

UNIHAND Interface

Interface via Profibus/Profinet between the machine and the handling system of a third-party manufacturer

Single-Spindle Machines

Control INDEX C200-sl

Note on applicability

Illustrations in this publication may deviate from the product supplied. Errors and omissions due to technical progress expected.

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General

The UNIHAND interface is used to adapt external handling systems of third-party manufacturers to the machine.

Interface (via Profibus/Profinet)

The interface allows the workpiece program to

- query all addresses/signals,
- transmit certain addresses/signals to the handling system.

Important note when using a dummy plug

The system is supplied with a dummy plug. This bypasses the EMERGENCY STOP function of the handling system.



When a dummy plug is plugged in, the EMERGENCY STOP button at the handling system is ineffective.

Be sure to check the EMERGENCY STOP function when commissioning the complete system (including the handling system).



Robot cell with access door: The dummy plug may only be inserted when the access door to the robot cell is closed and mechanically secured, to prevent accidental opening (mechanical tumbler).



According to ISO 12100-1 Safety of Machinery, the operator/owner is responsible for proper function of safety circuits.

Electrical system

The interface information is exchanged between the devices via a Profibus or Profinet.

- The signals are transferred via the Profibus/Profinet by means of data bits.
- There are two connector strips on the control cabinet, one for the Profibus/Profinet connection and one for the hardware signals.
- The lines are connected to the mating terminal by the user. (Connection cross-section maximum 1.5 mm²)

On the hardware side, the following safety devices are available:

a) "EMERGENCY STOP" function (2-channel)

The interlocks (EMERGENCY STOP circuit) are wired to the hardware connector.
Port: Potential-free, 24V DC, 1 A).

b) Door signal of the machine to the external device.
Motion enabled, if

- Motion enable 1:
Doors locked
- Motion enable 2:
Doors locked or confirm key pressed.

Other functions that can be activated

Additional monitors and enables can be selected via PLC machine data.

For more information: Contact INDEX Service or your local country representative.

Using this function offered for all machine types, it is possible to set and reset signals in the workpiece program.

The signals allow the user to run custom add-on equipment (handling unit, washing station, conveyor belt, etc.).

The interface is programmed with the command:

Mi = j 98 Hxxx yyyyy z

The signals can be set/reset depending on the possible feedbacks. This means that the output signals are processed depending on the status of the input signals (conditional set/reset).

If the input signal does not have the expected status, a reader stop is set, otherwise the next program block is read. The reader stop acts on the channel in which the command is programmed.

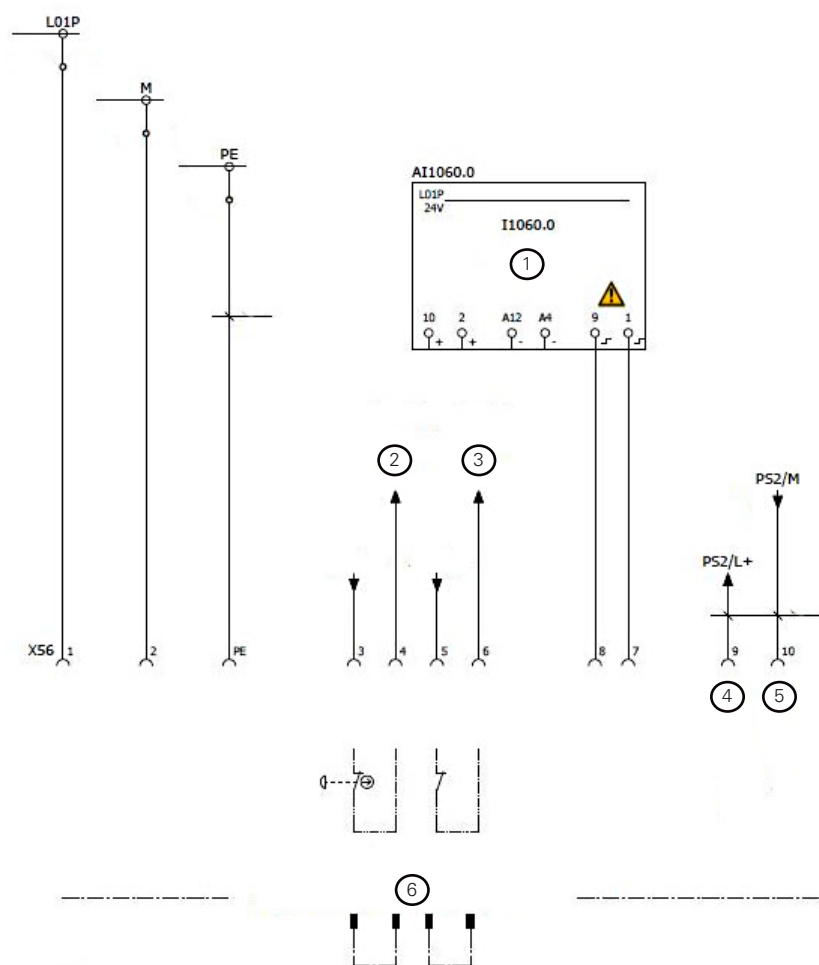
Hardware

Circuit diagram – hardware diagram for emergency stop and enable signals



The following circuit diagrams are only examples. They are not actual diagrams.

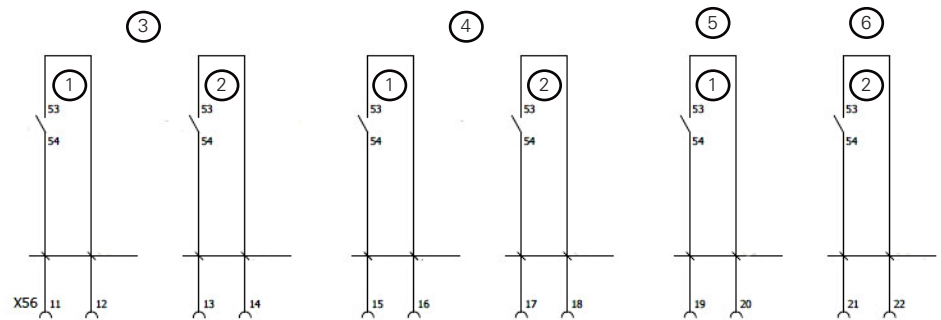
Handling system interface – Part 1



DIE132DE_01

- 1 External safety fence closed and locked
- 2 Channel 1 – no UNIHAND EMERGENCY STOP
- 3 Channel 2 – no UNIHAND EMERGENCY STOP
- 4 Power supply +24 V
- 5 DP/DP coupler
- 6 Dummy plug required if no handling system is present!

Handling system interface – Part 2



DIE132DE_02

- 1 Channel 1
- 2 Channel 2
- 3 Enable motions (working area door closed and locked)
- 4 Enable motions (working area door closed and locked or confirm key pressed)
- 5 No EMERGENCY STOP signal from INDEX
- 6 No EMERGENCY STOP signal from INDEX

For 3 and 4 (enable motions):

Do not use the INDEX working area door lock with external safety fence (in front of the working area door).

The handling system must realize its enable status with the locked safety fence.

Information on hardware configuration



A detailed description of the hardware configuration can be found in the commissioning documentation.

UNIHAND Profibus

UNIHAND Profibus connection DP/DP coupler (master) with universal module

Enter 8 words **800,8** universal module

consistent over unit

UNIHAND Profibus connection DP/DP coupler (master) without universal module

(Use only if universal module is not possible)

Enter 16 words **800,64** and **800,128**.

800 - 64 and 800 - 128 are only labels
For 32-byte inputs and outputs.

UNIHAND uses only 8 words (16 bytes), from byte 19 (819) to 32 (832) is used by job control.

Therefore, only job control data must be available when job control is active!

consistent over entire length

UNIHAND Profibus connection DP/DP coupler with measuring computer interface:

Enter 8 words **800,8** universal module, and
enter 2 words **368,2** universal module

consistent over unit

UNIHAND Profinet

UNIHAND Profinet connection PN/PN coupler - address 800 with 8 words.

Software

Setting and resetting output signals

Signals to be deleted or set by an NC RESET must be programmed first in cycle L408 and/or L409. The cycle is started automatically after RESET and executes the programmed commands.

After RESET, the INDEX cycle L849 starts in auxiliary channel 6, which in turn calls the custom cycle L408 or/and L409. Cycle L409 can have different content depending on the workpiece.

Condition:

Selection via "Machine parameter -> general -> Reset key behavior -> Activate cycle L409"

Selection via "Workpiece parameter -> general -> Reset key behavior -> Activate cycle L409"

The content of cycle L408/409 is the programmer's responsibility.

Example:

L409

MSG ("L409 active") Display L409 active

M13=98 H131008035 Reset DB131.DBX803.5

It is recommended here to set all commands of the handling system such that it no longer executes any jobs it has started.

In the examples, at least the same content should be programmed as in cycle L962 "Home"

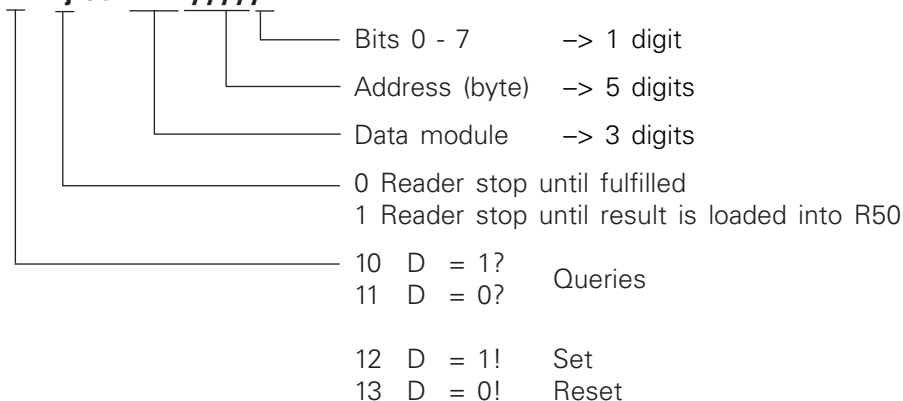
Functional description

Reading or writing PLC bits from/to data modules, inputs, outputs, and flags

To use sequence signals of the PLC in the workpiece program, direct addresses of data modules, inputs, outputs or flags must be used.

Data module

Mii = j 98 Hxxxxyyyyyz



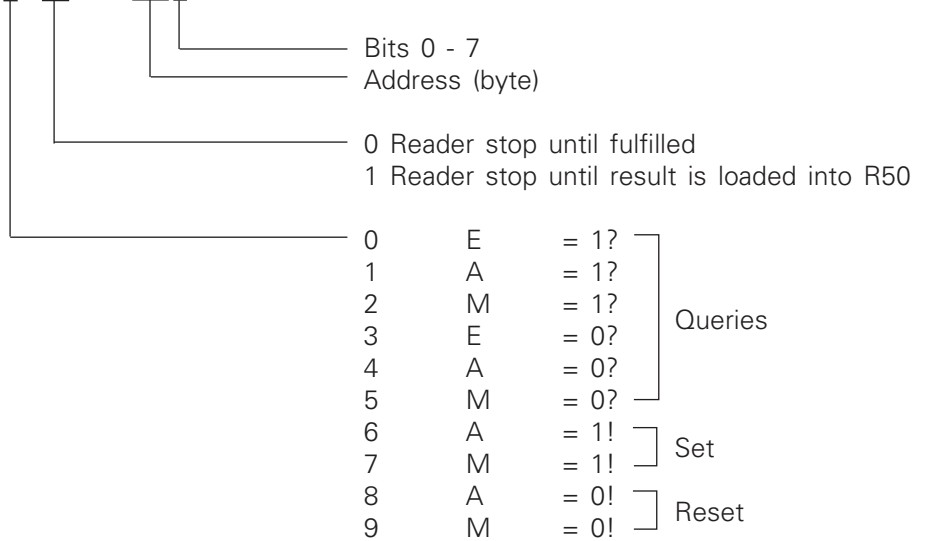
Note: D = data bit



The commands can be programmed in each channel. When $M_i = 198$, the current signal state (logical "1" or "0") is loaded into parameter R50. Before parameter R50 is queried in the workpiece program, the buffer must be cleared with the STOPRE command.

Input, output and flag

Mi = j 98 Hyyyz



Note: A = output
E = input
M = flag

Branches in the workpiece program

Example: Wait until Cycle Start key is pressed
 M0=98 H1201 ;E120.1=1?

Example: Branch to LABEL_1 if flag 78 bit 5=0 follow-up start is off.

```

M2=198 H785 (query M78.5=1, result into R50)
STOPRE
IF R50<>1 GOTOF LABEL1_      ;sequence if M78.5=1 -> follow-up start ON
GOTOF END_                    ;Jump address
LABEL1_:                      ;Sequence if M78.5=0 -> follow-up start OFF
END_                          ;Sequence for both versions;

```

The commands can be programmed in each channel. When Mi=198, the status is output to parameter R50.

Before parameter R50 is queried in the workpiece program, the buffer must be cleared with STOPRE.

Example: Wait until spindle 3 has stopped

M10=98 H38000614 (DB38 DBB1 bit 14=1?)

Example: Branch to LABEL2_, if block skip level 2N (DB214 byte 1036 bit 2) is selected.

```

M10=198 H214010372          ;Query DB214 DBB1037 bit 2=1 result into R50
STOPRE
IF R50==1 GOTOF LABEL2_     ;sequence if R50=0
GOTOF OFF_                  ;Jump address
LABEL2_:                    ;Sequence if R50=1
OFF_                        ;Sequence for both versions;

```

Information on block skip levels

DB214 DBB1037 bit 0 = block skip level /N
 Bit 1 = block skip level /1N
 Bit 2 = block skip level /2N
 Bit 3 = block skip level /3N
 Bit 4 = block skip level /4N
 Bit 5 = block skip level /5N
 Bit 6 = block skip level /6N
 Bit 7 = block skip level /7N

Loading methods

There are two loading methods:

- Through flaps and closed working area door
- Through the working area door with external safety fence

Flap in working area door

The flap in the working area door is used if the handling system loads workpieces into the working area via the machine.

When the working area door (cover) is closed and the flap is open, the main spindle and counter spindle speeds are limited to 50 rpm (SG3), which prevents ejection of workpieces.



SMAZU flaps are mounted over the main/counter spindle for the handling systems of third-party manufacturers.

Safety flap over machine (extra flap on the handling system)

If the handling system moves over the INDEX machine when loading several machines, a safety flap must be present and closed.

Function:

If the safety flap is not closed, opening of the machine working area door with M173.4=1 is prevented.

Display: "748756 Motion is in progress"

The request "Open machine working area door" sends the request *DB131.DBX803.7=1* to the handling system.

If the safety device (safety flap) of the handling system is closed (*DB130.DBX800.3=1*), the working area door can be opened.

The working area door must be opened.
After closing, the request *DB131.DBX803.7=0* to the handling system is deleted.

The handling system can open the safety device (safety flap) again. It is recommended that the handling system not open the safety flap until the next request.

Requirements:

- M1=81 Open working area door 1
- M2=81 Open working area door 2
- Softkey **Open door** - the error "*Function not allowed*" is displayed here. If the flap is closed, press the softkey again.
- SAFETY test requirement.

Handling systems without a safety flap can only be moved over the INDEX machine if the working area door is closed (two-channel hardware enable, working area door closed L+15).

Working area door with external safety fence

The machine is loaded through the working area door. There are no flaps installed in the working area door.

The external safety fence is placed around or in front of the machine such that access is impossible with the safety fence closed.

If the external safety fence is installed in front of the machine, the control panel must be secured against displacement, and monitored if necessary. The message should be connected in series with the external safety fence locked.

The following signals are available:

- DB130.DBX804.0 Request "Open safety fence" from the handling system/robot
- DB131.DBX800.4 "Working area door completely open" to handling system/robot
- DB131.DBX803.7 "Close external safety fence" to handling system/robot
- DB131.DBX804.0 "External safety fence can be opened" to handling system/robot
- E1060.0 "Safety fence is closed, locked and machine panel out of interference area" is monitored by two channels via SAFETY inputs. Both channels must always have the same status.

Machine door Safety fence Designation

Machine door	Safety fence	Designation
closed	closed	Production spindles/axes enabled at all speeds
closed	open	Production spindles/axes enabled at all speeds Handling system/robot is monitored by the external manufacturer
open	closed	Spindles and axes switched to SG1, spindles limited to 50 rpm and axes limited to 2 m/min. Flushing, providing axes, relief-moving, clamping/unclamping tailstock, opening/closing clamping devices, turret indexing, etc. are allowed
open	open	Machine operation possible via confirm key, no program run with speeds, axis movements with confirm key possible with SG1. Handling system/robot is monitored by the external manufacturer

Function activated with SMAZU_ext_fence

If the working area door is closed and locked, it is responsible for safety.

If the safety fence is closed and locked, it takes over security monitoring.

Now the working area door can be opened and closed from the workpiece program via **Mx=81/82**.

Another program run is possible. The spindles are limited to 50 rpm and the axes to 2 m/min.

A complete part change is possible, as with the flap in the working area door.

If the safety fence is closed and the working area door is opened with **Mx=81**, the working area door will not be closed by pressing the Cycle Start key.

If both are open, the same confirm logic applies as before.

On an R machine with tool magazine door (U4/5), the tool magazine door is also locked when the safety fence is locked.

After the safety test, the external safety fence must be opened.

Not opening the external safety fence at every safety test involves the risk of tampering with the external safety fence (bridge locked in the fence dummy plug).

Manual operation

Set manual loading under **Machine parameter** → **Workpiece feeding/removal**.

Switch off the handling system, or when the handling system is switched on, the *LOADER_out_of_INTERFERENCE_AREA* signal must be present.

Standard input/output assignments

From operating machines, the UNIHAND interface is configured with only 8 words.

Inputs

Signals from external device to machine

Byte/ Bit	Mapping in DB130	Designation
0.0	800.0	Profibus/Profinet is ready
0.1	800.1	Handling system is ready
0.2	800.2	No EMERGENCY STOP triggered on external device
0.3	800.3	Safety device of the handling system is closed
0.4	800.4	Handling system is outside the machine's interference area
0.5	800.5	Operator intervention
0.6	800.6	Handling system in motion
0.7	800.7	
1.0	801.0	Finished part removed from main spindle
1.1	801.1	Part change complete: main spindle
1.2	801.2	Finished part removed from counter spindle
1.3	801.3	Part change complete: counter spindle
1.4	801.4	Start machine
1.5	801.5	Request: Change over machine
1.6	801.6	Request: Load machine
1.7	801.7	Request: Unload machine (run handling system empty)
2.0	802.0	Release clamping device (main spindle)
2.1	802.1	Clamp clamping device (main spindle)
2.2	802.2	Release clamping device (counter spindle)
2.3	802.3	Clamp clamping device (counter spindle)
2.4	802.4	
2.5	802.5	
2.6	802.6	
2.7	802.7	Enable check workpiece type / workpiece detection of the handling system Valid data is already available
3.0	803.0	
3.1	803.1	
3.2	803.2	
3.3	803.3	
3.4	803.4	
3.5	803.5	Pre-signal "Acknowledge"
3.6	803.6	Fault handling system (was for DB13 master computer)
3.7	803.7	
4.0	804.0	Request: Open external safety fence
4.1	804.1	
4.2	804.2	Calibration master loaded
4.3	804.3	Start measurement
4.4	804.4	Scrap detected
4.5	804.5	
4.6	804.6	Good part detected
4.7	804.7	
5.0	805.0	
5.1	805.1	
5.2	805.2	

Byte/ Bit	Mapping in DB130	Designation
5.3	805.3	
5.4	805.4	
5.5	805.5	Free for user
5.6	805.6	Free for user
5.7	805.7	Free for user
Byte		Special part
6-15	806-815	Part detection, byte 806 Part code, workpiece type, machine number, drawing number




Depending on the setting, input signals are also queried in the PLC software.
(see signal description PLC / NC -> PLC)

Signal description of loading device

Bit / Byte	PLC / NC	Description
E0.0	PLC	Profibus/Profinet ready Profibus/Profinet ready not required - own Profibus/Profinet diagnostics
E0.1	PLC	Handling system ready only for error display "no enable signal from external", if Profibus/Profinet ready and handling systemready are missing. <u>Conditions:</u> <ul style="list-style-type: none"> – NC mode: Automatic – Workpiece program is running – Machine motion enable bit is set A0.1 – Flap is open Error display is hidden with parameter Machine / workpiece feed/discharge - manual loading.
E0.2		No emergency stop triggered on handling system not used - emergency stop button in emergency stop chain (hardware)
E0.3	PLC	Safety device of handling system closed If the handling system moves over the machine when loading several machines, the safety flap must be closed. If the safety device of the handling system is closed, the machine's working area door can be opened. See A3.7 Closing external loading flap
E0.4	PLC / NC	Handling system is outside the interference area If the signal is zero , flaps or, for an external safety fence, the machine's working area door cannot be closed. If not in automatic mode and the handling system is inside the interference area, a V-stop is set for all axes. When the traversing keys are pressed, 78455 Risk of collision in Z-axis display is set. Axes can still be traversed by pressing the clear error softkey and the traversing keys. If the cover is open, also press the confirm key Pedal switch operation tailstock Z4 axis is enabled. With MAZU workpiece feed/discharge UNIHAND, the 2nd software end position for Z1/Z2 axes applies when the flap is open. This is only useful with 2 separately controlled flaps. The values of the 2nd software limit switches must be defined by the customer. 2. Software end position is set depending on the flap position and the "Handling system outside interference area" signal: <ol style="list-style-type: none"> 1. Both flaps open M120.5=1, M121.5=1 No 2nd software end position activated. 2. Flap 1 over main spindle open M120.5=1 Flap 2 over main spindle closed M121.5=0 sets 2nd software limit switch "+". 3. Flap 1 over main spindle close M120.5=0 Flap 2 over main spindle open M121.5=1 sets 2nd software limit switch "-".
E0.5	PLC	Operator intervention Operator intervention indicator lamp is set without further display on the screen. Condition: Indicator lamp is installed.

Bit / Byte	PLC / NC	Description
E0.6	PLC	Handling system in motion If signal comes, the machine's working area door remains locked, but the flap(s) are enabled. See A3.7 Request to open working area door (stop handling system) If the machine has stopped with program stop, this is indicated by the message 748756 Workpiece load/discharge motion in progress.
E0.7	PLC	Reserved
E1.0	NC	Finished part removed from main spindle
E1.1	NC	Part change completed on main spindle End of part change, i.e., blank loaded and finished part removed
E1.2	NC	Finished part removed from counter spindle
E1.3	NC	Part change completed on counter spindle End of part change, i.e., blank loaded and finished part removed
E1.4	NC	Machine start NC program interruption is canceled (program can continue running) Handling system must be outside the collision zone
E1.5	NC	Request machine changeover This is not yet used with automatic job control Machine is set to changeover sequence
E1.6	NC	Request "Load machine" (e.g., with automatic job control) load only blanks Machine is set to load sequence
E1.7	NC	Request "Unload machine" (e.g., with automatic job control) Discharge finished parts and do not feed blanks until the machine is empty. Machine is set to unload sequence.
E2.0	NC	Release clamping device on main spindle Gripper has clamped part and machine can release part
E2.1	NC	Clamp clamping device on main spindle Gripper has fed part and machine can clamp part
E2.2	NC	Release clamping device on counter spindle Gripper has clamped part and machine can release part
E2.3	NC	Clamp clamping device on counter spindle Gripper has fed part and machine can clamp part
		Bits 2.4 and 2.6 Reserved
E2.4		Reserved
E2.5		-
E2.6		Reserved

Bit / Byte	PLC / NC	Description
E2.7	PLC	<p>Workpiece type / data is available (valid) <u>Part detection sequence:</u></p> <ol style="list-style-type: none"> 1. Handling system creates code "Part detection" (byte 6) 2. Handling system sets strobe "Data valid" (must be before M9=yy62) 3. Machine is stopped with M command (reader stop) 4. Machine creates code "Part detection". 5. Machine's part detection is compared with handling system's part detection; if OK, the NC program continues (reader stop=0) 6. Machine sets strobe "Acknowledge valid data" 7. Machine clears strobe if strobe handling system sets "Data valid" to zero. <p>Reader stop is canceled if handling system code matches the machine code.</p>
 <p>Handling system must set "Data valid DB130.DBX802.7" again, if "Acknowledge valid data loaded" is DB131.DBX 802.7= 0, because data comparison (M9=yy62) is repeated at Reset.</p>		
		<p>DB130.DBX 806.0 Part detection code value 1 DB130.DBX 806.1 Part detection code value 2 DB130.DBX 806.2 Part detection code value 4 DB130.DBX 806.3 Part detection code value 8 DB130.DBX 806.4 Part detection code value 16 DB130.DBX 806.5 Part detection code value 32 DB130.DBX 806.6 Part detection code value 64 DB130.DBX 802.7 Part detection of handling system – Data is available (valid) DB131.DBX 802.7 Acknowledge load data valid Max. 99 part codes possible (M9=yy62)</p>
E3.0	-	Reserved
E3.1	-	-
E3.2	-	-
E3.3	-	-
E3.4	-	Reserved
E3.5	NC	<p>(For query, see structure of the Mi = j98 function) Pre-signal "Acknowledge" Pre-signal was detected. With the pre-signal, the handling system should only fetch blanks but not move into the machine. It must be at a suitable waiting position and move in only when the enable signal is received when bit A1.2 or A1.4 is set.</p>
E3.6	PLC	<p>Fault handling system optional DB13 Fault message for master computer</p>
E3.7	-	Reserved

Bit / Byte	PLC / NC	Description
E4.0	PLC	Request "Open external safety fence" External safety fence replaces the flaps in the machine's working area door. External safety fence can be opened if the machine's working area door is locked or no program is running or machine stop is pending. External safety fence is installed in front of the machine's working area door; loading and unloading through the machine's open working area door. If the machine's working area door is open and the safety fence is locked, the spindles and axes are switched to safe speed 1. (L+13=1) See also E0.4 Handling system outside interference area.
E4.1	-	Reserved
E4.2	PLC	Calibration master loaded - not yet implemented (automatic calibration should not be used, was not necessary so far) <u>Calibration sequence:</u> 1. Time for calibration expired (PLC or measuring device) 2. Calibration request to handling system bit 4.2 3. Handling system loads calibration master and sends signal bit E4.2 Loaded 4. "Start measuring" from handling system - part is ready to be measured 5. Machine PLC starts calibration on the measuring device 6. "Measuring finished" from measuring device 7. "Calibration finished" to handling system - part can be removed
E4.3	PLC	(EXA/M) Measurement start Part is ready to be measured
E4.4	PLC	(EXA/M) Scrap detected <u>Measuring sequence:</u> 8. "Start measuring" bit E4.3 from handling system - part is ready to be measured 9. Machine PLC starts measurement on the measuring device 10. "Measuring finished" from measuring device 11. "Measuring finished" bit A4.3 to external loader - part can be removed For good part, bit A4.6 is set, or for scrap, bit A4.4 is set 12. Handling system sets good part bit E4.6 or bit E4.4 "scrap detected"
E4.5	-	Reserved
E4.6	PLC	(EXA/M) Good part detected
E4.6	-	Reserved
E5.0	-	Reserved
E5.1	-	Reserved
E5.2	-	Reserved
E5.3	-	Reserved
E5.4	-	Reserved
E5.5	-	Free for user
E5.6	-	Free for user
E5.7	-	Free for user

Bit / Byte	PLC / NC	Description
6	PLC	Part code with M command (M9=yy62) See bit E2.7 – Part detection sequence Bit 6.0 Part detection code value 1 Bit 6.1 Part detection code value 2 Bit 6.2 Part detection code value 4 Bit 6.3 Part detection code value 8 Bit 6.4 Part detection code value 16 Bit 6.5 Part detection code value 32 Bit 6.6 Part detection code value 64 Bit 2.7 Part detection from handling system – data is ready (valid) Output bit Bit 2.7 Acknowledge data load valid Max. 99 part codes possible (M9=yy62)
7-15		Reserved

Signal exchange

Difference between NC and PLC signals

PLC signals are set cyclically, i.e. these signals are constantly set or queried. → **safe signals.**

NC signals are only set if the machine is in a machining sequence or the reset cycle is running (NC operating mode AUTOMATIC).



Collision hazard!

There is a collision hazard in the following case::

If the operator closes the loading flap manually and, e.g., only the NC output signal "Enable: Remove finished part" is queried when the handling system moves into the working area.

In this case, the PLC signal "Flap open" must always be queried when entering the working area.

Outputs

Signals from machine to external device

Byte/ Bit	Mapping in DB131	Designation
0.0	800.0	Profibus/Profinet ready (continuous signal or pulsing signal via MAZU)
0.1	800.1	Machine ready / enable motion
0.2	800.2	No EMERGENCY STOP triggered on machine
0.3	800.3	Machine's working area door closed and locked or external safety fence locked
0.4	800.4	Loading flap on machine open (over main spindle) or machine's working area door open with MAZU Ext. safety fence
0.5	800.5	Machine's loading flap over counter spindle open or flap to robot cell closed
0.6	800.6	Reset of machine
0.7	800.7	Reserved (see development documentation)
1.0	801.0	Enable: Part change
1.1	801.1	Enable: Remove finished part (main spindle)
1.2	801.2	Enable: Feed blank (main spindle)
1.3	801.3	Enable: Remove finished part: counter spindle
1.4	801.4	Enable: Feed blank: counter spindle
1.5	801.5	Machine is in Changeover mode
1.6	801.6	Machine is in Load mode
1.7	801.7	Machine is in Unload mode (run machine until empty)
2.0	802.0	Clamping device released: main spindle
2.1	802.1	Clamping device clamped: main spindle
2.2	802.2	Clamping device released: counter spindle
2.3	802.3	Clamping device clamped: counter spindle
2.4	802.4	Main spindle stopped
2.5	802.5	Counter spindle stopped
2.6	802.6	Machine started

Byte/ Bit	Mapping in DB131	Designation
2.7	802.7	Acknowledgment: "Workpiece type (strobe)" and "Load data valid"
3.0	803.0	
3.1	803.1	Flap to robot cell open
3.2	803.2	
3.3	803.3	Remove remnant from main spindle
3.4	803.4	Pre-signal: Fetch remnant from main spindle
3.5	803.5	Pre-signal: Supply
3.6	803.6	
3.7	803.7	Close external loading flap / request "open cover" (-> stop handling system)
4.0	804.0	External safety fence can be opened
4.1	804.1	
4.2	804.2	Request calibration
4.3	804.3	Measurement finished / calibration finished
4.4	804.4	Scrap (workpiece measuring)
4.5	804.5	Bad part (if tool breakage)
4.6	804.6	Good part (external measurement)
4.7	804.7	Fault message – external indicator lamp
5.0	805.0	
5.1	805.1	
5.2	805.2	Reserved (see development documentation)
5.3	805.3	
5.4	805.4	
5.5	805.5	Free for user
5.6	805.6	Free for user
5.7	805.7	Free for user
Byte		Special part
6-15	806-815	Part detection, part code, workpiece type, machine number, drawing number




- Output signals set by the software must not be set/deleted by the workpiece program. However, queries are still possible (see signal description PLC /NC -> PLC").
- More information about signals can be obtained from INDEX Service or the local country representative.

Signal description of loading device

Bit / Byte	PLC / NC	Description
A0.0	PLC	Profibus/Profinet ready (continuous signal or pulsing signal via MAZU)
A0.1	PLC	<p>Machine ready (enable motion to handling system) Do not use with external safety fence (in front of working area door). The handling system may only use A0.4 Door open. There are 2 versions possible, of which version b) should be the preferred version for the handling system.</p> <p>a)</p> <ul style="list-style-type: none"> – Machine's working area door closed and locked – No safety test request <p>b)</p> <ul style="list-style-type: none"> – Machine's working area door closed and locked – No STOP/error is pending – Override $\gg 0$ – Program running – No safety test request <p>Here a sequence can be interrupted, handling system must not enter an error condition, handling system must continue to run without acknowledgment after enabling.</p> <p>Safety test request to handling system can be deselected via MAZU (i.e. enable motion signal is not reset during safety test and safety test does not wait for handling system stop.)</p>
A0.2	PLC	No emergency stop triggered on machine.
A0.3	PLC	Machine's work area door closed and locked or ext. safety fence locked
A0.4	PLC	<p>Loading flap in the machine's working area door is open (over the main spindle) or the machine's working area door is open with MAZU external safety fence.</p> <ul style="list-style-type: none"> • If the flap is not closed, the main spindle speed is limited. • With external safety fence (SMAZU), the machine's working area door is open (SMAZU flap installed, must not be set). <p>External safety fence is installed in front of the machine's working area door. Loading and unloading through the machine's open working area door.</p>
A0.5	PLC	<p>Loading flap in the machine's working area door over the counter spindle is open</p> <p><u>Condition:</u> Flap over counter spindle is controlled separately or the flap to the robot cell is closed if the flap to the robot cell is installed.</p>
A0.6	PLC	Reset of machine
A0.7	PLC	Reserved
A1.0	NC	<p>Enable part change Pre-signal before enabling finished part/blank is usually not necessary (M12=98H131008010 set, see structure of Mi = j98 function)</p>
A1.1	NC	<p>Enable removing finished part (main spindle) Handling system can move into machine to remove finished part from main spindle</p>
A1.2	NC	<p>Enable feeding blank (main spindle) Handling system can move into machine to load blank into main spindle.</p>

Bit / Byte	PLC / NC	Description
A1.3	NC	Enable removing finished part (counter spindle) Handling system can move into machine to remove finished part from counter spindle
A1.4	NC	Enable feeding blank (counter spindle) Handling system can move into machine to load blank into counter spindle.
A1.5	NC	Machine in changeover mode is not implemented optional
A1.6	NC	Machine in load mode Feed blank only
A1.7	NC	Machine in unload mode Do not feed blank, only remove finished part
A2.0	NC	Unclamp clamping device (main spindle) Handling system can remove finished part from main spindle or handling system can feed blank to main spindle
A2.1	NC	Clamping device clamps (main spindle) Handling system can open gripper
A2.2	NC	Clamping device unclamps (counter spindle) Handling system can remove finished part from counter spindle or handling system can feed blank to counter spindle
A2.3	NC	Clamping device clamped (counter spindle) Handling system can open gripper
A2.4	NC	Main spindle stopped Spindle speed zero
A2.5	NC	Counter spindle stopped Spindle speed zero
A2.6	NC	Machine started Acknowledgment of handling system signal E1.4 Machine START

Bit / Byte	PLC / NC	Description
A2.7	PLC	<p>Acknowledge workpiece type (strobe) / acknowledge data load valid <u>Part detection sequence:</u></p> <ul style="list-style-type: none"> • Handling system creates code "Part detection" (byte 6) • Handling system sets strobe "Data valid" (must be before M9=yy62) • Machine is stopped with M command (reader stop) • Machine creates code "Part detection". • Machine's part detection is compared with handling system's part detection; if OK, the NC program continues (reader stop=0) • Machine sets strobe "Acknowledge valid data" • Machine clears strobe if strobe handling system sets "Data valid" to zero. <p>Reader stop is canceled if handling system code matches the machine code or by Reset.</p>
 <p>Handling system must set "Data valid DB130.DBX802.7" again, if "Acknowledge valid data loaded" is DB131.DBX 802.7= 0, because data comparison (M9=yy62) is repeated at Reset.</p>		
A3.0		Reserved
A3.1	NC	Reserved
A3.1	PLC	(If MAZU robot cell installed) Flap to robot cell open
A3.2	NC	Reserved
A3.3	NC	Remove remnant from main spindle. Handling system can move into the machine to dispose of remnant from main spindle – scrap
A3.4	NC	Pre-signal "remove remnant from main spindle". Pre-signal instructs the handling system to dispose of the remnant from the main spindle – scrap – and not move into the machine. Only if the A3.3 signal is set. Handling system can already move to a suitable waiting position.
A3.5	NC	Provide pre-signal Pre-signal instructs the handling system to only pick up the blank but not move into the machine until the Enable feed signal A1.2 or A1.4 is set.
A3.6		Reserved

Bit / Byte	PLC / NC	Description
A3.7	PLC	<p>Operator requests to open the machine's working area door (handling system stop) Close external loading flap (if available) Use signal only when loading through flap Request Open machine's working area door solenoid (from PLC) outputs signal bit 3.7. If the external flap on the handling system (safety flap) is closed, the machine's working area door can be opened. When the handling system moves over the machine, the handling system's safety flap must be closed so that the flap on the machine's handling system is covered.</p> <p>Request Open machine's working area door (handling system stop) is sent also without a safe loading flap. For handling system stop, E0.6 handling system in motion should become zero. See E0.3 Safety flap of handling system closed</p>
A4.0	PLC	<p>External safety fence can be opened Signal is sent if machine's working area door is locked or no program is running or machine stop and request Bit 4.0 is pending from the handling system. External safety fence replaces the flaps in the machine's working area door. External safety fence is installed in front of the machine's working area door. Loading and unloading through the machine's open working area door. If the machine's working area door is open and the safety fence is locked, the spindles and axes are switched to safe speed 1. (door voltage L+13=1) See also E0.4 Handling system outside interference area</p>
A4.1		Reserved
A4.2	PLC	<p>(EXA/M) Calibration request - not yet implemented (Automatic calibration should not be used, as this was not necessary so far) Handling system should load calibration master</p> <p><u>Calibration sequence:</u></p> <ol style="list-style-type: none"> 1. Time for calibration expired (PLC or measuring device) 2. Calibration request to handling system bit A4.2 3. Handling system loads calibration master and sends signal bit E4.2 Loaded 4. "Start measuring" from handling system - part is ready to be measured 5. Machine PLC starts calibration on the measuring device 6. "Measuring finished" from measuring device 7. "Calibration finished" to handling system bit A4.3 - part can be removed
A4.3	PLC	<p>(EXA/M) Measurement finished / calibration finished</p>

Bit / Byte	PLC / NC	Description
A4.4	PLC	(EXA/M) Scrap detected <u>Measuring sequence:</u> <ol style="list-style-type: none"> 1. "Start measuring" bit 4.3 from handling system - part is ready to be measured 2. Machine PLC starts measurement on the measuring device 3. "Measuring finished" from measuring device 4. "Measuring finished" bit 4.3 to handling system - part can be removed For good part, bit 4.6 is set, or for scrap, bit 4.4 is set 5. Handling system sets good part detected bit 4.6 or bit 4.4 scrap detected
A4.5	NC	Scrap part (for tool breakage with 801.1/3 MS/CS) If the tool is broken, the finished part should be removed as a scrap part with signal enable 1.1 or 1.3 .
A4.6	PLC	(EXA/M) - Good part Measuring sequence: see bit 4.4
A4.7	PLC	Fault message if central indicator lamp is present on the handling system.
A5.0		Reserved
A5.1		Reserved
A5.2		Reserved
A5.3		Reserved
A5.4		Reserved
A5.5		Free for user
A5.6		Free for user
A5.7		Free for user
6-15		Reserved
Bytes 6-9		Only output code to handling system Part detection (E2.7 , EB 6 , A2.7) is not possible here. (Output code or part detection can be selected via MAZU) With M9=yy62 , an output code is sent to the handling system. It can be used in many ways. e.g.: Length range CODE to handling system This CODE is not deleted with Reset Command M9=yy62 is programmed in the workpiece program. Yy = CODE 0 to 99

Sequence chart

The sequence may change depending on the application. All NC signals can be changed in the NC program.

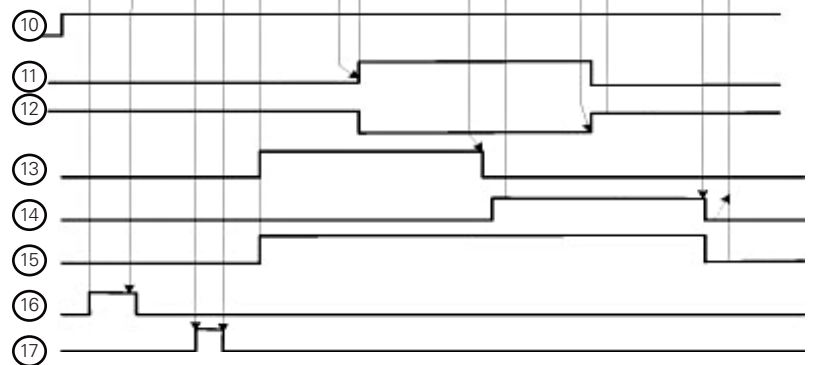
Signals from handling system

Inputs



Signals to handling system

Outputs



DIE132DE_03

1	E0.1	Handling system ready	10	A0.1	PLC	Machine ready Enable motion
2	E2.0	Release clamping device	11	A2.0	NC	Clamping device released
3	E2.1	Clamp clamping device	12	A2.1	NC	Clamping device clamped
4	E1.0	Finished part removed	13	A1.1	NC	Remove finished part
5	E1.4	Start to machine	14	A1.2	NC	Feed blank
6	E0.4	Handling system out of collision zone	15	A0.4	PLC	Loading flap open
7	E3.5	Pre-signal "Acknowledge"	16	A3.5	NC	Pre-signal "workpiece change"
8	Byte 6	Part detection Data code	17	A2.7	PLC	Acknowledge "data ready"
9	E2.7	Data ready				

Examples

Example of a sequence on main spindle and counter spindle:

At end of program, a semi-finished part will be in the counter spindle

Action	Signal
1 Open loading door.	A0.4
2 Feed blank to main spindle.	A1.2, E2.1, A2.1
3 When handling system has moved out of the interference area, close loading door.	E0.4, A0.4 = 0
4 Machine blank and semi-finished part	
5 Open loading door again	A0.4
6 Discharge finished part from counter spindle	A1.3, E2.2, A2.2
7 Close loading door	E0.4, E1.3, A0.4 = 0
8 Counter spindle fetches semi-finished part from main spindle	

At end of program, a semi-finished part will be in the main spindle and a finished part in the counter spindle

Action	Signal
1 Open loading door	A0.4
2 Discharge finished part from counter spindle	A1.3, E2.2, A2.2
3 Move handling system out of the interference area	E0.4
4 Counter spindle fetches semi-finished part from main spindle	
5 Feed blank to main spindle	A1.2, E2.1, A2.1
6 Close loading door	E0.4, E1.1, A0.4 = 0



The loading door only needs to be opened once In this example.

Programming example

Signal exchange during unloading and loading (main spindle)

Other subprogram numbers can also be used.
INDEX suggests the cycles described below.

The examples are only suggestions and must be adapted to the respective work-piece, depending on the sequence flow of the third-party device.

For behavior after RESET, see Section: "Setting and resetting the output signals"

L760 Loading

```
%_N_L760_SPF
LOAD PART
;
-----
; ***** Include this section in the workpiece program *****
;M10=98 H130008027           ;Data available?
;M9=1062 ;TYP J =101)
;M12=98 H131008035           ;PRE-SIGNAL "SUPPLY PART"
;-----
M12=98 H131008021           ;SET "CLAMPING DEVICE CLAMPED"
M13=98 H131008020           ;CLEAR "CLAMPING DEVICE RELEASED"

MSG ("LOADING")

M13=98 H131008011           ;CLEAR "REMOVE FINISHED PART"
M13=98 H131008035           ;CLEAR PRE-SIGNAL "SUPPLY PART"
M4=81                       ;OPEN FLAP
M10=98 H130008001           ;HANDLING SYSTEM READY?
M2=69                       ;FACE DRIVER BACK
M1=69                       ;MAIN SPINDLE: RELEASE CLAMPING DEVICE
M9=69                       ;TAILSTOCK BACK
M9=25                       ;CHECK TAILSTOCK
M13=98 H131008021           ;CLEAR "CLAMPING DEVICE CLAMPED"
M12=98 H131008020           ;CLAMP OPEN, FEED BLANK
M12=98 H131008012           ;FEED BLANK
M10=98 H130008021           ;CLAMP BLANK?
M9=268                      ;BLANK: PRE-CLAMP TAILSTOCK
M9=25                       ;BLANK: CHECK PRE-CLAMP TAILSTOCK
M12=98 H131008021           ;SET "CLAMPING DEVICE CLAMPED"
M13=98 H131008020           ;CLEAR "CLAMPING DEVICE RELEASED"
M9=68                       ;BLANK: CLAMP TAILSTOCK
M10=98 H130008004           ;HANDLING SYSTEM OUTSIDE MACHINE?
M10=98 H130008011           ;PART CHANGE FINISHED?
M4=QU(82)                   ;CLOSE FLAP
M13=98 H131008012           ;BLANK: RESET FEED
M17
```

L761 Unload

Automatic call of unloading program achieved by number of pieces.

1) Optional - according to the respective workpiece detection

L762 Unload and load

```

%_N_L762_SPF
;UNLOAD_LOAD PART
;
-----
; ***** Include this section in the workpiece program *****
;M10=98 H130008027 ;Data available?
;M9=1062 ;TYP J =101)
;M12=98 H131008035 ;PRE-SIGNAL "SUPPLY WORKPIECE"
-----

M12=98 H131008021 ;SET "CLAMPING DEVICE CLAMPED"
M13=98 H131008020 ;CLEAR "CLAMPING DEVICE RELEASED"

MSG (" UNLOAD ")

M13=98 H131008012 ;"CLEAR "FEED BLANK"
M13=98 H131008035 ;CLEAR PRE-SIGNAL "SUPPLY PART"
M4=81 ;OPEN FLAP
M10=98 H130008001 ;HANDLING SYSTEM READY?
M12=98 H131008011 ;DISCHARGE FINISHED PART
M2=69 ;FACE DRIVER BACK
M1=69 ;RELEASE CLAMPING DEVICE
M10=98 H130008020 ;CLAMPING DEVICE RELEASED?
M9=69 ;TAILSTOCK BACK
M9=25 ;CHECK TAILSTOCK
M13=98 H131008021 ;CLEAR "CLAMPING DEVICE CLAMPED"
M12=98 H131008020 ;SET "CLAMPING DEVICE RELEASED"
M10=98 H130008010 ;FINISHED PART DISCHARGED
M13=98 H131008011 ;SET "DISCHARGE FINISHED PART"

MSG ("UNLOAD")

M13=98 H131008011 ;CLEAR "REMOVE FINISHED PART"
M13=98 H131008035 ;CLEAR PRE-SIGNAL "SUPPLY PART"
H9=30802 ; CHECK CLAMPING DEVICE EMPTY, otherwise error message 750034
; (see Manual Programming H9 Functions DB214.DBW1038)

M4=81 ;OPEN FLAP
M10=98 H130008001 ;QUERY "HANDLING SYSTEM READY?"
M2=69 ;FACE DRIVER BACK
M1=69 ;OPEN CLAMPING DEVICE
M9=69 ;TAILSTOCK BACK
M9=25 ;CHECK TAILSTOCK
M13=98 H131008021 ;CLEAR "CLAMPING DEVICE CLAMPED"
M12=98 H131008020 ;SET "CLAMPING DEVICE RELEASED"
M12=98 H131008012 ;FEED BLANK
M10=98 H130008021 ;CLAMP BLANK?
M9=268 ;BLANK: PRE-CLAMP TAILSTOCK
M9=25 ;BLANK: CHECK PRE-CLAMP TAILSTOCK
M12=98 H131008021 ;SET "CLAMPING DEVICE CLAMPED"
M13=98 H131008020 ;CLEAR "CLAMPING DEVICE RELEASED"
M9=68 ;BLANK: CLAMP TAILSTOCK
M9=25 ;BLANK: CHECK CLAMP TAILSTOCK
M10=98 H130008004 ;HANDLING SYSTEM OUTSIDE MACHINE?
M10=98 H130008011 ;PART CHANGE FINISHED?
M4=QU(82) ;CLOSE FLAP
M13=98 H131008012 ;"CLEAR "FEED BLANK"
M17

```

1) Optional - according to the respective workpiece detection

L408 / L409 HomeCondition:

Selection via "Machine parameter -> general -> Reset key behavior -> Activate cycle L408"

Selection via "Workpiece parameter -> general -> Reset key behavior -> Activate cycle L409"

```
%_N_L409_SPF
; CYCLE NAME: L409.SPF LINK WITH EXTERNAL DEVICE
; HOMING sequence
M13=98 H131008012      ;CLEAR "FEED BLANK"
M13=98 H131008011      ;CLEAR "REMOVE FINISHED PART"
M13=98 H131008035      ;CLEAR PRE-SIGNAL "SUPPLY WORKPIECE"
.
M17
```

Call in the main program

```
%_N_1_0_MPF
M10=98 H130008027      ;Data available?
M9=1062                ;WORKPIECE TYPE1) J =10 , K =11, L = 12 , M = 13
M12=98 H131008035      ;PRE-SIGNAL "SUPPLY PART"
N10 L100
L760                   ;LOAD
WAITM(1,1,2)
START_:
N45 G73 X440 Z400
..
..                     Machining
..
M10=98 H130008027      ;Data available?
M9=1062                ;TYP J
M12=98 H131008035      ;PRE-SIGNAL "SUPPLY PART"
..
..                     Machining
..
WAITM(60,1,2)
L762                   ;UNLOAD-LOAD
WAITM(65,1,2)
I_M392
IF I_START GOTOB START_
M30
```

1) Optional - according to the respective workpiece detection



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