sigPOD APPLICATION GUIDE
RESISTANCE WELDING

sciemetric

Spot Welding

T100

OVERVIEW

This **sigPOD Spot Weld application template** was designed for resistance weld monitoring and is suitable for use with most commercial DC resistance spot welders. These welders are commonly used to fasten two metal sub-components together. Variations in physical process parameters, such as force, current, distance and voltage, can ultimately affect finished part quality. By monitoring and analyzing these parameters, this application will allow you to capture a broad range of defects, including:

- Inadequate or excessive heating
- Poor bonding due to presence of foreign materials
- Deformation of the part due to excessive force
- Misalignment of probes
- Deteriorating electrode conditions due to oxidation or change in gap width

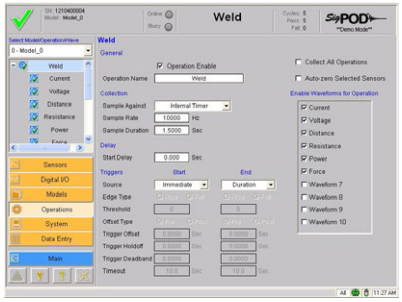
Please note that this configuration is intended as a starting point and may require modifications to meet your specific requirements.

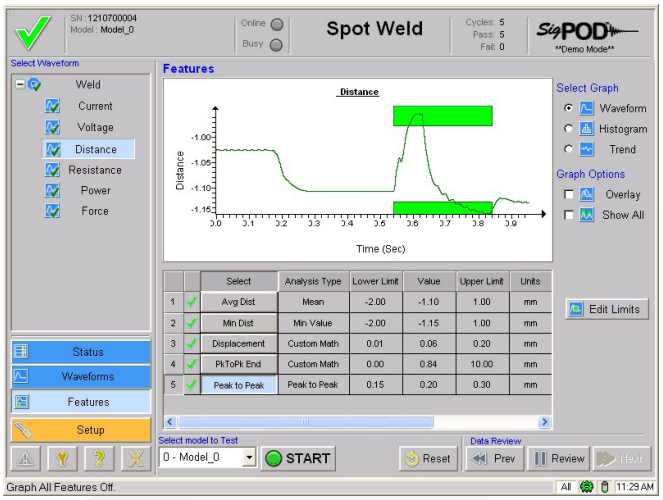
Installing the template

You can install the template using the **System Shell** interface. See the last page of this guide for complete installation instructions.

SETUP

The data acquisition is set up with a 10 kHz sampling rate over a 1.5 second duration; however, these parameters should be optimized for each specific implementation to ensure the spot weld process is properly characterized. The settings will depend on the specific resistance welder and the sub-components being welded.





SENSORS

The assigned analog input channels in this application are **00: Voltage, 01: Current, 02: Distance, 03: Force.**

VOLTAGE

(Analog Input 00) can be measured directly from the two electrodes if the open circuit voltage is less than 10 volts. Higher voltages would require a voltage divider circuit to attenuate the signal.

CURRENT

The Current (Analog Input 01) is collected by measuring the voltage drop across a current transducer

DISTANCE

Distance sensing (Analog Input 02) can be achieved in two ways:

1. DC output linear sensor such as a DC/DC LVDT
2. Linear 5 VDC TTL Quadrature Encoder

FORCE

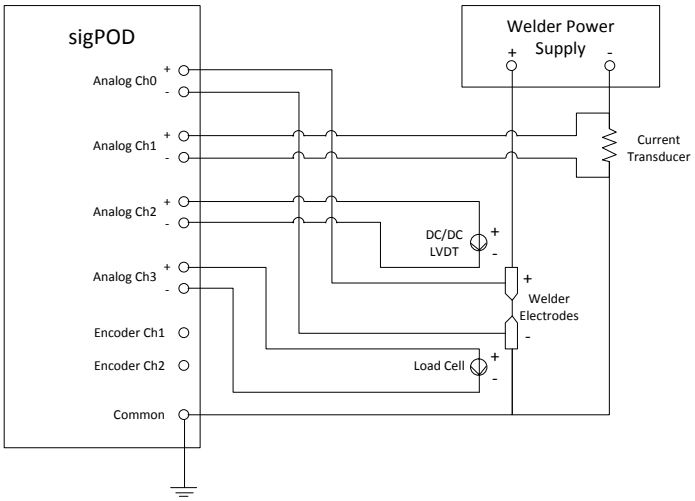
The Force (Analog Input 03) measurement is collected from a force sensor.

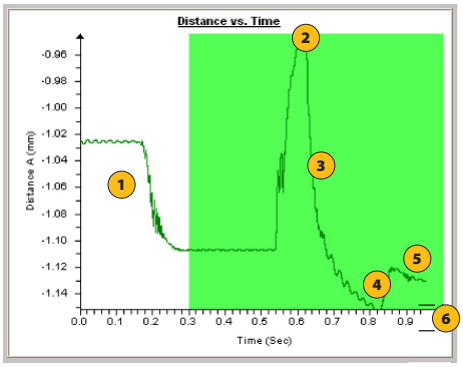
Two options are:

1. A load cell mechanically coupled to one of the electrodes. Some weld-specific load cells offer secondary current monitoring.
2. A piezo strain-type load sensor. This sensor, when combined with the Sciemetric ICP input conditioning module, is ideal when the traditional electrode mounting area is restricted. The piezo strain sensor is easily mounted onto a flat surface (usually the frame) with a single screw. The piezo quartz crystal offers significant advantages when compared with traditional strain gage sensors: extreme sensitivity (up to six decades, with excellent stability), very high overload protection, no fatigue and virtually no deflection.

SCHEMATIC DIAGRAM

Schematic diagram of the sigPOD Spot Weld test setup.





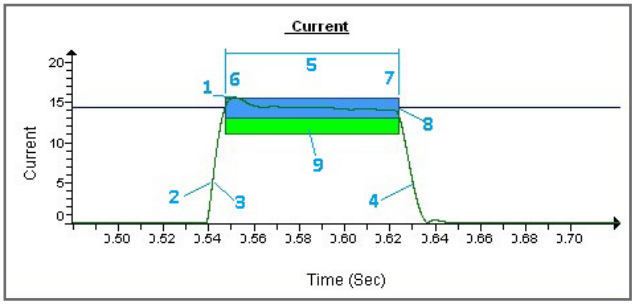
1. **Force Applied**
2. **Expansion of metal due to heat of weld current**
3. **Metal melts and flows**
4. **Force on elecrodes is removed**
5. **Metal cools down and contracts**
6. **Weld Travel**

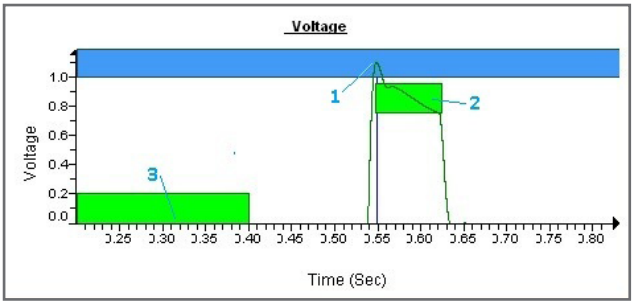
PROCESSING AND ANALYSIS

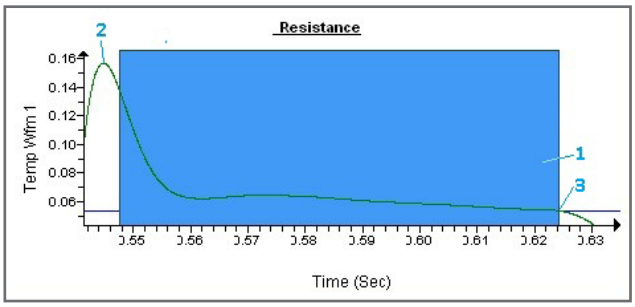
The default Spot Weld configuration comes with one operation configured, Weld; others may be configured if desired, eg: to monitor multiple welds on the same part. Please see the sigPOD PSV User Guide for more details on configuring operations.

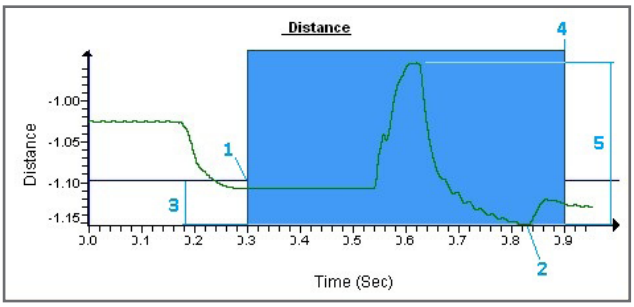
Within the Spot Weld Application, the following waveforms and features are configured:

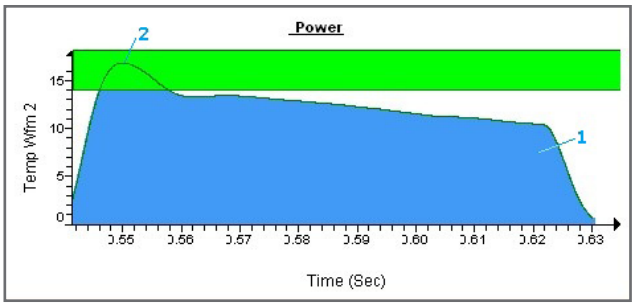
WAVEFORMS

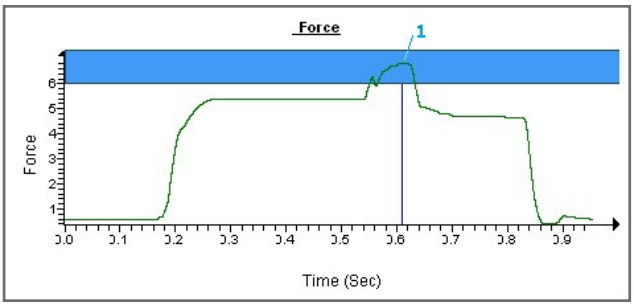












WAVEFORM DEFINITIONS

WAVEFORM	Y-INPUT	X-INPUT	WAVEFORM PROCESSING	DESCRIPTION
Current (stored to Temp Wfm2)	**Current**	**Time**	1) Low Pass Filter	50 Hz Low Pass Filter to remove Weld power supply switching noise
			2) Running RMS	Remove noise and convert to positive values (band pass 500Hz)
			3) Store to Temp Wfm1	Used to calculate dynamic resistance and power
Voltage	**Voltage**	**Time**	1) Low Pass Filter	50 Hz Low Pass Filter to remove Weld power supply switching noise
			2) Running RMS	Remove noise and convert to positive values (band pass 500Hz)
			3) Stored to Temp Wfm2	Used to calculate dynamic resistance and power
Distance	**Distance**	**Time**	1) Low Pass Filter	50 Hz Low Pass Filter to remove Weld power supply switching noise
			2) Smoother	
Resistance	**Current**	**Time**	1) Math: Temp Wfm2 / Temp Wfm1	Dynamic Resistance = Voltage / Current
			2) Low Pass Filter	50 Hz Low Pass Filter to remove Weld power supply switching noise
			3) Extract	Extract portion between Start Thresh and Stop Thresh (see Current features in table below) to simplify analysis
Power	**Voltage**	**Time**	1) Math: Temp Wfm1 x Temp Wfm2	Power = Voltage * Current
			2) Extract	Extract portion between Start Thresh and Stop Thresh (see Current features in table below) to simplify analysis
Force	**Force**	**Time**	Low Pass Filter	50 Hz Low Pass Filter to remove Weld power supply switching noise

FEATURE DEFINITIONS

WAVEFORM	FEAT #	FEATURE NAME	FEATURE TYPE	DESCRIPTION	EXAMPLES OF DEFECTS DETECTED
Current (stored to Temp Wfm2)	1	Max Current	Peak Value	Maximum across the entire waveform	Overheating caused by excessive current
	2	Calc 30pct	Custom Math	30% of the maximum current is calculated to be used as a threshold crossing.	N/A – used only as a parameter to define the analysis window
	3	Start Thresh	ThresholdCrossing	Using the previously calculated threshold, the start time of the weld is found.	N/A – used only as a parameter to define the analysis window
	4	Stop Thresh	Threshold Crossing	Using the previously calculated threshold, the end time of the weld is found.	N/A– used only as a parameter to define the analysis window
	5	Duration	Custom Math	The total duration is found by subtracting the start time from the end time from above. These start/end values are used to create dynamic analysis windows for the Voltage, Resistance and Power waveforms.	Insufficient weld time can have a significant impact on the quality of the weld. This is generally indicative of a mal-function of the weld controller.
	6	Start Min	Custom Math	Add about 7% of the weld duration to the 'Start Thresh' to avoid analyzing the area before current is applied.	N/A– used only as a parameter to define the Min Current analysis window
	7	End Min	Custom Math	Subtract about 7% of the weld duration from the 'Stop Thresh' to avoid analyzing the area after current is applied.	N/A– used only as a parameter to define the Min Current analysis window
	8	Avg Current	Mean	Using the window defined by Start Min and End Min, the average current is defined.	Low avg current can indicate a poor weld due to presence of contamination, electrode wear, etc. resulting in poor electrode contact
	9	Min Current	Minimum	Using the window defined by Start Min and End Min, the minimum current during the weld is found.	Low current can indicate a poor weld due to presence of contamination, electrode wear, etc. resulting in poor electrode contact
Voltage	1	Max Voltage	Peak Value	Ensures the voltage remains within a specified range throughout the weld.	High voltage indicates deteriorating electrode conditions, contamination
	2	Avg Voltage	Mean	Using the window defined by Start Min and End Min, the average voltage during the weld is found.	
	3	Off Voltage	Mean	Measured before the weld begins	Typically caused by equipment faults resulting in leakage current/voltage outside of the weld time
Distance	1	Avg Dist	Mean		Can indicate gross issues with part thickness, foreign matter or missing parts.
	2	Min Dist	Min Value	Displacement = Avg Dist – Min Dist	Can indicate gross issues with part thickness, foreign matter or missing parts.
	3	Displacement	Custom Math	Stop Thresh + offset to capture peak in weld	Excessive heat, poor material quality can result in greater travel during the weld
	4	PkToPk End	Custom Math	Evaluated between Start Thresh and PkToPk End	N/A – used to evaluate Peak to Peak
	5	Peak to Peak	Peak to Peak		The distance travelled during the weld can be an indicator of weld penetration, or inferior material quality
Resistance	1	Avg Resist	Mean		Oxidation, poor electrode quality and gaps can lead to higher impedance, potentially causing poor surface bonding.
	2	Max Resist	Peak Value		Gaps in the material, contamination can lead to poor or incomplete surface bonding.
	3	Min Resist	Minimum	Between Start Min and End Min to avoid start/stop	Low Min Resist indicative of overheating
Power	1	Energy	True Area		
	2	Max Power	Peak Value		Monitoring the total energy put into the weld ensures the parts are bonded sufficiently but not burned.
Force	1	Max Force	Peak Value		An improper application of force on the electrodes can result in poor bonding or deformed material.

Before you install the template

You can install the template using the **System Shell** interface.

- If the template is on a USB flash drive, ensure the flash drive is inserted in the USB port of the sigPOD.

To install the template

1. On the ***System Shell*** toolbar, click ***Install*** to open the ***Install*** dialog box.
2. In the ***Type*** area, ensure ***Back Up*** is selected.
3. From the ***Location*** drop-down list, select one of the following:
   - **X:\[Removable]** – if the template file is on a USB flash drive
   - ***<Network Places>*** – if the template file is on a network drive
4. Click the  button next to the Location drop-down list.
5. In the ***Open*** dialog box, navigate to the template file (.SBK) to be installed.
6. Select the template filename, and click ***Open***.

   The template filename and properties are displayed in the ***Install*** dialog box.
7. In the ***Install*** column, ***Component*** area, ensure the ***Calibration***, ***Configuration***, and ***Application Data*** check boxes are selected.
8. Click ***OK***.
9. To start the installed template, click ***Run*** on the ***System Shell*** toolbar.

For more information about installing application backup files, including template files, see the ***InspeXion System Shell User Guide***. (To access, click ***Install*** on the ***System Shell*** toolbar, and then click ***Help*** in the ***Install*** dialog box).

About sigPOD Application Templates

sigPOD is a uniquely versatile platform that can be used for different applications across the production line. A sigPOD template serves as a starting point for configuration of the unit for a particular manufacturing test or monitoring requirement. Additional manual configuration will usually be required to fit to a test environment's specific circumstance. Please consult the sigPOD PSV user guide to learn more about how to configure the software. If you have suggestions on other templates or would like to share your own, contact us. If you require a customized application to meet your specific needs, our Manufacturing Intelligence Team can develop one for you. Request more information at inquiries@sciemetric.com.

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