

## Automatic sequential switching

### Objective

By application of CFC logic in a SIPROTEC device, an automated sequential switching must be implemented so that, for maintenance purposes in the switchgear bay, earthing is automatically applied. As soon as the earthing switch is closed, the circuit breaker must be closed automatically.

### The CMD-CHAIN module

A module of the expanded CFC library is the command chain module CMD\_CHAIN. This module is ideally suited for defining the progression of switching sequences. Monitoring of the individual stages of a sequence or command chain is one of the main advantages of this module. Amongst others, the feed-back signals of activated commands are monitored. The initiation of the switching sequence may be derived from a number of information sources. Every stage of the switching sequence is individually monitored so that in the event of a fault, the switching sequence is immediately stopped and reset. The following are typical examples for switching sequences:

- Isolation of a feeder
- Bus-bar transfer
- Automatic earthing etc.

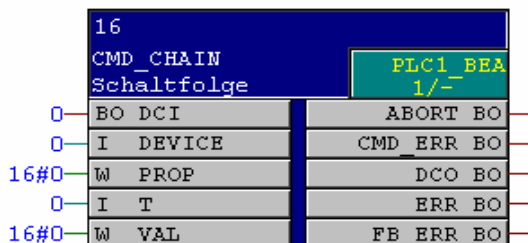


Figure 1: CMD\_CHAIN Module

### Solution

Initially the CMD\_CHAIN module is started via the DCI Input. In this example, the switching command will be initiated by the Function Key 1. Initially a new internal single point (Tagging) event must be applied in the matrix and then be allocated with Source “F” and Destination “CFC”.

	Information				Quelle			Ziel					
	Nummer	Displaytext	Langtext	Typ	BE	F	C	BA	LE	P	C	B	ST
											A	G	
Fx-Tasten		F1-Erden	F1-Erden	IE		1					X		

Figure 2: Internal single point event (Tagging) for allocation to a function key (in this case F-Key 1)

The high state on the *DCI* input of the *CMD\_CHAIN* module originating from the function key causes the initiation of command that is output via the *DEVICE* input.

**Note:** Normally the left hand margin although the left side is defined as “Input” for the CFC chart and the right side as “Output”. But the executing command *DEVICE* by the *CMD\_CHAIN* module is routed to the left hand margin as an output signal !

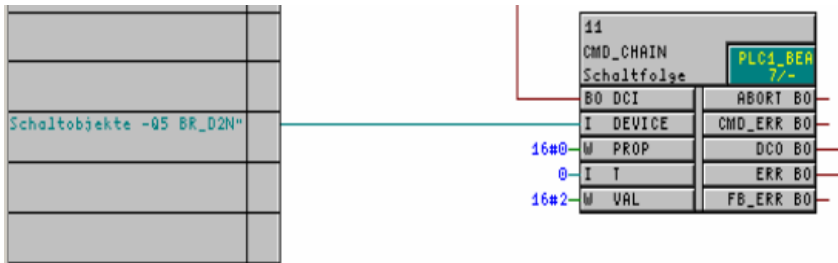


Figure 3: Switching command from *CMD\_CHAIN* module is linked with the input of the CFC!

The command type “Open” or “Close” is selected by the value of the *VAL* input : “2” for close and “1” for open.

Following successful execution of the command the *CMD\_CHAIN* module initiates the next command in the sequence with the output *DCO*. By connecting the output *DCO* of a sequential switching command with the input *DCI* of the next command in the sequence, the switching sequence (“Daisy Chain“) can be created.

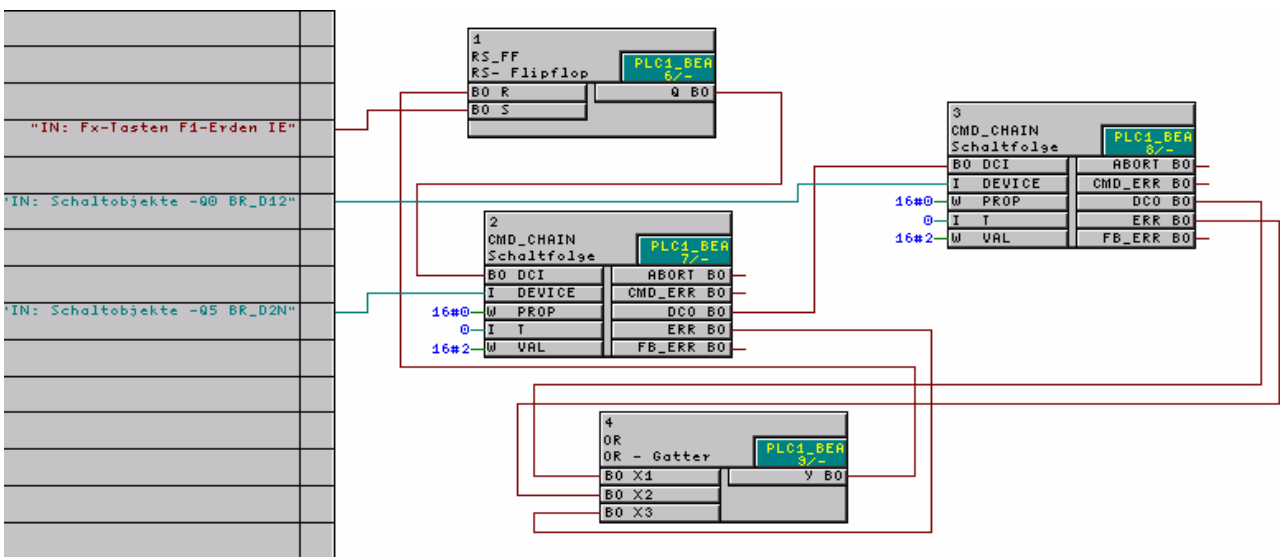


Figure 4: CFC chart automatic earthing

In this example, the command “Earth switch CLOSE” must initiate the command “CB CLOSE”. The second *CMD\_CHAIN* module receives a signal on its *DCI* input following the successful execution of the “Earth switch CLOSE” command and therefore issues a “CB CLOSE” command via its *DEVICE* output. The switching sequences may be expanded, i.e. further *CMD\_CHAIN* modules may inserted in the daisy chain.

The RS\_FlipFlop module (see Figure 4) holds the input signal from the F-Key high for the entire duration of the switching sequence. Successful execution of the switching sequence results in an output at the *DCO* output of the last *CMD\_CHAIN* module which is used to reset the RS\_FlipFlop to allow renewed execution of the switching sequence. If the input at one of the *DCI* of any of the modules resets during the switching sequence, the switching sequence is immediately stopped and reset. The *ERR* output of the *CMD\_CHAIN* modules then provide the reset signal for the RS\_FlipFlop in the event of a fault.

**I/O Assignment:**

	<b>Name</b>	<b>Data type</b>	<b>Comment</b>
<b>Inputs:</b>	DCI	Bool	Daisy Chain input of the block  In a command chain, the input must be interconnected with the <b>DCO</b> output of the preceding <b>CMD_CHAIN</b> block.
	DEVICE	Int	Object address of the command to be addressed  The input must be interconnected with the left border. The name of the command object is entered there.
	PROP	Word	Command ID
	T	Int	Output time (0...65,535)
	VAL	Word	Switching direction
<b>Outputs:</b>	ABORT	Bool	Abort  The output is active if a running command has been canceled.
	CMD_ERR	Bool	Command Error  The output is active if a command has not been executed successfully.
	DCO	Bool	Daisy Chain output of the block  In a command chain, the output must be interconnected with the <b>DCI</b> input of the following <b>CMD_CHAIN</b> block. The output is active if the switching command has been successfully processed by the block.  <b>DCO</b> is switched inactive, as soon as the <b>DCI</b> input has been switched inactive
	ERR	Bool	Group error  The output is active if <b>ABORT</b> , <b>CMD_ERR</b> or <b>FB_ERR</b> is active or, if an internal error has occurred
	FB_ERR	Bool	Feed Back Error  The output is active if command execution does not receive a checkback.

Figure 5: Object properties of the *CMD\_CHAIN* module

It must be noted that the LOOP module can be used for the feedback of signals, for the PLC1 level (slow task), instead of the RS\_FlipFlop

After successful execution the DCI-input of the first CMD\_CHAIN module of the switching sequence must be set back to zero to terminate the switching sequence and to be prepared for the initiation of a new sequence. This may be done with the LOOP-module which detects if the sequence has been carried out successfully, in a maximum of 5 execution cycles of the CFC chart, and may therefore be reset.



Figure 6: LOOP module