Alarm Manager 128 Library for Coolmay FX3G PLC

Roadmap

- Special register to contain system errors

Changelog

v.1.1

- add - Function to move alarms from D register to M consecutively

Terminology

- Alarm - is an object that stores Boolean state (TRUE\FALSE) along with other specific properties. It is an entity of types - Warning or Error.
- Event - is a reserved bit of TRUE\FALSE state. It is an entity of a type - Message.
- Register alarm - is an action during with Alarm goes from FALSE to TRUE state

Description

This library helps you to manage different alarms and events in you processes. Main concept is that once you initialize all possible alarms. Then you set each alarm with different condition to register alarm state. Then you can get registered alarms filtered buy process number, severity to affect your processes logic in a POU.

You may create 128 alerts.

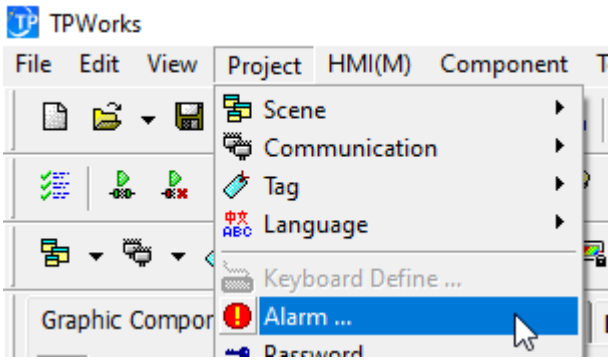
Initialization

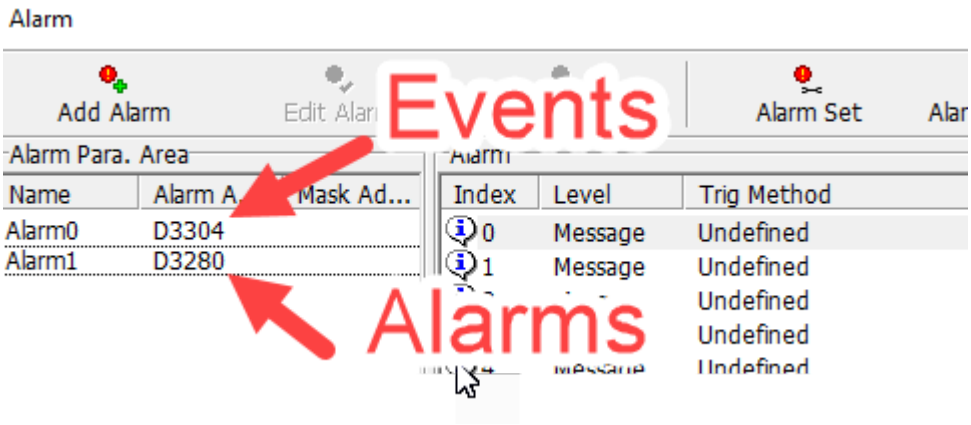
Before you can start using alarms you have to set where you want this data to be stored. When PLC starts use `M8002` set global parameter.

```
IF M8002 THEN
    AM_D_START := 3000;
END_VAR
```

This means that all alerts data will be stored starting from `D3000`. It totally takes 313 registers. So `D3000`-`D3313` will be used to save alerts states and parameters.

To access your alarms from HMI or other device you can use 8 devices starting from `AM_D_START` + 280. For instance if you set `AM_D_START` to 3000, then `D3280` - `D3287` will contain states of your alarms by bits. `D3280.0` is alarm ID 0, `D3287.F` is alarm ID 127.

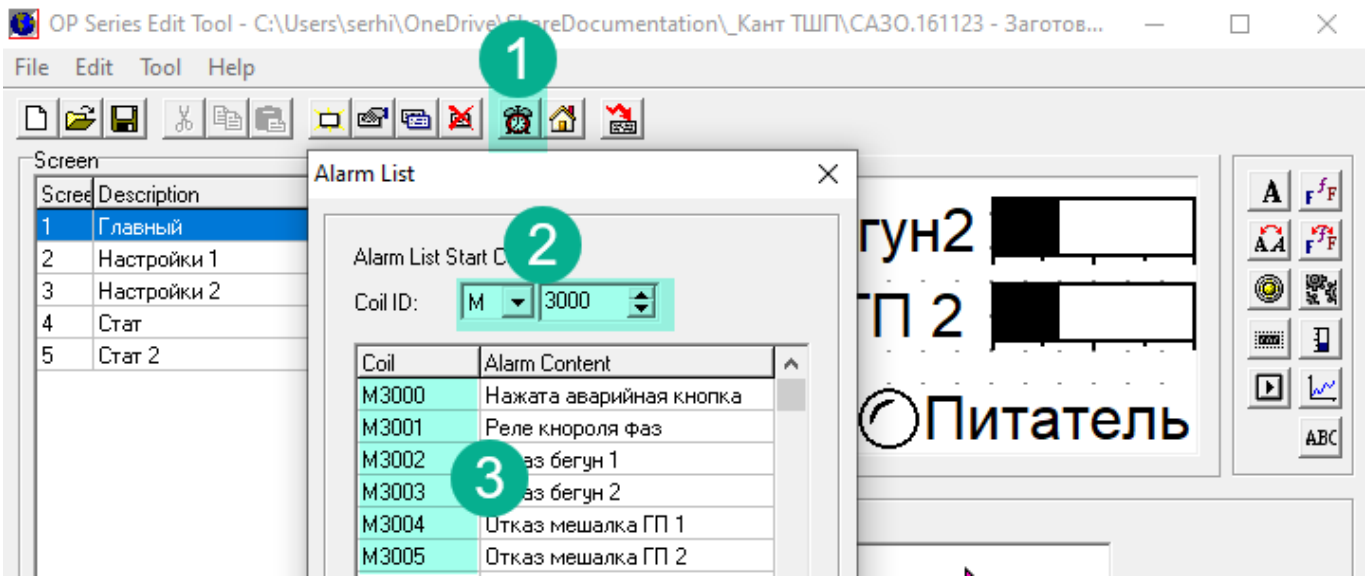




Sometimes HMIs alarm manager does not support read from `D` devices but only from `M` devices. For instance OP320A/S. In this case you have to use `AM_MOVE_TO_M` function.

```
M0 := AM_MOVE_TO_M(AM_D_START, 3000);
```

This will move bits from `D3280` to `M3000` and you can access alarms in the HMI.



Functions $ Function Blocks

Name	Type	Description
`AM_INIT`	Function Block	Initialize alarms

Name	Type	Description
AM_SET	Function Block	Set condition for alarm to register
AM_ON	Function	Check individual alarm state
AM_ORISON	Function Block	Check individual alarm state with chain OR
AM_RESET	Function	(Deprecated, use AM_RST) Reset all alarms
AM_RST	Function Block	Reset all alarms
AM_IS_BLOCK	Function Block	Check if there are blocking alarms
AM_HAS_ALARM	Function Block	Check if there are alarms
AM_BUZZER	Function Block	Check if there are alarms for buzzer
AM_EVENT	Function Block	Create event
AM_EVENT	Function Block	Create event
AM_EVENT_RESET	Function Block	Reset all events latched
AM_MOVE_TO_M	Function	Moves alarm states from D to M.

AM_INIT

This block allows you to initialize properties of all alarms you plan to have. You should run this FB only once when program starts. You can use M8002 flag to run block of code or separate program POU in a new Task.

Variable	Scope	Type	Description
iNum	INPUT	ANY16	Alarm ID. From 0 to 128
iSeverity	INPUT	ANY16	Severity of an alarm
iProcess	INPUT	ANY16	Number of process.
xLock	INPUT	Bit	Does this alarm should lock (stop) the process
xLatch	INPUT	Bit	Is it a latching alarm
xBuzzer	INPUT	Bit	Does this alarm produce buzzer signal

Alarm Properties

iSeverity

Severity defines weight of your alarm. Although it does not treat alarms differently and do not do any additional actions because of this property. It is lately used for filtering alarms. The values could be as number as global constant:

- 0 - Not set
- 1 - Message AM_INFO
- 2 - Warning AM_WARNING

- `3` - Error `AM_ERROR`

`iProcess`

Process number. This is a way to group your alarms to different categories. You can use any numbers here. For instance you have 2 different processes in your program. If one stops another should continue to work. So you init different alarms in different processes (groups) and then when check for registered alarms you can filter by this property.

`xLock`

Indicates either this alarm should lock or stop the process. Let's say you have gas heater. If fire detector fail to see fire you want to close Gaz valve. Then you setup "No fire" alarm as locking, and then you filter for all locking alarms and lock process if it is found.

`xLatch`

Latching alarms do not deregister itself when gone and require manual reset by operator. None-latching alarms are automatically deregistered as soon as an alarm condition switch to FALSE.

`xBuzzer`

Should this alarm to activate buzzer.

Example

Define function block instance in Local Label of your POU.

```
VAR
    fbAMInit: AM_INIT;
END_VAR
```

Now in the body of POU

```
IF M8002 THEN
    (* Sensor od AD0 of pressue lost connection *)
    fbAMINIT(iNum := 0, iProcess := 1, iSeverity := 2,
        xLock := TRUE, xLatch := FALSE, xBuzzer := TRUE);

    (* No fire alarm on X10 input *)
    fbAMINIT(iNum := 1, iProcess := 1, iSeverity := 3,
        xLock := TRUE, xLatch := TRUE, xBuzzer := TRUE);
END_IF
```

AM_SET

This FB register alarms conditions. This is used on every program cycle.

Variable	Scope	Type	Description
iNum	INPUT	ANY16	Alarm ID. From 0 to 127
xState	INPUT	Bit	Condition for alarm to be registered

Example

Define function block instance in Local Label of your POU.

```
VAR
    fbAMSet: AM_SET;
END_VAR
```

Now in the body of POU

```
fbAmSet(iNum := 0, xState := (D8030 = 32760));
fbAmSet(iNum := 1, xState := (NOT X10));
```

If you want to use delay for alarm you have to use it manually. Turned out that it is hard to reserve even 32 not to say 128 timers when those could even not used. This version of Alarm Manger I give timeout control to user. Here is how.

```
(* Alert will be set after 0.5 second (1 = 100ms) *)
OUT_T((D8030 = 32760), TC0, 5);
fbAmSet(iNum := 0, xState := TS0);

(* Alert will be set after 1 second (1 = 100ms) *)
OUT_T((NOT X10), TC1, 10);
fbAmSet(iNum := 1, xState := TS1);
```

AM_ON

This is a function that detects a presence of a single alarm. Although it requires to input all those global variable, you can use this functions inside expression without saving result into intermidiate marker.

Variable	Scope	Type	Description
DNUM	INPUT	ANY16	Global variable AM_D_START.
ANUM	INPUT	ANY16	Global constant AM_BLOCK_ALARM
iNum	INPUT	ANY16	Alarm ID. From 0 to 128

This function little bit cluttered, because we cannot use global variables in the function we have to pass it as a parameter. This makes it a bit long but as an exchange you can use it as a function in expressions.

```
xErrorSensor := AM_ON(AM_D_START, AM_BLOCK_ALARM, 0);

IF AM_ON(AM_D_START, AM_BLOCK_ALARM, 1) THEN
    (* Do something *)
END_IF;
```

AM_ORISON

This function block allow to check few alarms and combine them by OR logic.

Variable	Scope	Type	Description
iNum	INPUT	ANY16	Alarm ID.
Q	IN_OUT	Bit	Result.

Define FB

```
VAR
    fbAMOrIsOn: AM_ORISON;
    xResult: Bit;
END_VAR
```

Then in POU

```
xResult := FALSE;
fbAMOrIsOn(iNum := 0,  Q := xResult);
fbAMOrIsOn(iNum := 5,  Q := xResult);
fbAMOrIsOn(iNum := 11, Q := xResult);

IF xResult THEN
    (* On of the 0, 5, 11 alarms is ON *)
END_IF;
```

AM_RESET

Reset all alarms. Deprecated. Use AM_RST function block instead.

Variable	Scope	Type	Description
DNUM	INPUT	ANY16	Global variable AM_D_START.
DSTATE	INPUT	ANY16	Global constant AM_BLOCK_STATE.

Example

```
IF MEP(xResetAlarms) THEN
    M0 := fbAMReset(AM_D_START, AM_BLOCK_STATE);
END_IF;
```

Again, because we cannot use global variables in function we have to pass it as a parameters. Also any function call should have left hand side, thus `M0 :=` is required.

AM_RST

Reset all alarms. If you reset stated during one cycle, sometimes it is too fast to register alarm reset sync with HMI. It requires little bit longer reset time. This is what this FB is for. It holds resets during 1 second.

Variable	Scope	Type	Description
`IN`	IN_OUT	Bit	Signal to reset by.

Example

Define FB

```
VAR
    fbAMRst: AM_RST;
END_VAR
```

And then call in program

```
fbAMRst(IN := xReset);
```

As an `IN` parameter use bit that should reset alarms. After alarms are reset this bit is reset too. So you may pass here a pulse or SET ON variable and it will reset itself after 1 second.

AM_IS_BLOCK

Detects if there are registered alarms with `xLock` property `TRUE`.

Variable	Scope	Type	Description
`iProcessNum`	INPUT	ANY16	Number or process. If 0 will search through all alarms. If number will match against `iProcess` property of alarm given during initialization.

Variable	Scope	Type	Description
`iSeverity`	INPUT	ANY16	Severity level. If 0 will search through all alarms. If number will match against `iSeverity` property of alarm given during initialization.
`Q`	OUTPUT	Bit	Result

Example

Define function block instance in Local Label of your POU.

```
VAR
    fbAMBlock: AM_IS_BLOCK;
END_VAR
```

Now in the body of POU. This example will have `Q` active if any registered alarm with `xLock` property is found.

```
fbAMBlock();
IF NOT fbAMBlock.Q THEN
    (* Do something if there is not blocking alarm *)
END_IF;
```

This example will have `Q` active if any registered alarm with `xLock` property and severity level 3 (Error) is found.

```
fbAMBlock(iSeverity := 3);
IF NOT fbAMBlock.Q THEN
    (* Do something if there is not blocking alarm *)
END_IF;
```

AM_HAS_ALARM

Detects if there are any registered alarms.

Variable	Scope	Type	Description
`iProcessNum`	INPUT	ANY16	Number or process. If 0 will search through all alarms. If number will match against `iProcess` property of alarm given during initialization.
`iSeverity`	INPUT	ANY16	Severity level. If 0 will search through all alarms. If number will match against `iSeverity` property of alarm given during initialization.
`Q`	OUTPUT	Bit	Result

Example

Define function block instance in Local Label of your POU.

```
VAR
    fbAMHas: AM_HAS_ALARM;
END_VAR
```

Now in the body of POU. This example will have `Q` active if any registered alarm is found.

```
fbAMHas();
IF NOT fbAMHas.Q THEN
    (* Do something if there is not blocking alarm *)
END_IF;
```

This example will have `Q` active if any registered alarm with severity level 3 (Error) is found.

```
fbAMHas(iSeverity := 3);
IF NOT fbAMHas.Q THEN
    (* Do something if there is not blocking alarm *)
END_IF;
```

AM_BUZZER

Detects if there are any registered alarms with `xBuzzer` property.

Variable	Scope	Type	Description
`Q`	OUTPUT	Bit	Result. One pulse when number of alarms increases

Example

Define function block instance in Local Label of your POU.

```
VAR
    fbAMBuzzer: AM_BUZZERER;
END_VAR
```

Now in the body of POU. This example will have `Q` active if any registered alarm with `xBuzzer` property is found. In this example `DO_Buzzer` is an PLC output for buzzer, `DI_BuzzerReset` is a PLC input button to reset buzzer signal.

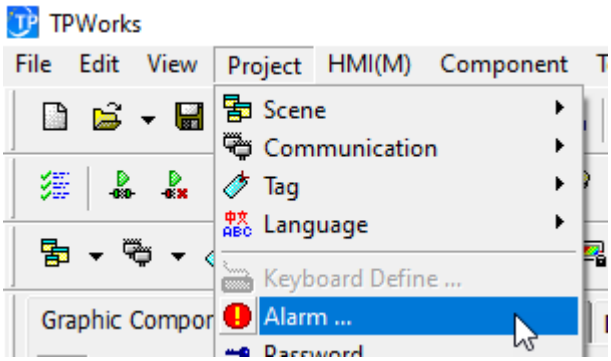
```
fbAMBuzzer();
SET(fbAMBuzzer.Q, DO_Buzzer);
RST(DI_ButtonBuzzerReset, DO_Buzzer);
```

Events

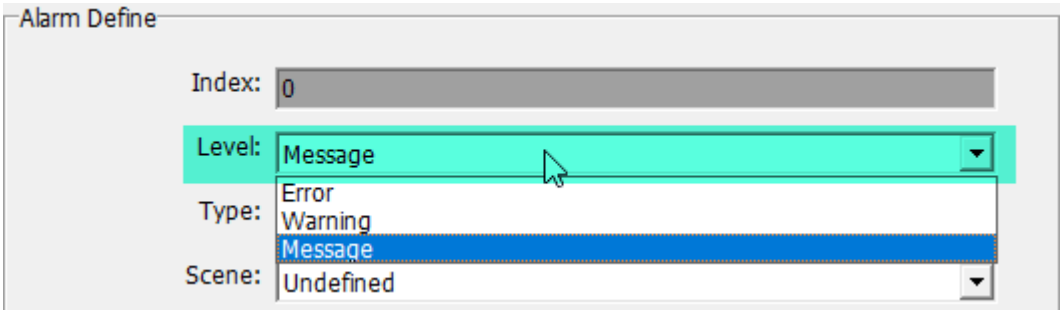
Events are almost the same as alarms but do not have so many parameters. The main problem here is limitation of program to 32k steps. If create library for 256 alarms, if fully utilized, it might take 20k steps.

On the other hand there might be a lot of events that you only need to path to HMI to Alarm Manger as an information without using it in logic.

First note that in Coolmay HMI there is no separation between Alarms and Events. They all should be registered in Alarms manager. But in other HMIs alarms list and Events list are separated.

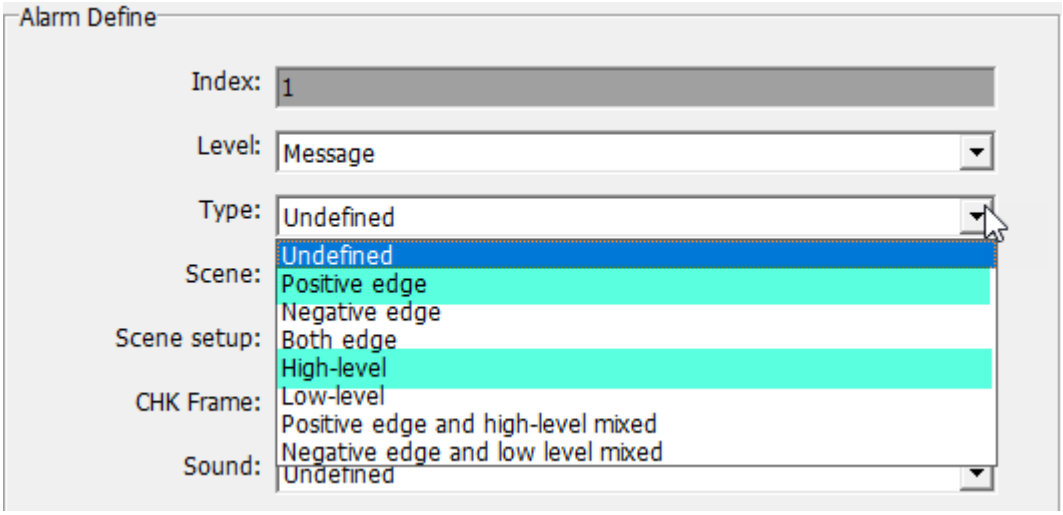


You just need to register them as Messages type.

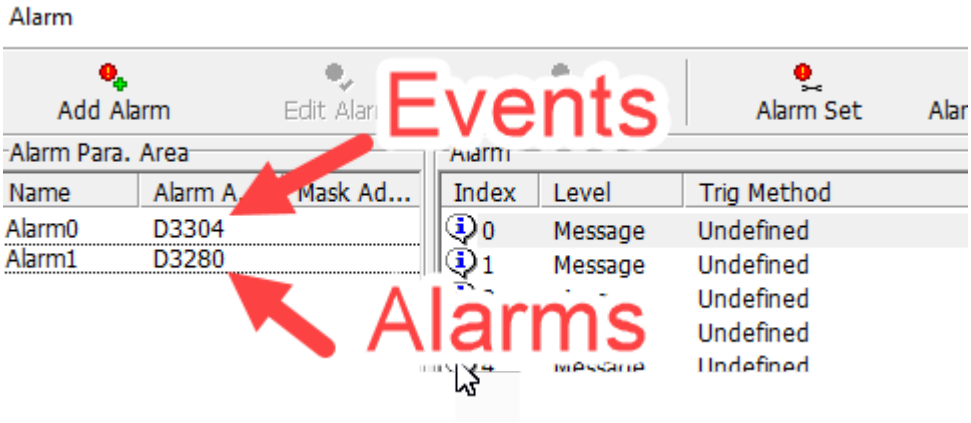


There are basically 2 main event types:

- Positive Edge - Events of this type will self clear from active events to history after few seconds. Even if event is Latched.
- High Level - Events of this type will stay in active events table as long as event state is `TRUE`.



To access event in HMI you read 8 registers starting from `AM_D_START` + 304. For instance, you set `AM_D_START := 3000` then events will be stored in `D3304` - `D3312`. Every register stores 16 events, one for each bit. `D3304.0` will be even ID 0

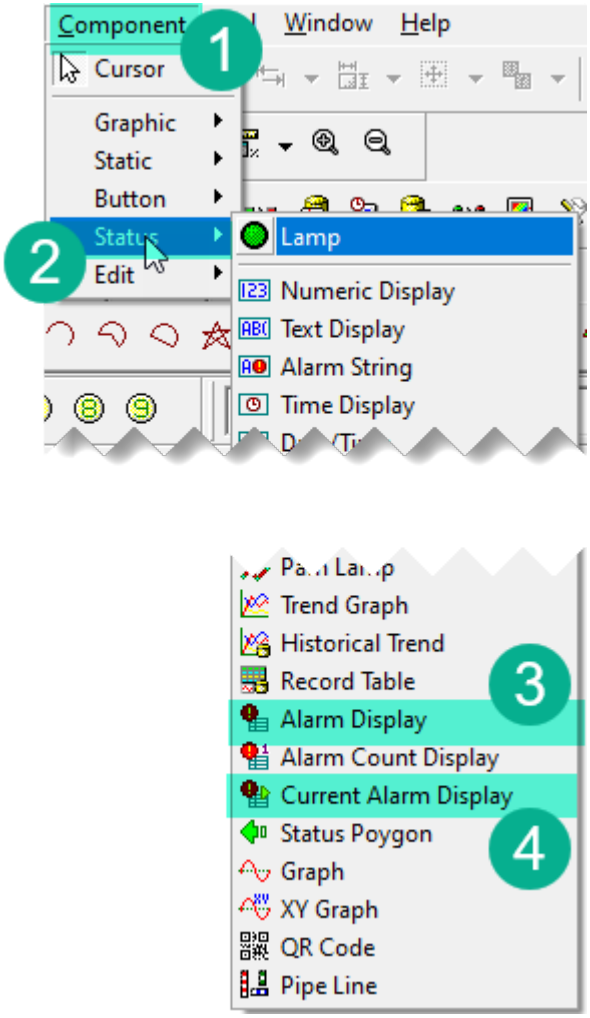


AM_EVENT

Adds new event.

Variable	Scope	Type	Description
`EventNum`	INPUT	(Word[Signed])	ID of the event
`EventState`	INPUT	Bit	Event state
`EventLatch`	INPUT	Bit	Should this event be latched

All events with state `TRUE` are shown in current alarms table (4) and in Alarms history table (3). **Positive Edge** events in few seconds disappear from current alarms table and **High Level** events stay in current alarms table as long as they remain active. After event goes to `FALSE` it is still in alarms history but not in current alarm table.



Example

Define function block instance in Local Label of your POU.

```
VAR
    fbAMEvent: AM_EVENT;
END_VAR
```

Now in the POU.

```
(* Button started activated *)
fbAMEvent(EventNum := 0, EventState := X0);
(* Button started deactivated *)
fbAMEvent(EventNum := 2, EventState := NOT X0);
(* Water pump start working *)
fbAMEvent(EventNum := 3, EventState := Y0);
```

AM_EVENT_RESET

Reset all events. This should be called only if you have Latched events. Otherwise events reset itself.

Variable	Scope	Type	Description
IN	IN_OUT	Bit	Command to reset events

Parameter IN is self cleared after 1 second.

```
VAR
    fbAMEventReset: AM_EVENT_RESET;
END_VAR
```

Now in the POU.

```
fbAMEventReset(IN := xReset);
```

AM_MOVE_TO_M

Move current states of alarms from D device to M devices.

Variable	Scope	Type	Description
startr	INPUT	(Word[Signed])	Constant for start D device
mnum	INPUT	(Word[Signed])	Start M device

Example

```
M0 := AM_MOVE_TO_M(AM_D_START, 3000);
```

Now state of alarm 0 will be in M0, and alarm 17 in M17 and so on.