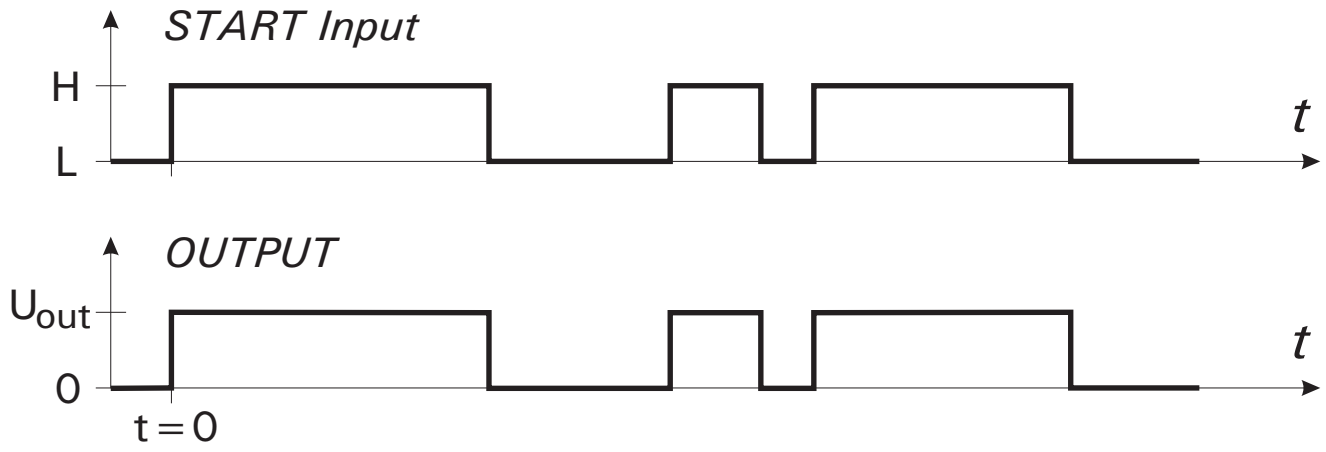
Warranty

We give you full warranty service, including rest parts for the period of 3 years by default. Longer warranty periods can also be defined and agreed (the actual conditions should be discussed before placing the order).

International technical hotline by phone: (36) (20) 9234-386

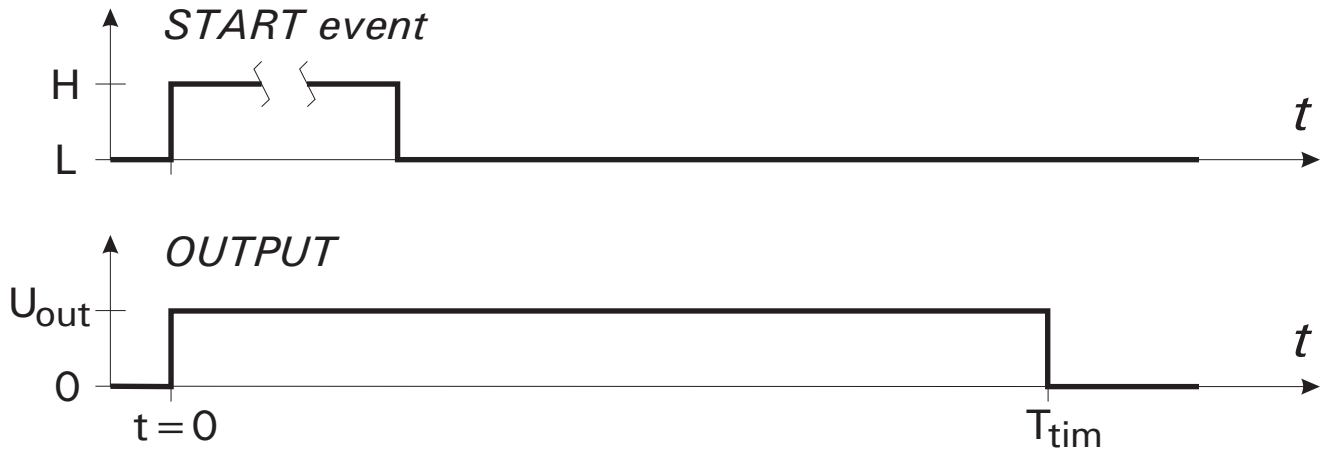
Technical hotline by email: csaba.niedetzky@superte.ch

DC via Control



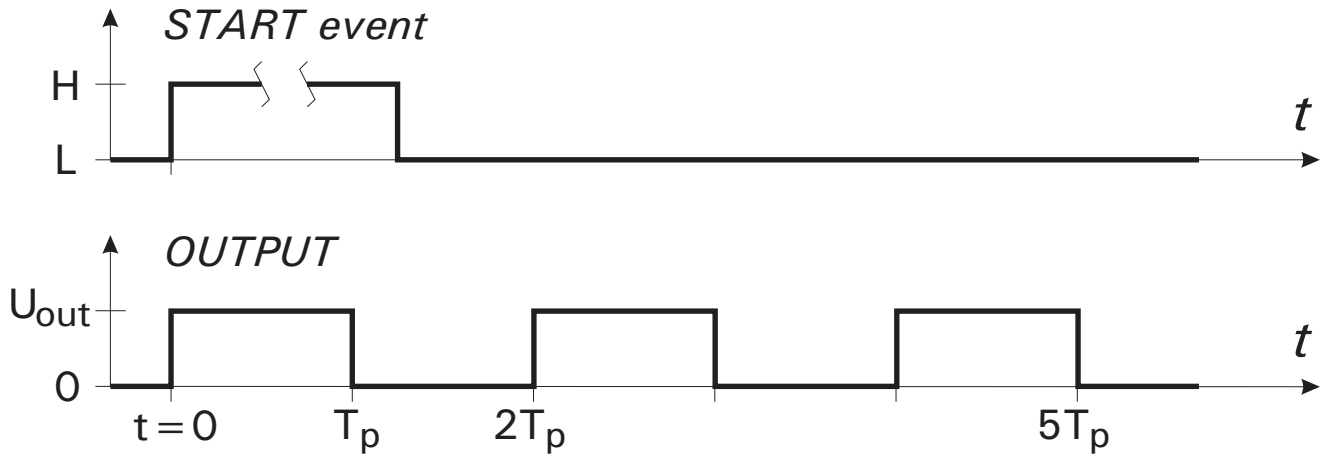
Output is active, while START button is pressed, or TTL high level is applied to START Input. This mode offers free control capability from any other equipment (e.g. another stimulator controller, or a TTL port bit of a computer).

DC by Long-Timer



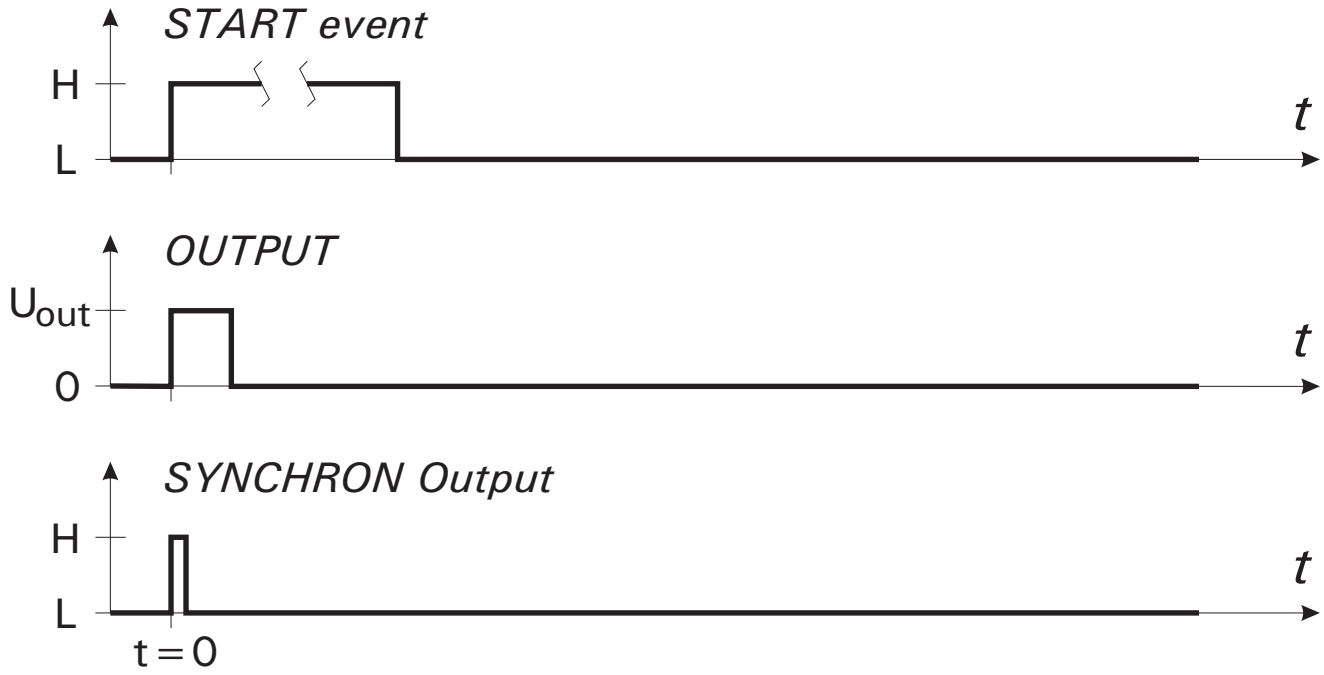
Output is active (constant DC level adjustable by the helical potmeter on the End-stage) in a programmed period, in the range of 10 - 600 sec, with 10 sec of resolution. This period starts at the beginning of the START event.

Wide Pulse/Pause



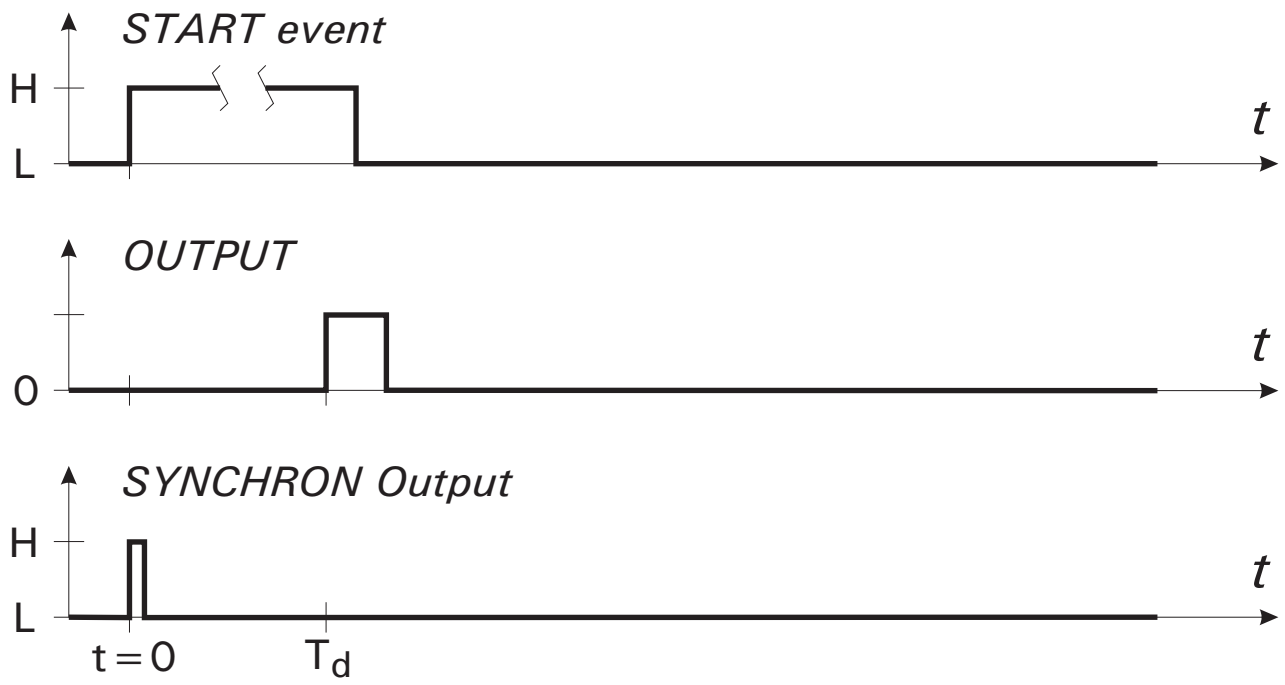
Wide pulses, and pauses (they are equal in width) are generated. The duration of the pulses (and the pauses) can be programmed from 10 - 990 milliseconds, in 10 ms steps.

Single Pulse



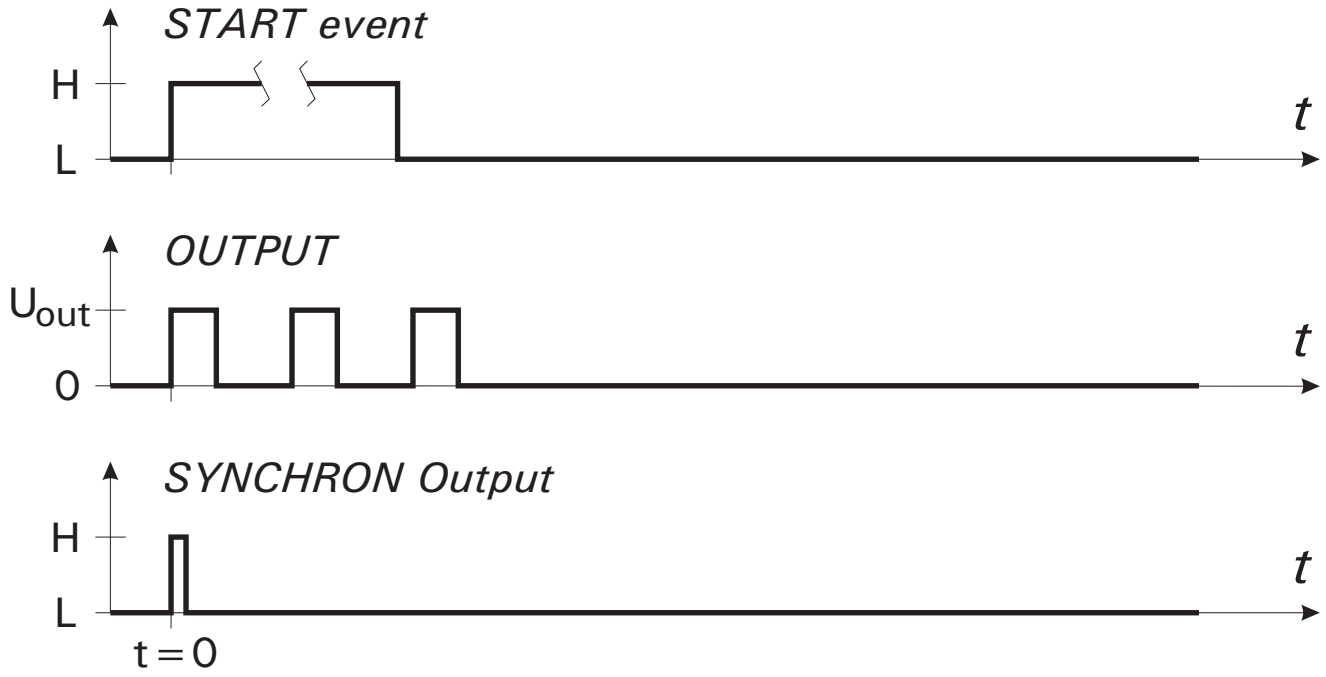
One Output pulse is generated (0.1 - 9.9 milliseconds in width, with 0.1 ms of resolution) at the START event. A Synchron pulse (50 μs) is generated at the beginning of the Output pulse. Single Pulse function is a special case of Delayed Pulse function, when delay time equals to zero.

Delayed Pulse



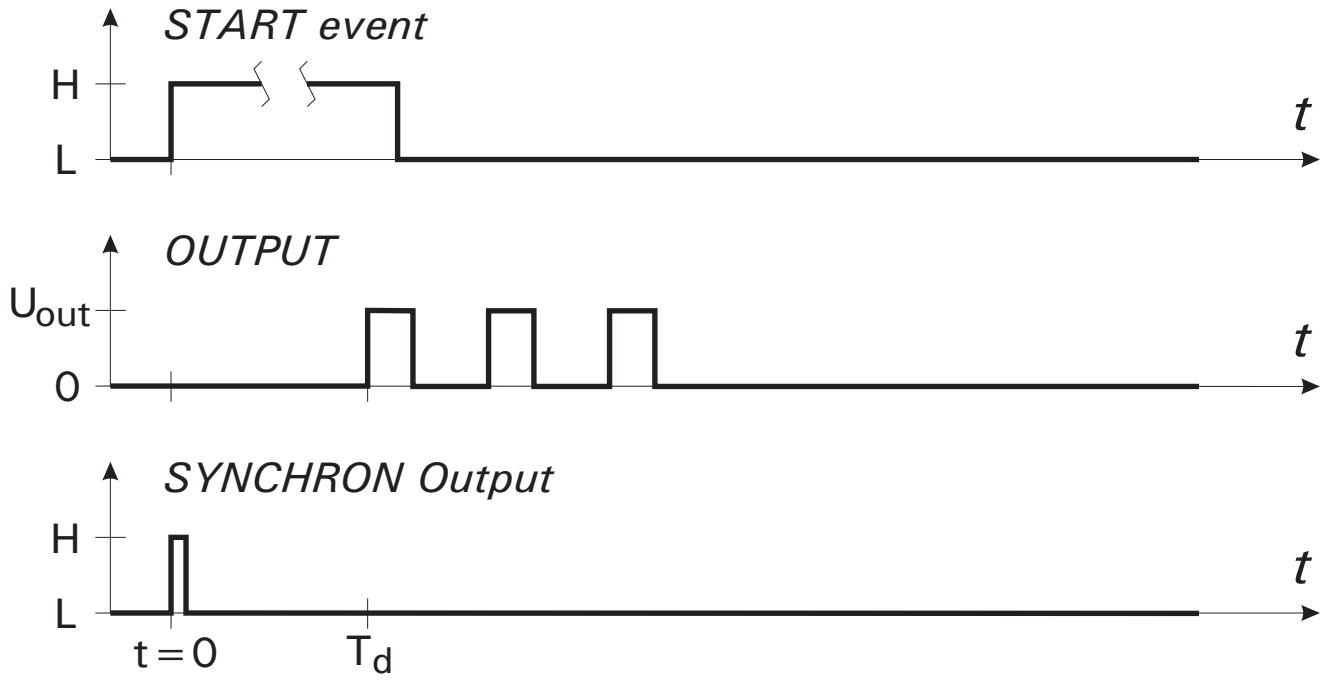
A delay (1 - 250 milliseconds in width, with 1 ms of resolution) is occurring after START event. Just after the delay time an Output pulse is generated (0.1 - 9.9 milliseconds in width, with 0.1 ms of resolution). A Synchron pulse (50 μs) is generated at the START event (at the beginning of the delay time period). Single Pulse function is a special case of Delayed Pulse function, when delay time equals to zero.

Single Burst



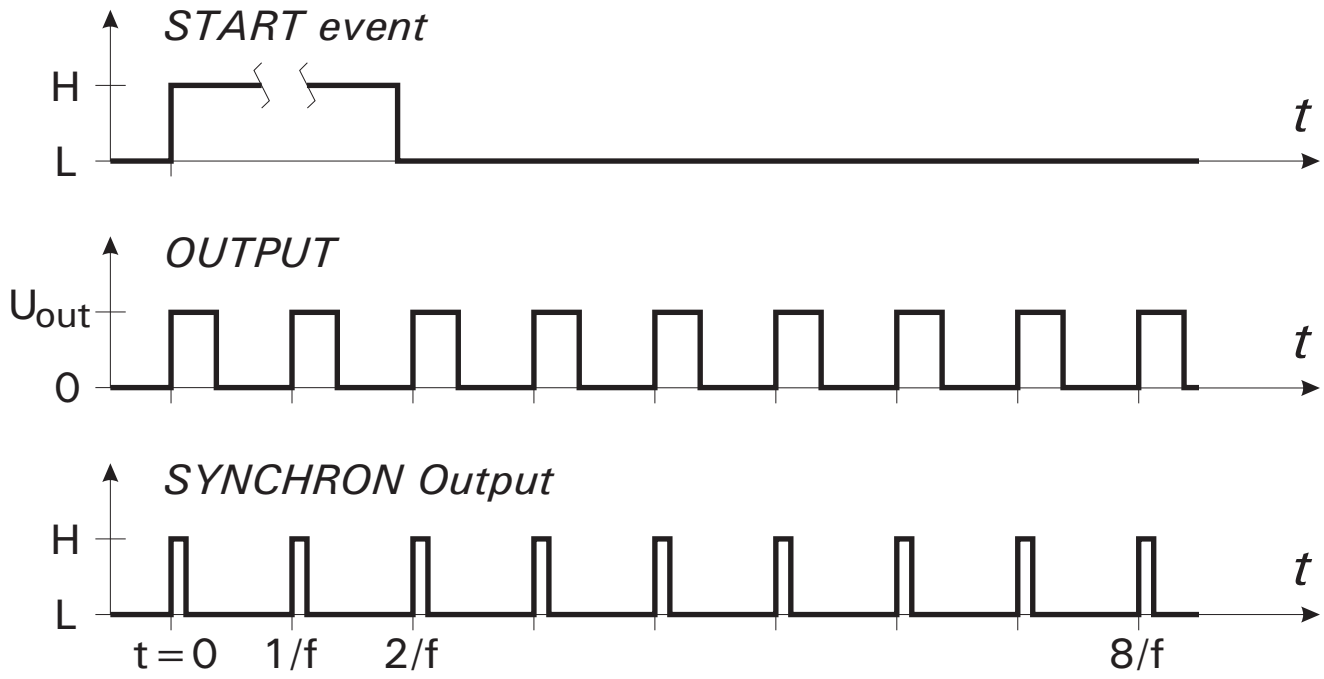
A programmed number (2 - 99 pieces) of pulses are generated at the START event. The width of the pulses, and the pauses between the pulses can be set in the range of 0.1 - 9.9 milliseconds, with 0.1 ms of resolution. A Synchron pulse (50 μs) is generated at the START event (once at the beginning of the first Output pulse, in every bursts). Single Burst function is a special case of Delayed Burst function, when delay time equals to zero.

Delayed Burst



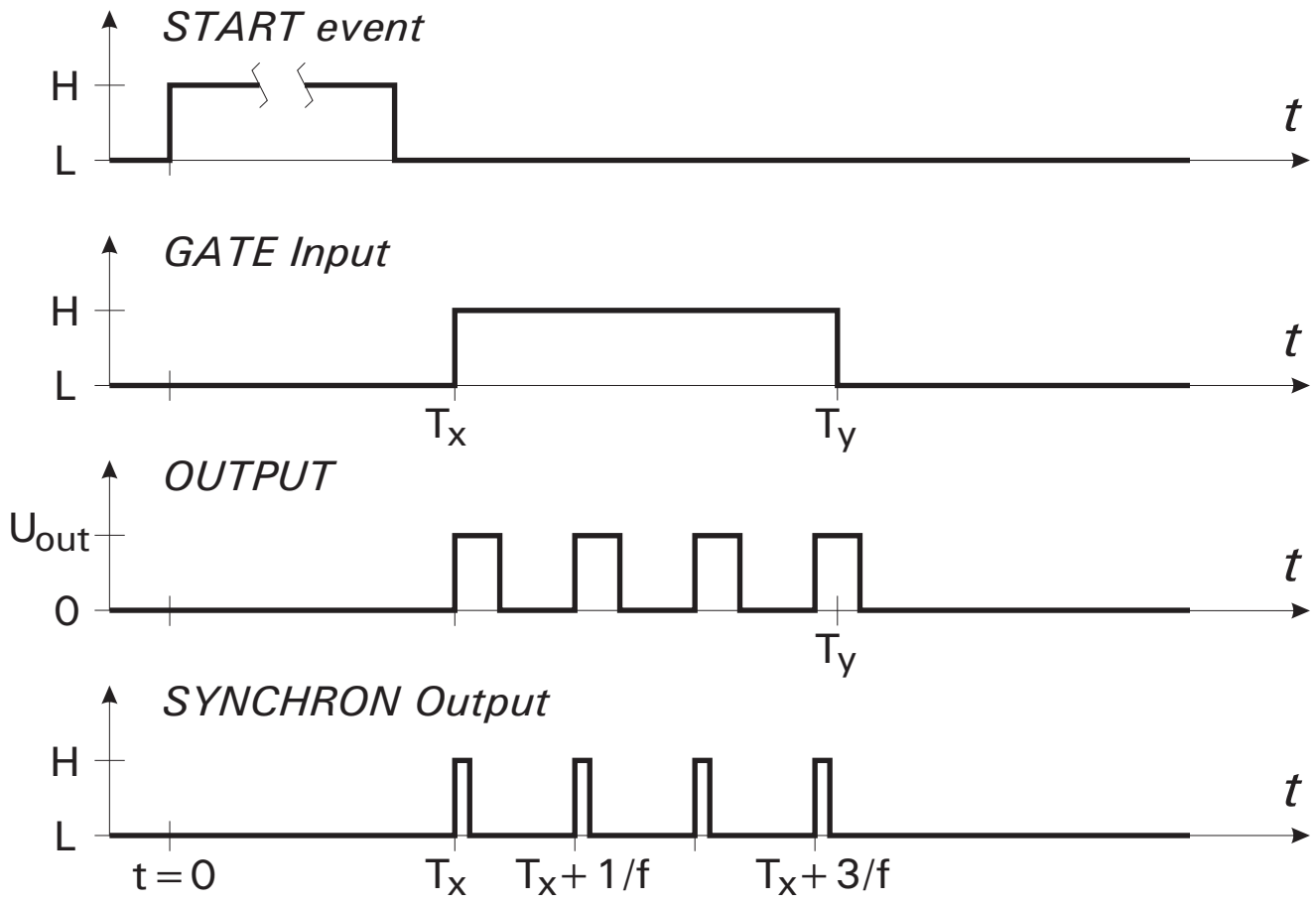
A delay (1 - 250 milliseconds in width, with 1 ms of resolution) is occurring after START event. Just after the delay time a programmed number (2 - 99 pieces) of pulses are generated. The width of the pulses, and the pauses between the pulses can be set in the range of 0.1 - 9.9 milliseconds, with 0.1 ms of resolution. A Synchron pulse (50 μs) is generated at the START event (once at the beginning of the delay time period, in every bursts). Single Burst function is a special case of Delayed Burst function, when delay time equals to zero.

Continual Pulses



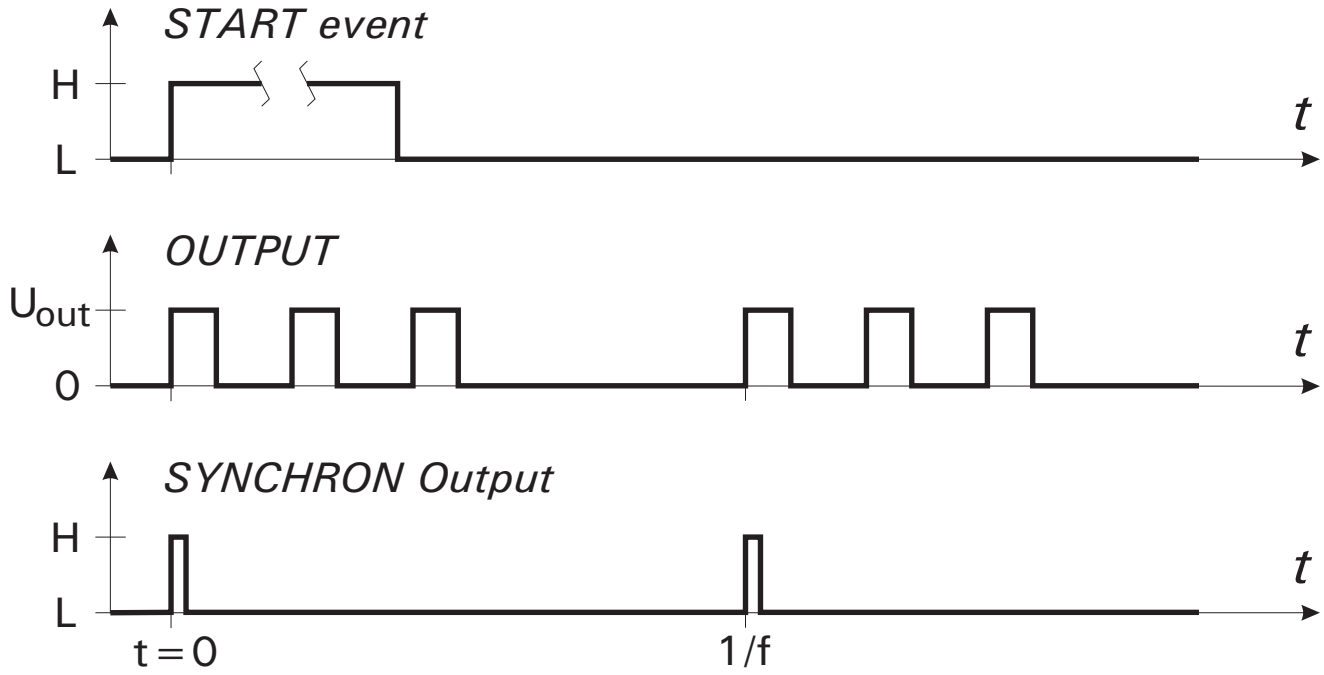
Repetitive pulses (0.1 - 9.9 milliseconds in duration, with 0.1 ms of resolution) are generated on Output. The repetition cycle time (Tc) can be set from 10 ms - 60 sec, in 10 ms steps. Synchron pulses are generated at the beginning of every Output pulses. Continual Pulses function is a special case of Gated Continual function, when BioStim Controller ignores the Gate signal, resulting continuous flow of pulses, beginning at START event.

Gated Continual



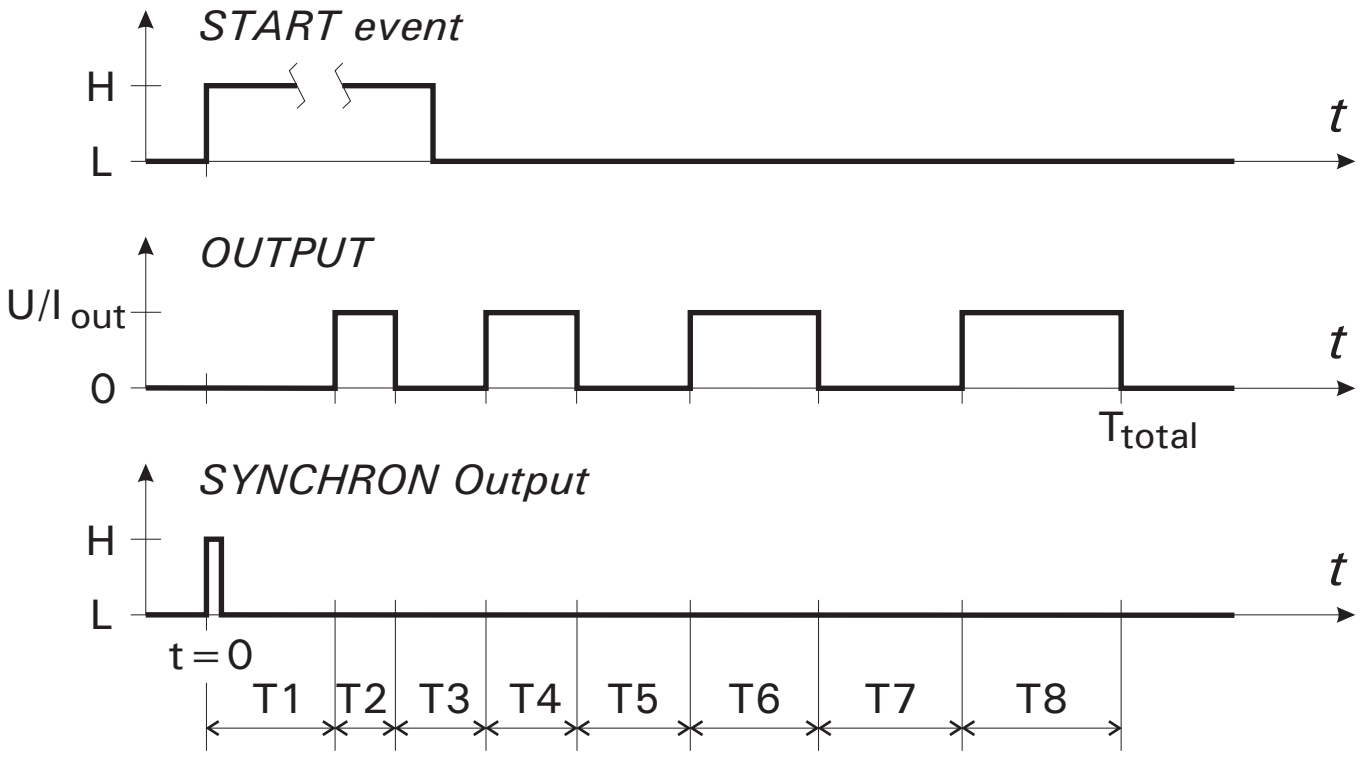
Repetitive pulses (0.1 - 9.9 milliseconds in duration, with 0.1 ms of resolution) are generated on Output. The repetition cycle time (Tc) can be set from 10 ms - 60 sec, in 10 ms steps. Synchron pulses are generated at the beginning of every Output pulses. The flow of Output pulses are disabled if TTL low level is applied to the Gate input. The pulses are never broken, because an asynchronous Gate signal is synchronised internally. Remotely controlled bursts can be realised in this function using another stimulator controller, or a computer. Continual Pulses function is a special case of Gated Continual function, when BioStim Controller ignores the Gate signal, resulting continuous flow of pulses, beginning at START event.

Continual Bursts



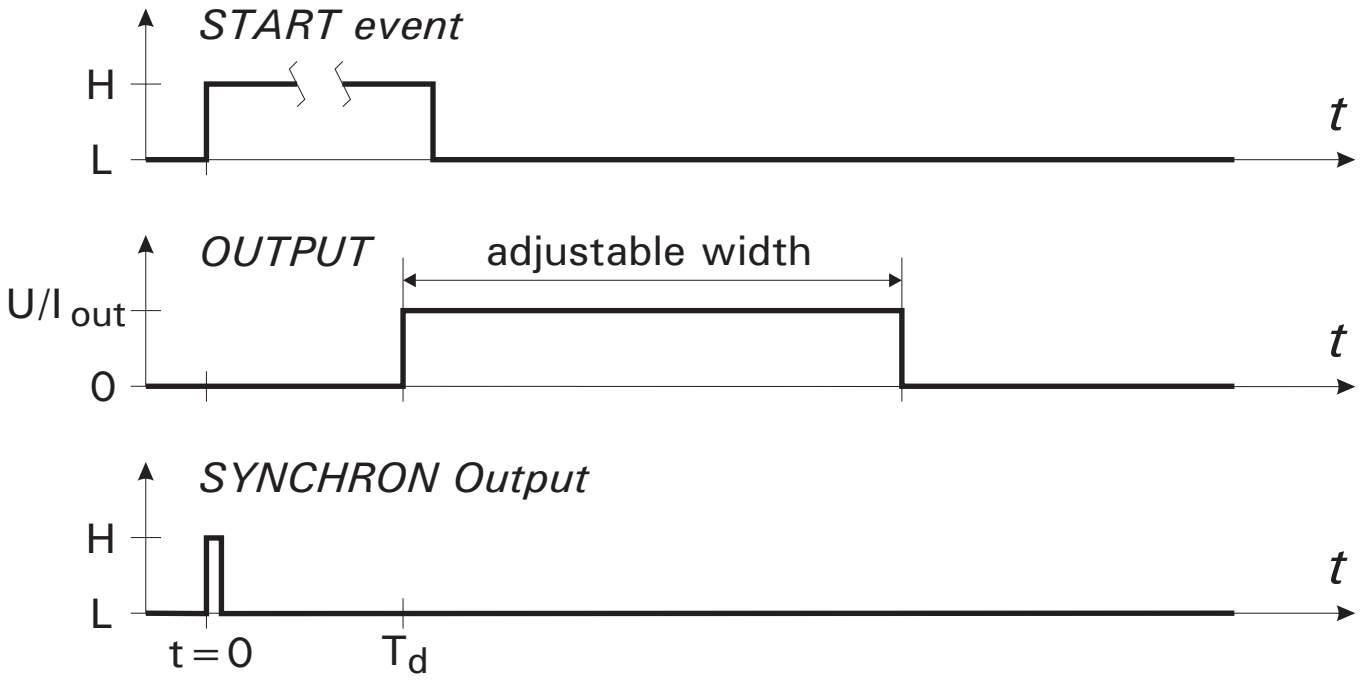
Repetitive bursts of pulses (2 - 99 pulses/cycle) are generated on the Output. The time parameters of the components in the bursts are the same as in the Single Burst, and the Delayed Burst functions. The repetition cycle time (Tc) can be set from 10 ms - 60 sec, with 10 ms of resolution. A Synchron pulse is generated at the rising edge of the first Output pulse (once at the beginning in every bursts).

Flexible Burst



A freely defined burst of pulses can be composed in this function. The number of pulses in the burst can be set from 2 to 10. The length of the pauses, and the durations of the pulses can be set independently from each other. The pauses can be programmed from 0.1 ms to 500.0 ms, with 0.1 ms of resolution. The width of pulses can be programmed from 0.1 ms to 25.0 ms, with 0.1 ms of resolution. A Synchron pulse (50 μs) is generated at START event at the beginning of the first pause (in other words at the beginning of delay time period).

Variable Pulse



A delay (1 - 250 milliseconds in width, with 1 ms of resolution) is occurring after START event. A Synchron pulse is generated at the beginning of delay time period. Just after the delay time an Output pulse is appearing. The duration of the Output pulse can be set from 10 μs to 20.0 ms, with very fine, 10 μs of resolution. The width of the Output pulse can be modified on-the-fly. If you modify the pulse width, the actual pulse will be finished with the last duration, but the next one will be produced with the new duration (at the next START event).