Spot-welder power controller PCB for sale

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Spot welder timer board

With this controller, you can set the power of a spot welder. This is done by setting three timings: the pre-weld pulse, the weld pause and the welding time. You can use it for a DIY spot welder made of a microwave oven transformer (MOT).

I have developed the [D.I.Y spot welder](#) because I needed a special spot welder for the building of my [Maxun One solar bike](#). It turned out that the spot welder is being built by many people worldwide. Because the electronics was not so easy to build, I have made a printed circuit board, which is for sale, together with some other parts:

FOR SALE: spot welder parts

How to order

To order, [contact me](#) personally. Usually, everything is in stock, and you can pay with PayPal. Note that I don't have assembled boards or any other electronic parts. For example, the total price for all 4 parts including shipping is €44.80 You will also support my website financially this way.

A. spot welder controller board €15,95

PCB for the Arduino spot welder controller, without components, to assemble by yourself. You don't have to know anything about the Arduino, software or electronics. All you need to do is to solder all the components, connect the board, then power up and press weld button. To make it easy, only standard parts are used that every electronic (e)shop should have, see the partlist. Anyone can build the spot welder controller, it is not difficult and it is nice job too.

B. programmed ATMEGA328 v6.1 €8,95

The software can be used with or without TFT display.

C. radiator earth clamp set €7,95

Size 20mm x 20mm x 12mm

D. welding electrode set €4,95

Pure red copper, length 45mm, diameter 6mm.

It is important that the electrodes are made of the right material, not all types of copper are suitable. Note that there are special copper alloys for spot welding, such as Class 2 Chromium Copper 18200 or Chromium Zirconium Copper 18150, but these are just needed for example at car production. My welding electrodes don't stick to nickel tabs. You only need one set of electrodes in your life, because the wear is negligible, unless you have to weld thousands of batteries.

Shipping and handling costs €6.95 for all countries worldwide.

--- New TFT display ---

There was a lot of demand for the TFT display software, so I made it now. The spot welder board was already prepared for it. Note that the display is optionally:

- Without display, the weld time can be set by the rotary switch in 9 steps of 50ms. Normally, this is sufficient.
- With display, the pre-weld time, pause, and weld time and can be set in a large range.

If you program the ATmega328 yourself, you can easily change the weld times in the code.

The new software v6.1 is suitable for both situations.

Note that the display is much faster than on the video, because of the improved [TFT_22_ILI9225 library from Johan Cronje](#).

Universal Arduino solid state relay / dimmer

This board can be used also as a solid state relays or dimmer for many applications.
The advantages are:

- Integrated 5V power supply
- No separate Arduino board needed.
- Can handle high inductive loads.
- Zero cross detection.
- Contains breadboard pads for custom modifications.
- Optional TFT 2.2" LCD module control.

Microwave oven repair safety precautions

Working on a microwave oven is extremely dangerous. You will normally **NOT** survive the high voltage, the available power of more than 1000W is enough to kill you instantly like an electric chair. Please read this article first.

Kende DN-100E

The Kende DN-100E does not have an electronic control of the welding time. Therefore it is hard to make high-quality weldings with a good repeatability. The Arduino spot welder controller can also be used to improve this welding machine, see here how to do.

Questions

If you have any questions, please post them on forum.arduino.cc.

Weld times

- Weld time: 0ms to 450ms in steps of 50ms.
- Pre-weld pulse 50ms.
- Weld pause time after pre-weld pulse: 500ms

Software v6.1

Download the software at GitHub.
Here you can also download a project zip file that also contains all necessary libraries.

Circuit description

The PCB contains the entire spot welder controller; there is no Arduino board needed. Solid state relays with TRIACs will not work here, because the load is highly inductive. With inductive loads, an inverse parallel SCR control works far better than a TRIAC control. TRIACs have turn-off problems with inductive loads, while SCRs always turn off at the negative half-cycle. The RC snubber network R9 and C9 protects the circuit from voltage transient spikes. D1 is a transient-voltage-suppression diode (TVS), without this diode the ATMEGA328 may be damaged by voltage spikes.

By the use of a WH50 power resistor, it is possible to weld at a lower current. This is normally not necessary; I used it for welding highly sensitive electronic components. The resistor value depends on the required current, transformer, mains voltage and must be determined experimentally. Here, the WH50 wire resistor dissipates 600W; this is an overload by a factor 12! For short weld times this is allowed.
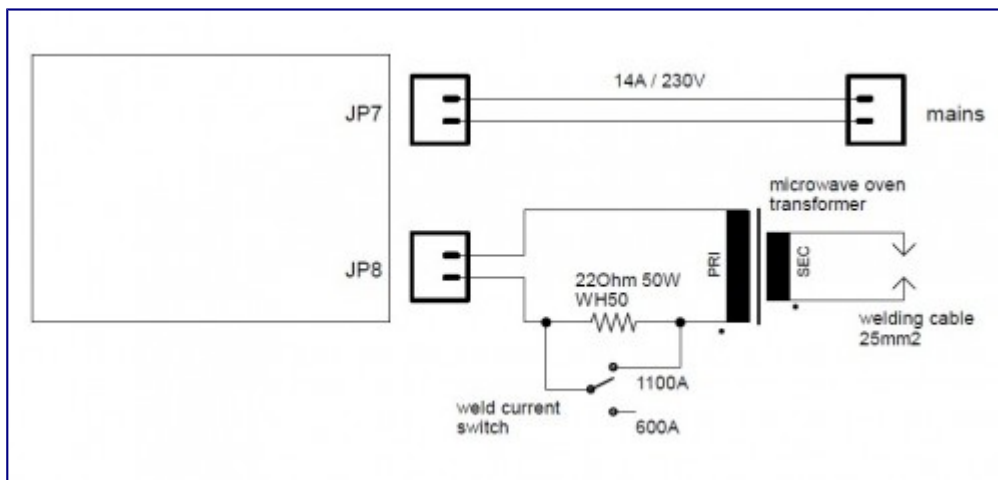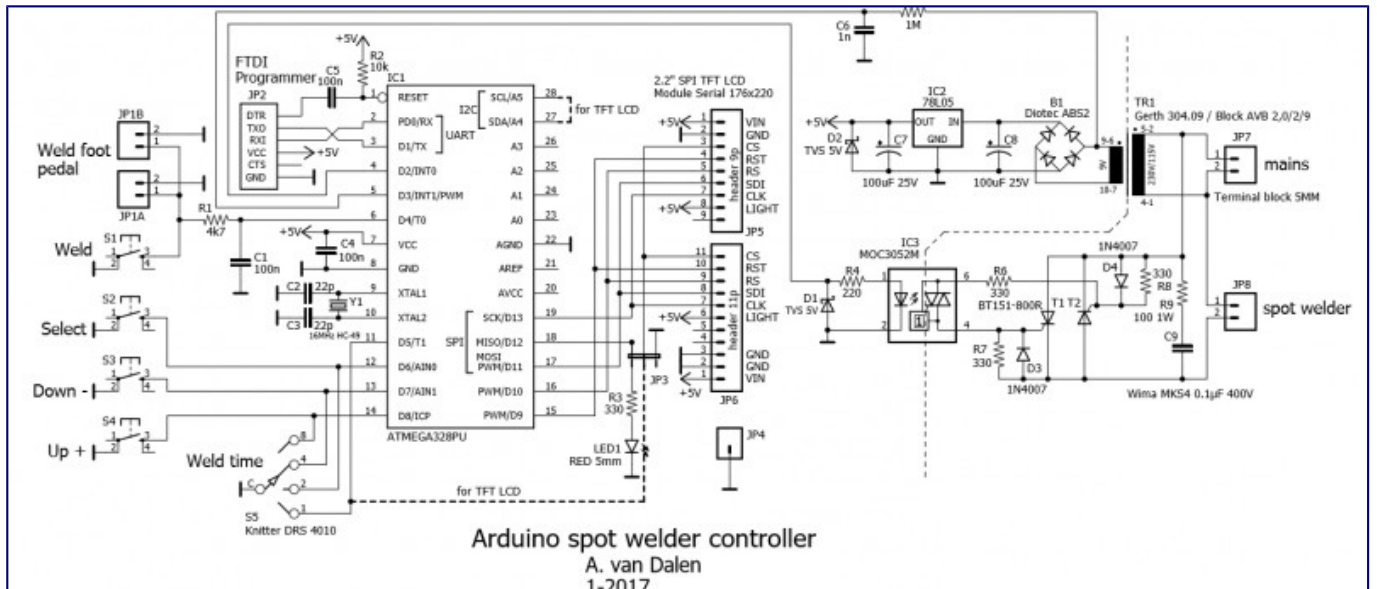

Here is an alternative circuit:
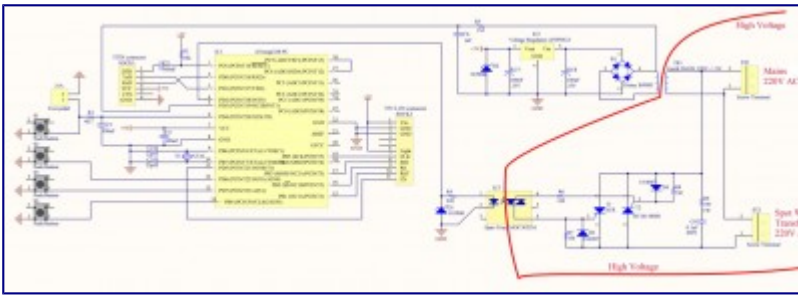
Reducing the weld transformer inrush current

The current through the weld transformer, which is an inductive load, will lag behind the voltage by 90°. This is the reason that, to reduce the inrush current, the optimal switch-on time is not the zero point of the mains sinus but the top of the sinus. To be able to do this, the Arduino has to detect the mains zero crossings, this is done by R5 and C6. The two internal clamping diodes of the ATMEGA328 limit the input voltage to 0 and 5V. The delay time in the software "sinusMax_us" is 4583μs, this strange number is the average of 1/4 cycle of 50Hz and 60Hz.
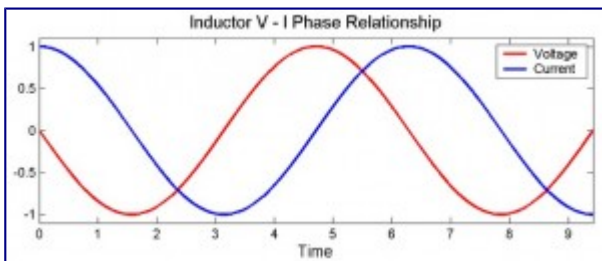
High voltage!

Pay attention: the PCB is directly connected to the mains, just the low voltage part is safe. **Usage is at your own risk**.

Maximum thyristor current

The maximum RMS on-state current for the BT151-800R is 12A. However, for short weld times we can take the non-repetitive peak on-state current, this is 50A for weld times below 0.5s. For a normal microwave oven transformers the thyristors are adequate oversized. Take stronger thyristors if you are using a large weld transformer.

User guide

With TFT display:

- Use the up, down and select button for setting the parameters, see the [video on YouTube](#).
- The settings are stored in the EEPROM.
- Press the weld button to weld.

Without TFT display:

- After power on, the LED blinks 4 times to show that the Arduino is alive and than is stays on.
- Set the weld time by the rotary switch S5: the weld time = position number * 50ms.
- Press the weld button to weld. To show the welding cycle, the LED is turned off during the weld pulse.

Continuous mode:

There is a possibility to weld as long as the weld button is pressed. To enable this mode, set the welding time to 0 (*note*), press and hold down the weld button simultaneously during power on for 1 second and than release the button. Now you can weld continuously without the timer. Take care: the transformer will be overheated easily, so use this feature only for testing or for measuring the weld current. To protect the WH50 power resistor (for 600A), don't weld longer than 1 second. (*note*) In the old software version 5.3, the switch should be in position 1..9.


Modifications for using the TFT display

These parts have to be mounted for the TFT display too:

- Menu control tactile buttons S2, S3 and S4. Attention: mount at the other side!
- TFT LCD Module 2.2". Available on eBay (11pins). Attention: mount at the other side! Some TFT displays have different pin-outs, therefore, there are two different TFT connectors on the PCB.

Modifications:

- Cut the trace of the solder jumper JP3, see image 1.
- Connect a wire from JP6 pin11 to S5 pin1, see image 2.
- Connect IC1 pin27 to pin28 (this switches the software to TFT), see image 3.
- Remove rotary switch if it was mounted already, or put it to **position 0**.
- LED1 is no longer needed, it still does work but will give less light. You can remove the LED if it was already mounted.
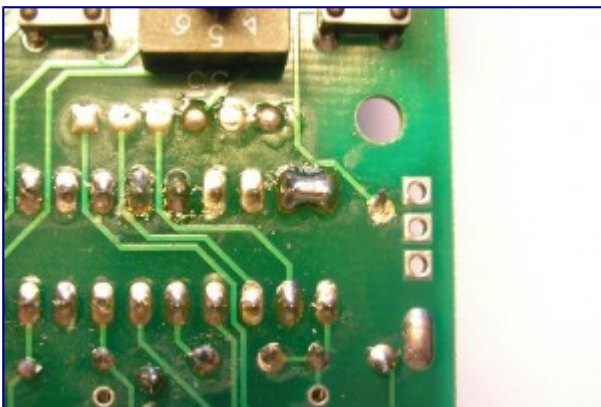
Orientation:

It has turned out that some TFT displays have a different orientation. Therefore, I made a new software version 6.1 in May 2017. The orientation can be changed now by pressing the up and down buttons while switching on the mains voltage.

Troubleshooting

- If the LCD display text is upside down, start up while pressing the up and down button.
- Set the weld time to maximum. To test whether the programmed ATMEGA328 works, check if the LED blinks 4 times after power up and than stays on. If the weld button is pressed, the LED should turn off a moment. If this works, the fault is in the thyristor section, the zero cross detector, or the switches S1 or S5.
- If you want to measure the output voltage, use a load, for example a light bulb. Don't use a LED lamp.
- You can test the zero cross detector as follows: If the spot welder only works in continuous mode but not in normal mode, then the zero cross detector is not working.

Part list

All components are standard; every electronic (e)shop should have them. The total cost of the components is about $20.
You can order all items with just one click. Note that the ATMEGA328 and the TFT display are not on the partlist:

Conrad (send just to Europe): [Conrad whish list](#).

I have made a [bill of materials (BOM) for Mouser](#) that you can upload to your shopping cart, select Service & Tools > BOM Tool > Upload Spreadsheet and follow the steps. Check if the quantities are correct.

If parts are temporarily not available, you can usually take an equal part that fits to the PCB. The TVS diodes 1N5908 are not necessarily required.

(note) If the TFT display is used:

- Don't buy the rotary switch S5.
- Buy 1 tactile switch.
- Don't buy LED1.

If a part is out of stock at Conrad, take the alternative, see below:

Qty	Value	Parts	Description	Conrad number / alternative
3	100nF	C1, C4, C5	Capacitor	531855-89
2	22pF	C2, C3	Capacitor	457167-89
1	100nF 400V	C9	Capacitor	459861-89 / 1468330-89
1	1nF	C6	Capacitor	451602-89
2	100uF 25V radial	C7, C8	Capacitor	445453-89
1	Perpendicular 6p	JP2	Connector	733879-89
2	Terminal block 5mm	JP7, JP8	Connector	731091-89
1	Molex KK or else	JP1	Connector	740155-89
1	Molex KK or else	JP1	Housing	740549-89
2	Molex KK or else	JP1	Terminal	741112-89
1	16MHz HC-49	Y1	Crystal	155164-89
2	1N4007	D3, D4	Diode	162272-89
1	LED 5mm (note)	LED1	Diode	184543-89
2	1N5908	D1, D2	TVS 5V	168279-89
1	MOC3052M	IC3	IC	1265985-89
1	78L05	IC2	IC	175676-89
1	ATMEGA328PU	IC1	IC	92026-89
1	Bridge rectifier	B1	Rectifier	140725-89 / 140730-89
4	330 Ohm	R3, R6, R7,	Resistor	1089141-89

		R8		
1	1M	R5	Resistor	1089183-89
1	220 Ohm	R4	Resistor	1089139-89
1	10k	R2	Resistor	1089159-89
1	4k7	R1	Resistor	1089155-89
1	100 Ohm 1W	R9	Resistor	419443-89
1	Rotary 10 pos (note)	S5	Switch	705684-89
4	Tactile switch (note)	S1 (S2, S3, S4)	Switch	701749-89
2	BT151-800R / 2N6509TG	T1, T2	Thyristor	151330-89 / 151409-89
	Gerth 304.09 for 230V	TR1	Transformer	1092870-89
	Block AVB 2,0/2/9 *) for 120V	TR1	Transformer	
1	28pin DIL Socket	IC1	Socket	183812-89

Mains voltage 230V or 120V

*) For 230V 50Hz, use the Gerth 304.09 transformer 1092870-89 from Conrad. For 120V 60Hz (United States, Canada) , use the transformer Block AVB 2,0/2/9, available at among others Newark and Farnell. Instead of the AVB 2,0/2/9, you can use the AVB 2,0/1/9 too.

For 120V, the optional WH50 power resistor has to be about 10Ω, if you need a weld current of 600A.

Solder wire

Today, lead-free solder is standard used in the industry. However, <u>it is not the best solder</u>, it is just less toxic. The best solder for electronics work is still the old fashioned **60/40** alloy. It is much easier to use than lead-free solder and it has excellent characteristics and therefore it is still legal in military and medical applications, where the quality outweigh the health risks.
For electronics work, I recommend: **flux-cored 60/40 tin/lead with a diameter of 0.5mm - 0.6mm**.
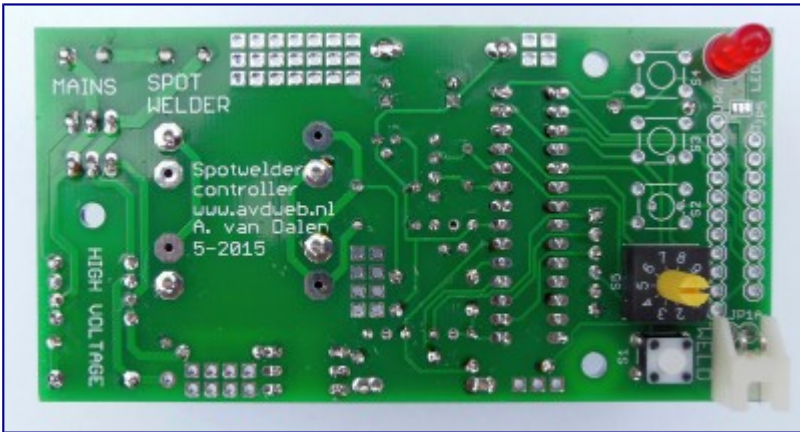
PCB assembly

There can't go wrong much, but you need to use a soldering iron for electronics work and work accurately, see the images for the result.
The middle pin on the 9V side of the transformer Block AVB 2,0/2/9 has to be cut, otherwise it will not fit to the board.

Spotwelder
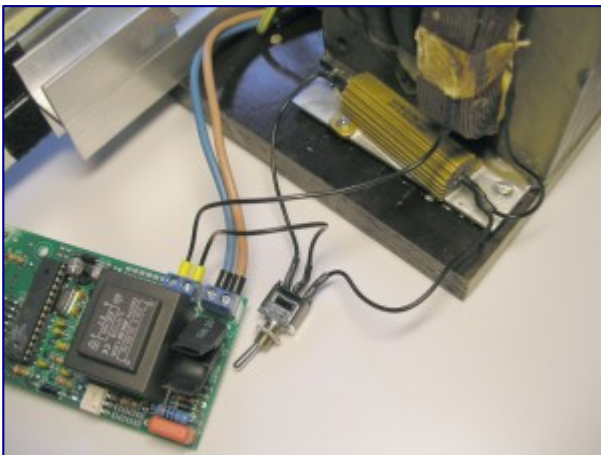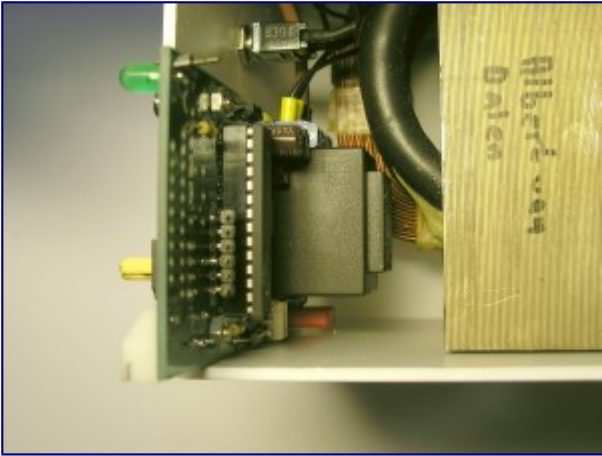controller
www.avdweb.nl
A. van Dalen
12-2014
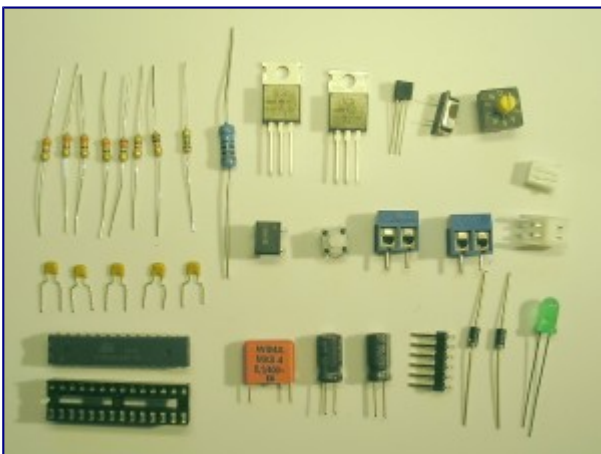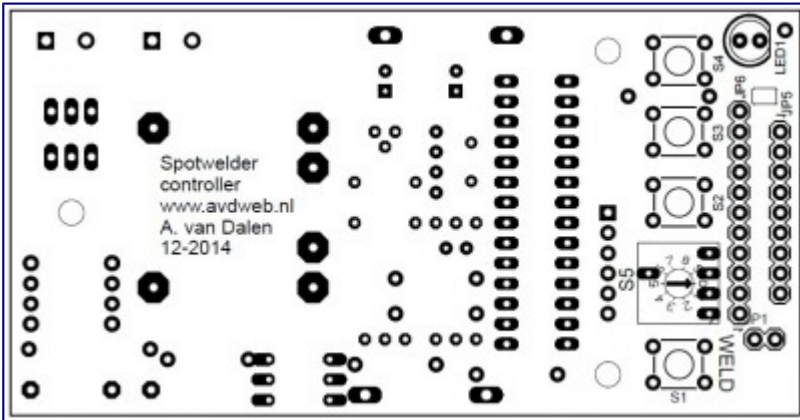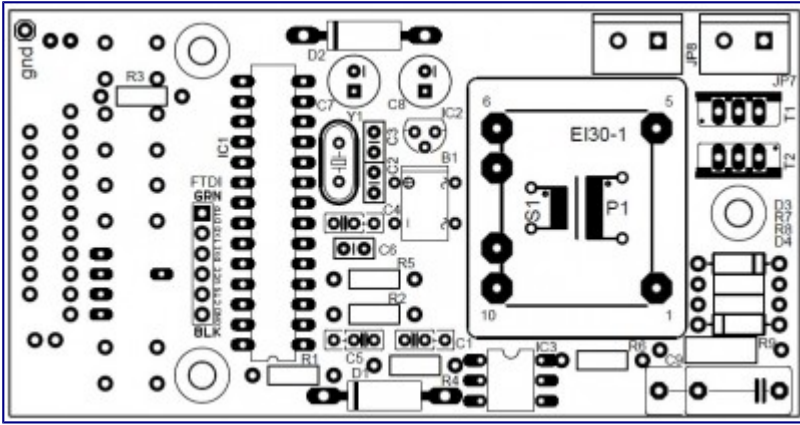
If you don't want to hand solder these boards yourself, [Quick PCB Assembly's prototype services](#) can do the job for you at an affordable price. They are located in the USA.

Wiring and mounting

Repairing the Sunkko 788 battery spot welder

The electronics of the Sunkko battery spot welder is not made well and often brakes-down. You san simply repair it: just replace the electronics by the Arduino spot welder controller. Pictures are coming soon.

Programming

The Arduino chip can be programmed in three ways:

- Just buy the programmed chip here.
- With an Arduino board by which you can program the chip yourselve.
- Using a FTDI adapter, see the picture. Google on "FTDI USB To TTL Serial Converter Adapter Module For Arduino". With this adapter connected, the spot welder controller board behaves as a regular Arduino Uno and can be programmed in the same way as the Arduino Uno.
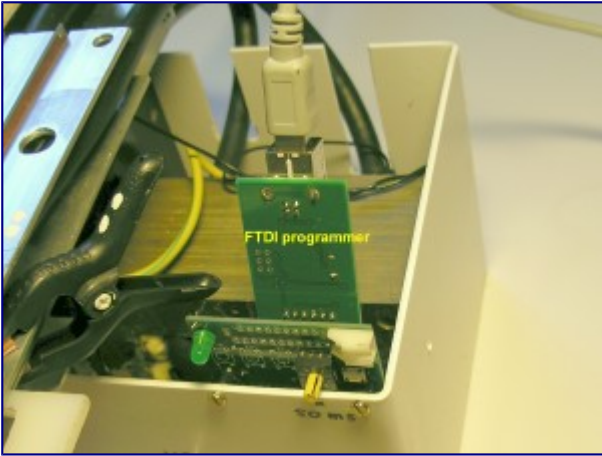
Links

- [Fundamentals of small parts resistance welding](#)
- [Battery Pack Manufacturing - Best practice](#)
- [Spot welding technical charts](#)

155164 —89

With this controller, you can set the power of a spot welder. This is done by setting three timings: the pre-weld pulse, the weld pause and the welding time. You can use it for a DIY welder made of a microwave oven transformer (MOT).