

Transmission Line Protection – Selector Guide

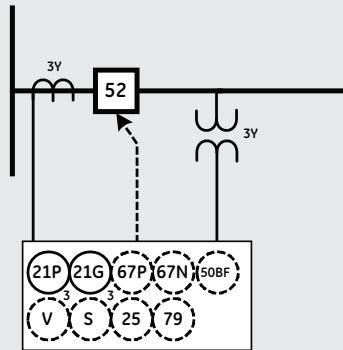
Features	Device	D30	D60	D90 ^{Plus}	L30	L60	L90
FUNCTIONALITY							
Stepped Distance	21	•	•	•		•	•
Pilot Protection			•	•			•
Line Current Differential	87L				•		•
Line Phase Comparison	87PC					•	•
Breaker-and-Half configurations			•	•		•	•
PROTECTION & CONTROL							
Typical Operating Time (cycles)		<1.5	<1.5	< 1	<1.5	<1	<1.5
Phase & Ground Current Differential	87LP/G				•		•
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	G/N/P_2	G/N/P_2	G/N/P_2	G/N/P_2	G/N/P_2	G/N/P_2
Time Overcurrent	51G/N/P_2	G/N/P_2	G/N/P_2	G/N/P_2	G/N/P_2	G/N/P_2	G/N/P_2
Directional overcurrent	67G/N/P_2	N/P_2	N/P_2	N/P_2	N/P	N/P_2	N/P_2
Restricted Ground Fault	87G						
Wattmetric Ground Fault	32N		•	•		•	•
Sensitive Directional Power	32		•	•		•	•
Overvoltage	59P/X/N/_2	P/X/N/_2	P/X/N/_2	P/X/N/_2	P/X/_2	P/X/N/_2	P/X/N
Undervoltage (Phase/Auxiliary)	27P/X	•	•	•		•	•
Under/Over frequency	81U/O		•	•	u		•
Frequency Rate of Change	81R		•	•			•
Power Swing Blocking/Out-of-Step Tripping	68/78	•	•	•		•	•
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	4	4	4
Trip Modes: Three-Pole/Single-Pole		3	1&3	1&3	3	1&3	1&3
Trip Bus (No. of Elements)		6	6	6	6	6	6
Pilot Protection Logic		•	•	•	•	•	•
Series Compensation		•	•	•	•	•	•
Three terminal lines		•	•	•	•	•	•
Lines with In-zone transformers		•	•	•	•	•	•
Synchrophasors		•	•	•	•	•	•
AUTOMATION							
Programmable Protection Logic (no of lines)		512	512	512	512	512	512
Programmable Automation Logic (no of lines)				4096			
FlexElements™ (number)		8	8	16	8	8	8
User Programmable Self-Test Contact		•	•	•	•	•	•
Settings Groups		6	6	6	6	6	6
Non-volatile latches (up to)		16	16	16	16	16	16
Contact Inputs Programmable - (up to)		80	80	115	80	80	80
Contact Outputs Programmable - (up to)		70	70	60	70	70	70
Virtual Inputs - (up to)		64	64	64	64	64	64
Virtual Outputs - (up to)		96	96	96	96	96	96
Direct Inputs/Outputs		•	•	•	•	•	•
Breaker Control (up to)		2	4	2	2	2	4
User-Programmable LEDs (up to)		48	48		48	48	48
User - Programmable Annunciator Alarms (up to)				288			
User-Programmable Push Buttons (up to)		16	16	30	16	16	16
User Definable Displays		•	•	•	•	•	•
Large HMI (Graphical)							
Timers (number)		32	32	32	32	32	32
Selector Switch (number)		2	2	10	2	2	2
Digital Counters (number)		8	8	8	8	8	8
Digital Elements (number)		48	48		48	48	48
IRIG-B Input		•	•	•	•	•	•
Analog Inputs (up to)		24	24		24	24	24
Analog Outputs (up to)		12	12		12	12	12
RTD Inputs (up to)		24	24		24	24	24
MONITORING & METERING							
Current, voltage		•	•	•	•	•	•
Symmetrical Components		•	•	•	•	•	•
Power - Apparent, Real, Reactive		•	•	•	•	•	•
Energy		•	•	•	•	•	•
Power Factor		•	•	•	•	•	•
Frequency		•	•	•	•	•	•
Demand		•	•	•	•	•	•
Fault Location		•	•	•	•	•	•
Fault Report (number)		15	15	15	15	15	15
Event Recorder - Number of Events		1024	1024	8192	1024	1024	1024
Oscillography - Sampling Rate		64/32/16/8	64/32/16/8	256/128/64/32/16	64/32/16/8	64/32/16/8	64/32/16/8
Disturbance Recorder - Sampling Rate (sample/cycle)				1			
Voltage Transformer Fuse Failure	VTFF	•	•	•	•	•	•
Current Transformer Supervision		•	•	•	•	•	•
Open Pole Detector		•	•	•	•	•	•
Broken Conductor Detection		•	•	•	•	•	•
Thermal Overload		•	•	•	•	•	•
Breaker Arcing Current		•	•	•	•	•	•
Breaker Flashover		•	•	•	•	•	•
Breaker Restrike		•	•	•	•	•	•
Trip/Close Coil Supervision		•	•	•	•	•	•
Data Logger		•	•	•	•	•	•
COMMUNICATIONS INTERFACES							
RS232 Port		•	•	•	•	•	•
USB Port		•	•	•	•	•	•
RS485 Port		•	•	•	•	•	•
Ethernet Port (Fiber and Copper, up to)		3	3	3	3	3	3
Direct Fiber Communications (800nm, 1330nm, 1550nm)		•	•	•	•	•	•
Communication Interface (RS422, G.703, C37.94)		•	•	•	•	•	•
PROTOCOLS							
ModBus RTU and TCP/IP)		•	•	•	•	•	•
DNP3		•	•	•	•	•	•
IEC 60870-5-104		•	•	•	•	•	•
UCA2/MMS		•	•	•	•	•	•
IEC61850		•	•	•	•	•	•
IEEE 1588 (PTP)		•	•	•	•	•	•
IEC 62439 Parallel Redundancy Protocol		•	•	•	•	•	•
Simple Network Time Protocol (SNTP)		•	•	•	•	•	•
HTTP, FTP, SFTP		•	•	•	•	•	•
IEC 60870-5-103		•	•	•	•	•	•
Process Bus (IEC 61850-9-2)		•	•	•	•	•	•

Transmission Protection

For the most up-to-date selector guides, please visit Passport.GEDigitalEnergy.com

Transmission Line Protection – Typical Applications

Stepped-Distance Protection



Typical Functions

- 21P Phase distance
- 21G Ground distance

Synchrophasors

Phasor Measurement Unit

Additional Functions

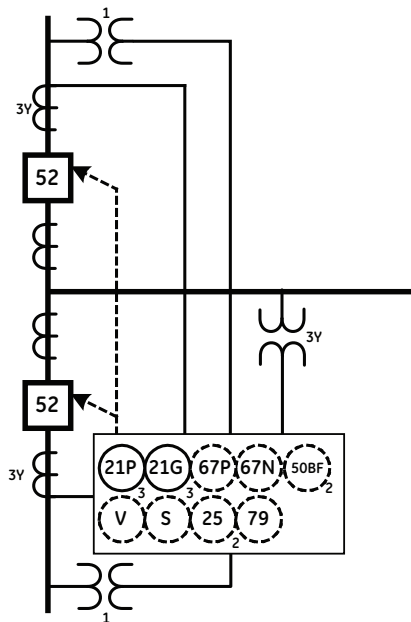
- 67P/N_2 Directional overcurrent
- 50BF Breaker Failure
- 25 Synchrocheck
- 79 Reclosing
- V, W, VAR Voltage and Power metering
- V, S Voltage and Power metering

Functions	Typical Product Order Code
Base Configuration	D30-U00-HKH-F8L-H6P-MXX-PXX-UXX-WXX
Alternative	D60-U00-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+ Ethernet (Copper and Fiber)	D60-U00-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+ Advanced Comms (IEC61850, IEEEE1588-PTP, PRP)	D60-UE3-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+ Synchrophasors (PMU)	D60-UE7-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+ Advanced Comms and CyberSentry	D60-UG7-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+HardFiber IEC 61850 Process Bus	D60-U03-HKH-FXX-H81-MXX-PXX-UXX-WXX

Note: For single pole trip-logic replace D30 with D60

Note 2: For other options and languages, please visit GE's OLS at www.GEDigitalEnergy.com/Onlinestore

Stepped-Distance Protection - Dual Breaker



Typical Functions

- 21P Phase distance
- 21G Ground distance

Synchrophasors

Phasor Measurement Unit

Additional Functions

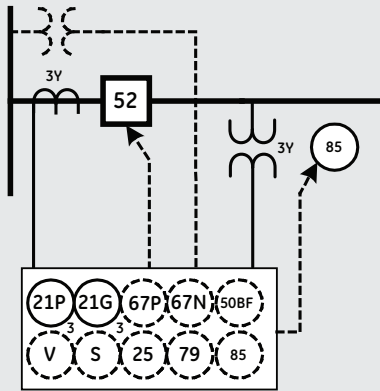
- 67P/N_2 Directional overcurrent
- 50BF Breaker Failure
- 25 Synchrocheck
- 79 Reclosing
- V, W, VAR Voltage and Power metering
- V, S Voltage and Power metering

Functions	Typical Product Order Code
Base Configuration	D30-U00-HKH-F8L-H6P-MXX-PXX-UXX-WXX
Alternative	D60-U00-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+ Ethernet (Copper and Fiber)	D60-U00-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+ Advanced Comms (IEC61850, IEEEE1588-PTP, PRP)	D60-UE3-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+ Synchrophasors (PMU)	D60-UE7-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+ Advanced Comms and CyberSentry	D60-UG7-HKH-F8L-H6P-MXX-PXX-UXX-WXX
+HardFiber IEC 61850 Process Bus	D60-U03-HKH-FXX-H81-MXX-PXX-UXX-WXX

Note: For single pole trip-logic replace D30 with D60

Note 2: For other options and languages, please visit GE's OLS at www.GEDigitalEnergy.com/Onlinestore

Pilot Protection Schemes



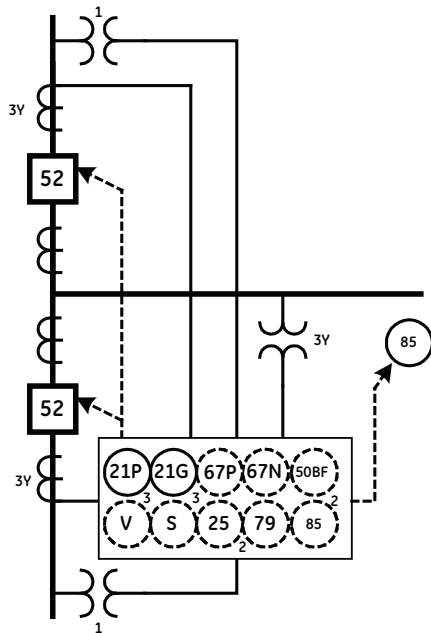
Typical Functions		Additional Functions	
21P	Phase distance	67P/N/_2	Directional overcurrent
21G	Ground distance	50BF	Breaker Failure
85	Power line carrier / microwave transmitter & receiver / fiber or digital channel	25	Synchrocheck
		79	Reclosing
		V, W, VAR	Voltage and Power metering
		V, S	Voltage and Power metering

Other Communications Options		Synchrophasors	
85	Inter-Relay Communications		Phasor Measurement Unit
85	Sonet Multiplexer		

Functions	Typical Product Order Code
External Teleprotection interface	
Base Configuration	D60-U00-HKH-F8L-H6P-M6F-P6D-UXX-WXX
Alternative (Pilot Schemes based on Flex-Logic)	D30-U00-HKH-F8L-H6P-M6F-P6D-UXX-WXX
+ Ethernet (Copper and Fiber)	D60-U00-HKH-F8L-H6P-M6F-P6D-UXX-WXX
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	D60-UE3-HKH-F8L-H6P-M6F-P6D-UXX-WXX
+ Synchrophasors (PMU)	D60-UE7-HKH-F8L-H6P-M6F-P6D-UXX-WXX
+ Advanced Comms and CyberSentry	D60-UG7-HKH-F8L-H6P-M6F-P6D-UXX-WXX
+HardFiber IEC 61850 Process Bus	D60-U03-HKH-FXX-H81-M6F-P6D-UXX-WXX

Functions	Typical Product Order Code
Embedded Digital Teleprotection Interfaces	
IEEE C37.94, 820 nm, multimode, LED, 2 Channels	D60-UE7-HKH-F8L-H6P-MXX-PXX-UXX-W77
1550 nm, single-mode, LASER, 2 Channels	D60-UE7-HKH-F8L-H6P-MXX-PXX-UXX-W7K
G.703, 2 Channels	D60-UE7-HKH-F8L-H6P-MXX-PXX-UXX-W7S
RS422, 2 Channels	D60-UE7-HKH-F8L-H6P-MXX-PXX-UXX-W7W
Hybrid: Channel 1 - IEEE C37.94, MM, 64kbps; Channel 2 - 1550 nm, single-mode, LASER	D60-UE7-HKH-F8L-H6P-MXX-PXX-UXX-W2J

Pilot Protection Schemes - Dual Breakers

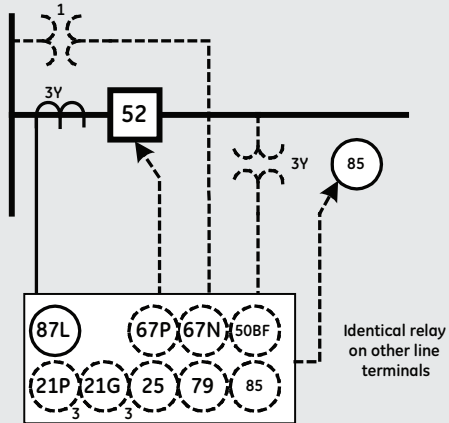


Typical Functions		Additional Functions	
21P	Phase distance	67P/N/_2	Directional overcurrent
21G	Ground distance	50BF	Breaker Failure
85	Power line carrier / microwave transmitter & receiver	25	Synchrocheck
		79	Reclosing
		V, S	Voltage and Power metering

Other Communications Options		Synchrophasors	
85	Inter-Relay Communications		Phasor Measurement Unit
85	Sonet Multiplexer		

Functions	Typical Product Order Code
External Teleprotection interface	
Base Configuration	D60-U02-HKH-F8L-H6P-M8L-P6F-U6D-WXX
Alternative (External sum of currents)	D60-U00-HKH-F8L-H6P-MXX-P6F-U6D-WXX
+ Ethernet (Copper and Fiber)	D60-U02-HKH-F8L-H6P-M8L-P6F-U6D-WXX
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	D60-UE5-HKH-F8L-H6P-M8L-P6F-U6D-WXX
+ Synchrophasors (PMU)	D60-UE9-HKH-F8L-H6P-M8L-P6F-U6D-WXX
+ Advanced Comms and CyberSentry	D60-UG9-HKH-F8L-H6P-M8L-P6F-U6D-WXX
+HardFiber IEC 61850 Process Bus	D60-U03-HKH-FXX-H81-MXX-P6F-U6D-WXX
Embedded Digital Teleprotection Interfaces	
IEEE C37.94, 820 nm, multimode, LED, 2 Channels	D60-UE9-HKH-F8L-H6P-M8L-PXX-UXX-W77
1550 nm, single-mode, LASER, 2 Channels	D60-UE9-HKH-F8L-H6P-M8L-PXX-UXX-W7K
G.703, 2 Channels	D60-UE9-HKH-F8L-H6P-M8L-PXX-UXX-W7S
RS422, 2 Channels	D60-UE9-HKH-F8L-H6P-M8L-PXX-UXX-W7W
Hybrid: Channel 1 - IEEE C37.94, MM, 64kbps; Channel 2 - 1550 nm, single-mode, LASER	D60-UE9-HKH-F8L-H6P-M8L-PXX-UXX-W2J

Line Current Differential Protection

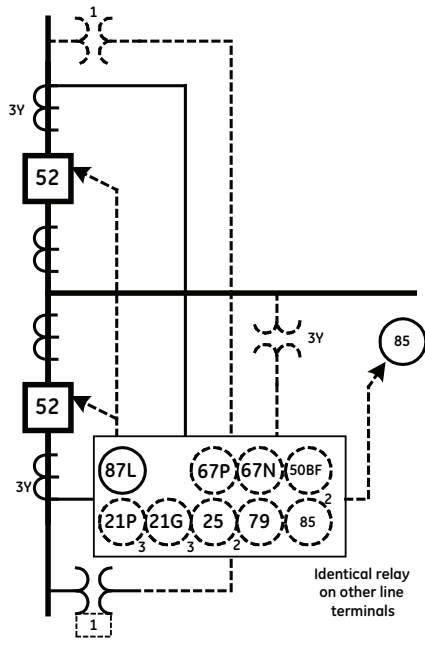


Typical Functions		Additional Functions	
87L	Line differential	21P	Phase distance
85	Sonet Multiplexer	21G	Ground distance
Other Communications Options		67P/N/_2	Directional overcurrent
85	Inter-Relay Communications	50BF	Breaker Failure
Synchrophasors		25	Synchrocheck
Phasor Measurement Unit		79	Reclosing
		V, W, VAR	Voltage and Power metering
		V, S	Voltage and Power metering

Functions	Typical Product Order Code
Base Configuration	L90-U00-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W77
Alternative (Pilot Schemes based on Flex-Logic)	L30-U00-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W77
+ Ethernet (Copper and Fiber)	L90-U00-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W77
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	L90-UE3-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W77
+ Synchrophasors (PMU)	L90-UE7-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W77
+ Advanced Comms and CyberSentry	L90-UG7-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W77
+HardFiber IEC 61850 Process Bus	L90-UG7-HKH-FXX-H81-LXX-NXX-SXX-UXX-W77

Optional Communication Interfaces	
IEEE C37.94, 820 nm, multimode, LED, 2 Channels	L90-UE7-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W77
1550 nm, single-mode, LASER, 2 Channels	L90-UE7-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W7K
G.703, 2 Channels	L90-UE7-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W7S
RS422, 2 Channels	L90-UE7-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W7W
Hybrid: Channel 1 - IEEE C37.94, MM, 64kbps; Channel 2 - 1550 nm, single-mode, LASER	L90-UE7-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W7J

Line Current Differential Protection – Dual Breaker



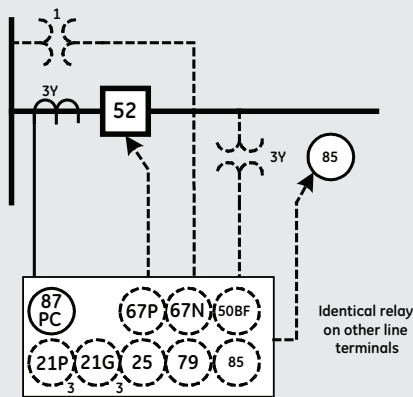
Typical Functions		Additional Functions	
87L	Line differential	21P	Phase distance
85	Sonet Multiplexer	21G	Ground distance
Other Communications Options		67P/N/_2	Directional overcurrent
85	Inter-Relay Communications	50BF	Breaker Failure
Synchrophasors		25	Synchrocheck
Phasor Measurement Unit		79	Reclosing
		V, W, VAR	Voltage and Power metering
		V, S	Voltage and Power metering

Functions	Typical Product Order Code
Base Configuration	L90-U02-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W77
Alternative (Pilot Schemes based on Flex-Logic, external sum of current)	L90-U00-HKH-F8L-H6P-LXX-NXX-SXX-UXX-W77
+ Ethernet (Copper and Fiber)	L90-U02-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W77
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	L90-UE5-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W77
+ Synchrophasors (PMU)	L90-UE9-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W77
+ Advanced Comms and CyberSentry	L90-UG9-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W77
+HardFiber IEC 61850 Process Bus	L90-UG7-HKH-FXX-H81-LXX-NXX-SXX-UXX-W77

Communication Options	
IEEE C37.94, 820 nm, multimode, LED, 2 Channels	L90-UE9-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W77
1550 nm, single-mode, LASER, 2 Channels	L90-UE9-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W7K
G.703, 2 Channels	L90-UE9-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W7S
RS422, 2 Channels	L90-UE9-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W7W
Hybrid: Channel 1 - IEEE C37.94, MM, 64kbps; Channel 2 - 1550 nm, single-mode, LASER	L90-UE9-HKH-F8L-H6P-L8L-NXX-SXX-UXX-W7J

Transmission Protection

Phase Comparison Protection



Typical Functions

87PC	Phase Comparison
85	Power Line Carrier / Microwave

Additional Functions

21P	Phase distance
21G	Ground distance
67P/N/2	Directional overcurrent
50BF	Breaker Failure
25	Synchrocheck
79	Reclosing
V, W, VAR	Voltage and Power metering

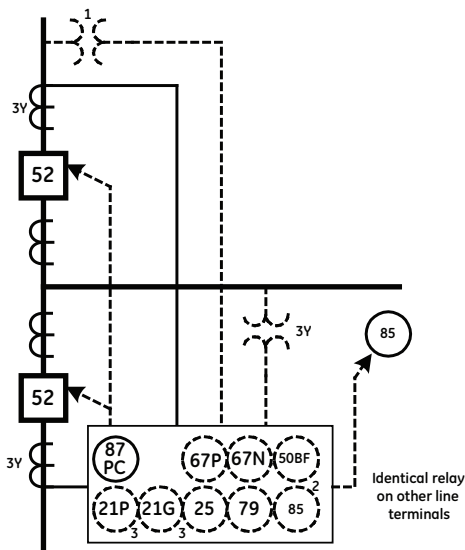
Functions

Base Configuration	L60-U00-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Ethernet (Copper and Fiber)	L60-U00-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	L60-UE3-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Advanced Comms and CyberSentry	L60-UG3-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX

Typical Product Order Code

Base Configuration	L60-U00-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Ethernet (Copper and Fiber)	L60-U00-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	L60-UE3-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Advanced Comms and CyberSentry	L60-UG3-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX

Phase Comparison Protection - Dual Breakers



Typical Functions

87PC	Phase Comparison
85	Power Line Carrier / Microwave

Additional Functions

21P	Phase distance
21G	Ground distance
67P/N/2	Directional overcurrent
50BF	Breaker Failure
25	Synchrocheck
79	Reclosing
V, W, VAR	Voltage and Power metering

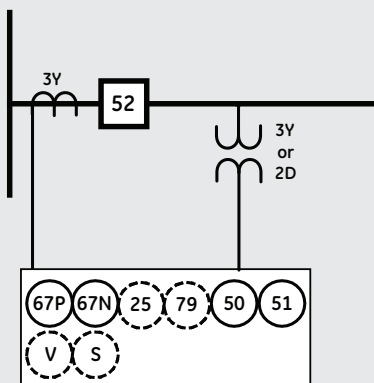
Functions

Base Configuration	L60-U00-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Ethernet (Copper and Fiber)	L60-U00-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	L60-UE3-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Advanced Comms and CyberSentry	L60-UG3-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX

Typical Product Order Code

Base Configuration	L60-U00-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Ethernet (Copper and Fiber)	L60-U00-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	L60-UE3-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX
+ Advanced Comms and CyberSentry	L60-UG3-HKH-F8P-H6P-L8L-NXX-SXX-UXX-WXX

Sub-Transmission – Multi-stage Overcurrent w/Directional Control



Typical Functions

67P/N/2	Directional overcurrent
50P/N/G/_2	Instantaneous overcurrent
51P/N/G/_2	Time delay overcurrent
21P/G	Distance (alternative)

Additional Functions

25	Synchrocheck
79	Reclosing
V, W, VAR	Voltage and Power metering

Functions

Base Configuration	F60-U00-HKH-F8L-H6L-M8L-P6L-UXX-WXX
Alternative	D60-U02-HKH-F8L-H6L-M8L-P6L-UXX-WXX
+ Ethernet (Copper and Fiber)	F60-U02-HKH-F8L-H6L-M8L-P6L-UXX-WXX
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	F60-UE5-HKH-F8L-H6L-M8L-P6L-UXX-WXX
Advanced Comms and CyberSentry	F60-UG5-HKH-F8L-H6L-M8L-P6L-UXX-WXX
+HardFiber IEC 61850 Process Bus	F60-U05-HKH-FXX-H81-MXX-PXX-UXX-WXX

Typical Product Order Code

Base Configuration	F60-U00-HKH-F8L-H6L-M8L-P6L-UXX-WXX
Alternative	D60-U02-HKH-F8L-H6L-M8L-P6L-UXX-WXX
+ Ethernet (Copper and Fiber)	F60-U02-HKH-F8L-H6L-M8L-P6L-UXX-WXX
+ Advanced Comms (IEC61850, IEEE1588-PTP, PRP)	F60-UE5-HKH-F8L-H6L-M8L-P6L-UXX-WXX
Advanced Comms and CyberSentry	F60-UG5-HKH-F8L-H6L-M8L-P6L-UXX-WXX
+HardFiber IEC 61850 Process Bus	F60-U05-HKH-FXX-H81-MXX-PXX-UXX-WXX