Description

The SIPROTEC 7SJ86 overcurrent protection has specifically been designed as backup or emergency protection for the line protection devices. With its modular structure, flexibility and the high-performance DIGSI 5 engineering tool, the SIPROTEC 7SJ86 device offers future-oriented solutions for protection, control, automation, monitoring, and Power Quality – Basic.

Main function	Overcurrent protection (definite-time overcurrent protection/inverse-time overcurrent protection)
Tripping	3-pole
Inputs and outputs	3 predefined standard variants with 4/4 current transformers/voltage transformers, 11 to 23 binary inputs, 9 to 25 binary outputs
Hardware flexibility	Flexibly adjustable and expandable I/O quantity structure within the scope of the SIPROTEC 5 modular system.
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
- Highest availability even under extreme environmental conditions by standard coating of the modules
- Cybersecurity in accordance with NERC CIP and BDEW White-paper requirements

Functions

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

- Overcurrent protection as backup / emergency line protection for all voltage levels with 3-pole tripping
- Optimized tripping times due to directional comparison and protection communication
- 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, dir. detection of intermittent ground faults, harmonic detection, and admittance measurement
- Ground-fault detection using the pulse-detection method
- Fault locator plus for accurate fault location with inhomogenous line sections and targeted automatic overhead-line section reclosing (AREC)
- Arc protection
- Automatic frequency relief for underfrequency load shedding, taking changed infeed conditions due to decentralized power generation into consideration
- Overvoltage and undervoltage protection
- Frequency protection and frequency-change protection for load-shedding applications
- Power protection, configurable as active or reactive-power protection

[SIP5_GD_SS_W3, 2, --_--]

Figure 2.10/1   SIPROTEC 5 Device with Expansion Module

- Directional reactive-power undervoltage protection (QU 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, interruption; TDD, THD, and harmonics
- Control, synchrocheck, and switchgear interlocking protection
- Circuit-breaker failure protection
- Circuit-breaker reignition monitoring
- Graphical logic editor to create high-performance automation functions in the device
- Single-line representation in the small or large display
- Fixed integrated electrical Ethernet RJ45 interface for DIGSI 5 and IEC 61850 (reporting and GOOSE)
- 4 optional, 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)
- Serial protection communication via optical fibers, two-wire connections, and communication networks (IEEE C37.94 and others), including automatic switchover between ring and chain topology
- Reliable data transmission via PRP and HSR redundancy protocols
- Extensive cybersecurity functionality, such as role-based access control (RBAC), logging of security-related events, signed firmware, or authenticated IEEE 802.1X network access

2.10

- 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

- Phasor Measurement Unit (PMU) for synchrophasor measured values and IEEE C37.118 protocol

- Time synchronization using IEEE 1588

- 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

- Backup and emergency protection for line protection

- Detection and selective 3-pole tripping of short circuits in electrical equipment of star networks, lines with infeed at 1 or 2 ends, parallel lines and open-circuited or closed ring systems of all voltage levels

- Used in switchgear with breaker-and-a-half layout configuration

- Detection of ground faults in isolated or arc-suppression-coil-ground systems in star, ring, or meshed arrangement

- Serial protection communication with SIPROTEC 5 and SIPROTEC 4 devices over different distances and physical media, such as optical fiber, two-wire connections, and communication networks

- Backup protection for differential protection devices of all kind for lines, transformers, generators, motors, and busbars

- Phasor Measurement Unit (PMU)

- Reverse-power protection

- 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 all basic configurations and default settings.

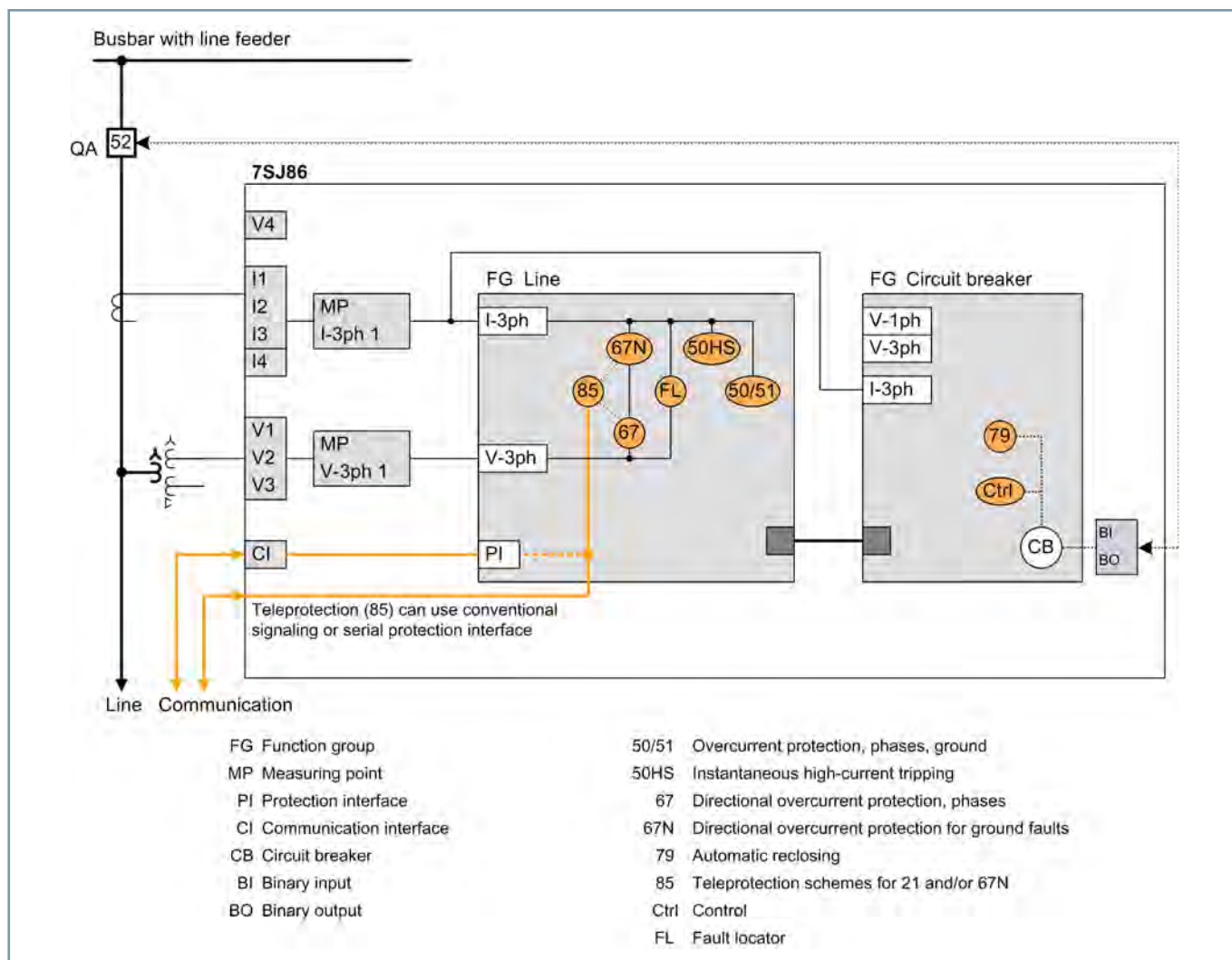The following application templates are available:

- SIPROTEC 7SJ86 Non-directional overcurrent protection

- SIPROTEC 7SJ86 Directional overcurrent protection

Application Example

Figure 2.10/2 shows an application example for directional protection of an overhead line. The functional scope is based on the application template **Directional overcurrent protection**. The functions **Instantaneous high-current tripping, Fault locator**, and **Automatic reclosing** from the DIGSI 5 library are also used.

2.10

[dw_7SJ86_Ltg, 2, en_US]

Figure 2.10/2   Application Example: Directional Overcurrent Protection for Overhead Line

ANSI	Function	Abbr.	Available	Application Templates	
				1	2
	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	■		
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<>	■		
37	Undercurrent	I<	■		
38	Temperature supervision	θ>	■		
46	Negative-sequence system overcurrent protection	I2>	■		
46	Negative-sequence system and overcurrent protection with direction	I2>, ∠(V2, I2)	■		
47	Overvoltage protection, negative-sequence system	V2>	■		
49	Thermal overload protection	θ, I²t	■		
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	■		
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	■		
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>	■		
67	Directional overcurrent protection, phases	I>, ∠(V, I)	■		■
67N	Directional ground-fault protection in grounded power systems	IN>, ∠(V, I)	■		■

2.10

Overcurrent Protection as Backup Protection for Line Protection – SIPROTEC 7SJ86

ANSI	Function	Abbr.	Available	Application Templates 1	2
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>	■		
85/67N	Teleprotection scheme for directional ground-fault protection		■		
86	Lockout		■		■
87N T	Restricted ground-fault protection	ΔIN	■		
90 V	Voltage controller for two-winding transformer		■		
90 V	Voltage controller for three-winding transformer		■		
90 V	Voltage controller for grid coupling transformer		■		
FL	Fault Locator, single-side	FL-one	■		
FL	Fault Locator Plus (from V7.9)	FL plus	■		
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)		■		
	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		■	■	
	Region, France: Overload protection for 'PSL-PSC' lines		■		

2.10

Overcurrent Protection as Backup Protection for Line Protection – SIPROTEC 7SJ86

ANSI	Function	Abbr.	Available	Application Templates	
				1	2
	Region, France: 'MAXI-L' overcurrent protection		■		
	Region, France: 'PDA' system decoupling protection		■		
	Region, France: Overload protection for transformers		■		
	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	50
The configuration and function point class for your application can be determined in the SIPROTEC 5 order configurator at *www.siemens.com/siprotec*.					

Table 2.10/1   SIPROTEC 7SJ86 – Functions, Application Templates

(1)   Non-directional definite-time overcurrent protection/inverse-time overcurrent protection (4*I, 4*V)

(2)   Directional definite-time overcurrent protection/inverse-time overcurrent protection – grounded power system

2.10