Description

The SIPROTEC 7SK85 motor protection device is designed for the protection of motors of all sizes. With its modular structure, flexibility and the high-performance DIGSI 5 engineering tool, SIPROTEC 7SK85 offers future-oriented solutions for protection, control, automation, monitoring, and Power Quality – Basic.

For motors in explosive environments, the SIPROTEC 7SK85 is also available with EN 60079-14 or VDE 0165, Part 1, ATEX (Verband der Elektrotechnik, Elektronik und Informationstechnik) certification.

Main function	Motor protection for motors of all sizes
Inputs and outputs	3 predefined standard variants with 4 current transformers, 4 voltage transformers, 11 to 27 binary inputs, 9 to 17 binary outputs
Hardware flexibility	Flexibly adjustable and expandable I/O quantity structure within the scope of the modular SIPROTEC 5 system. 1/6 expansion modules can be added, available with large or small display, or without display
Housing width	1/3 × 19 inches to 2/1 × 19 inches

Benefits

- Safety due to high-performance protection functions
- Purposeful and easy handling of devices and software thanks to a user-friendly design
- Cybersecurity in accordance with NERC CIP and BDEW White-paper requirements
- Highest availability even under extreme environmental conditions by standard coating of the modules
- Full compatibility between IEC 61850 Editions 1, 2.0, and 2.1

Functions

DIGSI 5 permits all functions to be configured and combined as required and as per the functional scope that has been ordered.

- Motor protection functions: Starting time supervision, thermal overload protection for stator and rotor, restart inhibit, unbalanced-load protection, load-jam protection
- Stator and storage-temperature monitoring via temperature sensors with external RTD unit.
- Differential motor protection as fast short-circuit protection for motors of high power
- Sensitive ground-fault protection (non-directional, directional) to detect stator ground faults
- Directional and non-directional overcurrent protection (short-circuit protection) with additional functions
- Detection of ground faults of any type in compensated or isolated electrical power systems using the following functions: 3I0>, V0>, transient ground fault, cos φ, sin φ, harmonic, dir. detection of intermittent ground faults and admittance
- Ground-fault detection using the pulse-detection method
- Overvoltage and undervoltage protection
- Arc protection

[SIP5_GD_SS_W3, 2, --_--]

Figure 2.12/4   SIPROTEC 5 Device with Expansion Module

- Power protection, configurable as active or reactive-power protection
- Detection of current and voltage signals up to the 50th harmonic with high accuracy for selected protection functions (such as thermal overload protection) and operational measured values
- PQ – Basic: Voltage unbalance; voltage changes: overvoltage, dip, open circuit; TDD, THD, and harmonics
- Control, synchrocheck, and switchgear interlocking protection
- Graphical logic editor to create high-performance automation functions in the device
- Fixed integrated electrical Ethernet RJ45 interface for DIGSI 5 and IEC 61850 (reporting and GOOSE)
- Up to 4 pluggable communication modules, usable for different and redundant protocols (IEC 61850-8-1, IEC 61850-9-2 Client, IEC 60870-5-103, IEC 60870-5-104, Modbus TCP, DNP3 serial and TCP, PROFINET IO, PROFINET IO S2 redundancy)
- Virtual network partitioning (IEEE 802.1Q - VLAN)
- Reliable data transmission via PRP and HSR redundancy protocols
- Certification for use in environments at risk of explosion (EN 60079-14 or VDE 0165, Part 1, ATEX)
- Extensive cybersecurity functionality, such as role-based access control (RBAC), logging of security-related events, signed firmware, or authenticated IEEE 802.1X network access.
- Simple, fast, and secure access to the device via a standard Web browser to display all information and diagnostic data, vector diagrams, single-line and device display pages
- Secure serial protection communication, also over great distances and all available physical media (optical fiber, two-wire connections, and communication networks)

2.12

- Detecting operational measured variables and protection-function measured values to evaluate the systems, to support commissioning, and to analyze faults
- Synchrophasor measured values with the IEEE C37.118 protocol integrated (PMU)
- High-performance fault recording (buffer for a max. record time of 80 s at 8 kHz or 320 s at 2 kHz)
- Auxiliary functions for simple tests and commissioning
- Flexibly adjustable I/O quantity structure within the scope of the SIPROTEC 5 modular system

Applications

- Protection against thermal overload of the stator from over-current, cooling problems, or pollution
- Protection against thermal overload of the rotor during startup due to: Frequent startups, excessively long startups, or blocked rotor
- Monitoring for voltage unbalance or phase outage
- Monitoring the thermal state and the storage temperatures with temperature measurement
- Detection of idling drives of pumps and compressors, for example
- Detection of ground faults in the motor
- Protection against motor short circuits
- Protection against instability due to undervoltage
- Detection and recording of power-quality data in the medium-voltage and subordinate low-voltage power system

Application Templates

DIGSI 5 provides application templates for standard applications. They include basic configurations and default settings.

The following application templates are available:

- *Current measurement*
  - Thermal overload protection for stator and rotor
  - Starting time supervision
  - Restart inhibit
  - Unbalanced-load protection (thermal)
  - Temperature supervision
  - Load-jam protection
  - Overcurrent protection (non-directional) for phases and ground
  - Transformer inrush-current detection
- *Current and voltage measurement*
  - Thermal overload protection for stator and rotor
  - Starting time supervision
  - Restart inhibit

- Unbalanced-load protection (thermal)
- Temperature supervision
- Load-jam protection
- Overcurrent protection (non-directional) for phases and ground
- Transformer inrush-current detection
- Directional sensitive ground-fault detection for isolated or grounded power systems and for detection of stator ground faults
- Overvoltage protection with zero-sequence system V0
- Undervoltage protection with positive-sequence system V1
- Measuring-voltage failure detection

- *Motor differential protection, current and voltage measurement*
  - Motor differential protection
  - Thermal overload protection for stator and rotor
  - Starting time supervision
  - Restart inhibit
  - Unbalanced-load protection (thermal)
  - Temperature supervision
  - Load-jam protection
  - Overcurrent protection (non-directional) for phases and ground
  - Transformer inrush-current detection
  - Directional sensitive ground-fault detection for isolated or grounded power systems and for detection of stator ground faults
  - Overvoltage protection with zero-sequence system V0
  - Undervoltage protection with positive-sequence system V1
  - Measuring-voltage failure detection
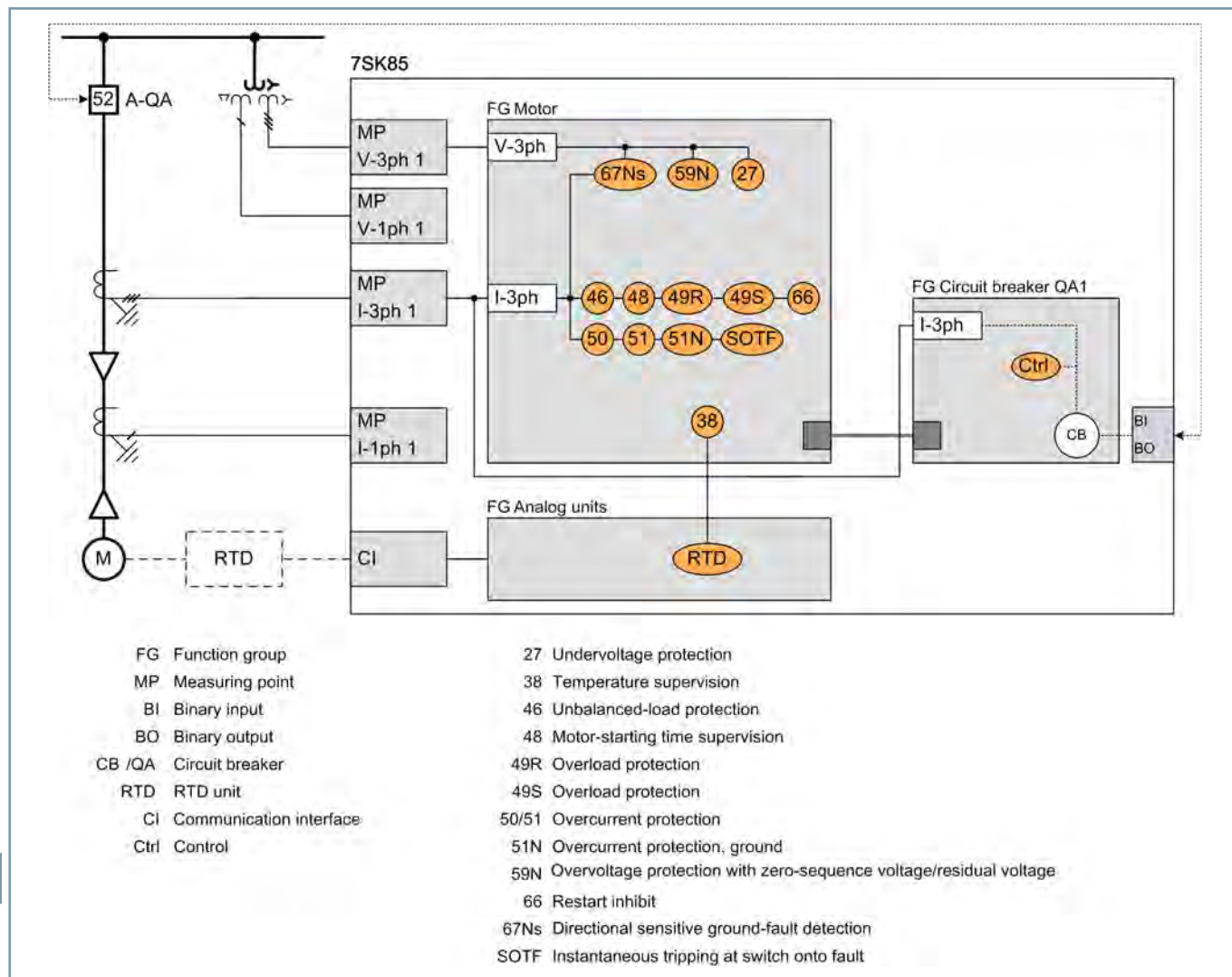
Application Example

SIPROTEC 7SK85 – Protection of a medium-power motor

The motor protection functions and the overcurrent protection of the SIPROTEC 7SK85 protect an asynchronous motor of medium power (up to approximately 2 MW) against thermal and mechanical overload and short circuits. The directional sensitive ground-fault detection and the overvoltage protection with zero-sequence voltage V0 detect stator ground faults in the motor. An external RTD unit captures and monitors the thermal state of the motor and the storage temperatures. The RTD unit is connected to the device via Ethernet or serial communication.

Figure 2.12/5 shows the functional scope and the basic configuration of a SIPROTEC 7SK85 for this application. It is based on the application template "Current and voltage measurement". In addition, the device must be equipped with a plug-in module for communication with the RTD unit.

2.12

Motor Protection – SIPROTEC 7SK85

[Motorschutz-7SK85, 1, en_US]

Figure 2.12/5   Protection of a Medium-Power Motor

FG	Function group	
MP	Measuring point	
BI	Binary input	
BO	Binary output	
CB /QA	Circuit breaker	
RTD	RTD unit	
CI	Communication interface	
Ctrl	Control	

27 Undervoltage protection
38 Temperature supervision
46 Unbalanced-load protection
48 Motor-starting time supervision
49R Overload protection
49S Overload protection
50/51 Overcurrent protection
51N Overcurrent protection, ground
59N Overvoltage protection with zero-sequence voltage/residual voltage
66 Restart inhibit
67Ns Directional sensitive ground-fault detection
SOTF Instantaneous tripping at switch onto fault

2.12

ANSI	Function	Abbr.	Available	Application Templates		
				1	2	3
	Protection functions for 3-pole tripping	3-pole	■	■	■	■
	Expandable hardware quantity structure	I/O	■	■	■	■
	Process bus client protocol (hint: PB client requires a separate ETH-BD-2FO plug-in module, from V8.0)	PB client	■			
	IEC61850-9-2 Merging Unit Stream (hint: Each stream requires a separate ETH-BD-2FO plug-in module, from V8.0)	MU	■			
	IEC61850-9-2 Merging Unit Stream 7SS85 CU (hint: Only for communication with a 7SS85 CU. A separate ETH-BD-2FO plug-in module is required starting with V8.40)	MU	■			
14	Locked rotor	I> + n<	■	■	■	■
24	Overexcitation protection	V/f	■			
25	Synchrocheck, synchronization function	Sync	■			
27	Undervoltage protection: "3-phase" or "positive-sequence system V1" or "universal Vx"	V<	■		■	■
27R, 59R	Voltage change protection (starting with V8.30)	dV/dt	■			
	Undervoltage-controlled reactive power protection	Q>/V<	■			
32, 37	Power protection active/reactive power	P<>, Q<>	■			
32R	Reverse-power protection	- P<	■			
37	Undercurrent	I<	■			
38	Temperature supervision	θ>	■	■	■	■
46	Negative-sequence system overcurrent protection	I2>	■			
46	Unbalanced-load protection (thermal)	I2² t>	■	■	■	■
46	Negative-sequence system and overcurrent protection with direction	I2>, ∠(V2, I2)	■			
47	Overvoltage protection, negative-sequence system	V2>	■			
47	Overvoltage protection: "Negative-sequence system V2" or "negative-sequence system V1/positive-sequence system V1"	V2>; V2/V1>	■			
48	Starting time monitoring for motors	I²start	■	■	■	■
49	Thermal overload protection	θ, I²t	■	■	■	■
49	Thermal overload protection, user-defined characteristic curve	θ, I²t	■			
49R	Thermal overload protection, rotor (motor)	θR	■	■	■	■
50/51 TD	Overcurrent protection, phases	I>	■	■	■	■
	Instantaneous tripping at switch onto fault	SOTF	■			
50HS	Instantaneous high-current tripping	I>>>	■			
50/51 TD	Overcurrent protection with positive-sequence current I1 (from V7.9)	I1>	■			
50N/ 51N TD	Overcurrent protection, ground	IN>	■	■	■	■
50N/ 51N TD	Overcurrent protection, 1-phase	IN>	■			
50 Ns/ 51Ns	Sensitive ground-fault detection for grounded arc suppression coils and isolated power systems including a) 3I0> b) admittance Y0>, c) 3I0-harm> (from V7.8)	INs>	■			
	Sensitive ground-fault detection via pulse detection; hint: this stage also requires the function 50Ns/51Ns or 67Ns "sensitive ground-fault detection for grounded arc suppression coils and isolated power systems"	IN pulse	■			
	Intermittent ground-fault protection	IIE>	■			
50BF	Circuit-breaker failure protection, 3-pole	CBFP	■			

2.12

Motor Protection – SIPROTEC 7SK85

ANSI	Function	Abbr.	Available	Application Templates 1	2	3
50EF	End-fault protection (hint: For use only in decentralized busbar protection with a 7SS85 CU starting with V8.40)		■			
50RS	Circuit breaker restrike monitoring	CBRM	■			
50L	Load-jam protection	I>L	■	■	■	■
51V	Voltage-controlled overcurrent protection	t=f(I, V)	■			
59, 59N	Overvoltage protection: "3-phase" or "zero-sequence system V0" or "positive-sequence system V1" or "universal Vx"	V>	■			
60	Voltage-comparison supervision	ΔV>	■			
66	Restart inhibit for motors	I²t	■	■	■	■
67	Directional overcurrent protection, phases	I>, ∠(V, I)	■			
67N	Directional overcurrent protection, ground	IN>, ∠(V, I)	■			
67 Ns	Sensitive ground-fault detection for grounded arc suppression coils and isolated power systems including a) 3I0> b) V0>, c) cos/sine Phi, d) transient ground fault, e) Phi(V, I), f) admittance		■		■	■
	Directional tripping stage with one harmonic; hint: this stage also requires the function "67Ns sensitive ground-fault detection for grounded arc suppression coils and isolated power systems"	∠(V0h,I0h)	■			
	Directional Intermittent Ground-Fault Protection	IIEdir>	■			
74TC	Trip-circuit supervision		■			
74CC	Single circuit monitoring (from V7.9)		■			
79	Automatic reclosing, 3-pole	AREC	■			
81	Frequency protection: "f>" or "f<" or "df/dt"	f<>; df/dt<>	■			
81U	Underfrequency load shedding	f<(ULS)	■			
	Vector-jump protection	Δφ>	■			
86	Lockout		■	■	■	■
87N T	Restricted ground-fault protection	ΔIN	■			
87M	Differential motor protection	ΔI	■			■
90 V	Voltage controller for two-winding transformer		■			
90 V	Voltage controller for two-winding transformer with parallel control		■			
	Number of two-winding transformers with parallel control (hint: only together with the function "voltage controller for two-winding transformer with parallel control")		■			
90 V	Voltage controller for three-winding transformer		■			
90 V	Voltage controller for grid coupling transformer		■			
FL	Fault Locator, single-side	FL-one	■			
PMU	Synchrophasor measurement	PMU	■			
AFD	Arc protection (only with plug-in module ARC-CD-3FO)		■			
	Measured values, standard		■	■	■	■
	Measured values, extended: Min, max, average		■			
	Switching statistics counter		■			
	PQ – Basic measured values: THD (Total Harmonic Distortion) and harmonic component (starting with V8.01) and THD voltage average values (starting with V8.40)		■			
	PQ – Basic measured values: Voltage unbalance (starting with V8.40)		■			
	PQ – Basic measured values: Voltage changes – monitoring of voltage dips, overvoltages and voltage interruptions (starting with V8.40)		■			

2.12

ANSI	Function	Abbr.	Available	Application Templates		
				1	2	3
	PQ – Basic measured values: TDD - Total Demand Distortion (starting with V8.40)		■			
	CFC (standard, control)		■	■	■	■
	CFC arithmetic		■			
	Circuit-breaker wear monitoring	ΣIx, I²t, 2P	■			
	Switching sequence function		■			
	Inrush-current detection		■	■	■	■
	External trip initiation		■			
	Control		■	■	■	■
	Circuit breaker		■	■	■	■
	Disconnector/grounding conductor		■			
	Fault recording of analog and binary signals		■	■	■	■
	Monitoring		■	■	■	■
	Protection interface, serial		■			
	Frequency group tracking (from V7.8)		■			
	Cyber security: Role-Based Access Control (from V7.8)		■			
	Temperature recording via communication protocol		■			
	Cyber security: Authenticated network access using IEEE 802.1X (starting from V8.3)		■			
Function point class:				0	40	100
The configuration and function point class for your application can be determined in the SIPROTEC 5 order configurator at *www.siemens.com/siprotec*.						

Table 2.12/3   SIPROTEC 7SK85 – Functions, Application Templates

(1)   Current measurement

(2)   Current and voltage measurement

(3)   Differential protection with current and voltage measurement

2.12

Motor Protection – SIPROTEC 7SK85

Standard Variants for SIPROTEC 7SK85		
R1	1/3, 11 BI, 9 BO, 4 I, 4 V	
	Housing width 1/3 x 19",	
	11 binary inputs,	
	9 binary outputs (1 life contact, 2 standard, 6 fast)	
	4 current transformers	
	4 voltage transformers	
	Contains the following modules: base module with PS201 and IO202	
R2	1/2, 17 BI, 16 BO, 4 I, 4 V	
	Housing width 1/2 x 19",	
	17 binary inputs,	
	16 binary outputs (1 life contact, 9 standard, 6 fast)	
	4 current transformers	
	4 voltage transformers	
	Contains the following modules: base module with PS201 and IO202, expansion module IO206	
R3	1/2, 27 BI, 17 BO, 4 I, 4 V	
	Housing width 1/2 x 19",	
	27 binary inputs,	
	17 binary outputs (1 life contact, 10 standard, 6 fast)	
	4 current transformers	
	4 voltage transformers	
	Contains the following modules: base module with PS201 and IO202, expansion module IO207	

Table 2.12/4   Standard Variants for SIPROTEC 7SK85 Motor Protection Devices

You can find the technical data in the manual
www.siemens.com/siprotec

2.12