European Plastics and Rubber Machinery

EUROMAP 82.1	OPC UA interfaces for plastics and rubber machinery – Peripheral devices – Part 1: Temperature control devices

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Foreword

This specification was created by a joint working group of the OPC Foundation and EUROMAP. It is adopted identically as VDMA Specification.

Amendments

The previous edition of this document is EUROMAP 82.1:2019 (Release 1.00) which has been adopted as VDMA Specification VDMA 40082-1:2019-11 without any modification. It has not been released under the OPC Foundation, because the joint working group was established afterwards.

This document differs from the previus version as follows:

a) The namespace has been changed to http://opcfoundation.org/UA/PlasticsRubber/TCD/.

b) URIs for Profiles have been added.

c) It has been adopted to the template for Companion Specifications of the OPC Foundation.

d) Errors is the NodeSet-file have been corrected.

Previous editions

EUROMAP 82.1, version 1.00 = VDMA 40082-1:2019-11

EUROMAP

EUROMAP is the European umbrella association of the plastics and rubber machinery industry which accounts for annual sales of around 13.5 billion euro and a 40 per cent share of worldwide production. Almost 75 per cent of its European output is shipped to worldwide destinations. With global exports of 10.0 billion euro, EUROMAP's around 1,000 machinery manufacturers are market leaders with nearly half of all machines sold being supplied by EUROMAP members.

EUROMAP provides technical recommendations for plastics and rubber machines. In addition to standards for machine descriptions, dimensions and energy measurement, interfaces between machines feature prominently. The provision of manufacturer independent interfaces ensures high levels of machine compatibility.

OPC Foundation

OPC is the interoperability standard for the secure and reliable exchange of data and information in the industrial automation space and in other industries. It is platform independent and ensures the seamless flow of information among devices from multiple vendors. The OPC Foundation is responsible for the development and maintenance of this standard.

OPC UA is a platform independent service-oriented architecture that integrates all the functionality of the individual OPC Classic specifications into one extensible framework. This multi-layered approach accomplishes the original design specification goals of:

– Platform independence: from an embedded microcontroller to cloud-based infrastructure

– Secure: encryption, authentication, authorization and auditing

– Extensible: ability to add new features including transports without affecting existing applications

– Comprehensive information modelling capabilities: for defining any model from simple to complex

1 Scope

OPC 40082-1 describes the interface for temperature control devices (TCD) for data exchange via OPC UA. The target of OPC 40082-1 is to provide a standardized interface for TCD from different manufacturers to ensure compatibility.

The following functionalities are covered:

– General information about the temperature control device

– Status information

– Process data

Safety related signals like emergency stop are not included.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

OPC 10000-1, *OPC Unified Architecture - Part 1: Overview and Concepts*
http://www.opcfoundation.org/UA/Part1/

OPC 10000-2, *OPC Unified Architecture - Part 2: Security Model*
http://www.opcfoundation.org/UA/Part2/

OPC 10000-3, *OPC Unified Architecture - Part 3: Address Space Model*
http://www.opcfoundation.org/UA/Part3/

OPC 10000-4, *OPC Unified Architecture - Part 4: Services*
http://www.opcfoundation.org/UA/Part4/

OPC 10000-5, *OPC Unified Architecture - Part 5: Information Model*
http://www.opcfoundation.org/UA/Part5/

OPC 10000-6, *OPC Unified Architecture - Part 6: Mappings*
http://www.opcfoundation.org/UA/Part6/

OPC 10000-7, *OPC Unified Architecture - Part 7: Profiles*
http://www.opcfoundation.org/UA/Part7/

OPC 10000-8, *OPC Unified Architecture - Part 8: Data Access*
http://www.opcfoundation.org/UA/Part8/

OPC 10000-9, *OPC Unified Architecture - Part 9: Alarms and Conditions*
http://www.opcfoundation.org/UA/Part9/

OPC 10000-11, *OPC Unified Architecture - Part 11: Historical Access*
http://www.opcfoundation.org/UA/Part11/

OPC 10001-1, *OPC Unified Architecture V1.04 - Amendment 1: AnalogItem Types*
http://www.opcfoundation.org/UA/Amendment1/

OPC 10001-3, *OPC Unified Architecture V1.04 - Amendment 3: Method Metadata*
http://www.opcfoundation.org/UA/Amendment3/

OPC 10000-100, *OPC Unified Architecture - Part 100: Devices*
http://www.opcfoundation.org/UA/Part100/

OPC 40083: OPC UA interfaces for plastics and rubber machinery – General Type definitions (version 1.02)
http://www.opcfoundation.org/UA/PlasticsRubber/GeneralTypes

3 Terms, definitions and conventions

3.1 Overview

It is assumed that basic concepts of OPC UA information modelling are understood in this specification. This specification will use these concepts to describe the OPC 40082-1 Information Model. For the purposes of this document, the terms and definitions given in the documents referenced in Clause 2 apply.

Note that OPC UA terms and terms defined in this specification are *italicized* in the specification.

3.2 Conventions used in this document

The conventions described in OPC 40083 apply.

3.3 Abbreviations

TCD temperature control device

4 General information to OPC UA interfaces for plastics and rubber machinery and OPC UA

For general information on OPC UA interfaces for plastics and rubber machinery and OPC UA see OPC 40083.

5 Use cases

OPC 40082-1 covers the following functionalities:

– General information about the temperature control device
– Status information
– Process data

6 TCD_InterfaceType

6.1 TCD_InterfaceType Definition

This OPC UA *ObjectType* is used for the root *Object* representing a TCD with its subcomponents. It is formally defined in Table 1.

NOTE: To promote interoperability of *Client*s and *Server*s, all instantiated *Devices* shall be aggregated in an *Object* called “DeviceSet” (see OPC UA for Devices)

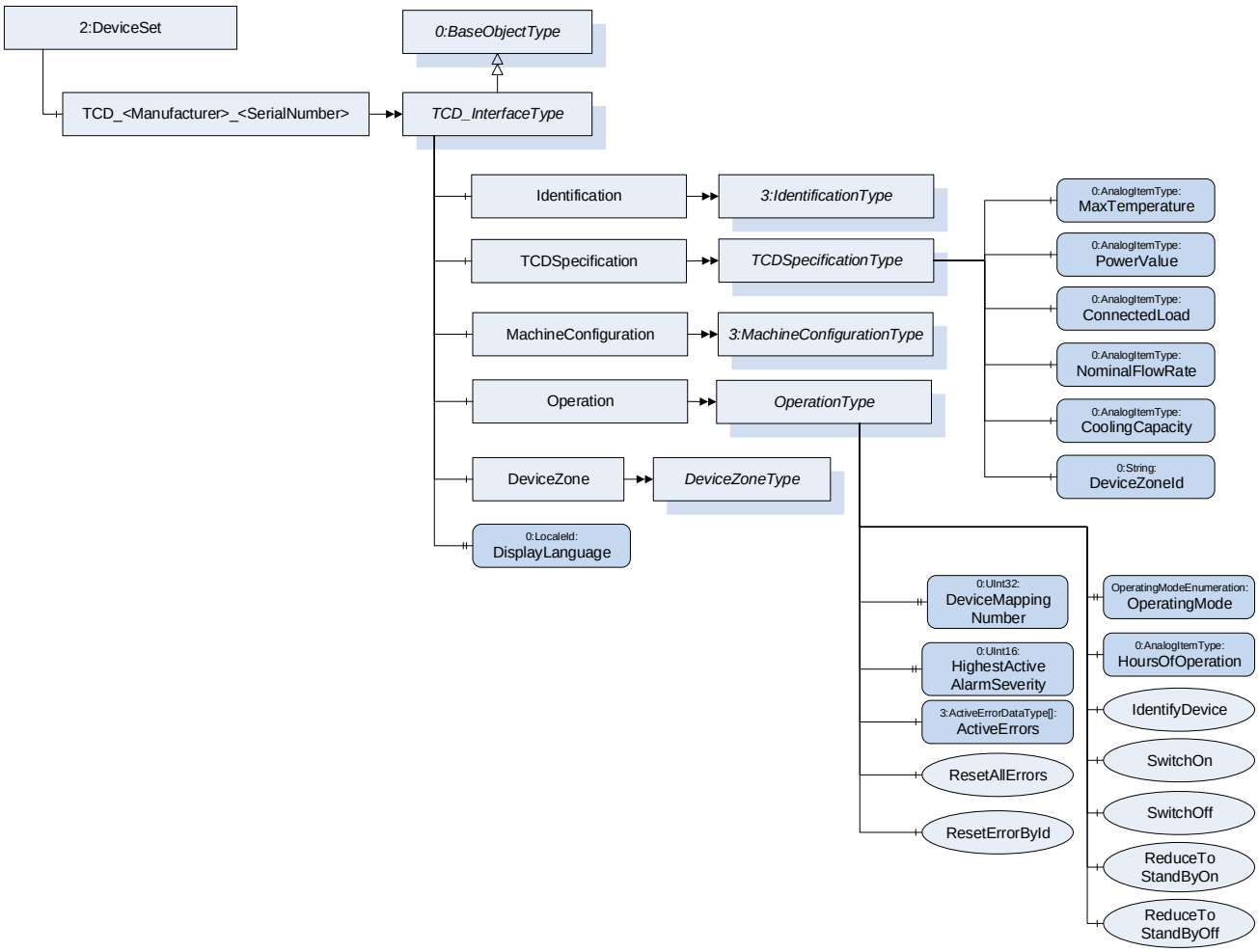

Figure 1 – TCD_InterfaceType Overview

Table 1 – TCD_InterfaceType Definition

Attribute	**Value**				
BrowseName	TCD_InterfaceType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasComponent	Object	Identification		3:IdentificationType	M
0:HasComponent	Object	TCDSpecification		TCDSpecificationType	M
0:HasComponent	Object	MachineConfiguration		3:MachineConfigurationType	M
0:HasComponent	Object	Operation		OperationType	M
0:HasComponent	Object	DeviceZone		DeviceZoneType	M
0:HasProperty	Variable	DisplayLanguage	0:LocaleId	0:PropertyType	O, RW
0:GeneratesEvent	ObjectType	TCDHelpOffNormalAlarmType			

The *BrowseName* of the object instance shall be "TCD_<Manufacturer>_<SerialNumber>"

Example: "TCD_HB-Therm_0123456".

Some TCD have several device zones (see 0). For these, the OPC UA server needs to create several instances of the TCD_InterfaceType. As the TCD has only one serial number, the BrowseNames of the objects shall include an extension e.g. “TCD_Wittmann_634_a” and “TCD_Wittmann_634_b”.

NOTE: The namespace of this *BrowseName* is the local server URI with namespace index 1 or a vendor specific namespace with server specific namespace index (see Table 28). The *BrowseNames* of the nodes below are in the namespace of the specification where used Type is defined.

Examples:

BrowseName	Namespace	Namespace index	Remarks
TCD_HB-Therm_0123456	Local Server URI or vendor specific namespace	1 or server specific	OPC 40082-1 only defines the *TCD_InterfaceType*. The instance is generated in the local server
↓			
Identification	http://opcfoundation.org/UA/PlasticsRubber/TCD/	server specific	The object *Identification* is a child of *TCD_InterfaceType* which is defined in OPC 40082-1
↓			
Manufacturer	http://opcfoundation.org/UA/PlasticsRubber/GenrealTypes/	server specific	The variable *Manufacturer* is a child of *IdentificationType* which is defined in OPC 40083.

BrowseName	Namespace	Namespace index	Remarks
TCD_HB-Therm_0123456	Local Server URI or vendor specific namespace	1 or server specific	OPC 40082-1 only defines the *TCD_InterfaceType*. The instance is generated in the local server
↓			
DeviceZone	http://opcfoundation.org/UA/PlasticsRubber/TCD/	server specific	The object *DeviceZone* is a child of *TCD_InterfaceType* which is defined in OPC 40082-1
↓			
ExternalChannels	http://opcfoundation.org/UA/PlasticsRubber/TCD/	server specific	The object *ExternalChannels* is a child *DeviceZoneType* which is defined in OPC 40082-1
↓			
ExternalChannel_1	Local Server URI or vendor specific namespace	1 or server specific	The objects for the extern channels are modelled as *OptionalPlaceholder*. The instances are server specific
↓			
PressureDifference	http://opcfoundation.org/UA/PlasticsRubber/TCD/	server specific	The object *PressureDifference* is a child *ExternalChannelType* which is defined in OPC 40082-1
↓			
ActualValue	http://opcfoundation.org/UA/PlasticsRubber/GenrealTypes/	server specific	The variable *ActualValue* is a child of *PressureDifference* which has the *MontoredItemType* as type definition which is defined in OPC 40083

BrowseName	Namespace	Namespace index	Remarks
TCD_HB-Therm_0123456	Local Server URI or vendor specific namespace	1 or server specific	OPC 40082-1 only defines the *TCD_InterfaceType*. The instance is generated in the local server
↓			
DeviceZone	http://opcfoundation.org/UA/PlasticsRubber/TCD/	server specific	The object *DeviceZone* is a child of *TCD_InterfaceType* which is defined in OPC 40082-1
↓			
ExternalChannels	http://opcfoundation.org/UA/PlasticsRubber/TCD/	server specific	The object *ExternalChannels* is a child *DeviceZoneType* which is defined in OPC 40082-1
↓			
NodeVersion	http://opcfoundation.org/UA/	0	The Property *NodeVersion* is defined in OPC UA

6.2 DisplayLanguage

With the *DisplayLanguage Property* the client can set the desired language on the user interface at the TCD. If the peripheral device does not support the configured language, it can keep the previous setting or use English as the default.

7 Identification

The *IdentificationType* for the identification of the device is defined in OPC 40083. All mandatory nodes shall be filled with valid values from the server.

The *DeviceClass Property* in the *Identification Object* shall have the value "Temperature Control Device".

8 TCDSpecificationType

This OPC UA *ObjectType* is used representing the basic specification of a TCD temperature control device with its subcomponents. It is formally defined in Table 2.

Table 2 – TCDSpecificationType Definition

Attribute	**Value**				
BrowseName	TCDSpecificationType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasComponent	Variable	MaxTemperature	0:Int32	0:AnalogItemType	M, RO
0:HasComponent	Variable	PowerValue	0:Double	0:AnalogItemType	M, RO
0:HasComponent	Variable	ConnectedLoad	0:Double	0:AnalogItemType	M, RO
0:HasComponent	Variable	NominalFlowRate	0:Double	0:AnalogItemType	M, RO
0:HasComponent	Variable	CoolingCapacity	0:UInt32	0:AnalogItemType	O, RO
0:HasProperty	Variable	DeviceZoneId	0:String	0:PropertyType	O, RO

8.1 MaxTemperature

Description: Defines the maximum working temperature of the TCD

Unit: °C or °F

Example: 160

8.2 PowerValue

Description: Power value, defines the heating capacity of the TCD with the rated voltage

Unit: kW

Example: 8

8.3 ConnectedLoad

Description: Connected load, defines the connections of the TCD (pump performance, heating capacity and performance of the remaining components)

Unit: kW

Example: 10.2

8.4 NominalFlowRate

Description: Nominal flow rate, defines the maximum achievable flow rate of the TCD

Unit: l/min, gal/min or ft^3/min

Example: 45

8.5 CoolingCapacity

Description: Power value for cooling, defines the power value for cooling at temperature difference 60 K between cooling water and heat transfer medium

Unit: kW

Example: 30

8.6 DeviceZoneId

Description: As written in 4.1, for a TCD with several device zones, there shall be several instances of *TCD_InterfaceType* with one object *DeviceZone* each. In this case, the *DeviceZoneId* shall be used to identify the different device zones.

Example: “A”

9 OperationType

This *ObjectType* contains components which are necessary to operate the TCD. It is formally defined in Table 3.

Table 3 – OperationType Definition

Attribute	**Value**				
BrowseName	OperationType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasProperty	Variable	DeviceMappingNumber	0:UInt32	0:PropertyType	M, RW
0:HasProperty	Variable	HighestActiveAlarmSeverity	0:UInt16	0:PropertyType	M, R
0:HasComponent	Variable	ActiveErrors	3:ActiveErrorData Type[]	0:BaseDataVariableType	M, R
0:HasComponent	Method	ResetAllErrors			O
0:HasComponent	Method	ResetErrorById			O
0:HasProperty	Variable	OperatingMode	OperatingMode Enumeration	0:PropertyType	M, RO
0:HasComponent	Variable	HoursOfOperation	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Method	IdentifyDevice			O
0:HasComponent	Method	SwitchOn			M
0:HasComponent	Method	SwitchOff			M
0:HasComponent	Method	ReduceToStandByOn			O
0:HasComponent	Method	ReduceToStandByOff			O

9.1 DeviceMappingNumber

Description: Unique identifier/address/number for devices of the same *DeviceType* within a local network. Several peripheral devices of the same *DeviceType* can be connected to a machine. In most applications, the machine must map the connected peripheral devices to internal logical devices and zones in a fixed configuration (e.g. hot runner systems according to the wiring or temperature control devices according to the tubing).
The mapping shall be stable after reconnecting the devices and is therefore not possible via IP addresses, which can be assigned dynamically via DHCP. *DeviceMappingNumber* sets the mapping order of peripheral devices of the same type on the local network and is therefore of type *UInt32*.

Example: 1

9.2 HighestActiveAlarmSeverity

Description: Indication of the severity of the highest active alarm (0 = no active alarm – 1000 = possible error). Together with *ActiveErrors*, it provides a minimal error handling for devices without alarm support. However, the variable shall be filled even if alarms are supported.

Example: 400

9.3 ActiveErrors

Description: List of the active errors of the device. It provides a minimal error handling for devices without alarm support. However, the variable shall be filled even if alarms are supported. The *ActiveErrorDataType* is defined in OPC 40083. If there is no active error, the array is empty.

9.4 ResetAllErrors

Description: Method to reset all errors of the device.

Signature

```
ResetAllErrors();
```

9.5 ResetErrorById

Description: Method to reset one error of the device.

Signature

```
ResetErrorById(
   [in]    String           Id);
```

Table 4 –ResetErrorById Method Arguments

Argument	Description
Id	Id of the error, listed in *ActiveErrors*, that shall be reset.

Table 5 – ResetErrorById Method AddressSpace Definition

Attribute	Value				
BrowseName	ResetErrorById				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Modelling Rule**
HasProperty	Variable	InputArguments	Argument[]	PropertyType	Mandatory

9.6 OperatingMode

Description: Actual operating mode of the TCD.

Table 6 – OperatingModeEnumeration Values

Name	Value	Description
OTHER	0	Operating mode of the TCD is unknown
READY_TO_OPERATE	1	TCD is ready to operate (heating, pump and cooling are switched off)
NORMAL_OPERATION	2	TCD is running in normal operating mode
LEAK_STOPPER	3	TCD is running in leak stopper operating mode
MOULD_EVACUATION	4	TCD is carrying out a mould evacuation process
PRESSURE_RELIEF	5	TCD is carrying out a pressure relief process
COOLING	6	TCD is cooling down to *StandbyTemperature* and switch off
SAFETY_COOLING	7	TCD is cooling down to *SwitchingOffTemperature* and switch off
ECO	8	TCD is running in Eco operating mode (energy is saved via the reduced pump speed)
BOOST	9	TCD is running in Boost operating mode (pump runs at maximum possible speed)

9.7 HoursOfOperation

Description: Actual hours of operation

Unit: h

Example: 4586

9.8 IdentifyDevice

Description: The TCD on which this method is called shows itself by e.g. activation of a LED.

Signature

```
IdentifyDevice ();
```

9.9 SwitchOn

Description: Main switch method of the TCD for switching on. OperatingMode shows the actual state of the device.

Signature

```
SwitchOn ();
```

9.10 SwitchOff

Description: Main switch method of the TCD for switching off. OperatingMode shows the actual state of the device.

Signature

```
SwitchOff ();
```

9.11 ReduceToStandByOn

Description: Activate the cooling down function on the TCD followed by switching off. OperatingMode shows the actual state of the device during the cooling down process.

Signature

```
ReduceToStandByOn ();
```

9.12 ReduceToStandByOff

Description: Deactivate the cooling down function on the TCD. If it is already in progress, it will be interrupted and the device changes back to the last selected operating mode.

Signature

```
ReduceToStandByOff ();
```

10 DeviceZoneType

The *DeviceZoneType* represents the functional main component of a TCD and is therefore mandatory.

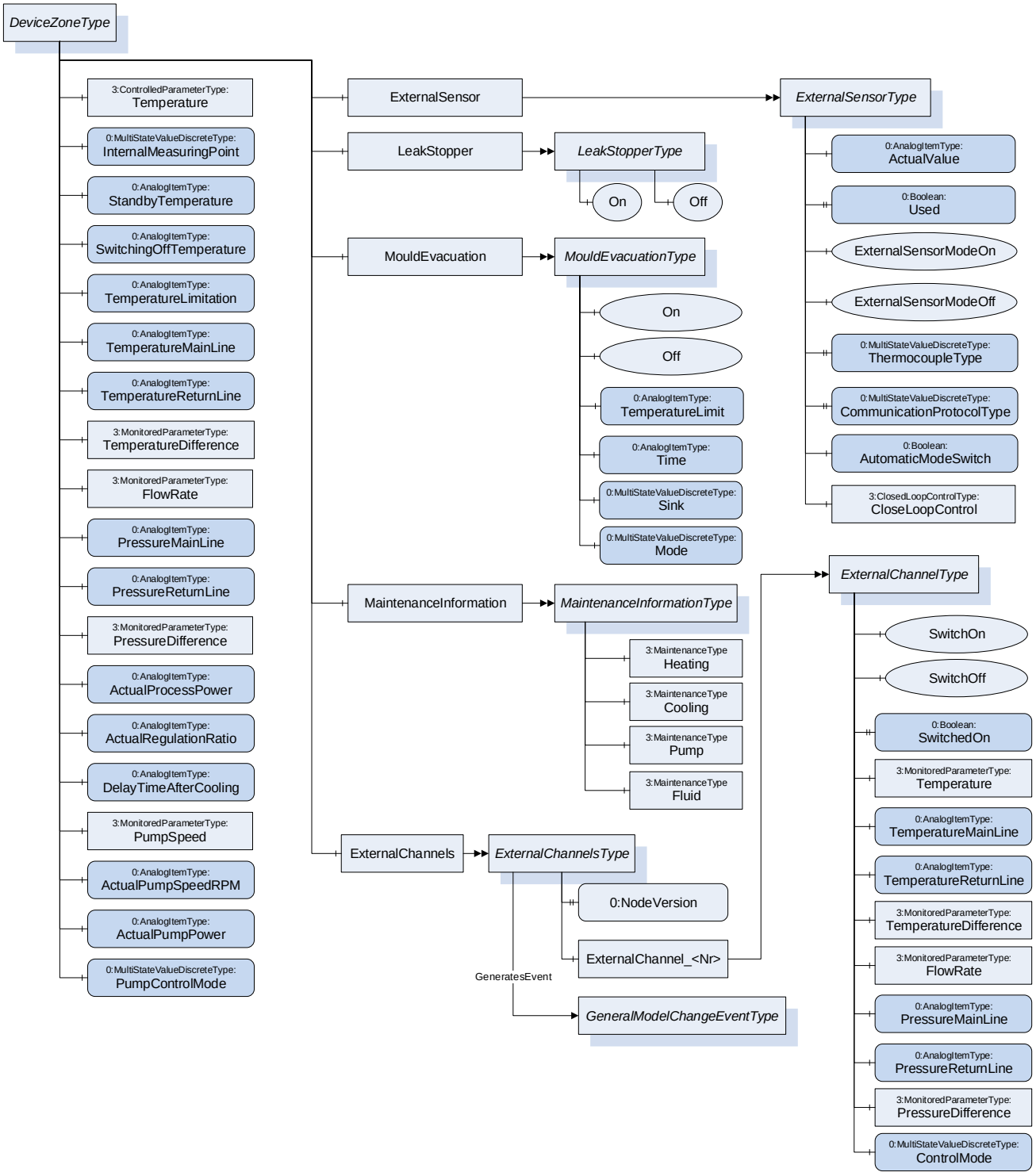

Figure 2 – DeviceZoneType Overview

Table 7 – DeviceZoneType Definition

Attribute	Value				
BrowseName	DeviceZoneType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasComponent	Object	Temperature		ControlledParameterType	M
0:HasComponent	Variable	InternalMeasuringPoint	0:UInt16	0:MultiStateValueDiscreteType	O, RW
0:HasComponent	Variable	StandbyTemperature	0:Double	0:AnalogItemType	O, RW
0:HasComponent	Variable	SwitchingOffTemperature	0:Double	0:AnalogItemType	O, RW
0:HasComponent	Variable	TemperatureLimitation	0:Double	0:AnalogItemType	O, RW
0:HasComponent	Variable	TemperatureMainLine	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Variable	TemperatureReturnLine	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Object	TemperatureDifference		3:MonitoredParameterType	O
0:HasComponent	Object	FlowRate		3:MonitoredParameterType	O
0:HasComponent	Variable	PressureMainLine	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Variable	PressureReturnLine	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Object	PressureDifference		3:MonitoredParameterType	O
0:HasComponent	Variable	ActualProcessPower	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Variable	ActualRegulationRatio	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Variable	DelayTimeAfterCooling	0:Double	0:AnalogItemType	O, RW
0:HasComponent	Object	PumpSpeed		3:MonitoredParameterType	O
0:HasComponent	Variable	ActualPumpSpeedRPM	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Variable	ActualPumpPower	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Variable	PumpControlMode	0:UInt16	0:MultiStateValueDiscreteType	O, RW
0:HasComponent	Object	ExternalSensor		ExternalSensorType	O
0:HasComponent	Object	LeakStopper		LeakStopperType	O
0:HasComponent	Object	MouldEvacuation		MouldEvacuationType	O
0:HasComponent	Object	MaintenanceInformation		MaintenanceInformationType	O
0:HasComponent	Object	ExternalChannels		ExternalChannelsType	O

NOTE: The *MonitoredParameterType* is defined in OPC 40083. If the Parameter is not only monitored but controlled, the subtype *ControlledParameterType* can be used.

10.1 Temperature

Description: Setting and/or monitoring of the temperature in the main or return line (see *InternalMeasuringPoint*) or active external Sensor (*ExternalSensorModeOn*)

Unit: °C or °F

Example (for *ActualValue)*: 120

10.2 InternalMeasuringPoint

Description: This determines whether the temperature of the main or the return is to be controlled.

The *TypeDefinition* is *MultiStateValueDiscreteType*, so the *Properties EnumValues* and *ValueAsText* must be filled with the supported values out of Table 8.

Table 8 – Values for InternalMeasuringPoint

EnumValue	ValueAsText	Description
0	MAIN_LINE	Control of the forward flow temperature
1	RETURN_LINE	Control of the return flow temperature

10.3 StandbyTemperature

Description: The standby value temperature is approached with the Method *ReduceToStandByOn*. The TCD switches off.

Unit: °C or °F

Example: 35.0

10.4 SwitchingOffTemperature

Description: Defines the temperature to which the TCD must be cooled down before it switches off.

Unit: °C or °F

Example: 70.0

10.5 TemperatureLimitation

Description: This setpoint is for temperature limitation of the mould circuit e.g. to protect the connected tubes or the downstream water distribution system.

Unit: °C or °F

Example: 120

10.6 TemperatureMainLine

Description: Actual temperature in the main line.

Unit: °C or °F

Example: 100

10.7 TemperatureReturnLine

Description: Actual temperature in the return line.

Unit: °C or °F

Example: 105

10.8 TemperatureDifference

Description: Setting and/or monitoring of the temperature difference between return and main line. Positive if temperature in return line is higher than in main line.

Unit: °C or °F

Example (for *ActualValue*): 5

10.9 FlowRate

Description: Setting and/or monitoring of the flow rate.

Unit: l/min, gal/min or ft^3/min

Example (for *ActualValue*): 10.0

10.10 PressureMainLine

Description: Actual pressure in the main line (Pressure return line + pump pressure).

Unit: bar or lbf/in^2 (=psi)

Example: 6.5

10.11 PressureReturnLine

Description: Actual pressure in the return line.

Unit: bar or lbf/in^2 (=psi)

Example: 6

10.12 PressureDifference

Description: Setting and/or monitoring of the pressure difference between main and return line

Unit: bar or lbf/in^2 (=psi)

Example: 2.8

10.13 ActualProcessPower

Description: Actual calculated process performance (from the view of the TCD: heating = positive value, cooling = negative value)

Unit: kW

Example: - 2.3

10.14 ActualRegulationRatio

Description: Actual Regulation Ratio (heating = positive value, cooling = negative value)

Unit: %

Example: -0.15

10.15 DelayTimeAfterCooling

Description: Delay Time after cooling before switching off the TCD

Unit: min

Example: 2

10.16 PumpSpeed

Description: Setting and/or monitoring the speed of the pump in percent of maximum speed

Unit: %

Example (for *ActualValue*): 100

10.17 ActualPumpSpeedRPM

Description: Actual speed of the pump in revolutions per minute

Unit: min-1

Example: 3000

10.18 ActualPumpPower

Description: Actual power of the pump in kW

Unit: kW

Example: 1.5

10.19 PumpControlMode

Description: Defines to which setpoint or function the pump is controlled. The *TypeDefinition* is *MultiStateValueDiscreteType*, so the *Properties EnumValues* and *ValueAsText* must be filled with the supported values out of Table 9.

Table 9 – Values for PumpControlMode

EnumValue	ValueAsText	Description
0	NORMAL	Normal Operation: fixed pump rotational speed
1	AUTO	Automatic adjustment of the pump rotational speed
2	SPEED	Speed controlled: the pump is controlled according to the specified nominal value *PumpSpeed*
3	FLOW	Flow rate controlled: the pump is controlled according to the specified nominal value *FlowRate*
4	TEMP_DIFF	Temperature difference controlled: the pump is controlled according to the specified nominal value *TemperatureDifference*
5	PRESS_DIFF	Pressure difference controlled: the pump is controlled according to the specified nominal value *PressureDifference*
6	BOOST	Boost mode: the pump is operated at the maximum possible rotational pump speed

10.20 ExternalSensorType

ExternalSensor is an optional component from *DeviceZoneType* and includes variables for the operation with an external temperature sensor. The temperature sensor is connected at the TCD directly or the value can come from the connected machine.

Table 10 – ExternalSensorType Definition

Attribute	Value				
BrowseName	ExternalSensorType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*aseObjectType* defined in OPC UA Part 5					
0:HasComponent	Variable	ActualValue	0:Double	0:AnalogItemType	M, RW
0:HasProperty	Variable	Used	0:Boolean	0:PropertyType	M, RO
0:HasComponent	Method	ExternalSensorModeOn			M
0:HasComponent	Method	ExternalSensorModeOff			M
0:HasComponent	Variable	ThermocoupleType	0:UInt16	0:MultiStateValueDiscreteType	M, RW
0:HasComponent	Variable	CommunicationProtocolType	0:UInt16	0:MultiStateValueDiscreteType	M, RW
0: HasProperty	Variable	AutomaticModeSwitch	0:Boolean	0:PropertyType	O, RW
0:HasComponent	Object	ClosedLoopControl		3:ClosedLoopControlType	O

10.20.1 ActualValue

Description: Actual value of external temperature sensor

Unit: °C or °F

Example: 41.0

The value is only writeable if the *CommunicationProtocolType* is OPC_UA (value 3).

10.20.2 Used

Description: Return whether an external temperature sensor is used for control

Example: true

10.20.3 ExternalSensorModeOn

Description: Activate the mode where the external temperature sensor is used for temperature control

Signature

```
ExternalSensorModeOn ();
```

10.20.4 ExternalSensorModeOff

Description: Deactivate the mode where the external temperature sensor is used for temperature control

Signature

```
ExternalSensorModeOff ();
```

10.20.5 ThermocoupleType and CommunicationProtocolType

This two *Variables* are used to specify the type of connected external temperature sensor and the used communication protocol between the sensor and the control system of the TCD.

The *TypeDefinition* for both *Variables* is *MultiStateValueDiscreteType*, so the *Properties EnumValues* and *ValueAsText* must be filled with the supported values out of Table 11 and Table 12.

Table 11 – Values for ThermocoupleType

EnumValue	ValueAsText	Description
0	OTHER	Other sensor type
1	E	Type E sensor: NiCr-CuNi
2	J	Type J, L sensor: Fe-CuNi
3	K	Type K sensor: NiCr-Ni
4	N	Type N sensor: NiCrSi-NiSi
5	T	Type T sensor: Cu-CuNi
6	PT100	Pt 100-Sensor

Table 12 – Values for CommunicationProtocolType

EnumValue	ValueAsText	Description
0	OTHER	Other connection type
1	LOCAL	Communication integrated in the local control system (local input)
2	PROFIBUS	Values via Profibus
3	OPC_UA	Values via OPC UA
4	I2C	Values via I2C
5	CAN	Values via CAN

Which sensor types and protocols and combinations are supported is device dependent. Especially when the *CommunicationProtocolType* has the value 1 (LOCAL), the *ThermocoupleType* could be set to a fixed value by the TCD.

10.20.6 AutomaticModeSwitch

Setting whether switching to external sensor is performed automatically (TRUE) or manually (FALSE). If TRUE, temperature control is regulated to the external sensor when the external sensor is plugged, and again switched automatically to the internal measurement site when the external sensor is unplugged.

10.20.7 ClosedLoopControl

With this *Object* of C*losedLoopControlType* (defined in OPC 40083) the client can do settings for the closed loop control for the sensor.

10.21 LeakStopperType

LeakStopperType is an optional component of *DeviceZoneType* and is used for switching the leak stopper mode.

Table 13 – LeakStopperType Definition

Attribute	Value				
BrowseName	LeakStopperType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasComponent	Method	On			M
0:HasComponent	Method	Off			M

10.21.1 On

Description: Activate the leak stopper mode (emergency operation in case of leaks in the system)

Signature

```
On ();
```

10.21.2 Off

Description: Deactivate the leak stopper mode

Signature

```
Off ();
```

10.22 MouldEvacuationType

MouldEvacuationType is an optional component of *DeviceZoneType* and includes parameters and nodes for mould evacuation.

Table 14 – MouldEvacuationType Definition

Attribute	**Value**				
BrowseName	MouldEvacuationType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasComponent	Method	On			M
0:HasComponent	Method	Off			M
0:HasComponent	Variable	TemperatureLimit	0:Double	0:AnalogItemType	O, RW
0:HasComponent	Variable	Time	0:Double	0:AnalogItemType	O, RW
0:HasComponent	Variable	Sink	0:UInt16	0:MultiStateValueDiscreteType	O, RW
0:HasComponent	Variable	Mode	0:UInt16	0:MultiStateValueDiscreteType	O, RW

10.22.1 On

Description: Activate evacuation mode

Signature

```
On ();
```

10.22.2 Off

Description: Deactivate evacuation mode

Signature

```
Off ();
```

10.22.3 TemperatureLimit

Description: Temperature Limitation of the mould evacuation. TCD is cooled to this temperature first if necessary.

Unit: °C or °F

Example: 70

10.22.4 Time

Description: Duration of the mould evacuation.

Unit: s

Example: 45

10.22.5 Sink

Description: Defines where the medium is to be emptied

The *TypeDefinition* is *MultiStateValueDiscreteType*, so the *Properties EnumValues* and *ValueAsText* must be filled with the supported values out of Table 15.

Table 15 – Values for Sink

EnumValue	ValueAsText	Description
0	DRAIN	medium is passed into the cooling or system water outlet
1	TANK	medium is conducted in a separate outlet

10.22.6 Mode

Description: Defines how the medium is to be emptied.

The *TypeDefinition* is *MultiStateValueDiscreteType*, so the *Properties EnumValues* and *ValueAsText* must be filled with the supported values out of Table 16.

Table 16 – Values for Mode

EnumValue	ValueAsText	Description
0	PUMP	Evacuation by the pump
1	COMPRESSED_AIR	Evacuation with compressed air

10.23 MaintenanceInformationType

Information on the maintenance status of heating, cooling, pump and fluid.

Table 17 – MaintenanceInformationType Definition

Attribute	Value				
BrowseName	MaintenanceInformationType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasComponent	Object	Heating		3:MaintenanceType	O
0:HasComponent	Object	Cooling		3:MaintenanceType	O
0:HasComponent	Object	Pump		3:MaintenanceType	O
0:HasComponent	Object	Fluid		3:MaintenanceType	O

The *MaintenanceType* is defined in OPC 40083.

10.24 ExternalChannelsType

This *ObjectType* is a container for the external channel(s). It is formally defined in Table 18.

Table 18 – ExternalChannelsType Definition

Attribute	Value				
BrowseName	ExternalChannelsType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasProperty	Variable	0:NodeVersion	String	0:PropertyType	M, RO
0:HasComponent	Object	ExternalChannel_<Nr>		ExternalChannelType	OP
0:GeneratesEvent	ObjectType	0:GeneralModelChangeEventType			

When instances for device zones are created, the *BrowseNames* shall be "ExternalChannel_<Nr>" (starting with 1).

10.25 ExternalChannelType

ExternalChannelType includes information for monitoring or controlling of external temperature, flow rate or pressure channels. (One zone of the TCD is split into several external channels).

Table 19 – ExternalChannelType Definition

Attribute	**Value**				
BrowseName	ExternalChannelType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 0:*BaseObjectType* defined in OPC UA Part 5					
0:HasComponent	Method	SwitchOn			O
0:HasComponent	Method	SwitchOff			O
0:HasProperty	Variable	SwitchedOn	0:Boolean	0:PropertyType	O, RO
0:HasComponent	Object	Temperature		3:MonitoredParameterType	O
0:HasComponent	Variable	TemperatureMainLine	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Variable	TemperatureReturnLine	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Object	TemperatureDifference		3:MonitoredParameterType	O
0:HasComponent	Object	FlowRate		3:MonitoredParameterType	O
0:HasComponent	Variable	PressureMainLine	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Variable	PressureReturnLine	0:Double	0:AnalogItemType	O, RO
0:HasComponent	Object	PressureDifference		3:MonitoredParameterType	O
0:HasComponent	Variable	ControlMode	0:UInt16	0:MultiStateValueDiscreteType	O, RW

NOTE: The *MonitoredParameterType* is defined in OPC 40083. If the Parameter is not only monitored but controlled, the subtype *ControlledParameterType* can be used.

10.25.1 SwitchOn

Description: Switch method of the external channel for switching on. *SwitchedOn* shows the actual state of the channel.

Signature

```
SwitchOn ();
```

10.25.2 SwitchOff

Description: Switch *method* of the external channel for switching off. *SwitchedOn* shows the actual state of the channel.

Signature

```
SwitchOff ();
```

10.25.3 SwitchedOn

Description: Information if the external channel is switched on. If the methods *SwitchOn* and *SwitchOff* are provided, also this Property shall be available.

Example: TRUE

10.25.4 Temperature

Description: Setting and/or monitoring of the temperature

Unit: °C or °F

Example (for *ActualValue)*: 120

10.25.5 TemperatureMainLine

Description: Actual temperature in the main line

Unit: °C or °F

Example: 120

10.25.6 TemperatureReturnLine

Description: Actual temperature in the return line

Unit: °C or °F

Example: 115

10.25.7 TemperatureDifference

Description: Setting and/or monitoring of the temperature difference between return and main line. Positive if temperature in return line is higher than in main line.

Unit: °C, K or °F

Example (for *ActualValue*): 5

10.25.8 FlowRate

Description: Setting and/or monitoring of the flow rate.

Unit: l/min, gal/min or ft^3/min

Example (for *ActualValue*): 10,0

10.25.9 PressureMainLine

Description: Actual value of the pressure in the main line.

Unit: bar or lbf/in^2 (=psi)

Example: 6

10.25.10 PressureReturnLine

Description: Actual value of the pressure in the return line.

Unit: bar or lbf/in^2 (=psi)

Example: 5

10.25.11 PressureDifference

Description: Setting and/or monitoring of the pressure difference between main and return line

Unit: bar or lbf/in^2 (=psi)

Example (for *ActualValue*): 2.5

10.25.12 ControlMode

Description: Defines to which setpoint the external channel is controlled

The *TypeDefinition* is *MultiStateValueDiscreteType*, so the *Properties EnumValues* and *ValueAsText* must be filled with the supported values out of Table 20.

Table 20 – Values for ControlMode

EnumValue	ValueAsText	Description
0	NONE	No control, only monitoring
1	TEMPERATURE	Temperature controlled
2	FLOW	Flow rate controlled
3	TEMP_DIFF	Temperature difference controlled
4	PRESS_DIFF	Pressure difference controlled

11 Alarms

For alarms (alarms, warnings, information) of the TCD the *TCDHelpOffNormalAlarmType* as defined in Table 21 shall be used, if the alarm facet is supported. A machine which connects to a TCD via OPC 40082-1 shall subscribe this event.

Table 21 – TCDHelpOffNormalAlarmType Definition

Attribute	**Value**				
BrowseName	TCDHelpOffNormalAlarmType				
IsAbstract	False				
References	**Node Class**	**BrowseName**	**DataType**	**TypeDefinition**	**Other**
Subtype of 3:*HelpOffNormalAlarmType* (defined in OPC 40083)					
0:HasProperty	Variable	DeviceMappingNumber	0:UInt32	0:PropertyType	M, RO

The value of *DeviceMappingNumber* corresponds to the value given in the instance of the *OperationType* (see 9.1) for assigning the alarm to a device.

For unique identification of the alarm event, the *SourceNode* (included in *BaseEventType*) of the device needs to be sent for every alarm message. The *SourceNode* includes the namespace number and the Identifier from the object instance of *TCD_InterfaceType* (for general events) or the *NodeId* of a child element (e.g. a variable of *MonitoredParameterType* if this is out of tolerance).

For the *Severity Property* (included in *BaseEventType*) the following classes shall be used:

Table 22 – Severity Classes

Range of Severity	**Description**
667-1000	Messages of high urgency (error, system alarm): Limit values have been exceeded. The transgression has a direct influence on the operational safety of the unit. Acknowledgement: compulsory
334-666	Messages of medium urgency (warning, process alarm): Limit values have been exceeded. The transgression has no influence on the operational safety of the unit. Acknowledgement: not compulsory
1-333	Messages of low urgency (Information)

12 Profiles and Conformance Units

This chapter defines the corresponding profiles and conformance units for the OPC UA Information Model for OPC 40082-1. *Profiles* are named groupings of conformance units. Facets are profiles that will be combined with other *Profiles* to define the complete functionality of an OPC UA *Server* or *Client.* The following tables specify the facets available for *Servers* that implement the OPC 40082-1 Information Model companion specification.

NOTE: The names of the supported profiles are available in the *Server Object* under *ServerCapabilities.ServerProfileArray*

Table 23 lists all Profiles defined in this document and defines their URIs.

Table 23 – Profile URIs for OPC 40082-1

Profile	**URI**
OPC 40082-1 Basic Server Profile	http://opcfoundation.org/UA-Profile/PlasticsRubber/TCD/Server/Basic
OPC 40082-1 Alarms Server Facet	http://opcfoundation.org/UA-Profile/PlasticsRubber/TCD/Server/Alarms
OPC 40082-1 Maintenance Server Facet	http://opcfoundation.org/UA-Profile/PlasticsRubber/TCD/Server/Maintenance

Table 24 – OPC 40082-1 Basic Server Facet Definition

Conformance Unit	Description	Optional/ Mandatory
OPC 40082-1 Basic	Support of *TCD_InterfaceType* and all mandatory child elements giving information on the temperature control device itself, the current configuration and status.	M
Profile		
ComplexType Server Facet (defined in OPC UA Part 7)		M
Method Server Facet (defined in OPC UA Part 7)		M
BaseDevice_Server_Facet (defined in OPC UA Part 100)		M

Table 25 – OPC 40082-1 Alarms Server Facet Definition

Conformance Unit	Description	Optional/ Mandatory
OPC 40082-1 Alarms	Support of *HelpOffNormalAlarmType* providing error information. If this facet is supported and a client subscribes to the events, the server shall provide all errors via alarms in addition to the error variables included in the *OperationType*	M
A & C Alarm Server Facet (defined in OPC UA Part 7)		M

Table 26 – OPC 40082-1 Maintenance Server Facet Definition

Conformance Unit	Description	Optional/ Mandatory
OPC 40082-1 Maintenance	Support of *MaintenanceType* for device zones	M

13 Namespaces

13.1 Namespace Metadata

Table 27 defines the namespace metadata for this specification. The *Object* is used to provide version information for the namespace and an indication about static *Nodes*. Static *Nodes* are identical for all *Attributes* in all *Servers*, including the *Value Attribute*. See Part5 for more details.

The information is provided as *Object* of type *NamespaceMetadataType*. This *Object* is a component of the *Namespaces Object* that is part of the *Server Object*. The *NamespaceMetadataType ObjectType* and its *Properties* are defined in Part5.

The version information is also provided as part of the ModelTableEntry in the UANodeSet XML file. The UANodeSet XML schema is defined in Part 6.

Table 27 – NamespaceMetadata Object for this Specification

Attribute	Value		
BrowseName	http://opcfoundation.org/UA/PlasticsRubber/TCD/		
References	**BrowseName**	**DataType**	**Value**
HasProperty	NamespaceUri	String	http://opcfoundation.org/UA/PlasticsRubber/TCD/
HasProperty	NamespaceVersion	String	1.01
HasProperty	NamespacePublicationDate	DateTime	2020-06-01 00:00:00
HasProperty	IsNamespaceSubset	Boolean	False
HasProperty	StaticNodeIdTypes	IdType[]	{Numeric}
HasProperty	StaticNumericNodeIdRange	NumericRange[]	Null
HasProperty	StaticStringNodeIdPattern	String	Null

13.2 Handling of OPC UA Namespaces

Namespaces are used by OPC UA to create unique identifiers across different naming authorities. The *Attributes NodeId* and *BrowseName* are identifiers. A *Node* in the UA *AddressSpace* is unambiguously identified using a *NodeId*. Unlike *NodeIds*, the *BrowseName* cannot be used to unambiguously identify a *Node*. Different *Nodes*

may have the same *BrowseName*. They are used to build a browse path between two *Nodes* or to define a standard *Property*.

Servers may often choose to use the same namespace for the *NodeId* and the *BrowseName*. However, if they want to provide a standard *Property*, its *BrowseName* shall have the namespace of the standards body although the namespace of the *NodeId* reflects something else, for example the *EngineeringUnits Property*. All *NodeIds* of *Nodes* not defined in this document shall not use the standard namespaces.

Table 28 provides a list of mandatory and optional namespaces used in an OPC 40082-1 OPC UA *Server*.

Table 28 – Namespaces used in an OPC 40082-1 Server

NamespaceURI	Description	Use
http://opcfoundation.org/UA/	Namespace for *NodeIds* and *BrowseNames* defined in the OPC UA specification. This namespace shall have namespace index 0.	Mandatory
Local Server URI	Namespace for nodes defined in the local server. This may include types and instances used in a device represented by the server. This namespace shall have namespace index 1.	Mandatory
http://opcfoundation.org/UA/DI/	Namespace for *NodeIds* and *BrowseNames* defined in OPC UA Part 100. The namespace index is server specific.	Mandatory
http://opcfoundation.org/UA/PlasticsRubber/GeneralTypes/	Namespace for *NodeIds* and *BrowseNames* defined in OPC 40083. The namespace index is server specific.	Mandatory
http://opcfoundation.org/UA/PlasticsRubber/TCD/	Namespace for *NodeIds* and *BrowseNames* defined in this specification. The namespace index is server specific.	Mandatory
Vendor specific types and instances	A server may provide vendor specific types like types derived from *MachineType* or *MachineStatusType* or vendor specific instances of devices in a vendor specific namespace.	Optional

Table 29 provides a list of namespaces and their index used for *BrowseNames* in this specification. The default namespace of this specification is not listed since all *BrowseNames* without prefix use this default namespace.

Table 29 – Namespaces used in this specification

NamespaceURI	Namespace Index	Example
http://opcfoundation.org/UA/	0	0:NodeVersion
http://opcfoundation.org/UA/DI/	2	2:DeviceClass
http://opcfoundation.org/UA/PlasticsRubber/GeneralTypes/	3	3:MachineInformationType

Annex A
(normative)

OPC 40082-1 Namespace and mappings

A.1 Namespace and identifiers for OPC 40082-1 Information Model

This appendix defines the numeric identifiers for all of the numeric *NodeIds* defined in this specification. The identifiers are specified in a CSV file with the following syntax:

`<SymbolName>, <Identifier>, <NodeClass>`

Where the *SymbolName* is either the *BrowseName* of a *Type Node* or the *BrowsePath* for an *Instance Node* that appears in the specification and the *Identifier* is the numeric value for the *NodeId*.

The *BrowsePath* for an *Instance Node* is constructed by appending the *BrowseName* of the instance *Node* to the *BrowseName* for the containing instance or type. An underscore character is used to separate each *BrowseName* in the path. Let's take for example, the *MachineInformationType ObjectType Node* which has the *ControllerName Property*. The **Name** for the *ControllerName InstanceDeclaration* within the *MachineInformationType* declaration is: *MachineInformationType_ControllerName*.

The *NamespaceUri* for all *NodeIds* defined here is http://opcfoundation.org/UA/PlasticsRubber/TCD/

The CSV released with this version of the specification can be found here:

– http://www.opcfoundation.org/UA/schemas/PlasticsRubber/TCD/1.01/NodeIds.csv

NOTE The latest CSV that is compatible with this version of the specification can be found here:

– http://www.opcfoundation.org/UA/schemas/PlasticsRubber/TCD/NodeIds.csv

A computer processible version of the complete Information Model defined in this specification is also provided. It follows the XML Information Model schema syntax defined in Part 6.

The Information Model Schema released with this version of the specification can be found here:

– http://www.opcfoundation.org/UA/schemas/PlasticsRubber/TCD/1.01/Opc.Ua.PlasticsRubber.TCD.NodeSet2.xml

NOTE The latest Information Model schema that is compatible with this version of the specification can be found here:

– http://www.opcfoundation.org/UA/schemas/PlasticsRubber/TCD/Opc.Ua.PlasticsRubber.TCD.NodeSet2.xml

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