

SIPROTEC 5 Devices and Fields of Application

Differential and Distance Protection – SIPROTEC 7SL86

Description

The combined SIPROTEC 7SL86 line differential and distance protection has specifically been designed for the protection of lines. With its modular structure, flexibility and the powerful DIGSI 5 engineering tool, SIPROTEC 7SL86 offers future-oriented system solutions with high investment security and low operating costs.

| | |
|----------------------|---|
| Main function | Differential and distance protection |
| Tripping | 3-pole, minimum tripping time: 9 ms |
| Inputs and outputs | 12 predefined standard variants with 4/4 or 8/8 current/voltage transformers, 5 to 31 binary inputs, 8 to 46 binary outputs |
| Hardware flexibility | Flexibly adjustable I/O quantity structure within the scope of the SIPROTEC 5 modular system |
| Housing width | 1/3 × 19" to 2/1 × 19" |

Functions

DIGSI 5 permits all functions to be configured and combined as required.

- Minimum tripping time: 9 ms
- Main protection function is differential protection with adaptive algorithm for maximum sensitivity and stability even with the most different transformer errors, current-transformer saturation and capacitive charging currents
- Several distance-protection functions as backup protection or 2nd main protection for selection: Classic, reactance method (RMD), impedance protection for transformers
- Directional backup protection and various additional functions
- Adaptive power-swing blocking, out-of-step protection
- Detection of current-transformer saturation for fast tripping with high accuracy
- Arc protection
- 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
- 3-pole automatic reclosing function
- Control, synchrocheck and switchgear interlocking protection
- Graphical logic editor to create powerful automation functions in the device
- Single line representation in small or large display
- Integrated electrical Ethernet RJ45 for DIGSI 5 and IEC 61850 (reporting and GOOSE)
- Up to 4 optional pluggable communication modules, usable for different and redundant protocols (IEC 61850, IEC 60870-5-103, IEC 60870-5-104, Modbus TCP, DNP3 (serial and TCP))
- Serial protection data communication via optical fibers, two-wire connections and communication networks (IEEE C37.94, and others), including automatic switchover between ring and chain topology



[SIP5_GD_W3, 1, --]

Figure 2.8/3 SIPROTEC 7SL86

- Redundancy protocols PRP and HSR
- Cyber security in accordance with NERC CIP and BDEW White-paper requirements
- Phasor measurement unit (PMU) for synchrophasor measured values and IEEE C37.118 protocol
- Time synchronization using IEEE 1588
- Powerful 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

- Line protection for all voltage levels with 3-pole tripping
- Phase-selective protection of overhead lines and cables with single-ended and multi-ended infeed of all lengths with up to 6 line ends
- Also used in switchgear with breaker-and-a-half configuration
- Transformers and compensating coils in the protection zone
- Detection of ground faults in isolated or arc-suppression-coil-ground power systems in star, ring, or meshed arrangement
- Protection data communication over different distances and physical media, such as optical fiber, two-wire connections, and communication networks
- Phasor measurement unit (PMU).

Application templates

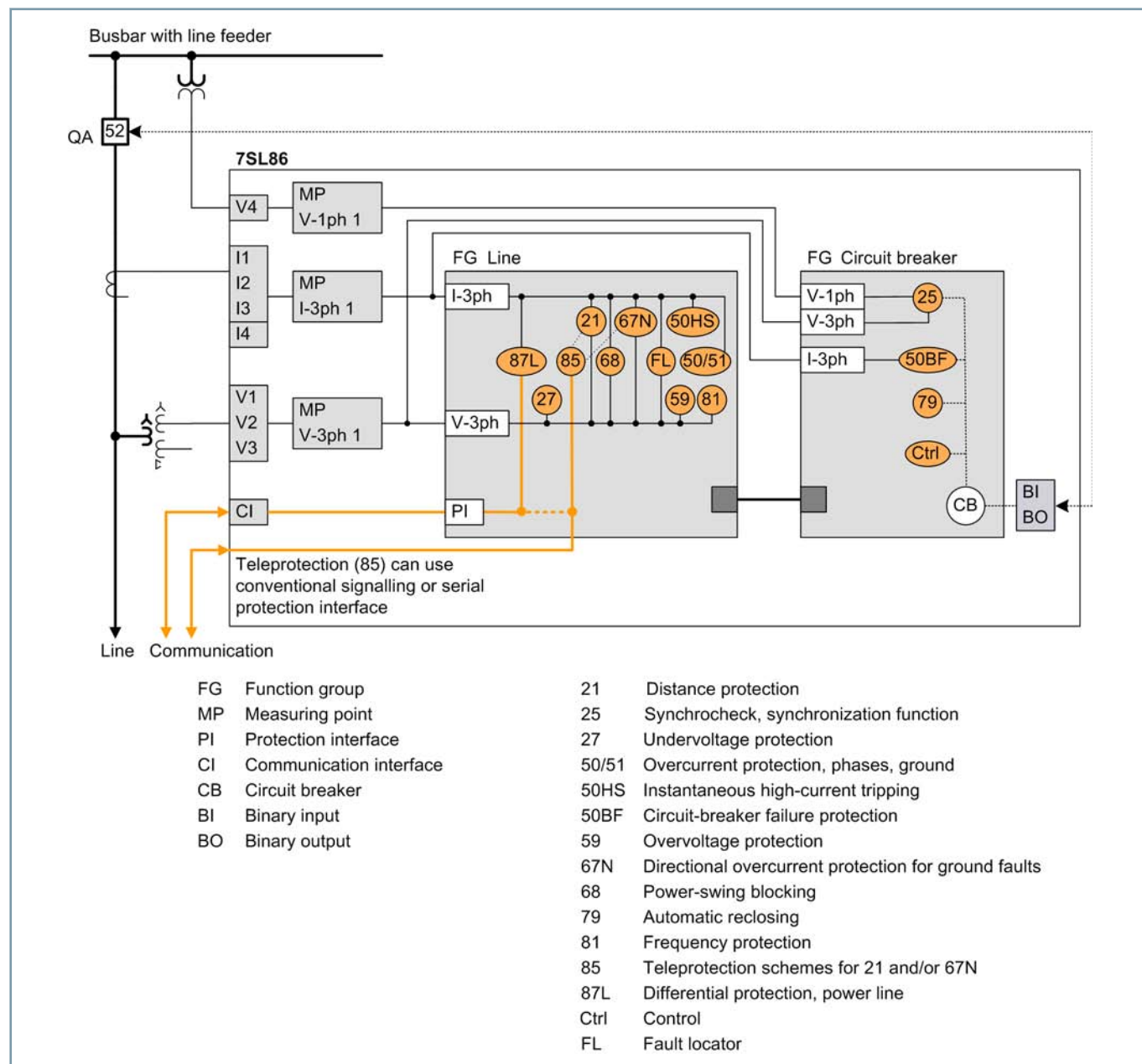
Application templates are available in DIGSI for standard applications. They comprise all basic configurations and default settings.

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The following application templates are available:

- Basic
- Differential and distance protection with RMD for overhead line in grounded systems
- Differential and distance protection with RMD for overhead line in grounded systems, with AR for applications with breaker-and-a-half schemes.



[dw_7SL86_Ltg, 1, en_US]

Figure 2.8/4 Application example: Combined line differential and distance protection for overhead line

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Differential and Distance Protection – SIPROTEC 7SL86

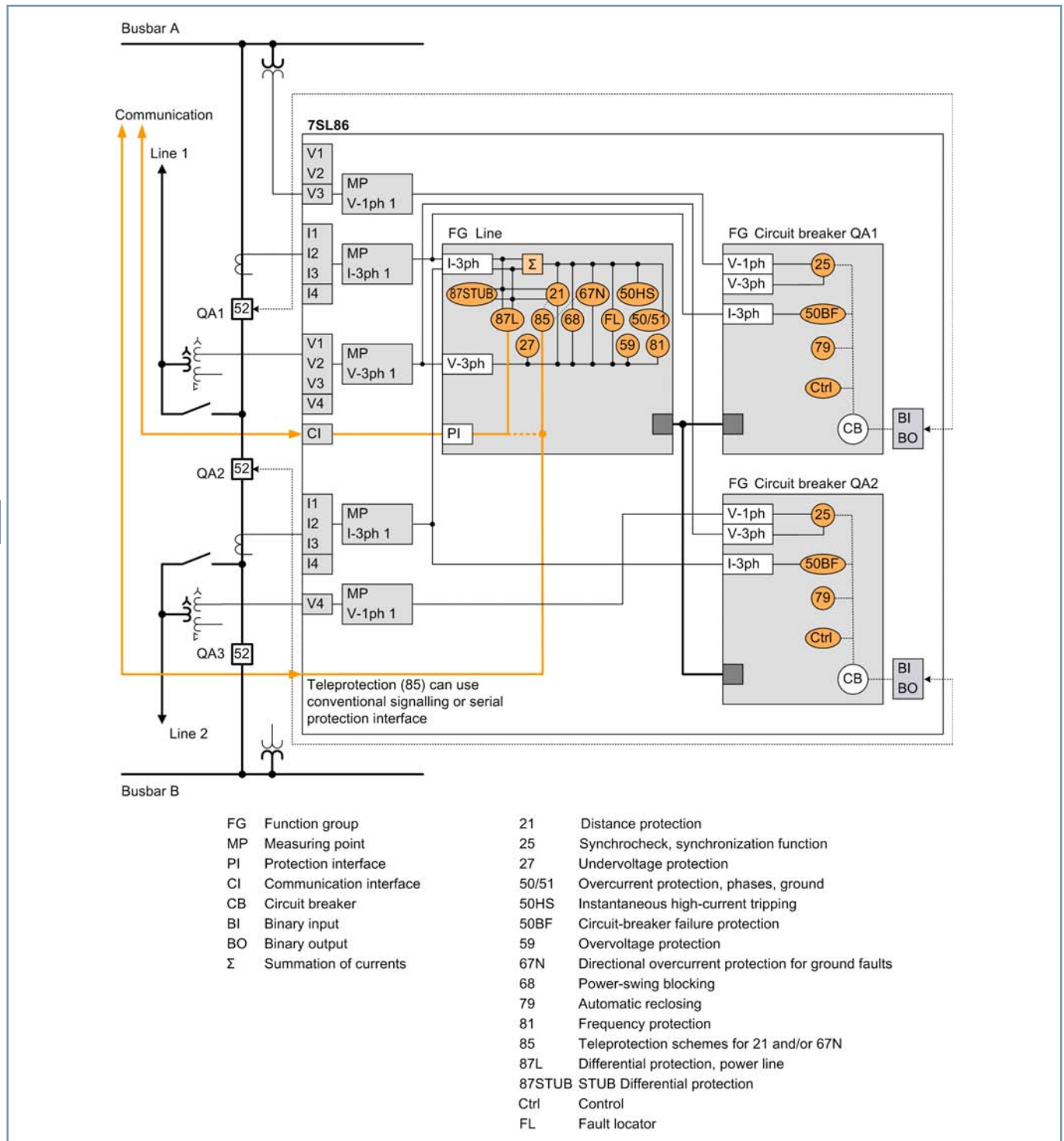


Figure 2.8/5 Application example: Combined line differential and distance protection for overhead line with breaker-and-a-half scheme

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Functions, application templates

| ANSI | Functions | Abbr. | Available | Template | | |
|-------------|--|-----------------------------|-----------|----------|---|---|
| | | | | 1 | 2 | 3 |
| | Protection functions for 3-pole tripping | 3-pole | ■ | ■ | ■ | ■ |
| | Hardware quantity structure expandable | I/O | ■ | ■ | ■ | ■ |
| 21/21N | Distance protection | $Z<, V< /I> / \angle (V,I)$ | ■ | ■ | ■ | ■ |
| 21T | Impedance protection for transformers | $Z<$ | ■ | | | |
| 87L | Line differential protection for 2 line ends | ΔI | ■ | ■ | ■ | ■ |
| 87L | Line differential protection for 3 to 6 line ends (dependent on Significant properties) | ΔI | ■ | ■ | ■ | ■ |
| 25 | Synchrocheck, synchronizing function | Sync | ■ | | ■ | ■ |
| 27 | Undervoltage protection: "3-phase" or "pos.seq. V1" or "universal Vx" | $V<$ | ■ | | | |
| | Undervoltage-controlled reactive power protection | $Q>/V<$ | ■ | | | |
| 32, 37 | Power protection active/reactive power | $P<>, Q<>$ | ■ | | | |
| 37 | Undercurrent | $I<$ | ■ | | | |
| 38 | Temperature Supervision | $\theta>$ | ■ | | | |
| 46 | Negative sequence overcurrent protection | $I2>$ | ■ | | | |
| 46 | Negative sequence overcurrent protection with direction | $I2>, \angle(V2,I2)$ | ■ | | | |
| 47 | Overvoltage protection, negative-sequence system | $V2>$ | ■ | | | |
| 49 | Thermal overload protection | θ, I^2t | ■ | | ■ | ■ |
| 50/51 TD | Overcurrent protection, phases | $I>$ | ■ | ■ | ■ | ■ |
| 50N/ 51N TD | Overcurrent protection, ground | $IN>$ | ■ | ■ | ■ | ■ |
| 50HS | High speed instantaneous overcurrent protection | $I>>>$ | ■ | ■ | ■ | ■ |
| | Instantaneous tripping at switch onto fault | SOTF | ■ | | | |
| 50N/ 51N TD | Overcurrent protection, 1-phase | $IN>$ | ■ | | | |
| 50Ns/ 51Ns | Sensitive ground-current protection for systems with resonant or isolated neutral | $INs>$ | ■ | | | |
| | Intermittent ground fault protection | $lie>$ | ■ | | | |
| 50BF | Circuit-breaker failure protection, 3-pole | CBFP | ■ | | ■ | ■ |
| 50RS | Circuit-breaker restrike protection | CBRS | ■ | | | |
| 51V | Voltage dependent overcurrent protection | $t=f(I,V)$ | ■ | | | |
| 59, 59N | Overvoltage protection: "3-phase" or "zero seq. V0" or "pos.seq. V1" or "universal Vx" | $V>$ | ■ | | ■ | ■ |
| 67 | Directional overcurrent protection, phases | $I>, \angle(V,I)$ | ■ | | | |
| 67N | Directional overcurrent protection for ground faults in grounded systems | $IN>, \angle(V,I)$ | ■ | | ■ | ■ |
| 67Ns | Dir. sensitive ground-fault detection for systems with resonant or isolated neutral incl. a) $3I0>$, b) $V0>$, c) Cos/SinPhi , d) Transient fct., e) $\text{Phi}(V,I)$, f) admittance | | ■ | | | |
| | Directional intermittent ground fault protection | $lie\ dir>$ | ■ | | | |
| 68 | Power-swing blocking | $\Delta Z/\Delta t$ | ■ | | ■ | ■ |
| 74TC | Trip circuit supervision | TCS | ■ | | | |
| 78 | Out-of-step protection | $\Delta Z/\Delta t$ | ■ | | | |
| 79 | Automatic reclosing, 3-pole | AR | ■ | | ■ | ■ |
| 81 | Frequency protection: "f>" or "f<" or "df/dt" | $f>,<; df/dt>,<$ | ■ | | | |
| 85/21 | Teleprotection for distance protection | | ■ | ■ | ■ | ■ |
| 85/27 | Weak or no infeed: Echo and Tripping | WI | ■ | ■ | ■ | ■ |
| 85/67N | Teleprotection for directional ground fault protection | | ■ | ■ | ■ | ■ |

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| ANSI | Functions | Abbr. | Available | Template | | |
|--|--|------------------------|-----------|----------|-----|-----|
| | | | | 1 | 2 | 3 |
| 86 | Lockout | | ■ | | | |
| 87N T | Restricted ground-fault protection | Δ IN | ■ | | | |
| 87L/ 87T | Option for line differential protection: including power transformer | Δ I | ■ | | | |
| | Option for line differential protection:charging-current compensation | Δ I | ■ | | | |
| | Broken-wire detection for differential protection | | ■ | | | |
| 87 STUB | STUB Differential protection (for one-and-half circuit-breaker applications) | | ■ | | | ■ |
| 90V | Automatic voltage control for 2 winding transformer | | ■ | | | |
| 90V | Automatic voltage control for 3 winding transformer | | ■ | | | |
| 90V | Automatic voltage control for grid coupling transformer | | ■ | | | |
| FL | Fault locator, single-ended measurement | FL-one | ■ | ■ | ■ | ■ |
| PMU | Synchrophasor measurement (1 PMU can be used for max. 8 voltages and 8 currents) | PMU | ■ | | | |
| AFD | Arc-protection (only with plug-in module ARC-CD-3FO) | | ■ | | | |
| | Measured values, standard | | ■ | ■ | ■ | ■ |
| | Measured values, extended: Min, Max, Avg | | ■ | | | |
| | Switching statistic counters | | ■ | ■ | ■ | ■ |
| | Circuit breaker wear monitoring | $\Sigma I_x, I^2t, 2P$ | ■ | | | |
| | CFC (Standard, Control) | | ■ | ■ | ■ | ■ |
| | CFC arithmetic | | ■ | | | |
| | Switching sequences function | | ■ | | | |
| | Inrush current detection | | ■ | | | |
| | External trip initiation | | ■ | ■ | ■ | ■ |
| | Control | | ■ | ■ | ■ | ■ |
| | Fault recording of analog and binary signals | | ■ | ■ | ■ | ■ |
| | Monitoring and supervision | | ■ | ■ | ■ | ■ |
| | Protection interface, serial | | ■ | ■ | ■ | ■ |
| | Circuit Breaker | | ■ | ■ | ■ | ■ |
| | Disconnecter | | ■ | | | ■ |
| | Region France: Overload protection for lines and cables 'PSL-PSC' | | ■ | | | |
| | Region France: Overcurrent protection 'MAXI-L' | | ■ | | | |
| | Region France: Net decoupling protection 'PDA' | | ■ | | | |
| | Region France: Overload protection for transformers | | ■ | | | |
| Function-points class: | | | | 0 | 200 | 350 |
| The configuration and function points for your application can be ascertained in the SIPROTEC 5 order configurator under: www.siemens.com/siprotec | | | | | | |

Table 2.8/2 SIPROTEC 7SL86 - Functions and application templates

- 1 DIFF/DIS Basic
- 2 DIFF/DIS RMD overhead line, solid grounded neutral point
- 3 DIFF/DIS RMD overhead line, 1.5 CB