

Production Mode art. 817

Application notes for interfacing with MES software for Industry 4.0

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Document review

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Foreword

CEBORA MIG KINGSTAR and WIN TIG series generators have a wired network interface and an internal web server through which REST APIs (*Application Program Interfaces*) are implemented for integration with third-party application software. These APIs define what requests can be made and how they should be made, allowing software developers to extend the system by interacting with the generator without necessarily knowing the implementation details of its software.

In order to create a production system that complies with the specifications of Industry 4.0, the generator will have to be interfaced with a third-party software of the MES type (*Manufacturing Execution System*) that will manage and control the production function of the company.

The *Production Mode* software option (art. **817**) provides for the management of welding processes and parameters through Jobs, to be configured in advance in the generator using the control panel of the generator itself or through the remote panel of the integrated web app. This document describes the set of commands that can be performed by the MES through the dedicated production management APIs made available by this option.

Preliminary configuration

NOTE: It is recommended to update the generator to the latest available software release.

The generator must be interconnected to the company's LAN network via cable, or optionally via an external Wi-Fi module, so that it can be reached by the MES software via a known IP address. In order to ensure secure communication (HTTPS) it is necessary to install the *trusted root certificate* in the MES operating system. For the details of this configuration, please refer to the specific manual code **3301067**; in this document, we assume that the assigned IP address is 192.168.13.210.

In order to guarantee a controlled access to the configuration of the welding system, the *Application-to-Application* communication between the generator and the MES must always take place through the *Basic HTTP Authentication*, that is by specifying one of the users with administrator rights configured in the generator (e.g. the default *admin* user) and the relevant password (PIN). The configuration of the users with remote access is linked to the *User Management* function in the generator. Refer to the machine instruction manual for details regarding the possible *OFF* and *Basic* modes and to the specific manual for the *Advanced* mode available as an option (art. **809**).

The REST protocol implemented in the generators allows the data exchange via textual data in JSON format and files in ZIP format. Please refer to the specific programming manual for details on the individual REST calls and the format of the JSON fields. The instructions in this manual refer to the REST API version **1.8**; it is possible to check which version is available in the generator by means of the command:

URL https://192.168.13.210/api/version Method GET

Optionally, you can receive real-time data directly from the generator by opening a websocket on port 5678.

On the generator it is necessary to unlock the software option art. 817 with the specific password; then plant administrator will have to set the *Production Mode* item in the *Settings* menu to **ON**.



Preparing a job

Using the machine panel or the integrated web app, the operator must prepare one or more welding setups on the generator to carry out a specific *job*, saving the values in the 99 slots provided.

Each of the saved jobs corresponds to the settings required to perform one or more weld beads.

If necessary, with the *Quality Control* software option (art. 273), it will also be possible to set alarm thresholds on current and arc voltage measurements.

This set of jobs represents all the settings needed to perform a specific job. To identify it, the MES can set its name (in the example "R890") by modifying the *jobsName* attribute with the command:

URL https://192.168.13.210/api/works/parameters/jobsName
Method PATCH
Payload {"value":"R890"}

At this point, the MES can download the job from the generator and store its setup, consisting of all jobs from 1 to 99, in one of the two following equivalent ways:

a) in **ZIP** format using the *Backup* command:

URL https://192.168.13.210/api/backup?level=jobs Method GET

b) or in **JSON** format:

URL	https://192.168.13.210/api/jobs
Method	GET
Payload	<pre>{see REST API documentation}</pre>

In both cases, the data received from the MES must contain only the jobs actually set by the operator for use in the processing to be performed.

For documentation purposes, it is also possible to export the single jobs, e.g. job 5, in PDF format:

URL https://192.168.13.210/api/jobs/5/export?format=pdf Method GET



Work sequence

Using the MES software, the operator selects a specific machining to start a job order of a certain number of pieces. Then the MES will implement the following procedure:

1) The machining setup is downloaded in the generator in one of the two possible ways indicated below:

a) in **ZIP** format with the *Restore* command:

URL	https://192.168.13.210/api/restore?level=jobs
Method	POST
Payload	ZIP file

b) or in **JSON** format:

URL	https://192.168.13.210/api/jobs
Method	POST
Payload	<pre>{see REST API documentation}</pre>

Using the JSON format, the MES can also decide to change the job name during the process, by modifying or adding the "*jobsName*" parameter in the file: "*Nome*".

2) Set the generator in job mode (*Job Mode* = **ON**):

URL	https://192.168.13.210/api/works/parameters/jobMode
Method	PATCH
Payload	{"value":"on"}

3) Set the first job in the sequence (e.g. *Job Number* = 1):

URL	https://192.168.13.210/api/works/parameters/jobNumber
Method	РАТСН
Payload	{"value":1}

Optionally, it is possible to set the number of total pieces required by the job order: URL https://192.168.13.210/api/works/parameters/pieces Method PATCH Payload {"value":99}

NOTE: Writing the trackingId field, automatically resets the piece counter to 1 and the total number of pieces required for the job to 0.

Once all the parameters have been set, the strings indicating the job order code, the machining name, the current piece count and, if different from 0, the total number of pieces required, will be displayed in the information bar of the main screen of the generator panel. In this example:

Abcd | R890 | 1 / 99





At this point the generator is ready and the operator or robot can perform the weld beads through a *Start/Stop* sequence.

At the end of each piece, the operator/robot must report it in order to increase the count of the processed pieces and make the generator automatically return to the first job:

- manually by pressing the bottom right button on the generator panel [\checkmark +1]
- by means of the robot by temporarily setting value "0" in the job field in the *process-data*.

NOTE: The part counter increase only occurs after an actual arc ignition.

The MES software can verify the current piece number using the command:

URL https://192.168.13.210/api/works/parameters/pieceCount Method GET

and reset it if necessary (e.g. to value 20) with the command:

URL	https://192.168.13.210/api/works/parameters/pieceCount
Method	РАТСН
Payload	{"value":20}

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Generator status monitoring

The MES must monitor the plant correct operation so that corrective action can be taken if problems occur. The generator makes available two specific commands that can be used via polling by setting an update interval in the order of seconds.

To obtain the generator Standby, Run, Error, etc. general status and the welding status:

URL	https://192.168.13.210/api/state
Method	GET
Payload	<pre>{see REST API documentation}</pre>

It is also possible to obtain the value of certain significant quantities (such as the welding current), in order to take corrective actions if necessary:

URL	https://192.168.13.210/api/measures
Method	GET
Payload	<pre>{see REST API documentation}</pre>

Weld monitoring

For each piece made, the MES can access the measurements stored in the generator database by accessing the welds table through the command:

URL https://192.168.13.210/api/measurelogs Method GET

In fact, the generator records the measurements of each carried out bead, identifying them with a unique *id* and associating them with the name of the job, the processing and the piece counter. The welds table can contain up to 10,000 records and therefore the *GET* command must be accompanied by appropriate parameters (*query*) in order to filter only the data of interest for the current processing.

Example of filter by identifier:

URL	<pre>https://192.168.13.210/api/measurelogs?page[size]=50 %filter[startId]=12576%part=_id</pre>
Method	GET
Payload	<pre>{see REST API documentation}</pre>
The startId v	value is the identifier of the last previously requested bead.

Example of filter by date:

URL	<pre>https://192.168.13.210/api/measurelogs?page[size]=50</pre>
	&filter[startDate]=2019-01-01T00:00:00
	&filter[endDate]=2019-01-31T23:59:59&sort=-id
Method	GET
Payload	<pre>{see REST API documentation}</pre>

The MES software will then analyse the data received and extrapolate the records relating to individual pieces or to the particular order according to your needs.

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Export

The weld data can also be exported to file using the /export command in CSV or PDF by specifying the &format parameter.

id	startTimeStamp	welder	trackingId	jobsName	pieceId	jobId	[]
13576	16-10-18 09:07:23	Mike	Abcd12345	J0047	1	1	
13577	16-10-18 09:07:59	Mike	Abcd12345	J0047	1	2	
13578	16-10-18 09:08:33	Mike	Abcd12345	J0047	1	3	
13579	16-10-18 09:10:05	Mike	Abcd12345	J0047	2	1	
13580	16-10-18 09:10:55	Mike	Abcd12345	J0047	2	2	
13581	16-10-18 09:11:01	Mike	Abcd12345	J0047	2	3	
13582	16-10-18 09:13:44	Mike	Abcd12345	J0047	3	1	

Example of export in PDF format:

Art.395-U39501 Weldments [15-05-20]											5-2020]	
Weldments												
id jobld Start Time		Welding Time Arc-on [s] Duration [s]		Average Average Energy Current [A] Voltage [V] Provided [J]		Supplied Gas [s]	Supplied Gas Welder QC Order [1]		Work	Piece		
831	11-05-20 12:48:29	10.7	5.5	80	14.5	4443	10.6	1.8	A1234	ABCD	1	
821	11-05-20	11.3	1.1	111	20.7	4172	11.3	1.9	Commessal	34 WorkAA	A1	

Post-analysis

At the end of each batch, the MES can analyse the records acquired for each weld and produce reports (per piece or per batch) containing data such as:

- total gas consumption
- total wire consumption
- energy consumption (...)
- number of quality control errors (if art. **273** option is available)
- lead time



Websocket

The use of this software technology is **optional** and it is only aimed at avoiding the access to the generator from the MES by simple polling and to allow the real time notification of the events recorded by the generator.

The data automatically notified by the generator are always represented in the JSON format and are structured in a similar way to the REST commands previously described.

Among the notified events, those useful for integration with the MES are:

- stateChanged notifies a change in generator status (e.g. start or end of a weld)
- **newMeasure** notifies the update of a measurement (e.g. welding current)
- newMeasureLog notifies the record of a new weld in the internal database
- worksParamChanged notifies when a user parameter has been changed (e.g. job number changed)
- userChanged notifies that a new user has logged in.