
FUNCTION BLOCK DESCRIPTION

# Overfrequency protection

## ANSI 81O, IEC F>, F>>

PROTECTA HUNGARY

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PROTECTION, AUTOMATION AND CONTROL FOR POWER INDUSTRY

## VERSION INFORMATION

| VERSION | DATE | MODIFICATION | COMPILED BY |
|---|---|---|---|
| Preliminary | 2009-11-24 | Preliminary version, without technical information | Petri |
| | 2010-10-05 | Naming revision | Csipke |
| 1.0 | 2010-11-11 | First edition | Petri |
| 1.1 | 2016-12-21 | Technical data table updated, minor formatting | Erdős |
| 1.2 | 2017-06-08 | Min. operate time lowered | Erdős |
| 2.0 | 2019-06-05 | Technical data table updated according to IEC 60255-181 tests; new design (parameter listing updated, new look), event list added, notes for testing added | Erdős |
| 2.1 | 2020-02-11 | Online data table corrected | Erdős |
| 2.2 | 2021-07-30 | **Modified:**<br>• 2.3 Technical data updated<br>• 2.3.1 Notes for testing<br>• Description of parameter U limit added | Tóth F.,<br>Seida Z. |
| 3.0 | 2024-12-10 | **Added:**<br>• Graphic analogue input<br>• IEC61850 data attributes<br>**Modified:**<br>• Technical data updated with accuracy data applying CVS module<br>• Additional notes for graphic analogue inputs<br>• Minor corrections | Seida,<br>Ádám,<br>Erdős |
| | | | |

# CONTENTS

# 1 Application

The deviation of the frequency from the rated system frequency indicates unbalance between the generated power and the load demand. If the available generation is large compared to the consumption by the load connected to the power system, then the system frequency is above the rated value. The overfrequency protection function is usually applied to decrease generation to control the system frequency.

Another possible application is the detection of unintended island operation of distributed generation and some consumers. In the island, there is low probability that the power generated is the same as the consumption; accordingly, the detection of high frequency can be one of the indications of island operation.

## 1.1 Mode of operation

Depending on the hardware-software configuration, the frequency measurement is usually based on channel No. 1 (line voltage) and channel No. 4 (busbar voltage) of any voltage input module.

The accurate frequency measurement is performed by measuring the time period between two rising edges and also between two falling edges at zero crossing of a voltage signal. The frequency value is calculated by the average of these two values. At each zero crossing the average value (and the frequency) is recalculated.

For the acceptance of the measured frequency, at least four subsequent valid measurements are needed. Similarly, four invalid measurements are needed to reset the measured frequency from the last valid value to zero.

The minimum voltage condition can be set as a parameter for enabling the evaluation of the frequency. This parameter is called U limit.

The overfrequency protection function generates a start signal if at least five measured frequency values are above the preset level.

# 2 Overfrequency protection function overview

The graphic appearance of the function block of the overfrequency protection function is shown below. The block shows all binary input and output status signals which are applicable in the graphic equation editor.

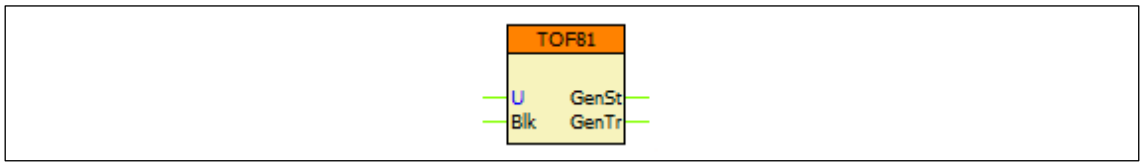


Figure 2-1 Graphic appearance of the function block of the overfrequency protection function

## 2.1 Settings

### 2.1.1 Parameters

The available parameters are listed below in order of their appearance in the *parameters* menu. If the setting range of a parameter should be extended, contact Protecta Support.

Table 2-1 Parameters of the overfrequency protection function

| TITLE | DIM | RANGE | STEP | DEFAULT | EXPLANATION |
|---|---|---|---|---|---|
| Operation | - | Off, On | - | Off | Enabling the function |
| Start Signal Only | - | FALSE, TRUE | - | FALSE | Enabling start signal only |
| Start Frequency | Hz | 40.00 – 70.00 | 0.01 | 51.00 | Setting value of the comparison |
| U limit | *Un | 0.10 – 1.00 | 0.01 | 0.45 | Minimum voltage condition for enabling the operation of the function |
| Time Delay | msec | 140* – 60000 | 1 | 200 | Time delay (including the algorithm time, see Chapter 2.3.1 for more explanation) |

**The minimum operate time is lower than the settable minimum delay, however below this value the timing is less accurate, see Chapter 2.3 for details*

## 2.2 Function I/O

This section describes briefly the analogue and digital inputs and outputs of the function block.

### 2.2.1 Analogue inputs

The function uses the sampled values of a voltage input or a calculated line-to-line voltage. This is defined in the configuration.

### 2.2.2 Analogue outputs (measurements)

**Graphic Analogue inputs *(only from firmware version 2.10.2.3010 and up)***

The sources of the analogue inputs are defined by the user, applying the graphic equation editor (*Logic Editor*). Parts written in **bold** are seen on the left side of the function block in the Logic editor.

The frequency measurement is displayed *MXU_F – frequency measurement* function which is an independent function.

Table 2-2 The analogue input signal of the overfrequency protection function

| ANALOGUE INPUT SIGNAL | SIGNAL TITLE | EXPLANATION |
|---|---|---|
| TOF81_**U**_AnIn | Voltage | Input for voltage |

The applied analogue connectors must be identical to the analogue input type (i.e. voltage to voltage input etc.), Invalid connections are not allowed.

### 2.2.3 Binary input signals (graphed output statuses)

The conditions of the binary inputs are defined by the user, applying the graphic equation editor (*Logic Editor*). Parts written in **bold** are seen on the left side function block in the Logic editor.

Table 2-3 The binary input signal of the overfrequency protection function

| BINARY INPUT SIGNAL | EXPLANATION |
|---|---|
| TOF81_**Blk**_GrO_ | Blocking input of the function |

### 2.2.4 Binary output signals (graphed input statuses)

These signals can be used in EuroCAP to assign to LED, user LCD object etc. Parts written in **bold** are seen on the right side of the function block in the *Logic Editor*.

Table 2-4 The binary output signals of the overfrequency protection function

| BINARY OUTPUT SIGNAL | SIGNAL TITLE | EXPLANATION |
|---|---|---|
| TOF81_**GenSt**_GrI_ | General Start | General start signal of the function |
| TOF81_**GenTr**_GrI_ | General Trip | General trip command of the function |

### 2.2.5 Online data

Visible values on the *online data* page.

Table 2-5 Online displayed data of the overfrequency protection function

| SIGNAL TITLE | DIMENSION | EXPLANATION |
|---|---|---|
| General Start | - | General start signal of the function |
| General Trip | - | General trip command of the function |
| *Voltage input assignment* | - | *Status of the graphical analogue input (if exists) (Complete if OK, Missing if not connected)* |

### 2.2.6 Events

The following events are generated in the event list, as well as sent to the SCADA according to the configuration.

Table 2-6 Generated events of the overfrequency protection function

| EVENT | VALUE | EXPLANATION | IEC61850 DATA ATTRIBUTES |
|---|---|---|---|
| General Start | off, on | General start of the function | TOF81PTOF1$ST$Str |
| General Trip | off, on | General trip command of the function | TOF81PTOF1$ST$Op |

## 2.3 Technical data

The technical data, except for the min. operate voltage, are based on the function block testing according to the directives of the **IEC 60255-181:2019** standard.

Table 2-7 Technical data of the overfrequency protection function

| FUNCTION | VALUE | ACCURACY |
|---|---|---|
| Operate range | 40 - 60 Hz (50 Hz system)<br>50 - 70 Hz (60 Hz system) | ± 3 mHz (20 mHz*) with VT+/xxxx voltage transformer input module<br>± 3 mHz (70 mHz*) with CVS+/xxxx sensor input module |
| Effective range | 45 - 55 Hz (50 Hz)<br>55 - 65 Hz (60 Hz) | ± 3 mHz (10 mHz*) with VT+/xxxx voltage transformer input module<br>± 3 mHz (70 mHz*) with CVS+/xxxx sensor input module |
| Min. operate time | 93 ms (50 Hz)<br>73 ms (60 Hz) | ± 32 ms<br>± 27 ms |
| Time delay | 140 – 60000 ms<br><140 ms (50 Hz)<br><140 ms (60 Hz) | ± 4 ms<br>± 32 ms<br>± 27 ms |
| Reset frequency | [Start freq.] – 101 mHz | ± 1 mHz |
| Reset time | 98 ms (50 Hz)<br>85 ms (60 Hz) | ± 6 ms |
| Reset ratio for U limit | 0.8 | |

**with the harmonic content according to the standard*

### 2.3.1 Notes for testing

Normally in the EuroProt+ devices the trip contacts are assigned to the Trip Logic function block, and not to the protection function blocks. Because of this, the testing personnel must make sure that the Trip Logic is switched on ('Operation' parameter is set to other than 'Off') before starting the tests, otherwise there will be no physical trip on the relay.

Note that the time delay parameter incorporates the algorithm time as well, so the time delay *does **not** mean the time difference between the appearance of the start and trip signals* of the function. In other words: it is not the delay between the detection of the fault and the trip that follows it. This should be taken into consideration when checking the disturbance records.

Instead, the time delay parameter defines the elapsed time from the appearance of the faulty state to the trip. Because of this, while testing, the delay measurement should start *from the moment of the fault injection* until the trip signal.

The source voltage for frequency measurement is defined by the voltage input of the functionblock. This can be checked in the functionblock properties in EuroCAP

Before the fault injection at least 1 second pre-fault should be simulated with nominal frequency and voltage.

Based on IEC 60255-181 standard recommendations, the operation time shall be measured with a frequency of 0.5Hz higher than the setting value for Start frequency.

**Additional notes for Graphic Analogue inputs *(only from firmware version 2.10.2.3010 and up):***

Starting from the firmware version **2.10.2.3010**, the majority of the function blocks can be updated to be equipped with graphic analogue inputs which **allow the user to assign the functions' analogue inputs by applying the graphic equation editor**.

The analogue connections of these functions can be checked by examining the source that is connected to their inputs (just like examining the source of a logic signal).

These functions must be placed in the Logic Editor and their graphic analogue inputs must be connected to make them operate. If a connection is intact, the online status of the corresponding analogue input will show "Complete". If it is missing, the status will be "Missing" and the function will not operate.

*Note that these graphical inputs do not exist in the earlier firmware/function versions (2.8.x.xxxx)! Checking and modifying the analogue assignments in these cases are done by using the EuroCAP Software Configuration menu.*