Technical Delivery Specification

MC01 – Machine Connectivity

This document describes the requirements for the delivery and documentation of systems.

Revision status:

This technical delivery specification, „MC01 – Machine Connectivity" replaces all previous specifications.

Version:	Site/s:	Description of the revision:	Datum:
V 1.0	all	Creation of the Document	27.05.2021
V 1.1	7,8,9	Changes of the Specification	15.06.2022
V1.2	all	Clarifications and Corrections	19.10.2022

Responsible:	Hirschmann Automotive
Department:	P_GP; P_MA; IT_DI

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List of Abbreviations

Abbreviation	Definition
HA	Hirschmann Automotive
ME	Manufacturing Execution
MES	Manufacturing Execution System
MII	Manufacturing Integration and Intelligence
NTP	Network Time Protocol
PCo	Plant Connectivity
TDS	Technical Delivery Specification

1 General

1.1 Area of Application

This technical delivery specification (TDS) defines the standards for the connectivity of machines, systems, and production facilities of Hirschmann Automotive (HA).

1.2 Deviations

Any deviations from this TDS require communication with and written approval from HA. In case of ambiguity or if specifications are unclear, please contact HA.

1.3 Regulations, Norms, and Industry Standards

The contractor is fully responsible for adhering to and fulfilling any requirements resulting from applicable regulations, norms, and industry standards, even if not explicitly stated in this TDS.

Any specifications referenced in this TDS should be checked by the contractor against the most current regulations, norms, and industry standards.

Suppose the contractor identifies any problems arising from the specifications in this TDS that would render the services provided by the contractor partially or completely unsuitable for the intended purpose. In that case, the contractor has to inform HA about this immediately.
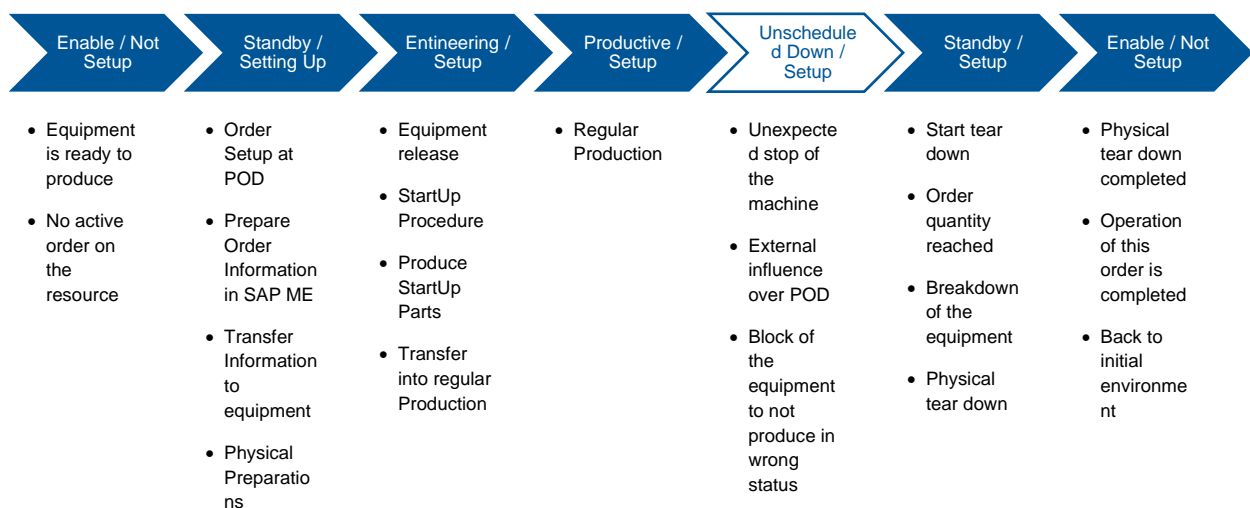
2 Overview Hirschmann Automotive ME-System

2.1 General

HA uses SAP ME (and additional SAP software (SAP MII, SAP PCo, etc.) as its manufacturing execution system solution. This system handles production operations, provides (limited) remote machine control, and collects machine/order status information.

2.2 Production Phases

Production operations run in distinct phases. These different phases are defined as follows:

Enable / Not Setup	Standby / Setting Up	Entineering / Setup	Productive / Setup	Unscheduled Down / Setup	Standby / Setup	Enable / Not Setup
• Equipment is ready to produce • No active order on the resource	• Order Setup at POD • Prepare Order Information in SAP ME • Transfer Information to equipment • Physical Preparations	• Equipment release • StartUp Procedure • Produce StartUp Parts • Transfer into regular Production	• Regular Production	• Unexpected stop of the machine • External influence over POD • Block of the equipment to not produce in wrong status	• Start tear down • Order quantity reached • Breakdown of the equipment • Physical tear down	• Physical tear down completed • Operation of this order is completed • Back to initial environment

3 Connectivity Standards

3.1 General

HA uses the Open Platform Communications Unified Architecture (OPC UA) as a standard for shopfloor connectivity. This industry standard ensures secure communication between machines and upper-layer systems and specifies the transport of data, security mechanisms, and semantic structures.

In the non-fulfillment of this standard, the contractor must inform HA about this fact and declare available communication standards for machine connectivity and data exchange.

3.2 Protocols

The primary connection between the machine and MES is made via SAP PCo over a TCP/IP.

3.3 OPC UA Server

The OPC UA server can be operated natively on the controller or by using additional software or hardware.

3.4 OPC UA Security

Unsecured connections are not permissible. The minimum required security for any connection is an authorization with username and password. The use of certificates is strongly advised.

3.5 OPC UA Server Profile

The OPC UA server requires profiles, which can be found in the OPC UA specifications.
In general, the server profiles are to be designed so that the requirements demanded by the client can be fulfilled.

3.6 OPC UA Connections

The OPC UA server should be set up to make multi-client sessions possible.
There will be a maximum of 5 connections at the same time. However, you should leave some leeway in case additional client connections need to be made later.

3.7 Tags

Tags are defined as data points in an OPC UA server structure, which contains data from the source system and can be identified by a unique ID. Usually, the tags define the lowest level of the complete source system structure hierarchy.

Examples:

- MachineTotalHours

- MachineLastCycletime

- MachineAirVolume

- …

The tags can change their values over a setup process or display a reaction to the machine's behavior.

3.8 Methods

Methods are used to trigger certain events or behaviors within a machine. If methods are unavailable, the contractor must communicate this to HA. In this case, an analog using data structures and handshakes must be implemented to approximate the functionality of the methods.

The following methods should be made available:

- EnableAutomaticRun (no input, method call result as output)
  - Unlocks machine for production

- DisableAutomaticRun (no input, method call result as output)
  - Locks machine for production
  - Stops machine if already productive

- PreLoadNextShopOrder (order data as input, method call result as output)
  - Preloads next order
  - Examples of order data
    - ShopOrderNumber
    - ShopOrderArticle
    - ShopOrderTarget
    - ShopOrderBatchSize
    - …

- ActivateNextShopOrder (no input, method call result as output)

- o Activates next order (if the following order was preloaded)
- DeleteActiveOrder (no input, method call result as output)
  - o Deletes the currently active order

3.9 Network Time Protocol

The network time protocol (NTP) is used to set, control and monitor the time and date settings of the assets in HA. If NTP is unavailable, the contractor has to communicate this to HA and provide an alternative method for time synchronization (for instance, via an OPC UA method).

3.10 Network Interface

The contractor has to ensure that any machine that is to be connected to the MES should have at least one free RJ45 for this purpose. If more than one machine operates as an integrated system, each machine should have its own free RJ45 port.

3.11 Data Loss

The interface must be protected against data loss. In case of power loss, no data may be lost. In case of connection loss with the MES, the machine should be able to produce without a connection for at least as long as its autonomy time (time it takes to empty raw material bunkers). If the contractor cannot provide this data buffer, this has to be communicated to HA.

3.12 Translation Table

The contractor must provide a translation table that contains an overview of all the data points and methods available in the machine interface, including a description of their content and/or functionality. The translation table must always contain English and the equipment's national language at the operation site.

3.13 Structure and Design

The contractor is responsible for the general structure and the OPC UA Server's design.

The use of CamelCase is recommended. Spaces and signs should be avoided if at all possible.

Ideally, the adjacent parameters should be grouped into structures (folders).

4 Connectivity Levels

The general machine connectivity standards of HA are defined based on the technology used, the machine type, or the requirements of our customers.

4.1 Machine Data

Here we list the data associated with machine status.
We still distinguish between retrofitting existing machines (RF) and new equipment (NE). Therefore, the respective tags are marked below.

If the use of the OPC Alarms and Conditions system is possible, this should be implemented instead of warning/error tags.

Name	Read/Write	Type	Description	Usage
MachineTimestamp	R	Tag	Asset time	RF / NE
MachineNumber	R	Tag	Asset Serial Number	RF / NE
MachineMACAddress	R	Tag	Asset MAC Address	RF / NE
MachineOperationMode	R	Tag	Asset operation mode (Productive, Warning, Error, …)	RF / NE
MachineLampGreen	R	Tag	Signal lamp green	RF / NE
MachineLampYellow	R	Tag	Signal lamp yellow	RF / NE
MachineLampRed	R	Tag	Signal lamp red	RF / NE
MachineTotalPartsOK	R	Tag	Total produced OK parts of lifetime	RF / NE
MachineTotalPartsNOK	R	Tag	Total produced NOK parts of lifetime	RF / NE
MachineTotalParts	R	Tag	Total produced parts of lifetime	RF / NE
MachineTotalHours	R	Tag	Total hours of lifetime	RF / NE
MachineSoftwareVersion	R	Tag	Actual installed software version on the asset.	NE
MachineActiveUserLevel	R	Tag	Logged user at the asset. (Service, Admin, etc.)	NE
MachineLastCycleTime	R	Tag	Last operation/cycle duration	NE
MachineWarningID	R	Tag	Unique WarningID	NE
MachineWarningDescription	R	Tag	Warning Description	NE
MachineErrorID	R	Tag	Unique ErrorID	NE
MachineErrorDescription	R	Tag	Error Description	NE
DisableAutomaticRun	R/W	Method	Set the Tag AutomaticRunEnabled to FALSE	NE
EnableAutomaticRun	R/W	Method	Set the Tag AutomaticRunEnabled to TRUE	NE

[1] If the machine is offline due to being non-required, it should not impact the Key Figures (OEE, …)
[2] If the tags marked with "NE" can be implemented without hardware changes, they must also be implemented.

4.2 Order Data

The order parameters as described below are written to the system from the higher-level system and read out again.

In order to maintain flexibility, it must be possible to fill or activate the parameters/tags directly on the HMI. (Autonomous operation possible)

Name	Read/Write	Type	Description	Usage [1]
ShopOrderStatus	R	Tag	Actual Shop Order is Active, Interrupted, Finished	RF / NE
ShopOrderNumber	R/W	Tag	Number of the actual active Shop Order	RF / NE
ShopOrderArticle	R/W	Tag	Article number of the actual active Shop Order	RF / NE
ShopOrderTarget	R/W	Tag	Target Quantity from the Shop Order	RF / NE
ShopOrderBatchSize	R/W	Tag	Packing size from the Shop Order	RF / NE
ShopOrderPartsOK	R/W	Tag	Produced OK parts from the Actual Shop Order.	RF / NE
ShopOrderPartsNOK	R/W	Tag	Produced NOK parts from the Actual Shop Order.	RF / NE
ShopOrderPartsTotal	R/W	Tag	Produced Total parts from the Actual Shop Order.	RF / NE
AutomaticRunEnabled	R	Tag	See if the automatic run is enabled or disabled	RF / NE

[1] RF -> retrofit; NE -> new equipment

4.3 Part Data

Machine parameters, production process parameters, and test results, e.g., must be able to be matched to the respective individual part or component (SFC).

For this purpose, the component must be provided with a unique sequential number (SFC/supplier coding/ID).

The critical characteristics and production process parameters must be worked out together with the customer.

Name	Read/Write	Type	Description	Usage [1]
PartSerialnumberStartValue	R/W	Tag	Start value for the actual shop order	RF / NE
PartSerialnumber	R	Tag	Part_SerialnumberStartValue + n	RF / NE
PartParameterXX	R	Tag	Productionprocessparameter (Length, force, color, …) - every process parameter	RF / NE
PartResult	R	Tag	e.g., a test result of a camera system (OK/NOK)	RF / NE
PartErrorCode	R	Tag	Error code of the part	RF / NE

[1] RF -> retrofit; NE -> new equipment

The system must be individually checked and specified for necessary process and test parameters.

Regardless of appearance, all machine and production process parameters (e.g., OK / NOK, measured value, RAL value, ...) must be clearly assigned to the manufactured component.

Data storage must be ensured for the defined autonomy time on the system.

5 Core Technologies / Technology Package

5.1 High Speed Assembly

The systems must be designed to provide station-related analysis and evaluation via the interface.

Name	Read/Write	Type	Description	Usage [1]
Station[x]TotalPartsOK	R	Tag	Total OKParts of station [x]	RF / NE
Station[x]TotalPartsNOK	R	Tag	Total NOKParts of station [x]	RF / NE
Station[x]TotalParts	R	Tag	Total produced parts of the station [x]	RF / NE
Station[x]ShopOrderPartsOK	R	Tag	ShopOrder OKParts of station [x]	RF / NE
Station[x]ShopOrderPartsNOK	R	Tag	ShopOrder NOKParts of station [x]	RF / NE
Station[x]ShopOrderParts	R	Tag	ShopOrder produced Parts of the station [x]	RF / NE
Station[x]ShopOrderMaterial	R/W	Tag	The material which is used at this station	NE
ShopOrderStation [x] Active	R	Tag	Is station [x] active or not	RF / NE

[1] RF -> retrofit; NE -> new equipment
[2] Is present in MC Level 2 and is only integrated in combination with MC Level 1.

Required afford must be checked (System: ECC, Master data, and useability by the equipment).