PRESENTED BY

PRECISION CONTROL & MONITORING OF TIG AND MIG WELDING PARAMETERS

STEPHEN DANGEL - PRESIDENT
DANGEL ROBOTS & MACHINERY INC.
BEDFORD, MASSACHUSETTS
Robot Welding Quality Control System

Visualize welding status, Securely store welding data
System Configuration

Collect and store data with simple system configuration

Available in FD11 controller and the WB series welding power source package.

*1 Available for the arc tracer system only.
Feature Highlights

- **Welding status Monitoring**
  - Even 1 minute of current / voltage change can be monitored with the high-quality current/voltage monitor during welding.
  - Various of items listed on the monitor to check affective elements of welding quality.
  - Current/ voltage waveforms displayed in real-time on the teach pendant during welding.

- **Welding status Storing**
  - The welding information regarding when, where, what and how can be recorded in a computer.
  - In the event of a communication error, the system can automatically back up the data.

- **Welding status Analyzing**
  - With 6 preset conditions and 19 user-defined conditions, various welding defects can be automatically detected.
  - Stored data can be reviewed later to verify abnormalities.
Monitor welding status

- Small current / voltage changes can be monitored.

When sampling frequency is low

- Instantaneous arc breaking
- Arc breaking is overlooked

Small changes can be detected with 10 kHz sampling frequency.
* Conventional model: 20 Hz

Affective elements of welding quality can be detected.

The following factors that may affect welding can be monitored. This function is useful for identifying the causes of welding defects.

- Welding current
- Welding voltage
- Travel speed
- Feed load
- Feeding speed (feeder unit)
- Feeding speed (measure unit)
- Feed motor current
- Gas flow rate
- Gas pressure
- Primary voltage
- Power supply internal temperature
- Power supply fan rotation speed

12 items in total

* Red: Additional items for Arc Monitor.

Welbee Inverter series welding power source

Current and voltage can be monitored at 100 μsec interval.

Measure unit

Feeder unit

Feeding speed monitor (Option)
View of welding status

Welding status can be checked with the robot Teach Pendent.

- During the welding
  - Digital Display
  - Free Run Display

- After the welding
  - Welding Result Display
  - Recorder function

* Option

- Arc on time
- Welding Dist.
- Current(Ave.)
- Current(Max.)
- Current(Min.)

Robot automatically collects data when welding defect occurred.
Feature Highlights

- **Welding status Monitoring**
  
  - Even 1 minute of current / voltage change can be monitored with the high-quality current/voltage monitor during welding.
  - Various of items listed on the monitor to check affective elements of welding quality.
  - Current/ voltage waveforms displayed in real-time on the teach pendant during welding.

- **Welding status Storing**

  - The welding information regarding when, where, what and how can be recorded in a computer.
  - In the event of a communication error, the system can automatically back up the data.

- **Welding status Analyzing**

  - With 6 preset conditions and 19 user-defined conditions, various welding defects can be automatically detected.
  - Stored data can be reviewed later to verify abnormalities.
Storing welding status

All monitored results are stored in the recorder of a computer.

Storage period: With 1 GB storage capacity, the system can record welding monitor data for one welding power source for approx. 6 hours at maximum sampling frequency. With 1 TB storage capacity, can record data for approx. 3 years. (8 hours/day, 250 days/ year)

Stored work result information

- Work No.
- Work Name
- Work serial No.
- Welding section No.
- Robot controller No.
- Robot controller name
- Prog. No.
- Weld step No.
- Welding section name
- Weld start date
- Error code
- Welding defect
- Welding stop time
- WPS No.
- WPS Name
- Welding process
- Arc ON time
- Welding distance
- Average welding current
- Average welding voltage
- Average welding speed
- Average feed speed
- Average gas flow rate
- Average gas pressure
- Average feed load

* Red indicate additional items of work result information.
**Storing welding status**

Data can be automatically stored for reliable traceability.

- In the event of a communication error, data for approx. 6 hours is temporarily stored in the USB memory of the arc tracer I/F board.
- After recovery from communication error, the temporarily stored data will be automatically transferred to the PC.
- If any data cannot be stored due to a power failure or communication error, it is indicated as a defect in the history.
Even 1 minute of current/voltage change can be monitored with the high-quality current/voltage monitor during welding. Various items listed on the monitor to check affective elements of welding quality. Current/voltage waveforms displayed in real-time on the teach pendant during welding.

The welding information regarding when, where, what and how can be recorded in a computer. In the event of a communication error, the system can automatically back up the data.

With 6 preset conditions and 19 user-defined conditions, various welding defects can be automatically detected. Stored data can be reviewed later to verify abnormalities.
The system simultaneously monitors different elements that can affect welding, the occurrence of a defect will not be overlooked. Monitor different conditions to detect one defect.

- 6 presets detecting conditions
- 9 threshold detecting conditions
- 10 user-defined detecting conditions

- Arc start error
- Arc loss
- Rapid arc loss
- Wire sticking
- Deficient bead at start
- Deficient bead at end

Monitor upper and lower limits of the following monitoring items:
- Current
- Voltage
- Wire feeding load
- Wire feeding speed
- Reduction rate
- Gas flow rate
- Gas pressure
- Filler wire load
- Filler wire speed

Monitor items and method (determination time and sensitivity) can be user-customized.

Up to 3 detection conditions can be combined ("and")
Example: combine conditions of “Current > 400 A” & “Voltage < 10 V”
Analyzing welding status

Set defect detecting sensitivity individually, to prevent detection miss and failure.

The best sampling cycle time can be set specifically for each defect type.

The best defect determination time can be set specifically for each defect type.

Example of arc breaking detection setting

At the beginning of welding, “lack of beads at start” is detected as a defect. The detecting condition set as WCR OFF continues for 0.15 second.

During welding, “arc breaking” is detected as a defect. The detecting condition set as WCR OFF status continues for 0.5 second.

At the end of welding, “lack of beads at end” is detected as a defect. The detecting condition is WCR OFF continues for 0.2 second.

Note: The robot returns to the WCR OFF position, where arc can be automatically restarted. (Except for at the end)
Analyzing welding status

Work result data that has been stored in the recorder in a pc can be checked afterwards.

- Review the data by different determination conditions for analyzing.
- Defect work results extraction.
- Review filter/threshold conditions
- Range measurement
- Output to Excel format
NEW

Preventive Maintenance

- Automatically compares with the recorded data in computer, defect can be detected right away. Flow of defective components to the next process can be avoided.
- Based on the recorded data in PC, the condition of welding defects can be calculated.
Welding Waveform Pattern Matching

Detect the welding defects by comparing with the recorded normal condition data in PC.

FD-AM

Recorded normal condition data

Leg(1)

Leg(2)

Leg(3)

Leg(4)

Welding Results
Leg(1)(2)(3)(4)

Store the welding results

Keep operation

Match

Compared with the normal condition

Error!!

Not match

normal condition area can be customized

Real-time monitoring

normal condition area
Diagnosis The Foreseeability of Welding Defects

Based on the same welding path and long-term transition, the foreseeability of welding defects are calculated.

Store the average current/voltage of same program, same welding path.

< Example >

System alert “The foreseeability of welding defects on 6/25 detected.”

Threshold (limit) level

The Foreseeability of transition from past data generated.
Diagnosis The Foreseeability of Welding Defects

Based on the monitoring data, Presume the consumption of consumables.

- **Feeding Path**
  - Conduit
  - Liner
  - Feeding roll
  - Coaxial power cable

- **Power Supply**
  - Contact Tip
  - Power brush of positioner

**Factors (consumables)**

- Clogged Liner
- Abraded Conduit
- Feeding load -> Increase
- Feeding speed -> Unstable

- Abraded Contact Tip
- Change the current and voltage

- Change of environment

**Contact Tip is worn down!**

**Average current and voltage during welding**

- Current: Decrease
- Voltage: Increase

Counts (per 25 weld)
## Comparison Between New and Previous Version

<table>
<thead>
<tr>
<th>Version</th>
<th>New Version (Red: changed points)</th>
<th>Previous Version</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With Arc Trace I/F</td>
<td>Without Arc Trace I/F</td>
</tr>
<tr>
<td>Sampling Frequency</td>
<td>10KHz [100u sec]</td>
<td>20Hz [50m sec]</td>
</tr>
<tr>
<td>[Sampling Cycle]</td>
<td>10KHz [100u sec]</td>
<td>20Hz [50m sec]</td>
</tr>
<tr>
<td>Sampling frequency can be set per each recording contents</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recording contents</td>
<td>Order: Current, Voltage, Feeding speed, Gas flow value 1</td>
<td>Current, Voltage, Welding speed, Feeding load, Feeding speed (Feeder), Current of feed motor, Gas flow value 1, Gas pressure 1, Input voltage of WPS 2, Temperature inside of WPS 2, Fan Frequency in WPS 2</td>
</tr>
<tr>
<td></td>
<td>actual measurement</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Display type: Digital, Waveform</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Welding result display: Real time: (Average, Max, min, Weld time, Weld length)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Record: (Average, Weld time, Weld length, with or without weld failure)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communication function: Ethernet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Auto-connection/Re-connection function available</td>
<td>Auto-connection/Re-connection function unavailable</td>
</tr>
<tr>
<td></td>
<td>Maximum connected robots: 32 robots</td>
<td>16 robots</td>
</tr>
<tr>
<td></td>
<td>Welds specification method: Robot controller name, Program comment, Work name, Work serial number, Weld leg name</td>
<td>Robot controller number, Program number, Step number, Work number</td>
</tr>
<tr>
<td></td>
<td>Failure monitoring function: Misfit from order, and Aberration from rated value - 2 pattern (Error or Caution)</td>
<td>Misfit from order, and Aberration from rated value - 1 pattern (Error)</td>
</tr>
<tr>
<td></td>
<td>Failure display: Error code and Error message</td>
<td>Error code</td>
</tr>
</tbody>
</table>

* 1 Option, * 2 Only for Welbee Series
7 AXIS TIG WELDING SYSTEM WITH FILLER WIRE DURING INTEGRATION
6 AXIS ROBOT WITH 2 POSITIONERS
TIG WELD CELL FOR ARCHITECTURAL COUNTER TOP BRACKETS
2 STATION MIG WELD CELL
LONG REACH 6 AXIS ROBOT FOR MIG
WELDED CHAIR BASES
THANK YOU

DANGELO ROBOTS
AND
OTC DAIHEN