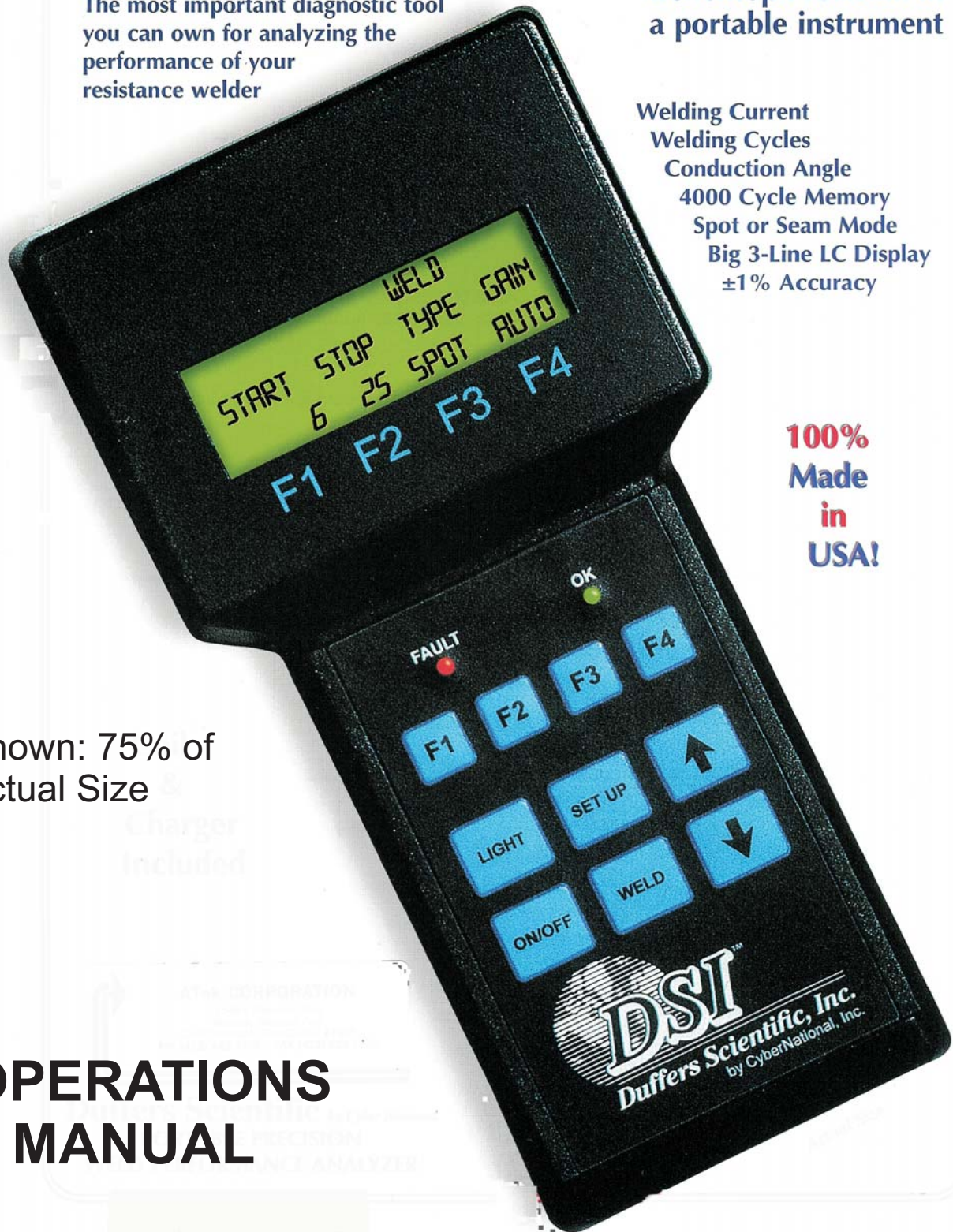


WELD PERFORMANCE ANALYZER

The most important diagnostic tool you can own for analyzing the performance of your resistance welder

Benchtop Precision in a portable instrument

Welding Current
Welding Cycles
Conduction Angle
4000 Cycle Memory
Spot or Seam Mode
Big 3-Line LC Display
±1% Accuracy



100%
Made
in
USA!

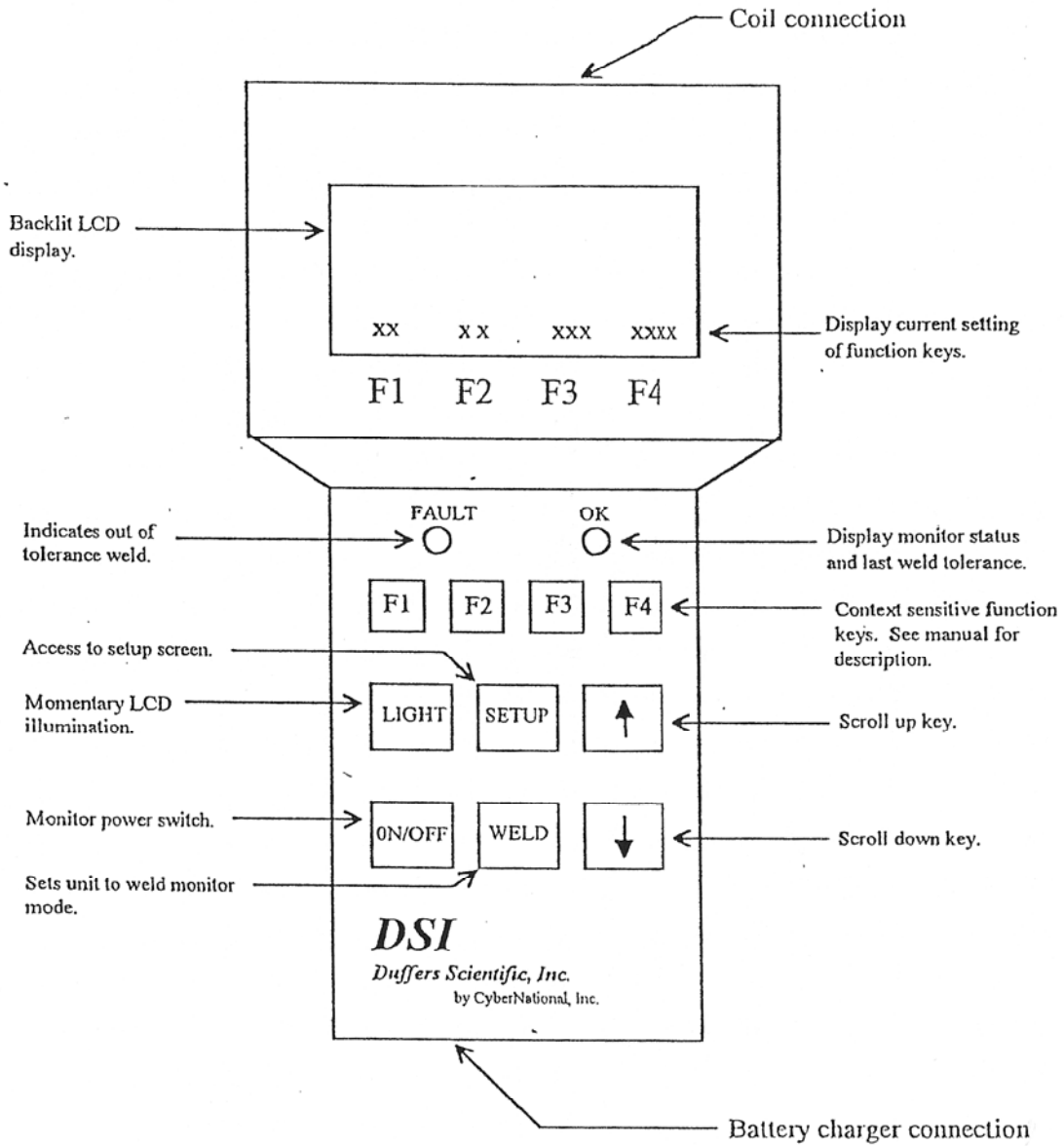
Shown: 75% of
Actual Size

OPERATIONS
MANUAL

INDUSTRIAL QUALITY
TECHNICAL SUPPORT

PERFORMANCE
DEPENDABILITY

DSI WELD MONITOR OVERVIEW



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Introduction

The DSITM weld monitor is a portable handheld weld current analyzer. The weld monitor features low power operation with up to 20 hours continuous use battery life. Battery life is further extended by automatic shut down. Battery recharging requires only 90 minutes and the weld monitor may be used during charging with no degradation in performance. The weld monitor has a large memory buffer capable of storing magnitude and conduction information for up to 6553 welds. User configuration includes the ability to handle up to 127 consecutive cool cycles or to ignore up slope or down slope cycles. Ease of use is enhanced by an **automatic weld range selection** with manual override.

Setup

Press the on/off button to turn on the unit. The green LED will illuminate and the software version is shown on the top line of the display. This manual is current for version 3.x.

Configuration parameters are accessed by pressing the SETUP key. The three setup screens are shown in figures 1, 2 and 3 along with the setup defaults. Pressing the UP ARROW key scrolls from setup screen 1 to setup screen 2 and screen 3. The DOWN ARROW key scrolls through the screens backwards. Pressing the WELD key exits setup mode.

The first setup screen is shown in figure 1.

START		STOP		TYPE		GAIN	
0		0		SEAM		AUTO	
F1	F2	F3	F4				

Figure 1: First Setup Screen

START AND STOP

START and STOP allow up slope and down slope intervals to be omitted from the current measurements. START indicates the first cycle in a weld sequence that will be measured, while STOP determines the last cycle to be measured. To change START, press and hold F1 then press the UP ARROW or DOWN ARROW key. STOP is changed in the same manner by pressing F2.

The range of START and STOP is from 0 to 127. If STOP is set to 0, all weld cycles after START will be stored. Setting START and STOP to 0 measures all cycles. If STOP is less than or equal to START (with the exception of setting STOP to 0) no data will be measured. START and STOP have no affect in DC mode. When DC mode is selected these variables are not shown and cannot be changed.

WELD TYPE

Pressing F3 scrolls the weld type through the six weld modes shown in table 1. Seam mode stores and displays each cycle separately while spot mode stores and displays the average of a series of cycles. See the operation section of this manual for more information on spot seam and DC modes.

Mode	RAM Capacity	Configuration Parameters	Notes
All Seam	6553 Cycles	Start, Stop, Gain, Freq, Reset Delay, Reset Mode, Min, Max, Time Display	Stores each cycle in a seam. Old data is overwritten with each new seam.
Err Seam	4681 Cycles	Start, Stop, Gain, Freq, Reset Delay, Reset Mode, Min, Max, Time Display	Stores cycles less than MIN, greater than MAX or half cycles. New seam does not overwrite old data until RAM is full. After RAM is full retains the most recent 4681 cycles.
All Spot	6553 Spots with at least 127 cycles per spot	Start, Stop, Gain, Freq, Reset Delay, Reset Mode, Min, Max, Time Display	Stores each pulse. Start and Stop control which cycles are averaged into a pulse. New pulse does not overwrite old data until RAM is full. After RAM is full retains the most recent 6553 pulses.
Err Spot	4681 Spots with at least 127 cycles per spot	Start, Stop, Gain, Freq, Reset Delay, Reset Mode, Min, Max, Time Display	Stores pulses less than MIN, greater than MAX or half cycles. New pulse does not overwrite old data until RAM is full. After RAM is full retains the most recent 4681 pulses.
All DC	6553 Pulses	Gain, Reset Mode, Min, Max	Same as All Spot
Err DC	4681 Pulses	Gain, Reset Mode, Min, Max	Same as ERR Spot

Table 1

GAIN

Pressing F4 scrolls the gain through LOW, AUTO and HI. Set to AUTO for automatic ranging of RMS amp reading. When set to auto, large changes in current (such as a tap change) may cause the first reading to be inaccurate. On the second weld, the reading will be correct.

Setup Screen 2 is shown in figure 2.

		RESET	RESET	
FREQ	COIL	DELAY	MODE	
60	10X	0	MAN	
F1	F2	F3	F4	

Figure 2: Second Setup Screen

FREQ

Pressing F1 toggles the frequency between 60 Hz and 50 Hz. Frequency has no affect while in DC mode and is not displayed and cannot be edited.

COIL

Pressing F2 toggles the coil type between 10X and 1X.

RESET DELAY

Reset delay determines the maximum number of sequential cool cycles that may be inserted into a weld sequence. To change the reset delay, press and hold F3 then press the UP ARROW or DOWN ARROW key. The range is from 0 to 127. See the operation section of this manual for more information on reset delay. Reset delay has no affect while in DC mode and is not displayed and cannot be edited.

RESET MODE

F4 toggles the reset mode between MAN and AUTO. In MAN mode, data acquisition stops after 1 weld sequence. Manual reset is useful when two welds are too close together to allow data from the first weld to be examined before the next sequence begins. Reset is accomplished by pressing the WELD button, which also clears the RAM. Auto mode allows continuous acquisition.

Setup Screen 3 is shown in figure 3.

MIN	MAX	TIME	DISP
0.0	0.0	160	SEC
F1	F2	F3	F4

Figure 3: Third Setup Screen

MIN AND MAX

MIN and MAX set the current range for error checking. To change MIN, press and hold F1 then press the UP ARROW or DOWN ARROW key. Setting MAX less than MIN will cause an error flag to be set for all welds. The red and green LED's indicate "in" or "out" of tolerance.

CALIBRATION

F3 is the calibration constant that can be used to scale the weld current reading to match a local standard. This should only be changed under controlled conditions. See the Calibration section for more information.

TIME DISPLAY

In AC mode, press F4 to toggle the SCR conduction angle between degrees and milliseconds. In DC mode F4 selects either milliseconds or cycles of heat. If 50 HZ is selected, 1 cycle is equal to 20 milliseconds. If 60 HZ is selected, 1 cycle is equal to 16.6667 milliseconds.

STORING CONFIGURATION

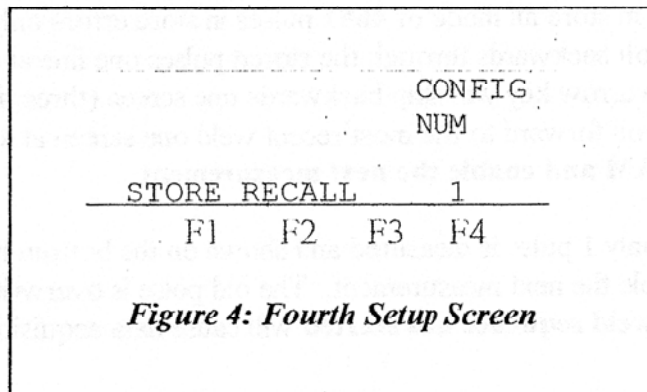


Figure 4: Fourth Setup Screen

The final setup screen is used to store and recall user configurations is shown in figure 4. To enter this screen from setup screen 3, press the SETUP and up arrow keys simultaneously.

Nine blocks of RAM are reserved for storing user configuration parameters. The number shown above F4 is used to select which block to address. Pressing F1 writes the present configuration set to the present address **overwriting any data previously stored in that location**. Pressing F2 retrieves the configuration previously stored. Press the down arrow key to exit without changing parameters and return to setup screen 3. After storing or recalling a parameter set the weld monitor displays setup screen 1.

Operation

The weld monitor operates in AC spot mode, AC seam mode or DC spot mode. Each of these modes can be configured to store all welds or only those that are out of tolerance. Seam mode is used to examine each individual cycle in a weld sequence while spot mode shows the average RMS current of several cycles. You may use seam mode to look at individual half cycle information on a spot weld.

Spot Mode

When in SPOT mode, the weld monitor displays and stores the average RMS current and average conduction angle for a series of weld cycles. A series of heat and cool cycles is called a pulse. The maximum allowable number of heat cycles per pulse varies depending on the magnitude of the weld pulse. The minimum number of cycles per pulse is 110 for an 80 Ka pulse with 179 degree conduction angle. Longer pulses may be measured at lower current levels or shorter conduction periods. Overflow is indicated by an O in the error field next to each pulse.

RESET MODE

In auto reset mode, the pulse is stored in RAM and the next pulse is measured. The RAM will hold up to **6553** pulses in store all mode or **4681** pulses in store errors only mode. Press the down arrow key to scroll backwards through the stored pulses one line at a time. Pressing F1 while holding the down arrow key will skip backwards one screen (three lines) at a time. Press the up arrow key to scroll forward to the most recent weld one screen at a time. **Press the Weld button to clear the RAM and enable the next measurement.**

In manual reset mode only 1 pulse is measured and shown on the bottom line of the display. Press the weld button to enable the next measurement. The old pulse is overwritten. Pressing the WELD button **after a weld sequence has started** will cause data acquisition to start immediately with **unknown** results.

START and STOP

START sets the number of full cycles to ignore before data is collected. STOP sets the last full cycle to measure. Setting STOP to 0 causes all cycles after START to be averaged into the pulse. Setting both START and STOP to zero causes all cycles to be averaged into the pulse.

RESET DELAY

The reset delay must be set equal to or greater than the longest cool cycle in the weld pulse to be monitored. Assume you have a weld pulse with 10 heat cycles followed by 4 cool cycles. This pulse is repeated three times. START and STOP are both set to 0, instructing the weld monitor to measure all cycles. A reset delay of 4 or more will store 1 pulse representing the average RMS current and conduction time of the 30 heat cycles. A reset delay less than 4 will interpret the sequence as 3 pulses. If RESET MODE is set to MAN, the average of the first 10 cycles will be stored as pulse number 1 and the remaining cycles are ignored. If RESET MODE is set to AUTO, 3 pulses are stored, each the average of 10 heat cycles. The monitor displays the last pulse at the completion of the sequence. Use the down arrow key to scroll through the previous pulses.

MIN AND MAX

Each pulse is compared to the MIN and MAX values. If the last pulse was outside the range indicated by MIN and MAX, the FAULT LED is turned on. A '<' indicates the weld was under range and a '>' symbol indicates over range. In store errors mode, only faults are stored. A fault can be a pulse that is greater than max, less than MIN, a half cycle (indicated by a H) or over range (indicated by a O). Error mode also stores a counter ranging from 1 to 65535 to indicate how many pulses have been measured.

Seam Mode

Seam mode measures and displays each cycle separately. The RMS current and conduction angle for each half cycle is averaged and displayed starting with the first cycle measured. The RAM will hold up to **6553** cycles in store all mode or **4681** cycles in store errors only mode. Press the down arrow key to scroll backwards through the stored pulses one line at a time. Pressing F1 while holding the down arrow key will skip backwards one screen (three lines) at a time. Press the up arrow key to scroll forward to the most recent weld one screen at a time. **Press the Weld button to clear the RAM and enable the next measurement.**

RESET MODE

In auto reset mode, a new seam will automatically overwrite the old data.

In manual reset mode the weld button must be pressed to enable additional measurements. Previous data are retained in RAM and may be recalled by pressing the up or down arrow keys until the weld button is pressed.

START AND STOP

START sets the number of full cycles to ignore before data is collected. STOP sets the last full cycle to measure. Setting STOP to 0 causes all cycles after START to be captured and stored in RAM. Setting both START and STOP to zero causes all cycles to be measured.

RESET DELAY

The reset delay must be set equal to or greater than the longest cool cycle in the weld schedule to be monitored. Assume you have a weld pulse with 10 heat cycles followed by 4 cool cycles. This pulse is repeated three times. START and STOP are both set to 0, instructing the weld monitor to measure all cycles. A reset delay of 4 or more will store 30 cycles. A reset delay less than 4 will store only 10 cycles, the first 10 if reset is set to MAN and the last 10 if reset is set to AUTO. To capture the middle 10 heat cycles only, set START equal to 14, RESET DELAY equal to 0 and RESET MODE to MAN.

MIN AND MAX

Each cycle is compared to the MIN and MAX values. If any cycle in a seam was outside the range indicated by MIN and MAX, the FAULT LED is turned on. A '<' indicates the weld was under range and a '>' symbol indicates over range. In store errors mode, only faults are stored. A fault can be a cycle that is greater than max, less than MIN, a half cycle (indicated by a H) or over range (indicated by a O). Error mode also stores a counter ranging from 1 to 65535 to indicate how many pulses have been measured.

DC Mode

DC mode is used to measure RMS current for 50 Hz, 60 Hz and hi frequency inverter DC welders. Each pulse is stored and displayed as in AC spot mode.

RESET MODE

In auto reset mode, the pulse is stored in RAM and the next pulse is measured. The RAM will hold up to **6553** pulses in store all mode or **4681** pulses in store errors only mode. Press the down arrow key to scroll backwards through the stored pulses one line at a time. Pressing F1 while holding the down arrow key will skip backwards one screen (three lines) at a time. Press the up arrow key to scroll forward to the most recent weld one screen at a time. **Press the Weld button to clear the RAM and enable the next measurement.**

In manual reset mode only 1 pulse is measured and shown on the bottom line of the display. Press the weld button to enable the next measurement. The old pulse is overwritten. Pressing the **WELD button after a weld sequence has started** will cause data acquisition to start immediately with **unknown** results.

START

Start indicates the number of cycles to omit from the RMS current calculations at the start of the DC pulse. A cycle is 16.667 milliseconds if 60 HZ is selected or 20 milliseconds if 50 HZ is selected.

MIN AND MAX

Each pulse is compared to the MIN and MAX values. If the last pulse was outside the range indicated by MIN and MAX, the FAULT LED is turned on. A '<' indicates the weld was under range and a '>' symbol indicates over range. In store errors mode, only faults are stored. A fault can be a pulse that is greater than max, less than MIN, or over range (indicated by a O). Error mode also stores a counter ranging from 1 to 65535 to indicate how many pulses have been measured.

Examples

Figure 4 shows an example weld sequence of 6 heat cycles followed by 1 cool cycle

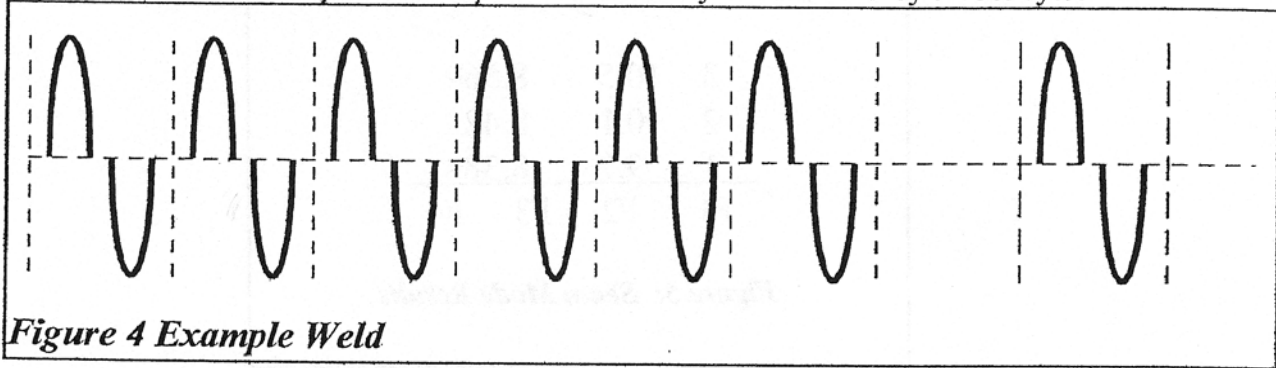


Figure 4 Example Weld

Figure 5 shows the results of measuring the weld in figure 4 with the weld monitor set to the following:

Start	0
Stop	0
Weld Type	SEAM
Gain	AUTO
Freq	60
Reset Delay	0
Reset Mode	MAN
MIN	9.9
MAX	10.2
Time Disp	SEC

3	10.5	8.56>	
2	10.1	8.42	
1	9.7	8.38<	
F1	F2	F3	F4

Figure 5: Seam Mode Results

Pressing the UP ARROW key displays the results for cycles 4, 5, and 6 as shown in figure 6.

6	10.4	8.56>	
5	10.2	8.42	
4	9.8	8.38<	
F1	F2	F3	F4

Figure 6: Seam Mode Results

Pressing the DOWN ARROW key 1 time will display cycles 5, 4, and 3. Note that pressing the UP ARROW key displays the next 3 cycles while pressing the DOWN ARROW key goes backwards 1 line at a time.

Figure 7 shows the results of measuring the same weld with the weld type set to spot. The current magnitude of 10.1 is the average of the 6 magnitudes and the conduction time of 8.45 is the average of the 6 conduction times.

1	10.1	8.45	
F1	F2	F3	F4

Figure 7: Spot Mode Results

If START had been set to 1, the data shown in figures 5 and 6 would instead look like figures 8 and 9.

3	9.8	8.38<	
2	10.5	8.56>	
1	10.1	8.42	
F1	F2	F3	F4

Figure 8: Seam Mode Results

START tells the weld monitor how many cycles to count before accumulating data. Setting START to 1 results in the first cycle not being measured and the second cycle being measured and shown as cycle 1:

5	10.4	8.56	>
4	10.2	8.42	
F1	F2	F3	F4

Figure 9: Seam Mode Results

STOP indicates how many cycles to count before no more data is accumulated, **including cycles ignored by START**. For instance if STOP were set to 6, the results would be the same as figures 8 and 9. The total cycles counted equals STOP which is equal to 6. The total cycles for which data are accumulated is STOP - START or 6-1 = 5. If STOP were set to 5, line 5 in figure 9 would be blank. Data accumulation would have stopped after 5 cycles with STOP - START = 4 lines displayed.

START and STOP are useful when measuring welds with slope at the beginning or end, especially when in SPOT mode. For the same weld sequence as above, setting START = 1 and STOP = 5 and setting the mode to SPOT results in the magnitude displayed as $10.1 = (10.1 + 10.5 + 9.8 + 10.2) / 4$.

RESET DELAY allows the insertion of cool cycles into a weld sequence. Figure 10 shows a weld sequence with cool cycles inserted at cycles 3, 6 and 7.

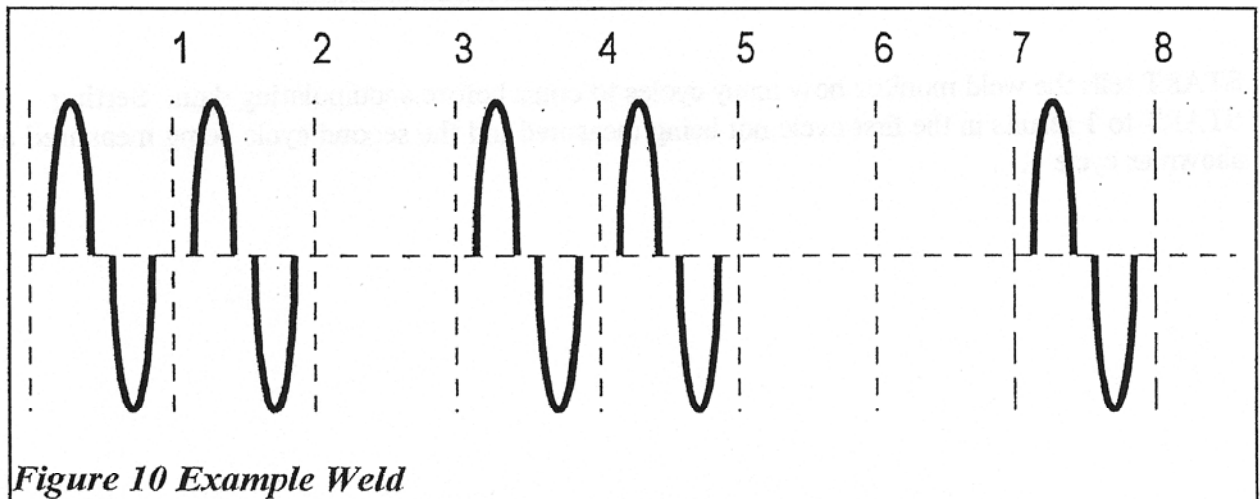


Figure 10 Example Weld

If RESET DELAY is equal to 0, the sequence in figure 10 is considered terminated after the first half of the third cycle. If reset mode is equal to MAN, seam mode would display 2 lines of data while spot mode would show 1 line with the magnitude equal to the average of cycles 1 and 2. If RESET DELAY were increased to 1 the sequence would terminate midway through the seventh cycle. Seam mode would display 4 lines of data while SPOT mode would show the average of the first, second, fourth and fifth cycles. Note that SPOT mode does not include cool cycles in the average RMS calculations, only heat cycles are included.

Calibration

The calibration constant mentioned in the setup section may be changed by the user to adjust the current reading of the weld monitor to a local standard. This constant is retained in RAM as long as the battery is not totally discharged. To edit, press the F3 and ON/OFF keys simultaneously then use the UP or DOWN arrow keys to change the constant. If the battery is discharged, the constant returns to the default of 127. Increasing the constant increases the current displayed for the next measurements while decreasing the constant decreases the reading. The constant can range from 1 to 255. Separate constants are used for 50 Hz, 60 Hz and DC modes.

Display Back Light

An LED back light is incorporated in the display. When the charger is not connected, pressing the LIGHT key turns the back light on. The light remains on for one minute then shuts off automatically. The light can also be turned off by pressing the LIGHT key again. The back light uses quite a bit of current, each minute of use will decrease the battery life by about ten minutes. The back light cannot be turned on when the battery is low. This is indicated by a 'B' in the upper left corner of the display.

When the battery charger is connected and the battery is in fast charge, the back light is turned off and cannot be turned on. When the fast charge cycle is complete, the back light is turned on and remains on until the charger is disconnected. See the Battery Care section for more information on battery charge cycles.

Battery Care

The weld monitor uses a rechargeable nicad battery with internal charge control circuitry. The battery should give several years of trouble free service. The low battery indicator is a 'B' in the upper left corner of the display. The back light is disabled when a low battery is detected. When the low battery indicator appears, the charger should be connected immediately to avoid loss of configuration parameters. The weld monitor does not need to be turned on to charge the battery. The normal charge cycle takes 90 minutes or less. The monitor continues to function normally with the charger connected. A 'C' in the upper left corner indicates the fast charge cycle is in progress. During this period, the back light is disabled and cannot be turned on. After the charge

cycle is terminated, the 'C' is erased and the back light is turned on. The battery will trickle charge as long as the charger is connected.

For maximum battery performance wait until the low battery indicator comes on before charging the battery.

If the battery is allowed to fully discharge, the charger will trickle charge until the battery voltage exceeds 5 volts. This may take a few seconds to several minutes depending on the state of the battery. After the threshold voltage is reached, the charger begins a normal fast charge cycle.

The charge cycle is only enabled for temperatures between 60 and 140 degrees Fahrenheit. If the charger is plugged in at a temperature less than 60 degrees, the battery will trickle charge until the temperature exceeds 60 degrees, at which time a normal charge cycle will start. If the temperature exceeds 140 degrees when the charger is connected, the battery will trickle charge but will not enter a fast charge cycle, even if the temperature drops below 140 degrees. If the temperature exceeds 140 degrees at any time during the fast charge cycle, the cycle is terminated and the battery will trickle charge as long as the charger remains connected. If the fast charge cycle is not completed, the battery will be completely charged in 10 to 12 hours.

Replacing the battery with one that has different charge characteristic, including other nicad batteries, may result in fire or explosion.

Duffers Scientific *by CyberNational*
PRECISION WELD PERFORMANCE ANALYZER
SPECIFICATIONS (rev. 4/14/99)

Weld Current	Range	0.4 KA* to 80.0 KA auto ranging, 110 heat cycles/pulse
	Value	RMS value of measurement period
	Accuracy	±1% Full Scale
Spot Mode	Impulse Memory	Up to 6553 impulses (STORE ALL) 4681 (ERROR ONLY) Modes
	Start	0 to 127 cycles
	Stop	0 to 127 cycles
	Reset Delay	0 to 127 cycles

Weld Current	Range	0.4 KA* to 80.0 KA, auto ranging
	Value	RMS current of each cycle
	Accuracy	±1% Full Scale
Seam Mode	Cycle Memory	Up to 6553 cycles (STORE ALL) 4681 (ERROR ONLY) Modes
	Start	0 to 127 cycles
	Stop	0 to 127 cycles
	Reset Delay	0 to 127 cycles

Conduction	Range	25° to 180° or 1.39 ms to 8.33 ms
	Value	Average conduction time for measurement period, degrees or milliseconds
	Accuracy	±0.2%

Memory		6553 welds or 4681 errors
Display		Three-line LCD with backlighting
Weight		1.18 lbs (536 g)
Dimensions		8.25 x 4.25 x 1.5 in (21 x 10.8 x 3.8 cm)
Battery Life	Rechargeable	20 hrs continuous operation (w/o back light) 90 minute recharge

*Requires 10 X coil