



26 AUG 2024

IEC 61850 Variable Diagnosis Tool Manual



Variable Diagnosis

TCP Connection Status / mms Status

Diagnosis variable: *!ConnectionState

Driver Object Type	Channel type	Read	Write	Supported data types
Connection state	36	X	--	UDINT

The *Connection State* variable does not provide an evaluation of whether it was possible to activate the URCBs via 'max. auto used URCBs'.

★ The standard process for the value change of the variable is:

Start of the Service Engine (o. TCPⓈ_CONNECT_FAILED)

- TCP_CONNECTING
- TCP_CONNECTED
- TCP_CONNECTED + MMS_ASSOCIATED

Or, in the event of a persistent TCPⓈ error:

- TCP_CONNECT_FAILED
- TCP_CONNECTING
- TCP_CONNECT_FAILED

Or, if the connection was established correctly but the activation of an RCB failed:

TCP_CONNECTED + MMS_ ASSOCIATED + MMS_RCB_ENABLE_FAILED

Internal variables of this object type show the status of the connection to the 850 server.

The variable must have *ConnectionState* as a reference and the correct **Net address**Ⓢ.

Example: **Name**Ⓢ or **Symbolic address**Ⓢ: *!ConnectionState.

You can find more information in the chapter **Establishment of a connection and detection of a connection failure**.



TCP Connection Status / mms Status

Diagnosis variable: `*!ConnectionState`

A *Connection State* variable, if created, provides information on whether the **driver** has a **TCP** and then MMS connection to the 850 server and whether the connection exists via primary or secondary IP addresses. Furthermore, you receive information on whether all configured static RCB assignments have been successfully registered.

This variable must be created with the *Connection state***Driver object type**. It must contain the correct **net address** of the connection, the reference with a configured syntax **!ConnectionState* and the data type has to be **UDINT**.

The bits of the variable value mean the following:

For the primary **TCP**/IP connection to the 850 server:

Bit	Meaning	Value (hex)
1	<i>TCP_CONNECTED</i>	0x02
2	<i>TCP_CONNECTING</i>	0x04
3	<i>TCP_CONNECT_FAILED</i>	0x08
16	<i>MMS_ASSOCIATED</i>	0x10000
17	<i>MMS_RCB_ENABLE_FAILED</i>	0x20000

For the secondary **TCP**/IP connection:

Bit	Meaning	Value (hex)
5	<i>TCP_CONNECTED</i>	0x20
6	<i>TCP_CONNECTING</i>	0x40
7	<i>TCP_CONNECT_FAILED</i>	0x80
24	<i>MMS_ASSOCIATED</i>	0x1000000
25	<i>MMS_RCB_ENABLE_FAILED</i>	0x2000000

The *MMS_RCB_ENABLE_FAILED* bit is only set if one (or more) RCBs that have been configured in the **driver** configuration in **RCB assignment** could not be activated. This happens for example if the IEC850 server does not write to RCB data attributes because another **client** is already using this report.



Driver Connection

Diagnosis variable: *!Communication

ConnectionStates *STRING* 61

Internal connection status of the **driver** to the **PLC**.

Connection statuses:

- **0**: Connection OK
- **1**: Connection failure
- **2**: Connection simulated

Formating:

<Net address>:<Connection status>;...;;

A connection is only known after a variable has first signed in. In order for a connection to be contained in a string, a variable of this connection must be signed in once.

The status of a connection is only updated if a variable of the connection is signed in. Otherwise there is no communication with the corresponding controller.

Cause of Transmission

Diagnosis variable: Binary Status

Cause of Transmission [COTx]



Bit number	Display	Set	Available
32 - 37	COT0 to COT5	automatic	for energy standards

The Cause of Transmission (COT) in accordance with the IEC60870 protocol.

The value of the Cause of Transmission (see [IEC60870-5-101 7.2.3](#)) is mapped to status bits 32 - 37. Up to 6 COTx bits can thus be set (x represents bit numbers 0 to 5).

For example: the lowest bit of the COT value is shunted to status bit 32 and named *COT0* in zenon.

The complete COT value can be evaluated in Service Engine via a reaction matrix (multi-numeric or multi-binary). For each COTx bit, the value of the cause of transmission is increased as follows:

- $COT0 = 2^0 = 1$
- $COT1 = 2^1 = 2$
- $COT2 = 2^2 = 4$
- $COT3 = 2^3 = 8$
- $COT4 = 2^4 = 16$
- $COT5 = 2^5 = 32$

32	COT0	Cause of transmission bit 1	_VSB_TCB0
33	COT1	Cause of transmission bit 2	_VSB_TCB1
34	COT2	Cause of transmission bit 3	_VSB_TCB2
35	COT3	Cause of transmission bit 4	_VSB_TCB3
36	COT4	Cause of transmission bit 5	_VSB_TCB4
37	COT5	Cause of transmission bit 6	_VSB_TCB5

Cause of Transmission

Diagnosis variable: Binary Status

Example			
Typical COT values:			
Status	Value	Cause of transmission	Short name
COT0	1	<i>periodic, cyclic/poll</i>	COT_per
COT1	2	<i>background scan/integrity</i>	COT_back
COT0, COT1	1+2 = 3	<i>spontaneous/reported</i>	COT_spont
COT0, COT1, COT2	1+2+4 = 7	<i>activation (command) confirmation</i>	COT_actcon
COT1, COT3	2+8 = 10	<i>activation (command) termination</i>	COT_actterm
COT2, COT4	4+16 = 20	<i>interrogated by general interrogation</i>	COT_inrogen

Timestamp code

Diagnosis variable: Binary Status

49	T_INVALID	External timestamp invalid
53	T_UNSYNC	ClockNotSynchronized (IEC 61850)

External timestamp invalid [T_INVALID]

Bit number	Display	Set	Available
49	T_INVALID	automatic	<ul style="list-style-type: none">IEC870, IEC850Process Gateway IEC870 SlavestratonNG driver

The *invalid time* status is set by a driver if the real-time stamp received by the controller is marked as invalid. In this case, the zenon services use the received value of the variable with the local timestamp of the computer. This status bit can be selected in **Multi reaction matrices**, in **Combined elements** and in the **Interlocking formula**.

⚠ The status of a variable can be either *T_EXTERN* or *T_INTERN*.

- If a value has the status *T_EXTERN* and no *T_INVALID*, the value of the external timestamp is used as a timestamp. The external timestamp is the time value that the controller has provided to the driver together with the value.
- If a value has the status *T_INTERN* or has *T_EXTERN* and *T_INVALID*, the value of the internal time stamp is used as a time stamp. The internal time stamp is the time point at which the driver has received the value from the controller.

Based on this, all zenon services sort the values.

ClockNotSynchronized [T_UNSYNC]

Bit number	Display	Set	Available
<div>X53</div>	T_UNSYNC	automatic	<div>IEC850</div> <div>stratonNG driver</div>

Signalizes *ClockNotSynchronized* information in *TimeQuality* according to the IEC 61850 standard. The controller informs you that its clock is not synchronized with an external time source.

This status bit can be selected in the **combined element**.

i You can find further information about this in the documentation for the **IEC850 driver** in the **Quality, timestamp and status bits of the variable** chapter.



Variable Status

Diagnosis variable: binary status

12	MAN_VAL	Manual value	_VSB_MVALUE
17	SPONT	Spontaneous	_VSB_SPONT
18	INVALID	Invalid	_VSB_I_BIT
27	ALT_VAL	Alternate value	_VSB_AVALUE

Variable Status

Diagnosis variable: binary status

Manual value [MAN_VAL]

Bit number	Display	Set	Available
12	MAN_VAL; Manual value	automatic	with all drivers

This state is set, as soon as a value in an **archive** has been changed by hand. These **archive** value changes can be made manually with the **Report Generator** or in the **Archive revision** screen.

In addition, the validation of the **Metering Point Administration** sets this status if a measured value is edited manually.

Alternative value [ALT_VAL]

Bit number	Display	Set	Available
27	ALT_VAL; alternative value	by the user	with all drivers

To substitute a value, it can be switched to the alternative value. At this the value is completely uncoupled from the process as with **Switched off (OFF)**. Similar to Switch off the last process value is displayed. There is however the possibility to change the **alternate value** in Service Engine; e.g. via the **set value** input dialog:

- Modify alternate value:**
Only changes the alternate value
- Switch to and modify alternate value:**
Switches to **alternate value** and changes it to the **set value**.
- Modify spontaneous value:**
A **set value** is sent to the hardware despite an **alternate value**. The variable however retains the **alternate value**.
- Switch to spontaneous value:**
Switches off the **alternate value**.

Invalid [INVALID]

Bit number	Display	Set	Available
18	INVALID; Invalid	automatic	with all drivers

This bit is set, if there is a problem in the communication with the **driver** or with a single variable. Most of the zenon drivers however are polling drivers, thus only a general problem in the communication can be indicated (and not a separate one for each variable).

In the event of a fault in the communication, the status bits *INVALID* and *SPONT* exclude each other mutually. However, both bits can be set at the same time for the following exceptions:

- Protocol-dependent

In some spontaneous protocols, the controllers have the possibility of marking a value as invalid, such as IEC 60870 indicator INV, IEC 61850 Quality. Values marked as such then get the *INVALID* bit, possibly at the same time as with *SPONT*. You can find details in the corresponding **driver** documentation.
- Driver monitoring through Service Engine

Service Engine monitors the availability of the **driver** via a watchdog. This monitoring is not applicable for internal drivers. If a **driver** is no longer available, the *INVALID* status bit is also set by Service Engine. You can find details in the corresponding **driver** documentation.

i The status bit is shown in the Service Engine with a red square in the top right corner of the screen element.

The display can be amended individually using properties in Engineering Studio:

- Representation/Display status of variable** element property: Activates or deactivates the display.
- Status of variable/Communication failure to PLC** project property: Enables the color of the display to be amended.

Spontaneous [SPONT]

Bit number	Display	Set	Available
17	SPONT; Spontaneous	automatic	with all drivers

Current value is valid. Everything OK.



Quality

Diagnosis variable: binary status

39	TEST	Test bit (IEC870 [T])	_VSB_T_BIT
44	BL_870	IEC 60870 status: <i>blocked</i>	_VSB_BL_BIT
45	SB_870	IEC 60870 status: <i>substituted</i>	_VSB_SP ⓘ_BIT
47	OV_870	IEC 60870 status: <i>overflow</i>	_VSB_OV_BIT
52	OR_DRV	Value out of the valid range (IEC 61850)	not defined

Quality

Diagnosis variable: binary status

Test bit [TEST]

Bit number	Display	Set	Available
39	TEST	automatic	IEC870, IEC850

Signalizes the *Test* status in accordance with the IEC IEC 61850: Quality= *Test*. This status bit can be evaluated in the **Combined element** and in the **Interlocking formula**. The evaluation of the reaction matrix is available as a multi-binary or multi-numeric reaction matrix.

IEC status: Blocked [BL_870]

Bit number	Display	Set	Available
44	BL_870	automatic	IEC870, IEC850

Signalizes *Blocked* status according to the IEC 60870 standard and after IEC 61850: Quality= *OperatorBlocked*. The controller reports that the value is blocked for transfer and remains in the status it had before it was blocked. This status bit can be selected in **Multi reaction matrices**, in **Combined elements** and in the **Interlocking formula**.

In **VBA** the top 32 bits can be polled with **StatusExtValue()**. With **SetValueWithStatusEx()** all 64 status bits can be polled.

IEC status: Substituted [SB_870]

Bit number	Display	Set	Available
45	SB_870	automatic	IEC870, IEC850 Process Gateway IEC870 Slave

Signalizes *Substituted* status according to the IEC 60870 standard and after IEC 61850: Quality= *Substituted*. The controller reports that the value no longer comes from hardware but was simulated in the controller. This status bit can be selected in **Multi reaction matrices**, in **Combined elements** and in the **Interlocking formula**.

In **VBA** the top 32 bits can be polled with **StatusExtValue()**. With **SetValueWithStatusEx()** all 64 status bits can be polled.

IEC status: Overflow [OV_870]

Bit number	Display	Set	Available
47	OV_870	automatic	IEC870, IEC850 Process Gateway IEC870 Slave

Signalizes *Overflow* status according to the IEC 60870 standard and after IEC 61850: Quality= *Overflow*. The controller reports that the value is outside the predefined bandwidth or that there is a counter overrun. This status bit can be selected in **Multi reaction matrices**, in **Combined elements** and in the **Interlocking formula**.

Value out of the valid range [OR_DRV]

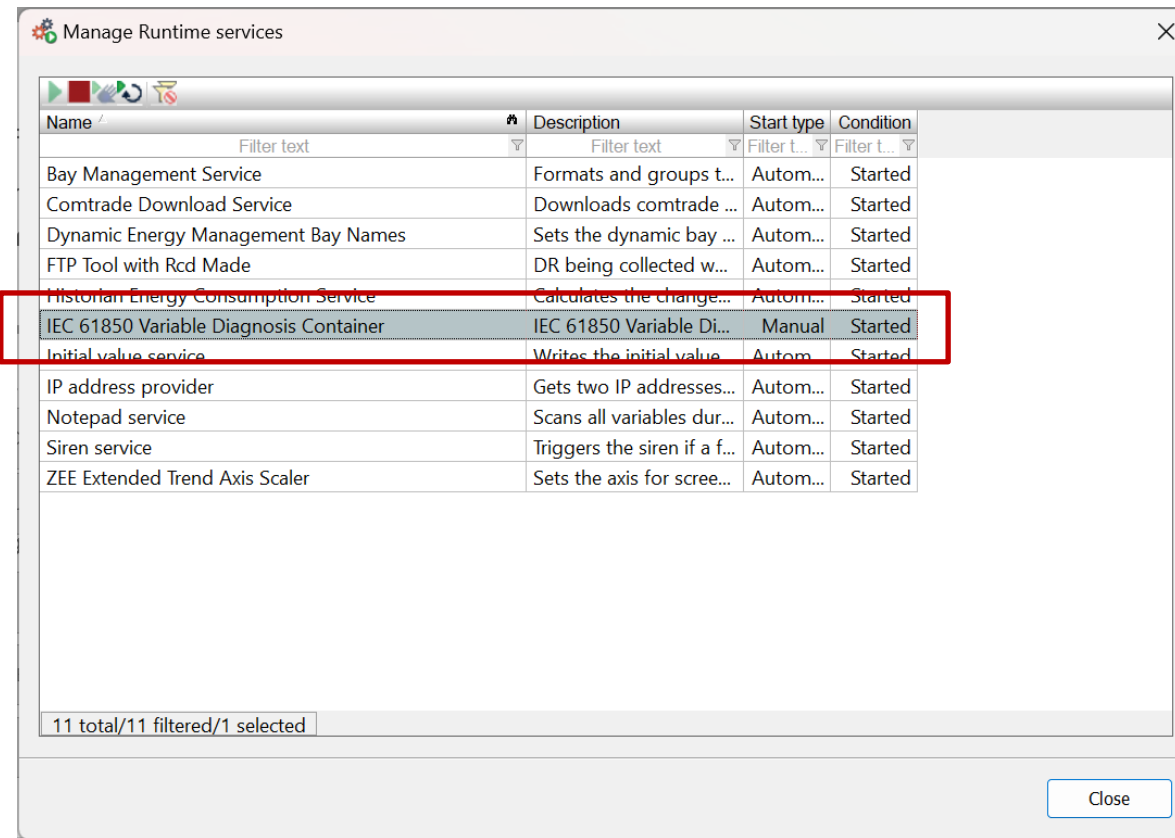
Bit number	Display	Set	Available
52	OR_DRV	automatic	IEC850

Signalizes *Out of Range* in accordance with the IEC 61850 standard, corresponds to Quality= *OutOfRange*. The controller reports that the value is outside of the predefined measurement range. This status bit can be selected in the **Combined element** and in the **Interlocking formula**.



Runtime Tool Manual

Start Diagnosis Container in Runtime Service



Start Diagnosis Tool

Create profile

Existing profiles

IEC 61850 Diagnosis Tool

Profile name: Save

Profile selection:

ABB

Variable Name	Driver Name	Last Update Time	TCP Connection Status	mms Status	Driver Connection	Actual Value	Cause of Transmission	Timestamp Code	Variable Status	Quality
For variables other than control variable										

Variable Name	Driver Name	Last Update Time	TCP Connection Status	Actual Value	Set Value	Cause of Transmission	AddCause
For control variables							

Select Variable

Refresh

Delete Selected

Set Selected CO

Set All CO

Column Selection

Profile Manager

ABB

Open Form for variable selection

Refresh variable status

Delete selected variables

Set variable value for selected variables

Set variable value for all variables

Column selection for viewer

Manager for profile setting

Variable selection Form

Variable Selection

Variable name filter: Include Not Include Clear Filter

Selected count: 0 Show Selection

Select	Variable Name	Data Type	Identification	Symbolic Address
<input checked="" type="checkbox"/>	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSB...	BOOL	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGGI...	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGG...
<input type="checkbox"/>	E011_HP26_PMCC.CB[1].OpenEnable	BOOL	E011_HP26_PMCC!E011_HP26_PMCCCTRL/CILO1/E...	E011_HP26_PMCC!E011_HP26_PMCCCTRL/CILO1/...
<input type="checkbox"/>	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSB...	BOOL	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGGI...	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGG...
<input type="checkbox"/>	E011_HP28_PMCC.MX.TotVAr	REAL	DNP IN = 75 // EC = 2 // AI-76 // E011_HP28_PMCC // ...	E011_HP28_PMCC!E011_HP28_PMCCMEA/MMXU1/...
<input type="checkbox"/>	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSB...	BOOL	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGGI...	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGG...
<input type="checkbox"/>	E011_HP28_PMCC.ES[1].OpenEnable	BOOL	E011_HP28_PMCC!E011_HP28_PMCCCTRL/CILO3/E...	E011_HP28_PMCC!E011_HP28_PMCCCTRL/CILO3/...
<input type="checkbox"/>	E011_HP28_PMCC!E011_HP28_PMCCSYS/INSB...	BOOL	E011_HP28_PMCC!E011_HP28_PMCCSYS/INSBGGI...	E011_HP28_PMCC!E011_HP28_PMCCSYS/INSBGG...
<input type="checkbox"/>	E011_HP28_PMCC!E011_HP28_PMCCPROT/SCB...	BOOL	E011_HP28_PMCC!E011_HP28_PMCCPROT/SCBR1/...	E011_HP28_PMCC!E011_HP28_PMCCPROT/SCBR1/...
<input type="checkbox"/>	E011_HP28_PMCC.IED.LoA	BOOL	E011_HP28_PMCC!E011_HP28_PMCCCTRL/GENGG...	E011_HP28_PMCC!E011_HP28_PMCCCTRL/GENG...
<input type="checkbox"/>	E011_HP29_PMCC.ES[1].Pos	UDINT		E011_HP29_PMCC!E011_HP29_PMCCCTRL/XSWI2/...
<input type="checkbox"/>	E011_HP29_PMCC!E011_HP29_PMCCPROT/SCB...	BOOL	E011_HP29_PMCC!E011_HP29_PMCCPROT/SCBR1/...	E011_HP29_PMCC!E011_HP29_PMCCPROT/SCBR1/...
<input type="checkbox"/>	E011_HP29_PMCC!E011_HP29_PMCCCTRL/GAP...	BOOL	DNP IN = 119 // CO-120 // E011_HP29_PMCC // 11kV饋...	E011_HP29_PMCC!E011_HP29_PMCCCTRL/GAPC1/...
<input type="checkbox"/>	E011_HP27_PMCC!E011_HP27_PMCCCTRL/GAP...	BOOL	DNP IN = 117 // CO-118 // E011_HP27_PMCC // 11kV饋...	E011_HP27_PMCC!E011_HP27_PMCCCTRL/GAPC1/...
<input type="checkbox"/>	E069_0910_MCC.DC[2].CloseEnable	BOOL	E069_0910_MCC!E069_0910_MCCCTRL/CILO3/Ena...	E069_0910_MCC!E069_0910_MCCCTRL/CILO3/Ena...
<input type="checkbox"/>	E069_0910_MCC.IED.ChLiv	BOOL	E069_0910_MCC!E069_0910_MCCSYS/LCCH1/ChLiv...	E069_0910_MCC!E069_0910_MCCSYS/LCCH1/ChLiv...
<input type="checkbox"/>	E069_0620_MCC!E069_0620_MCCMEA/INTMMTR...	UDINT	DNP IN = 70 // ACCU-71 // E069_0620_MCC // 中市西...	E069_0620_MCC!E069_0620_MCCMEA/INTMMTR1/...

Confirm

Select All

Clear All

Check All Selection

Filter for variable name column

Counting for selected variables

Variable selection Form

Variable Selection

Variable name filter:

Include

Not Include

Clear Filter

Selected count: 3

Show Selection

	Select	Variable Name	Data Type	Identification	Symbolic Address
	<input type="checkbox"/>	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSB...	BOOL	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGGI...	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGG...
	<input type="checkbox"/>	E011_HP26_PMCC.CB[1].OpenEnable	BOOL	E011_HP26_PMCC!E011_HP26_PMCCCTRL/CILO1/E...	E011_HP26_PMCC!E011_HP26_PMCCCTRL/CILO1/...
	<input type="checkbox"/>	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSB...	BOOL	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGGI...	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGG...
	<input type="checkbox"/>	E011_HP28_PMCC.MX.TotVAr	REAL	DNP IN = 75 // EC = 2 // AI-76 // E011_HP28_PMCC // ...	E011_HP28_PMCC!E011_HP28_PMCCMEA/MMXU1/...
	<input checked="" type="checkbox"/>	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSB...	BOOL	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGGI...	E011_HP26_PMCC!E011_HP26_PMCCSYS/INSBGG...
	<input type="checkbox"/>	E011_HP28_PMCC.ES[1].OpenEnable	BOOL	E011_HP28_PMCC!E011_HP28_PMCCCTRL/CILO3/E...	E011_HP28_PMCC!E011_HP28_PMCCCTRL/CILO3/...
	<input type="checkbox"/>	E011_HP28_PMCC!E011_HP28_PMCCSYS/INSB...	BOOL	E011_HP28_PMCC!E011_HP28_PMCCSYS/INSBGGI...	E011_HP28_PMCC!E011_HP28_PMCCSYS/INSBGG...
	<input checked="" type="checkbox"/>	E011_HP28_PMCC!E011_HP28_PMCCPROT/SCB...	BOOL	E011_HP28_PMCC!E011_HP28_PMCCPROT/SCBR1/...	E011_HP28_PMCC!E011_HP28_PMCCPROT/SCBR1/...
	<input checked="" type="checkbox"/>	E011_HP28_PMCC.IED.LoA	BOOL	E011_HP28_PMCC!E011_HP28_PMCCCTRL/GENGG...	E011_HP28_PMCC!E011_HP28_PMCCCTRL/GENG...
	<input type="checkbox"/>	E011_HP29_PMCC.ES[1].Pos	UDINT		E011_HP29_PMCC!E011_HP29_PMCCCTRL/XSWI2/...
	<input type="checkbox"/>	E011_HP29_PMCC!E011_HP29_PMCCPROT/SCB...	BOOL	E011_HP29_PMCC!E011_HP29_PMCCPROT/SCBR1/...	E011_HP29_PMCC!E011_HP29_PMCCPROT/SCBR1/...
	<input type="checkbox"/>	E011_HP29_PMCC!E011_HP29_PMCCCTRL/GAP...	BOOL	DNP IN = 119 // CO-120 // E011_HP29_PMCC // 11kV饋...	E011_HP29_PMCC!E011_HP29_PMCCCTRL/GAPC1/...
	<input type="checkbox"/>	E011_HP27_PMCC!E011_HP27_PMCCCTRL/GAP...	BOOL	DNP IN = 117 // CO-118 // E011_HP27_PMCC // 11kV饋...	E011_HP27_PMCC!E011_HP27_PMCCCTRL/GAPC1/...
	<input type="checkbox"/>	E069_0910_MCC.DC[2].CloseEnable	BOOL	E069_0910_MCC!E069_0910_MCCCTRL/CILO3/Ena...	E069_0910_MCC!E069_0910_MCCCTRL/CILO3/Ena...
	<input type="checkbox"/>	E069_0910_MCC.IED.ChLiv	BOOL	E069_0910_MCC!E069_0910_MCCSYS/LCCH1/ChLiv...	E069_0910_MCC!E069_0910_MCCSYS/LCCH1/ChLiv...
	<input type="checkbox"/>	E069_0620_MCC!E069_0620_MCCMEA/INTMMTR...	UDINT	DNP IN = 70 // ACCU-71 // E069_0620_MCC // 中市西...	E069_0620_MCC!E069_0620_MCCMEA/INTMMTR1/...

Confirm

Select All

Clear All

Check All Selection

Variable container set.

OK

IEC 61850 Diagnosis Tool

Profile name:

Save

Profile selection:

ABB

	Variable Name	Driver Name	Last Update Time	TCP Connection Status	mms Status	Driver Connection	Actual Value	Cause of Transmission	Timestamp Code	Variable Status	Quality
▶	E011_HP26_P...	E011_HP26_P...	8/26/2024 12:2...			Connection si...	0	NA		SPONT	
	E011_HP28_P...	E011_HP28_P...	8/26/2024 12:2...	1: TCP connect...		Connection OK	0	NA		INVALID	
	E011_HP28_P...	E011_HP28_P...	8/26/2024 12:2...	1: TCP connect...		Connection OK	0	NA		INVALID	

Show all variable status after refreshing

	Variable Name	Driver Name	Last Update Time	TCP Connection Status	Actual Value	Set Value	Cause of Transmission	AddCause
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Select Variable

Refresh

Delete Selected

Set Selected CO

Set All CO

Column Selection

Profile Manager

Form 3 & 4

Column selection for viewer

Column Selection

General Table:

- ☒ Variable Name
- ☒ Driver Name
- ☒ Last Update Time
- ☒ TCP Connection Status
- ☒ mms Status
- ☒ Driver Connection
- ☒ Actual Value
- ☒ Cause of Transmission
- ☒ Timestamp Code
- ☒ Variable Status
- ☒ Quality

Control Table:

- ☒ Variable Name
- ☒ Driver Name
- ☒ Last Update Time
- ☒ TCP Connection Status
- ☒ Actual Value
- ☒ Set Value
- ☒ Cause of Transmission
- ☒ AddCause

Confirm

Manager for profile setting

Profile Manager

Profile_01

>>

E011_HP26_PMCC!E011_HP;
E011_HP28_PMCC!E011_HP;
E011_HP28_PMCC.IED.Lo

Delete Selected Profile

Delete Selected Variables

ABB