

Application

Module Configuration

There is no configuration required to the physical Output Module. All configurable characteristics of the Module are performed using tools on the Engineering Workstation (EWS) and become part of the application or System.INI file that is loaded into the TMR Processor. The TMR Processor automatically configures the Output Module after applications are downloaded and during an Active/Standby changeover.

The IEC 61131 TOOLSET provides the main interface to configure the Output Module. Details of the configuration tools and configuration sequence are provided in Trusted Toolset Suite, publication [ICSTT-RM249](#) (PD-T8082). There are three procedures necessary to configure the Output Module:

1. Define the necessary I/O variables for the field output data and Module status data using the Dictionary Editor of the IEC 61131 TOOLSET.
2. Create an I/O Module definition in the I/O Connection Editor for each I/O Module. The I/O Module definition defines physical information, for example, Chassis and Slot location, and allows variables to be connected to the I/O channels of the Module.
3. Using the Trusted System Configuration Manager, define custom LED indicator modes, per-channel default or fail-safe states, and other Module settings.

T8480 Complex Equipment Definition

The T8480 I/O Complex Equipment Definition includes eight I/O boards, referenced numerically by Rack number:

Table 3 Complex Equipment Definition

Rack	I/O Board	Description	Data Type	Direction	No. of Channels
1	AO	OEM Parameters	-	-	-
		Field Output Status	Analog	Out	40
2	STATE	Field Output State	Integer	In	40
3	AI	Output voltage	Integer	In	40
4	CI	Output current	Integer	In	40
5	LINE_FLT	Line Fault Status	Boolean	In	40
6	DISCREP	Channel Discrepancy	Integer	In	3
7	HKEEPING	Housekeeping Registers	Integer	In	57
8	INFO	I/O Module Information	Integer	In	11

There are two OEM parameters included in the first rack (AO Board). These OEM parameters define the primary Module position; declaring the Module's chassis and slot location. There is no need to define the secondary Module position within the IEC 61131 TOOLSET. Where systems may be required to start up with Modules in the secondary position as the Active Module, for

example, primary Module is not installed when application is started, the secondary Module’s position should be declared in the Module definition of the System Configuration Manager.

Table 4 OEM Parameters

OEM Parameter	Description	Notes
TICS_CHASSIS	The number of the Trusted Chassis where the Primary I/O Module is installed	The Trusted Controller Chassis is 1, and Trusted Expander Chassis are 2 to 15.
TICS_SLOT	The slot number in the Chassis where the Primary I/O Module is installed	The I/O Module slots in the Trusted Controller Chassis are numbered from 1 to 8. The I/O Module slots in the Trusted Expander Chassis are numbered from 1 to 12.

Rack 1: AO

This board provides the connection to the logical output control signal for each of the field outputs.

Table 5 Rack 1: AO Descriptions

Channel	Description
1	Field output channel 1 command
2	Field output channel 2 command
40	Field output channel 40 command

The output command scaling is designed to be consistent with the T8431 Analog Input Module. This table describes this relationship:

Table 6 Rack 1: Output Current Descriptions

Command	Output Current
-1024	Off (Minimum leakage current flowing)
0	4 mA
4096	20 mA

Rack 2: State

This board provides the majority voted numerical output state. This indicates the operational status of the output channel and associated field connection.

Table 7 Rack 2: STATE Descriptions

Channel	Description
1	Field output channel 1 state
2	Field output channel 2 state
40	Field output channel 40 state

Table 8 Rack 2: STATE value Descriptions

Value	Description
7	Channel fault
6	Current demand cannot be met
5	Unused
4	Output energized (0+mA)
3	Open circuit in field wiring or load
2	Output de-energized (demand < 0 mA)
1	No field supply voltage
0	Unused

Rack 3: AI

The AI board returns the field loop voltage at the output.

Table 9 Rack 3: AI Descriptions

Channel	Description
1	Field output channel 1 voltage
2	Field output channel 2 voltage
40	Field output channel 40 voltage

The voltage is the median value taken from the triplicated Module. The voltage level is reported as an integer, with the units being 1/1000V. This may be used directly, scaled arithmetically or scaled using the IEC 61131 TOOLSET conversion tables.

To scale the value arithmetically, simply divide the returned 'integer' by 1000 to return the voltage as either a REAL or INTEGER as required.

The IEC 61131 TOOLSET conversion tables may be used to convert the value to engineering units, in this case voltage. The full-scale range for this number format is decimal ± 32 , corresponding to physical range -32000 to $+32000$.

Rack 4: CI

The CI board returns the field loop current at the output.

Table 10 RACK 4: CI Descriptions

Channel	Description
1	Field output channel 1 current
2	Field output channel 2 current
40	Field output channel 40 current

The current is the sum value taken from the triplicated Module. The current level is reported as an integer, with the units being 1/1000A. This may be used directly, scaled arithmetically, or scaled using the IEC 61131 TOOLSET conversion tables.

To scale the value arithmetically, simply divide the returned 'integer' by 1000 to return the current as either a REAL or INTEGER as required.

The IEC 61131 TOOLSET conversion tables may be used to convert the value to engineering units, in this case current. The full-scale range for this number format is decimal ± 32 , corresponding to physical range -32000 to $+32000$.

Rack 5: LINE_FLT

Table 11 Rack 5: LINE_FLT Descriptions

Channel	Description
1	Field output channel 1 line fault
2	Field output channel 2 line fault
40	Field output channel 40 line fault

The line fault input state is reported as true (logic '1') for a line fault condition (open circuit, short circuit, and no field supply voltage). The logic state is the majority voted value.

Rack 6: DISCREP

Table 12 Rack 6: DISCREP Descriptions

Channel	Description
1	Discrepancy status outputs 1 to 16 (output 1 is LSB)
2	Discrepancy status outputs 17 to 32 (output 17 is LSB)
3	Discrepancy status outputs 33 to 40 (output 33 is LSB)

Each of the words reports the discrepancy status of 16 output channels. The corresponding bit within the word is set to '1' when a discrepancy condition is detected on that output channel's output state (rack 2).

Rack 7: HKEEPING

Table 13 Rack 7: Housekeeping Descriptions

Channel	Description		Units (Full Scale Range)		
	FCR				
1	A	24V2 Output Voltage	Series A and B: -32768	Series A and B: 32767	mV
2	B				
3	C		Series C: 11700	Series C: 13000	
4	A	Internal supply voltage (post regulator)	Series A and B: -32768	Series A and B: 32767	mV
5	B				
6	C		Series C: 11700	Series C: 13000	
7	A	Internal supply current (post regulator)	0	65535	mA
8	B				
9	C				
10	A	Output voltage (post isolation)	-32768	32767	mV
11	B				
12	C				
13	A	24V1 Output Voltage	-32768	32767	mV
14	B				
15	C				
16	A	HIU Board Temperature (Note: Temperature, °C = input value / 256)	-32768	32767	-
17	B				
18	C				
19	A	Front Panel Load Current	0	65535	mA
20	B				
21	C				
22	A	SmartSlot Link Voltage	-32768	32767	mV
23	B				
24	C				
25	A	FIU Output Group 1 Field Supply Voltage	-32768	32767	mV
26	B				
27	C				
28	A	FIU Board Temperature, Output Group 1 (Note: Temperature, °C = input value / 256)	-32768	32767	-
29	B				
30	C				
31	A	FIU Output Group 2 Field Supply Voltage	-32768	32767	mV
32	B				
33	C				
34	A	FIU Board Temperature, Output Group 2 (Note: Temperature, °C = input value / 256)	-32768	32767	-
35	B				
36	C				
37	A	FIU Output Group 3 Field Supply Voltage	-32768	32767	mV
38	B				
39	C				
40	A	FIU Board Temperature, Output Group 3 (Note: Temperature, °C = input value / 256)	-32768	32767	-
41	B				
42	C				
43	A	FIU Output Group 4 Field Supply Voltage	-32768	32767	mV
44	B				
45	C				

Table 13 Rack 7: Housekeeping Descriptions

Channel	Description				
	FCR		Units (Full Scale Range)		
46	A	FIU Board Temperature, Output Group 4 (Note: Temperature, °C = input value / 256)	-32768	32767	-
47	B				
48	C				
49	A	FIU Output Group 5 Field Supply Voltage	-32768	32767	mV
50	B				
51	C				
52	A	FIU Board Temperature, Output Group 5 (Note: Temperature, °C = input value / 256)	-32768	32767	-
53	B				
54	C				
55	A	Diagnostic error code			

Each input within the housekeeping rack is reported as an integer. In general, the application engineer will not normally require these inputs. They are provided to aid fault finding and diagnosis and may be used for reporting and display purposes. If a slice is Fatal, then all reported housekeeping inputs are set to zero.

Each input within the housekeeping rack is reported as an integer. In general, the application engineer will not normally require these inputs. They are provided to aid fault finding and diagnosis and may be used for reporting and display purposes. If a slice is Fatal, then all reported housekeeping inputs are set to zero.

Rack 8: INFO

Table 14 Rack 8: INFO Descriptions

Channel	Description
1	Active Module chassis number
2	Active Module slot number
3	Active Module healthy
4	Active Module mode
5	Standby Module chassis number
6	Standby Module slot number
7	Standby Module healthy
8	Standby Module mode
9	FCR status
10	Primary Module is active
11	Active Module is simulated

The Active Module chassis and slot numbers indicate the position of the currently Active Module. These values will change to match the primary or secondary Module position, depending on their Active status, that is, Active/Standby changeover will "swap" the values for the Active Module chassis and slot number channels with those in the standby Module chassis

and slot number channels. The chassis and slot numbers are set to zero if the Module is not present.

The Active and Standby Module healthy channel is returned as an integer, however only the least significant bit is used. A value of 0 indicates that a fault has been detected, a nonzero value indicates that the Module is healthy.

The Active and Standby Module Mode is an integer indicating the current operating mode of the associated Module. The value indicates the current internal operating mode of the Module.

Table 15 Rack 8: INFO bit Descriptions

Value	Module Mode
5	Shutdown
4	Maintain
3	Active
2	Standby
1	Configuration
0	Unknown, no Module present

The FCR Status channel reports the fault status of the Active and Standby Modules. The value is bit-packed as shown below, the least significant byte is used with the most significant 8 bits set to zero:

Table 16 Rack 8: FCR bit Descriptions

Bit							
7	6	5	4	3	2	1	0
Standby Module				Active Module			
Ejectors open	FCR C Healthy	FCR B Healthy	FCR A Healthy	Ejectors open	FCR C Healthy	FCR B Healthy	FCR A Healthy

The 'Primary Module is active' channel is set to nonzero if the primary Module is the current Active Module, that is, the Active Module is in the chassis and slot numbers defined within the OEM parameters.

The 'Active Module is simulated' channel is set to nonzero if the Active Module is being simulated, this will only be set if the Module is not present or the simulation enable has been set within the Module's configuration in the System.INI file.

Each Boolean Output Variable can be configured for automatic Sequence of Events (SOE) logging. This applies to the Output Status and Line Fault Status variables. A Boolean variable is configured for SOE during the variable definition in the Data Dictionary Editor. To select SOE, press the Extended Button in the Boolean Variable Definition Dialog Box to open the Extended Definition Dialog. Then check to box for Sequence of Events to enable the variable for automatic SOE logging.

During operation, the Output Module automatically reports time-stamped change of state information for the output data. The TMR Processor automatically logs change of state for configured SOE variables into the system SOE Log. The SOE Log can be monitored and retrieved using the SOE and Process Historian Package running on the EWS. This software package is

Sequence of Events Configuration

System.INI File Configuration

described in Trusted Sequence of Events and Process Historian Package, publication [ICSTT-RM243](#) (PD-T8013).

There are many operating characteristics of the Output Module that can be customized for a particular application. The System Configuration Manager is a tool that allows the user to configure the specific operating characteristics for each Module. Descriptions of the items that may be configured for the Trusted 4-20 mA Analog Output Module T8480 are contained in Trusted Toolset Suite, publication [ICSTT-RM249](#) (PD-T8082).

Certain characteristics apply to the entire Module and are considered Module Configurable Items. Other characteristics apply to individual output channels and are considered Channel Configurable Items. There are specific default settings for each of the configurable items. If the default settings are appropriate for a given application, then customization of the Module definition in the System Configuration Manager is not required.