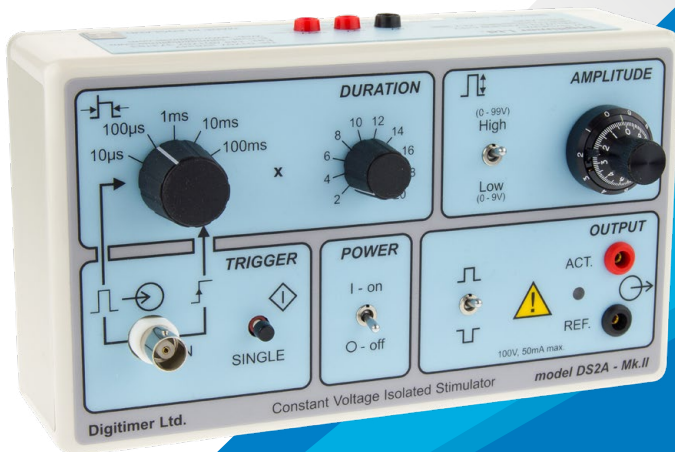


Digitimer

DS2A Isolated Stimulator with Constant Voltage Output OPERATOR'S MANUAL



PRODUCT REGISTRATION

Please take time out to register your new product.

You can even do it online at:-

www.digitimer.com/register



The **Digitimer** DS2A Isolated Stimulator with Constant Voltage Output

CONTACT ADDRESSES

Manufacturer

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Please contact **Digitimer** for information regarding representation in other countries.

PURCHASE INFORMATION

A record of salient information, on this page, will aid the Operator should this information become necessary in the future.

Date of Purchase:

Dealer:

Dealers Tel. Number:

Dealers Fax Number:

Dealers e-mail address:

Contact name at Dealer:

Serial Number of Unit:

Other Notes:

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PRODUCT REGISTRATION

For a speedy response to all your questions now and in the future, please take time out to register your new **DS2A** stimulator at **www.digitimer.com/register now!**

Product registration permits us to quickly advise you of any safety matters or new product information.

This web address is your point of contact for all questions regarding the DS2A. The contents of this site are now growing rapidly, so please bookmark it so that you can visit it regularly to check out the new items.

Why Register your purchase?

Digitimer periodically offers enhancements and firmware updates to our products. Without product registration, users of our products may miss out on announcements of important enhancements to the products that they are using. Digitimer Limited does not make our customer list available to anyone else. Any information that you provide to us is strictly confidential.

How to Register your purchase

Product registration can be accomplished in two ways. You may fill out and mail in the product registration/warranty card supplied with each Digitimer Limited product. You may also register on-line at our **www.digitimer.com/register** website.

Product announcement mailing list

Digitimer has E-mailing lists which we use as our primary outlet for announcements of new products, product enhancements and product updates. We strongly recommend that all users of our products sign up for the list that is most appropriate to their area of interest. E-mail is kept to a minimum and list membership is kept in the strictest confidence. Only Digitimer Limited can send mail to members of our e-mailing lists.

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EU DECLARATION OF CONFORMITY

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 EN45014

Manufacturer's Name: Digitimer Ltd
Manufacturer's Address: 37 Hydeway
Welwyn Garden City
Hertfordshire.
AL7 3BE
England

as the manufacturer of the apparatus listed, declare that the product (s):

Product Name: Isolated Stimulator
Model Number: DS2A - Mk.II
Product Options:

conforms to the following Standards:

EN50082-1 : 1992;
EN50081-1 : 1992;
EN61010-1 : 1993.

The products herewith comply with the requirements of:

the EMC directive 89/336/EEC as amended by 92/31/EEC
and
the Low Voltage Directive 73/23/EEC as amended by 93/68/EEC

The products were tested in a typical configuration.

Issued on: June 30, 2000

Authorised by:  John R Smale
Technical Director

HISTORY OF THE DS2A

The DS2A is the most recent isolated stimulator in a long line that spans back over 30 years. The line started with the Devices Ltd model 2530, then through Mk II, Mk III and Mk IV to the 2533 - all of which needed a -12V trigger signal. The DS2 evolved using self-contained, readily available, 9V batteries and worked with either a -12V or +12V trigger input. The DS2A is characterised for use with positive trigger signals that also include most "TTL" outputs. A negative signal can also be used as described below.

The DS2A provides an isolated source of power and is isolated from the trigger source by an optical device which ensures a very low capacitive coupling between trigger source and stimulator of approximately 3pF. The self-contained batteries, without a DC-DC converter, ensure that the stimulator is ultra-quiet and does not induce any high-frequency noise into the recording system.

A ten-turn dial on the front panel of the instrument provides a continuous adjustment of the maximum available output which is indicated on the vernier dial as a percentage of the maximum 99V output. The existence of an output pulse is indicated by an LED.

The output impedance is dependent on the position of the amplitude control. When set to the mid position, the output impedance is 1.25k ohms dropping to 200 ohms at either end. The range of pulse widths available can be varied using a five-position switch and multiplier within the range 20microseconds to 2 seconds.

A feature of this stimulator is the automatic overload circuit preventing excessive output current being drawn by reducing the output pulse width to less than 10 μ s when an overload current is detected. An overload current is sensed when the output reaches approximately 50mA. It is also worth noting that battery current is only drawn when the stimulator is delivering an output pulse.

The stimulator may be mounted in a 19" rack using a mounting frame (model D121-11) specially fabricated by Digitimer Ltd. Alternatively, the unit may be clamped to a laboratory stand by means of a 1/4" diameter rod, available from Digitimer Ltd., using 0.25" DCA rod clamps.

The stimulator is produced in a box made of an insulating material and may therefore be connected to a metal mounting frame without connecting the internal circuits of the instrument to ground.

In 2021 the DS2A was internally updated with a new PCB that is fitted with surface mount (SMT) rather than thru-hole components.

HARDWARE & CONTROLS OVERVIEW

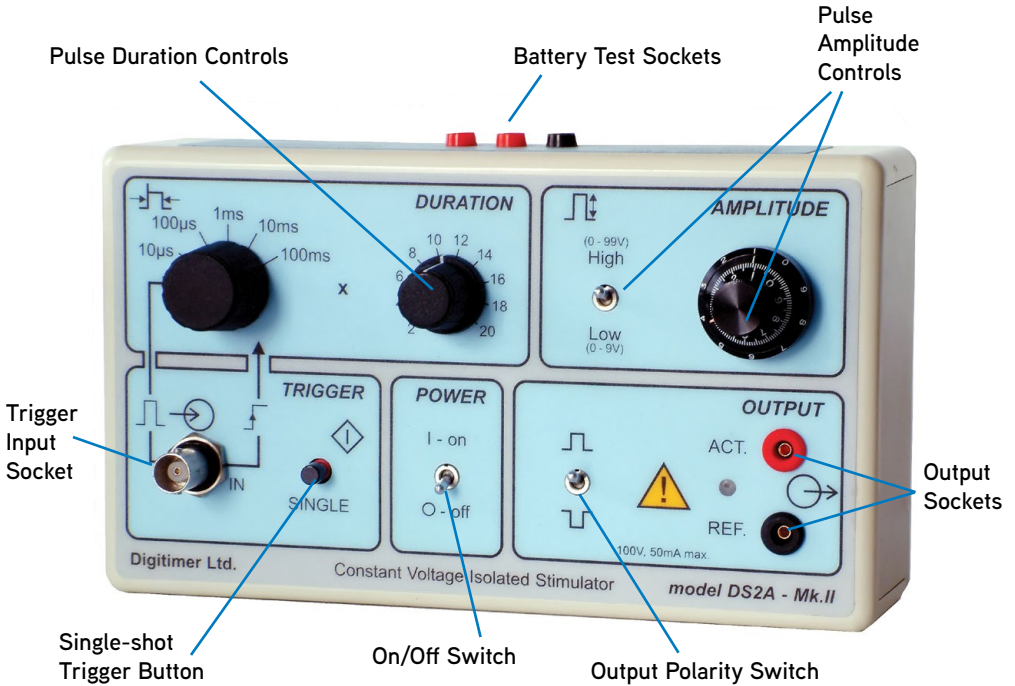


Figure 1 – DS2A Front panel connections and controls.

The DS2A provides a precise Constant Voltage stimulus controllable in Pulse Duration and Amplitude from self-contained batteries.

The range of pulse duration's available may be varied using a six-position switch and multiplier within the range 20µs to 2 seconds, as well as being externally controlled.

The DS2A features two voltage output ranges – “Low” and “high” which allow output amplitudes of 0-9V and 0-99V respectively. A two-position toggle switch selects the active range, while a ten-turn dial on the front panel of the instrument provides a continuous adjustment of the output amplitude. A locking lever prevents inadvertent changes in amplitude.

In order to prevent damage, this locking lever must be released before adjustment of the dial.

The presence of an output pulse is indicated by an LED located next to the output sockets.

The Output is isolated from the trigger source by an optical device that ensures a very low capacitive coupling between trigger source and stimulator to reduce artefact.

The self-contained batteries, without a DC-DC converter, ensure that the stimulator is ultra-quiet and does not induce any high-frequency noise into the recording system.

It is also worth noting that battery current is only drawn when the stimulator is delivering an output pulse. This greatly extends the life of the batteries.

The stimulator is produced in a box made of an insulating material and may therefore be connected to a metal mounting frame without connecting the internal circuits of the instrument to ground.

MAJOR FEATURES

- Self-contained unit using standard internal batteries.
- Output is isolated from trigger source.
- Low current consumption. No current used when no output pulse.
- Triggers from most sources. From 3V, 5 μ s upwards.
- Single shot button.
- Wide Constant Voltage range (0-9V and 0-99V)
- Accurate and repeatable Voltage Amplitude
- 50mA current overload limit
- Indication of every output pulse delivered.
- Wide range of Pulse Durations (20 μ s to 2 seconds, Internal)
- External control of Pulse Duration (using External Control position).
- Accurate and repeatable Pulse Duration.
- Output polarity reversal switch.
- Touch-proof 2mm output sockets.

SYMBOLS USED













	Off (power) - Indicates OFF position of Battery Power switch.		On (power) - Indicates ON position of Battery Power switch.
	Input - signal input connector.		Output - stimulus output connector.
	Positive going pulse required.		Active "high" square wave pulse required.
	"Start Process" Manual Trigger Button (Single).		Warning, consult accompanying documents.
	Output Pulse Duration Controls.		Output Pulse Amplitude Controls.
	Normal Polarity Output Pulse. Red socket goes positive wrt Black socket.		Reverse Polarity Output Pulse. Red socket goes negative wrt Black socket.

Table 1 - Symbols used on the DS2A.

TRIGGER SOURCES & INPUT REQUIREMENTS

Digitimer Ltd offer a growing range of trigger sources. These range from simple pulse generators and other timing modules of the **NeuroLogtm** system through to crystal-controlled programmers.

Input Requirements

The DS2A stimulator will trigger only from a positive pulse. Should it be necessary to use a negative trigger pulse, this can be done as the BNC socket is isolated from the rest of the circuitry. By connecting the centre of the input BNC socket to ground (or common) and driving the body of the BNC negative, the unit triggers as normal.

The amplitude of the trigger pulse applied to the BNC socket on the front panel should be between 3V and 15V when loaded by the input circuit of the stimulator.

The trigger input characteristics graph shows the minimum usable pulse width ($\mu\text{s}/\text{V}$) and the minimum input current (mA/V) to ensure satisfactory operation.

The stimulator will trigger from the leading edge of the trigger pulse with a delay of approx. $20\mu\text{s}$ at 2.5V reducing to $6\mu\text{s}$ at 5V. As the graph shows, if a higher amplitude trigger pulse is available, it should be used. This lowers the pulse width required as well as the delay generated by the unit.

Single Shot: A single-shot facility is provided by means of a push button, which operates at all times irrespective of other trigger inputs.

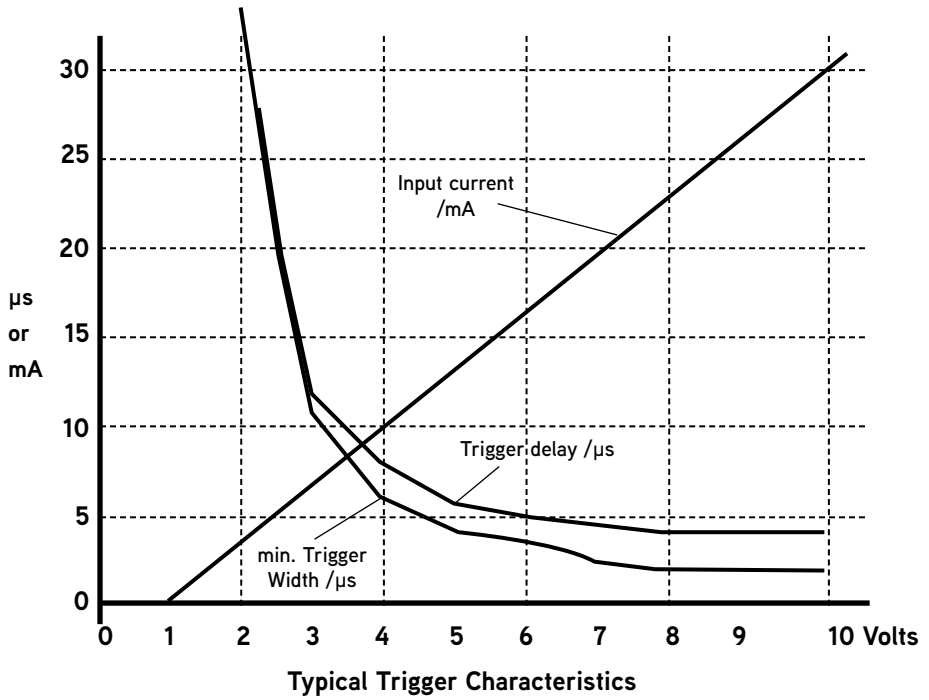


Figure 2 - DS2A Trigger-In Characteristics.

EXTERNAL PULSE DURATION CONTROL

External control of pulse duration is activated by rotating the 6 position rotary switch to the most anti-clockwise (counter-clockwise) position, so the white line on the knob lines up with the arrow below the $10\mu\text{s}$ label on the front panel.

When external control of pulse duration is selected the output stimulus timing will be controlled by the duration of the Trigger-In stimulus pulse.

It should be noted that (with a 5V input pulse) there is only a very short delay of $<2\mu\text{s}$ for the turn-on and $<6\mu\text{s}$ for the turn-off. When a typical TTL pulse is used, which will only be about 3V, these are matched at $4\mu\text{s}$ each.

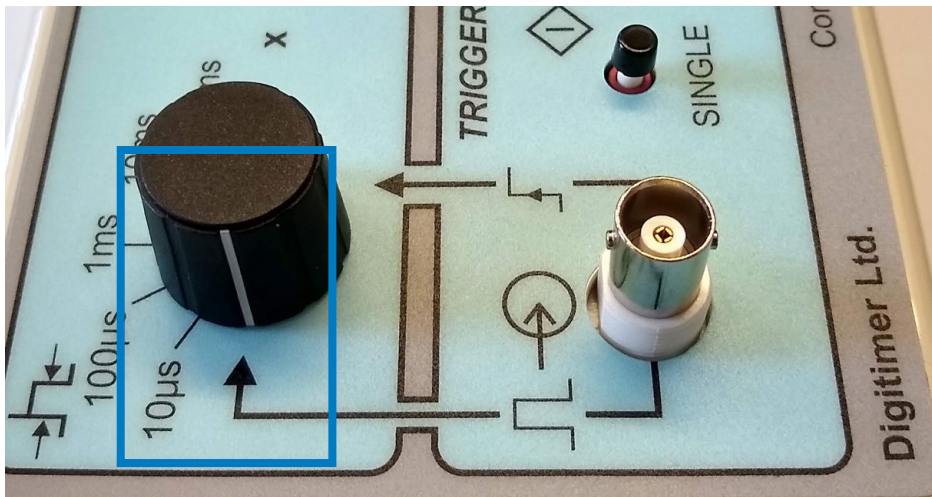


Figure 3 - Pulse duration control - Rotated anti-clockwise to the “external control” position.

SINGLE-SHOT TRIGGER BUTTON

A single-shot facility is provided by means of a push button to the left of the on/off switch. This operates at all times irrespective of other trigger inputs.

It should be noted that in external control of pulse duration, the single shot button produces a single very short ($\sim 10\mu\text{s}$) pulse OR an output for the duration of holding the button, dependant on an internal jumper. This jumper is factory preset to give a short pulse. See the “**Single**” **Jumper** section, later in the manual, if you need to change this behaviour.

OUTPUT CHARACTERISTICS

The stimulus output is isolated from the trigger source by an optical circuit providing less than 3pF capacitive coupling. Power is provided by a battery source that is loaded only during the generation of an output pulse. Continuous control of pulse width from 20 microseconds to 2 seconds is available by means of a five-position range switch and multiplier potentiometer. A ten-turn potentiometer varies the amplitude of the output pulse from zero to the maximum battery voltage. The DS2A stimulator has a toggle switch that selects either one or eleven battery sections. The output pulse is of a square shape, having rise time of 1 microsecond and fall time of 3 microseconds into a resistive load and is indicated by a front panel LED.

The output impedance varies with the position of the amplitude control. The maximum of 1.25kohms appears at the centre position of the output potentiometer.

An automatic overload circuit prevents excessive output current by reducing the output pulse width to less than 10 μ s when an overcurrent condition of approximately 50mA is detected. The circuit will automatically reset when the overload condition is removed. The polarity of the output pulse may be reversed by means of the Normal/Reverse switch. Normal means that the red output terminal goes positive with respect to the black terminal.

OUTPUT IMPEDANCE

The output impedance is dependent on the position of the amplitude control. When set to the mid position, the output impedance is 1.25k ohms dropping to 200 ohms at either end.

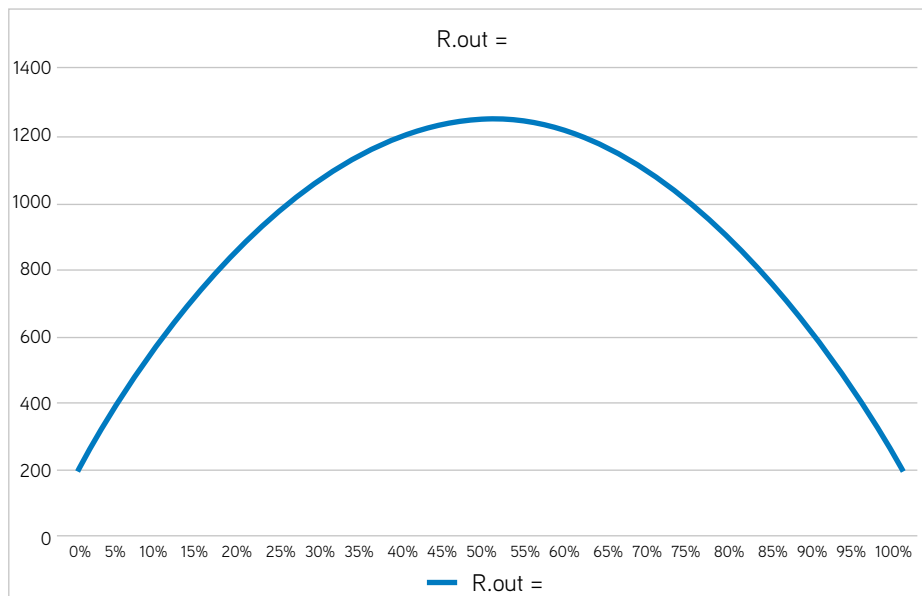


Figure 4 - Output impedance plot for the DS2A, showing how R.out varies with amplitude dial setting.

DEVICE MOUNTING

The **DS2A** can be mounted and positioned in any plane and 19" rack mounting is possible by using two of the box fixing screws through the model D121-11.

ACCESSORIES

The DS2A is supplied with the following parts -

- Full set of batteries (fitted)
- A pair of unwired output connector plugs (NL985P)
- Operators Manual (this manual)

The following accessories are available for purchase from from Digitimer Ltd.

- **D121-11** - Mounting frame that allows two units to be mounted together in a 19" rack
- **DG2A** - Train Delay Generator, provides stimulus frequency inc. a delayed pulse
- **NL985P** - Additional pairs of output plugs (one red/one black)

BATTERIES

The DS2A stimulator employs a total of 11 x 9V (PP3, IEC - 6R61) batteries using one of them to power the timing circuits. It will operate satisfactorily when the batteries are discharged down to approximately 60% of their nominal voltage without undue loss of timing accuracy, but, of course, with reduced maximum output voltage.

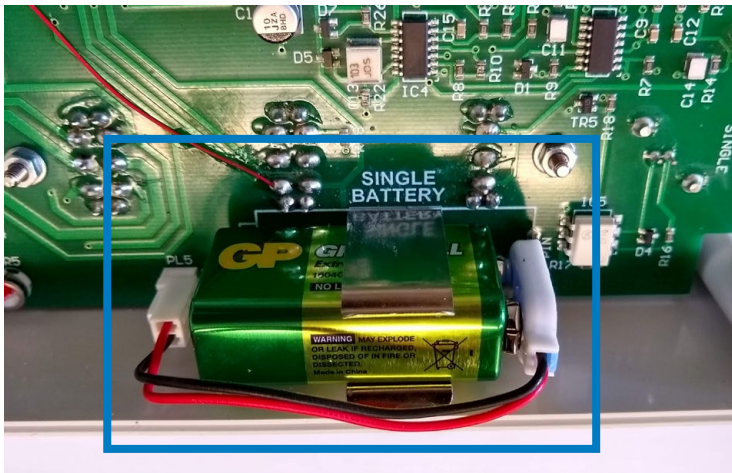


Figure 5 - The single control circuit battery is mounted on the main PCB.

Battery Testing

When using the battery test terminals, it is desirable that the battery voltage is measured when operating with a repetitive trigger signal providing a duty cycle greater than 20% or by using the single-shot facility with the maximum (2 second) pulse duration. The usual stimulating electrode(s) should be placed in a saline-filled bath, so as to mimic the typical impedance of the preparation. This method will show up any high-resistance battery condition.



Figure 6 - Battery test sockets are provided to test the output and control batteries without disassembling the DS2A.

Battery Life

This will depend on the frequency of operation and will therefore vary widely with the application, but the following example may be considered typical.

Output current - 20mA, duty cycle - 1:10, period of operation - 2 hours/day. Estimated life to end point voltage of 6V per 9V battery - 2 months.

Replacement batteries should be of premium grade sealed type and batteries should not be left in an unused stimulator for more than, say, 9 months without replacement.

Battery Replacement

This must only be performed by a competent person.

CAUTION must be used when replacing the batteries as they present voltages up to 99V between different points.



Figure 7 - Underside of the DS2A showing the case screw locations.

The **DS2A** stimulator is manufactured in a two-part plastic box that is held together by four screws through the base of the box.



Figure 8 - With screws removed, the case halves can be slid apart.

The two halves may be separated by removing these screws, sliding the two halves apart and disconnecting the battery leads by removing the connectors.

Ten of the batteries are firmly held within the black compartment that is screwed to the base and one within the clip fixed to the main PCB.

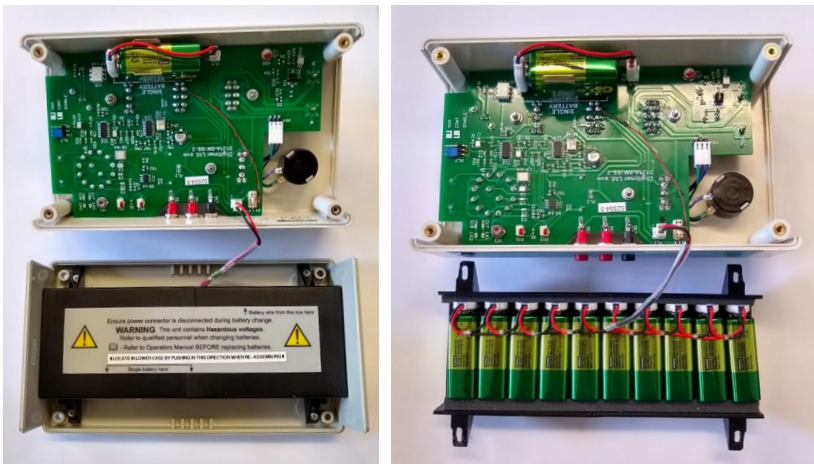


Figure 9 - Images of the opened unit (left) and the exposed battery pack (right).

All batteries must be replaced at the same time. Only use new batteries that are from the same manufacturer and are the same type. See "Batteries" section in this manual.

Reassembly is the reverse process of the above ensuring that the base is fitted to the lid with the single battery on the side indicated by the label on the battery pack label. Do NOT tighten the screws more than necessary and ensure that there are no trapped wires between the case top and bottom when they are assembled.

INTERNAL VIEW & JUMPERS

This will depend on the frequency of operation and will therefore vary widely with the application, but the following example may be considered typical.

Output current - 20mA, duty cycle - 1:10, period of operation - 2 hours/day. Estimated life to end point voltage of 6V per 9V battery - 2 months.

Replacement batteries should be of premium grade sealed type and batteries should not be left in an unused stimulator for more than, say, 9 months without replacement.

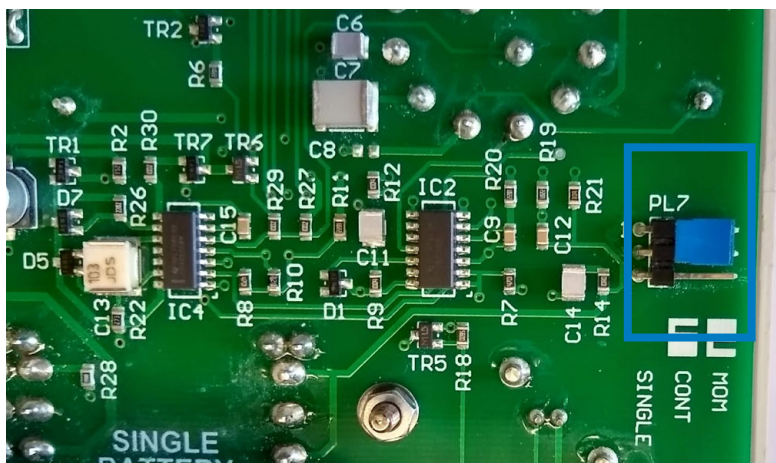


Figure 10 - Internal view of DS2A, showing jumper location.

"Single" Jumper

The "Single" jumper determines the Output delivered if the "SINGLE" button is pressed when the external duration control is selected.

- | | |
|-------------------------|--|
| "MOM" (factory setting) | Produces a very short pulse ~10 μ s when pressed. |
| "CONT" | Produces an active output for the duration of the press.
This could be useful in dye marking etc. |

SPECIFICATIONS

Maximum Output Voltage

97V (High), 7V (Low) selected by front panel switch. Square wave pulse shape, typical rise time $1\mu\text{s}$, fall time $3\mu\text{s}$ into resistive load.

Amplitude Control

A ten-turn dial provides continuous adjustment. The dial indicates percentage of maximum output.

Output Indicator

An LED operates for the duration of each output pulse.

Normal/Reverse Switch

Normal: Red output terminal positive w.r.t. Black.

Reverse: Red output terminal negative w.r.t. Black.

Output Impedance

Dependent on the position of the amplitude control, 1.25kohms max. at centre position, 200 ohms at either end of control.

Output Terminals

Two 2mm sockets on the front panel, spaced at $0.75''$.

Overload

An automatic overload circuit prevents excessive output current being drawn by reducing the output pulse width to less than $10\mu\text{s}$ when a current of greater than 50mA is detected.

Pulse Width Controls

Two controls provide continuous adjustment over the range $20\mu\text{s}$ to 2s .

(1) Five-position switch for pulse widths:-

0.02 , 0.2 , 2 , 20 , 200ms with $\pm 10\%$ accuracy.

(2) Multiplier continuously variable over range $\times 1$ to $\times 10$.

The pulse width is the product of the two dial settings.

Trigger Requirements

A positive pulse of minimum 3V , maximum 20V amplitude is required to trigger the stimulator.

The trigger input current varies from 7mA to 63mA over the above voltage range. The trigger pulse width should not normally be less than $10\mu\text{s}$.

Trigger Isolation

Optical coupling is employed between the trigger source and the stimulator circuitry.

The capacity coupling is less than 3pF .

Single Shot

A single-shot push button is provided. This operates at all times irrespective of other trigger inputs.

Batteries

Self-contained batteries are used to provide an isolated source of power. Current is drawn only when delivering an output pulse. The maximum current drain is 30mA plus the load current for the DS2A.

Battery Type

11 x PP3 - (IEC-6R61) style batteries. Alkaline preferred.

Battery Test Sockets

Sockets are provided on the top of the instrument case to allow the batteries to be checked without removing them from the case.

Dimensions

Panel Size: 190mm x 110mm.

Depth

80mm over knobs.

Mounting

One or two stimulators may be mounted in a 19" rack using a specially fabricated mounting frame (model D121-11) available from Digitimer Ltd.

Alternatively, the unit may be clamped to a laboratory stand by means of a 1/4" diameter rod (available from Digitimer Ltd.) and employing 0.25" DCA rod clamps.

Weight

800g complete with batteries.

WARRANTY INFORMATION

Limited Warranty

Digitimer Limited warrants to the first purchaser, for a period of one year from the date of purchase, that this Digitimer instrument (hereafter referred to as the "Product") will be free from defective workmanship and materials, and agrees that it will, at its option, either repair the defect or replace the defective Product or part thereof at no charge to the purchaser for parts and labour. The Product must be returned to Digitimer Limited, carriage paid and insured. Digitimer Limited will return the Product, carriage paid and insured, in the most appropriate method as determined by Digitimer Limited. If a faster shipping service is desired by the customer, any additional special delivery expenses must be paid by the customer.

This warranty does not apply to shipping damage. Digitimer Limited fully insures all shipments. Any claims of damage upon receipt must be filed with the carrier and Digitimer Limited immediately.

This warranty does not apply to any exterior appearance item of the Product which has been damaged or defaced, which has been subjected to misuse and abuse, abnormal service or handling, or which has been altered or modified in design or construction.

This warranty does not apply to any interconnection cables supplied with the Product.

This warranty does not apply if any unauthorised repairs, modifications or alterations have been made to the Product.

No sales organisations, other than Digitimer Limited itself, are authorised to make any warranties other than those described above, or to extend the duration of any warranties beyond the time period described above on the behalf of Digitimer Limited. If Digitimer Limited agrees to such a modification of this warranty, Digitimer will furnish a modified copy of this agreement, which must be presented if a claim is being made under these modified terms.

Obtaining Warranty Service

Warranty service of this Product can be obtained by returning the Product, carriage paid and insured, to Digitimer Limited, or the Distributor from whom the equipment was purchased. Prior authorisation before shipping the product is advised for the most expedient service.

Product change or discontinuation

Digitimer reserve the right to discontinue any instrument or to change its specification without notice, and without responsibility for incorporating changes in instruments already sold.

REFERENCES

Google scholar reports over 900 papers that cite use of the DS2A and its predecessors. Below is a very small sample of the most highly cited papers published since 2019.

Hansen, J. O., Omland, P. M., Nilsen, K. B., Sand, T., & Matre, D. (2021). Experimental sleep restriction increases latency jitter in pain elicited cortical responses. *Heliyon*, *7*(2).

<https://doi.org/10.1016/j.heliyon.2021.e06188>

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<https://doi.org/10.3389/fnbeh.2021.615796>

Manaf, F. A., Peiffer, J. J., Maker, G. L., & Fairchild, T. J. (2021). Branched-chain amino acid supplementation improves cycling performance in untrained cyclists. *Journal of Science and Medicine in Sport*, *24*(4), 412–417. **<https://doi.org/10.1016/j.jsams.2020.10.014>**

Muhle, P., Labeit, B., Wollbrink, A., Claus, I., Warnecke, T., Wolters, C. H., ... Suntrup-Krueger, S. (2021). Targeting the sensory feedback within the swallowing network—Reversing artificially induced pharyngolaryngeal hypesthesia by central and peripheral stimulation strategies. *Human Brain Mapping*, *42*(2), 427–438. **<https://doi.org/10.1002/hbm.25233>**

Cook, D. N., Thompson, S., Stomberg-Firestein, S., Bikson, M., George, M. S., Jenkins, D. D., & Badran, B. W. (2020). Design and validation of a closed-loop, motor-activated auricular vagus nerve stimulation (MAAVNS) system for neurorehabilitation. *Brain Stimulation*, *13*(3), 800–803. **<https://doi.org/10.1016/j.brs.2020.02.028>**

Norum, M., Risvang, L. C., Bjørnson, T., Dimitriou, L., Rønning, P. O., Bjørgen, M., & Raastad, T. (2020). Caffeine increases strength and power performance in resistance-trained females during early follicular phase. *Scandinavian Journal of Medicine and Science in Sports*, *30*(11), 2116–2129. **<https://doi.org/10.1111/sms.13776>**

Oliva, M. K., Pérez-Moreno, J. J., O’Shaughnessy, J., Wardill, T. J., & O’Kane, C. J. (2020). Endoplasmic Reticulum Lumenal Indicators in *Drosophila* Reveal Effects of HSP-Related Mutations on Endoplasmic Reticulum Calcium Dynamics. *Frontiers in Neuroscience*, *14*. **<https://doi.org/10.3389/fnins.2020.00816>**

Mirabella, F., Desiato, G., Mancinelli, S., Fossati, G., Rasile, M., Morini, R., ... Pozzi, D. (2020). Transient maternal IL-6 boosts glutamatergic synapses and disrupts hippocampal connectivity in the offspring. *BioRxiv*. **<https://doi.org/10.1101/2020.11.02.364356>**

Ree, A., Nilsen, K. B., Knardahl, S., Sand, T., & Matre, D. (2020). Sleep restriction does not potentiate nocebo-induced changes in pain and cortical potentials. *European Journal of Pain (United Kingdom)*, *24*(1), 110–121. **<https://doi.org/10.1002/ejp.1466>**

FREQUENTLY ASKED QUESTIONS

1. What is the maximum trigger rate of the DS2A?

The unit can be triggered fast enough to allow >99% "on" time, but the "off" time must >20 microseconds – so, very fast!

2. Can the DS2A be used to stimulate human subjects?

The DS2A does not have medical device directive (MDD) certification and has not been designed for safe human use. We offer a range of MDD compliant stimulators for human/patient connection.

3. Can I control the DS2A using a computer?

Yes and no. The DS2A features an external "gate" input allowing externally derived trigger pulses to define stimulus duration. However, the output amplitude is always determined by the front panel setting of the stimulator. We recommend our NeuroLog system to those interested in using a computer generated waveform to define stimulus timing/polarity and strength.

4. I want to stimulate with a longer pulse duration than 2 seconds, in order to lesion some tissue, is it possible to do this?

Yes, there are two simple methods:-

(i) The DS2A has the ability to be gated by an external pulse i.e. when external control of pulse duration is selected the output stimulus timing will be controlled by the trigger-in stimulus pulse. It should be noted that (with a 5V input pulse) there is only a very short delay of <2 μ s for the turn-on and <6 μ s for the turn-off. When a typical TTL pulse is used, which will only be about 3V, these are matched at 4 μ s each.

(ii) Alternatively, if a trigger pulse is not available or exact timing is not crucial (for instance when lesioning or injecting dye, there is a jumper which can be set to allow the unit to deliver a current for the duration the single shot button is held down. The internal "Single" jumper determines the output delivered when the "SINGLE" button is pressed (when "EXTERNAL" Duration is selected).

"MON" (factory setting) produces a very short pulse ~10 μ s when pressed.

"CONT" produces an active output for the duration of the press. This could be useful in dye marking etc.

5. I can't decide between the constant current DS3 and constant voltage DS2A - how should I choose?

The visible difference between the two units (apart from the colour!) is that the output control of the DS2A is defined in Volts while the output of the DS3 is defined in Amps. The actual stimulus passing through your preparation is measured in Amps in both cases and is dependent upon Ohms Law ($V = IR$). If your preparation has a variable impedance (R) and you

are using a constant voltage (V) source such as the DS2A, then the actual current (I) passing through the tissue may vary considerably between each stimulus, which may not be a good idea if you want to apply reproducible stimuli. With the DS3, the constant current circuitry prevents variations in tissue impedance from altering the size of current applied (within the 90V compliance limit of the unit), leading to the stimulator equivalent of WYSIWYG – “What You Set Is What You Get”. Unfortunately, there are no well-defined rules governing the circumstances under which either stimulator should be used. If you are not sure and feel the need to evaluate either or both please contact us.

6. I have an old DS2 constant voltage stimulator and I recall that Digitimer offer a conversion to constant current. Is this still possible?

No, Digitimer no longer offers this service. Since the introduction of the new DS3 constant current stimulator, this unit is now offered to customers requiring a constant current version of the DS2A.

7. Is it possible to use two DS2A stimulators in parallel in order to stimulate through the same electrodes with different pulse types?

Yes, this is quite simple to setup and has been summarized in an application note available from our website.

8. How long do the batteries last for and can I use rechargeable replacements?

Battery life will depend on the frequency of operation and will therefore vary widely with the application. Replacement batteries should be of premium grade sealed type, alkaline preferred and batteries should not be left in an unused stimulator.

Rechargeable batteries are NOT recommended, as their voltages tend to decline very suddenly, which could lead to a failure in the middle of an experiment.

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