Operating Instructions and Spare Parts List

PLC 1 Programmable Logical Control

![PLC 1 Interface Diagram]
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PLC 1 PROGRAMMABLE LOGICAL CONTROL

1 FUNCTIONS

1.1 OPERATION WITH OP 3 OPERATOR PANEL

The power supply to the control unit is switched on with the Key switch. This is indicated with a green pilot lamp on the drawer unit.

![Operator Panel](image)

Figure 1

The reciprocators can now be positioned manually to the Reference point. The booth can now be operated with the Operator Panel. The following selection of operations are available:

- Automatic operation: The guns, and the axes are switched on or off with the Gap control.
- Manual operation: The guns are switched on. The axes must be switched on or off manually.
- Setup: All the necessary booth parameters can be input here with the Operator Panel.

1.2 INTERLOCKING

After switching on the booth with the Operator Panel the control unit is released for operation and fluidizing, and prefluidizing are started.

1.3 GAP CONTROL FOR MAX. 16 GUNS (PGC 1) AND 2 RECIPROCATORS (PRC 2)

The workpiece data are “read-in” at the light barrier and the data are fed to the control unit. The guns, and the axes are switched on or off as a result of these data. When there is a gap the guns are switched off and individually rinsed (HRC 1). If a gap is sufficiently large, the axes are stopped at the lower reversing point.
1.4 CHAIN STOP

A chain stop is detected at the control unit with the aid of an incremental pulse generator fitted on the conveyor drive shaft. At a chain stop all guns are switched off and rinsed. The reciprocators stop at the lower reversing point. All guns are switched on after the conveyor is restarted. The reciprocators are also restarted after a delay.

1.5 CONTROL FOR TWO INDEPENDENT FRESH POWDER SYSTEMS

Two sensors are available for powder level monitoring for each of the two powder hoppers. The upper sensors regulate the fresh powder feed. A powder shortage is detected with the lower sensors. In this case a message to the Operator Panel is indicated and the signal horn is switched on.

1.6 PERIPHERAL COMPONENTS

**Inputs:**
- Signal A/B of the incremental pulse generator
- Status/Error bit of the light barrier
- Level sensor A above/below
- Level sensor B above/below
- Axis 1: PRC 2 operating
- Axis 2: PRC 2 operating
- Booth ready (external signal)

**Outputs:**
- PGC Power supply
- APS 2 Main solenoid valve
- Prefluidization
- Signal horn
- Conveyor released
- HRC 3 Rinsing
- Axis 1: PRC 2 Start
- Axis 2: PRC 2 Start
- Fresh powder request A
- Fresh powder request B
- Guns on/off (maximum 16)
- Gun rinsing (maximum 16)
2 OPERATION - GENERAL

2.1 AUTOMATIC BOOTH WITH PLC AND TEXT DISPLAY

The text display is a display screen, and an operating pad, where all data, and control commands for the automatic coating booth are input. The process control and process visualization simplify operations. Action messages give an overview and control. All functions of the coating booth can be controlled and monitored through the text display.

- Input errors are eliminated through process visualization.
- The operator is lead clearly through the process.
- Variable data can be called up or changed.
- Greater flexibility, simpler adaptation of new data inputs.
- Action messages appear on the text display, which help the operator when searching for errors, for example.
- Also legible under poor lighting conditions.
- IP 65 Type of protection.
- Available in different languages.

The text display is a communications terminal based on an LCD display screen. Process control, and process visualization give the operator an overview and control over the whole coating sequence. Input errors are almost completely eliminated. Only valid keys appear on the display and are released.

3 MASK DESCRIPTION

3.1 OPERATION MASKS

As a rule, the operation masks have the following structure:

Top Line: Title line, Mask description (Capital letters)
Bottom Line: Menu points or information

All inputs are password protected. Password level 1 is necessary for data input and Password level 9 is necessary for System input. The Passwords can be edited by the user on the panel (see 3.2.4.2 Password).

No password is required for operating the plant.
3.1.1 STATIC SCREEN DISPLAY

After the coating booth is switched on with the Main switch and the Key switch, the control and the text display switch on. After an internal test the STATIC SCREEN DISPLAY appears on the display.

After the coating booth is switched on with the Main switch and the Key switch, the control and the text display switch on. After an internal test the STATIC SCREEN DISPLAY appears on the display.

GEMA VOLSTATIC
Press ENTER

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

By pressing the ENTER key the display returns to the Start display level.

3.1.2 START DISPLAY

On the OP 3 Panel the Keys F1 to F5 can be used as Soft keys. In operation the Soft key function is activated by holding down the SHIFT Key and pressing one of the keys 1 to 5.

BOOTH CONTROL

<table>
<thead>
<tr>
<th>On</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

When the OP 3 is not operated for one minute, the panel automatically returns to the message level. If no operation message is displayed, the static screen message appears on the display. The display level is returned to again by pressing the ENTER key.

On

The plant is started and initialized with Key '1'. The text display switches to the Operating Mode mask. All previously read-in workpiece data are deleted.

By pressing the Soft key F4 the INFORMATION display screen is entered. By pressing the Soft key F5 the SPECIAL FUNCTIONS display screen is entered (For more information see 3.2.4 Special Functions).

3.1.3 OPERATING MODE

OPERATING MODE

<table>
<thead>
<tr>
<th>Auto</th>
<th>Man</th>
<th>Set</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td>F4</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Auto

The booth is switched to automatic operation with the Key '1'.

Man

The booth is switched to manual operation with the Key '3'.

Set

The booth is switched to setup operation with Key '4'.

Off

The booth is switched off with Key '5'. The Start display appears on the screen.
3.1.4 AUTOMATIC OPERATION

All parts, which pass through the object recognition are detected and registered in the memory. Due to this data all the guns and PRC 2 Axes are switched on or off.

<table>
<thead>
<tr>
<th>AUTOMATIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man</td>
</tr>
<tr>
<td>&amp;M</td>
</tr>
<tr>
<td>Off</td>
</tr>
</tbody>
</table>

Man

The booth switches directly to manual operation with Key "3", without the loss of data in the memory.

&M

The message level is entered to view messages already present, with the Key "4".

Off

Operating mode is returned to with Key "5".

3.1.5 MANUAL OPERATION

The operation of the PRC 2 Axes is released and all guns are switched on.

All parts, which pass through the object recognition are detected and registered as with the automatic operations.

<table>
<thead>
<tr>
<th>MANUAL OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
</tr>
<tr>
<td>&amp;M</td>
</tr>
<tr>
<td>Off</td>
</tr>
</tbody>
</table>

Auto

The booth is switched directly to automatic operation with Key "1", without the loss of data already in the memory.

&M

The message level is entered with Key "4" to view messages already present.

Off

Operating mode is returned to with Key "5".
3.2 SETUP OPERATION

The parameters of the booth must be reset for each customer and on every big change. When, for example, a gun is displaced, the Start position of the gun must be reset. There is a Setup operation for these changes.

3.2.1 SETUP 1

This operation is reserved exclusively for Gema Service engineers, because changes made in this area can lead to damage to the booth.

### SETUP 1

<table>
<thead>
<tr>
<th>Axis</th>
<th>Gun</th>
<th>Gen</th>
<th>Set2</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td>F4</td>
<td>F5</td>
</tr>
</tbody>
</table>

---

**Axis**: The input mode for axes parameters is entered with Key "1".

**Gun**: The input mode for gun parameters is entered to with Key "2".

**Gen**: The input mode for general parameters is entered with Key "3".

**Set 2**: The "SET-UP 2" display is entered with Key "4".

**Off**: Operating mode is returned to with Key "5".

---

### 3.2.1.1 AXES PARAMETERS

All axes parameter can be input in this area. The display inputs can be browsed through with the Arrow keys ↑ and ↓. As soon as the cursor blinks, the desired values can be input on the key pad, and finally, acknowledged with the ENTER key. The base Setup mask can be returned to again by simultaneously pressing the SHIFT and "5" keys.

#### Start Offset

<table>
<thead>
<tr>
<th>Start Offset</th>
<th>Puls</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

The following parameters can be set:

- **Start Offset**: The number of pulses required before the reciprocator begins to reciprocate in front of the workpieces (+ and - values are possible).

- **Extension**: The number of pulses, which the reciprocator switches off after the workpiece again. For the value of the extension the sum of the Start Offset, and the Extension must be input (+ and - values are possible).
3.2.1.2 GUN PARAMETERS

All gun parameters can be input in this area. The screen inputs can be browsed through with the Arrow keys ↑ and ↓. As soon as the cursor blinks, the desired values can be input on the key pad, and finally, acknowledged with the ENTER Key. The base Setup mask can be returned to again by simultaneously pressing the SHIFT, and '5' keys.

The following parameters can be set:

- **Number of guns**
  A maximum of 16 guns are possible

- **Start Offset guns**
  The number of pulses, after which the guns switch on in front of the workpieces (+ and - values are possible).

- **Extension guns**
  The number of pulses, after which the guns switch off again after the workpieces. For the value of the extension the sum of the Start Offset, and the Extension must be input. (+ and - values are possible).

- **Starting point Gun 1**
  Distance between the gun and the Object recognition in pulses.

- **Starting point Gun 16**
  Distance between the gun and the Object recognition in pulses.
3.2.1.3 GENERAL PARAMETERS

The remaining parameters can be input in this area. The display inputs can be browsed through with the ↑ and ↓ keys. As soon as the cursor starts to blink the desired values can be input through the key pad, and finally, acknowledged with the ENTER key. The initial SETUP display is returned to by simultaneously pressing the SHIFT, and the 5 keys.

<table>
<thead>
<tr>
<th>LB Check distance</th>
<th>Puls</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>1</td>
</tr>
<tr>
<td>F2</td>
<td>2</td>
</tr>
<tr>
<td>F3</td>
<td>3</td>
</tr>
<tr>
<td>F4</td>
<td>4</td>
</tr>
<tr>
<td>F5</td>
<td>5</td>
</tr>
</tbody>
</table>

The following parameters can be set:

- **LB Check distance**: When the light barrier remains interrupted for longer than this set check distance the message "LB Fault" is generated. It should be longer than the longest workpiece.

- **Prefluidization duration**: Total time of prefluidization.

- **Prefluidization ON**: Pulse length of prefluidization.

- **Prefluidization OFF**: Pause length of prefluidization.

- **Sensor Debouncing**: Debounce time of the level sensor.

- **Request delay of FP**: Delay time of fresh powder request, after no powder is detected by the level sensor.

- **Switching on time of FP**: Minimum time fresh powder is switched on.

- **Pulse divider ratio**: Divides the number of pulses generated by the incremental pulse generator by the value set (see also 3.2.2.1 Encoder).

- **Rinsing value**: Number of pulses during which the gun is rinsed.

- **Conveyor stop: max. Pulse time**: This time must be longer than two consecutive conveyor pulses at the slowest conveyor speed. If this time is overstepped, then a conveyor stop is carried out.

- **Conveyor stop: Gun ON delay**: This is the switching on delay for restarting the gun after a conveyor stop.

- **Conveyor stop: Axes ON delay**: This is the switching on delay for restarting the axes after a conveyor stop.
3.2.2 SETUP 2

<table>
<thead>
<tr>
<th></th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enco</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lang</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dnld</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set1</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Enco The Test mode for the Incremental pulse generator is entered with Key "1".
Lang The Language mode is entered with Key "2".
Dnld The MPI Download mode is entered with Key "3".
Set1 The Setup 1 mode is entered with Key "4".
Off The Operating mode display is returned to with Key "2".

3.2.2.1 ENCODER TEST

<table>
<thead>
<tr>
<th></th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strt</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

The conveyor pulses used by the PLC can be counted and displayed in this mode in order to determine the relationship between the conveyor pulses, and the conveying distance in pulses per cm.

Procedure:
1. Define a measured distance on the conveyor (preferably over several metres).
2. Define the identification markers (chain link, hooks etc).
3. Delete the internal counter by pressing Key "3" (Reset).
4. When the identification marker reaches the starting point of the measured distance, press Key "1" (Strt). The internal counter starts. The values must be positive. If, however negatives values are displayed, this is an indication that the incremental pulse generator is running in the wrong direction. The A, and B signals from the incremental pulse generator must be reversed.
5. When the identification mark reaches the end of the measured distance, Key "2" (Stop) is pressed.
6. The measured distance divided by the number of pulses gives the pulse length. e.g. A measured distance of 5 m and 50 pulses give a pulse length of 10 cm. If a pulse length of 2 cm is required, then the pulse division ratio in "General Parameters" must be decreased by a factor of 5.

Strt The counting process is started with Key "1".
Stop The counting process is stopped with Key "2".
Reset The internal counter is deleted with Key "3".
Off The "Setup2" display is returned to with Key "5".
3.2.2 LANGUAGE

The desired operating language is selected in this mode.

<table>
<thead>
<tr>
<th>Language</th>
<th>Deut</th>
<th>Engl</th>
<th>Lang3</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td>F4</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Deut  German is selected as the operating language with the Key ‘1’.
Engl English is selected as the operating language with the Key ‘2’.
Lang3 Lang3 is reserved for customer specific languages but is occupied with English, from the factory. A programming device, and the specific language program are required for translating these languages.
Off The “Setup2” display is returned to with Key ‘5’.

3.2.3 DOWNLOAD

The data from the programming device can be transferred to the OP 3 in this mode. For further information see “OP 3 Operating Instructions”.

3.2.3 INFORMATION

<table>
<thead>
<tr>
<th>PLC1Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version: X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Version This is the current version of the PLC Software. The “Start” display is returned to by pressing Key ‘F5’.
3.2.4 SPECIAL FUNCTIONS

The Special Functions must be operated with the aid of the Soft keys. On the OP 3 keys F1 to F5 operate as Soft keys. The Soft key functions are released in operation, when the SHIFT key is pressed and held down, and one of the keys 1 to 5 are pressed.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>1</td>
</tr>
<tr>
<td>F2</td>
<td>2</td>
</tr>
<tr>
<td>F3</td>
<td>3</td>
</tr>
<tr>
<td>F4</td>
<td>4</td>
</tr>
<tr>
<td>F5</td>
<td>5</td>
</tr>
</tbody>
</table>

3.2.4.1 MODE

If the Soft key "F1" is pressed the operating mode of the OP 3 can be changed. The following selection of operating modes are available:

- Operating mode Online In Online operation a logical connection exists between OP 3 and the control unit or the OP 3 attempts to make a connection.

- Operating mode MPITrans In the Transfer mode the data from the PC is transferred to the OP 3. A logical connection between the control and OP 3 does not exist. During the transfer the OP 3 cannot be operated. The data transfer takes place through the MPI interface.

- Operating mode Transfer The data transfer takes place through the serial interface (V.24/RS 232).

- Operating mode Offline In Offline operation no logical connection exists between OP 3 and the control.

The operating modes listed above are returned to by simultaneously pressing the SHIFT key, and the keys ↑ or ↓. First, however, the code for the password level 9 must be given, so that this mode can be accessed. The Transfer mode is terminated with the ESC key and a new start of the panel is carried out.

A return to Setup screen display is done by simultaneously pressing the SHIFT key, and the ENTER key again.
3.2.4.2 PASSWORD

The password can be changed with the Soft Key "F3". The password is input and completed with "ENTER". The password input is exited with "ESC".

<table>
<thead>
<tr>
<th>Index</th>
<th>Password</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3138</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The standard Supervisor password (Level 9), which is set by Gema is: 3138.

The Setup screen display is returned to again by simultaneously pressing the SHIFT key, and the ENTER key.

4 OPERATION MESSAGES

Faults can occur during operation, which appear as operation messages on the display. If an operation message is present, the operator panel changes from the display level to the message level. By pressing key "1" the display level is returned to, that is, in the automatic or manual operation display. The signal horn can be acknowledged with Key "5". When more operation messages are present, the different messages can be viewed with the Arrow keys ↑ and ↓.

The messages are as follows:

- **Battery low**  
  The program memory is buffered with a battery.  
  If this message appears on the display, the battery must be replaced.

- **LB Fault**  
  The light barrier is interrupted for longer than the set check distance. It must be inspected for defects or contamination.

- **Too little powder A**  
  The powder level in Hopper A has sunk below the lower level sensor.

- **Too little powder B**  
  The powder level in Hopper B has sunk below the lower level sensor.

- **Booth not ready**  
  The external signal "Booth ready" from the Booth Control not present
5 SPARE PARTS LIST

ORDERING SPARE PARTS

When ordering spare parts for powder coating booth, please indicate the following specifications:

1. Type and serial number of your powder coating booth
2. Order number, quantity, and description of each spare part

Example:

1. Type PLC 1, Serial no: 80011496

2. Order no: 201618, 5 pieces, fuse - 1.25 AT

When ordering cable or hose material the length required must also be given.
The spare part numbers of this yard/metre ware is always marked with an *

The spare part number of yard/metre ware always begins with 1xx xxx. All wear parts are marked with a #.

All dimensions of plastic hoses are given as external and internal diameters:
e.g. ø 8 / 6 mm = 8 mm outside diameter (o/d) / 6 mm inside diameter (l/d).
## PLC 1 PROGRAMMABLE LOGICAL CONTROL

<table>
<thead>
<tr>
<th>Item</th>
<th>Component</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>OP3 Operator Panel</td>
<td>253 200</td>
</tr>
<tr>
<td>22</td>
<td>Key switch</td>
<td>203 521</td>
</tr>
<tr>
<td>23</td>
<td>Switch base</td>
<td>201 294</td>
</tr>
<tr>
<td>31</td>
<td>Grommet - PG16</td>
<td>204 366</td>
</tr>
<tr>
<td>32</td>
<td>Clamp ring - PG16</td>
<td>204 412</td>
</tr>
<tr>
<td>41</td>
<td>Contact plate - 0.25 mm² - P3-LT</td>
<td>241 636</td>
</tr>
<tr>
<td>42</td>
<td>Contact plate - 0.25 mm² - N3-LT</td>
<td>241 644</td>
</tr>
<tr>
<td>43</td>
<td>Contact plate - 0.25 mm² - PE3-L</td>
<td>241 652</td>
</tr>
<tr>
<td>44</td>
<td>End piece - Base clamp - 3-P</td>
<td>241 660</td>
</tr>
<tr>
<td>45</td>
<td>Terminal plate - 2.5 mm²</td>
<td>238 368</td>
</tr>
<tr>
<td>46</td>
<td>Bridging piece - 1 to 4</td>
<td>250 481</td>
</tr>
<tr>
<td>51</td>
<td>Sealing strip - 9 x 2 mm</td>
<td>100 250*</td>
</tr>
</tbody>
</table>

* Indicate length required
# Wear parts
PLC 1 PROGRAMMABLE LOGICAL CONTROL

21 23 22

45 44 41; 42; 43; 46 31; 32

51