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Plant Data Interface for the Food & Beverage Industry

Interface description based on OMAC

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Table of contents

1 Overview of a plant wide automation concept

1.1 Overview Plant Wide Concepts for Food and Beverage Industry

In the Food & Beverage Industry is substantial room for improvement, to increase the efficiency and effectiveness of existing and planned new production lines.

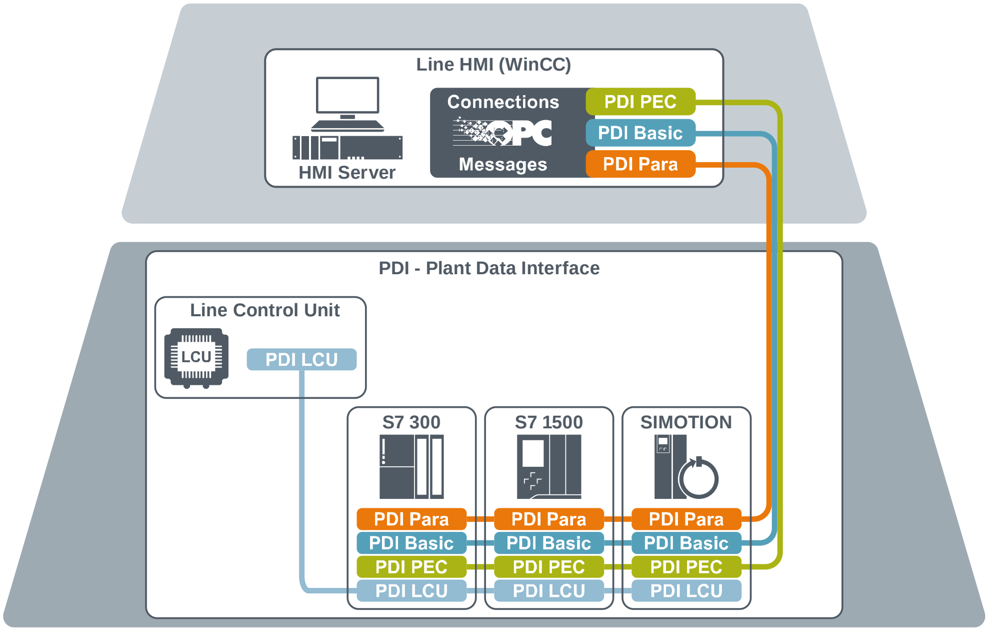
An essential contribution to this will provide the integrated linking of production lines and machines from the inbound of raw material to production, packaging up to the outgoing goods, as well as the consistent recording of production parameters like quantities, machine time, etc. These data can be analyzed at management systems and sustainable measures for improvement can be initiated.

Today this partly causes big efforts, because machines and components of different manufacturers have to be linked and the collected data has to be synchronized. Therefore a plant wide integration concept for line integration from Siemens AG includes the machine level, supervisory systems up to MES (Manufacturing Execution System) from incoming goods across food processing and food packaging areas to outgoing goods and storage.

This concept contains different modules such as Line Monitoring, Line Control, Line HMI (Human Machine Interface), plant energy, and so on. One such module is the machine interface, which is described herein.

1.2 Layout overview for plant wide data interface

The following picture shows the automation information flow related to the Plant Data Interface (PDI) between PSS (Plant Supervisory System), LCU (Line Control Unit) and OEMs' (Original Equipment Manufacturer) machine PLC (Programmable Logic Controller).



Four data-interfaces exist in the current architecture, PDI Basic, PDI Para, PDI LCU and PDI PEC, when combined they are referred as the Plant Data Interface or PDI. The PDI Basic provides the necessary information for Line Visualization and Line Monitoring (LM). The PDI LCU contains only information required for Line Control. The PDI PEC gives information about energy consumption. PDI Para is a data interface for additional data of machine specific parameters.

The PDI will be available in 2 different versions. One version is currently available for OMAC (Organization for Machine Automation and Control), which is described here and another version is available for Weihenstephan and is described in additional documentation.

1.3 Definitions

1.3.1 Default values

All values and counters that are not used or cannot be provided due to an out-of-range or undefined condition are set to "–1" or in case of type STRING to "". Counters are always 0 or positive".

Mandatory values for the different end customer functions are marked by function.

1.3.2 Data types

Type **Used in this document**	**Description**	**OMAC**	**Weihenstephan**	**S7-Type**		**SIMOTION**	**HMI-Type**		**OPC SIMATIC NET**	**LM/MES/MOM**
				S7-3xx/4xx	**S7-1x00**		**WinCC DM**	**TIA Portal**	**S7-3xx/4xx**	**S7-1x00**
DINT	Integer with 32bit	Int(32)	Signed32	DINT	Dint	DINT	Signed 32-bit value	Dint	Int32	LONG
UDINT	Integer with 32bit (positive values only)	n.a.	Unsigned32	DWORD	UDint	UDINT	Unsigned 32-bit value	UDint	UInt32	ULONG
REAL	32bit floating number	REAL	REAL	REAL	Real	REAL	Floating-point 32-bit	Real	Float	REAL
BIT[x]	32bit variable were each bit is interpreted as on unique value 0 or 1	Bool struct	n.a. workaround: use only first bit in Hex32	DWORD each single bit can be addressed	DWORD each single bit can be addressed	DWORD each single bit can be addressed	Binary tag	Bool	UInt32	BOOL array dimension = 32
DWORD	32 bit double word	n.a.	Hex32	DWORD	DWord	DWORD	Unsigned 32-bit value	DWord	UInt32	ULONG
BOOL	Variable 0 or not 0	Bool	n.a.	BOOL	Bool	BOOL	Binary tag	Bool	Boolean	BOOL
STRING	String limited to the number of characters in [num. of characters] ASCII only	String	n.a.	STRING[x]	String[x]	STRING[x]	Text tag 8-bit	String[x]	String	STRING dimension = X
STRING16	16 bit simple Unicode	n.a.	String16	n.a.	n.a	n.a.	Text tag 16-bit	n.a	n.a.	STRING dimension = X

1.4 PDI Overview

1.4.1 PDI Basic

The basic interface provides basic information regarding the machine, e.g. mode and state, machine speed and counters. The flow of information through the interface is from machine/production level (OEM) upwards to the LCU and/or PSS respectively. There is no data transfer from upper level LCUs/PSSs downwards to the machine/production level (OEM).This information is used for:

- Operator information about the machine state for line overviews (HMI), on a line server or an HMI client in a control room.
- Line monitoring for basic OEE / KPI (Overall Equipment Effectiveness / Key Performance Indicators) information.

All data exchanged with the PDI Basic are tag based and can be polled by the upper level at any time. The data itself can be written to the interface e.g. as data block in any PLC cycle. All data should however be written simultaneously to the interface to ensure consistency of data.

1.4.2 PDI LCU

The LCU interface provides additional data for line control functionality, e.g. start/stop and set line speed. Machine state information is communicated upwards from machine/production level (OEM) up to the LCU and/or PSS. Control and command data such as machine speed and start/stop are transmitted downwards from upper level LCUs/PSSs to the machine/production level (OEM). The data is used…

- to provide operator information about machine speed and entry/exit buffer of single machines on line overview (HMI) screens, on line servers or at HMI clients in a control room
- by the Line Control Unit to control the line, in terms of speed, buffer fill-levels and start/stop of machines

All data exchanged with the PDI LCU between line HMI (PSS) and the OEM PLC (Programmable Logic Controller) are tag based and can be polled by upper level systems at any time. Transfer of data between the Line Control Unit and OEM should be performed block-wise to ensure data consistency.

Implementation of the PDI LCU is only required for systems implementing the Line Control Unit. The LCU is an additional package for a plant wide automation that requires additional hardware and software components.

1.4.3 PDI PEC

The PEC provides additional data for energy monitoring and on top level to support implementation of a corporate energy data management system with following objectives:

- Compliance and support of national and international sustainability programs and standards, like ISO50001
- Continuous improvement of energy and water conservation
- Reduce costs for procurement of energy and water
- Increase employee awareness for energy efficiency

All data exchanged with the PDI-PEC between line HMI (PSS) and the OEM PLC are tag based and can be polled by upper level systems at any time. Implementation of the PDI PEC is optional.

1.4.4 PDI Para

The PDI-Para interface provides additional data for machine specific parameters.

The information can be delivered as Boolean, Integer, Real or String values. The delivered information contains typically process, order or reporting information.

Implementation of the PDI Para is optional.

2 Interface descriptions based on OMAC

2.1 PDI Basic

The basic interface provides basic information regarding machine state and parameters. The information is communicated upwards from machine/production level to the PSS level. There is no data transfer from upper level PSS systems downward to the machine/production level.

This information is used for:

- Operator information about machine state on line overview (HMI) screens, on line servers or on HMI clients in a control room. This includes:
  - machine state and mode information
  - material state information related to the machine
  - alarm information
- Line monitoring of basic OEE / KPI information
  - production results (downtime information, OEE, global efficiency)
  - raised alarm hit list
  - MTTR (Mean time to repair), MTBF (Mean time between failures
  - KPI trends

Group	Name (Interface description)[1]	Type	OMAC	Man-datory	Description
Status	Status.PDIVersion	String[10]	☐	☑	PDI version info. “PDI V2.0.0” fix for this implementation
Status	Status.ProjectVersion	String[10]	☐	☐	Project specific version
Status	Status.UnitModeCurrent	DINT	☑	☑	Values indicates the current unit mode ID
Status	Status.StateCurrent	DINT	☑	☑	Machine state ID related to the machines state model
Status	Status.MachSpeed	REAL	☑	☑	Describes the set point for the current speed of the machine in primary pieces/minute
Status	Status.CurMachSpeed	REAL	☑	☑	Value of the current machine speed in primary pieces/minute
Status	Status.EquipmentInterlock.Blocked	BOOL	☑	☑	Indicates that the downstream machine is not producing or transfer is blocked.
Status	Status.EquipmentInterlock.Starved	BOOL	☑	☑	Indicates that the upstream machine is not producing or transfer is blocked.
Status	Status.Parameter0.Value	DINT	☐	☐	Machine powered up time accumulated in hours
Status	Status.Parameter1.Value	REAL	☐	☐	Consumed electrical energy in kWh
Status	Status.Parameter2.Value	DINT	☐	☐	ProductRatio in primary pieces
Status	Status.Parameter3.Value	BOOL	☐	☐	1=depacker, 0=packer: Packer will be default
Status	Status.LightStack	DWORD	☐	☐	Represents the machine light stack with different color levels
Admin	Admin.ProdProcessedCount[0].Count	DINT	☑	☑	Counter of products (good + defective) by the production machine.
Admin	Admin.ProdProcessedCount[0].AccCount	DINT	☑	☑	Accumulated counter of products processed (good + defective) by the production machine
Admin	Admin.ProdDefectiveCount[0].Count	DINT	☑	☑	Counter of products rejected by the production machine.
Admin	Admin.ProdDefectiveCount[0].AccCount	DINT	☑	☑	Accumulated counter of products rejected by the production machine.
Admin	Admin.MachDesignSpeed	REAL	☑	☑	Max value of machine speed in primary pieces/minute in the installed environment based on currently processed product.
Admin	Admin.StopReason.ID	DINT	☑	☑	Machine Stop Reason is used for“First Out Fault” Stop Reason MessageID (OMAC RC)

[1] For parameter naming for different systems (PLC, OPC, HMI-Tag,…) please see later table in this documentation

Group	Name (Interface description)[1]	Type	OMAC	Man-datory	Description
Admin	Admin.StopReason.Value	DINT	☑	☐	OEM specific Message Identification Number

“Status.Parameter0” up to “Status.Parameter69” is reserved for all covered values in PDI interfaces. PDI Basic is using index 0 to 3.
“Status.Parameter70” and higher indexes are reserved for OEM specific parameters.
In case machine specific or project specific parameters are required, the parameters can be delivered via the PDI PARA interface.

2.1.1 Interface description detailed information

Status.PDIVersion

Name	Type	Comment
Status.PDIVersion	String[10]	Version of the used plant data interface

The parameter gives information about the version of the used plant data interface. For this implementation the string is fix: “PDI V2.0.0”

Status.ProjectVersion

Name	Type	Comment
Status.ProjectVersion	String[10]	Project specific version description

This data point provides a project specific version description of the interface implementation. Regarding the content there are no specifications determined.

Status.UnitModeCurrent

Name	Type	Comment
Status.UnitModeCurrent	DINT	Current mode of the machine

The value shows the current mode of the machine. The following values are defined for PDI in the F&B industry (Food and Beverage)

Value	Mode	Man-datory	Description
0	Invalid	☐	The machine delivers an undefined mode.
1	Production	☑	The machine executes relevant logic in production mode. The machine is producing product or able to produce product.
2	Maintenance	☐	This mode indicates that the machine is in maintenance mode. This mode would typically be used for faultfinding, machine trials or testing operational improvements.
3	Manual	☐	This mode indicates that the machine is in manual mode. This feature may be used for the commissioning of the individual drives, verifying the operation of synchronized drives, testing the drive as result of modifying parameters, etc.
4 – n	User defined	☐	A user defined mode can indicate a dedicated machine mode with its own state model.

There are no pre-specified user defined modes defined within the PDI Basic.

Status.StateCurrent

Name	Type	Comment
Status.StateCurrent	DINT	Indicates the machine state related to the OMAC model

This Value indicates the machine state related to the OMAC machine state model.

Value	State	Mandatory
1	Clearing	
2	Stopped	Yes
3	Starting	
4	Idle	Yes
5	Suspended	
6	Execute	Yes
7	Stopping	
8	Aborting	
9	Aborted	Yes
10	Holding	
11	Held	
12	UnHolding	
13	Suspending	
14	Unsuspending	
15	Resetting	
16	Completing	
17	Complete	

For detailed description please see chapter 3.2 State description.

Status.MachSpeed

Name	Type	Comment
Status.MachSpeed	Real	Actual setpoint of the machine speed in primary pieces/minute

This describes the set point for the current speed of the machine in primary packages per minute. Keeping speed in a primary package unit of measure (UoM) allows for easier control integration. The primary package UoM is the normalized rate for the machine, normalized to a value chosen on the line. The following example is for a bottle line running at balance line speed of 1000 pieces/minute. The UoM chosen is equivalent to be the actual count of the Filler, or Labeler.

Status.CurMachSpeed

Name	Type	Comment
Status.CurMachSpeed	Real	Current machine speed in primary pieces/minute.

The following example is for a packaging line running at balanced line speed of 1200 bottles/minute. The specified UoM (Unit of Measurement) is chosen to correspond with that of the current count of the Filler or Labeler.

The following table shows an example of the machine speed.

Machine	Actual Pack Counts	CurMachSpeed in UoM
Bulk depalletizer	50 (24 pack equiv.)	1.200 bottles/min
Filler	1.200	1.200 bottles/min
Labeler	1.200	1.200 bottles/min
Packer	100 (12 packs)	1.200 bottles/min

In the case of batch processing this parameter indicates the throughput, measured in the UoM per batch (e.g. kg/batch, batch/hour, etc.).The value is calculated cyclically at the machine level.

Status.EquipmentInterlock.Blocked

Name	Type	Comment
Status.EquipmentInterlock.Blocked	BOOL	Downstream machine not producing or blocked

This parameter indicates that the downstream machine is not producing or that the transfer is blocked

Status.EquipmentInterlock.Starved

Name	Type	Comment
Status.EquipmentInterlock.Starved	BOOL	Upstream machine not producing or blocked

This data point indicated that the upstream machine is not producing or that the transfer is blocked, so that the equipment does not get any pieces anymore.

Status.Parameter0.Value

Name	Type	Comment
Status.Parameter0.Value	DINT	Accumulated machine up time

The Status.Parameter0.Value describes the accumulated machine up time in hours and is named as “Mach_Cum_Time”. The value starts counting as soon as the machine is powered on. There is an overflow at 2147483647 and the value starts again at 0. Up to two 2 decimal places are allowed. There is no reset in between.

This value has to be retained during PLC start/stop and PLC power off.

Status.Parameter1.Value

Name	Type	Comment
Status.Parameter1.Value	REAL	Consumed electrical energy in kWh

The Status.Parameter1.Value describes the consumed electrical energy in kWh w/o decimal places. The parameter is named as “ConsumedElecEnergy”.

Status.Parameter2.Value

Name	Type	Comment
Status.Parameter2.Value	DINT	The ratio between primary units of the line and units which leaves the machine

The Status.Parameter2.Value gives the ratio between exit items (secondary packages) for the machine and primary units of the line. This parameter is named as “ProductRatio”.

The value contains the number of primary packages included in the current produced secondary packages. E.g.:

- Packer packs six packs from single bottles → Value = 6
- Depacker empties one crate (20 bottles) into single bottles → Value = 20
- Depalletizer empties one pallet (32 crates) into single bottles → Value = 640

Together with “Status.Parameter3.Value” it will be defined if the machine is a packer or an unpacker.

Status.Parameter3.Value

Name	Type	Comment
Status.Parameter3.Value	BOOL	Machine Is a packer or a unpacker

Indicates if the machine packs or unpacks pieces. If Value = 0 the machine is a packer. This is the default value. If Value = 1 the machine is an unpacker.

Status.LightStack

Name	Type	Comment
Status.LightStack	DWORD	Machine signal light stack

The machine light stack provides easy indication of the machine state for operators, based on EN / IEC 60204-1.

Color	Meaning	Description and operator task	Light	Signal
Red	Emergency	Hazardous condition. Immediate action to deal with hazardous condition (e.g. switch off Energy supply).	Static	Bit[0]
			Flashing	Bit[1]
Yellow	Abnormal	Abnormal condition impending critical conditions. Monitoring and/or intervention (e.g. by reestablishing intended function).	Static	Bit[2]
			Flashing	Bit[3]
Blue	Mandatory	Indication of a condition that requires an operator action.	Static	Bit[4]
			Flashing	Bit[5]
Green	Normal	Normal condition	Static	Bit[6]
			Flashing	Bit[7]
White	Neutral	Other condition; may be used whenever doubts exist about the implementation of RED;YELLOW,BLUE or GREEN	Static	Bit[8]
			Flashing	Bit[9]

The light stack is mainly used for the operator to identify required operator intervention at the machine.

The colors red and green are mandatory, all others are optional. Machines where additional colors would be useful should provide them.

NOTE The flashing lights are used for differentiation or highlighting of the signal:

- to thrill attention
- to request immediate action
- to show discrepancy between command and current state
- to show change of process (e.g transition)

Admin.ProdProcessedCount[0]

Name	Type	Comment
Admin.ProdProcessedCount[0] .Count	DINT	Resettable sum of rejected and good items produced by the machine
Admin.ProdProcessedCount[0] .AccCount	DINT	Accumulative sum of all rejected and good items produced by the machine

The value represents the number of processed products/items by the production machine w/o decimal places. The unit of measurement is depending on the produced product.

The ProdProcessedCount[0].Count is the sum of rejected and good items produced by the machine. It is not the entry product counter of the machine.

The ProdProcessedCount[0].AccCount is the accumulative sum of all rejected and good items produced by the machine. A reset of this counter is not allowed.

Both values must be calculated within the same PLC cycle.

There is an overflow of both values at 2147483647, at which time they wraparound to 0. The counters Count and AccCount count continuously regardless of unit mode (see Status.UnitModeCurrent).

Count can be reset manually on the machine level e.g. on shift change, product change, order change, etc. This is to be defined per end customer specification. AccCount is never reset.

The values of Count and AccCount must be retained during PLC start/stop and PLC power off.

ProdProcessedCount[0] and ProdDefectiveCount[0] (see below) require the same UoM for Count and AccCount. Not allowed is the counting of different items e.g. ProdProcessedCount in six-packs and ProdDefectiveCount[0] in single bottles.

Admin.ProdDefectiveCount[0]

Name	Type	Comment
Admin.ProdDefectiveCount[0] .Count	DINT	Resettable sum of rejected items from the machine
Admin.ProdDefectiveCount[0] .AccCount	DINT	Accumulative sum of all rejected items from the machine

Data type: DINT for Count and AccCount

The ProdDefectiveCount[0] represents the number of rejected items processed by the production machine w/o decimal places. The unit of measurement is depending on the produced product.

The ProdProcessedCount[0].Count is the sum of rejected items from the machine. It is not the entry product counter of the machine.

The ProdProcessedCount[0].AccCount is the accumulative sum of all rejected items from the machine. A reset of this counter is not possible.

There is an overflow of both values at 2147483647, at which time they wraparound to 0. The counters Count and AccCount count continuously regardless of unit mode (see Status.UnitModeCurrent).

Count can be reset manually on the machine level e.g. on shift change, product change, order change, etc. This is to be defined per end customer specification. AccCount is never reset.

The counter values must be retained during PLC start/stop and PLC power off.

ProdProcessedCount[0] and ProdDefectiveCount[0] (see below) require the same UoM for Count and AccCount. Not allowed is the counting of different items e.g. ProdProcessedCount in six-packs and ProdDefectiveCount[0] in single bottles.

Admin.MachDesignSpeed

Name	Type	Comment
Admin.MachDesignSpeed	REAL	Maximum speed of the machine in packages/min

The machine design speed tag represents the maximum design speed of the machine in primary packages per minute for the current product setup.

The machine design speed provided by the machine builder, indicates the speed of the machine, for the given configuration and product selection. In the event, that the maximum machine speed, be downgraded due to the line constellation, any necessary adjustments for OEE or other KPIs, should be made within the line level and not on a machine level.

Admin.StopReason.ID

Name	Type	Comment
Admin.StopReason.ID	DINT	Stop reason ID

This ID is related to the appendix A1 alarm codes (ANSI/ISA-TR88.00.02-2008). At a minimum, the simplified reason group fault code is to be provided. Should other alarm codes be available, they should be placed within the appropriate range. (i.e. Safety Related faults identified with a value from 1-31)

Value	Detailed reason group	Simplified reason group fault code
0		Undefined
32	Safety related	Machine internal reason
64	Operator action	
256	Product related	
512	Equipment fault	
999	All other internal	
2499	Machine ext. **Upstream** process reason	Main product flow
3499	Machine ext. **Downstream** process reason	
4499	Out of service (planned and unplanned)	
4999	Branch- or sub-utility equipment	Other external reasons

Most important to the alarm ID are the three main categories

- Machine internal error (value 1 to 1999)
- Machine upstream reason (value 2000 to 2999)
- Machine downstream reason (value 3000 to 3999)

These categories, among other values, are needed for basic RCA (Root Cause Analysis). For line OEE/KPI calculation at least the simplified reason group fault codes are required.

The Admin.StopReason.ID is set as soon as the machine detects an error condition. The Admin.StopReason.ID is reset as soon the alarm is acknowledged.

After the Admin.StopReason.ID is acknowledged a new alarm can be set.

NOTE There is a template prepared in the HMI part where the message creation is described:
https://support.industry.siemens.com/cs/ww/en/view/100744248

Admin.StopReason.Value – “InitialError”

Name	Type	Comment
Admin.StopReason.Value	DINT	The value stores the initial machine error

The value stores the initial machine error, when the machine exits the “execute” state, regardless of cause. The parameter is named as “InitialError” and has no unit of measurement and comes w/o decimal places.

The number is reset to 0 (=no error) as soon as the machines goes back to the “execute” state. In the case that the initial error is not immediately known when the machine exits the “execute” state, the value 0 will remain valid and has to be updated, as soon as the initial error is known.
The initial error value is only to be written on transition out of “execute”. The error code is machine specific. The OEM is to provide a listing of possible error numbers and their description in CSV-format. The file must contain English-language descriptions as a minimum. If available, the list should contain additional languages. The allowed format is column 1 = error id, column 2 = English description, column 3 = additional language description, repeating for each additional language. The header row for columns 3 and above should indicate the language used.

This parameter is mainly used for operator information on line HMIs and for basic RCA (Root Cause Analysis).

Should the Admin.StopReason.ID (see before) be fully implemented on the machine level, as documented in (ANSI/ISA-TR88.00.02-2015), this parameter will give the value of Admin.StopReason.ID when exiting the “execute” state.

In the event, that the alarm is acknowledged, the value of Admin.StopReason.Value is not reset. This is a different behavior compared to Admin.StopReason.ID

2.2 PDI LCU

The LCU interface provides additional data for line control functionality, e.g. start/stop and set line speed. Machine state information is communicated upwards from machine/production level (OEM) up to the LCU and/or PSS. Control and command data such as machine speed and start/stop are transmitted downwards from upper level LCUs/PSSs to the machine/production level (OEM) (see also **Fehler! Verweisquelle konnte nicht gefunden werden.**). The data is used…

- To provide operator information about machine speed and entry/exit buffer of single machines on line overview (HMI) screens, on line servers or at HMI clients in a control room
- By the Line Control Unit to control the line, in terms of speed, buffer fill-levels and start/stop of machines

All data exchanged with the PDI LCU between line HMI (PSS) and the OEM PLC are tag based and can be polled by upper level systems at any time. Transfer of data between the Line Control Unit and OEM PLC should be performed block-wise to ensure data consistency.

Implementation of the PDI LCU is only required for systems implementing the Line Control Unit. The LCU is an additional package for plant wide automation that requires additional hardware and software components.

2.2.1 Interface description overview

Group	Name (Interface description)[2]	Type	OMAC	Man-datory	Description
Command	Command.UnitMode	DINT	☑	☑	Unit mode is the selected target mode, requested by the line system for this machine
Command	Command.UnitModeChangeRequest	BOOL	☑	☑	Is set when the unit mode change to the mode present in UnitName.Command.UnitMode should start.
Command	Command.MachSpeed	REAL	☑	☑	Setpoint of machine speed in primary pieces/minute in the installed environment based on currently processed products
Command	Command.CntrlCmd	DINT	☑	☑	State command to drive a state change in the Base State Model
Command	Command.CmdChangeRequest	BOOL	☑	☑	Commands to proceed the state change as soon as it is set to 1
Command	Command.Parameter0.Value	BOOL	☐	☑	RemoteControlActive indicates line controller is controlling the machine from external.
Status	Status.PDIVersion	String[10]	☐	☑	PDI version info. “PDI V2.0.0” fix for this implementation
Status	Status.ProjectVersion	String[10]	☐	☐	Project specific version
Status	Status.StateRequested	DINT	☑	☑	As soon as the state change command is set (CntrlCmd = valid value and CmdChangeRequest= 1) the StateRequested value indicates the numerical value of target state
Status	Status.StateChangeInProcess	BOOL	☑	☑	Indicates a state change initiated by CmdChangeRequest is in progress.
Status	Status.Parameter4.Value	DINT	☐	☐	MachBufferEntry in % from 0 to 100 (optional)
Status	Status.Parameter5.Value	DINT	☐	☐	MachBufferExit in % from 0 to 100 (optional)
Status	Status.Parameter6.Value	BOOL	☐	☑	RemoteControlAllowed indicates if line controller / operator is allowed to control the machine from external command

[2] For parameter naming for different systems (PLC, OPC, HMI-Tag,…) please see later table in this documentation

Status.Parameter(s) with index up to and including 69 are reserved for all covered values in PDI interfaces. PDI LCU is using index 4 to 6.

Status.Parameter(s) with index 70 or higher are reserved for OEM specific parameters.

In case machine specific or project specific parameters are required, the parameters can be delivered via the PDI PARA interface.

These two tags: "Command.UnitMode" and "Command.UnitModeChangeRequest" are added for future use and will not be used in this version.Interface description detailed information.

2.2.2 Interface description detailed information

Command.UnitMode

Name	Type	Comment
Command.UnitMode	DINT	The value describes the desired and unit modes

Data type: DINT

This value is predefined by the user/OEM, and stands for the desired unit modes of the machine. The UnitMode tag is a numerical representation of the commanded mode. There can be any number of unit modes, and for each unit mode there is an accompanying state model. The UnitMode according to ISA-88 (ANSI/ISA-TR88.00.02-2015).

Value	Mode	Description
0	Invalid	The machine delivers an undefined mode.
1	Production*	The machine executes relevant logic in production mode. The machine is producing product or able to produce product.
2	Maintenance	This mode indicates that the machine is in maintenance mode. This mode would typically be used for faultfinding, machine trials or testing operational improvements.
3	Manual	This mode indicates that the machine is in manual mode. This feature may be used for the commissioning of the individual drives, verifying the operation of synchronized drives, testing the drive as result of modifying parameters, etc.
4 – n	User Defined	A user defined mode can indicate a dedicated machine mode with its own state model.

Command.UnitModeChangeRequest

Name	Type	Comment
Command. UnitModeChangeRequest	BOOL	Request for changing the unit mode

When a unit mode request takes place a numerical value must be present in the "Command.UnitMode" tag to change the unit mode. Local processing and conditioning of the requested mode change is necessary in order to accept, reject, or condition the timing of the change request.

Command.MachSpeed

Name	Type	Comment
Command. MachSpeed	REAL	Set point for requested machine speed

The value defines the set point for requested machine speed for the current product setup, measured in primary packages per minute. This set point is sent as a value to the machine PLC. The machine itself is required to adjust its speed to the requested set point, insofar that the mechanical construction allows and such speed lies within the acceptable range.

Command.CntrlCmd

Name	Type	Comment
Command. CntrlCmd	DINT	Provides the state command to execute a state change

The value provides the state command to execute a state change, as per the OMAC Base State Model. The control commands regarding ISA-88 (ANSI/ISA-TR88.00.02-2015).

Value	Command	from current state		to new state
0	Undefined		→	
1	Reset	Complete, Stop	→	Resetting
2	Start	Idle	→	Starting
3	Stop	Aborting Aborted Clearing Stopping Stopped	→	Stopping
4	Hold	Execute	→	Holding
5	Unhold	Held	→	Unholding
6	Suspend	Execute	→	Suspending
7	Unsuspend	Suspended	→	Unsuspending
8	Abort	Aborting Aborted Clearing Stopping Stopped	→	Aborting
9	Clear	Aborted	→	Clearing

For implementation of a state change refer to chapter 2.2.3 Handshake for state change.

Command.CmdChangeRequest

Name	Type	Comment
Command. CmdChangeRequest	BOOL	Initiate the machine to state change

This Boolean value commands the machine to initiate the state change, as indicated by CntrlCmd.

For implementation of a state change refer to chapter 2.2.3 Handshake for state change.

Command.Parameter0.Value – "RemoteControlActive"

Name	Type	Comment
Command. Parameter0.Value	BOOL	Remote control

The Parameter is named as "RemoteControlActive" and signals to the OEM-PLC that the LCU is actively controlling the machine regarding start/stop and machine speed. The command parameter is set by the LCU. When Command.Parameter[0].Value is 1, the machine should only assume local control in case an emergency condition raise up or the LCU causes the machine to run outside of specification. Command.Parameter[0].Value unequal 1 (typically 0) states that there is no LCU control active. This parameter is only relevant while the machine is in the "execute" state. In all other states or in any other production mode the machine is to assume control.

Status.PDIVersion

Name	Type	Comment
Status.PDIVersion	String[10]	The used PDI version

The PDIVersion parameter gives information about the version of the used plant data interface. For this implementation the string is fix: "PDI V2.0.0".

Command.ProjectVersion

Name	Type	Comment
Status.ProjectVersion	String[10]	Project specific version of the interface

This data point provides a project specific version description of the interface implementation. Regarding the content there are no specifications determined.

Status.StateRequested

Name	Type	Comment
Status.StateRequested	DINT	The target state after a change state command was received

This value indicates the target state after a change state command was received. The “CmdChangeRequest” Boolean directs the machine to proceed into a state change. As soon as the state change command is set (CntrlCmd = valid value and CmdChangeRequest = 1) the “StateRequested” value indicates the numerical value of the target state based on the OMAC Base State Model.

For implementation of a state change refer to chapter 2.2.3 Handshake for state change.

Status.StateChangeInProcess

Name	Type	Comment
Status. StateChangeInProcess	BOOL	Indicates that a state change is in progress

This value indicates that a state change is in progress. The “CmdChangeRequest“ Boolean directs the machine to proceed a state change. As soon as the machine begins to transition to the new state, the “StateChangeInProcess” value will be ‘1’ indicating that the state change is in progress.

For implementation of a state change refer to chapter 2.2.3 Handshake for state change.

Status.Parameter4 – “MachBufferEntry”

Name	Type	Comment
Status. Parameter4	DINT	Fill level of the machine entry buffer in %

This value describes the fill-level of the machine entry buffer in % with one decimal place. This parameter is named as “MachBufferEntry”
This parameter indicates the current fill-level in % of the machine entry buffer between 0% (empty) and 100% (full). This value depends on the installed hardware. In case an analog meter is installed, any real value from 0.0 to 100.0 is possible. In case of one or more digital level sensors there are only dedicated values possible.

In case no buffer sensor is available or the buffer fill-level is controlled by an external buffer controller the value is set to -1.

Status.Parameter5 – "MachBufferExit"

Name	Type	Comment
Status. Parameter5	DINT	Level of the machine exit buffer in %

Data type: DINT

This value describes the level of the machine exit buffer in % with one decimal place. This parameter is named as "MachBufferExit"

This parameter indicates the current fill-level in % of the machine exit buffer between 0% (empty) and 100% (full). This value depends on the installed hardware. In case an analog meter is installed any real value from 0.0 to 100.0 is possible. In case of one or more digital level sensors there are only dedicated values possible.

In case no buffer sensor is available or the buffer fill-level is controlled by an external buffer controller the value is set to -1.

Status.Parameter6 – "RemoteControlAllowed"

Name	Type	Comment
Status. Parameter6	BOOL	Indicates that the machine will accept a state change command

This value indicates that the machine will accept a state change command. This parameter is named as "RemoteControlAllowed".

If the machine will accept a state change command from the LCU, the value attribute should be set to 1; otherwise the parameter should take on a value of 0.

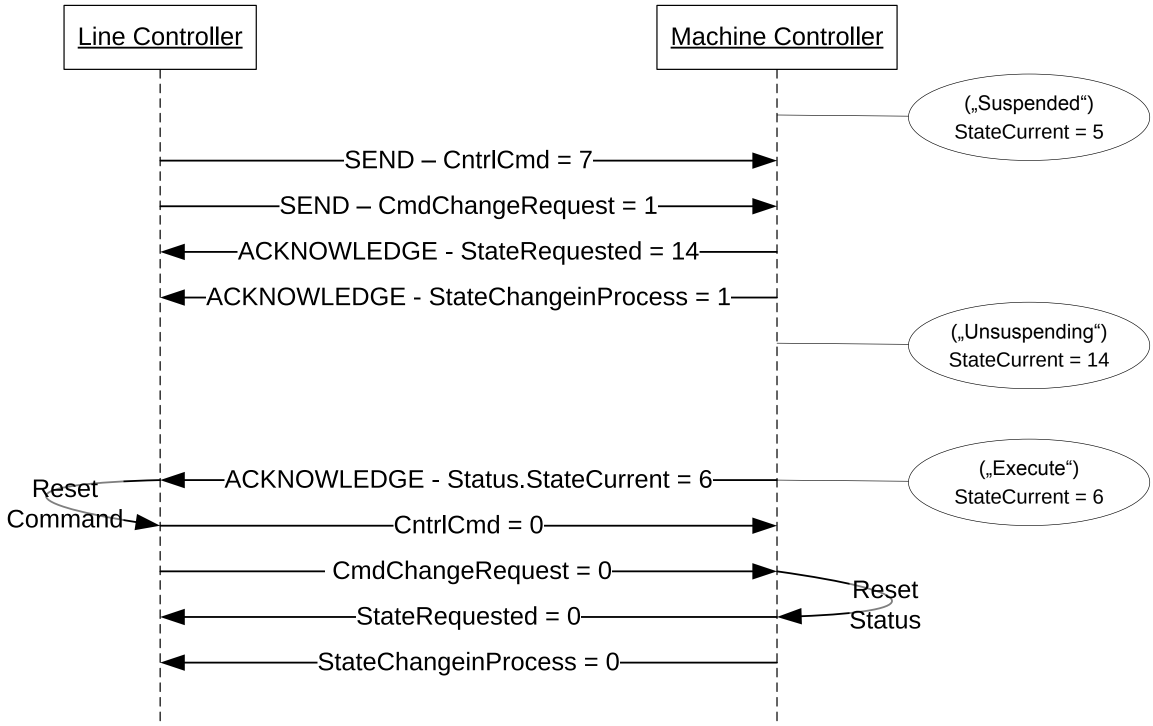
Any value for the value attribute, other than 0 indicates that the machine accepts status change commands from the LCU.

2.2.3 Handshake for state change

This chapter describes the handshake required to initiate a machine state change triggered from external command or how to refuse the incoming command.

Scenario 1: State change request accepted

The following example describes the state change from machine state 5 (="Suspended") to machine state 6 (="Execute") initiated by a control command 7 (="Unsuspend").



It is recommended resetting the "StateRequested" value to 0 after the "CmdChangeRequest" equal 0 is received. But this is not mandatory; keeping the old value is also applicable.

In case the hand shake is used in a tag based communication between machine and LCU the "CntrlCmd" value must be set at least one full tag runtime cycle before the "CmdChangeRequest" is set. The full tag runtime cycle is the time that is needed in worst case from reading the value from LCU and writing it to the machine and is based on the project specific configuration. The same is valid for the "StateRequested" and the "StateChangeInProcess". In this case the "StateChangeInProcess" is reset first.

At the beginning the following values are given:

Tag	Value	Description
Command.CntrlCmd	0	Undefined
Command.CmdChangeRequest	0	no request active
Status.StateCurrent	5	“Suspended”
Status.StateRequested	0	Undefined
Status.StateChangeInProcess	0	no requested state change active

The LCU sets the “Command.CntrlCmd” to 7 and “Command.CmdChangeRequest” to 1 indicating a state change should be processed by the machine.

At that time the following values are given:

Tag	Value	Description
Command.CntrlCmd	7	Unsuspend
Command.CmdChangeRequest	1	request active
Status.StateCurrent	5	“Suspended”
Status.StateRequested	0	Undefined
Status.StateChangeInProcess	0	no requested state change active

The machine controller set “Status.StateChangeInProcess” to 1 and “Status.StateRequested” to 14. The bit “Status.StateChangeInProcess**”** indicates that a change in state is in progress following a state change request command.

At that time the following values are given:

Tag	Value	Description
Command.CntrlCmd	7	Unsuspend
Command.CmdChangeRequest	1	request active
Status.StateCurrent	5	“Suspended”
Status.StateRequested	14	Unsuspending
Status.StateChangeInProcess	1	requested state change active

As soon as the state “execute” is reached “Status.StateCurrent” is set to 6. This indicates that the requested command has been completed. The line controller resets “Command.CntrlCmd” and the “Command.CmdChangeRequest” to 0. “Command.CntrlCmd” equal 0, indicates undefined and “Command.CmdChangeRequest” equal 0 indicates no state change requested.

At that time the following values are given:

Tag	Value	Description
Command.CntrlCmd	0	Undefined
Command.CmdChangeRequest	0	No request active
Status.StateCurrent	6	“Execute”
Status.StateRequested	14	Unsuspending
Status.StateChangeInProcess	1	requested state change active

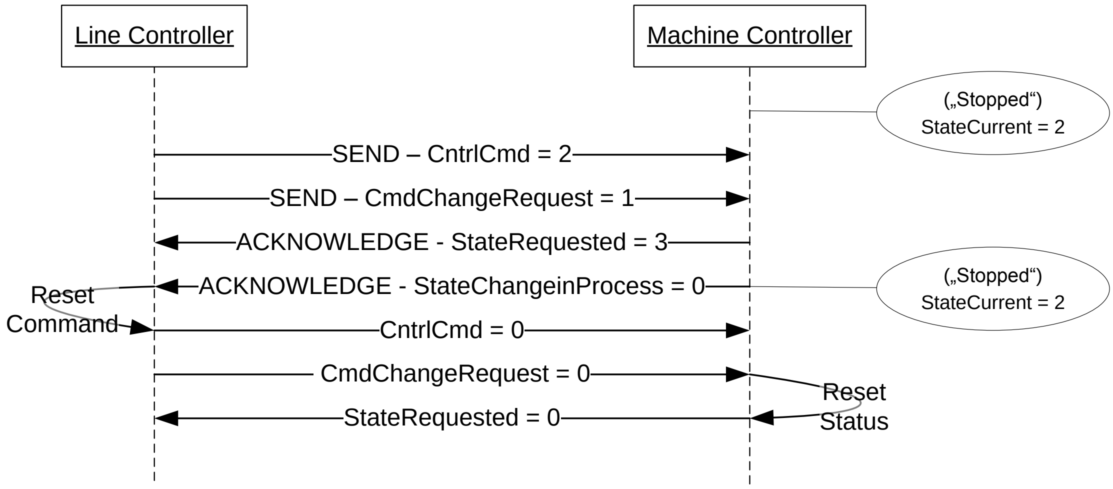
As soon as the “Command.CmdChangeRequest” is 0, the machine controller resets “Status.StateRequested” and “Status.StateChangeInProcess” to 0.

At the end the following values are given:

Tag	Value	Description
Command.CntrlCmd	0	Undefined
Command.CmdChangeRequest	0	No request active
Status.StateCurrent	6	“Execute”
Status.StateRequested	0	Undefined
Status.StateChangeInProcess	0	No requested state change active

Scenario 2: State change request refused

The following example describes the refusal of a state change from machine state 2 = “Stopped” to machine state 3 =”Starting” initiated by a control command 2 =”Start”.



This is not possible because the machine should be in the “idle” state before transitioning to “start”. As per the OMAC State Model, the line operator or LCU must issue a Reset command to transition to “idle” before issuing a start command.

It is recommended resetting the “StateRequested” value to 0 after the “CmdChangeRequest” equal 0 is received. But this is not mandatory; keeping the old value is also applicable.

In case the hand shake is used in a tag based communication between machine and LCU the “CntrlCmd” value must be set at least one full tag runtime cycle before the “CmdChangeRequest” is set. The full tag runtime cycle is the time that is needed in worst case from reading the value from LCU and writing it to the machine and is based on the project specific configuration. The same is valid for the “StateRequested” and the “StateChangeInProcess”. In this case the “StateChangeInProcess” is reset first.

At the beginning the following values are given:

Tag	Value	Description
Command.CntrlCmd	0	Undefined
Command.CmdChangeRequest	0	No request active
Status.StateCurrent	2	“Stopped”
Status.StateRequested	0	Undefined
Status.StateChangeInProcess	0	No requested state change active

The LCU sets the “Command.CntrlCmd” to 2 and “Command.CmdChangeRequest” to 1 indicating a state change should be processed by the machine.

At that time the following values are given:

Tag	Value	Description
Command.CntrlCmd	2	Start
Command.CmdChangeRequest	1	Request active
Status.StateCurrent	2	“Stopped”
Status.StateRequested	0	Undefined
Status.StateChangeInProcess	0	No requested state change active

The machine controller rejects the request by setting “Status.StateChangeInProcess” to 0 and “Status.StateRequested” to 3. The bit “Status.StateChangeInProcess” indicates that a change in state following a state change request command is rejected.

At that time the following values are given:

Tag	Value	Description
Command.CntrlCmd	2	Start
Command.CmdChangeRequest	1	Request active
Status.StateCurrent	2	“Stopped”
Status.StateRequested	3	“Starting”
Status.StateChangeInProcess	0	No requested state change active

The LCU resets the “Command.CntrlCmd” and the “Command.CmdChangeRequest” to 0 as soon the “Status.StateChangeInProcess” indicates 0 and “Status.StateRequested” is unequal 0 (=command rejected).

At that time the following values are given:

Tag	Value	Description
Command.CntrlCmd	0	Undefined
Command.CmdChangeRequest	0	No request active
Status.StateCurrent	2	“Stopped”
Status.StateRequested	3	“Starting”
Status.StateChangeInProcess	0	No requested state change active

As soon as the command from the LCU is reset, the machine controller must reset the “Status.StateRequested” to 0 (=Undefined).

At the end the following values are given:

Tag	Value	Description
Command.CntrlCmd	0	Undefined
Command.CmdChangeRequest	0	No request active
Status.StateCurrent	2	“Stopped”
Status.StateRequested	0	Undefined
Status.StateChangeInProcess	0	No requested state change active

2.3 PDI PEC

The PEC provides additional data for energy monitoring and on top level to support implementation of a corporate energy data management system with following objectives.

- Compliance and support of national and international sustainability programs and standards, like ISO50001
- Continuous improvement of energy and water conservation
- Reduce costs for procurement of energy and water
- Increase employee awareness for energy efficiency

All data exchanged with the PDI-PEC between line HMI (PSS) and the OEM PLC are tag based and can be polled by upper level systems at any time.

Implementation of the PDI PEC is optional.

2.3.1 Interface description overview

The “PDI_PEC” structure type is designed for 5 energy mediums.

Group	Name (Interface description)	Type	OMAC	Man-datory	Description
Status	Status.PDIVersion	String[10]	☐	☑	PDI version info. “PDI V2.0.0” fix for this implementation
Status	Status.ProjectVersion	String[10]	☐	☐	Project specific version
Status	Status.Energy[0..4].TypeID	DINT	☐	☐	Type of Energy, Number according to predefined ID List (see definition table)
Status	Status.Energy[0..4].CurCons	REAL	☐	☐	Current consumption [kW, m³/h, kg/h, l/h]
Status	Status.Energy[0..4].EngyCurConsUoM	DINT	☐	☐	Unit of Measure ID of the current Energy consumption (according the SI Unit of Measure ID List)
Status	Status.Energy[0..4].Count	REAL	☐	☐	Accumulating counter (meter) in [kWh, m³, kg, l], defined Overflow
Status	Status.Energy[0..4].EngyCountUoM	DINT	☐	☐	Unit of Measure ID of the accumulated Energy consumption (according the SI Unit of Measure ID List)

2.3.2 Interface description detailed information

Status.PDIVersion

Name	Type	Comment
Status.PDIVersion	String[10]	Version of the used plant data interface

The parameter gives information about the version of the used plant data interface. For this implementation the string is fix: “PDI V2.0.0”.

Status.ProjectVersion

Name	Type	Comment
Status.ProjectVersion	String[10]	Project specific version description

This data point provides a project specific version description of the interface implementation. Regarding the content there are no specifications determined.

Status.Energy[x].TypeID

Name	Type	Comment
Status.Energy[x].TypeID	DINT	Description of the used energy type

The value defines the type of energy being measured. It is a numerical representation of the energy type according to the predefined ID list:

ID	Base unit	Base unit CurCons	Description
00000	-	-	Undefined (Defined in SCADA)
00001	m³	m³/h	Water
00002	m³	m³/h	Air
00003	m³	m³/h	Gas
00004	kWh	kW	Electricity
00005	KG	KG/h	Steam

Status.Energy[x].Count

Name	Type	Comment
Status.Energy[x].Count	Real	Accumulating counter of an energy meter

The value contains an accumulating counter of an energy meter.

The value starts counting as soon the meter counts. There is an overflow at 9.999.999,99 and the value starts again at 0. No decimal places are allowed. There is no reset in between.

This value has to be retained during PLC start/stop and PLC power off.

Status.Energy[x].EngyCountUoM

Name	Type	Comment
Status.Energy[x].EngyCountUoM	DINT	Unit of measure for the accumulating energy counter

The value defines the unit of measure for the accumulating energy counter. The DINT value of the tag is related to the unit in the corresponding ID list:

TIA@FuB UoM ID	TypeID	Symbol	Coversion Factor	Quantity	Description
1082	1, 2, 3	m^3	m^3	Volume	cubic metre
1084	1, 2, 3	l	10^{-3} m^3	Volume	Litre
1086	1, 2, 3	cm^3	10^{-6} m^3	Volume	cubic centimeter
1087	1, 2, 3	dm^3	10^{-3} m^3	Volume	cubic decimeter
1089	1, 2, 3	hl	10^{-1} m^3	Volume	Hectoliter
1104	1, 2, 3	in^3	16,387 064 x 10^{-6} m^3	Volume	cubic inch
1106	1, 2, 3	yd^3	0,764 555 m^3	Volume	cubic yard
1107	1, 2, 3	gal (UK)	4,546 092 x 10^{-3} m^3	Volume	gallon (UK)
1108	1, 2, 3	gal (US)	3,785 412 x 10^{-3} m^3	Volume	gallon (US)
1127	1, 2, 3	fl oz (US)	2,957 353 x 10^{-5} m^3	Volume	fluid ounce (US)
3002	5	kg	kg	Mass	Kilogram
3008	5	t	10^3 kg	Mass	tonne (metric ton)
3014	5	lb	0,453 592 37 kg	Mass	Pound
3320	4	J	J	work, energy, potential energy	Joule
3321	4	kJ	10^3 J	work, energy, potential energy	Kilojoule
3326	4	MJ	10^6 J	work, energy, potential energy	Megajoule
3330	4	W·h	3,6 x 10^3 J	work, energy, potential energy	watt hour
3331	4	MW·h	3,6 x 10^9 J	work, energy, potential energy	megawatt hour (1000 kW.h)
3332	4	kW·h	3,6 x 10^6 J	work, energy, potential energy	kilowatt hour

Status.Energy[x].CurCons

Name	Type	Comment
Status.Energy[x].CurCons	REAL	Value of the current consumption

The value contains the current consumption. Depending on the value of "Status.Energy[x].EngyCurConsUoM" the appropriate unit is either kW, m³/h, kg/h or l/h.

Status.Energy[x].EngyCurConsUoM

Name	Type	Comment
Status.Energy[x].EngyCurConsUoM	DINT	Unit of the measured consumption

The value represents the unit of the measured consumption of energy. It is a numerical representation of the unit given in the ID list:

TIA@FuB UoM ID	TypeID	Symbol	Coversion Factor	Quantity	Description
3362	5	kg/s	kg/s	mass flow rate	kilogram per second
3378	5	kg/d	$1{,}157\,41 \times 10^{-5}$ kg x s^{-1}	mass flow rate	kilogram per day
3381	5	kg/h	$2{,}777\,78 \times 10^{-4}$ kg x s^{-1}	mass flow rate	kilogram per hour
3384	5	kg/min	$1{,}666\,67 \times 10^{-2}$ kg x s^{-1}	mass flow rate	kilogram per minute
3401	5	ton (US) /h	2,519 958 x 10^{-1} kg/s	mass flow rate	ton (US) per hour
3402	5	lb/h	1,259 979 x 10^{-4} kg/s	mass flow rate	pound per hour
3420	5	t/d	1,157 41 x 10^{-2} kg/s	mass flow rate	tonne per day
3423	5	t/h	2,777 78 x 10^{-1} kg/s	mass flow rate	tonne per hour
3426	5	t/min	16,666 7 kg/s	mass flow rate	tonne per minute
3429	5	t/s	10^3 kg/s	mass flow rate	tonne per second
3438	5	klb/h	0,125 997 889 kg/s	mass flow rate	kilopound per hour
3444	1, 2, 3	m³/s	m³/s	volume flow rate	cubic metre per second
3445	1, 2, 3	m³/h	2,777 78 x 10^{-4} m³/s	volume flow rate	cubic metre per hour
3452	1, 2, 3	cm³/d	$1{,}157\,41 \times 10^{-11}$ m³ x s^{-1}	volume flow rate	cubic centimetre per day
3455	1, 2, 3	cm³/h	$2{,}777\,78 \times 10^{-10}$ m³ x s^{-1}	volume flow rate	cubic centimetre per hour
3464	1, 2, 3	m³/d	$1{,}157\,41 \times 10^{-5}$ m³ x s^{-1}	volume flow rate	cubic metre per day
3469	1, 2, 3	m³/min	$1{,}666\,67 \times 10^{-2}$ m³ x s^{-1}	volume flow rate	cubic metre per minute
3493	1, 2, 3	ft³/h	7,865 79 x 10^{-6} m³/s	volume flow rate	cubic foot per hour
3494	1, 2, 3	ft³/min	4,719 474 x 10^{-4} m³/s	volume flow rate	cubic foot per minute
3495	1, 2, 3	barrel (US)/min	2,649 79 x 10^{-3} m³/s	volume flow rate	barrel (US) per minute
5178	4	J/s	W	power (for direct current), active power	joule per second
5179	4	kW	10^3 W	power (for direct current), active power	kilowatt
5180	4	MW	10^6 W	power (for direct current), active power	megawatt
5183	4	mW	10^{-3} W	power (for direct current), active power	milliwatt

TIA@FuB UoM ID	TypeID	Symbol	Coversion Factor	Quantity	Description
5184	4	J/min	1,666 67 × 10^{-2} W	power (for direct current), active power	joule per minute
5185	4	J/h	2,777 78 × 10^{-4} W	power (for direct current), active power	joule per hour
5186	4	J/d	1,157 41 × 10^{-5} W	power (for direct current), active power	joule per day
5189	4	kJ/h	2,777 78 x 10^{-1} W	power (for direct current), active power	kilojoule per hour
5190	4	kJ/d	1,157 41 x 10^{-2} W	power (for direct current), active power	kilojoule per day

2.3.3 Energy Interface Add-on

Especially for S7 PLC the E2M add-on can be added. This add-on allows PLC with connected SENTRON, PAC or ET 200SP AI Energy Meter provides detailed information about electrical energy.

In order to use the standard E2M library within the PWA concept, the library from the topic Measuring and Visualizing Energy Data must be used.

2.4 PDI Para

The Para interface provides additional data for machine specific parameters. This information will be delivered as Boolean, Integer, Real or String values and contains typically process, order or reporting information.

All data exchanged with the PDI-Para between line HMI and the OEM PLC are tag based and can be polled by upper level systems at any time.

The information is communicated upwards from machine/production level to the PSS level. There is no data transfer from upper level PSS systems downward to the machine/production level. This information is used for:

- Operator information about machine values on line overview (HMI) screens, on line servers or on HMI clients in a control room.
- Machine values to store as Historical Information for trends, analyses, …

Implementation of the PDI Para is optional.

2.4.1 Interface description overview

The PDI Para structure type is designed for machine specific parameters.

Group	Name (Interface description)	Type	OMAC	Man-datory	Description
Status	Status.PDIVersion	String[10]	☐	☑	PDI version info. “PDI V2.0.0” fix for this implementation
Status	Status.ProjectVersion	String[10]	☐	☐	Project specific version
Status	Status.Parameter_DINT_Value[0..5]	DINT	☐	☐	Parameter value - Dint
Status	Status.Parameter_REAL_Value[0..5]	REAL	☐	☐	Parameter value - REAL
Status	Status.Parameter_BOOL_Value[0..4]	BOOL	☐	☐	Parameter value - BOOL
Status	Status.Parameter_STR_Value[0..1]	String[32]	☐	☐	Parameter value – String [32]

2.4.2 Interface description detailed information

Satus.PDIVersion

Name	Type	Comment
Status.PDIVersion	String[10]	Version of the used plant data interface

The parameter gives information about the version of the used plant data interface. For this implementation the string is fix: “PDI V2.0.0”.

Status.ProjectVersion

Name	Type	Comment
Status.ProjectVersion	String[10]	Project specific version description

This data point provides a project specific version description of the interface implementation. Regarding the content there are no specifications determined.

Status.Parameter_DINT_Value[x]

Name	Type	Comment
Status.Parameter_DINT_Value[x]	DINT	Machine specific information

The value contains machine specific information. Six tags are set up as placeholder for additional parameters of the data type DINT.

Status.Parameter_REAL_Value[x]

Name	Type	Comment
Status.Parameter_REAL_Value[x]	REAL	Machine specific information

The value contains machine specific information. Six tags are set up as placeholder for additional parameters of the data type REAL.

Status.Parameter_BOOL_Value[x]

Name	Type	Comment
Status.Parameter_BOOL_Value[x]	BOOL	Machine specific information

The value contains machine specific information. Five tags are set up as placeholder for additional parameters of the data type BOOL

Status.Parameter_STR_Value[x]

Name	Type	Comment
Status.Parameter_STR_Value[x]	String[32]	Additional textual information

The value gives additional textual information. Two tags are available as parameters of the data type STRING.

3 General PDI Information

3.1 Technical Implementation

All technical implementation templates are available for download. The templates are stored in different folders, one for each destination system.

Downloads regarding the PDI interface:

- STEP 7 Source files → for creating S7-3xx and S7-4xx data blocks
- TIA Portal Library → for creating S7-1x00 data blocks
- SIMOTION Source Files → for SIMOTION data blocks usable in SCOUT

Here you can download the files:
https://support.industry.siemens.com/cs/ww/en/view/86302104

3.1.1 STEP 7 (S7-300 / S7-400)

The source files (STL) are available as STEP 7 source files. The source files include Version 2.0 of the data block source in STL as well as an UDT as SCL source.

- DB_PDI_OMAC_BASIC_V2.awl - (contains the DB PDI Basic)
- DB_PDI_OMAC _LCU_V2.awl - (contains the DB PDI LCU)
- DB_PDI_OMAC _PEC_V2.awl - (contains the DB PDI PEC)
- DB_PDI_OMAC _PARA_V2.awl - (contains the DB PDI PARA)
- UDT_PDI_OMAC _BASIC_V2.scl - (contains the UDT PDI Basic)
- UDT_PDI_OMAC _LCU_V2.scl - (contains the UDT PDI LCU)
- UDT_PDI_OMAC _PEC_V2.scl - (contains UDT PDI PEC)
- UDT_PDI_OMAC _PARA_V2.scl - (contains UDT PDI PARA)

In order to use those files STEP 7 V5.5 SP4 is recommended.

3.1.2 TIA Portal (S7-300 / S7-400 / S7-1200 / S7-1500)

The zip-file “TIA_Portal_Library_OMAC_V2.zip” includes TIA Portal library “PDI_OMAC_V2.al13” containing the data blocks and UDTs for PDI Basic, PDI LCU, PDI PEC, PDI PARA.

A short step-by-step description is included that shows how to import the TIA Portal library PDI_OMAC_V2.al13.

In order to use these files TIA Portal Professional V13 SP1 is required.

3.1.3 SIMOTION SCOUT

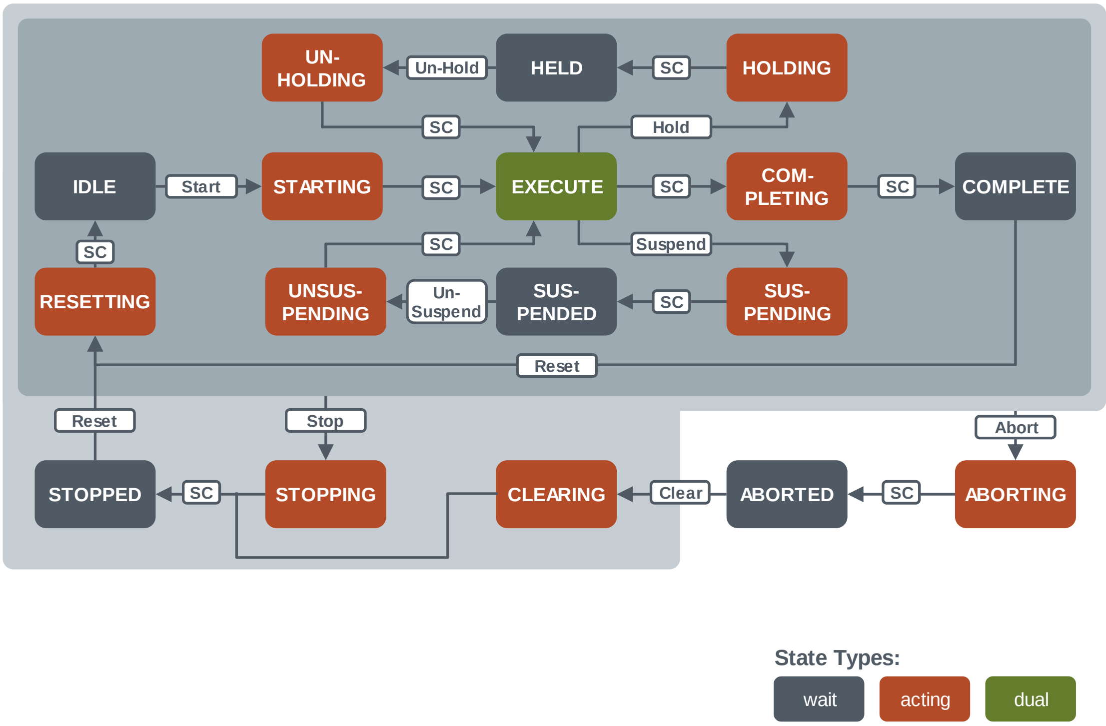
The SIMOTION PDI interfaces are available as xml files, which include the ST units with the data structures for PDI_BASIC, PDI_LCU, PDI_PEC and PDI_PARA. Depending on project requirements the corresponding PDI can be imported respectively.

In order to use this files SCOUT 4.4 or higher is required.

3.2 State description

For more details please see original source /2/ ISA-TR88.00.02.

The picture shows the complete state model with all 17 states:



STOPPED (State type: wait)

The machine is powered and stationary after completing the STOPPING state. All communications with other systems are functioning (if applicable). A reset command will cause an exit from STOPPED to the RESETTING state.

STARTING (State type: acting)

This state provides the steps needed to start the machine and is a result of a starting type command (local or remote). Following this command the machine will begin to Execute.

IDLE (State type: wait)

This is a state which indicates that RESETTING is complete. This state maintains the machine conditions which were achieved during the RESETTING state, and performs operations required when the machine is in IDLE.

SUSPENDING (State type: acting)

This state is a result of a change in monitored conditions due to process conditions or factors. The trigger event will cause a temporary suspension of the EXECUTE state. SUSPENDING is typically the result of starvation of upstream material in-feeds (i.e., container feed, beverage feed, crown feed, lubricant feed, etc.) that is outside the dynamic speed control range or a downstream outfeed blockage that prevents the machine from EXECUTING continued steady production. During the controlled sequence of SUSPENDING the machine will transition to a SUSPENDED state. The SUSPENDING state might be forced by the operator.

SUSPENDED (State type: wait)

The machine may be running at a relevant set point speed, but there is no product being produced while the machine is waiting for external process conditions to return to normal. When the

offending process conditions return to normal, the SUSPENDED state will transition to UNSUSPENDING and hence continue towards the normal EXECUTE state.

UNSUSPENDING (State type: acting)

This state is a result of a machine generated request from SUSPENDED state to go back to the EXECUTE state. The actions of this state may include ramping up speeds, turning on vacuums, and the re-engagement of clutches. This state is done prior to EXECUTE state, and prepares the machine for the EXECUTE state.

EXECUTE (State type: dual)

Once the machine is processing materials it is deemed to be executing or in the EXECUTE state. Different machine modes will result in specific types of EXECUTE activities. For example, if the machine is in the Production mode, the EXECUTE will result in products being produced, while in Clean Out mode the EXECUTE state refers to the action of cleaning the machine.

STOPPING (State type: acting)

This state executes the logic which brings the machine to a controlled stop as reflected by the STOPPED state. Normal STARTING of the machine cannot be initiated unless RESETTING had taken place.

ABORTING (State type: acting)

The ABORTED state can be entered at any time in response to the abort command or on the occurrence of a machine fault. The aborting logic will bring the machine to a rapid safe stop.

Operation of the emergency stop will cause the machine to be tripped by its safety system. It will also provide a signal to initiate the ABORTING State.

ABORTED (State type: wait)

This state maintains machine status information relevant to the Abort condition. The machine can only exit the ABORTED state after an explicit clear command, subsequently to manual intervention to correct and reset the detected machine faults.

HOLDING (State type: acting)

When the machine is in the EXECUTE state, the hold command can be used to start HOLDING logic which brings the machine to a controlled stop or to a state which represents HELD for the particular unit control mode. A machine can go into this state either when an internal equipment fault is automatically detected or by an operator command. The hold command offers the operator a safe way to intervene manually in the process and restarting execution when conditions are safe.

HELD (State type: wait)

The HELD state holds the machine's operation while material blockages are cleared, or to stop throughput while a downstream problem is resolved, or enable the safe correction of an equipment fault before the production may be resumed.

UNHOLDING (State type: acting)

The UNHOLDING state is a response to an Operator command to resume the EXECUTE state. Issuing the un-hold command will retrieve the saved set-points and return the status.

Conditions to prepare the machine to re-enter the normal EXECUTE state.

NOTE An operator UNHOLD command is always required and UNHOLDING can never be initiated automatically.

COMPLETING (State type: acting)

This state is an automatic response from the EXECUTE state. Normal operation has run to completion (i.e., processing of material at the infeed will stop).

COMPLETE (State type: wait)

The machine has finished the COMPLETING state and is now waiting for a reset command before transitioning to the RESETTING state.

RESETTING (State type: acting)

This state is the result of a RESET command from the STOPPED or complete state. RESETTING will typically cause a machine to sound a horn and place the machine in a state where components are energized awaiting a start command.

CLEARING (State type: acting)

Initiated by a state command to clear faults that may have occurred when ABORTING, and are present in the ABORTED state before proceeding to a STOPPED state.

3.3 Cross naming reference (system wide)

The following table shows the naming conventions in regards to the different standards and the implemented naming within the various components of the SIEMENS plant wide automation architecture.

The column “Name based on OMAC” gives the identifier as defined by the OMAC standard. To make comparison between the Weihenstephan Standards and the OMAC standard easier, the column “Name based on Weihenstephan” is provided as information. In all system packages needed for a plant wide automation where the implementation of both OMAC and Weihenstephan standards requires abstract naming conventions, neutral naming is useful. Therefore, the use of the abstract names as provided in column “Naming on WinCC” is highly recommended.

Name based on OMAC	Name based on Weihenstephan	Name in WinCC
Status.PDIVersion	SIE_Ver_Basic	PDI_Version
Status.ProjectVersion	SIE_Ver_Proj_Basic	Project_Version
Status.UnitModeCurrent	WS_Cur_Prog	Current_Mode
Status.StateCurrent	WS_Cur_State	Current_State
Status.MachSpeed	WS_Set_Mach_Spd	Setpoint_Speed
Status.CurMachSpeed	WS_Cur_Mach_Spd	Current_Speed
Status.EquipmentInterlock.Blocked	-	Equipment_Interlock_Blocked
Status.EquipmentInterlock.Starved	-	Equipment_Interlock_Starved
Status.Parameter0.Value	SIE_Mach_Cum_Time	Power_Up_Time
Status.Parameter1.Value	WS_Cons_Electricity	Consumed_Energy
Status.Parameter2.Value	WS_Prod_Ratio	Product_Ratio
Status.Parameter3.Value	SIE_Prod_Ratio_Typ	Product_Ratio_Type
Status.LightStack	SIE_Light_Stack	Light_Stack
Admin.ProdProcessedCount[0].Count	SIE_Tot_Packages	All_Processed_Counter_Resettable
Admin.ProdProcessedCount[0].AccCount	WS_Tot_Packages	All_Processed_Counter_Non_Resettable
Admin.ProdDefectiveCount[0].Count	SIE_Bad_Packages	Defect_Counter_Resettable
Admin.ProdDefectiveCount[0].AccCount	WS_Bad_Packages	Defect_Counter_Non_Resettable
Admin.MachDesignSpeed	WS_Mach_Design_Spd	Design_Speed
Admin.StopReason.ID	SIE_Not_Of_Fail_Group	First_Fault
Admin.StopReason.Value	WS_Not_Of_Fail_Code	OEM_First_Fault

Name based on OMAC	Name based on Weihenstephan	Name in WinCC
Command.UnitMode	SIE_Set_Cur_Prog	Set_Cur_Prog
Command.UnitModeChangeRequest	SIE_Prog_Change_Req	Prog_Change_Req
Command.MachSpeed	SIE_Cmd_Mach_Speed	Set_Mach_Speed
Command.CntrlCmd	SIE_Cntrl_Cmd	Cntrl_Cmd
Command.CmdChangeRequest	SIE_Cmd_Change_Req	Cmd_Change_Req
Command.Parameter0.Value	SIE_LCU_Cntrl_Active	LCU_Ctrl_Active
Status.PDIVersion	SIE_Ver_LCU	PDI_Version
Status.ProjectVersion	SIE_Ver_Proj_LCU	Project_Version
Status.StateRequested	SIE_State_Requested	State_Requested
Status.StateChangeInProcess	SIE_State_Change_Act	State_Change_Act
Status.Parameter4.Value	SIE_Buffer_Infeed	Buffer_Infeed
Status.Parameter5.Value	SIE_Buffer_Discharge	Buffer_Discharge
Status.Parameter6.Value	SIE_LCU_Allow_Cntrl	LCU_Allow_Cntrl
Status.PDIVersion	SIE_Ver_PEC	PDI_Version
Status.ProjectVersion	SIE_Ver_Proj_PEC	Project_Version
Status.Energy[0].TypeID	SIE_EngyTypeID_1	S_Energy[0]TypeID
Status.Energy[0].CurCons	SIE_EngyCurCons_1	S_Energy[0]CurCons
Status.Energy[0].EngyCurConsUoM	SIE_EngyCurConsUoM_1	S_Energy[0]CurConsUoM
Status.Energy[0].Count	SIE_EngyCount_1	S_Energy[0]Count
Status.Energy[0].EngyCountUoM	SIE_EngyCountUoM_1	S_Energy[0]CountUoM
Status.Energy[1].TypeID	SIE_EngyTypeID_2	S_Energy[1]TypeID
Status.Energy[1].CurCons	SIE_EngyCurCons_2	S_Energy[1]CurCons
Status.Energy[1].EngyCurConsUoM	SIE_EngyCurConsUoM_2	S_Energy[1]CurConsUoM
Status.Energy[1].Count	SIE_EngyCount_2	S_Energy[1]Count
Status.Energy[1].EngyCountUoM	SIE_EngyCountUoM_2	S_Energy[1]CountUoM
Status.Energy[2].TypeID	SIE_EngyTypeID_3	S_Energy[2]TypeID
Status.Energy[2].CurCons	SIE_EngyCurCons_3	S_Energy[2]CurCons
Status.Energy[2].EngyCurConsUoM	SIE_EngyCurConsUoM_3	S_Energy[2]CurConsUoM
Status.Energy[2].Count	SIE_EngyCount_3	S_Energy[2]Count
Status.Energy[2].EngyCountUoM	SIE_EngyCountUoM_3	S_Energy[2]CountUoM
Status.Energy[3].TypeID	SIE_EngyTypeID_4	S_Energy[3]TypeID
Status.Energy[3].CurCons	SIE_EngyCurCons_4	S_Energy[3]CurCons
Status.Energy[3].EngyCurConsUoM	SIE_EngyCurConsUoM_4	S_Energy[3]CurConsUoM
Status.Energy[3].Count	SIE_EngyCount_4	S_Energy[3]Count
Status.Energy[3].EngyCountUoM	SIE_EngyCountUoM_4	S_Energy[3]CountUoM
Status.Energy[4].TypeID	SIE_EngyTypeID_5	S_Energy[4]TypeID
Status.Energy[4].CurCons	SIE_EngyCurCons_5	S_Energy[4]CurCons
Status.Energy[4].EngyCurConsUoM	SIE_EngyCurConsUoM_5	S_Energy[4]CurConsUoM
Status.Energy[4].Count	SIE_EngyCount_5	S_Energy[4]Count
Status.Energy[4].EngyCountUoM	SIE_EngyCountUoM_5	S_Energy[4]CountUoM
Status.PDIVersion	SIE_Ver_Para	PDI_Version
Status.ProjectVersion	SIE_Ver_Proj_Para	Project_Version

Name based on OMAC	Name based on Weihenstephan	Name in WinCC
Status.Parameter_DINT_Value[0]	SIE_Para_UNSIGNED_1	Parameter_DINT[0]_Value
Status.Parameter_DINT_Value[1]	SIE_Para_UNSIGNED_2	Parameter_DINT[1]_Value
Status.Parameter_DINT_Value[2]	SIE_Para_UNSIGNED_3	Parameter_DINT[2]_Value
Status.Parameter_DINT_Value[3]	SIE_Para_UNSIGNED_4	Parameter_DINT[3]_Value
Status.Parameter_DINT_Value[4]	SIE_Para_UNSIGNED_5	Parameter_DINT[4]_Value
Status.Parameter_DINT_Value[5]	SIE_Para_UNSIGNED_6	Parameter_DINT[5]_Value
Status.Parameter_REAL_Value[0]	SIE_Para_REAL_1	Parameter_REAL[0]_Value
Status.Parameter_REAL_Value[1]	SIE_Para_REAL_2	Parameter_REAL[1]_Value
Status.Parameter_REAL_Value[2]	SIE_Para_REAL_3	Parameter_REAL[2]_Value
Status.Parameter_REAL_Value[3]	SIE_Para_REAL_4	Parameter_REAL[3]_Value
Status.Parameter_REAL_Value[4]	SIE_Para_REAL_5	Parameter_REAL[4]_Value
Status.Parameter_REAL_Value[5]	SIE_Para_REAL_6	Parameter_REAL[5]_Value
Status.Parameter_BOOL_Value[0]	-	Parameter_BOOL[0]_Value
Status.Parameter_BOOL_Value[1]	-	Parameter_BOOL[1]_Value
Status.Parameter_BOOL_Value[2]	-	Parameter_BOOL[2]_Value
Status.Parameter_BOOL_Value[3]	-	Parameter_BOOL[3]_Value
Status.Parameter_BOOL_Value[4]	-	Parameter_BOOL[4]_Value
Status.Parameter_STR_Value[0]	SIE_Para_STR_1	Parameter_STR[0]_Value
Status.Parameter_STR_Value[1]	SIE_Para_STR_2	Parameter_STR[1]_Value

4 Abbreviations

Abbr.	Description
E2M	Energy to Monitor
F&B	Food and Beverage
HMI	Human Machine Interface
IF	Interface
KPI	Key Performance Indicator
LCU	Line Control Unit
LM	Line Monitoring
MES	Manufacturing Execution System
MOM	Manufacturing Operation Management
MTBF	Mean time between failures
MTTR	Mean time to repair
OEE	Overall Equipment Effectiveness
OEM	Original Equipment Manufacturer
OMAC	Organization for Machine Automation and Control
PARA	Parameters
PDA	Plant Data Acquisition
PDI	Plant Data Interface
PEC	Plant Energy Concept
PLC	Programmable Logic Controller
PSS	Plant Supervisory System
PWA	Plant Wide Automation
RCA	Root Cause Analysis
SCADA	Supervisory Control and Data Acquisition
TIA	Total Integrated Automation
UoM	Unit of Measurement

5 Related literature

	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Download page of this entry https://support.industry.siemens.com/cs/ww/en/view/86302104
\3\	Line Integration at the Food & Beverage Industry (Overview) https://support.industry.siemens.com/cs/ww/en/view/109483779
\4\	OMAC – The Organization for Machine Automation and Control http://omac.org/workgroups/packaging-workgroup/
\5\	Weihenstephan Standards for Production Data Acquisition http://www.weihenstephaner-standards.de/index.php?id=5&L=1 WS Pack specification of the interface content (Part 2) Version 8.
\6\	ANSI/ISA-TR88.00.02-2015 https://www.isa.org/ A Technical Report prepared by ISA and registered with ANSI Machine and Unit States: An implementation example of ANSI/ISA-88.00.01 Approved 26 October 2015
\7\	Measuring and Visualizing Energy Data https://support.industry.siemens.com/cs/ww/en/view/86299299

6 History

Version			Date	Changes
V1.0			10/2013	First issue
V1.1			12/2013	Error correction
V1.2			10/2014	Add PEC interface
V2.0			05/2016	Adapt to current standards Add PARA interface