

# Transmission Line Differential & Phase – Selector Guide

| Features                                                 | Device     | L30  | L90  | P541/2   | P543/5 | P544/6 | L60 | P547  |
|----------------------------------------------------------|------------|------|------|----------|--------|--------|-----|-------|
| <b>APPLICATIONS</b>                                      |            |      |      |          |        |        |     |       |
| Stepped Distance                                         | 21         |      | •    |          | •      | •      |     | •     |
| Pilot Protection / Channel Aided Schemes                 |            | •    | •    |          | •      | •      |     | •     |
| Line Current Differential                                | 87L        |      |      | •        | •      | •      | •   |       |
| Line Phase Comparison                                    | 87PC       |      | •    |          |        | •      | •   | •     |
| Breaker-and-Half Configurations                          |            |      | •    |          |        | •      | •   |       |
| <b>PROTECTION &amp; CONTROL</b>                          |            |      |      |          |        |        |     |       |
| Typical Operating Time (cycles)                          |            | <1.5 | <1.5 | <1.5     | <1.5   | <1.5   | <1  | <1.75 |
| Phase Current Differential                               | 87LP       | •    | •    | •        | •      | •      |     |       |
| Ground (Neutral) Current Differential                    | 87N/G      | 96   | 96   |          | 32     | 32/64  | 96  | 32    |
| Mho Phase & Ground Distance (No. of Zones)               | 21P/G      |      | 5    |          | 5      | 5      | 3   | 5     |
| Quad Phase & Ground Distance (No. of Zones)              | 21P/G      |      | 5    |          | 5      | 5      | 3   | 5     |
| Instantaneous Overcurrent                                | 50G/N/P/ 2 | •    | •    | •        | •      | •      | •   | •     |
| Time Overcurrent                                         | 51G/N/P/ 2 | •    | •    | •        | •      | •      | •   | •     |
| Directional overcurrent - Neutral                        | 67N        | •    | •    |          | •      | •      | •   | •     |
| Directional overcurrent - Phase                          | 67P        | •    | •    |          | •      | •      | •   | •     |
| Directional overcurrent - Negative Sequence              | 67_2       | •    | •    |          | •      | •      | •   | •     |
| Time Overcurrent                                         |            | •    | •    | •        | •      | •      | •   | •     |
| Directional overcurrent - Neutral                        | 67N        | •    | •    |          | •      | •      | •   | •     |
| Directional overcurrent - Phase                          | 67P        | •    | •    |          | •      | •      | •   | •     |
| Directional overcurrent - Negative Sequence              | 67_2       | •    | •    |          | •      | •      | •   | •     |
| Overvoltage - Measured Neutral Displacement/Auxiliary    | 59X        | •    | •    |          | •      | •      | •   | •     |
| Overvoltage - Neutral                                    | 59N        |      | •    |          | •      | •      | •   | •     |
| Overvoltage - Negative Sequence                          | 59_2       | •    |      |          |        |        | •   |       |
| Undervoltage - Phase/Auxiliary                           | 27P/X      | •    | •    |          | •      | •      | •   | •     |
| Under Frequency                                          | 81U        | •    | •    |          | •      | •      |     | •     |
| Over Frequency                                           | 81O        |      | •    |          | •      | •      |     | •     |
| Frequency Rate of Change                                 | 81R        |      | •    |          | •      | •      |     | •     |
| Power Swing Blocking                                     | 68         |      | •    |          | •      | •      | •   | •     |
| Out-of-Step Tripping / System Separation                 | 78         | •    | •    |          |        |        | •   |       |
| Switch onto Fault (Line Pickup)                          | SOTF       |      | •    |          | •      | •      | •   | •     |
| Load Encroachment                                        |            |      | •    |          | •      | •      | •   | •     |
| Breaker Failure                                          | 50BF       | •    | •    | •        | •      | •      | •   | •     |
| Lockout Functionality                                    | 86         | •    | •    | •        | •      | •      | •   | •     |
| Synchronism Check or Synchronizing                       | 25         | •    | •    |          | •      | •      | •   | •     |
| AC Reclosing (No. of Shots)                              | 79         | 4    | 4    | 4 (P542) | 4      | 4      | 4   | 4     |
| Trip Modes: Three-Pole/Single-Pole                       |            | 3    | 1&3  | 3        | 1&3    | 1&3    | 1&3 | 1&3   |
| Channel Aided Schemes                                    |            |      | •    |          | •      | •      | •   | •     |
| Petersen Coil / Isolated Ground Systems                  |            |      |      | •        | •      | •      |     |       |
| Series Compensation                                      |            | •    | •    | •        | •      | •      | •   | •     |
| Three terminal lines                                     |            |      | •    | •        | •      | •      | •   | •     |
| Lines with In-zone transformers                          |            | •    | •    | •        | •      | •      |     |       |
| Synchphasors                                             |            | •    | •    |          |        |        | •   |       |
| <b>AUTOMATION</b>                                        |            |      |      |          |        |        |     |       |
| Programmable Protection Logic                            |            | •    | •    | •        | •      | •      | •   | •     |
| FlexElements™ (number)                                   |            | 8    | 8    |          |        |        | 8   |       |
| Watchdog/Critical Failure Self-Test Monitoring           |            | •    | •    | •        | •      | •      | •   | •     |
| Settings Groups                                          |            | 6    | 6    | 4        | 4      | 4      | 6   | 4     |
| Non-volatile latches (including contact latches) (up to) |            | 16   | 16   | •        | •      | •      | 16  | •     |
| Contact Inputs Programmable - (up to)                    |            | 80   | 80   | 8/16     | 16/32  | 16/24  | 80  | 24    |
| Contact Outputs Programmable - (up to)                   |            | 70   | 70   | 7/14     | 14/32  | 14/32  | 70  | 32    |
| Virtual Inputs - (up to)                                 |            | 64   | 64   |          | 32     | 32/64  | 64  | 32    |
| Virtual GOOSE Inputs / Remote Inputs (up to)             |            | 96   | 96   |          | 32     | 32/64  | 96  | 32    |
| Virtual Outputs - (up to)                                |            | 96   | 96   |          | 32     | 32/64  | 96  | 32    |
| Virtual GOOSE Outputs / Remote Outputs (up to)           |            | •    | •    |          | •      | •      | •   | •     |
| Breaker Control (up to)                                  |            | 2    | 4    | 1        | 1      | 2      | 2   | 1     |
| User-Programmable LEDs (up to)                           |            | 48   | 48   | 8        | 18     | 18     | 48  | 18    |
| User-Programmable Push Buttons (up to)                   |            | 16   | 16   |          | 10     | 10     | 16  | 10    |
| User Definable Displays                                  |            | •    | •    |          |        |        | •   |       |
| Timers (number)                                          |            | 32   | 32   | 16       | 16     | 16     | 32  | 16    |
| Selector Switch (number)                                 |            | 2    | 2    |          |        |        | 2   |       |
| Digital Counters (number)                                |            | 8    | 8    |          |        |        | 8   |       |
| Digital Elements / Limit Values (number)                 |            | 48   | 48   |          |        |        | 48  |       |
| IRIG-B Input                                             |            | •    | •    | •        | •      | •      | •   | •     |
| Transducer Analog Inputs (up to)                         |            | 24   | 24   |          |        |        | 24  |       |
| Transducer Analog Outputs (up to)                        |            | 12   | 12   |          |        |        | 12  |       |
| RTD Inputs (up to)                                       |            | 24   | 24   |          |        |        | 24  |       |

| Features Continued                               | Device   | L30        | L90        | P541/2 | P543/5 | P544/6 | L60        | P547 |
|--------------------------------------------------|----------|------------|------------|--------|--------|--------|------------|------|
| <b>MONITORING &amp; METERING</b>                 |          |            |            |        |        |        |            |      |
| Voltage                                          |          | •          | •          | •      | •      | •      | •          | •    |
| Current                                          |          | •          | •          | •      | •      | •      | •          | •    |
| Symmetrical Components                           |          | •          | •          | •      | •      | •      | •          | •    |
| Power - Apparent, Real, Reactive                 |          |            |            | •      | •      | •      |            | •    |
| Energy                                           |          | •          | •          | •      | •      | •      | •          | •    |
| Power Factor                                     |          | •          | •          |        | •      | •      | •          | •    |
| Frequency                                        |          | •          | •          |        | •      | •      | •          | •    |
| Demand                                           |          |            | •          | •      | •      | •      |            | •    |
| Fault Location                                   |          | •          | •          |        | •      | •      | •          | •    |
| Fault Report (number)                            |          | 15         | 15         | 15     | 15     | 15     | 15         | 15   |
| Event Recorder - Number of Events                |          | 1024       | 1024       | 512    | 1024   | 1024   | 1024       | 1024 |
| Oscillography/Transient Recorder - Sampling Rate |          | 64/32/16/8 | 64/32/16/8 | 48     | 48     | 48     | 64/32/16/8 | 48   |
| Voltage Transformer Fuse Failure                 | VTFF/VTS | •          | •          |        | •      | •      | •          | •    |
| Current Transformer Supervision                  | CTS      | •          | •          |        | •      | •      | •          | •    |
| Open Pole Detector / Pole Dead                   |          |            | •          | •      | •      | •      | •          | •    |
| Broken Conductor Detection                       |          | •          | •          | •      | •      | •      |            | •    |
| Thermal Overload                                 |          | •          | •          | •      | •      | •      | •          | •    |
| Breaker Arcing Current                           |          | •          | •          | •      | •      | •      | •          | •    |
| Breaker Flashover                                |          |            | •          |        |        |        | •          |      |
| Breaker Restrike                                 |          |            | •          |        |        |        |            |      |
| Trip/Close Coil Supervision                      |          | •          | •          | •      | •      | •      | •          | •    |
| Data Logger / Trend Recording                    |          | •          | •          |        |        |        | •          |      |
| <b>COMMUNICATIONS INTERFACES</b>                 |          |            |            |        |        |        |            |      |
| Front Port Local Access                          |          | •          | •          | •      | •      | •      | •          | •    |
| Rear RS485 Port                                  |          | •          | •          | •      | •      | •      | •          | •    |
| Rear Ethernet Port (Fiber and Copper, up to)     |          | 3          | 3          |        | 2      | 3      | 3          | 2    |
| Inter-Relay Direct Fiber Communications          |          | •          | •          | •      | •      | •      | •          |      |
| Rear Communication Interface (G.703, C37.94)     |          | •          | •          | •      | •      | •      | •          |      |
| Rear Communication Interface (RS422/RS485)       |          |            |            |        | •      | •      |            |      |
| Rear Communication Interface (V.35, X.21)        |          |            |            |        | 32     | 32/64  |            | 32   |
| <b>PROTOCOLS</b>                                 |          |            |            |        |        |        |            |      |
| ModBus RTU                                       |          | •          | •          | •      | •      | •      | •          |      |
| DNP3 Serial                                      |          | •          | •          | •      | •      | •      | •          | •    |
| IEC 60870-5-104                                  |          | •          | •          |        |        |        | •          |      |
| IEC 61850                                        |          | •          | •          |        | •      | •      | •          | •    |
| IEEE 1588 (PTP)                                  |          | •          | •          |        | •      | •      | •          |      |
| IEC 62439 Parallel Redundancy Protocol           |          | •          | •          |        | •      | •      | •          | •    |
| IEC 62439 HSR Ring Redundancy Protocol           |          |            |            |        | •      | •      |            |      |
| Simple Network Time Protocol (SNTP)              |          | •          | •          |        | •      | •      | •          | •    |
| HTTP, TFTP, SFTP                                 |          | •          | •          |        |        |        | •          |      |
| IEC 60870-5-103                                  |          | •          | •          | •      | •      | •      | •          | •    |
| Process Bus (IEC 61850-9-2)                      |          | •          | •          |        |        | P546   |            |      |



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# Transmission Line Distance & Backup – Selector Guide

| Features                                                 | Device                          | D30  | D60  | D90 <sup>Plus</sup> | P441/2/4         | P443/5/6           | P841  |
|----------------------------------------------------------|---------------------------------|------|------|---------------------|------------------|--------------------|-------|
| <b>APPLICATIONS</b>                                      |                                 |      |      |                     |                  |                    |       |
| Stepped Distance                                         | 21                              | •    | •    | •                   | •                | •                  |       |
| Pilot Protection / Channel Aided Schemes                 |                                 |      | •    | •                   | •                | •                  |       |
| Delta Directional Comparison                             |                                 |      |      |                     |                  | •                  |       |
| Breaker-and-Half Configurations                          |                                 |      | •    | •                   |                  | P446               | P841b |
| Petersen Coil / Isolated Ground Systems                  |                                 |      |      |                     |                  | •                  |       |
| <b>PROTECTION &amp; CONTROL</b>                          |                                 |      |      |                     |                  |                    |       |
| Typical Operating Time (cycles)                          |                                 | <1.5 | <1.5 | <1                  | <1.1             | <1 (P445<br><1.25) |       |
| Mho Phase & Ground Distance (No. of Zones)               | 21P/G                           | 5    | 5    | 5                   |                  | 5 (P443 - 6)       |       |
| Quad Phase & Ground Distance (No. of Zones)              | 21P/G                           | 5    | 5    | 5                   | 6                | 5 (P443 - 6)       |       |
| Instantaneous Overcurrent                                | 50G/NP/ 2                       | •    | •    | •                   | •                | •                  | •     |
| Time Overcurrent                                         | 51G/NP/ 2                       | •    | •    | •                   | •                | •                  | •     |
| Directional overcurrent - Neutral                        | 67N                             | •    | •    | •                   | •                | •                  | •     |
| Directional overcurrent - Phase                          | 67P                             | •    | •    | •                   | •                | •                  | •     |
| Directional overcurrent - Negative Sequence              | 67_2                            | •    | •    | •                   | •                | •                  | •     |
| Restricted Ground Fault                                  | 87G                             |      |      |                     |                  | •                  |       |
| Wattmetric Ground Fault                                  | 32N                             |      | •    | •                   | •                | •                  |       |
| Sensitive Directional Power                              | 32                              |      | •    |                     |                  |                    |       |
| Overvoltage - Phase                                      | 59P                             | •    | •    | •                   | •                | •                  | •     |
| Overvoltage - Measured Neutral Displacement/Auxiliary    | 59X                             | •    | •    | •                   | •                | •                  | •     |
| Overvoltage - Neutral                                    | 59N                             | •    | •    | •                   | •                | •                  | •     |
| Overvoltage - Negative Sequence                          | 59_2                            | •    | •    | •                   |                  |                    |       |
| Undervoltage - Phase/Auxiliary                           | 27P/X                           | •    | •    | •                   | •                | •                  | •     |
| Under Frequency                                          | 81U                             |      | •    | •                   | P442/4           | •                  | •     |
| Over Frequency                                           | 81O                             |      | •    | •                   | P442/4           | •                  | •     |
| Frequency Rate of Change                                 | 81R                             |      | •    |                     |                  | •                  | •     |
| Power Swing Blocking                                     | 68                              | •    | •    | •                   | •                | •                  |       |
| Out-of-Step Tripping / System Separation                 | 78                              | •    | •    | •                   | P442/4           | •                  | •     |
| Switch onto Fault (Line Pickup)                          | SOTF                            | •    | •    | •                   | •                | •                  |       |
| Load Encroachment                                        |                                 | •    | •    | •                   | P442/4           | •                  |       |
| Breaker Failure                                          | 50BF                            |      | •    | •                   | •                | •                  | •     |
| Lockout Functionality                                    | 86                              | •    | •    | •                   | •                | •                  | •     |
| Synchronism Check or Synchronizing                       | 25                              | •    | •    | •                   | •                | •                  | •     |
| AC Reclosing (No. of Shots)                              | 79                              | 4    | 4    | 4                   | 4                | 4                  | 4     |
| Trip Modes: Three-Pole/Single-Pole                       |                                 | 3    | 1&3  | 1&3                 | 1&3              | 1&3                | 1&3   |
| Channel Aided Schemes                                    |                                 |      | •    | •                   | •                | •                  |       |
| Petersen Coil / Isolated Ground Systems                  |                                 |      |      |                     |                  | •                  |       |
| Series Compensation                                      |                                 | •    | •    | •                   | •                | •                  |       |
| Three terminal lines                                     |                                 |      | •    | •                   | •                | •                  |       |
| Lines with In-zone transformers                          | Lines with In-zone transformers |      |      | •                   | •                | •                  |       |
| Synchrophasors                                           |                                 |      | •    | •                   |                  |                    |       |
| <b>AUTOMATION</b>                                        |                                 |      |      |                     |                  |                    |       |
| Programmable Protection Logic                            |                                 | •    | •    | •                   | •                | •                  | •     |
| FlexElements™ (number)                                   |                                 | 8    | 8    | 16                  |                  |                    |       |
| Watchdog/Critical Failure Self-Test Monitoring           |                                 | •    | •    | •                   | •                | •                  | •     |
| Settings Groups                                          |                                 | 6    | 6    | 6                   | 4                | 4                  | 4     |
| Non-volatile latches (including contact latches) (up to) |                                 | 16   | 16   | 16                  | •                | •                  |       |
| Contact Inputs Programmable - (up to)                    |                                 | 80   | 80   | 115                 | 8/16/24          | 32/16/24           | 24    |
| Contact Outputs Programmable - (up to)                   |                                 | 70   | 70   | 60                  | 14/21/46         | 32/16/32           | 32    |
| Virtual Inputs - (up to)                                 |                                 | 64   | 64   | 64                  | 64               | 32/32/64           | 32    |
| Virtual Outputs - (up to)                                |                                 | 96   | 96   | 96                  | 32               | 32/32/64           | 32    |
| Virtual GOOSE Outputs / Remote Outputs (up to)           |                                 | •    | •    | •                   | •                | •                  | •     |
| Breaker Control (up to)                                  |                                 | 2    | 4    | 2                   | 1                | 1/1/2              | 2     |
| User-Programmable LEDs (up to)                           |                                 | 48   | 48   |                     | 18 (P441<br>- 8) | 18                 | 18    |
| User-Programmable Annunciator Alarms (up to)             |                                 |      |      | 288                 |                  |                    |       |
| User-Programmable Push Buttons (up to)                   |                                 | 16   | 16   | 30                  | 10<br>(P442/4)   | 10                 | 10    |
| User Definable Displays                                  |                                 | •    | •    |                     |                  |                    |       |
| Graphical HMI                                            |                                 |      |      | •                   |                  |                    |       |
| Timers (number)                                          |                                 | 32   | 32   | 32                  | 16               | 16                 | 16    |
| Selector Switch (number)                                 |                                 | 2    | 2    | 10                  |                  |                    |       |
| Digital Counters (number)                                |                                 | 8    | 8    | 8                   |                  |                    |       |
| Digital Elements / Limit Values (number)                 |                                 | 48   | 48   |                     |                  |                    |       |
| IRIG-B Input                                             |                                 | •    | •    | •                   | •                | •                  | •     |
| Transducer Analog Inputs (up to)                         |                                 | 24   | 24   |                     |                  |                    |       |
| Transducer Analog Outputs (up to)                        |                                 | 12   | 12   |                     |                  |                    |       |
| RTD Inputs (up to)                                       |                                 | 24   | 24   |                     |                  |                    |       |

| Features                                         | Device  | D30        | D60        | D90 <sup>Plus</sup> | P441/2/4 | P443/5/6 | P841 |
|--------------------------------------------------|---------|------------|------------|---------------------|----------|----------|------|
| <b>MONITORING &amp; METERING</b>                 |         |            |            |                     |          |          |      |
| Voltage                                          |         | •          | •          | •                   | •        | •        | •    |
| Current                                          |         | •          | •          | •                   | •        | •        | •    |
| Symmetrical Components                           |         | •          | •          | •                   | •        | •        | •    |
| Power - Apparent, Real, Reactive                 |         | •          | •          | •                   | •        | •        | •    |
| Energy                                           |         | •          | •          | •                   | •        | •        | •    |
| Power Factor                                     |         | •          | •          | •                   | •        | •        | •    |
| Frequency                                        |         | •          | •          | •                   | •        | •        | •    |
| Demand                                           |         |            |            | •                   | •        | •        | •    |
| Fault Location                                   |         | •          | •          | •                   | •        | •        | •    |
| Fault Report (number)                            |         | 15         | 15         | 15                  | 5        | 15       | 15   |
| Event Recorder - Number of Events                |         | 1024       | 1024       | 8192                | 512      | 1024     | 512  |
| Oscillography/Transient Recorder - Sampling Rate |         | 64/32/16/8 | 64/32/16/8 | 256/128/64/32/16    | 48       | 48       | 48   |
| Voltage Transformer Fuse Failure                 | VTFF/VT | •          | •          | •                   | •        | •        | •    |
| Current Transformer Supervision                  | CTS     |            |            |                     | •        | •        | •    |
| Open Pole Detector / Pole Dead                   |         |            | •          | •                   | •        | •        | •    |
| Broken Conductor Detection                       |         | •          | •          |                     | •        | •        | •    |
| Thermal Overload                                 |         | •          | •          |                     | •        | •        | •    |
| Breaker Arcing Current                           |         | •          | •          | •                   | •        | •        | •    |
| Breaker Flashover                                |         |            | •          | •                   |          |          |      |
| Breaker Restrike                                 |         |            | •          |                     |          |          |      |
| Trip/Close Coil Supervision                      |         | •          | •          | •                   | •        | •        | •    |
| Data Logger / Trend Recording                    |         |            | •          | •                   |          |          |      |
| <b>COMMUNICATIONS INTERFACES</b>                 |         |            |            |                     |          |          |      |
| Front Port Local Access                          |         | •          | •          |                     | •        | •        | •    |
| Rear RS485 Port                                  |         | •          | •          | •                   | •        | •        | •    |
| Rear Ethernet Port (Fiber and Copper, up to)     |         | 3          | 3          | 3                   | 3        | 3        | 3    |
| Inter-Relay Direct Fiber Communications          |         | •          | •          | •                   | •        | •        | •    |
| Rear Communication Interface (G.703, C37.94)     |         | •          | •          | •                   |          | •        |      |
| Rear Communication Interface (RS422/RS485)       |         |            |            |                     | P442/4   | •        | •    |
| Rear Communication Interface (V.35, X.21)        |         |            |            |                     | 32       | 32/32/64 | 32   |
| <b>PROTOCOLS</b>                                 |         |            |            |                     |          |          |      |
| ModBus RTU                                       |         | •          | •          | •                   | •        |          | •    |
| DNP3 Serial                                      |         | •          | •          | •                   | •        | •        | •    |
| IEC 60870-5-104                                  |         | •          | •          | •                   |          |          |      |
| IEC 61850                                        |         | •          | •          | •                   | •        | •        | •    |
| IEEE 1588 (PTP)                                  |         | •          | •          |                     | •        | •        | •    |
| IEC 62439 Parallel Redundancy Protocol           |         | •          | •          | •                   | •        | •        | •    |
| Simple Network Time Protocol (SNTP)              |         | •          | •          | •                   | •        | •        | •    |
| HTTP, TFTP, SFTP                                 |         | •          | •          | •                   |          |          |      |
| IEC 60870-5-103                                  |         | •          | •          |                     | •        | •        | •    |
| Process Bus (IEC 61850-9-2)                      |         | •          | •          |                     | •        | P446     | •    |



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