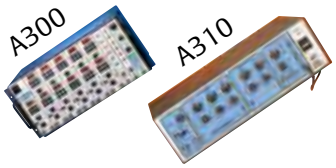
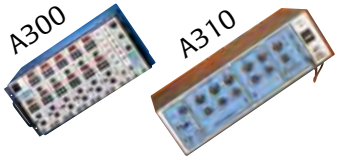
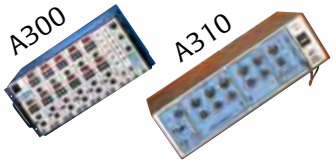
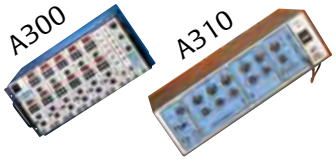
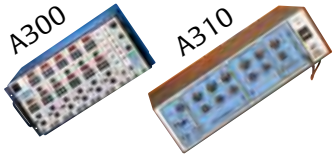
Stimulators, Isolators

	FEATURE	INPUT	OUTPUT	COMPATIBLE STIMULATOR:
A320				
	SIU/built-in stimulator	TTL	0-100 V 1 µA to 10 mA	
A365				
	Mono/Biphasic	TTL	±100 V 1 µA to 10 mA	
A385				
	High Current	TTL	±36 V 10 µA to 100 mA	
A395				
	Analog	Analog ±10 volts	±70 V 1 µA to 10 mA	
DUO 773				
	Intracellular Amplifier	Analog 0-1 volt	±500 nA	

A310 Accupulser™

Optional footswitch #3259

Combining the accuracy of digital electronics with the convenience of analog controls

A pulse generator/stimulator combining the reproducibility and accuracy of digital electronics with the fine resolution and continuous adjustment possible with analog circuitry. All timing parameters are entered with ten-turn readable potentiometers and six-position range switches. Outputs are accurate to within 1% of the set value.

Pulses can be created in continuous run, single-shot, or train/burst modes. Duration of the train/burst is easily controlled using the onboard envelope generator or by using either of two external gating inputs. Used in conjunction with the A360, A365, A385, or A395, bipolar pulses or trains may be easily produced. Output stimulus can be fed through the Duo 773 for iontophoresis. Footswitch allows hands-free operation.

Three separate outputs are available on the front panel. A Monitor output provides 10-15 V signals (up to 50 mA) for viewing the output on an oscilloscope or for controlling other devices. The stimulator's signal, simultaneously available at the Isolator output, is sufficient to drive any WPI A300 Series stimulus isolator (A360, A365, or A385) and is also TTL and CMOS compatible. The Variable output can provide signals varying between ±10 V with a resolution of 1 mV. Separate variable outputs are provided for positive and negative signals.

SYS-A310	Accupulser™ Signal Generator
	Specify line voltage
OPTIONAL ACCESSORIES	
3259	Footswitch for A310
2933	Rack Mount Kit, 5¼ in. high

A310 ACCUPULSER™ SPECIFICATIONS

TIMING PARAMETERS		
EVENT INTERVAL	100 µs to1000 s*	
EVENT DELAY	10 µs to 100 s *	
PULSE WIDTH	10 µs to 100 s *	
TRAIN DURATION (ENVELOPE)	100 µs to 1000 s*	
PULSE INTERVAL	20 µs to 100 s*	
OUTPUTS		
SYNC	5 µs, TTL, and 5 V CMOS compatible, 20 mA max.	
MONITOR	10-15 V, 50 mA max.	
ISOLATOR	TTL & 5 V CMOS compatible, 20mA max.	
VARIABLE (Pos or Neg)		
PULSED/DC	LOW RANGE	HIGH RANGE
Range	0 to ±1 V	0 to ±10 V
Resolution	1 mV	10 mV
NOISE		
Pulsed at 100 kHz bandwidth	<500 µV	
DC Wide Band	<500 µV	
OUTPUT IMPEDANCE	<1 Ω	
INPUTS		
EXTERNAL SYNC	Accepts 1-µs minimum pulses TTL, CMOS compatible	
EXTERNAL GATE	Accepts 1-µs pulse to continuous TTL, CMOS compatible	
POWER	95-130 V or 190-260 V, switch selectable single phase, 50/60 Hz	
DIMENSIONS	17 x 5.25 x 10 in. (43 x 13 x 25 cm)	
SHIPPING WEIGHT	14 lb (6.4 kg)	

**Continuously variable in six ranges. All accuracies better than 1% of set value. 50kHz maximum pulse frequency.*

A300 Pulsemaster™ Multi-Channel Stimulator

CE

The Pulsemaster™ (Model A300) is WPI's third generation, multichannel, pulse/train generator/stimulator that combines the superb accuracy of digital electronics with the "you-see-what-you-get" displays only available on single-channel products. In one compact rack mountable enclosure, the Pulsemaster contains an event interval generator, five pulse train channels, two mixing channels and a very quiet variable voltage output channel. System timing is accurate to 100 ppm; output timing is continuously variable in 0.1% of full scale increments over a range of eight orders of magnitude. Bright, three-digit LED displays continuously and simultaneously show all the variable timing parameters.

An integrated five-channel pulse generator/stimulator including one interval generator, five pulse or train channels, two mixer channels and one very quiet variable voltage output stage

The Pulsemaster is designed for ease of use and flexibility. Each channel can be operated synchronized with the onboard event interval generator, triggered manually from any other channel or external source, and as an independent asynchronous pulse generator. Except for the external source, all channel interconnections are accomplished on the panel, without the use of cables. The output from each channel is compatible with standard digital circuitry and is also designed to drive WPI's A300 series stimulus isolators. If desired, any channel's output may be internally connected to the variable channel, whose amplitude can be continuously adjusted from millivolts to ten volts.

SYS-A300 Pulsemaster™ Multi-Channel Stimulator
Specify line voltage

A300 PULSEMASTER SPECIFICATIONS

EVENT INTERVAL CHANNEL

Operating Modes	EXTernal SYNC, SINGLE EVENT, CONTINUOUS ON
Input RS232C compatible	EXT SYNC accepts ≥ 1µs pulses; TTL, CMOS,
Timing	EVENT INTERVAL 10 µs to 999 s (100 kHz - 0.001 Hz), ±0.1% of full scale, continuously variable in 0.1% of full scale increments, through three orders of magnitude, in six ranges
Output	SYNC OUT pulse of ≈6 µs, TTL, 5 V CMOS compatible

PULSE TRAIN CHANNEL (5 provided)

Operating Modes	EXTernal SYNC, SELF SYNC, manual SINGLE event, sync from Event Interval, sync from any of other four Pulse Trains, sync from one of the MIXers, off, TRAIN/PULSE
Input	EXT SYNC accepts ≥ 1µs pulses; TTL, CMOS
Timing	DELAY and WIDTH 10 µs to 999 s, ±0.1% of full scale
Output	OUTPUT PULSE/TRAIN of preset timing, TTL, 5 V CMOS compatible, 4 mA sink and source

MIXER CHANNEL (2 provided)

Inputs	Any combination of an EXTernal pulse, the outputs of the five Pulse Train channels, and DC continuous ON/ DC MOMentary EXT INPUT accepts ≥ 1µs pulses
Output	OUTPUT, TTL, 5V CMOS compatible, 4 mA sink and source

VARIABLE CHANNEL

Inputs	Output from any one PULSE TRAIN channel or one of the two MIXER channels or DC
Output	0 to +1 V low range, 1 mV resolution 0 to +10 V high range, 10 mV resolution 5 mA max sink and source
Output Impedance	<1 ohm
Noise	<500 µV peak @ 100 kHz bandwidth, PULSED mode <500 µV, wide band, DC mode
Signal Ground	Floating, *i.e.,* not connected to chassis

POWER	95-135 V or 220-240 V, 50/60 Hz
BATTERIES	Three 1.2 V DC, size AA, NiMH batteries
DIMENSIONS	8.5 x 19 x 8.75 in. (22 x 45 x 22 cm)
SHIPPING WEIGHT	21 lb (9.5 kg)

Isostim™ Stimulator/Isolator

Combining the ease of use and accuracy of WPI's 300 Series stimulators with the power output of a stimulus isolator

Timing

Pulse interval and width are set with single-turn continuously variable controls from 5 ms to 5.5 s in three ranges. Pulse width is continuously variable from 50 µs to 550 ms in four ranges.

Modes of operation

In FREE RUN, Isostim™ generates continuous square waves. In EXT GATE or EXT SYNC modes, externally applied pulses can generate trains or single events. Single pulses of finite duration can be produced using a push-button on the instrument's front panel. EXT/DC mode converts Isostim to a passive stimulus isolator.

Dual tone audible alarm

A tone sounds when an open circuit is detected or when system compliance is reached. A second tone, which sounds when a signal is applied to the input, can only be heard if the batteries have sufficient charge to operate the isolator. A violation light advises when pulse width exceeds the interval.

Current delivery

Stimulus currents up to 10 mA can be set on the front panel with a control knob and a two-position range switch. Output current is load-independent.

Power

Isostim model A320D is powered by readily obtainable 9-volt alkaline batteries (included). Under average use these will last several months before replacement is required. The rechargeable A320R is supplied with a nickel metal hydride battery stack which provides 10-12 hours of operation before recharge is required. **The A362 Battery Charger must be used with the A320R.**

ISOSTIM™ SPECIFICATIONS

TIMING PARAMETERS	
Interval	5 ms to 5.5 s continuously variable in three ranges (0.18 to 200 Hz)
Pulse width	50 µs to 550 ms continuously variable in four ranges
INPUT	
External sync	Accepts 1 µs minimum pulses
External gate	Accepts 1 µs pulse to continuous
External command voltage	5.0 V at 3.0 mA (TTL level), 10 V max.
Trigger threshold	2.0 V at 0.5 mA
OUTPUT	
Waveform	DC, pulse from internal timing or externally generated pulse
Current ranges	0-1 mA, 0-10 mA
Load voltage excursion (compliance)	100 V nom., 150 V max.
Output polarity	Reversible, manual switch
Current rise time and delay	8 µs, typical (1 K Ω load)
Current fall time and delay	10 µs, typical (1 K Ω load)
Leakage resistance, output to ground	10^{12} Ohms
Optocoupler	2500 V rated min. breakdown voltage
POWER	
Dry Cell (Version D)	16 alkaline 9V batteries included
Rechargeable (Version R)	16 rechargeable NiMH 9V batteries incl
DIMENSIONS	8.5 x 3.5 x 4.9 in (22 x 9 x 12 cm)
SHIPPING WEIGHT	4 lb (1.8 kg)

A362 Battery Charger

Required for A320R, A365R and A395R

Recharges the high-voltage nickel-cadmium or NiMH battery stack in the A320R, A365R or A395R. LED lamp indicates charging status. Full charge overnight. Dimensions: 2.8 x 4.1 x 5 in. (7 x 10 x 13 cm). Shipping weight: 4 lb (1.8 kg).

SYS-A362	Battery Charger for A320R, A365R, A395R
A320RC	A320R with Charger (A362)
SYS-A320D	Isostim™ Stimulator/Isolator
SYS-A320R	Isostim™ Stimulator/Isolator (rechargeable)

Specify line voltage

OPTIONAL ACCESSORIES	
DRL	Dummy Load Resistor Kit (set of 3)
13347	BNC-to-Double Banana Adapter

Stimulus Isolator / Precision Current Source

Model A365 includes the same features and specifications as A360 but with the added capability for automated bipolar pulsing for zero net charge on biological preparations.

Polarity — Output polarity is determined by a push switch on the front panel. Bipolar current is toggled by the command waveform, setting alternating pulses as positive or negative.

A365 SPECIFICATIONS

OUTPUT WAVEFORM	DC or current pulse
OUTPUT CURRENT RANGES	0.1, 1.0, and 10 mA
CURRENT AMPLITUDE ERROR	0.5% of full scale, max.
CURRENT RESOLUTION	0.1% of full scale, typical
OUTPUT LOAD VOLTAGE EXCURSION (COMPLIANCE)	100 V
EXTERNAL COMMAND VOLTAGE	5.0 V at 3.0 mA (TTL level), 10 V max.
TRIGGER THRESHOLD	2.0 V at 0.5 mA
OUTPUT POLARITY	Reversible, manual switch or automatic
CURRENT RISE TIME & DELAY	6 µs, typical (1 KΩ load)
CURRENT FALL TIME & DELAY	10 µs, typical (1 KΩ load)
OUTPUT TO GROUND RESISTANCE	$10^{12}\Omega$
OPTOCOUPLER	2500 V, rated min. breakdown voltage
POWER	
Model A365D (dry cell)	16 alkaline 9 V batteries, included
Model A365R (rechargeable)	16 rechargeable NiMH 9 V batteries incl.
DIMENSIONS	8.5 x 3.5 x 5 in (22 x 9 x 12 cm)
SHIPPING WEIGHT	4 lb (1.8 kg)

SYS-A365D	High Voltage Isolator, Bipolar, alkaline batteries
A365RC	A365R with charger (A362)
SYS-A365R	High Voltage Isolator, Bipolar, rechargeable
SYS-A362	Battery Charger for A320R, A365R, A395R

Specify line voltage

OPTIONAL ACCESSORIES

DRL	Dummy Load Resistor Kit (set of 3)
3468	Dual Rack Mount Kit for A365
3469	Single Rack Mount Kit for A365
13347	BNC-to-Double Banana Adapter

DRL — Dummy Load Resistor Kit
Converts current output to precise voltages.

Combines optical isolation with a ±100 mA current generator

A385 High Current Stimulus Isolator

Delivers positive, negative, or bipolar currents. For bipolar delivery, polarity of the output is toggled to the opposite state with each pulse presented to the input. Pulse duration is controlled by an externally applied voltage. Input connector is a standard BNC, allowing signals from any source — such as computer D/A or I/O lines — to be used.

Output amplitude is set on a 3-digit, ten-turn dial as a percentage of the range selected: for example, a setting of 45.6 in the 0-10 mA range translates to 4.56 mA at the output. Accuracy and repeatability are excellent. Designed for subcutaneous stimulation, maximum output voltage at the stimulating electrodes is 36 volts, reducing the possibility of serious accidental transcutaneous shocks. A compliance/output alarm sounds when the 36-volt limit is reached. Internal circuitry maintains electrodes short-circuited during inactive periods ("electrode exhauster" feature). A385 is not appropriate for transcutaneous stimulation.

The 1.2 amp-hour rating of the six heavy-duty lead-acid rechargeable batteries ensures that experiments will not be interrupted by dead batteries — even at peak currents. Indicator lights and audible alarms keep the user constantly apprised of battery charge status. These batteries must be recharged by the A382 System Charger designed especially for the A385.

A385 SPECIFICATIONS

OUTPUT WAVEFORM	DC or current pulse
OUTPUT CURRENT RANGES	1, 10, and 100 mA
CURRENT AMPLITUDE ERROR	0.5% of full scale, max
CURRENT RESOLUTION REPEATABILITY	0.1% of full scale, typical
OUTPUT LOAD VOLTAGE EXCURSION (COMPLIANCE)	36 V
EXTERNAL COMMAND VOLTAGE	5.0 V at 3.0 mA (TTL level), 10 V max.
TRIGGER THRESHOLD	2.0 V at 0.5 mA
OUTPUT POLARITY	Reversible, manual switch, or electronically switched bipolar delivery
CURRENT RISE TIME AND DELAY	6 µs, typical (1 KΩ load)
CURRENT FALL TIME AND DELAY	10 µs, typical (1 KΩ load)
OUTPUT TO GROUND RESISTANCE	10^{12} Ω
OPTOCOUPLER	2500 V, rated minimum breakdown voltage
POWER	Six rechargeable lead-acid batteries (Requires companion charger A382)
DIMENSIONS	8.5 x 3.5 x 5 in. (22 x 9 x 12 cm)
SHIPPING WEIGHT	5 lb (2.3 kg)

A385RC	A385R with A382 Charger
SYS-A385R	High Current Isolator, rechargeable
SYS-A382	Battery Charger for A385 (see below)

Specify line voltage

OPTIONAL ACCESSORIES

3468	Dual Rack Mount Kit

A382 Battery Charger

An innovative three-step charger, A382 employs fast, medium, and trickle charges at a safe, low current, greatly extending battery life. After a fast initial phase, the charger automatically switches to a constant voltage mode. When charging is complete, the charger switches to the trickle-charge mode. LED lamps indicate charging status. *(For use only in charging batteries installed in the A385.)*

A382 SPECIFICATIONS

POWER	95-135 V or 220-240 V, 50/60 Hz
DIMENSIONS	8.5 x 3.5 x 5 in (22 x 9 x 12 cm)
SHIPPING WEIGHT	5 lb (2.3 kg)

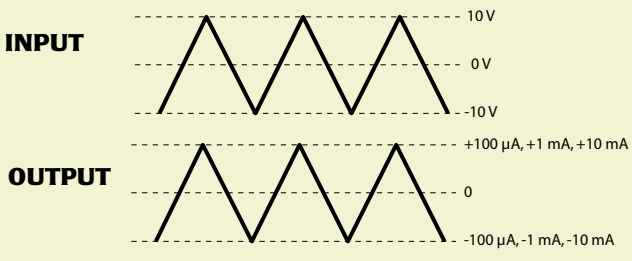
A395 Linear Stimulus Isolator

Replicates a programmed waveform of any shape or polarity

All WPI stimulus isolators are designed to supply constant current because current threshold (not voltage) is the most quantitatively reproducible parameter for stimulation of nerve and muscle. Model A395 dispenses current reproducibly from its Output terminals; the amplitude being determined by the selected current RANGE and the input voltage. Current amplitude is "constant", that is, load resistance independent, provided that the I x R (load) product does not exceed the available battery supply voltage. A visual indicator (the compliance LEDs) displays if I x R reaches this limit. When the unit is out of compliance, one of the two LEDs (labeled - and +) illuminate, depending in which direction the current is flowing. Model A395 D can generate a voltage of 70 volts or more across its OUTPUT terminals. Thus, the user can be sure that the amplitude of the current will be as dialed as long as the voltage drop across the load (stimulus electrode path) does not reach the magnitude of the supply voltage. The compliance LEDs will then be visible. The user would then know that (a) too much current was dialed for a given load or (b) inter-electrode resistance was too high or the electrode circuit path was open.

Model A395 generates an output current of arbitrary (user-defined) wave shape; DC, AC, pulse, and combinations thereof. Battery operated, and photoelectrically-isolated from the input voltage drive, the instrument regenerates output currents which are linearly proportional to the analog voltage waveforms provided by your D/A converter or signal generator (see diagram below).

The A395 is ideally suited for data acquisition and stimulator generators. It can be easily daisy-chained for mutiple channel requirements.



Accepts analog input

Current Delivery —A 10 V input produces the maximum output current for the current range selected, *i.e.,* 100 µA, 1 mA, or 10 mA. Front panel controls allow DC current to be generated. Externally applied signals can be superimposed simultaneously (DC offset). Warning lamps indicate open circuit or excessive current conditions.

Digital Meter — Measures DC or average output current.

Overload Lamps — Indicate when output voltage has reached positive or negative compliance voltage limit.

A395RC	A395R with Charger (A362)
SYS-A395D	Linear Stimulus Isolator
SYS-A395R	Linear Stimulus Isolator, Rechargeable
SYS-A362	Battery Charger

Specify line voltage

OPTIONAL ACCESSORIES

3468	Dual Rack Mount Kit
3469	Single Rack Mount Kit

A395 SPECIFICATIONS

OUTPUT CURRENT, I_{max}	3 ranges: 100µA, 1 mA, and 10 mA
OUTPUT VOLTAGE RANGE	± 70 V
OUTPUT BANDWIDTH	10 kHz (measured across 1KΩ load R)
INPUT RESISTANCE	> 20 MΩ
INPUT VOLTAGE @ I_{max}	± 10 volts
INPUT/OUTPUT LINEARITY ERROR	< 0.5%
RISE, FALL TIME	26 µs @ 10 KΩ
POWER	
Model A395D	17 alkaline 9 V batteries
Model A395R	17 rechargeable NiMH 9 V batteries
DIMENSIONS	6.5 x 4 x 3.5 in. (16 x 10 x 9 cm)
SHIPPING WEIGHT	4 lb (1.8 kg)

A362 Battery Charger

Required for A320R, A365R and A395R

Recharges the high-voltage nickel-cadmium or NiMH battery stack in the A320R, A365R or A395R. LED lamp indicates charging status. Full charge overnight.

Dimensions: 2.8 x 4.1 x 5 in. (7 x 10.5 x 12.7 cm).

Shipping weight: 4 lb (1.8 kg).