

FUNCTION BLOCK DESCRIPTION

Motor Startup Supervision

ANSI 48/66, IEC Istart/I(t)



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PROTECTION, AUTOMATION AND
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VERSION INFORMATION

VERSION	DATE	MODIFICATION	COMPILED BY
1.0	2010-11-11	First edition	Petri
1.1	2014-01-08	New integer parameter and output status signal	Petri
2.0	2022-03-03	New design, new chapters (overview, notes for testing) added	Saina, Erdős

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1 Application

1.1 Monitoring the Startup

The available functions of the motor startup supervision provide optimal protection during the startup procedure.

The starting process, which is an extreme stress for the motor, is automatically detected based on the fact that the current is zero before starting (below the set *Idle Current* parameter), then it increases above that level. During the motor starting process, the duration of which is limited by the *Start-up Time* parameter, a dedicated binary output signal indicates the startup process. This signal can be applied, for instance, to activate the startup overcurrent protection function, which takes over the protection tasks from the normal overcurrent protection functions.

During the starting time the normal overcurrent protection function is not effective, but the special overcurrent function can operate without any considerable time delay: if the current rises above the increased current setting, the function generates an immediate trip command for the circuit breaker. Based on the starting signal at the end of the successful starting process, the normal overcurrent function is activated again, the setting of which can be below the starting current, providing optimal protection for the motor.

1.2 Locked Rotor Protection

If the starting process of the motor lasts too long, the motor is subject to a harmful overstress. If the starting current in excess of the motor *Start-up Current* parameter value can be detected after the defined *Start-up Time*, the function generates a trip command.

1.3 Operation of the Motor Startup Supervision

As the basic setting, the rated current of the motor must be defined as a percentage of the rated current of the current transformer. The parameter is *InMotor/InCT*.

The starting state is recognized by the algorithm if the current changes from zero value (below the *Idle Current* limit) to a higher current. This event triggers a timer, which is in “running” state for the starting time set, then it changes to the “time-out” state. The starting time is set by the parameter *Start-up Time*. The output signal is **MSS48_Starting_Grl_** (Starting).

If the current is above the *Idle Current* limit, then the motor is considered to be in running state, which is indicated by the signal **MSS48_Running_Grl_** (Running).

If the timer defined by the *Start-up Time* parameter runs out, then the current must be below a level defined by the parameter *Start-up Current*. Otherwise, it is an indication of prolonged startup time or a locked rotor. In this case, the function generates a signal, which can be applied to interrupt the starting procedure by tripping the circuit breaker. The output signal is **MSS48_LongStr_Grl_** (Long Start).

When the startup timer runs out, another independent timer is started. During the running time of this second timer no restarting is allowed because the repeated increased starting current could cause overheating in the motor. This inhibition timer's designated parameter is the *Restart Time*. The restart inhibition time is also started if the starting process is interrupted and the current falls below the *Idle Current*. The restart inhibition output signal is **MSS48_ReStrInh_Grl_** (Restart Inhibited).

The function counts the subsequent startups within the last hours. This count must not be above the permitted startup numbers, defined by a dedicated parameter. If this parameter is 0 then no limit is considered. The last remaining restart possibility is indicated by an output status signal of the function block. After the last restart the restart inhibition output signal **MSS48_ReStrInh_Grl_** (Restart Inhibited) is set to 1 state. This state is reset if the first considered restart attempt is out of the last hour.

The **inputs** of the motor startup supervision function are:

- the Fourier base harmonic components of three phase currents,
- binary input,
- parameters.

The **output** of the motor startup supervision function is:

- binary output status signals.

2 Motor Startup Supervision Function Overview

The graphic appearance of the motor startup supervision function block is shown in Figure 2-1. This block shows all binary input and output status signals that are applicable in the graphic equation editor.

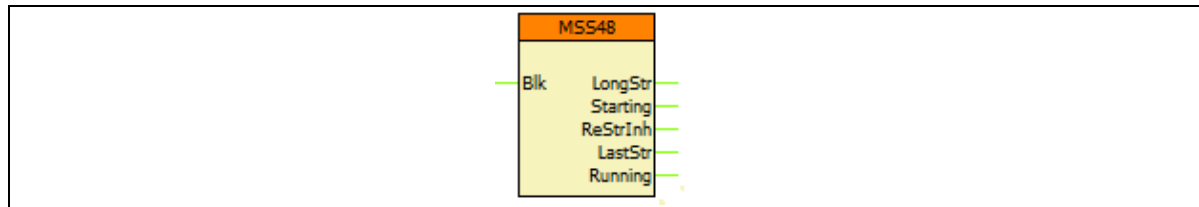


Figure 2-1 The function block of the motor startup supervision function

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 motor startup supervision function

TITLE	DIM	RANGE	STEP	DEFAULT	EXPLANATION
Operation	-	Off, On	-	Off	Parameter for disabling or enabling the operation of the function.
InMotor/InCT	%	20 – 150	1	100	Rated current of the motor as a percentage of the rated current of the CT.
Start-up Current	%	50 – 1000	1	200	Current limit above which the motor is considered to be in startup mode. Set as a percentage of the <i>motor rated current</i> .
Idle Current	%	5 – 50	1	10	Current limit below which the motor is considered to be idle (not running). Set as a percentage of the <i>motor rated current</i> .
Start-up Time	sec	1 – 100	1	5	If this timer runs out, then the motor is not allowed to be in startup mode. Otherwise, it is an indication of prolonged startup or a locked rotor.
Restart Time	sec	10 – 5000	1	20	Timer parameter value below which motor is not allowed to be restarted after an unsuccessful start (restart is inhibited).
No of StartUp	StartUp/Hour	0 – 5	1	0	Number of permitted subsequent startups in a time period of 1 hour.

2.2 Function I/O

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

2.2.1 Analogue Inputs

This function uses the Fourier base harmonic components of three phase currents.

2.2.2 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 of the function block in the Logic editor.

Table 2-2 The binary input signals of the motor startup supervision function

BINARY INPUT SIGNAL	SIGNAL TITLE	EXPLANATION
MSS48_ Bik _GrO_	Block	Input for disabling the function

2.2.3 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 2-3 The binary output signals of the motor startup supervision function

BINARY OUTPUT SIGNAL	SIGNAL TITLE	EXPLANATION
MSS48_ LongStr _Grl_	Long Start	Indicates prolonged starting time or locked rotor state
MSS48_ Starting _Grl_	Starting	The motor is in startup mode
MSS48_ ReStrInh _Grl_	Restart Inhibited	The restart of the motor is inhibited
MSS48_ Running _Grl_	General Trip	The motor is running
MSS48_ LastStr _Grl_	LastStrNext	Indication if only one permitted restart is left

2.2.4 Online Data

The following values are visible in the *online data* page.

Table 2-4 Online data of the motor startup supervision function

SIGNAL TITLE	DIMENSION	EXPLANATION
Last Start-up Inrush	%	Magnitude of the inrush current during the last startup
Last Start-up Time	sec	Duration of the last startup
No of starts	-	Counter for number of subsequent starts
Long Start-up	-	Indicates prolonged starting time or locked rotor state
Starting	-	The motor is in startup mode
Restart Inh.	-	The restart of the motor is inhibited
Running	-	The motor is running
LastStrNext	-	Indication if only one restart is left

2.2.5 Events

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

Table 2-5 Generatable events of the motor startup supervision function

EVENT	VALUE	EXPLANATION
Last Start-up Inrush	...%	Magnitude of the current during the last startup
Last Start-up Time	...sec	Duration of the last startup
Long Start-up	off, on	Indicates prolonged starting time or locked rotor state

2.3 Technical Data

Table 2-6 Technical data of the motor startup supervision function

FUNCTION	VALUE	ACCURACY
Current accuracy	20 – 2000% of I_n	< 6%
Reset ratio	0.95 at startup current (0.7 at idle current)	
Operating time accuracy		+5% or ± 15 ms, whichever is greater
Reset time	< 60 ms	

2.4 Notes for Testing

Keep in mind that setting values are set based on the motor rated current.