MiCOM
P543, P544, P545 & P546

Current Differential Protection Relay

P54x/EN M/Ka4+Kb4

Software Version 45, 47, 55 & 57
Hardware Suffix K

Technical Manual

Contains:	P54x/EN AD/Kb4	V47 & 57 K Addendum
	P54x/EN M/Ka4	V45 & 55 K Manual

Schneider Electric

Note: The technical manual for this device gives instructions for its installation, commissioning, and operation. However, the manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact the appropriate Schneider Electric technical sales office and request the necessary information.

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Update Documentation

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UPDATE DOCUMENTATION

P54x UPDATE DOCUMENTATION

In the firmware version 45 and 55K of P54x, several changes on existing features have been added. These are described with reference to the documentation listed below:

Release	Version	Documentation
16.03.2009	P54x/EN M/Ka4	Technical Manual

Document Ref.	Section	Page No.	Description
P54x/EN IT/Ga4	3.1	1-7	**Functional overview** 64 REF protection added Corrected 67/46 to show 4 stages
	3.2	1-10 1-11	**Ordering options** Hardware options updated Redundant Etherner Options added Software number updated
P54x/EN TD/Ja4	-	2-7	**Protection functions** Phase and ground (earth) Overcurrent modified to Three Phase Overcurrent Protection. Addition of Accuracy claims. Earth Fault added REF Added
	-	2-12 2-15	**Settings, measurements and records list** Configuration updated EIA(RS)232 Teleprotection added INTERMiCOM conf. added Prot comms/IM64 updated
	-	2-17 2-19	**Protection functions** Phase current differential protection updated Sensitive earth fault updated
	-	2-24 2-26	**Measurements list** Measurements 1 updated Fault Record Proforma updated
P54x/EN ST/Ba4	1.1	4-4 4-6	**Relay settings configuration** Sensitive E/F modified to SEF/REF PROT'N IREF>Stage added Restricted Earth Fault Protection added Read Only mode feature added
	1.2	4-6	**Integral teleprotection settings** New section
	1.2.1	4-6	**EIA(RS)232 InterMiCOM** New section
	1.3	4-8	**Protection communication configuration** GPS Sync updated Char Mod Time updated Char Mod Ex feature added Char Mod Ex Time feature added
	1.4.2	4-17	**Distance setup (only for models with distance option)** Cells under DELTA DIRECTION updated

Document Ref.	Section	Page No.	Description
P54x/EN ST/Ba4 Continued	1.4.4	4-23	**Phase differential** Compensation: Vector group text changed to Transformer Inrush Restraint updated to add blocking feature Ih (2) & (5) features added Id High Set updated
	1.4.12	4-38 4-39	**Sensitive earth fault** Sensitive E/F modified to SEF/REF HI Z REF Protection added IREF> Is setting added
	1.5.1	4-68	**System data** Software Ref.1 and 2 updated
P54x/EN OP/Ba4	1.1.1.2	5-18	**Time alignment of current vectors with GPS input (all models)** Section updated to reflect changes to GPS SYNC setting.
	1.2	5-20	**Protection of transformer feeders (P543 and P545)** Previously 1.1.4 Section updated
	1.2.1	5-20	**Enabling or disabling differential protection for in-zone power transformer** New section
	1.2.2	5-20	**Transformer magnetizing inrush (P543/P545)** Previously 1.1.4.1 Heading and section updated
	1.2.2.1	5-20	**Second harmonic restraint (P543/P545)** New section
	1.2.2.2	5-20	**Second harmonic blocking (P543/P545)** New section
	1.2.2.3	5-20	**Fifth harmonic blocking (P543/P545)** New section
	1.2.2.4	5-20	**High set differential (P543/P545)** Section split: previously part of 1.1.4.1
	1.6.2	5-27	**Tripping mode - selection of single or three phase tripping** Previously 1.5.2 Figure 17 updated
	1.29	5-84	**Earth fault, Sensitive Earth Fault (SEF) and Restricted Earth Fault (REF) protection** Previously 1.28 Heading and section updated
	1.29.2	5-84	**Restricted Earth Fault protection (REF)** New section
	1.32	5-90	**Undervoltage protection** Figure 67 updated
	1.33	5-91	**Overvoltage protection** Figure 68 updated
	1.35.1	5-96	**Reset mechanisms for breaker fail timers** Figure 71 updated Figure 72 updated

Document Ref.	Section	Page No.	Description
P54x/EN OP/Ba4 Continued	2.1.6	5-105	**Switched communication networks** Char Mod Ex feature added
	2.1.12.1	5-111	**Pilot isolation** Section deleted
	2.1.12.2	5-111	**Baseband modem and P590 specification** Section deleted
	2.1.12.3	5-112	**Baseband modem propagation delay** Section deleted
	2.1.12.4	5-112	**Baseband modem and relay configuration** Section deleted
	2.1.13	5-111	**Unconditioned 2 wire pilot communications for distances greater than 1.2 km** New section
	2.2	5-117	**InterMiCOM** New section
	2.2.1	5-117	**Protection signaling** New section
	2.2.2	5-117	**InterMiCOM variants** New section
	2.2.3	5-117	**InterMiCOM features** New section
	2.2.4	5-117	**Definition of teleprotection commands** New section
	2.3	5-117	**MODEM InterMiCOM, EIA(RS)232 InterMiCOM or Copper InterMiCOM** New section
	2.3.1	5-117	**Communications media** New section
	2.3.2	5-117	**General features and implementation** New section
	2.3.3	5-117	**EIA(RS)232 physical connections** New section
	2.3.4	5-117	**Direct connection** New section
	2.3.5	5-117	**EIA(RS)232 modem connection** New section
	2.3.6	5-117	**RS422 connection** New section
	2.3.7	5-117	**Fiber optic connection** New section
	2.3.8	5-117	**InterMiCOM functional assignment** New section
	2.3.9	5-117	**InterMiCOM statistics and diagnostics** New section
	3.8	5-132	**Read Only mode** New section
	3.8.1	5-132	**Protocol/port implementation:** New section

Document Ref.	Section	Page No.	Description
P54x/EN OP/Ba4 Continued	3.8.1.1	5-132	**IEC 60870-5-103 protocol on rear port 1:** New section
	3.8.1.2	5-132	**Courier protocol on rear port 1/2 and Ethernet** New section
	3.8.1.3	5-132	**IEC 61850** New section
	3.8.2	5-132	**Courier database support** New section
	3.8.3	5-132	**New DDB signals** New section
P54x/EN AP/Ja4	2.1.4	6-11	**Transformers in-zone applications (P543 and P545 models)** Paragraph two amended Paragraph after Note deleted
	2.1.4.1	6-12	**Magnetizing inrush stabilization (P543 and P545)** New section
	2.1.4.2	6-12	**Second harmonic restraint (P543 and P545)** New section
	2.1.4.3	6-12	**Second harmonic blocking (P543 and P545)** New section
	2.1.4.4	6-12	**Fifth Harmonic blocking (P543 and P545)** New section
	2.1.4.7	6-13	**High set differential setting (P543 and P545)** Heading and paragraph one amended
	2.8.4	6-39	**Restricted earth fault protection** New section
	2.8.4.1	6-39	**Setting guidelines for high impedance Restricted Earth fault (REF)** New section
	2.18.4.2	6-19	**Use of METROSIL non-linear resistors** New section
	2.17	6-47	**Integral intertripping** New section
	2.17.1	6-47	**EIA(RS)232 InterMiCOM (“Modem InterMiCOM”)** New section
	4.4	6-76	**Read Only mode** New section

Document Ref.	Section	Page No.	Description
P54x/EN PL/Ba4	1.7	7-16-54	**Description of logic node** DDB 80 added DDBs 87 to 88 added DDB 95 added DDBs 365 to 368 DDBs 460 to 461 updated DDB 682 added DDBs 737 to 740 updated DDBs 1016 to 1019 updated DDBs 1021 to 1023 added DDBs 1437 to 1440 updated DDB 1616 added DDBs 1665 to 1671 added DDB 1696 to 1697 added DDB 1710 to 1711 added DDB 1728 added DDBs 1759 to 1760 added DDB 1791 added
P54x/EN MR/Ba4	1.4.1	8-11	**Measured voltages and currents** Paragraph one updated
	1.4.8	8-14	**Measurement display quantities** CT1 and CT2 Magnitude added CT1 and CT2 Phase angle added
P54x/EN VH/I84	-	16-1-46	**Firmware and service manual version history** Updated with latest relay software details

INTRODUCTION (P54x/EN IT/Ga4)

3.1 Functional overview

The P54x distance relay contains a wide variety of protection functions. The protection features are summarized below:

			Models			
ANSI	**FEATURE**		**P543**	**P544**	**P545**	**P546**
	Optocoupled digital inputs		16	16	24	24
	Standard relay output contacts		14	14	32	32
	Standard and high break output contacts		(11)	(11)	(24)	(24) (20)
	Dual rated 1A and 5A CT inputs		•	•	•	•
	Tripping Mode - single or three pole		•	•	•	•
	ABC and ACB phase rotation		•	•	•	•
	Multiple password access control levels		•	•	•	•
87	Phase segregated current differential		•	•	•	•
	2 and 3 terminal lines/cables		•	•	•	•
	Feeders with in-zone transformers		•		•	
	Control of dual circuit breakers			•		•
	Suitable for use with SDH/SONET networks (using P594)		•	•	•	•
	InterMiCOM^{64} teleprotection for direct relay-relay communication		•	•	•	•
21P/21G	Distance zones, full-scheme protection		(5)	(5)	(5)	(5)
	Characteristic	Phase elements	Mho and quadrilateral			
		Ground elements				
	CVT transient overreach elimination		•	•	•	•
	Load blinder		•	•	•	•
	Easy setting mode		•	•	•	•
	Mutual compensation (for fault locator and distance zones)		•	•	•	•
85	Communication-aided schemes, PUTT, POTT, Blocking, Weak Infeed		•	•	•	•
	Accelerated tripping - loss of load and Z1 extension		•	•	•	•
50/27	Switch on to fault and trip on recluse - elements for fast fault clearance upon breaker closure		•	•	•	•
68	Power swing blocking		•	•	•	•
78	Out of step		•	•	•	•
67N	Directional earth fault (DEF) unit protection		•	•	•	•
50/51/67	Phase overcurrent stages, with optional directionality		4	4	4	4
50N/51N/ 67N	Earth/ground overcurrent stages, with optional directionality		4	4	4	4
51N/67N/SEF	Sensitive Earth Fault (SEF)		4	4	4	4
64	High impedance Restricted Earth Fault		•	•	•	•
67/46	Negative sequence overcurrent stages, with optional directionality		4	4	4	4
46BC	Broken conductor (open jumper), used to detect open circuit faults		•	•	•	•
49	Thermal overload protection		•	•	•	•

		Models			
ANSI	**FEATURE**	**P543**	**P544**	**P545**	**P546**
27	Undervoltage protection stages	2	2	2	2
59	Overvoltage protection stages	2	2	2	2
59 Remote	Remote overvoltage protection stages	2	2	2	2
59N	Residual voltage stages (neutral displacement)	2	2	2	2
81U/O/R	A 4-stage underfrequency, 2-stage overfrequency and an advanced 4-stage rate of change of frequency element as well.	•	•	•	•
50BF	High speed breaker fail. Two-stage, suitable for re-tripping and backtripping	•	•	•	•
CTS	CT supervision (including differential CTS, patent pending)	•	•	•	•
VTS	Current and voltage transformer supervision	•	•	•	•
79	Auto-reclose - shots supported	4	4	4	4
25	Check synchronism, 2 stages	•	•	•	•
	Alternative setting groups	4	4	4	4
FL	Fault locator	•	•	•	•
	SOE event records	512	512	512	512
	Disturbance recorder, samples per cycle. For waveform capture	48	48	48	48
	Circuit breaker condition monitoring	•	•	•	•
	Graphical programmable scheme logic (PSL)	•	•	•	•
	IRIG-B time synchronism	•	•	•	•
	Second rear communication port	•	•	•	•
	High speed, high break (HB) contacts	•	•	•	•

The P54x supports the following relay management functions in addition to the functions illustrated above.

- Measurement of all instantaneous & integrated values
- Circuit breaker control, status & condition monitoring
- Trip circuit and coil supervision
- Programmable hotkeys (2)
- Control inputs
- Programmable allocation of digital inputs and outputs
- Fully customizable menu texts
- Power-up diagnostics and continuous self-monitoring of relay

Application overview

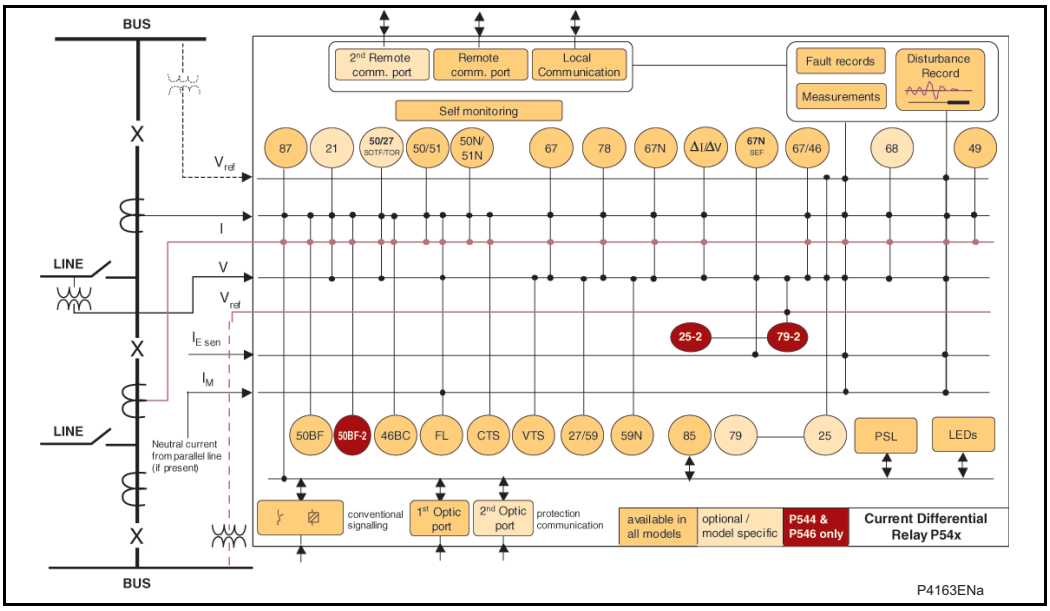


Figure 1: Functional diagram

3.2 Ordering Options

Information required with order

P54x Current differential protection	**P54**											**K**
Current Differential for single breaker (60TE/12")	3											
Current Differential for dual breaker (60TE/12")	4											
Current Differential for single breaker (80TE/12")	5											
Current Differential for dual breaker (80TE/12")	6											
Auxiliary voltage rating												
24 - 48 Vdc		1										
48 - 125 Vdc (40 - 100 Vac)		2										
110 - 250 Vdc (100 - 240 Vac)		3										
In/Vn rating												
Dual rated CT (1 & 5 A: 100 - 120 V)			1									
Hardware Options												

	Protocol Compatibility	
Standard - None	1, 3 & 4	1
IRIG-B Only (Modulated)	1, 3 & 4	2
Fiber Optic Converter Only	1, 3 & 4	3
IRIG-B (Modulated) & Fiber Optic Converter	1, 3 & 4	4
Ethernet (100 Mbit/s)	6, 7 & 8	6
Ethernet (100 Mbit/s) plus IRIG-B (Modulated)	6, 7 & 8	A
Ethernet (100 Mbit/s) plus IRIG-B (De-modulated)	6, 7 & 8	B
IRIG-B (De-modulated)	1, 3 & 4	C
Second rear comms + Interrupt InterMiCOM	1, 3 & 4	E
IRIG-B (Modulated) + second rear comms + Interrupt InterMiCOM	1, 3 & 4	F
Redundant Ethernet Self-Healing Ring, 2 multi-mode fiber ports + Modulated IRIG-B	6, 7 & 8	G
Redundant Ethernet Self-Healing Ring, 2 multi-mode fiber ports + Un-modulated IRIG-B	6, 7 & 8	H
Redundant Ethernet RSTP, 2 multi-mode fiber ports + Modulated IRIG-B	6, 7 & 8	J

Redundant Ethernet RSTP, 2 multi-mode fiber ports + Un-modulated IRIG-B	6, 7 & 8	K
Redundant Ethernet Dual-Homing Star, 2 multi-mode fiber ports + Modulated IRIG-B	6, 7 & 8	L
Redundant Ethernet Dual-Homing Star, 2 multi-mode fiber ports + Un-modulated IRIG-B	6, 7 & 8	M

Product specific

850 nm dual channel	A
1300 nm SM single channel	B
1300 nm SM dual channel	C
1300 nm MM single channel	D
1300 nm MM dual channel	E
1550 nm SM single channel	F
1550 nm SM dual channel	G
850 nm MM + 1300 nm SM	H
850 nm dual channel + 32 Inputs (Note 1)	I
850 nm dual channel + 8 std + 12hb (Note 2)	I
850 nm MM + 1300 nm MM	J
850 nm MM + 1550 nm SM	K
1300 nm SM + 850 nm MM	L
1300 nm MM + 850 nm MM	M
1300 nm SM single channel + 32 Inputs (Note 1)	N
1300 nm SM single channel + 8 std + 12hb (Note 2)	N
1300 nm SM dual channel + 32 Inputs (Note 1)	O
1300 nm SM dual channel + 8 std + 12hb (Note 2)	O
1300 nm MM single channel + 32 Inputs (Note 1)	P
1300 nm MM single channel + 8 std + 12hb (Note 2)	P
1300 nm MM dual channel + 32 Inputs (Note 1)	Q
1300 nm MM dual channel + 8 std + 12hb (Note 2)	Q
1550 nm SM + 850 nm MM	R
850 nm dual channel + High Break	S
1300 nm SM single channel + High Break	T
1300 nm SM dual channel + High Break	U
1300 nm MM single channel + High Break	V
1300 nm MM dual channel + High Break	W
1550 nm SM single channel + High Break	X
1550 nm SM single channel + High Break	Z
850 nm MM + 1300 nm SM + High Break	0
850 nm MM + 1300 nm MM + High Break	1
850 nm MM + 1550 nm SM + High Break	2
1300 nm SM + 850 nm MM + High Break	3
1300 nm MM + 850 nm MM + High Break	4
1550 nm SM + 850 nm MM + High Break	5
1550 nm SM single channel + 32 Inputs (Note 1)	8
1550 nm SM single channel + 8 std + 12 hb (Note 2)	8
1550 nm SM single channel + 32 Inputs (Note 1)	9
1550 nm SM single channel + 8 std + 12 hb (Note 2)	9

Protocol Options

	Hardware Compatibility	
K-Bus	1, 2, 3, 4, 7, 8 & C, E & F	1
IEC870	1, 2, 3, 4, 7, 8 & C, E & F	3
DNP3.0	1, 2, 3, 4, 7, 8 & C, E & F	4
IEC 61850 + Courier via rear RS485 port	6, A, B, G, H, J, K, L & M	6
IEC 61850+IEC 60870-5-103 via rear RS485 port	6, A, B, G, H, J, K, L & M	7
DNP3.0 Over Ethernet with Courier rear port K-Bus/RS485 protocol	6, A, B, G, H, J, K, L & M	8

Mounting

Flush Panel	M
Rack (P545, P546 only)	N

Language options

Multilingual - English, French, German, Spanish	
Multilingual - English, French, German, Russian	0
Multilingual - Chinese, English or French via	5
HMI,with English or French only via Communications port	C

Software number

P543/P545 Without Distance	47
P543/P545 With Distance	57
P544/P546 Without Distance	47
P544/P546 With Distance	57

Settings file	
Default	0
Customer	A
Hardware suffix	
Note 3.	K

Note 1: Option applies to P545 only.

Note 2: Option applies to P546 only

Note 3:

A = Original

B = Universal Optos, New Relays, New Co-Processor Board, New PSU

G = CPU2

J = Dual Rated Optos

K = Extended CPU2

For up-to-date information on the cortec, please visit the website.

TECHNICAL DATA (P54x/EN TD/Ja4)

Protection functions

Phase current differential protection

Accuracy

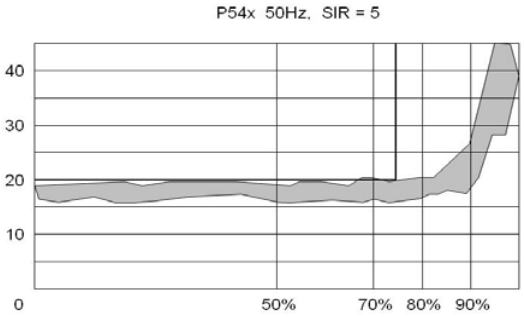
Pick-up: Formula ±10%
Drop-off: 0.75 x Formula ±10%
IDMT characteristic shape: ±5% or 40 ms whichever is greater
DT operation: ±2% or 20 ms whichever is greater
Instantaneous Operation: <30 ms
Reset time: <60 ms
Repeatability: ±2.5%
Characteristic:
UK curves IEC 60255-3 – 1998
US curves IEEE C37.112 – 1996
Vector compensation:
No affect on accuracy
Current transformer ratio Compensation
No affect on accuracy
High set characteristic setting:
No affect on accuracy
Two ended scheme operation:
No affect on accuracy
Three ended scheme operation:
No affect on accuracy

Distance protection

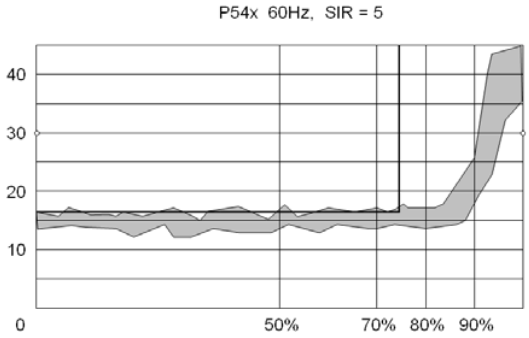
All quoted operating times include the closure of the trip output contact.

The following tripping characteristics, show Operating time Versus reach percentage, for faults close to line angle

50 Hz operation



60 Hz operation



Accuracy

Characteristic shape, up to SIR = 30:
±5% for on-angle fault (the set line angle)
±10% off-angle
(Example: For a 70 degree set line angle, injection testing at 40 degrees would be referred to as "off-angle").
Zone time delay deviations:
±20 ms or 2%, whichever is greater.

Sensitivity

Settings < 5/In Ω: (0.05 In*5/(setting*In)) ±5%
Settings > 5/In Ω: 0.05 In ±5%

Out of step

Accuracy of zones and timers as per distance
Operating range: up to 7 Hz

Three phase overcurrent protection

Accuracy

Additional tolerance X/R ratios:
±5% over X/R 1…90
Overshoot: <30 ms

Inverse time characteristic

Accuracy

Pick-up: Setting ±5%
Drop-off: 0.95 x setting ±5%
Minimum trip level for IDMT elements:
1.05 x Setting ± 5%
Inverse time stages:
±40 ms or 5%, whichever is greater
Definite time stages:
±40 ms or 2%, whichever is greater
Repeatability: 5%
Directional boundary accuracy:
±2° with hysteresis <3°
Additional tolerance due to increasing X/R ratios:
±5% over the X/R ratio from 1 to 90.
Overshoot of overcurrent elements: <30 ms

Earth/Sensitive Fault protection

Earth Fault

DT Pick-up: Setting ±5%
Minimum IDMT Trip level: 1.05 x Setting ±5%
Drop-off: 0.95 x Setting ±5%
IDMT shape: ±5% or 40 ms whichever is greater *
IEEE reset: ±10% or 40 ms whichever is greater
DT operation: ±2% or 50 ms whichever is greater
DT reset: ±2% or 50 ms whichever is greater
Repeatability: ±5%

** Reference conditions TMS = 1, TD = 1 and IN > setting of 1A, operating range 2-20 In*

SEF

Pick-up: Setting ±5%
Drop-off: 0.95 x Setting ±5%
Minimum trip level of IDMT elements: 1.05 x Setting ±5%
IDMT characteristic shape: ±5% or 40 ms whichever is greater*
IEEE reset: ±17.5% or 60 ms whichever is greater
DT operation: ±2% or 50 ms whichever is greater
DT reset: ±5% or 50 ms whichever is greater
Repeatability: 5%

** Reference conditions TMS = 1, TD = 1, and IN> setting of 100 mA, accuracy operating range 2-20 Is*

REF

Pick-up: Setting formula ±5%
Drop-off: 0.80 x setting formula ±5%
Operating time: <60 ms
High pick up: Setting ±5%
High operating time: <30 ms
Repeatability: <15%

Wattmetric SEF

Pick-up P=0W: ISEF> ±5% or 5 mA
Pick-up P>0W: P> ±5%
Drop-off P=0W: (0.95 x ISEF >) ±5% or 5 mA
Drop-off P>0W: 0.9 x P> ±5%
Boundary accuracy: ±5% with 1° hysteresis
Repeatability: 1%

Polarizing quantities

VN> and V2> Level detectors:
Pick-up: ±10%
Resetting ratio: 0.9
I2> Level detector:
Pick-up: ±10%
Resetting ratio: 0.9

Negative sequence overcurrent

Accuracy

Pick-up: Setting ±5%
Drop-off: 0.95 x setting
Definite time operation: ±60 ms or 2%, whichever is greater
Repeatability: 1%
Directional boundary accuracy: ±2° with hysteresis <1°
Reset: <35 ms

Undervoltage

Accuracy

DT Pick-up: Setting ±2%
IDMT Pick-up: 0.98 x setting ±2%
Drop-off: 1.02 x setting ±2%
Definite time operation: ±40 ms or 2%, whichever is greater
Repeatability: 1%
IDMT characteristic shape: ±40 ms or 2%, whichever is greater
Reset: <75 ms

Overvoltage

Accuracy

DT Pick-up: Setting ±1%
IDMT Pick-up: 1.02 x setting ±2%
Drop-off: 0.98 x setting ±2%
Definite time operation: ±40 ms or 2%, whichever is greater
Repeatability: 1%
IDMT characteristic shape: ±40 ms or 2%, whichever is greater
Reset: <75 ms

Neutral displacement/residual overvoltage

Accuracy

DT Pick-up: Setting ±5%
IDMT Pick-up: 1.05 x setting ±5%
Drop-off: 0.95 x setting ±5%
Definite time operation: ±20 ms or 2%, whichever is greater
Instantaneous operation: <50 ms
Repeatability: 10%
IDMT characteristic shape: ±60 ms or 5%, whichever is greater
Reset: <35 ms

Circuit breaker fail and undercurrent

Accuracy

Pick-up: ±10% or 0.025 In, whichever is greater
Operating time: <12 ms
Timers: ±2 ms or 2%, whichever is greater
Reset: <15 ms

Broken conductor logic

Accuracy

Pick-up: Setting ±2.5%
Drop-off: 0.95 x setting ±2.5%
Definite time operation:
±50 ms or 2%, whichever is greater
Reset: <25 ms

Thermal overload

Accuracy

Thermal alarm pick-up:
Calculated trip time ±10%
Thermal overload pick-up:
Calculated trip time ±10%
Cooling time accuracy ±15% of theoretical
Repeatability: <5%
* *Operating time measured with applied current of 20% above thermal setting.*

Voltage transformer supervision

Accuracy

Fast block operation: <1 cycle
Fast block reset: <1.5 cycles
Time delay: ±20 ms or 2%, whichever is greater

Current transformer supervision

Standard CTS

Accuracy

IN> Pick-up: Setting ±5%
VN< Pick-up: Setting ±5%
IN> Drop-off: 0.9 setting ±5%
VN< Drop-off: (1.05 x setting) ±5% or 1 V, whichever is greater
Time delay operation: Setting ±2% or 20 ms, whichever is greater
CTS block operation: <1 cycle
CTS reset: <35 ms

Differential CTS

Accuracy

I1 Pick-up: Setting 5%
I1 Drop-off: (0.9 x setting) 5%
I2/I1> Pick-up: Setting 5%
I2/I1> Drop-off: (0.9 x setting) 5%
I2/I1>> Pick-up: Setting 5%
I2/I1>> Drop-off: (0.9 x setting) 5%
Time delay operation:
Setting 2% or 20 ms, whichever is greater
CTS block operation: <1 cycle
CTS block diff operation <1 cycle
CTS reset: <35 ms

CB state monitoring and condition monitoring

Accuracy

Timers:
±20 ms or 2%, whichever is greater
Broken current accuracy: ±5%

Programmable scheme logic

Accuracy

Output conditioner timer:
Setting ±20 ms or 2%, whichever is greater
Dwell conditioner timer:
Setting ±20 ms or 2%, whichever is greater
Pulse conditioner timer:
Setting ±20 ms or 2%, whichever is greater

Auto-reclose and check synchronism

Accuracy

Timers:
Setting ±20 ms or 2%, whichever is greater

Measurements and recording facilities

Accuracy

Typically ±1%, but ±0.5% between 0.2 - 2In/Vn
Current: 0.05 to 3 In
Accuracy: ±1.0% of reading
Voltage: 0.05 to 2 Vn
Accuracy: ±1.0% of reading
Power (W): 0.2 to 2 Vn and 0.05 to 3 In
Accuracy: ±5.0% of reading at unity power factor
Reactive power (Vars): 0.2 to 2 Vn to 3 In
Accuracy: ±5.0% of reading at zero power factor
Apparent power (VA): 0.2 to 2 Vn 0.05 to 3 In
Accuracy: ±5.0% of reading
Energy (Wh): 0.2 to 2 Vn 0.2 to 3 In
Accuracy: ±5.0% of reading at zero power factor
Energy (Varh): 0.2 to 2 Vn 0.2 to 3In
Accuracy: ±5.0% of reading at zero power factor
Phase accuracy: 0° to 360°
Accuracy: ±0.5%
Frequency: 45 to 65 Hz
Accuracy: ±0.025 Hz

IRIG-B and real time clock

Performance accuracy
(for modulated and un-modulated versions)
Real time clock accuracy: < ±2 seconds/day

Disturbance records

Maximum record duration : 50 seconds
No of records : Minimum 5 at 10 second each. Maximum 50 at 1 second each. (8 records of 3 seconds each via IEC 60870-5-103 protocol)

Accuracy
Magnitude and relative phases: ±5% of applied quantities
Duration: ±2%
Trigger position: ±2% (minimum Trigger 100 ms)

Fault locator

Accuracy
Fault location: ±2% of line length (under reference conditions)*
* Reference conditions solid fault applied on line

Event, fault & maintenance records

The most recent records are stored in battery-backed memory, and can be extracted via the communication port or be viewed on the front panel display.
No of Event Records: Up to 512 time tagged event records.
No of Fault Records: Up to 15
No of Maintenance Records: Up to 10

Plant supervision

Accuracy
Timers: ±2% or 20 ms whichever is greater
Broken current accuracy: ±5%

Timer accuracy
Timers: ±2% or 40 ms whichever is greater
Reset time: <30 ms

Undercurrent accuracy
Pick-up: ±10% or 25 mA whichever is greater
Operating time: <20 ms
Reset: <25 ms

InterMiCOM^{64} fiber optic teleprotection

End-end operation. Table below shows minimum and maximum transfer time for InterMiCOM^{64} (IM64).
The times are measured from opto initialization (with no opto filtering) to relay standard output and include a small propagation delay for back-back test (2.7 ms for 64 kbits/s and 3.2 ms for 56 kbits/s).
IDiff IM64 indicates InterMiCOM^{64} signals working in conjunction with the differential protection fiber optic communications channel.
IM64 indicates InterMiCOM^{64} signals working as a standalone feature.

Configuration	Permissive op times (ms)	Direct op times (ms)
IM64 at 64 k	13 - 18	17 - 20
IM64 at 56 k	15 - 20	19 - 22
IDiff IM64 at 64 k	22 - 24	23 - 25
IDiff IM64 at 56 k	24 - 26	25 - 27

Ethernet data (where applicable)

100 Base FX Interface

Transmitter Optical Characteristics
(TA = 0°C to 70°C, VCC = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max.	Unit
Output Optical Power BOL 62.5/125 µm, NA = 0.275 Fiber EOL	PO	-19 -20	-16.8	-14	dBm avg.
Output Optical Power BOL 50/125 µm, NA = 0.20 Fiber EOL	PO	-22.5 -23.5	-20.3	-14	dBm avg.
Optical Extinction Ratio				10 -10	% dB
Output Optical Power at Logic "0" State	PO ("0")			-45	dBm avg.

BOL - Beginning of life
EOL - End of life

Receiver Optical Characteristics
(TA = 0°C to 70°C, VCC = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max.	Unit
Input Optical Power Minimum at Window Edge	PIN Min. (W)		-33.5	–31	dBm avg.
Input Optical Power Minimum at Eye Center	PIN Min. (C)		-34.5	-31.8	Bm avg.
Input Optical Power Maximum	PIN Max.	-14	-11.8		dBm avg.

Settings, measurements and records list

Settings list

Global settings (system data):

Language: English/French/German/Spanish
English/French/German/Russian
Chinese/English/French
Frequency: 50/60 Hz

Circuit breaker control (CB control):

CB Control by: Disabled
Local
Remote
Local+remote
Opto
Opto+local
Opto+remote
Opto+rem+local

P543 and P545 specific CB control settings:

Close pulse time: 0.10…10.00 s
Trip pulse time: 0.10…5.00 s
Man close t max: 0.01…9999.00 s
Man close delay: 0.01…600.00 s
CB healthy time: 0.01…9999.00 s
Check sync time: 0.01…9999.00 s
Reset lockout by: User interface/CB close
Man close RstDly: 0.10…600.00 s
Single pole A/R: Disabled/Enabled
Three pole A/R: Disabled/Enabled
CB Status Input: None
52A 3 pole
52B 3 pole
52A & 52B 3 pole
52A 1 pole
52B 1 pole
52A & 52B 1 pole

P544 and P546 specific CB control settings:

Man Close Delay: 0.01…600 s
CB Healthy Time: 0.01…9999 s
Check Sync. Time: 0.01…9999 s
Rst CB mon LO By: User Interface,
CB Close
CB mon LO RstDly: 0.1…600 s
CB1 Status Input: None, 52A 3 pole,
52B 3 pole,
52A & 52B 3 pole,
52A 1 pole,
52B 1 pole,
52A & 52B 1 pole
CB Status Time 0.1 ... 5 s
CB2 Status Input: None, 52A 3 pole,
52B 3 pole,
52A & 52B 3 pole,
52A 1 pole,
52B 1 pole,
52A & 52B 1 pole
Res AROK by UI: Enabled/Disabled
Res AROK by NoAR: Enabled/Disabled
Res AROK by Ext: Enabled/Disabled
Res AROK by TDly: Enabled/Disabled
Res AROK by TDly: 1.0…9999 s
Res LO by CB IS: Enabled/Disabled
Res LO by UI: Enabled/Disabled
Res LO by NoAR: Enabled/Disabled
Res LO by ExtDDB: Enabled/Disabled
Res LO by TDelay: Enabled/Disabled
LO Reset Time: 1…9999 s

Date and time

IRIG-B Sync: Disabled/Enabled
Battery Alarm: Disabled/Enabled
LocalTime Enable: Disabled/Fixed/Flexible
LocalTime Offset: -720...720
DST Enable: Disabled or Enabled
DST Offset: 30...60
DST Start: First, Second, Third, Fourth, Last
DST Start Day: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday
DST Start Month: January, February, March, April, May, June, July, August, September, October, November, December
DST Start Mins: 0...1425
DST End: First, Second, Third, Fourth, Last
DST End Day: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday
DST End Month: January, February, March, April, May, June, July, August, September, October, November, December
DST End Mins: 0...1425
RP1 Time Zone: UTC or Local
RP2 Time Zone: UTC or Local
DNPOE Time Zone: UTC or Local
Tunnel Time Zone: UTC or Local

Configuration

Setting Group: Select via Menu
Select via Opto
Active Settings: Group 1/2/3/4
Setting Group 1: Disabled/Enabled
Setting Group 2: Disabled/Enabled
Setting Group 3: Disabled/Enabled
Setting Group 4: Disabled/Enabled
Distance: Disabled/Enabled
Directional E/F: Disabled/Enabled
Phase Diff: Disabled/Enabled
Overcurrent: Disabled/Enabled
Neg Sequence O/C: Disabled/Enabled
Broken Conductor: Disabled/Enabled

Earth Fault:	Disabled/Enabled
SEF/REF Prot'n:	Disabled/Enabled
Residual O/V NVD:	Disabled/Enabled
Thermal Overload:	Disabled/Enabled
Power Swing Block:	Disabled/Enabled
Volt Protection:	Disabled/Enabled
Freq Protection:	Disabled/Enabled
df/dt Protection:	Disabled/Enabled
CB Fail:	Disabled/Enabled
Supervision:	Disabled/Enabled
System Checks:	Disabled/Enabled
Auto-Reclose:	Disabled/Enabled
Input Labels:	Invisible/Visible
Output Labels:	Invisible/Visible
CT & VT Ratios:	Invisible/Visible
Record Control:	Invisible/Visible
Disturb Recorder:	Invisible/Visible
Measure't Setup:	Invisible/Visible
Comms Settings:	Invisible/Visible
Commission Tests:	Invisible/Visible
Setting Values:	Primary/Secondary
Control Inputs:	Invisible/Visible
Ctrl I/P Config:	Invisible/Visible
Ctrl I/P Labels:	Invisible/Visible
Direct Access:	Disabled/Enabled
InterMiCOM^{64} Fiber:	Disabled/Enabled
Function Key:	Invisible/Visible
LCD Contrast:	*(Factory pre-set)*

CT and VT ratios

P543 and P545 CT and VT ratio settings:

Main VT Primary:	100 V...1 MV
Main VT Sec'y:	80...140 V
C/S VT Primary:	100 V...1 MV
C/S VT Secondary:	80...140 V
Phase CT Primary:	1 A…30 kA
Phase CT Sec'y:	1 A/5 A
SEF CT Primary:	1 A…30 kA
SEF CT Sec'y:	1 A/5 A
MComp CT Primary:	1 A…30 kA
MComp CT Sec'y:	1 A/5 A
C/S Input:	A-N, B-N, C-N, A-B, B-C, C-A, A-N/1.732, B-N/1.732, C-N/1.732
Main VT Location:	Line/Bus
CT Polarity:	Standard /Inverted
CT2 Polarity:	Standard /Inverted
SEF CT Polarity:	Standard /Inverted
M CT Polarity:	Standard /Inverted
VTs Connected:	Yes/No

P544 and P546 CT and VT ratio settings:

Main VT Primary:	100 V…1000 kV
Main VT Sec'y:	80…140 V
CB1 CS VT Prim'y:	100 V…1000 kV
CB1 CS VT Sec'y:	80…140 V
CB2 CS VT Prim'y:	100 V…1000 kV
CB2 CS VT Sec'y:	80…140 V
Phase CT Primary:	1 A…30 kA
Phase CT Sec'y:	1…5 A
SEF CT Primary:	1 A…30 kA
SEF CT Secondary:	1…5 A
MComp CT Primary:	1…30 k
MComp CT Sec'y:	1…5 A
CS Input:	A-N, B-N, C-N, A-B, B-C, C-A
CT1 Polarity:	Standard/Inverted
CT2 Polarity:	Standard/Inverted
SEF CT Polarity:	Standard/Inverted
M CT Polarity:	Standard/Inverted
VTs Connected:	Yes/No
CB1 CS VT PhShft:	-180…+180 deg
CB1 CS VT Mag.:	0.2…3
CB2 CS VT PhShft:	-180…+180 deg
CB2 CS VT Mag.:	0.2…3

Sequence of event recorder (record control)

Alarm Event: Disabled/Enabled
Relay O/P Event: Disabled/Enabled
Opto Input Event: Disabled/Enabled
General Event: Disabled/Enabled
Fault Rec Event: Disabled/Enabled
Maint Rec Event: Disabled/Enabled
Protection Event: Disabled/Enabled
Flt Rec Extended: Disabled/Enabled
DDB 31 - 0:
(up to):
DDB 1791 - 1760:
Binary function link strings, selecting which DDB signals will be stored as events, and which will be filtered out.

Oscillography (disturb recorder)

Duration: 0.10…10.50 s
Trigger Position: 0.0…100.0%
Trigger Mode: Single/Extended
Analog Channel 1:
(up to):
Analog Channel 12:
Disturbance channels selected from:
IA, IB, IC, IN, IN Sensitive, VA, VB, VC, IM, V CheckSync (only for P543 and P545) and IA2, IB2, IC2 and VCheckSync2 (only for P544 and P546)

Digital Input 1:
(up to):
Digital Input 32:
Selected binary channel assignment from any DDB status point within the relay (opto input, output contact, alarms, starts, trips, controls, logic…).

Input 1 Trigger: No Trigger/Trigger
(up to):
Input 32 Trigger: No Trigger/Trigger

Measured operating data (measure't setup)

Default Display: 3Ph + N Current
3Ph Voltage
Power
Date and Time
Description
Plant Reference
Frequency
Access Level
Local Values: Primary/Secondary
Remote Values: Primary/Secondary
Measurement Ref: VA/VB/VC/IA/IB/IC
Measurement Mode: 0/1/2/3
Fix Dem Period: 1…99 mins
Roll Sub Period: 1…99 mins
Num Sub Periods: 1…15
Distance Unit: Miles/Kilometers
Fault Location: Distance
Ohms
% of Line
Remote 2 Values: Primary/Secondary

Communications

RP1 Protocol: Courier
IEC870-5-103
DNP3.0
IEC 61850

Courier protocol:

RP1 Address*:* 0…255
RP1 InactivTimer: 1…30 mins
RP1 PhysicalLink: Copper
Fiber Optic
RP1 Port Config: K Bus
EIA485 (RS485)
RP1 Comms Mode: IEC 60870 FT1.2 Frame
IEC 60870 10-Bit Frame
RP1 Baud Rate: 9600 bits/s
19200 bits/s
38400 bits/s

IEC870-5-103 protocol:

RP1 Address*:* 0…255
RP1 InactivTimer: 1…30 mins
RP1 Baud Rate: 9600 bits/s
19200 bits/s
RP1 Meas Period: 1…60 s
RP1 PhysicalLink: Copper or Fiber Optic
RP1 CS103 Blocking: Disabled
Monitor Blocking
Command Blocking

DNP3.0 protocol: (EIA485)

RP1 Address*:* 0…65519
RP1 Baud Rate: 1200 bits/s
2400 bits/s
4800 bits/s
9600 bits/s
19200 bits/s
38400 bits/s
RP1 Parity: Odd/Even/None
RP1 PhysicalLink: Copper or Fiber Optic
RP1 Time Sync: Disabled/Enabled
Meas Scaling: Primary, Secondary or Normalized.
Message gap: 0…50 ms
DNP Need time: 1...30 mins
DNP App Fragment: 100...2048
DNP App Timeout: 1...120 s
DNP SBO Timeout: 1...10 s
DNP Link Timeout: 0.1...60 s

DNP3.0 protocol: (Ethernet)

DNP Time Sync: Disabled/Enabled
Meas Scaling: Primary, Secondary or Normalized.
NIC Tunl Timeout: 1...30 mins
NIC Link Report: Alarm, Event, None
NIC Link Timeout: 0.1...60 s
DNP Need time: 1...30 mins
DNP App Fragment: 100...2048
DNP App Timeout: 1...120 s
DNP SBO Timeout: 1...10 s
DNP Link Timeout: 0.1...60 s

IEC 61850 protocol: (Ethernet)

NIC Tunl Timeout: 1...30 mins
NIC Link Report: Alarm, Event, None
NIC Link Timeout: 0.1...60 s

Optional additional second rear communication (rear port2 (RP2))

RP2 Protocol: Courier (fixed)
RP2 Port Config: Courier over EIA(RS)232
Courier over EIA(RS)485
K-Bus
RP2 Comms. Mode:
IEC60870 FT1.2 Frame
10-Bit NoParity
RP2 Address: 0…255
RP2 InactivTimer: 1…30 mins
RP2 Baud Rate: 9600 bits/s
19200 bits/s
38400 bits/s

Commission tests

Monitor Bit 1:
(up to):
Monitor Bit 8:
Binary function link strings, selecting which DDB signals have their status visible in the Commissioning menu, for test purposes
Test Mode: Disabled
Test Mode
Blocked Contacts
Test Pattern:
Configuration of which output contacts are to be energized when the contact test is applied.
Contact Test: No Operation,
Apply Test,
Remove Test
Test LEDs: No Operation
Apply Test
Test Auto-reclose: No Operation
Trip 3 Pole
Trip Pole A
Trip Pole B
Trip Pole C
Static Test Mode: Disabled/Enabled
Static Test: Disabled/Enabled
Loopback Mode: Disabled/Internal/External
IM64 TestPattern:
Configuration of which InterMiCOM^{64} commands are to be set high or low for a loopback test.
IM^{64} Test Mode: Disabled/Enabled

Circuit breaker condition monitoring (CB Monitor setup)

P543and P545 CB monitor setup:

Broken I^: 1.0…2.0
I^ Maintenance: Alarm Disabled/Enabled
I^ Maintenance: 1…25000
I^ Lockout: Alarm Disabled/Enabled
I^ Lockout: 1…25000
No. CB Ops Maint: Alarm Disabled/Enabled
No. CB Ops Maint: 1…10000
No. CB Ops Lock: Alarm Disabled/Enabled
No. CB Ops Lock: 1…10000
CB Time Maint: Alarm Disabled/Enabled
CB Time Maint: 0.005…0.500 s
CB Time Lockout: Alarm Disabled/Enabled
CB Time Lockout: 0.005…0.500 s
Fault Freq. Lock: Alarm Disabled/Enabled
Fault Freq. Count: 1…9999
Fault Freq. Time: 0…9999 s

P544 and P546 CB monitor setup:

CB1 Broken I^: 1…2
CB1 I^ Maintenance: Alarm Disabled/
Alarm Enabled
CB1 I^ Maintenance: 1…25000 In^
CB1 I^ Lockout: Alarm Disabled/
Alarm Enabled
CB1 I^ Lockout: 1…25000 In^
No. CB1 Ops. Maint.: Alarm Disabled/
Alarm Enabled
No. CB1 Ops. Maint.: 1…10000
No. CB1 Ops. Lock: Alarm Disabled/
Alarm Enabled
No. CB1 Ops. Lock: 1…10000
CB1 Time Maint.: Alarm Disabled/
Alarm Enabled
CB1 Time Maint.: 0.005…0.5 s
CB1 Time Lockout: Alarm Disabled/
Alarm Enabled
CB1 Time Lockout: 0.005…0.5 s
CB1 Fault Freq. Lock: Alarm Disabled/
Alarm Enabled
CB1 Flt Freq. Count: 1…9999
CB1 Flt Freq. Time: 0…9999 s
CB2 Broken I^:
(up to)
CB2 Flt Freq. Time:
All settings selected from the same ranges as per the first controlled circuit breaker, CB1.

Optocoupled binary inputs (opto config.)

Global threshold: 24 - 27 V
30 - 34 V
48 - 54 V
110 - 125 V
220 - 250 V
Custom
Opto Input 1:
(up to):
Opto Input #. *(# = max. opto no. fitted):*
Custom options allow independent thresholds to be set per opto, from the same range as above.
Filter Control:
Binary function link string, selecting which optos will have an extra 1/2 cycle noise filter, and which will not.
Characteristics: Standard 60% - 80%
50% - 70%

Control inputs into PSL (ctrl. I/P config.)

Hotkey Enabled:	*Binary function link string, selecting which of the control inputs will be driven from Hotkeys.*
Control Input 1:	Latched/Pulsed
(up to):	
Control Input 32:	Latched/Pulsed
Ctrl Command 1:	
(up to):	
Ctrl Command 32:	ON/OFF SET/RESET IN/OUT ENABLED/DISABLED

EIA(RS)232 Teleprotection (INTERMiCOM Comms.)

Source Address:	0…10
Received Address:	0…10
Data Rate:	600 Baud 1200 Baud 2400 Baud 4800 Baud 9600 Baud 19200 Baud
Loopback Mode:	Disabled/Internal/External
Test Pattern:	*Configuration of which InterMiCOM signals are to be energized when the loopback test is applied.*

INTERMiCOM conf.

IM Msg Alarm Lvl:	0.1…100.0%
IM1 Cmd Type:	Disabled/Direct/Blocking, Permissive
(up to):	
IM8 Cmd Type:	Disabled/Direct/Blocking, Permissive
IM1 FallBackMode:	Default/Latched
(up to):	
IM8 FallBackMode:	Default/Latched
IM1 DefaultValue:	0/1
(up to):	
IM8 DefaultValue:	0/1
IM1 FrameSyncTim:	1 ms…1.5 s
(up to):	
IM8 FrameSyncTim:	1 ms…1.5 s

Function keys

Fn. Key Status 1:	
(up to):	
Fn. Key Status 10	Disable Lock Unlock/Enable
Fn. Key 1 Mode:	Toggled/Normal
(up to):	
Fn. Key 10 Mode:	Toggled/Normal
Fn. Key 1 Label:	
(up to):	
Fn. Key 10 Label:	

User defined text string to describe the function of the particular function key

IED configurator

Switch Conf. Bank: No Action/Switch Banks

IEC 61850 GOOSE

GoEna:	Disabled Enabled
Test Mode:	Disabled/ Pass Through/ Forced
VOP Test Pattern:	0x00000000... 0xFFFFFFFF
Ignore Test Flag:	No/Yes

Prot comms/IM[64]

Scheme Setup:2 Terminal/Dual Redundant/3 Terminal

Address:	0-0, 1-A…20-A, 1-B….20-B
Address:	0-0, 1-A…20-A, 1-B….20-B, 1-C…20-C
Comm Mode:	Standard/IEEE C37.94
Baud Rate Ch 1:	56kbits/s or 64kbits/s
Baud Rate Ch 2:	56kbits/s or 64kbits/s
Clock Source Ch1:	Internal External
Clock Source Ch2:	Internal External
Ch1 N*64kbits/s:	Auto, 1, 2, 3... 12
Ch2 N*64kbits/s:	Auto, 1, 2, 3... 12
Comm Delay Tol:	0.001 s...0.00005 s
Comm Fail Timer:	0.1 s...600 s
Comm Fail Mode:	Ch 1 Failure/ Ch 2 Failure/ Ch 1 or Ch 2 Fail/ Ch 1 and Ch 2 Fail
GPS Sync:	GPS Disabled, GPS → Standard, GPS → Inhibit, GPS → Restrain
Char Mod Time:	0...30 s
Char Mod Ex :	Disabled Enabled
Char Mod Ex Time:	0... 30 s
Prop Delay Equal:	No operation/ Restore CDiff
Re-Configuration:	Three Ended/ Two Ended (R1&R2)/ Two Ended (L&R2)/ Two Ended (L&R1)
Channel Timeout:	0.1 s...10 s
Alarm Level:	0%...100%
Prop Delay Stats:	Disabled Enabled
MaxCh 1 PropDelay:	1 m...50 ms
MaxCh 2 PropDelay:	1 m...50 ms
TxRx Delay Stats:	Disabled Enabled
MaxCh1 Tx-RxTime:	1 m...50 ms
MaxCh2 Tx-RxTime:	1 m...50 ms
GPS Fail Timer:	0…9999 s

GPS Trans Fail: Disabled
Enabled
GPS Trans Count: 1…100 s
GPS Trans Timer: 0…9999 s
IM1 Cmd Type: Direct
Permissive
IM1 FallBackMode: Default
Latching
IMx(x=1 to 8) DefaultValue: 0 or 1
The IM1 – IM8 s setting are common to both Ch1 and Ch2 (i.e. if IM1 DefaultValue is set to 0, it will be 0 on Ch1 and on Ch2)

Control input user labels (Ctrl. I/P labels)

Control Input 1:
(up to):
Control Input 32:
User defined text string to describe the function of the particular control input

Settings in multiple groups

Note: *All settings here onwards apply for setting groups # = 1 to 4.*

Protection functions

Line parameters

GROUP # (for # = 1 to 4)
Line Length (km): 0.30…1000.00 km
Line Length (miles): 0.20…625.00 mi
Line Impedance: 0.05…500.00/In Ω
Line Angle: 20…90°
Residual Comp: 0.00…10.00
Residual Angle: -180…90°
Mutual Comp: Disabled/Enabled
KZm Mutual Set: 0.00…10.00
KZm Mutual Angle: -180…90°
Mutual cut-off (k): 0.0…2.0
Phase Sequence: Standard ABC
Reverse ACB
CB Tripping Mode (per CB as appropriate):
3 Pole
1 and 3 Pole
Line Charging Y: 0.00…10.00 ms

Distance setup

Setting Mode: Simple/Advanced

Phase distance

Phase Chars.: Mho/Quadrilateral
Quad Resistance: Common/Proportional
Fault Resistance: 0.05…500.00/In Ω
Zone 1 Ph Status: Disabled/Enabled
Zone 1 Ph Reach: 10…1000% of line
Zone 2 Ph Status: Disabled/Enabled
Zone 2 Ph Reach: 10…1000% of line
Zone 3 Ph Status: Disabled/Enabled
Zone 3 Ph Reach: 10…1000% of line
Zone 3 Ph Offset: Disabled/Enabled
Z3Ph Rev Reach: 10…1000% of line
Zone P Ph Status: Disabled/Enabled
Zone P Ph Dir.: Forward/Reverse
Zone P Ph Reach: 10…1000% of line
Zone 4 Ph Status: Disabled/Enabled
Zone 4 Ph Reach: 10…1000% of line

Ground distance

Ground Chars.: Mho/Quadrilateral
Quad Resistance: Common/Proportional
Fault Resistance: 0.05…500.00/In Ω
Zone1 Gnd Status: Disabled/Enabled
Zone1 Gnd Reach: 10…1000% of line
Zone2 Gnd Status: Disabled/Enabled
Zone2 Gnd Reach: 10…1000% of line
Zone3 Gnd Status: Disabled/Enabled
Zone3 Gnd Reach: 10…1000% of line
Zone3 Gnd Offset: Disabled/Enabled
Z3Gnd Rev Reach: 10…1000% of line
ZoneP Gnd Status: Disabled/Enabled
ZoneP Gnd Direction: Forward/Reverse
ZoneP Gnd Reach: 10…1000% of line
Zone4 Gnd Status: Disabled/Enabled
Zone4 Gnd Reach: 10…1000% of line
Digital Filter: Standard
Special Applics
CVT Filters: Disabled/Passive/Active

SIR Setting: *(for CVT)*:	5…60
Load Blinders:	Disabled/Enabled
Load/B Impedance:	0.10…500.00/In Ω
Load/B Angle:	15…65°
Load Blinder V<:	1.0…70.0 V (ph-g)
Distance Polarizing:	0.2…5.0
Delta Status:	Disabled/Enabled
Delta Char Angle:	0°...90°
Delta V Fwd:	1.0…30.0 V
Delta V Rev:	0.5…30.0 V
Delta I Fwd:	0.10…10.00 In
Delta I Rev:	0.05…10.00 In

Distance elements - phase distance

Z1 Ph. Reach:	0.05…500.00/In Ω
Z1 Ph. Angle:	20…90°
R1 Ph. Resistive:	0.05…500.00/In Ω
Z1 Tilt Top Line:	-30…30°
Z1 Ph. Sensit. Iph>1:	0.050…2.000 In
Z2 Ph. Reach:	0.05…500.00/In Ω
Z2 Ph. Angle:	20…90°
Z2 Ph Resistive:	0.05…500.00/In Ω
Z2 Tilt Top Line:	-30…30°
Z2 Ph. Sensit. Iph>2:	0.050…2.000 In
Z3 Ph. Reach:	0.05…500.00/In Ω
Z3 Ph. Angle:	20…90°
Z3' Ph Rev Reach:	0.05…500.00/In Ω
R3 Ph Res. Fwd.:	0.05…500.00/In Ω
R3' Ph Res. Rev.:	0.05…500.00/In Ω
Z3 Tilt Top Line:	-30…30°
Z3 Ph. Sensit. Iph>3:	0.050…2.000 In
ZP Ph. Reach:	0.05…500.00/In Ω
ZP Ph. Angle:	20…90°
ZP Ph Resistive:	0.05…500.00/In Ω
ZP Tilt Top line:	-30…30°
ZP Ph. Sensit. Iph>P:	0.050…2.000In
Z4 Ph. Reach:	0.05…500.00/In Ω
Z4 Ph. Angle:	20…90°
Z4 Ph Resistive:	0.05…500.00/In Ω
Z4 Tilt Top line:	-30…30°
Z4 Ph. Sensit. Iph>4:	0.050…2.000 In

Ground distance parameters

Z1 Gnd. Reach:	0.05…500.00/In Ω
Z1 Gnd. Angle:	20…90°
Z1 Dynamic Tilt:	Disabled or Enabled
Z1 Tilt top line:	-30°...30°
kZN1 Res. Comp.:	0.00…10.00
kZN1 Res. Angle:	-180…90°
kZm1 Mut. Comp.:	0.00…10.00
kZm1 Mut. Angle:	-180…90°
R1 Gnd. Resistive:	0.05…500.00/In Ω
Z1 Sensit Ignd>1:	0.050…2.000 In
Z2 Gnd. Reach:	0.05…500.00/In Ω
Z2 Gnd. Angle:	20…90°
Z2 Dynamic Tilt:	Disabled or Enabled
Z2 Tilt top line:	-30°...30°
kZN2 Res. Comp.:	0.00…10.00
kZN2 Res. Angle:	-180…90°
kZm2 Mut. Comp:	0.00…10.00
kZm2 Mut. Angle:	-180…90°
R2 Gnd Resistive:	0.05…500.00/In Ω
Z2 Sensit Ignd>2:	0.050…2.000 In
Z3 Gnd. Reach:	0.05…500.00/In Ω
Z3 Gnd. Angle:	20…90°
Z3 Dynamic Tilt:	Disabled or Enabled
Z3 Tilt top line:	-30°...30°
Z3' Gnd Rev Rch:	0.05…500.00/In Ω
kZN3 Res. Comp.:	0.00…10.00
kZN3 Res. Angle:	-180…90°
kZm3 Mut. Comp.:	0.00…10.00
kZm3 Mut. Angle:	-180…90°
R3 Gnd Res. Fwd:	0.05…500.00/In Ω
R3 Gnd Res. Rev:	0.05…500.00/In Ω
Z3 Sensit Ignd>3:	0.050…2.000 In
ZP Ground Reach:	0.05…500.00/In Ω
ZP Ground Angle:	20…90°
ZP Dynamic Tilt:	Disabled or Enabled
ZP Tilt top line:	-30°...30°
kZNP Res. Comp.:	0.00…10.00
kZNP Res. Angle:	-180…90°
kZmP Mut. Comp.:	0.00…10.00
kZmP Mut. Angle:	-180…90°
RP Gnd Resistive:	0.05…500.00/In Ω
ZP Sensit Ignd>P:	0.050…2.000 In
Z4 Gnd. Reach:	0.05…500.00/In Ω
Z4 Gnd. Angle:	20…90°
Z4 Dynamic Tilt:	Disabled or Enabled
Z4 Tilt top line:	-30°...30°
kZN4 Res. Comp.:	0.00…10.00
kZN4 Res. Angle:	-180…90°
kZm4 Mut. Comp.:	0.00…10.00
kZm4 Mut. Angle:	-180…90°
R4 Gnd. Resistive:	0.05…500.00/In Ω
Z4 Gnd Sensitivity:	0.050…2.000 In

Phase current differential protection

Phase Diff:	Enabled or Disabled
Phase Is1:	0.2 In...2 In
Phase Is2:	1 In...30 In
Phase k1:	30%...150%
Phase k2:	30%...150%
Phase Char:	DT/IEC S Inverse/ IEC V Inverse/ IEC E inverse/ UK LT Inverse/ IEEE M Inverse/ IEEE V Inverse/ IEEE E Inverse/ US Inverse/ US ST Inverse
Phase Time Delay:	0 s...100 s
Phase TMS:	0.025...1.2
Phase Time Dial:	0.01...100
PIT Time:	0 s...0.2 s
Ph CT Corr'tion:	1...8

Compensation:	None/ Cap Charging/ Transformer
Susceptance:	1E-8*In...10*In
Inrush Restraint:	Restraint/Blocking/Disabled
Ih(2) CrossBlock:	Disabled/Enabled
Ih(2) Multiplier:	1..20
Ih(2) %>:	5% ..50%
Ih(5) CrossBlock:	Disabled/Enabled
Ih(5) Blocking:	Disabled/Enabled
Ih(5) %>:	5% ..100%
Highset Status:	Disabled/Enabled
Id High Set:	4*In...32*In
Vectorial Comp:	Yy0 (0 deg)/ Yd1 (-30 deg)/ Yy2 (-60 deg)/ Yd3 (-90 deg)/ Yy4 (-120 deg)/ Yd5 (-150 deg)/ Yy6 (180 deg)/ Yd7 (+150 deg)/ Yy8 (+120 deg)/ Yd9 (+90 deg)/ Yy10 (+60 deg)/ Yd11 (+30 deg)/ Ydy0 (0 deg)/ Ydy6 (180 deg)
Phase Is1 CTS:	0.2*In...4*In
PIT I Selection:	Local or Remote

Scheme logic

Basic scheme

Zone 1 Tripping:	Disabled/ Phase only/ Ground only/ Phase and Ground
tZ1 Ph. Delay:	0 s...10 s
tZ1 Gnd. Delay:	0 s...10 s
Zone 2 Tripping:	Disabled/ Phase only/ Ground only/ Phase and Ground
tZ2 Ph. Delay:	0 s...10 s
tZ2 Gnd. Delay:	0 s…10 s
Zone 3 Tripping:	Disabled/ Phase only/ Ground only/ Phase and Ground
tZ3 Ph. Delay:	0 s...10 s
tZ2 Gnd. Delay:	0 s...10 s
Zone P Tripping:	Disabled/ Phase only/ Ground only/ Phase and Ground
tZP Ph. Delay:	0 s...10 s
tZP Gnd. Delay:	0 s...10 s
Zone 4 Tripping:	Disabled/ Phase only/ Ground only/ Phase and Ground
tZ4 Ph. Delay:	0 s...10 s
tZ4 Gnd. Delay:	0 s...10 s

Aided scheme 1

Aid 1 Selection:	Disabled/ PUR/ PUR Unblocking/ POR/ POR/ Unblocking/ Blocking 1/ Blocking 2/ Prog Unblocking/ Programmable
Aid 1 Distance:	Disabled/ Phase only/ Ground only/ Phase and Ground
Aid 1 Dist. Dly:	0 s...1 s
Unblocking Delay:	0 s...0.1 s
Aid 1 DEF:	Disabled/Enabled
Aid 1 DEF Dly:	0 s...1 s
Aid 1 DEF Trip:	1/3 Pole
Aid 1 Delta:	0.000…1.000 s
Aid1 Delta Dly:	0.000…1.000 s
Aid1 DeltaTrip:	3 Pole 1 and 3 Pole
tREV Guard:	0 s...0.15 s
Unblocking Delay:	0 s...0.1 s
Send on Trip	Aided / Z1, Any Trip or None
Weak Infeed:	Disabled/ Echo/ Echo and Trip
WI Sngl Pole Trp:	Disabled/Enabled
WI V< Thresh:	10 V...70 V
WI Trip Delay:	0 s...1 s
Custom Send Mask:	Bit 0 = Z1 Gnd/ Bit 1 = Z2 Gnd/ Bit 2 = Z4 Gnd/ Bit 3 = Z1 Ph/ Bit 4 = Z2 Ph/ Bit 5 = Z4 Ph/ Bit 6 = DEF Fwd/ Bit 7 = DEF Rev/ Bit
Custom Time PU:	0 s...1 s
Custom Time DO:	0 s...1 s

Aided scheme 2
(As per aided scheme 1)

Trip on close

SOTF Status:	Disabled/ Enabled Pole Dead/ Enabled ExtPulse/ En Pdead + Pulse
SOTF Delay:	0.2s...1000s
SOTF Tripping:	Bit 0 = Zone 1/ Bit 1 = Zone 2/ Bit 2 = Zone 3/ Bit 3 = Zone P/ Bit 4 = Zone 4/ Bit 5=CNV
TOR Status:	Disabled/Enabled

TOR Tripping:	Bit 0 = Zone 1/ Bit 1 = Zone 2/ Bit 2 = Zone 3/Bit 3 = Zone P/Bit 4 = Zone 4/Bit5=CNV
TOC Reset Delay:	0.1 s...2 s
TOC Delay	0.05 s…0.2 s
SOTF Pulse:	0.1 s...10 s

Z1 extension

Z1 Ext Scheme:	Disabled/ Enabled/ En. on Ch1 Fail/ En. On Ch2 Fail/ En All Ch Fail/ En. anyCh Fail
Z1 Ext Ph:	100%...200%
Z1 Ext Gnd:	100%...200%

Loss of load

LOL Scheme:	Disabled/ Enabled/ En. on Ch1 Fail/ En. On Ch2 Fail/ En All Ch Fail/ En. Any Ch Fail
LOL <I:	0.05 x In...1 x In
LOL Window:	0.01 s 0.1 s Phase

Phase overcurrent (overcurrent)

I>1 Status:	Disabled Enabled Enabled VTS Enabled Ch Fail En VTSorCh Fail En VTSandCh Fail
I>1 Function:	DT IEC S Inverse IEC V Inverse IEC E Inverse UK LT Inverse IEEE M Inverse IEEE V Inverse IEEE E Inverse US Inverse US ST Inverse
I>1 Directional:	Non-Directional Directional Fwd Directional Rev
I>1 Current Set:	0.08…4.00 In
I>1 Time Delay:	0.00…100.00 s
I>1 TMS:	0.025…1.200
I>1 Time Dial:	0.01…100.00
I>1 Reset Char:	DT/Inverse
I>1 tRESET:	0.00…100.00 s
I>2 Status (up to):	
I>2 tRESET	*All settings and options chosen from the same ranges as per the first stage overcurrent, I>1.*
I>3 Status:	Disabled Enabled Enabled VTS Enabled Ch Fail En VTSorCh Fail En VTSandCh Fail
I>3 Directional:	Non-Directional Directional Fwd Directional Rev
I>3 Current Set:	0.08…32.00 In
I>3 Time Delay:	0.00…100.00 s
I>4 Status (up to):	
I>4 Time Delay	*All settings and options chosen from the same ranges as per the third stage overcurrent, I>3.*
I> Char Angle:	-95…95°
I> Blocking:	*Binary function link string, selecting which overcurrent elements (stages 1 to 4) will be blocked if VTS detection of fuse failure occurs.*

Negative sequence overcurrent (neg seq O/C)

I2>1 Status:	Enabled/Disabled
I2>1 Function:	Disabled DT IEC S Inverse IEC V Inverse IEC E Inverse UK LT Inverse IEEE M Inverse IEEE V Inverse IEEE E Inverse US Inverse US ST Inverse
I2>1 Direction:	Non-Directional Directional Fwd irectional Rev
I2>1 Current Set:	0.08…4.00 In
I2>1 Time Delay:	0.00…100.00 s
I2>1 TMS:	0.025…1.200
I2>1 Time Dial:	0.01…100.00
I2>1 Reset Char.:	DT/Inverse
I2>1 tRESET:	0.00…100.00 s
I2>2 Status (up to):	
I2>2 tRESET	All settings and options chosen from the same ranges as per the first stage overcurrent, I2>1.
I2>3 Status:	Disabled Enabled

I2>3 Direction:	Non-Directional Directional Fwd Directional Rev
I2>3 Current Set:	0.08…32.00 In
I2>3 Time Delay:	0.00…100.00 s
I2>4 Status (up to):	
I2>4 Time Delay	All settings and options chosen from the same ranges as per the third stage overcurrent, I2>3.
I2> VTS Blocking:	Binary function link string, selecting which Neg. Seq. O/C elements (stages 1 to 4) will be blocked if VTS detection of fuse failure occurs
I2> Char Angle:	-95…95°
I2> V2pol Set:	0.5…25.0 (100 – 110 V)

Broken conductor

Broken Conductor:	Disabled/Enabled
I2/I1 Setting:	0.20…1.00
I2/I1 Time Delay:	0.0…100.0 s

Ground overcurrent (earth fault)

IN>1 Status:	Disabled Enabled Enabled VTS Enabled Ch Fail En VTSorCh Fail En VTSandCh Fail
IN>1 Function:	DT IEC S Inverse IEC V Inverse IEC E Inverse UK LT Inverse IEEE M Inverse IEEE V Inverse IEEE E Inverse US Inverse US ST Inverse IDG
IN>1 Directional:	Non-Directional Directional Fwd Directional Rev
IN>1 Current Set:	0.08…4.00 In
IN>1 IDG Is:	1...4
IN>1 IDG Time:	1…2
IN>1 Time Delay:	0.00…100.00 s
IN>1 TMS:	0.025…1.200
IN>1 Time Dial:	0.01…100.00
IN>1 Reset Char:	DT/Inverse
IN>1 tRESET:	0.00…100.00 s
IN>2 Status *(up to):*	
IN>2 tRESET	*All settings and options chosen from the same ranges as per the first stage ground overcurrent, IN>1.*
IN>3 Status:	Disabled Enabled Enabled VTS Enabled Ch Fail En VTSorCh Fail En VTSandCh Fail
IN>3 Directional:	Non-Directional Directional Fwd Directional Rev
IN>3 Current Set:	0.08…32.00 In
IN>3 Time Delay:	0.00…100.00 s
IN>4 Status *(up to):*	
IN>4 Time Delay	*All settings and options chosen from the same ranges as per the third stage ground overcurrent, IN>3.*
IN> Blocking:	*Binary function link string, selecting which ground overcurrent elements (stages 1 to 4) will be blocked if VTS detection of fuse failure occurs.*
IN> DIRECTIONAL	
IN> Char Angle:	-95…95°
IN> Polarization:	Zero Sequence Neg Sequence
IN> VNpol Set:	0.5…40.0 V
IN> V2pol Set:	0.5…25.0 V
IN> I2pol Set:	0.02…1.00 In

Directional aided schemes - DEF settings

DEF Status:	Disabled/Enabled
DEF Polarizing:	Zero Sequence *(virtual current pol)* Neg Sequence
DEF Char Angle:	-95…95°
DEF VNpol Set:	0.5…40.0 V
DEF V2pol Set:	0.5…25.0 V
DEF FWD Set:	0.08…1.00 In
DEF REV Set:	0.04…1.00 In

Sensitive Earth Fault protection/ Restricted Earth Fult protection

SEF/REF Options:	SEF Enabled Wattmetric SEF HI Z REF
ISEF>1 Function:	IDMT Curve Type Disabled DT IEC S Inverse IEC V Inverse IEC E Inverse UK LT Inverse IEEE M Inverse IEEE V Inverse

	IEEE E Inverse
	US Inverse
	US ST Inverse
	IDG
ISEF>1 Directional:	Non-Directional
	Directional Fwd
	Directional Rev
ISEF>1 Current Set:	0.005…0.1 In_{SEF}
ISEF>1 IDG Is:	1...4
ISEF>1 IDG Time:	1…2 s
ISEF>1 Time Delay:	0 s…..200 s
ISEF>1 TMS:	0.025…1.2
ISEF>1 Time Dial:	0.01…100
ISEF>1 Reset Char:	DT/Inverse
ISEF>1 tRESET:	0 s-100 s
ISEF>2 as ISEF>1	
ISEF>3 Status:	Disabled
	Enabled
ISEF>3 Directional:	Non-Directional
	Directional Fwd
	Directional Rev
ISEF>3 Current Set:	0.005…0.8 In_{SEF}
ISEF>3 Time Delay:	0 s…200 s
ISEF>3 Intertrip:	Enabled/Disabled
ISEF>4 as ISEF>3	
ISEFN> Blocking	
Bit 0 VTS Blks ISEF>1	
Bit 1 VTS Blks ISEF>2	
Bit 2 VTS Blks ISEF>3	
Bit 3 VTS Blks ISEF>4	
Bit 4 A/R Blks ISEF>3	
Bit 5 A/R Blks ISEF>4	
Bit 6 Not Used	
Bit 7 Not Used	
ISEF> Directional	
ISEF> Char Angle:	-95°…95° deg
ISEF> VNpol Set:	0.5…80 V
Wattmetric SEF	
PN> Setting:	0...20 In_{SEF} W
REF	
IREF>Is:	0.05 In .. 1.0 In

Neutral voltage displacement (residual O/V NVD)

VN>1 Function:	Disabled
	DT
	IDMT
VN>1 Voltage Set:	1…80 V
VN>1 Time Delay:	0.00…100.00 s
VN>1 TMS:	0.5…100.0
VN>1 tReset:	0.00…100.00 s
VN>2 Status:	Disabled/Enabled
VN>2 Voltage Set:	1…80 V
VN>2 Time Delay:	0.00…100.00 s

Thermal overload

Characteristic:	Disabled
	Single
	Dual
Thermal Trip:	0.08…4.00 In
Thermal Alarm:	50…100%
Time Constant 1:	1…200 mins
Time Constant 2:	1…200 mins

Power swing/out of step (power swing)

Power Swing:	Blocking
	Indication
PSB Reset Delay:	0.05…2.00 s
Zone 1 Ph PSB:	Blocking/Allow Trip
(up to):	
Zone 4 Ph PSB:	Blocking/Allow Trip
Zone 1 Gnd PSB:	Blocking/Allow Trip
(up to):	
Zone 4 Gnd PSB:	Blocking/Allow Trip
PSB Unblocking:	Disabled/Enabled
PSB Unblock Delay:	0.1…10.0 s
PSB Reset Delay:	0.5…2.0 s

Out of step

OST (Out of Step Tripping) mode:	
	Disabled
	Predictive and OST Trip
	OST Trip
	Predictive OST
Z5 Fwd Reach:	0.1…500.00/In Ω
Z6 Fwd Reach:	0.1…500.00/In Ω
Z5' Rev Reach:	0.1…500.00/In Ω
Z6' Rev Reach:	0.1…500.00/In Ω
R5 Res. Fwd:	0.1…200.00/In Ω
R6 Res. Fwd:	0.1…200.00/In Ω
R5' Res. Rev:	-0.1…-200.00/In Ω
R6' Res. Rev:	-0.1…-200.00/In Ω
Blinder Angle:	20…90°
Delta t Time Setting:	0.02 s…1 s
Tost Time Delay Setting:	0 s…1 s

Undervoltage protection

V< Measur't Mode:	V<1 & V<2 Ph-Ph,
	V<1 & V<2 Ph-N,
	V<1Ph-Ph V<2Ph-N,
	V<1Ph-N V<2Ph-Ph
V< Operate Mode:	V<1 & V<2 Any Ph
	V<1 & V<2 3Phase
	V<1AnyPh V<2 3Ph
	V<1 3Ph V<2AnyPh
V<1 Function:	Disabled
	DT
	IDMT
V<1 Voltage Set:	10…120 V
V<1 Time Delay:	0.00…100.00 s
V<1 TMS: 0.5…	100.0
V<1 Poledead Inh:	Disabled/Enabled
V<2 Status:	Disabled/Enabled
V<2 Voltage Set:	10…120 V

V<2 Time Delay: 0.00…100.00 s
V<2 Poledead Inh: Disabled/Enabled

Overvoltage protection

V> Measur't Mode: V>1 & V>2 Ph-Ph, V>1 & V>2 Ph-N, V>1Ph-Ph V>2Ph-N, V>1Ph-N V>2Ph-Ph
V> Operate Mode: V>1 & V>2 Any Ph, V>1 & V>2 3Phase, V>1AnyPh V>2 3Ph, V>1 3Ph V>2AnyPh
V>1 Function: Disabled, DT, IDMT
V>1 Voltage Set: 60…185 V
V>1 Time Delay: 0.00…100.00 s
V>1 TMS: 0.5…100.0
V>2 Status: Disabled/Enabled
V>2 Voltage Set: 60…185 V
V>2 Time Delay: 0.00…100.00 s
V1>1 Cmp Funct: Disabled, DT, IDMT
V1>1 Cmp Vlt Set: 60…110 V
V1>1 Cmp Tim Dly: 0.00…100.00 s
V1>1 CmpTMS: 0.5…100.0
V1>2 Cmp Status: Disabled/Enabled
V1>2 Vlt Set: 60… 110 V
V1>2 CmpTim Dly: 0.00…100.00 s

Underfrequency protection

F<1 Status: Disabled/Enabled
F<1 Setting: 45.00…65.00 Hz
F<1 Time Delay: 0.00…100.00 s
F<2 Status (up to):
F<4 Time Delay
All settings and options chosen from the same ranges as per the 1st stage
F< Function Link:
Binary function link string, selecting which frequency elements (stages 1 to 4) will be blocked by the pole-dead logic

Overfrequency protection

F>1 Status: Disabled/Enabled
F>1 Setting: 45.00…65.00 Hz
F>1 Time Delay: 0.00…100.00 s
F>2 Status *(up to):*
F>2 Time Delay
All settings and options chosen from the same ranges as per the 1st stage

Rate-of-change of frequency protection (df/dt protection)

df/dt Avg. Cycles: 6…12
df/dt>1 Status: Disabled/Enabled
df/dt>1 Setting: 0.1…10.0 Hz
df/dt>1 Dir'n.: Negative/Positive/Both
df/dt>1 Time: 0.00…100.00 s
df/dt>2 Status *(up to):* df/dt>4 Time
All settings and options chosen from the same ranges as per the 1st stage.

Circuit breaker fail

CB Fail 1 Status: Disabled/Enabled
CB Fail 1 Timer: 0.00…10.00 s
CB Fail 2 Status: Disabled/Enabled
CB Fail 2 Timer: 0.00…10.00 s
Volt Prot Reset: I< Only, CB Open & I<, Prot Reset & I<
Ext Prot Reset: I< Only, CB Open & I<, Prot Reset & I<
WI Prot Reset: Disabled/Enabled
Undercurrent
I< Current Set: 0.02…3.20 In
ISEF< Current Set: 0.001…0.8 In_{SEF}
Poledead
V< : 10 …40 V

Supervision

VT Supervision
VTS Mode: Measured + MCB, Measured only or MCB only
VTS Status: Disabled/ Blocking/ Indication
VTS Reset Mode: Manual/Auto
VTS Time Delay: 1 s...10 s
VTS I> Inhibit: 0.08....32 x In
VTS I2> Inhibit: 0.05...0.5 x In
Inrush Detection
I> 2nd Harmonic: 10%...100%
Weak Infeed Blk
WI Inhibit: Disabled/Enabled
I0/I2 Setting: 2...3
CTS Mode: Disabled, Standard, I Diff, Idiff + Standard
CTS Status: Restrain, Indication,
CTS Reset Mode: Manual or Auto
CTS Time Delay: 0...10 s
CTS VN< Inhibit: 0.5 V...22 V
CTS i1>: 0.05*In...4.0*In
CTS i2/i1>: 0.05...1
CTS i2/i1>>: 0.05...1

Systems check

Bus-Line Synchronism and Voltage Checks (System Checks)

P543 and P545 system checks:

Voltage Monitors	
Live Voltage:	1.0…132.0 V
Dead Voltage:	1.0…132.0 V
Synchrocheck (Check Synch)	
CS1 Status:	Disabled/Enabled
CS1 Phase Angle:	0…90°
CS1 Slip Control:	None Timer Frequency Both
CS1 Slip Freq:	0.02…1.00 Hz
CS1 Slip Timer:	0.0…99.0 s
CS2 Status *(up to):*	
CS2 Slip Timer	

All settings and options chosen from the same ranges as per the first stage CS1 element.

CS Undervoltage:	10.0…132.0 V
CS Overvoltage:	60.0…185.0 V
CS Diff Voltage:	1.0…132.0 V
CS Voltage Block:	None Undervoltage Overvoltage Differentia UV & OV UV & DiffV OV & DiffV UV, OV & DiffV
System Split	
SS Status:	Disabled/Enabled
SS Phase Angle:	90…175°
SS Under V Block:	Disabled/Enabled
SS Undervoltage:	10.0…132.0 V
SS Timer:	0.0…99.0 s

P544 and P546 system checks:

Voltage Monitors	
Live Line:	5…132 V
Dead Line:	5…132 V
Live Bus 1:	5…132 V
Dead Bus 1:	5…132 V
Live Bus 2:	5…132 V
Dead Bus 2:	5…132 V
CS UV:	5…120 V
CS OV:	60…200 V
Sys Checks CB1:	Enabled/Disabled
CB1 CS Volt. Blk:	V< , V> , Vdiff.> , V< and V>, V< and Vdiff> , V> and Vdiff> , V< V> and Vdiff> , None
CB1 CS1: Status	Enabled or Disabled
CB1 CS1 Angle:	0…90°
CB1 CS1 Vdiff:	1…120 V
CB1 CS1 SlipCtrl:	Enabled/Disabled
CB1 CS1 SlipFreq:	5 mHz…2 Hz
CB1 CS2: Status	Enabled/Disabled
CB1 CS2 Angle:	0…90°
CB1 CS2 Vdiff:	1…120 V
CB1 CS2 SlipCtrl:	Enabled/Disabled
CB1 CS2 SlipFreq:	5 mHz…2 Hz
CB1 CS2 Adaptive:	Enabled/Disabled
CB1 Cl Time:	10.0 ms…0.5 s
Sys Checks CB2: *(up to):*	
CB2 Cl Time:	*All settings and options chosen from the same ranges as per the first controlled circuit breaker, CB1.*
Manual System Checks	
Num CBs:	CB1 only, CB2 only, CB1 & CB2.
CB1M SC required:	Enabled/Disabled
CB1M SC CS1:	Enabled/Disabled
CB1M SC CS2:	Enabled/Disabled
CB1M SC DLLB:	Enabled/Disabled
CB1M SC LLDB:	Enabled/Disabled
CB1M SC DLDB:	Enabled/Disabled
CB2M SC required: (up to):	
CB2M SC DLDB:	*All settings and options chosen from the same ranges as per the first controlled circuit breaker, CB1.*

Auto-reclose

P543 and P545 auto-reclose:

Single Pole Shot:	1/2/3/4
Three Pole Shot:	1/2/3/4
1 Pole Dead Time:	0.05…5.00 s
Dead Time 1:	0.05…100.00 s
Dead Time 2:	1…1800 s
Dead Time 3:	1…3600 s
Dead Time 4:	1…3600 s
CB Healthy Time:	1…3600 s
Reclaim Time:	1…600 s
AR Inhibit Time:	0.01…600.00 s
Check Sync Time:	0.01…9999.00 s
Z2T AR: *(up to):*	
Z4T AR:	No Action Initiate AR Block AR *All time-delayed distance zones can be independently set not to act upon AR logic, to initiate a cycle, or to block.*
DEF Aided AR:	Initiate AR Block AR
TOR:	Initiate AR Block AR
I>1 AR: *(up to):*	
I>4 AR:	No Action Initiate AR Block AR

	All overcurrent stages can be independently set not to act upon AR logic, to initiate a cycle, or to block.
IN>1 AR:	
(up to):	
IN>4 AR:	No Action
	Initiate AR
	Block AR
	All ground/earth overcurrent stages can be independently set not to act upon AR logic, to initiate a cycle, or to block.
ISEF>1 AR:	
(up to):	
ISEF>4 AR:	No Action
	Initiate AR
	Block AR
	All ground/earth overcurrent stages can be independently set not to act upon AR logic, to initiate a cycle, or to block.
Mult Phase AR:	Allow Autoclose
	BAR 2 and 3Ph
	BAR 3 Phase
Dead Time Start:	Protection Op
	Protection Reset
Discrim Time:	0.10…5.00 s
System Checks	
CheckSync1 Close:	Disabled/Enabled
CheckSync2 Close:	Disabled/Enabled
LiveLine/DeadBus:	Disabled/Enabled
DeadLine/LiveBus:	Disabled/Enabled
DeadLine/DeadBus:	Disabled/Enabled
CS AR Immediate:	Disabled/Enabled
SysChk on Shot 1:	Disabled/Enabled
P544 and P546 Auto-reclose:	
Num CBs:	CB1 only,
	CB2 only,
	Both CB1 & CB2
Lead/Foll AR Mode:	L1P F1P,
	L1P F3P,
	L3P F3P,
	L1/3P
	F1/3P,
	L1/3P F3P,
	Opto
AR Mode:	AR 1P,
	AR 1/3P,
	AR 3P,AR Opto
Leader Select By:	Leader by Menu,
	Leader by Opto,
	Leader by Ctrl
Select Leader:	Sel Leader CB1,
	Sel Leader CB2
BF if LFail Cls:	Enabled/Disabled
Dynamic F/L:	Enabled/Disabled
AR Shots:	1…4
Multi Phase AR:	Allow Autoclose,
	BAR 2 and 3 ph,
	BAR 3 phase
Discrim Time:	20 ms…5 s
CB IS Time:	5…200 s
CB IS MemoryTime:	10 ms…1 s
DT Start by Prot:	Protection Reset,
	Protection Op,
	Disabled
3PDTStart WhenLD:	Enabled/Disabled
DTStart by CB Op:	Enabled/Disabled
Dead Line Time:	1…9999 s
SP AR Dead Time:	0…10 s
3P AR DT Shot 1:	10 ms…300 s
3P AR DT Shot 2:	1…9999 s
3P AR DT Shot 3:	1…9999 s
3P AR DT Shot 4:	1…9999 s
Follower Time:	100 ms…300 s
SPAR ReclaimTime:	1…600 s
3PAR ReclaimTime:	1…600s
AR CBHealthy Time:	0.01…9999 s
AR CheckSync Time:	0.01…9999 s
Z1 AR:	Initiate AR
	Block AR
Diff AR:	Initiate AR
	Block AR
Dist. Aided AR:	Initiate AR
	Block AR
Z2T AR:	
(up to):	
Z4T AR:	No Action
	Initiate AR
	Block AR
	All time-delayed distance zones can be independently set not to act upon AR logic, to initiate a cycle, or to block.
DEF Aided AR:	Initiate AR
	Block AR
Dir. Comp AR:	Initiate AR
	Block AR
TOR:	Initiate AR
	Block AR
I>1 AR:	
(up to):	
I>4 AR:	No Action
	Initiate AR
	Block AR
	All overcurrent stages can be independently set not to act upon AR logic, to initiate a cycle, or to block.
IN>1 AR:	
(up to):	
IN>4 AR:	No Action
	Initiate AR
	Block AR
	All ground/earth overcurrent stages can be independently set not to act upon AR

logic, to initiate a cycle, or to block.

ISEF>1 AR:
(up to):
ISEF>4 AR: No Action
Initiate AR
Block AR

All ground/earth overcurrent stages can be independently set not to act upon AR logic, to initiate a cycle, or to block.

Auto-reclose system checks

CB1L SC all:	Enabled/Disabled
CB1L SC Shot 1:	Enabled/Disabled
CB1L SC ClsNoDly:	Enabled/Disabled
CB1L SC CS1:	Enabled/Disabled
CB1L SC CS2:	Enabled/Disabled
CB1L SC DLLB:	Enabled/Disabled
CB1L SC LLDB:	Enabled/Disabled
CB1L SC DLDB:	Enabled/Disabled
CB2L SC all:	Enabled/Disabled
CB2L SC Shot 1:	Enabled/Disabled
CB2L SC ClsNoDly:	Enabled/Disabled
CB2L SC CS1:	Enabled/Disabled
CB2L SC CS2:	Enabled/Disabled
CB2L SC DLLB:	Enabled/Disabled
CB2L SC LLDB:	Enabled/Disabled
CB2L SC DLDB:	Enabled/Disabled
CB1F SC all:	Enabled/Disabled
CB1F SC Shot 1:	Enabled/Disabled
CB1F SC CS1:	Enabled/Disabled
CB1F SC CS2:	Enabled/Disabled
CB1F SC DLLB:	Enabled/Disabled
CB1F SC LLDB:	Enabled/Disabled
CB1F SC DLDB:	Enabled/Disabled
CB2F SC all:	Enabled/Disabled
CB2F SC Shot 1:	Enabled/Disabled
CB2F SC CS1:	Enabled/Disabled
CB2F SC CS2:	Enabled/Disabled
CB2F SC DLLB:	Enabled/Disabled
CB2F SC LLDB:	Enabled/Disabled
CB2F SC DLDB:	Enabled/Disabled

Opto input labels

Opto Input 1:
(up to):
Opto Input 32:
User defined text string to describe the function of the particular opto input.

Output labels

Relay 1:
(up to):
Relay 32:
User defined text string to describe the function of the particular relay output contact.

Measurements list

Measurements 1

Iφ Magnitude
Iφ Phase Angle
Per phase (φ = A, B, C) current measurements
IN derived Mag
IN derived Angle
ISEF Mag
ISEF Angle
I1 Magnitude
I2 Magnitude
I0 Magnitude
Iφ RMS
Per phase (φ = A, B, C) RMS current measurements
IN RMS
Vφ-φ Magnitude
Vφ-φ Phase Angle
Vφ Magnitude
Vφ Phase Angle
All phase-phase and phase-neutral voltages (φ = A, B, C).
V1 Magnitude
V2 Magnitude
V0 Magnitude
Vφ RMS
Vφ-φ RMS
All phase-phase and phase-neutral voltages (φ = A, B, C).
Frequency
(CB1) CS Volt Mag
(CB1) CS Volt Ang
(CB1) Bus-Line Ang
(CB1) CS Slip Freq
IM Magnitude
IM Phase Angle
I1 Magnitude
I1 Phase Angle
I2 Magnitude
I2 Phase Angle
I0 Magnitude
I0 Phase Angle
V1 Magnitude
V1 Phase Angle
V2 Magnitude
V2 Phase Angle
V0 Magnitude
V0 Phase Angle
CB2 CS Volt Mag (P544 and P546 only)
CB2 CS Volt Ang (P544 and P546 only)
CB2 Bus-Line Ang (P544 and P546 only)
CB2 CS Slip Freq (P544 and P546 only)
V1 Rem Magnitude
V1 Rem Phase Ang
IA CT1 Magnitude (P544 and P546 only)
IA CT1 Phase Ang (P544 and P546 only)
IB CT1 Magnitude (P544 and P546 only)
IB CT1 Phase Ang (P544 and P546 only)
IC CT1 Magnitude (P544 and P546 only)
IC CT1 Phase Ang (P544 and P546 only)
IA CT2 Magnitude (P544 and P546 only)
IA CT2 Phase Ang (P544 and P546 only)
IB CT2 Magnitude (P544 and P546 only)
IB CT2 Phase Ang (P544 and P546 only)
IC CT2 Magnitude (P544 and P546 only)
IC CT2 Phase Ang (P544 and P546 only)

Measurements 2

φ Phase Watts
φ Phase VArs
φ Phase VA
All phase segregated power measurements, real, reactive and apparent (φ = A, B, C).
3 Phase Watts
3 Phase VArs
3 Phase VA
Zero Seq Power
3Ph Power Factor
φPh Power Factor
Independent power factor measurements for all three phases (φ = A, B, C).
3Ph WHours Fwd
3Ph WHours Rev
3Ph VArHours Fwd
3Ph VArHours Rev
3Ph W Fix Demand
3Ph VArs Fix Dem
Iφ Fixed Demand
Maximum demand currents measured on a per phase basis (φ = A, B, C).
3Ph W Roll Dem
3Ph VArs Roll Dem
Iφ Roll Demand
Maximum demand currents measured on a per phase basis (φ = A, B, C).
3Ph W Peak Dem
3Ph VAr Peak Dem
Iφ Peak Demand
Maximum demand currents measured on a per phase basis (φ = A, B, C).
Thermal State

Measurements 3

IA Local
IA Angle Local
IB Local
IB Angle Local
IC Local
IC Angle Local
IA remote 1
IA Ang remote 1
IB remote 1
IB Ang remote 1
IC remote 1
IC Ang remote 1
IA remote 2
IA Ang remote 2
IB remote 2
IB Ang remote 2
IC remote 2
IC Ang remote 2
IA Differential
IB Differential
IC Differential
IA Bias
IB Bias
IC Bias

Measurements 4

Ch 1 Prop Delay
Ch 2 Prop Delay
Ch1 Rx Prop Delay
Ch1 Tx Prop Delay
Ch2 Rx Prop Delay
Ch2 Tx Prop Delay
Channel 1 Status
Channel 2 Status
Channel Status:
Bit 0= Rx
Bit 1= Tx
Bit 2= Local GPS
Bit 3= Remote GPS
Bit 4= Mux Clk F Error
Bit 5= Signal Lost
Bit 6= Path Yellow
Bit 7= Mismatch RxN
Bit 8= Timeout
Bit 9= Message Level
Bit 10= Passthrough
Bit 11= Hardware B to J model
Bit 12= Max Prop Delay
Bit 13= Max Tx-Rx Time
Binary function link strings denoting channel errors, and when self-healing has been initiated in 3-terminal applications.
IM^{64} Rx Status
Statistics
Last Reset on
Date/Time
Ch1 No. Vald Mess
Ch1 No. Err Mess
Ch1 No. Errored s
Ch1 No. Sev Err s
Ch1 No. Dgraded m
Ch2 No. Vald Mess
Ch2 No. Err Mess
Ch2 No. Errored s
Ch2 No. Sev Err s
Ch2 No. Dgraded m
Max Ch 1 Prop Delay
Max Ch 2 Prop Delay
Max Ch1 TxRx Time
Max Ch2 TxRx Time
Clear Statistics

Circuit breaker monitoring statistics

CB Operations
CB φ Operations
Circuit breaker operation counters on a per phase basis (φ = A, B, C).
Total Iφ Broken
Cumulative breaker interruption duty on a per phase basis (φ = A, B, C).
CB Operate Time

For a second circuit breaker (P544 and P546 only)
CB2 Operations
CB2 φ Operations
Circuit breaker operation counters on a per phase basis (φ = A, B, C).

CB2 Iφ Broken
Cumulative breaker interruption duty on a per phase basis (φ = A, B, C).
CB 2Operate Time

Fault record proforma

The following data is recorded for any relevant elements that operated during a fault, and can be viewed in each fault record.
Time & Date
Model Number:
Address:
Event Type: Fault record
Event Value
Faulted Phase:
Binary data strings for fast polling of which phase elements started or tripped for the fault recorded.
Start Elements
Trip Elements
Binary data strings for fast polling of which protection elements started or tripped for the fault recorded.
Fault Alarms
Binary data strings for fast polling of alarms for the fault recorded.
Fault Time
Active Group: 1/2/3/4
System Frequency: Hz
Fault Duration: s
CB Operate Time: s
Relay Trip Time: s
Fault Location: km/miles/Ω/%
I φPre Flt
Iφ Angle Pre Flt
Per phase record of the current magnitudes and phase angles stored before the fault inception.
IN Prefault Mag
IN Prefault Ang
IM Prefault Mag
IM Prefault Ang
Vφ Prefault Mag
Vφ Prefault Ang
Per phase record of the voltage magnitudes and phase angles stored before the fault inception.
VN Prefault Mag
VN Prefault Ang
Iφ Fault Mag
Iφ Fault Ang
Per phase record of the current magnitudes and phase angles during the fault.
IN Fault Mag
IN Fault Ang
IM Fault Mag
IM Fault Ang
Vφ Fault Mag
Vφ Fault Ang
Per phase record of the voltage magnitudes and phase angles during the fault.
VN Fault Mag
VN Fault Ang
IA local
IB local
IC local
IA remote 1
IB remote 1
IC remote 1
IA remote 2
IB remote 2
IC remote 2
IA Differential
IB Differential
IC Differential
IA Bias
IB Bias
IC Bias
Ch1 Prop Delay
Ch 2 Prop Delay
Ch1 Rx Prop Delay
Ch1 Tx Prop Delay
Ch2 Rx Prop Delay
Ch2 Tx Prop Delay
V1 Rem Magnitude
V1 Rem Phase Ang
Fault IA Local
Fault IB Local
Fault IC Local
Fault IA rem 1
Fault IB rem 1
Fault IC rem 1
Fault IA rem 2
Fault IB rem 2
Fault IC rem 2
Fault IA Diff
Fault IB Diff
Fault IC Diff
Fault IA Bias
Fault IB Bias
Fault IC Bias

SETTINGS (P54x/EN ST/Ba4)

1.1 Relay Settings Configuration

The relay is a multi-function device that supports numerous different protection, control and communication features. In order to simplify the setting of the relay, there is a configuration settings column which can be used to enable or disable many of the functions of the relay. The settings associated with any function that is disabled are made invisible in the menu. To disable a function change the relevant cell in the **Configuration** column from **Enabled** to **Disabled**.

The configuration column controls which of the four protection settings groups is selected as active through the **Active settings** cell. A protection setting group can also be disabled in the configuration column, provided it is not the present active group. Similarly, a disabled setting group cannot be set as the active group.

The column also allows all of the setting values in one group of protection settings to be copied to another group.

To do this firstly set the **Copy from** cell to the protection setting group to be copied, and then set the **copy to** cell to the protection group where the copy is to be placed. The copied settings are initially placed in the temporary scratchpad, and will only be used by the relay following confirmation.

Menu text	Default setting	Available settings
Restore Defaults	No Operation	No Operation All Settings Setting Group 1 Setting Group 2 Setting Group 3 Setting Group 4
Setting to restore a setting group to factory default settings. To restore the default values to the settings in any Group settings, set the 'restore defaults' cell to the relevant Group number. Alternatively it is possible to set the 'restore defaults' cell to 'all settings' to restore the default values to all of the IED's settings, not just the Group settings. The default settings will initially be placed in the scratchpad and will only be used by the relay after they have been confirmed by the user. **Note:** Restoring defaults to all settings includes the rear communication port settings, which may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station.		
Setting Group	Select via Menu	Select via Menu Select via Optos
Allows setting group changes to be initiated via Opto Input or via Menu.		
Active Settings	Group 1	Group 1, Group 2, Group 3, Group 4
Selects the active setting group.		
Save Changes	No Operation	No Operation, Save, Abort
Saves all relay settings.		
Copy from	Group 1	Group 1, 2, 3 or 4
Allows displayed settings to be copied from a selected setting group.		
Copy to	No Operation	No Operation Group 1, 2, 3 or 4
Allows displayed settings to be copied to a selected setting group (ready to paste).		
Setting Group 1	Enabled	Enabled or Disabled
If the setting group is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting (paste).		
Setting Group 2 (as above)	Disabled	Enabled or Disabled
Setting Group 3 (as above)	Disabled	Enabled or Disabled
Setting Group 4 (as above)	Disabled	Enabled or Disabled

Menu text	Default setting	Available settings
Distance	Enabled	Enabled or Disabled
Only in models with Distance option. To enable (activate) or disable (turn off) the Distance Protection: ANSI 21P/21G.		
Directional E/F	Enabled	Enabled or Disabled
Only in models with Distance option. To enable (activate) or disable (turn off) the Directional Earth Fault (DEF) Protection used in a pilot aided scheme: ANSI 67N. This protection is independent from back up Earth fault protection described below.		
Phase Diff	Enabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Differential Protection. To get the differential protection fully active, it is necessary also to enable the differential protection in the group. Phase Diff setting and InterMiCOM^{64} Fiber setting are mutually exclusive as with Phase Diff enabled, the digital message exchanged has the structure of the differential message (i.e. currents are sent to the remote end, etc) and with InterMiCOM^{64} Fiber the digital message exchanged has the structure and properties of the InterMiCOM^{64} Fiber.		
Overcurrent	Enabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Phase Overcurrent Protection function. I> stages: ANSI 50/51/67P.		
Neg. Sequence O/C	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Negative Sequence Overcurrent Protection function. I2> stages: ANSI 46/67.		
Broken Conductor	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Broken Conductor function. I2/I1> stage: ANSI 46BC.		
Earth Fault	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the back up Earth Fault Protection function. IN >stages: ANSI 50/51/67N.		
SEF/REF PROT'N	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Sensitive Earth Fault/Restricted Earth fault Protection function. ISEF >stages: ANSI 50/51/67N. IREF>stage: ANSI 64.		
Residual O/V NVD	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Residual Overvoltage Protection function. VN>stages: ANSI 59N.		
Thermal Overload	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Thermal Overload Protection function. ANSI 49.		
PowerSwing Block	Enabled	Enabled or Disabled
Only in models with Distance option. To enable (activate) or disable (turn off) the power swing blocking/out of step: ANSI 68/78.		
Volt Protection	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Voltage Protection (under/overvoltage) function. V<, V> stages: ANSI 27/59.		
Freq. Protection	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Frequency Protection (under/over frequency) function. F<, F> stages: ANSI 81O/U.		
df/dt Protection	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Rate of change of Frequency Protection function. df/dt> stages: ANSI 81R.		
CB Fail	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Circuit Breaker Fail Protection function. ANSI 50BF.		

Menu text	Default setting	Available settings
Supervision	Enabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Supervision (VTS & CTS) functions. ANSI VTS/CTS.		
System Checks	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the System Checks (Check Sync. and Voltage Monitor) function: ANSI 25.		
Auto-reclose	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) the Auto-reclose function. ANSI 79.		
Input Labels	Visible	Invisible or Visible
Sets the Input Labels menu visible further on in the relay settings menu.		
Output Labels	Visible	Invisible or Visible
Sets the Output Labels menu visible further on in the relay settings menu.		
CT & VT Ratios	Visible	Invisible or Visible
Sets the Current & Voltage Transformer Ratios menu visible further on in the relay settings menu.		
Record Control	Invisible	Invisible or Visible
Sets the Record Control menu visible further on in the relay settings menu.		
Disturb. Recorder	Invisible	Invisible or Visible
Sets the Disturbance Recorder menu visible further on in the relay settings menu.		
Measure't. Set-up	Invisible	Invisible or Visible
Sets the Measurement Setup menu visible further on in the relay settings menu.		
Comms. Settings	Visible	Invisible or Visible
Sets the Communications Settings menu visible further on in the relay settings menu. These are the settings associated with the second rear communications ports.		
Commission Tests	Visible	Invisible or Visible
Sets the Commissioning Tests menu visible further on in the relay settings menu.		
Setting Values	Primary	Primary or Secondary
This affects all protection settings that are dependent upon CT and VT ratios. All subsequent settings input must be based in terms of this reference.		
Control Inputs	Visible	Invisible or Visible
Activates the Control Input status and operation menu further on in the relay setting menu.		
Ctrl I/P Config.	Visible	Invisible or Visible
Sets the Control Input Configuration menu visible further on in the relay setting menu.		
Ctrl I/P Labels	Visible	Invisible or Visible
Sets the Control Input Labels menu visible further on in the relay setting menu.		
Direct Access	Enabled	Enabled/Disabled/Hotkey only/CB Cntrl. only
Defines what CB control direct access is allowed. Enabled implies control via menu, hotkeys etc.		
InterMiCOM^{64} Fiber	Disabled	Enabled or Disabled
To enable (activate) or disable (turn off) InterMiCOM^{64} (integrated 56/64kbit/s teleprotection). Note that Phase Diff setting and InterMiCOM^{64} Fiber setting are mutually exclusive as with Phase Diff enabled, the digital message exchanged has the structure of the differential message (i.e. currents are sent to the remote end, etc) and with InterMiCOM^{64} Fiber the digital message exchanged has the structure and properties of the InterMiCOM^{64} Fiber.		
Function Key	Visible	Invisible or Visible
Sets the Function Key menu visible further on in the relay setting menu.		
RP1 Read Only	Disabled	Disabled/Enabled
To enable (activate) or disable (turn off) Read Only Mode of Rear Port 1.		
RP2 Read Only	Disabled	Disabled/Enabled
To enable (activate) or disable (turn off) Read Only Mode of Rear Port 2.		

Menu text	Default setting	Available settings
NIC Read Only	Disabled	Disabled/Enabled
To enable (activate) or disable (turn off) Read Only Mode of Network Interface Card.		
LCD Contrast	11	0…31
Sets the LCD contrast.		

1.2 Integral Teleprotection Settings

1.2.1 EIA(RS)232 InterMiCOM

InterMiCOM operates via an EIA(RS)232 physical output on the back of the 2nd rear communication board. It provides 8 independently settable digital signals that can be conveyed between line ends. The InterMiCOM teleprotection is restricted to 2 ends. InterMiCOM input and output mapping has to be done in the Programmable Scheme Logic (PSL).

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
INTERMiCOM COMMS				
IM Input Status	00000000			
Displays the status of each InterMiCOM input signal, with IM1 signal starting from the right. When loop back mode is set, all bits will display zero.				
IM Output Status	00000000			
Displays the status of each InterMiCOM output signal.				
Source Address	1	1	10	1
Setting for the unique relay address that is encoded in the InterMiCOM sent message.				
Receive Address	2	1	10	1
The aim of setting addresses is to establish pairs of relays which will only communicate with each other. Should an inadvertent channel misrouting or spurious loopback occur, an error will be logged, and the erroneous received data will be rejected. As an example, in a 2 ended scheme the following address setting would be correct: Local relay: Source Address = 1, Receive Address = 2 Remote relay: Source Address = 2, Receive Address = 1				
Baud Rate	9600	600, 1200, 2400, 4800, 9600, or 19200		
Setting of the signaling speed in terms of number of bits per second. The speed will match the capability of the MODEM or other characteristics of the channel provided.				
Ch Statistics	Visible	Invisible or Visible		
Settings that makes visible or invisible Channel Statistics on the LCD. The statistic is reset by either relay's powering down or using the **Reset Statistics** cell.				
Rx Direct Count	0			
Displays the number of valid Direct Tripping messages since last counter reset.				
Rx Perm Count	0			
Displays the number of valid Permissive Tripping messages since last counter reset.				
Rx Block Count	0			
Displays the number of valid Blocking messages since last counter reset.				
Rx NewData Count	0			
Displays the number of different messages (change events) since last counter reset.				
Rx Errored Count	0			
Displays the number of invalid received messages since last counter reset.				
Lost Messages	0			
Displays the difference between the number of messages that were supposed to be received (based on set Baud Rate) and actual valid received messages since last reset.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Elapsed Time	0			
Displays the time in seconds since last counter reset.				
Reset Statistics	No	Yes or No		
Command that allows all Statistics and Channel Diagnostics to be reset.				
Ch Diagnostics	Visible	Invisible or Visible		
Setting that makes visible or invisible Channel Diagnostics on the LCD. The diagnostic is reset by either relay's powering down or using the **Reset Statistics** cell.				
DATA CD Status	OK, FAIL, or Absent			
Indicates when the DCD line (pin 1 on EIA232 Connector) is energized. OK = DCD is energized FAIL = DCD is de-energized Absent = Second Rear port board is not fitted				
FrameSync Status	OK, FAIL, Absent or Unavailable			
Indicates when the message structure and synchronization is valid. OK = Valid message structure and synchronization FAIL = Synchronization has been lost Absent = Second Rear port board is not fitted Unavailable = Hardware error present				
Message Status	OK, FAIL, Absent or Unavailable			
Indicates when the percentage of received valid messages has fallen below the **IM Msg Alarm Lvl** setting within the alarm time period. OK = Acceptable ratio of lost messages FAIL = Unacceptable ratio of lost messages Absent = Second Rear port board is not fitted Unavailable = Hardware error present				
Channel Status	OK, FAIL, Absent or Unavailable			
Indicates the state of the InterMiCOM communication channel. OK = Channel healthy FAIL = Channel failure Absent = Second Rear port board is not fitted Unavailable = Hardware error present				
IM H/W Status	OK, Read Error, Write Error, or Absent			
Indicates the state of InterMiCOM hardware OK = InterMiCOM hardware healthy Read or Write Error = InterMiCOM failure Absent = Second Rear port is not fitted or failed to initialize.				
Loopback Mode	Disabled	Disabled, Internal or External		
Setting to allow testing of the InterMiCOM channel. When 'Internal' is selected, only the local InterMiCOM software functionality is tested, whereby the relay will receive its own sent data. 'External' setting allows a hardware and software check, with an external link required to jumper the sent data onto the receive channel. During normal service condition Loopback mode must be disabled.				
Test Pattern	11111111	00000000	11111111	-
Allows specific bit statuses to be inserted directly into the InterMiCOM message, to substitute real data. This is used for testing purposes.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Loopback Status	OK, FAIL or Unavailable			
Indicates the status of the InterMiCOM loopback mode OK = Loopback software (and hardware) is working correctly FAIL = Loopback mode failure Unavailable = Hardware error present.				
INTERMiCOM CONF				
IM Msg Alarm Lvl	25%	0%	100%	0.1%
Setting that is used to alarm for poor channel quality. If during the fixed 1.6s window the ratio of invalid messages to the total number of messages that should be received (based on the **Baud Rate** setting) exceeds the above threshold, a **Message Fail** alarm will be issued.				
IM1 Cmd Type	Blocking	Disabled, Direct, Blocking or Permissive		
Setting that defines the operative mode of the InterMiCOM_1 signal. Selecting the channel response for this bit to **Blocking** allows fastest signaling, whereas setting to **Direct** offers higher security at the expense of speed. Selecting the channel response for this bit to **Permissive** offers higher dependability				
IM1 FallBackMode	Default	Default or Latching		
Setting that defines the status of IM1 signal in case of heavy noise and message synchronization being lost. If set to **Latching** the last valid IM1 status will be maintained until the new valid message is received. If set to **Default**, the IM1 status, pre-defined by the user in **IM1 DefaultValue** cell will be set. A new valid message will replace **IM1 DefaultValue**, once the channel recovers.				
IM1 DefaultValue	1	0	1	1
Setting that defines the IM1 fallback status.				
IM1 FrameSyncTim	1.5 s	0.01 s	1.5 s	0.01 s
Time delay after which **IM1 DefaultValue** is applied, providing that no valid message is received in the meantime.				
IM2 to IM4	Cells as for IM1 above			
IM5 Cmd Type	Direct	Disabled, Direct, Blocking or Permissive		
Setting that defines the operative mode of the InterMiCOM_5 signal. Selecting the channel response for this bit to **Blocking** allows fastest signaling, whereas setting to **Direct** offers higher security at the expense of speed. Selecting the channel response for this bit to **Permissive** offers higher dependability				
IM5 FallBackMode	Default	Default or Latching		
As for IM1				
IM5 DefaultValue	0	0	1	1
Setting that defines the IM5 fallback status.				
IM5 FrameSyncTim	1.5 s	0.01 s	1.5 s	0.01 s
Time delay after which **IM5 DefaultValue** is applied.				
IM6 to IM8	Cells as for IM5 above			

1.3 Protection Communication Configuration

The column **PROT COMMS/ IM64** is used to set up all the differential protection communications parameters required by differential protection and also the parameters required for teleprotection when Differential function is disabled and the relay is working as a Distance relay using InterMiCOM^{64} for teleprotection purposes.

InterMiCOM^{64} is a fiber-optic based teleprotection scheme, described in detail in the Operation and Application chapters of this service manual.

In the settings listed here, Channel1 and Channel2 refer to the communications channels, and are associated with configuring the communications ports fitted to the co-processor board.

Each setting below that refers to Channel 2 is associated with the communications setting of the second communications channel (where fitted) and is visible only when 3 Terminal or Dual redundant teleprotection configuration is set.

Note: InterMiCOM^{64} provides 2 groups of 8 InterMiCOM^{64} commands. These are referenced as Channel 1 and Channel 2. They have a subtly different meaning and should not be confused with communications channels 1 and 2.

InterMiCOM^{64} input and output mapping has to be done in the Programmable Scheme Logic (PSL).

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
PROT COMMS/IM64				
Scheme Setup	2 Terminal	2 Terminal, Dual Redundant, or 3 Terminal		
Settings to determine how many relay ends are connected in the differential zone or how many relays are connected to the teleprotection scheme for the protected line, with two or three ends possible. For a plain two terminal line, there is an additional option to use dual communication channels, to implement redundancy (i.e. employ a parallel “hot-standby” path).				
Address	0-0	0-0, 1-A…20-A, 1-B….20-B		
Setting for the unique relay address that is encoded in the Differential message and in the InterMiCOM^{64} sent message. The aim of setting the address is to establish pairs of relays which will only communicate with each other. Should an inadvertent fiber/MUX misrouting or spurious loopback occur, an error will be logged, and the erroneous received data will be rejected. As an example, in a 2 ended scheme the following address setting would be correct: Local relay: 1-A Remote relay: 1-B Address 0-0 is a universal address, whereby any relay will be free to communicate with any other (equivalent to disabling of the unique addressing). When PROT COMMS/IM64 is set to loop back mode, the address 0-0 will replace any existing address in the relay.				
Address	0-0	0-0, 1-A…20-A, 1-B….20-B, 1-C…20-C		
In 3 terminal schemes, communicating groups of three relays may be configured.				
Comm Mode	Standard	Standard or IEEE C37.94		
Setting that defines the data format that will be transmitted on the fiber outputs from the relay. If the Multiplexer accepts direct fiber inputs according to IEEE C37.94, the ‘IEEE C37.94’ setting is selected. For a direct fiber link between relays, and where the MUX connection is in electrical format (G.703 or V.35 or X.21), the ‘Standard’ message format needs to be set. For a setting change to take effect, rebooting of the relay will be required. The Comm Mode setting applies to both channels.				
Baud Rate Ch 1	64 kbits/s	56 kbits/s or 64 kbits/s		
Channel 1 data rate setting for signaling between ends. The setting will depend on the MUX electrical interface, set 64 kbit/s for G.703 and X.21, or generally 56 kbit/s for V.35. For direct fiber connection between relays, 64kbit/s will offer slightly faster data transmission. The setting is invisible when IEEE C37.94 Comm Mode is selected.				
Baud Rate Ch 2	64 kbits/s	56 kbits/s or 64 kbits/s		
As ‘Baud Rate Ch1’ cell.				
Clock Source Ch1	Internal	Internal or External		
Setting that defines which clock source is used to synchronize data transmissions over channel 1. The setting will depend on communications configuration and external clock source availability. If relays are connected direct fiber over channel 1, ‘Internal’ setting should be selected. If channel 1 is routed via a multiplexer, either setting may be required (see Application Notes).				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Clock Source Ch2	Internal	Internal or External		
Setting that matches the clock source being used for data synchronization over channel 2.				
Ch1 N*64kbits/s	1	Auto, 1, 2, 3, …..or 12		
Setting for channel 1 when connected to MUX. When set to 'Auto' P54x will configure itself to match the multiplexer. The setting is visible only when IEEE C37.94 Comm Mode is selected.				
Ch2 N*64kbits/s	1	Auto, 1, 2, 3, …..or 12		
Setting for channel 2 when connected to Mux. The setting is visible only when IEEE C37.94 Comm Mode is selected.				
Comm Delay Tol	0.00025 s	0.00025 s	0.001 s	0.00005 s
If successive calculated propagation times exceed this time delay setting, the relay will initiate a change in relay setting for a short time period ("Char Mod Time" setting) and will raise a Comm Delay Alarm.				
Comm Fail Timer	10 s	0.1 s	600 s	0.1 s
Time delay after which the 'Channel Fail Alarm' will be issued providing that no messages were received during the 'Channel Timeout' period or the 'Alarm Level' is exceeded.				
Comm Fail Mode	Ch 1 and 2 Fail	Ch 1 Failure/ Ch 2 Failure/ Ch 1 or Ch 2 Fail/ Ch 1 and Ch 2 Fail		
Fail mode setting that triggers the 'Channel Fail Alarm', providing that the Dual Redundancy or 3 ended scheme is set. Normally the alarm would be raised for any loss of an operational channel (logical **OR** combination). However, when relays in a 3 ended scheme are deliberately operated in Chain topology **AND** logic may be used, for indication when the scheme becomes finally inoperative, with no self-healing (signal rerouting) mode possible.				
GPS Sync	GPS Disabled	GPS Disabled,GPS -> Standard, GPS -> Inhibit, GPS -> Restrain		
Setting to define type of GPS Mode. Refer to Operating Guide for full explanation of settings. If set to **GPS Disabled**, **Char Mod Time** and **Char Mod Ex** are visible. **Prop Delay Equal** is invisible. If set to **GPS Standard**, **Char Mod Time** and **Char Mod Ex** are invisible. **Prop Delay Equal** is visible. If set to **GPS -> Inhibit, Char Mod Time** and **Char Mod Ex** are invisible. **Prop Delay Equal** is visible. If set to **GPS -> Restrain, Char Mod Time, Char Mod Ex** and **Prop Delay Equal** are visible.				
Char Mod Time	0.5 s	0	30 s	0.0001 s
Time delay during which the setting characteristic k1 is increased to 200% after successive calculated propagation delay time exceed the time delay setting **Comm Delay Tol**. This should be set to greater than the maximum switching delay expected.				
Char Mod Ex	Disabled	Disabled/Enabled		
Setting to enable **Char Mod Ex Time**.				
Char Mod Ex Time	0.5 s	0 s	30 s	0.0001 s
If the **Char Mod Time** has started then the **Char Mod Ex Timer** runs. If at the end of this timer and until **Char Mod Time** has expired, the bias current is above 5% In, and differential current is below 10% of bias current on all phases, then the **Char Mod Time** will reset and the characteristic will return to normal. If these conditions are not met, then the characteristic remains increased for the duration of the **Char Mod Time**. **Char Mod Ex Timer** should be set greater than the minimum switching delay expected, and less than **Char Mod Time**.				
Prop Delay Equal	No Operation	No operation or Restore CDiff		
If a P54x relay working with GPS sample synchronization loses GPS and there is a further switch in the protection communications network, the relay becomes Inhibited. If GPS become active again, the relay will automatically reset. But if not, the user can remove the inhibited condition by using this setting. This should only be performed if it can be guaranteed that the communication receiver and transmitter path delays are equal. The setting is invisible when GPS Sync mode is disabled.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Re-Configuration	Three Ended	Three Ended, Two Ended (R1&R2) , Two Ended (L&R2) or Two Ended (L&R1)		
This setting is to change the scheme from three ended scheme to two ended scheme or vice versa. An in deep explanation of relay performance for each case is given in chapter *P54x/EN OP*. The setting is invisible when 3 Terminal Scheme Setup is selected.				
Channel Timeout	0.1 s	0.1 s	10 s	0.1 s
A rolling time window beyond which any of the 8 IM signals that are set to 'Default' will be replaced by the corresponding 'IM_X Default Value' setting, providing that no valid message is received on that channel in the meantime. The 'Chnl Fail Alarm' timer will be also initiated. If only one channel is used, each out of 16 IM signals available that is set to 'Default' will convert to corresponding 'IM_X Default Value' If a Dual redundant or 3 ended scheme is selected, each out of 8 IM signals available that is set to 'Default' will convert to corresponding 'IM_X Default Value', but only for the affected channel.				
Alarm Level	25%	0%	100%	1%
Setting that is used to alarm for poor channel quality. If during a fixed 100 ms rolling window the number of invalid messages divided by the total number of messages that should be received (based upon the 'Baud Rate' setting) increase above the threshold, a 'Channel Fail Alarm' timer will be initiated.				
Prop Delay Stats	Enabled	Enabled or Disabled		
To enable (activate) or disable (turn off) the alarms of Maximum propagation delay time				
MaxCh 1 PropDelay	15 ms	1 ms	50 ms	1 ms
When the protection communications are enabled, the overall propagation delay divided by 2 is calculated and the maximum value is determined and displayed in Measurements 4 column. This value is displayed and compared against this setting. If the setting is exceeded, an alarm **MaxCh1 PropDelay** (DDB 1386) is raised.				
MaxCh 2 PropDelay	15 ms	1 ms	50 ms	1 ms
When the protection communications are enabled, the overall propagation delay divided by 2 is calculated and the maximum value is determined and displayed in Measurements 4 column. This value is displayed and compared against this setting. If the setting is exceeded, an alarm **MaxCh2 PropDelay** (DDB 1387) is raised.				
TxRx Delay Stats	Enabled	Enabled or Disabled		
To enable (activate) or disable (turn off) the alarms of absolute difference between the Transmission and Reception propagation delay. This setting is visible only in case that GPS Sync is Enabled.				
MaxCh1 Tx-RxTime	15 ms	1 ms	50 ms	1 ms
When the protection communications and GPS Sync are enabled, the absolute difference between the Transmission and Reception propagation delay is calculated and the maximum value is determined and displayed in Measurements 4 column. This value is displayed and compared against this setting. If the setting is exceeded, an alarm **MaxCh1 Tx-RxTime** (DDB 1388) is raised.				
MaxCh2 Tx-RxTime	15 ms	1 ms	50 ms	1 ms
When the protection communications and GPS Sync are enabled, the absolute difference between the Transmission and Reception propagation delay is calculated and the maximum value is determined and displayed in Measurements 4 column. This value is displayed and compared against this setting. If the setting is exceeded, an alarm **MaxCh2 Tx-RxTime** (DDB 1389) is raised.				
GPS Fail Timer	0 s	0 s	9999 s	1 s
Time delay setting after which the 'GPS Alarm' – DDB 310 is asserted following a loss of GPS signal or initiation by the GPS transient fail alarm function when active(see below).				
GPS Trans Fail	Disabled	Enabled or Disabled		
To enable (activate) or disable (turn off) the transient GPS Fail alarm function.				
GPS Trans Count	1 s	1 s	100 s	1 s
Sets the count for the number of failed GPS signals which must be exceeded in the set 'GPS Trans Timer' window after which the 'GPS Fail Timer' is initiated.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
GPS Trans Timer	1 s	0 s	9999 s	1 s
Sets the rolling time window in which the 'GPS Trans Count' must be exceeded after which the 'GPS Fail Timer' is initiated.				
IM1 Cmd Type	Permissive	Direct or Permissive		
Setting that defines the operative mode of the received InterMiCOM_1 signal. When **Direct** tripping is chosen, for security reasons 2 consecutive valid messages have to be received before a change in the signal status will be acknowledged. That will impose an additional 1-2 ms delay comparing to 'Permissive' mode. Set **Direct** in Direct Transfer Tripping (Intertripping) applications. Set **Permissive** to accommodate any Permissive or Blocking scheme.				
IM1 FallBackMode	Default	Default or Latching		
Setting that defines the status of IM1 signal in case of heavy noise and message synchronization being lost. If set to **Latching** the last valid IM1 status will be maintained until the new valid message is received. If set to **Default**, the IM1 status, pre-defined by the user in **IM1 Default Value** cell will be set. A new valid message will replace **IM1 Default Value**, once the channel recovers.				
IM1 DefaultValue	0	0	1	1
Setting that defines the IM1 fallback status.				
IM2 to IM8	Cells as for IM1 above			

Note: The IM1 – IM8 settings in the table above are applied the same to the 8 InterMiCOM^{64} commands grouped as Channel 1 as to the 8 InterMiCOM^{64} commands grouped as Channel 2. If IM1 Default Value is set to 0, then IM1 Channel 1, and IM1 Channel 2 will both default to 0.

1.4.4 Phase Differential

The column "GROUP x PHASE DIFF" is used to:

- Select the settings of the phase differential characteristic
- Define CT correction factors
- Define type of compensation (Capacitive Charging current or phase shift compensation). If charging current is selected, to set the value of susceptance and if phase shift is chosen, to set the value of vector compensation (P543 and P545 models only)
- Enable or Disable inrush restrain in the case of transformers in zone (P543 and P545 models only)
- Set the amount of positive sequence current required for Differential current transformer supervision

The column "GROUP x PHASE DIFF" is invisible if disabled in 'CONFIGURATION' column.

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Phase Diff	Enabled	Enabled or Disabled		
To enable (activate) or disable (turn off) the Differential protection function in the group.				
Phase Is1	0.2 In	0.2 In	2 In	0.05 In
Setting that defines the minimum pick-up level of the relay.				
Phase Is2	2 In	1 In	30 In	0.05 In
This setting defines the bias current threshold, above which the higher percentage bias k2 is used.				
Phase k1	30%	30%	150%	5%
The lower percentage bias setting used when the bias current is below Is2. This provides stability for small CT mismatches, whilst ensuring good sensitivity to resistive faults under heavy load conditions.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Phase k2	150% (2 end or dual redundant) 100% (3 end)	30%	150%	5%
The higher percentage bias setting used to improve relay stability under heavy through fault current conditions.				
Phase Char	DT	DT, IEC S Inverse, IEC V Inverse, IEC E inverse, UK LT Inverse IEEE M Inverse, IEEE V Inverse, IEEE E Inverse, US Inverse, US ST Inverse		
Setting for the tripping characteristic for differential protection element.				
Phase Time Delay	0 s	0 s	100 s	0.01 s
Setting for the time-delay for the definite time setting if selected. The setting is visible only when DT function is selected.				
Phase TMS	1	0.025	1.2	0.005
Setting for the time multiplier setting to adjust the operating time of the IEC IDMT characteristic.				
Phase Time Dial	0.01	0.01	100	0.01
Setting for the time multiplier setting to adjust the operating time of the IEEE/US IDMT curves. The Time Dial (TD) is a multiplier on the standard curve equation, in order to achieve the required tripping time. The reference curve is based on TD = 1. Care: Certain manufacturer's use a mid-range value of TD = 5 or 7, so it may be necessary to divide by 5 or 7 to achieve parity.				
PIT Time	0.2 s	0 s	0.2 s	0.005 s
This timer is initiated upon receipt of PIT flag in the message. Once this timer elapses, and as long as the current is above of Is1 setting, the relay closes its three phase differential trip contacts.				
Ph CT Corr'tion	1	1	8	0.01
Setting used to compensate CT ratios mismatch between terminals.				
Compensation	None	None, Cap Charging, Transformer		
Setting to define type of compensation. If set to **None**, **Susceptance Inrush Restraint** and **Transformer** are invisible. If set to **Cap Charging**, **Susceptance** setting becomes visible and **Inrush Restraint** and Transformer are invisible. If set to **Transformer**, **Inrush Restraint** and **Vectorial Comp** settings become visible while Susceptance setting is invisible. **Inrush Restraint**, **Id High Set** and **Vectorial Comp** are only applicable in relay models P543 and P545.				
Susceptance	1E-8*In	1E-8*In	10*In	1E-8*In
Visible when **Compensation** *is set to* **Cap Charging**. Setting to define the positive sequence susceptance value of the circuit for capacitive charging current compensation				
Inrush Restraint	Disabled	Disabled, Restraint, Blocking		
Only models P543 and P545 when **Compensation** *is set to* **Transformer**. Setting **Restraint** (activate), **Blocking** (Inrush blocking) or **Disable** (turn off) the additional bias inrush restrain. If set to **Restraint**, **Ih(2) Muliplier** setting becomes visible. If set to **Blocking**, **Ih(2) %>**, **Ih(2) CrossBlock** and **Ih(5) Blocking** settings becomes visible and **Ih(2) Muliplier** setting becomes invisible. **Note:** It must be ensure that this function is enabling at each end to avoid maloperation.				
Ih(2) Multiplier	4	1	20	0.01
Additional bias = **Ih(2) Multiplier** * √2 * Ih(2).				
Ih(2) %>	15%	5%	50%	1%
If the % of 2nd harmonic in any phase is greater than **Ih(2) %>** setting, then inrush conditions shall be detected.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Ih(2) CrossBlock	Disabled	Disabled/Enabled		
If **Ih(2) CrossBlock** is set Disabled then independent blocking is used. If enabled then Cross blocking is used.				
Ih(5) Blocking	Disabled	Disabled/Enabled		
Setting to enable 5th harmonic Blocking element. This shall be used to detect overfluxing conditions.				
Ih(5) %>	35%	5%	100%	1%
If the % of 5th harmonic in any phase is greater than **Ih(5) %>** setting, then overfluxing conditions shall be detected.				
Ih(5) CrossBlock	Disabled	Disabled/Enabled		
If Ih(5) CrossBlock is set Disabled then independent blocking is used. If enabled then Cross blocking is used.				
Highset Status	Disabled	Disabled/Enabled		
Setting to enable highset differential element. **HighSet Status** *only models P543 and P545 when Compensation is set to* **Transformer** *and Inrush Restraint is set to* **Restraint** *or* **Blocking**.				
Vectorial Comp	Yy0 (0 deg)	Yy0 (0 deg), Yd1 (-30 deg), Yy2 (-60 deg), Yd3 (-90 deg), Yy4 (-120 deg), Yd5 (-150 deg), Yy6 (180 deg), Yd7 (+150 deg), Yy8 (+120 deg), Yd9 (+90 deg), Yy10 (+60 deg), Yd11 (+30 deg), Ydy0 (0 deg), Ydy6 (180 deg)		
Only in models P543 and P545 when **Vectorial Comp** *is enable*. To define the vector compensation to account for phase shift correction and zero sequence current filtering (for transformer applications)				
Id High Set	4*In	4*In	32*In	0.01*In
Only in models P543 and P545 when **Inrush Restraint** *is set to Restrain or Blocking* Pick-up setting for high set differential protection				
Phase Is1 CTS	1.2*In	0.2*In	4*In	0.05*In
Setting that defines the minimum pick-up level of the relay when a current transformer supervision CTS is declared				
PIT I Selection PIT I selection Remote PIT I selection Remote	Remote	Local or Remote		
Setting that defines the current to be used for the Permissive Intertrip				

1.4.12 Sensitive Earth Fault

If a system is earthed through a high impedance, or is subject to high ground fault resistance, the earth fault level will be severely limited. Consequently, the applied earth fault protection requires both an appropriate characteristic and a suitably sensitive setting range in order to be effective. A separate four-stage sensitive earth fault element is provided within the P54x relay for this purpose, which has a dedicated input.

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
SEF/REF Options	SEF	SEF Enabled, Wattmetric SEF, HI Z REF		
Setting to select the type of sensitive earth fault protection function and the type of high-impedance function to be used.				
ISEF>1 Function	DT	Disabled, DT, IEC S Inverse, IEC V Inverse, IEC E inverse, UK LT Inverse , IEEE M Inverse, IEEE V Inverse, IEEE E Inverse, US Inverse, US ST Inverse, IDG		
Setting for the tripping characteristic for the first stage sensitive earth fault element.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
ISEF>1 Direction	Non-directional	Non-directional Direction Fwd Direction Rev		N/A
This setting determines the direction of measurement for the first stage sensitive earth fault element.				
ISEF>1 Current	0.05 x In_{SEF}	0.005 x In_{SEF}	0.1x In_{SEF}	0.00025 x In_{SEF}
Pick-up setting for the first stage sensitive earth fault element.				
ISEF>1 IDG Is	1.5	1	4	0.1
This setting is set as a multiple of **ISEF>** setting for the IDG curve (Scandinavian) and determines the actual relay current threshold at which the element starts.				
ISEF>1 Delay	1	0	200 s	0.01 s
Setting for the time delay for the first stage definite time element.				
ISEF>1 TMS	1	0.025	1.2	0.005
Setting for the time multiplier to adjust the operating time of the IEC IDMT characteristic.				
ISEF>1 Time Dial	1	0.1	100	0.1
Setting for the time multiplier to adjust the operating time of the IEEE/US IDMT curves.				
ISEF>1 Reset Char.	DT	DT or Inverse		N/A
Setting to determine the type of reset/release characteristic of the IEEE/US curves.				
ISEF>1 tRESET	0	0 s	100 s	0.01 s
Setting to determine the reset/release time for definite time reset characteristic.				
ISEF>1 IDG Time	1.2	1	2	0.01
Setting for the IDG curve used to set the minimum operating time at high levels of fault current.				
ISEF>2 Cells as for ISEF>1 Above				
ISEF>3 Status	Disabled	Disabled or Enabled		N/A
Setting to enable or disable the third stage definite time sensitive earth fault element.				
ISEF>3 Direction	Non-directional	Non-directional Directional Fwd Directional Rev		N/A
This setting determines the direction of measurement for the third stage element.				
ISEF>3 Current	0.4 x In_{SEF}	0.005 x In_{SEF}	0.8 x In_{SEF}	0.001 x In_{SEF}
Pick-up setting for the third stage sensitive earth fault element.				
ISEF>3 Delay	1	0 s	200 s	0.01 s
Setting for the operating time delay for third stage sensitive earth fault element.				
ISEF>4 Cells as for ISEF>3 Above				
ISEF> Func. Link	001111	Bit 0=VTS Blks ISEF>1, Bit 1=VTS Blks ISEF>2, Bit 2=VTS Blks ISEF>3, Bit 3=VTS Blks ISEF>4, Bit 4= A/R Blks ISEF>3, Bit 5=A/R Blks ISEF>4, Bit 6=Not Used, Bit 7=Not Used		
Settings that determine whether VT supervision and auto-reclose logic signals blocks selected sensitive earth fault stages.				
ISEF DIRECTIONAL				
ISEF> Char. Angle	90°	–95°	+95°	1°
Setting for the relay characteristic angle used for the directional decision.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
ISEF>VNpol Set	5	0.5 V	88 V	0.5 V
Setting for the minimum zero sequence voltage polarizing quantity required for directional decision.				
IREF> Is	0.2 * In_{sef}	0.05 * In_{sef}	1 * In_{sef}	0.01 * In_{sef}
Pick-up setting for the High Impedance restricted earth fault element.				
WATTMETRIC SEF	Sub-heading in menu			
PN> Setting	9 In_{SEF} W	0	20 In_{SEF} W	0.05 In_{SEF} W
Setting for the threshold for the wattmetric component of zero sequence power. The power calculation is as follows: The PN> setting corresponds to: Vres x Ires x Cos (ϕ – ϕc) = 9 x Vo x Io x Cos (ϕ– ϕc) Where; ϕ = Angle between the Polarizing Voltage (-Vres) and the Residual Current ϕc = Relay Characteristic Angle (RCA) Setting (ISEF> Char Angle) Vres = Residual Voltage Ires = Residual Current Vo = Zero Sequence Voltage Io = Zero Sequence Current				

1.5.1 System Data

This menu provides information for the device and general status of the relay.

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Language	English			
The default language used by the device. Selectable as English, French, German, Spanish.				
Password	****			
Device default password.				
Sys. Fn. Links	0			1
Setting to allow the fixed function trip LED to be self resetting (set to 1 to extinguish the LED after a period of healthy restoration of load current).				
Description	MiCOM P54x			
16 character relay description. Can be edited.				
Plant Reference	MiCOM			
Associated plant description and can be edited.				
Model Number	P54??1???M???0K			
Relay model number. This display cannot be altered.				
Serial Number	123456J			
Relay model number. This display cannot be altered.				
Frequency	50 Hz	50 Hz or 60 Hz		
Relay set frequency. Settable either 50 or 60 Hz				
Comms. Level 2				
Displays the conformance of the relay to the Courier Level 2 comms.				
Relay Address 1	255	0	255	1
Sets the first rear port relay address.				
Plant Status	0000000000000010			
Displays the circuit breaker plant status.				
Control Status	0000000000000000			
Not used.				

Menu text	Default setting	Setting range		Step size
		Min.	Max.	
Active Group	1	1	4	1
Displays the active settings group.				
CB Trip/Close	No Operation	No Operation/ Trip/Close		
Supports trip and close commands if enabled in the Circuit Breaker Control menu.				
Software Ref. 1	P54x____1__057_K			
Software Ref. 2	P54x____1__057_K			
Displays the relay software version including protocol and relay model. Software Ref. 2 is displayed for relay with IEC 61850 protocol only and this will display the software version of the Ethernet card.				
Opto I/P Status	00000000000000000000000000000000			
Display the status of the available opto inputs fitted.				
Relay O/P Status	00000000000000000000000000000000			
Displays the status of all available output relays fitted.				
Alarm Status 1	00000000000000000000000000000000			
32 bit field gives status of first 32 alarms. Includes fixed and user settable alarms.				
Alarm Status 2	00000000000000000000000000000000			
Next 32 alarm status defined.				
Access Level	2			
Displays the current access level. Level 0 - No password required - Read access to all settings, alarms, event records and fault records Level 1 - Password 1 or 2 required - As level 0 plus: Control commands, e.g. circuit breaker open/close Reset of fault and alarm conditions, Reset LEDs Clearing of event and fault records Level 2 - Password 2 required - As level 1 plus: All other settings				
Password Control	2			1
Sets the menu access level for the relay. This setting can only be changed when level 2 access is enabled.				
Password Level 1	****			
Allows user to change password level 1.				
Password Level 2	****			
Allows user to change password level 2.				

OPERATION (P54x/EN OP/Ba4)

1.1.1.2 Time alignment of current vectors with GPS input (all models)

The effect of the deployment of switched SDH (Synchronous Digital Hierarchy) networks on telecommunications circuits used in the application of numerical current differential protection to transmission lines.

Such telecommunications networks can be deployed in flexible, self-healing topologies. Typically, ring network topologies are employed and these are characterized by the ability to self-heal in the event of a failure of an interconnection channel.

Consider a simple ring topology with 6 nodes, A - F, and consider two equipment situated at nodes B and C. Under healthy conditions equipment at B communicates with equipment at C directly between nodes B and C and equipment at C communicates with equipment at B directly between nodes C and B. In this condition the communications propagation time between nodes B and C will be the same as that between nodes C and B and so the traditional technique described in could be used to apply numerical current differential protection (see Figure 4).

If the link fails in one direction, say between the transmitter at node B and the receiver at node C, the self-healing ring can continue to transfer signals from node B to node C via the standby route through nodes B, A, F, E, D and then C (obviously a longer path). In this case the communication propagation delay times between nodes B and C differ in the two directions, and if the difference is greater than 1ms the traditional time alignment technique described in section 1.1.1.1 is no longer adequate.

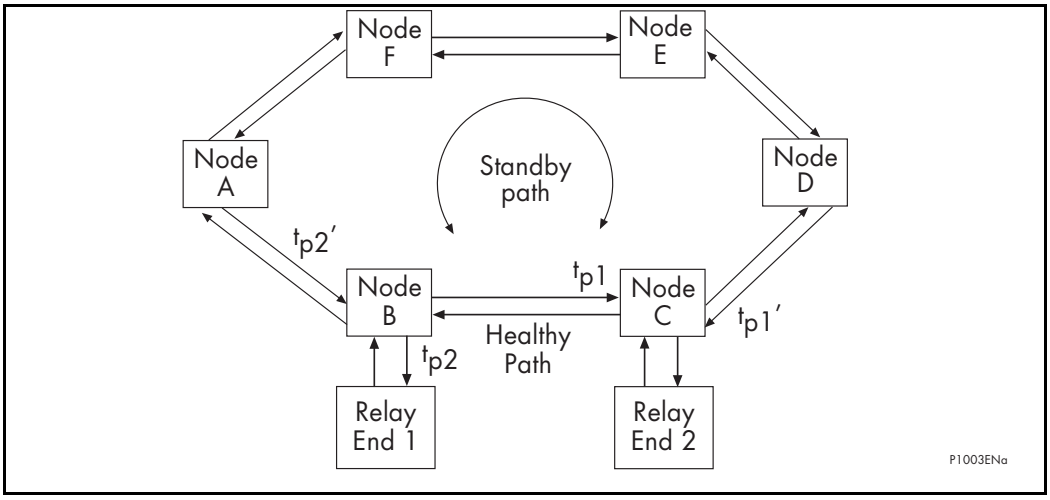


Figure 4: Example of switched synchronous digital hierarchy

P54x make use of the timing information available from the GPS system to overcome the limitation of the traditional technique, and therefore allow application to communications that can provide a permanent or semi-permanent split path routing.

A 1 pulse per second output from a GPS receiver is used to ensure that the re-sampling of the currents at each relay occurs at the same instant in time. The technique is therefore not dependant on equal transmit and receive propagation delay times; changes in one or both of the propagation delay times also do not cause problems. These factors make it suitable for use with switched SDH networks.

The GPS technique is taken further, however, to overcome concerns about the reliability of the GPS system. Consider a similar two ended system to that of Figure 3 where the re-sampling instants (tAn, tBn) are synchronized using the GPS timing information. Here the re-sampling instants at the two ends will be coincidental as shown in Figure 5.

Note: Figure 5 demonstrates a case where the communications path propagation delay times are not the same.

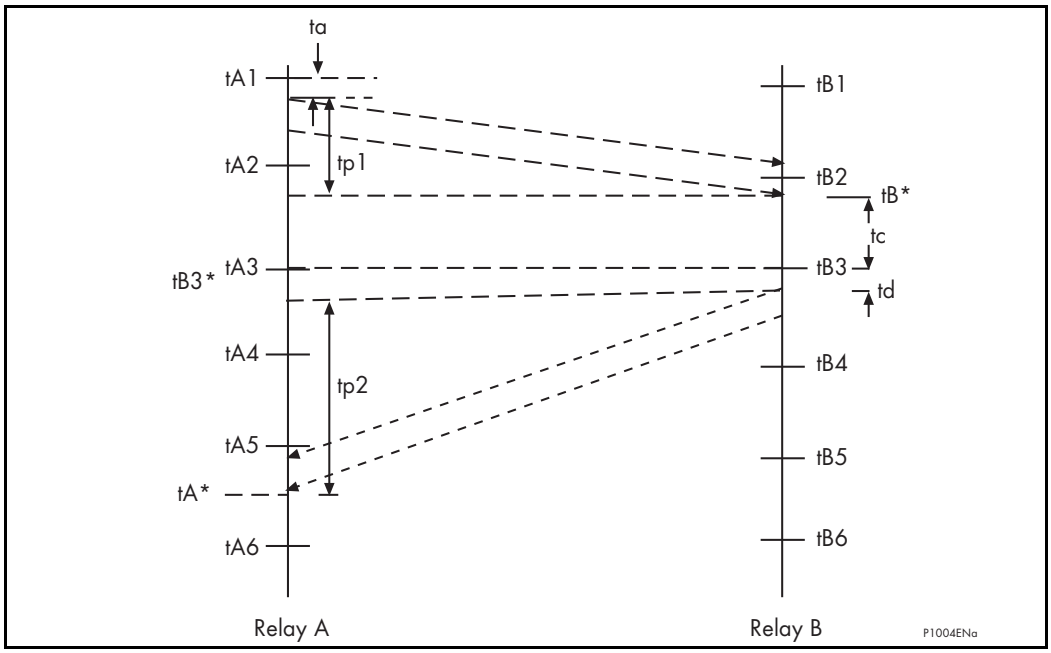


Figure 5: Data Transmission

Note: Relay A can measure the total elapsed time = (tA* - tA1). This equals the sum of the propagation delay times tp1 and tp2, the delay in sending out the initial message ta, and the delay time tc+td at end B. Hence

tp1 + tp2 = tA* - tA1 - ta - tc - td

However, because of the GPS synchronization of the re-sampling instants, tA3 is at the same instant as tB3 (therefore tB3* = tA3) we can use this knowledge to calculate the receive path delay

tp2= tA* - tA3 – td

And, by the same process the relay can also calculate tp1.

In the event of the GPS synchronizing signal becoming unavailable, the synchronization of the re-sampling instants at the different ends will be lost and the sampling will become asynchronous. However, the behavior depends on which mode is selected. If GPS -> Standard is selected, the time alignment of the current data will now be performed, by using the memorized value of propagation delay times prior to the GPS outage (tp2 in relay A and tp1 in relay B – Figure 4). Each relay also keeps measuring the overall propagation delay, tp1+tp2. As long as the change in overall propagation delay does not exceed the setting value under PROT COMMS/IM64/Comm Delay Tol, it is considered that the communication path has not been switched, tp2 and tp1 at the two ends remains valid and the differential protection remains active. If the overall propagation delay exceeds the above mentioned setting, the differential protection will be inhibited. This patented “fallback” strategy ensures protection continuity even in the event of antenna vandalism, maintenance error, extremely adverse atmospheric conditions etc – all of which could result in GPS outage.

Note: tp1 and tp2 do not need to be equal for the fallback strategy to become operational.

If GPS -> Inhibit mode is selected and GPS synchronizing signal becomes unavailable and tp1 = tp2 then the time alignment is performed using the average loop delay. If at the time the GPS fails (tp1 not equal tp2, split path) then the time alignment can be performed using the memorized value of propagation delay prior to the GPS outage.

Each relay continues to measure the overall propagation delay, tp1+tp2. As long as the change in overall propagation delay does not exceed the Comm Delay Tol setting it is decided that the communication path has not been switched, tp1 and tp2 at the two ends remain valid and the protection remains active. If the change in overall propagation delay is greater than the Comm Delay Tol setting, the differential protection shall be inhibited.

If the GPS signal returns, continue in the GPS -> Standard mode of operation.

In GPS -> Restrain mode, behavior is similar to that of GPS -> Inhibit, except that when average loop delay is used, i.e. GPS Sync is lost, if the change in overall propagation delay is greater than the Comm Delay Tol setting, the differential protection shall be restrained by invoking the Char Mod Time functionality, and not inhibited.

1.2 Protection of Transformers Feeders (P543 and P545)

MiCOM P543/P545 relays can be applied when power transformers are located in the differential zone. In order to obtain the correct performance of the relay for this application, MiCOM P543/P545 is provided with:

- Phase compensation to take unto account any phase shift across the transformer, possible unbalance of signals from current transformers either side of windings, and the effects of the variety of earthing and winding arrangements. In P543 and P545, software interposing CTs (ICTs) are provided to give the required compensation.
- Inrush blocking or restrain options to cater for high levels of magnetizing current during inrush conditions.
- For conditions where it is possible to temporarily load the transformer with a voltage in excess of the nominal voltage, the overfluxing blocking prevents unwanted tripping. The fifth harmonic blocking feature does not require a voltage signal. A fifth harmonic signal is derived from the differential current waveform on each phase and blocking is on a per phase basis. The overfluxing protection should be used in such applications to protect the transformer accordingly.
- CT ratio correction factor as mentioned in section 1.1.3 to match the transformer winding rated currents if needed.

Note: The P544 and P546 relays do not include any of the above features, except CT ratio mismatch compensation, and as such would not be suitable for the protection of in-zone transformer feeders.

1.2.1 Enabling or Disabling Differential Protection for In-Zone Power Transformer

Differential protection with an in-zone transformer can be enabled from the local control panel. Enabling can be done separately for each setting group. To enable the differential protection, set the cell [3310: Compensation] to **Transformer** under the **GROUP 1 PHASE DIFF** menu heading.

1.2.2 Transformer Magnetizing Inrush (P543 and P545)

The magnetizing inrush current to a transformer appears as a large operating signal to the differential protection. Special measures are taken with the relay design to ensure that no maloperation occurs during inrush.

Figure 7 shows a transformer magnetizing characteristic. To minimize material costs, weight and size, transformers are generally operated near to the ‘knee point’ of the magnetizing characteristic. Consequently, only a small increase in core flux above normal operating levels will result in a high magnetizing current.

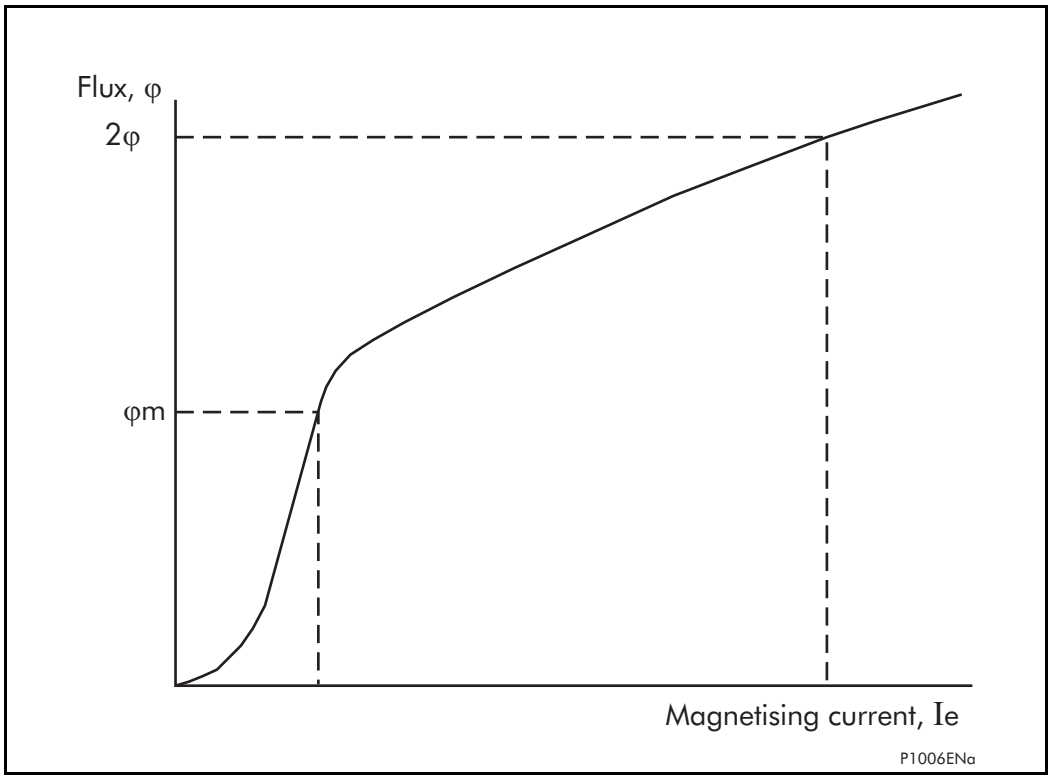


Figure 7: Transformer magnetizing characteristic

Under normal steady state conditions, the magnetizing current associated with the operating flux level is relatively small (usually less than 1% of rated current). However, if a transformer winding is energized at a voltage zero, with no remnant flux, the flux level during the first voltage cycle (2 x normal max. flux) will result in core saturation and in a high, non-sinusoidal magnetizing current waveform. This current is commonly referred to as magnetizing inrush current and may persist for several cycles. The magnitude and duration of magnetizing inrush current waveforms are dependent upon a number of factors, such as transformer design, size, system fault level, point on wave of switching, number of banked transformers, etc. Figure 8 shows typical transformer magnetizing currents for steady state and inrush conditions.

The magnetizing inrush current contains a high percentage of second harmonic. The P543 and P545 relays filter out this component of the waveform and use it as an additional bias quantity. The total bias used by the relay will therefore be a combination of the average load current on the line plus a multiple of the second harmonic component of the current. The multiplying factor is used to ensure stability and is a factory pre-set value.

Where P543 and P545 relays are used and inrush restrain function is enable, it must be ensure that this function is enabled at each end to avoid possible maloperation.

High set differential setting:

When inrush restrain is enabled, a high set differential protection becomes active. This unrestrained instantaneous 'Id High Set ' is provided to ensure rapid clearance for heavy internal faults with saturated CTs. The high set is not restrained by magnetizing inrush. A setting range 4 In -32 In (RMS values) is provided on P543 and P545.

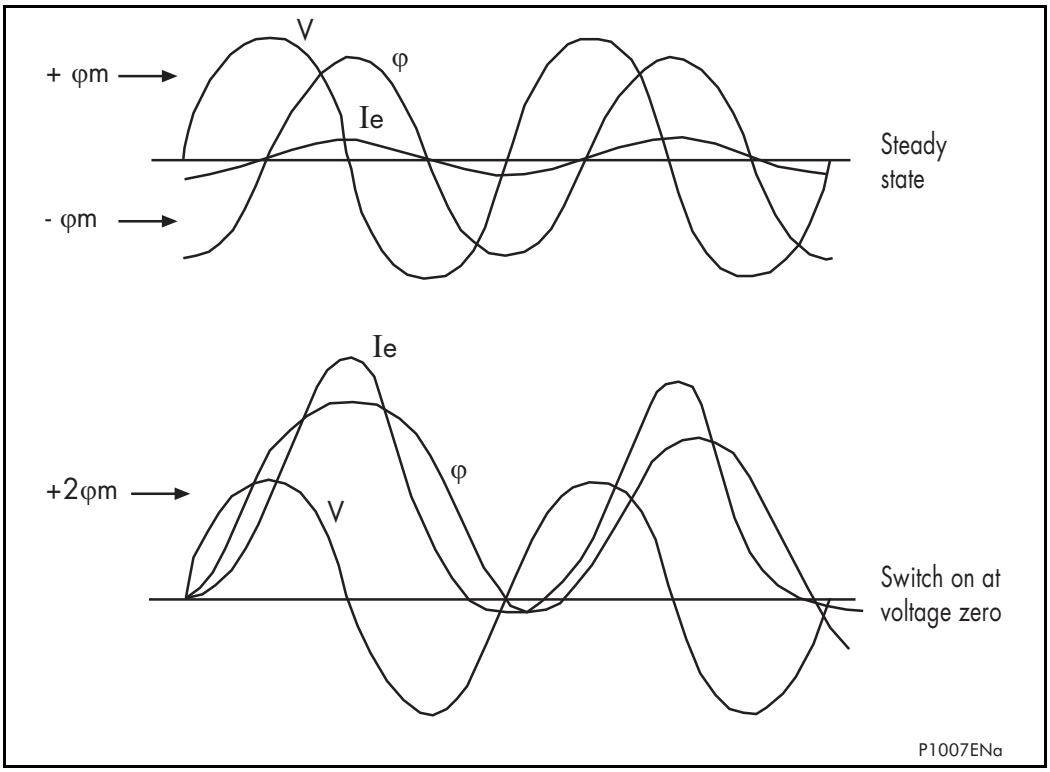


Figure 8: Magnetizing inrush waveforms

The P543 and P545 relay provides a choice between harmonic restraint and blocking by setting option, both providing stability during transformer inrush conditions.

To select second harmonic Restraint or Blocking option, set the cell [3312: Inrush Restraint] under the **GROUP 1 PHASE DIFF** menu heading to Restraint or Blocking.Second harmonic restraints or blocking provide security during transformer energization.

1.2.2.1 Second Harmonic Restraint (P543 and P545)

The magnetizing inrush current contains a high percentage of second harmonic. The P543 and P545 relays filter out this component of the waveform and use it as an additional bias quantity. The total bias used by the relay will therefore be a combination of the average load current on the line plus a multiple of the second harmonic component of the current. The multiplying factor which is used to ensure stability is controlled by the setting cell [3314: Ih(2) Multiplier] under the **GROUP 1 PHASE DIFF** menu heading provided the setting cell [3312: Inrush Restraint] is set to Restraint .

This multiplier is used in additional bias calculation as per following formula:

IF Inrush Restraint setting is set to Restraint

Additional bias = Ih(2) Multiplier * 1.414 * largest 2nd harmonic current

ELSE

Additional bias = 0

In the above equation 2nd harmonic current is derived from Fourier filtering techniques.

Where P543 and P545 relays are used and inrush restrain function is enabled, it must be ensured that this function is enabled at each end to avoid possible maloperation.

1.2.2.2 Second Harmonic Blocking (P543 and P545)

To select second harmonic blocking option, set the cell [3312: Inrush Restraint] under the **GROUP 1 PHASE DIFF** menu heading to Blocking.

Second harmonic blocking provides security during transformer energization.

For each phase, if the level of phase current is above 5% In, and if the ratio of second harmonic current, Ih(2) to fundamental in the line is above the settings at cell [3320: Ih(2) >%] then inrush conditions shall be detected which sets the appropriate phase block, to block local and remote ends.

Users have choice to apply Cross blocking or independent blocking by choosing the appropriate setting at cell [3321: Ih(2) CrossBlock] under the GROUP 1 PHASE DIFF menu heading. If **Ih(2) CrossBlock** is set to Disabled then independent blocking is used.

If independent blocking is enabled only the affected phase is blocked at all ends.If cross blocking is enabled all phases are blocked at all ends.

The following logic diagram shows the inhibiting of the differential algorithm by magnetizing inrush conditions:

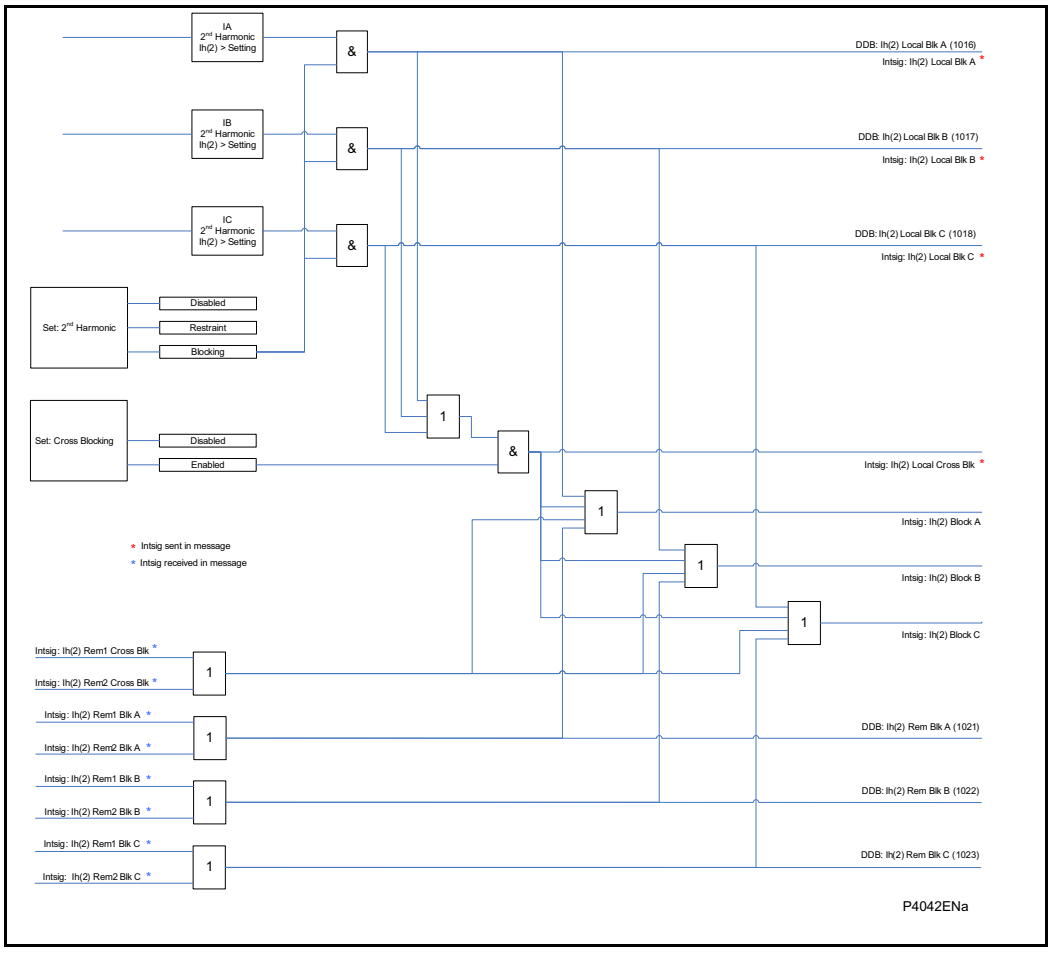


Figure 9: Second harmonic restraint and blocking logic

1.2.2.3 Fifth Harmonic Blocking (P543 and P545)

If the in-zone transformer on a protected line section is loaded with a voltage in excess of the nominal voltage, saturation effects occur. Without stabilization, these could lead to differential protection tripping. The fact that the current of the protected object under saturation conditions has a high proportion of fifth harmonic serves as the basis of stabilization.

The P543 and P545 determine the fundamental components and the fifth harmonic components from the line currents and provide fifth harmonic blocking option when the setting cell [3312: Inrush Restraint] under the **GROUP 1 PHASE DIFF** menu is set to **Blocking**.

For each phase, if the level of phase current is above 5% In, and if the ratio of fifth harmonic current ,Ih(5) to fundamental in the line is above the settings at cell [3328: Ih(5) >%] then the overfluxing conditions shall be detected which sets the appropriate phase block, to block local and remote ends.

Users have choice to apply Cross blocking or independent blocking by choosing the appropriate setting at cell [3329: Ih(5) CrossBlock] under the **GROUP 1 PHASE DIFF** menu heading. If **Ih(5) CrossBlock** is set to Disabled then independent blocking is used.

If independent blocking is enabled only the affected phase is blocked at all ends.If cross blocking is enabled all phases are blocked at all ends.

The following logic diagram shows the inhibiting of the differential algorithm by overfluxing conditions:

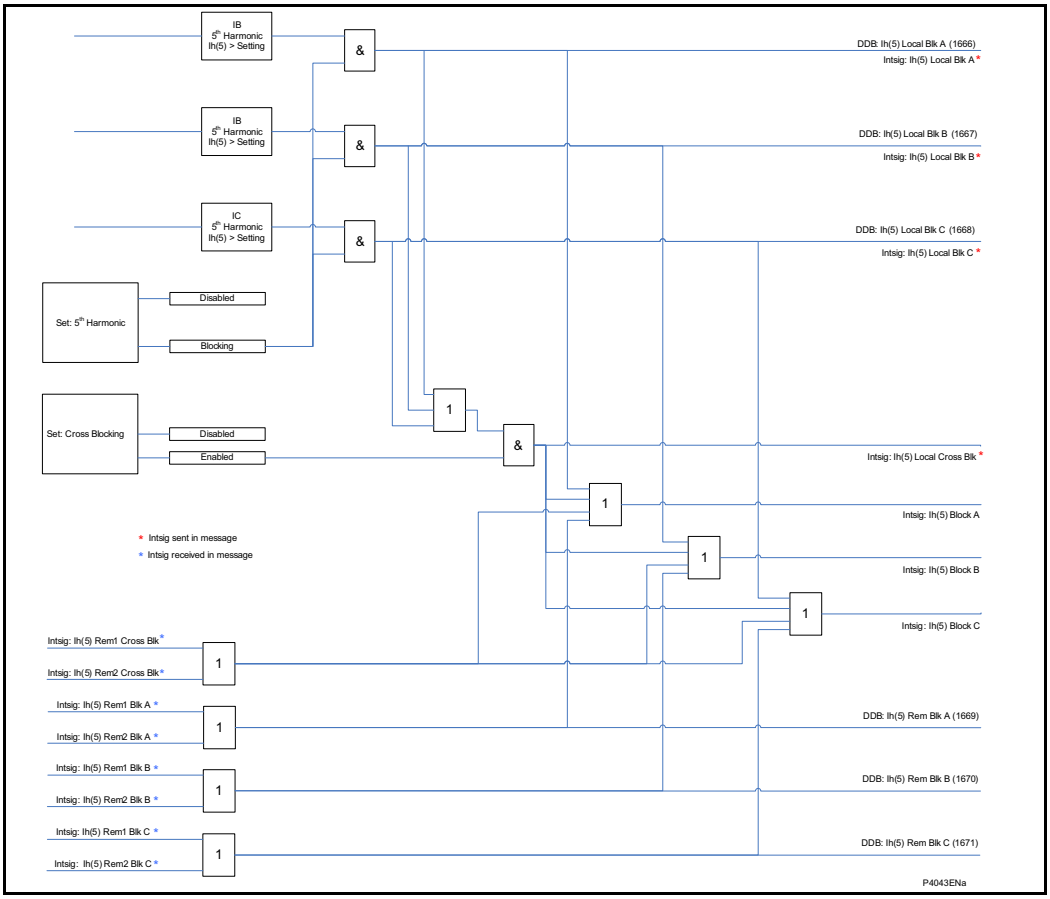


Figure 10: Fifth harmonic blocking logic

1.2.2.4 High Set Differential (P543 and P545)

When **Inrush Restraint** is set to Restraint or Blocking a high set differential protection becomes active. This unrestrained instantaneous **Id High Set** is provided to ensure rapid clearance for heavy internal faults with saturated CTs. The high set is not restrained by magnetizing inrush. A setting range 4 In -32 In (RMS values) is provided on P543 and P545.

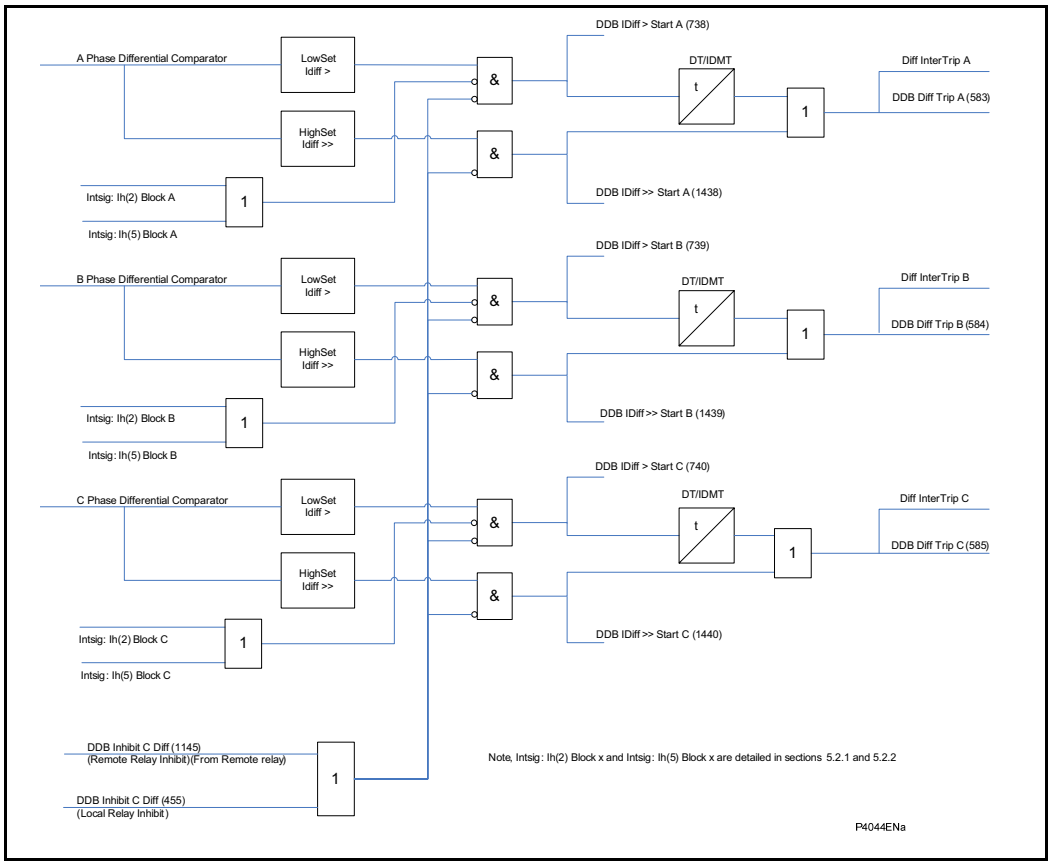


Figure 11: Highset element logic

1.6.2 Trpping Mode - Selection of Single or Three Phase Tripping

This selects whether instantaneous trips are permitted as Single pole, or will always be 3 pole. Protection elements considered as “instantaneous” are those normally set to trip with no intentional time delay, i.e.: Differential, directional earth/ground DEF aided scheme and if fitted, Zone 1 distance and distance channel aided scheme. The selection **1 and 3 pole** allows single pole tripping for single phase to ground faults. The selection **3 pole** converts all trip outputs to close Trip A, Trip B and Trip C contacts simultaneously, for three pole tripping applications.

In the case of the P544/P546, the tripping mode can be set independently for the two circuit breakers controlled.

Logic is provided to convert any double phase fault, or any evolving fault during a single pole auto-reclose cycle into a three phase trip. Two phase tripping is never permitted. This functionality is shown in Figure12 for P543/P545 and in AR Figure 63 (logic diagram supplement) for P544/P546 models.

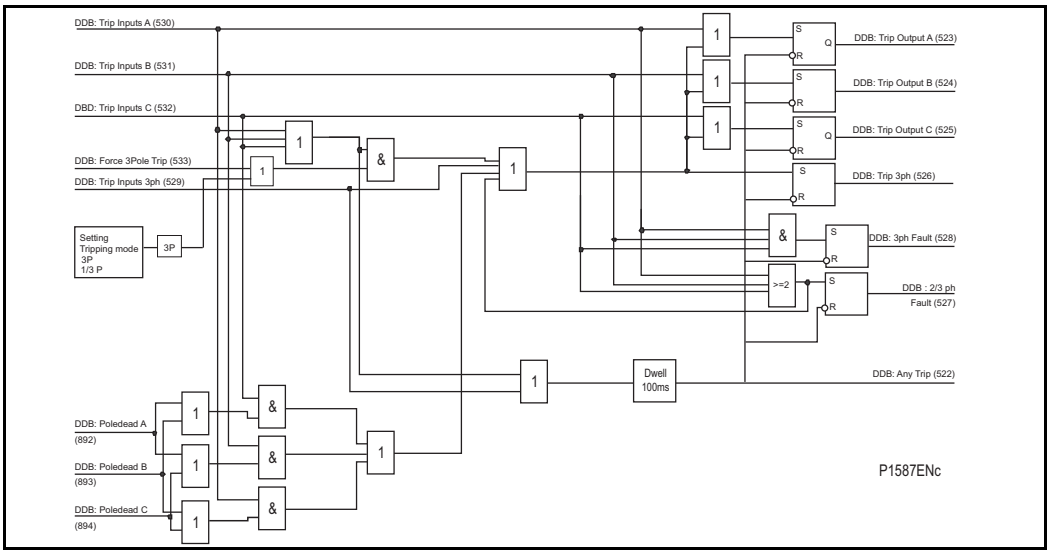


Figure 15: Trip conversion scheme logic

1.29 Earth Fault, Sensitive Earth Fault (SEF) and Restricted Earth Fault (REF) protection

The P54x relays include backup earth fault protection. Two elements are available; a derived earth fault element (where the residual current to operate the element is derived from the addition of the three line CT currents) and a sensitive earth fault element where low current settings are required. The sensitive earth fault element has a separate CT input and would normally be connected to a core balance CT. The derived and sensitive earth fault elements both have four stages of protection. The first two stages can be set either inverse time or definite time only. The third and fourth stages have a DT characteristic only. Each stage can be configured to be directional forward, directional reverse or non-directional.

> **Note:** The input CT which is designed specifically to operate at low current magnitudes is common to both the Sensitive Earth Fault (SEF) and high impedance Restricted Earth Fault (REF) protection, so these features are treated as mutually exclusive within the relay menu.

A feature also exists whereby the protection can be enabled upon failure of the differential protection communication channel (not applicable to SEF and REF Functions). Earth fault Overcurrent IN> can be set to:

- Permanently disabled
- Permanently enabled
- Enabled only in case of VT fuse/MCB failure
- Enabled only in case of protection communication channel failure
- Enabled if VT fuse/MCB or protection communication channel fail
- Enabled if VT fuse/MCB and protection communication channel fail

In addition, each stage (not for SEF/REF) may be disabled by a DDB (467,468,469 and 470) **Inhibit IN > x** (x = 1, 2, 3 or 4).

The VTS element of the relay can be selected to either block the directional element or simply remove the directional control.

The IN> and ISEF> Function Links settings have the following effect:

VTS Block - When the relevant is set to 1, operation of the Voltage Transformer Supervision (VTS) will block the stage if it directionalized. When set to 0 the stage will revert to non-directional upon operation of the VTS.

The inverse time characteristics available for the earth fault protection are the same as those for the phase overcurrent elements, but with the addition of an IDG curve characteristic.

Details of the IDG curve are provided below:

1.29.2 Restricted Earth Fault Protection (REF)

The REF protection in the P54x relays is a high impedance element which shares the same CT input as the SEF protection hence, only one of these elements may be selected.

The setting options are available under the **GROUP 1 SEF/REF PROT'N** menu.

The high impedance principle is best explained by considering a differential scheme where one CT is saturated for an external fault, as shown in Figure 60.

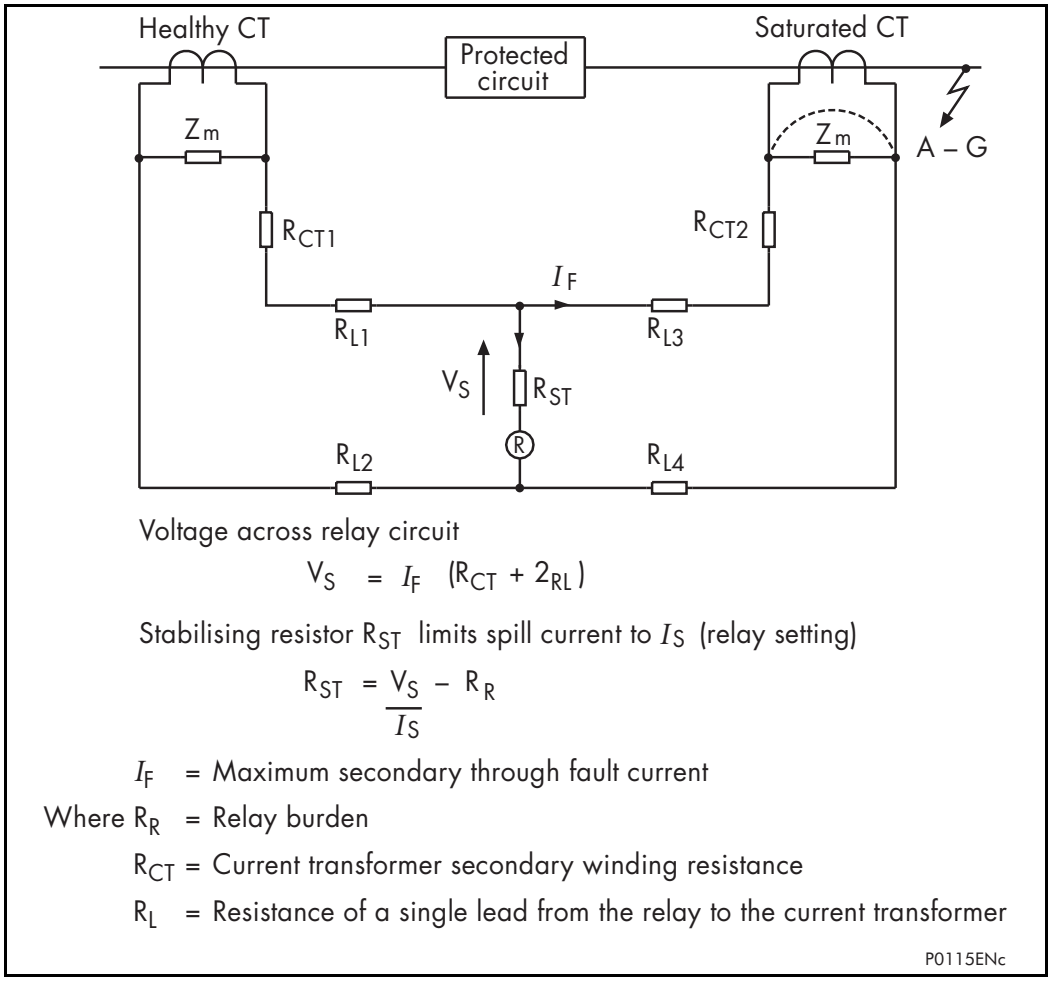


Figure 60: High impedance principle

If the relay circuit is considered to be a very high impedance, the secondary current produced by the healthy CT will flow through the saturated CT. If CT magnetizing impedance of the saturated CT is considered to be negligible, the maximum voltage across the relay circuit will be equal to the secondary fault current multiplied by the connected impedance, (R_{L3} + R_{L4} + R_{CT2}).

The relay can be made stable for this maximum applied voltage by increasing the overall impedance of the relay circuit, such that the resulting current through the relay is less than its current setting. As the impedance of the relay input alone is relatively low, a series connected external resistor is required. The value of this resistor, R_{ST}, is calculated by the formula shown in Figure 10. An additional non-linear, metrosil, may be required to limit the peak secondary circuit voltage during internal fault conditions.

To ensure that the protection will operate quickly during an internal fault, the CT's used to operate the protection must have a kneepoint voltage of at least 4 Vs.

The necessary relay connections for high impedance REF are shown in Figure 61.

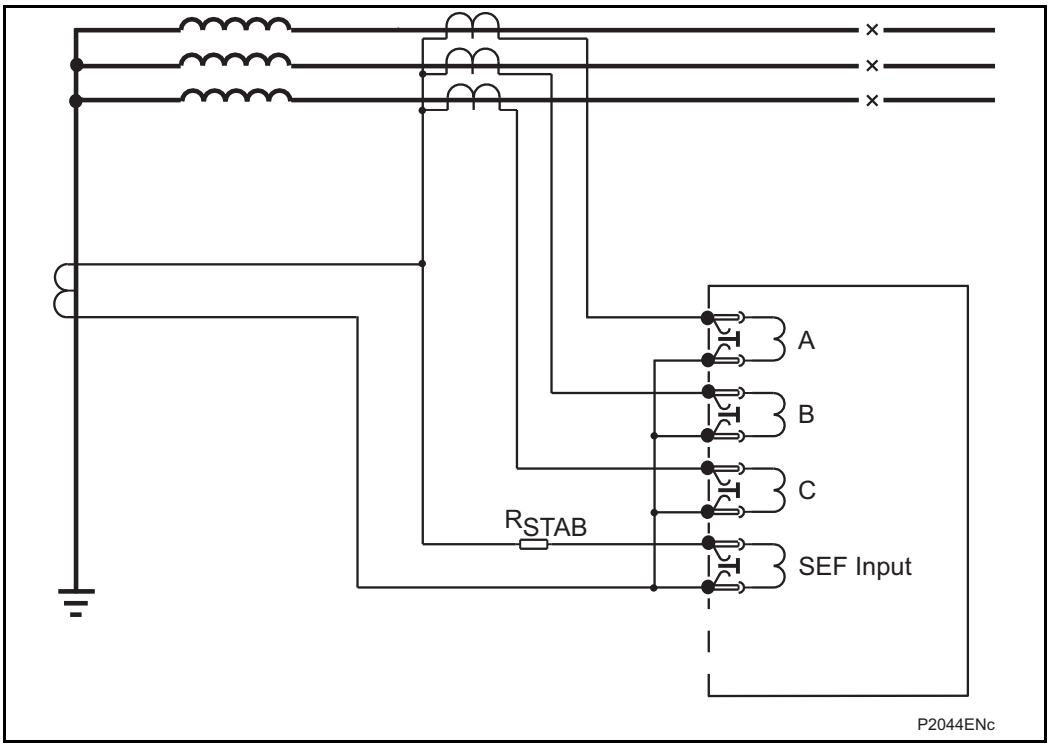


Figure 61: High impedance REF relay/CT connections

1.32 Undervoltage Protection

Both the under and overvoltage protection functions can be found in the relay menu **Volt Protection**. The measuring mode (ph-N or ph-ph) and operating mode (single phase or 3 phase) for both stages are independently settable.

Stage 1 may be selected as either IDMT, DT or Disabled, within the **V<1 function** cell. Stage 2 is DT only and is enabled/disabled in the **V<2 status** cell.

Two stages are included to provide both alarm and trip stages, where required. Alternatively, different time settings may be required depending upon the severity of the voltage dip.

Outputs are available for single or three phase conditions via the **V<Operate Mode** cell.

When the protected feeder is de-energized, or the circuit breaker is opened, an undervoltage condition would be detected. Therefore, the **V<Polehead Inh** cell is included for each of the two stages to block the undervoltage protection from operating for this condition. If the cell is enabled, the relevant stage will become inhibited by the inbuilt pole dead logic within the relay. This logic produces an output when it detects either an open circuit breaker via auxiliary contacts feeding the relay opto inputs or it detects a combination of both undercurrent and undervoltage on any one phase.

The IDMT characteristic available on the first stage is defined by the following formula:

t = K/(1 - M)

Where:

K = Time multiplier setting

t = Operating time in seconds

M = Measured voltage / relay setting voltage (V< Voltage Set)

The logic diagram for the first stage undervoltage function is shown in Figure 67.

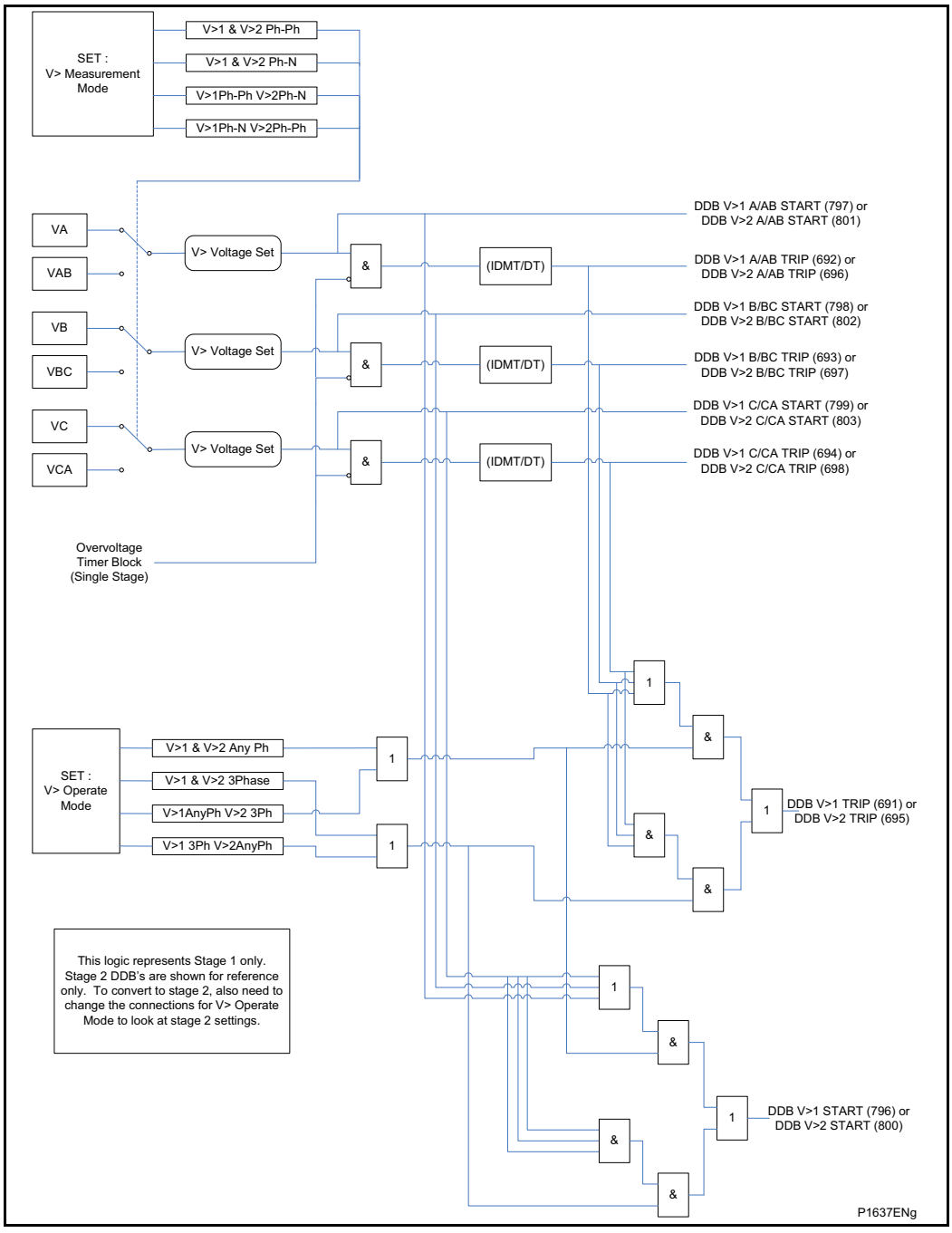


Figure 67: Undervoltage - single and three phase tripping mode (single stage)

Note: Undervoltage protection is phase segregated, but the operation of any phase is mapped to 3 phase tripping in the default PSL.

Each stage of Undervoltage protection may be disabled by a DDB (471 or 472) Inhibit Vx<.

1.33 Overvoltage Protection

Both the over and undervoltage protection functions can be found in the relay menu Volt Protection. The measuring mode (ph-N or ph-ph) and operating mode (single phase or 3 phase) for both stages are independently settable.

The IDMT characteristic available on the first stage is defined by the following formula:

t = K/(M - 1)

Where:

K = Time multiplier setting

t = Operating time in seconds

M = Measured voltage/relay setting voltage (V> Voltage Set)

The logic diagram for the first stage overvoltage function is shown in Figure 68.

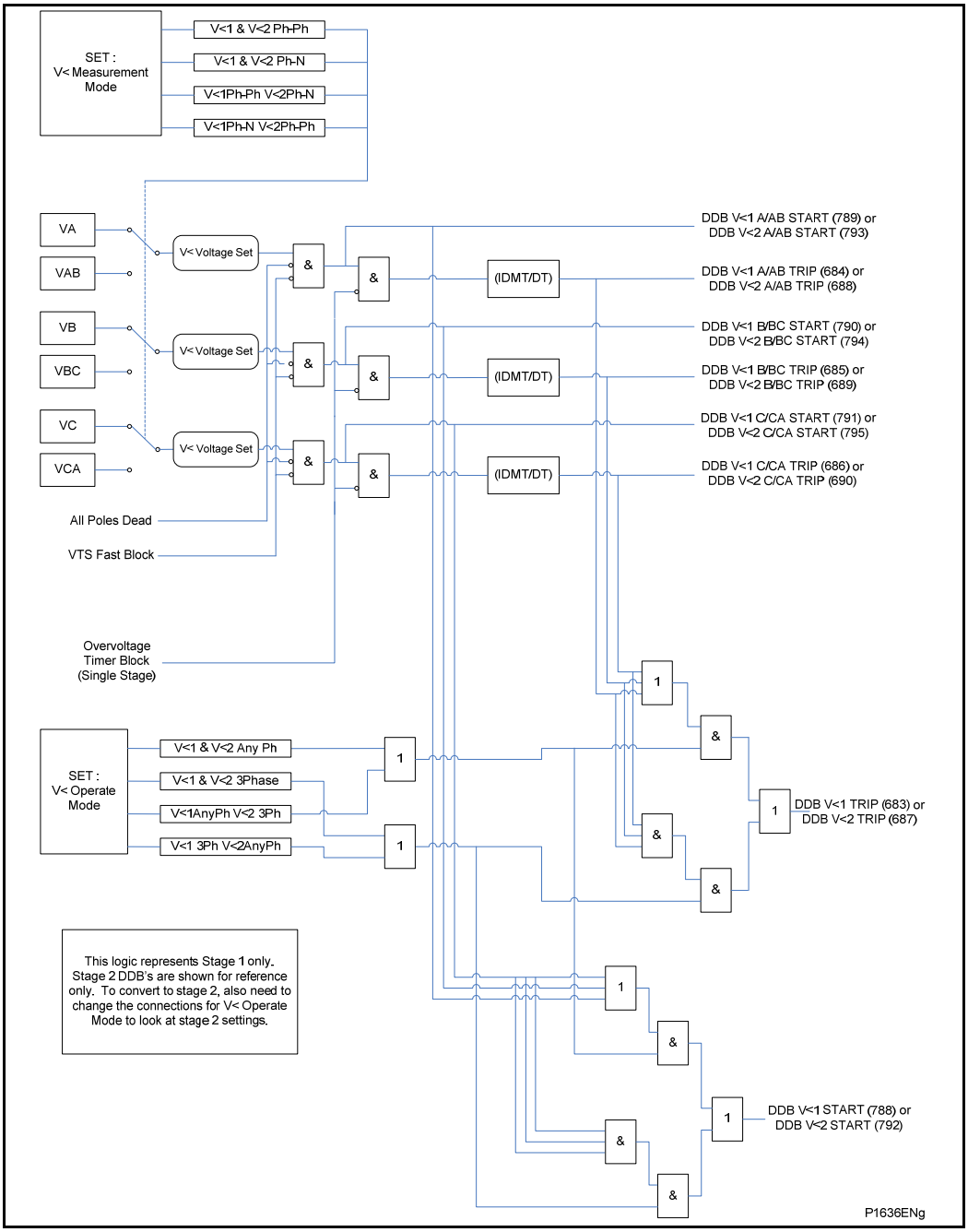


Figure 68: Overvoltage - single and three phase tripping mode (single stage)

Note: Phase overvoltage protection is phase segregated, but the operation of any phase is mapped to 3 phase tripping in the default PSL.

Each stage of Overvoltage protection may be disabled by a DDB (473 or 474) Inhibit Vx> (x = 1, 2).

1.35.1 Reset Mechanisms for Breaker Fail Timers

It is common practice to use low set undercurrent elements in protection relays to indicate that circuit breaker poles have interrupted the fault or load current, as required. This covers the following situations:

- Where circuit breaker auxiliary contacts are defective, or cannot be relied upon to definitely indicate that the breaker has tripped.
- Where a circuit breaker has started to open but has become jammed. This may result in continued arcing at the primary contacts, with an additional arcing resistance in the fault current path. Should this resistance severely limit fault current, the initiating protection element may reset. Therefore, reset of the element may not give a reliable indication that the circuit breaker has opened fully.

For any protection function requiring current to operate, the relay uses operation of undercurrent elements (I<) to detect that the necessary circuit breaker poles have tripped and reset the CB fail timers. However, the undercurrent elements may not be reliable methods of resetting circuit breaker fail in all applications. For example:

- Where non-current operated protection, such as under/overvoltage derives measurements from a line connected voltage transformer. Here, I< only gives a reliable reset method if the protected circuit would always have load current flowing. Detecting drop-off of the initiating protection element might be a more reliable method.
- Similarly, where the distance scheme includes Weak Infeed ("WI") trip logic, the reset of the WI trip condition should be used in addition to the undercurrent check. Set: 'WI Prot Reset' = Enabled.
- Where non-current operated protection, such as under/overvoltage derives measurements from a busbar connected voltage transformer. Again using I< would rely upon the feeder normally being loaded. Also, tripping the circuit breaker may not remove the initiating condition from the busbar, and hence drop-off of the protection element may not occur. In such cases, the position of the circuit breaker auxiliary contacts may give the best reset method.

Resetting of the CBF is possible from a breaker open indication (from the relay's pole dead logic) or from a protection reset. In these cases resetting is only allowed provided the undercurrent elements have also reset. The resetting options are summarized in the following table.

Initiation (menu selectable)	CB fail timer reset mechanism
Current based protection (e.g. 50/51/46/21/67)	The resetting mechanism is fixed [IA< operates] & [IB< operates] & [IC< operates] & [IN< operates]
Non-current based protection (e.g. 27/59)	Three options are available. The user can Select from the following options: [All I< and IN< elements operate] [Protection element reset] AND [All I< and N< elements operate] CB open (all 3 poles) AND [All I< and IN< elements operate]
External protection	Three options are available: The user can select any or all of the options. [All I< and IN< elements operate] [External trip reset] AND [All I< and IN< elements operate] CB open (all 3 poles) AND [All I< and IN< elements operate]

The complete breaker fail logic is illustrated in Figure 70, Figure 71 and Figure 72.

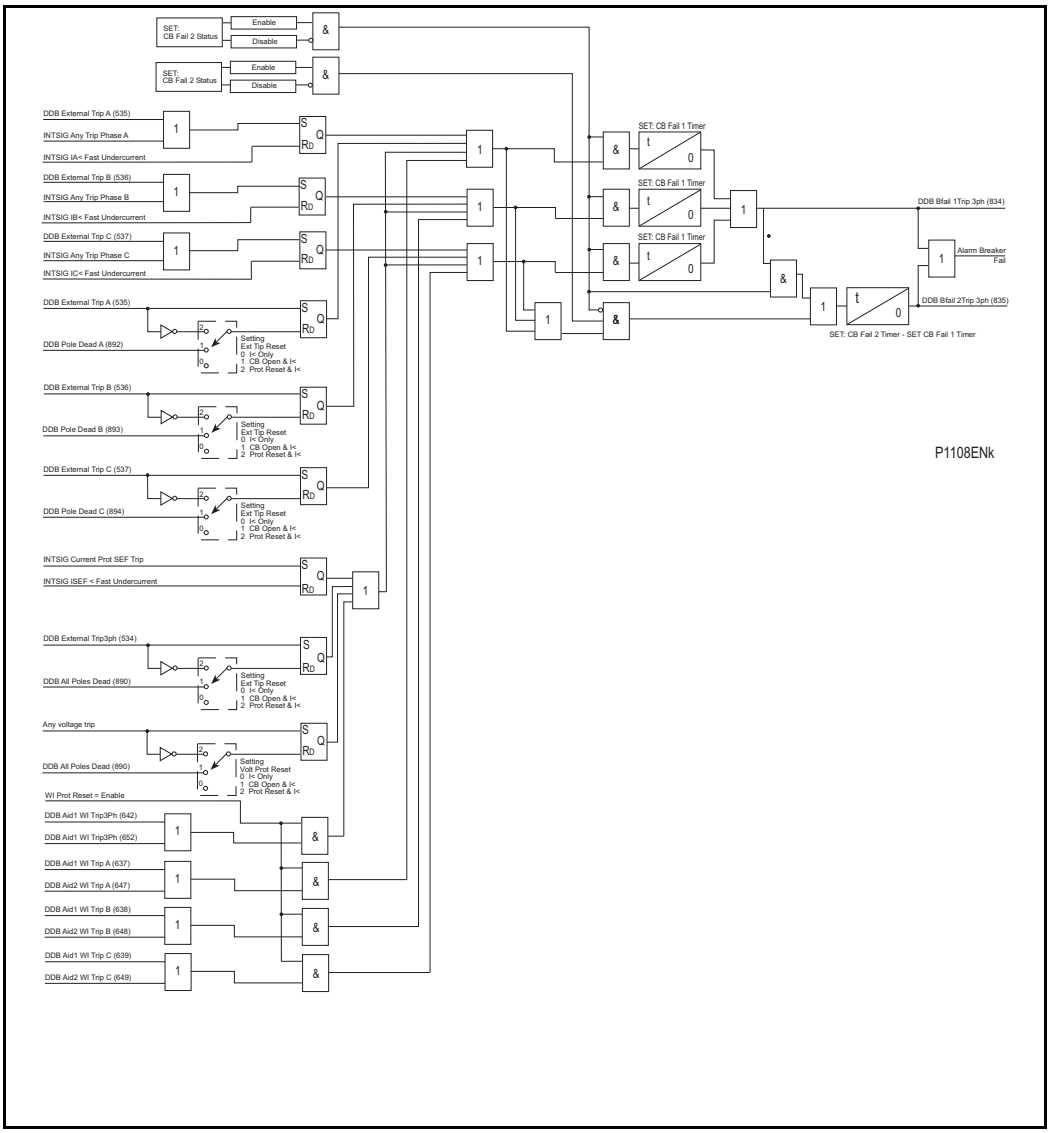


Figure 70: CB failure for P543 and P545 models

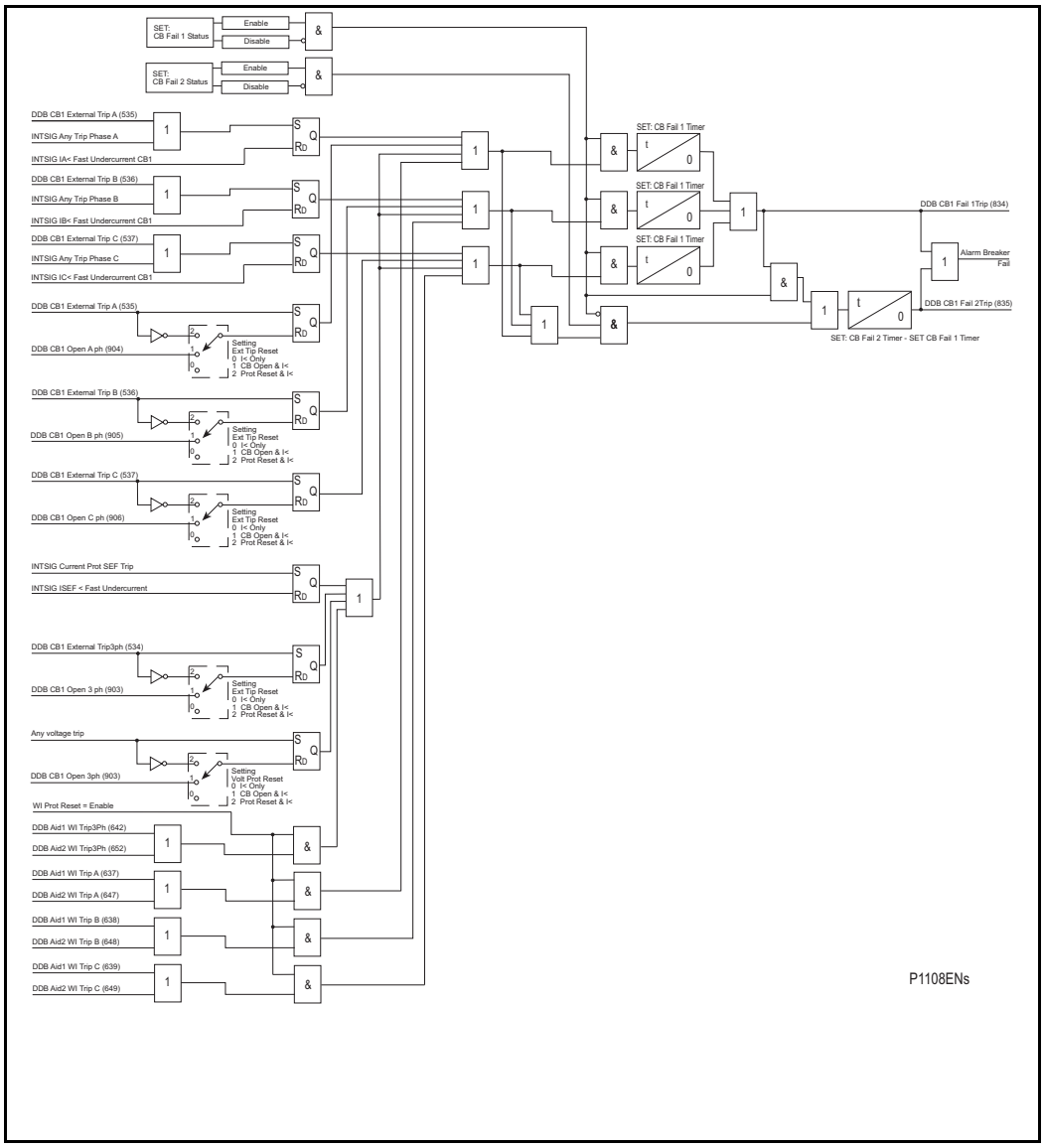


Figure 71: CB1 failure logic for P544 and P546 models

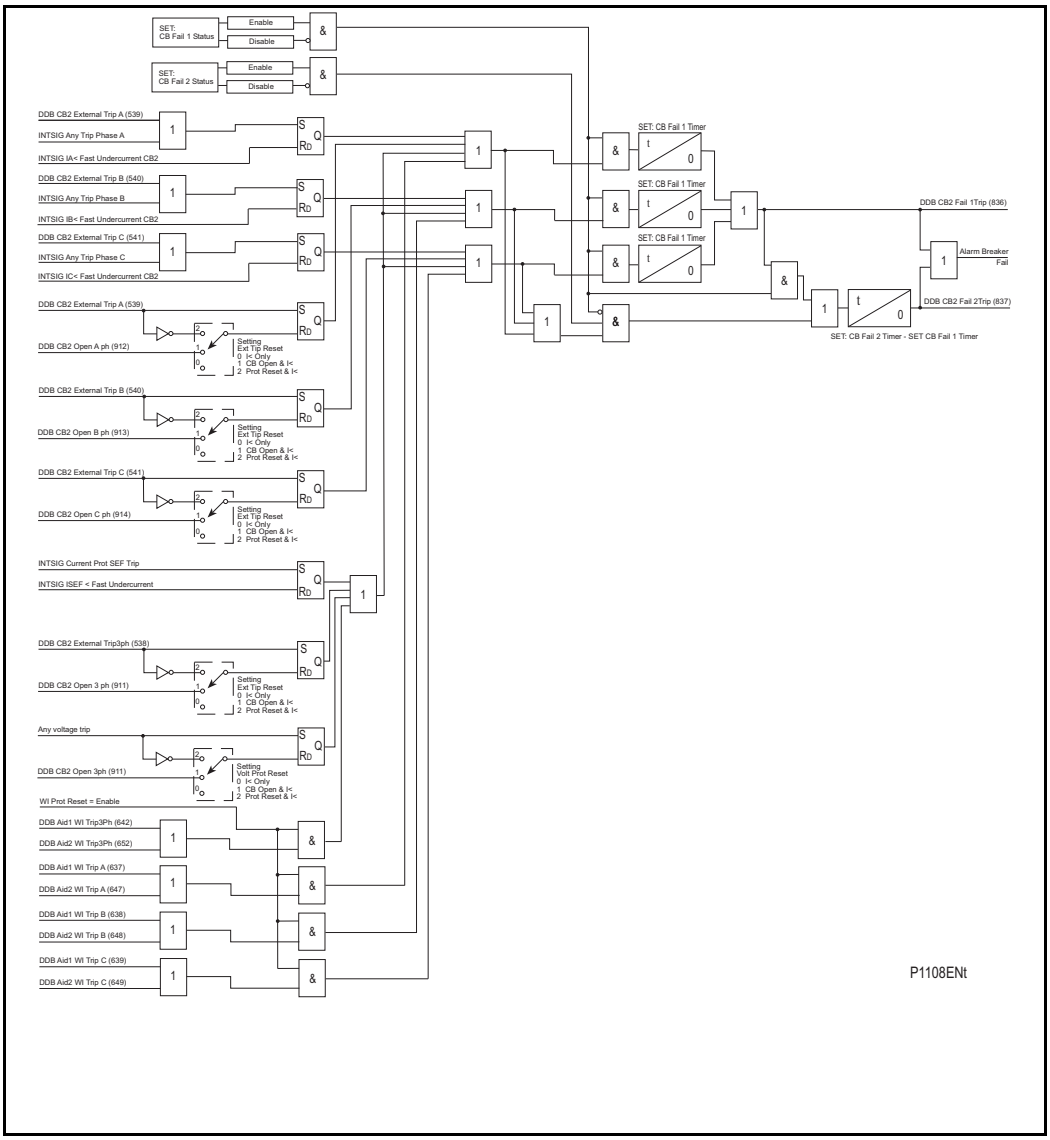


Figure 72: CB2 failure logic for P544 and P546 models

2.1.6 Switched Communication Networks

The P54x relays make use of digital communication signaling channels for the differential protection. For correct operation of this protection element, it is essential that the integrity of this link is continuously checked. For P54x relays, when GPS is not used it is also a requirement of this link that 'go' (tp1) and 'return' (tp2) times are similar (a difference of up to 1 ms can be tolerated). Times greater than this can result in relay instability.

Where switched communications networks are used, it is possible that during switching, a transient time period may exist with different 'go' and 'return' times. All P54x relays include a facility to ensure protection stability during this transient period.

One of the checks performed on the communications link is a check on the calculated propagation delay for each data message. During normal operation the difference in calculated time should be minimal (possible delays being introduced by multiplexers or other intermediary communication equipment). If successive calculated propagation delay times exceed a user settable value (250 – 1000 μs). The P54x raise a comm delay alarm and initiate a change in relay setting for a short time period (Char Mod Time setting) to overcome any switching delay. This change in setting is shown in Figure 79 whereby the relay bias setting, k1, is increased to 200%. This characteristic provides stability for all load conditions and will still allow tripping for most internal fault conditions.

Figure 73 shows a possible scenario for a switched network. Initially the P54x relays are communicating via path 1. The go and return times for this path are 2 ms and hence the calculated propagation delay is (2 + 2)/2 = 2 ms. When the channel is switched to path 2, a small time period exists where the P54x's could be sending messages via path 1 and returning via path 2.

The calculated propagation delay will now be (2 + 5)/2 = 3.5 ms. The resultant 1.5 ms error at each line end may cause the relay to maloperate due to incorrect time alignment of current vectors (see section 1.1.1.1). After a short delay, both 'go' and 'return' paths will follow route 2 and the calculated propagation delay will be (5 + 5)/2 = 5 ms. The relay will now be stable, as correct current vector time alignment exists at each line end.

The Char Mod timer is started when a change in propagation delay is detected. Any subsequent change during this period will cause the timer to restart. In the above example the timer will start for the first change (2 to 3.5 ms). The second change (3.5 ms to 5 ms) will cause the timer to restart, therefore allowing for multiple switching between communication paths.

A change in propagation delay may result in a temporary failure of the protection communications channel. If this occurs, the propagation delay change may not be detected by the relay. To overcome this problem, the Char Mod Timer is re-started when the channel recovers from a protection communications channel failure if the Char Mod Timer was running when the channel failure occurred.

When **Char Mod Ex** is enabled and if the **Char Mod Time** has started then the **Char Mod Ex Timer** runs. If at the end of this timer and until **Char Mod Time** has expired, the bias current is above 5% In, and differential current is below 10% of bias current on all phases, then the **Char Mod Time** will reset and the characteristic will return to normal. If these conditions are not met, then the characteristic remains increased for the duration of the **Char Mod Time**. **Char Mod Ex Timer** should be set greater than the minimum switching delay expected, and less than **Char Mod Time**.

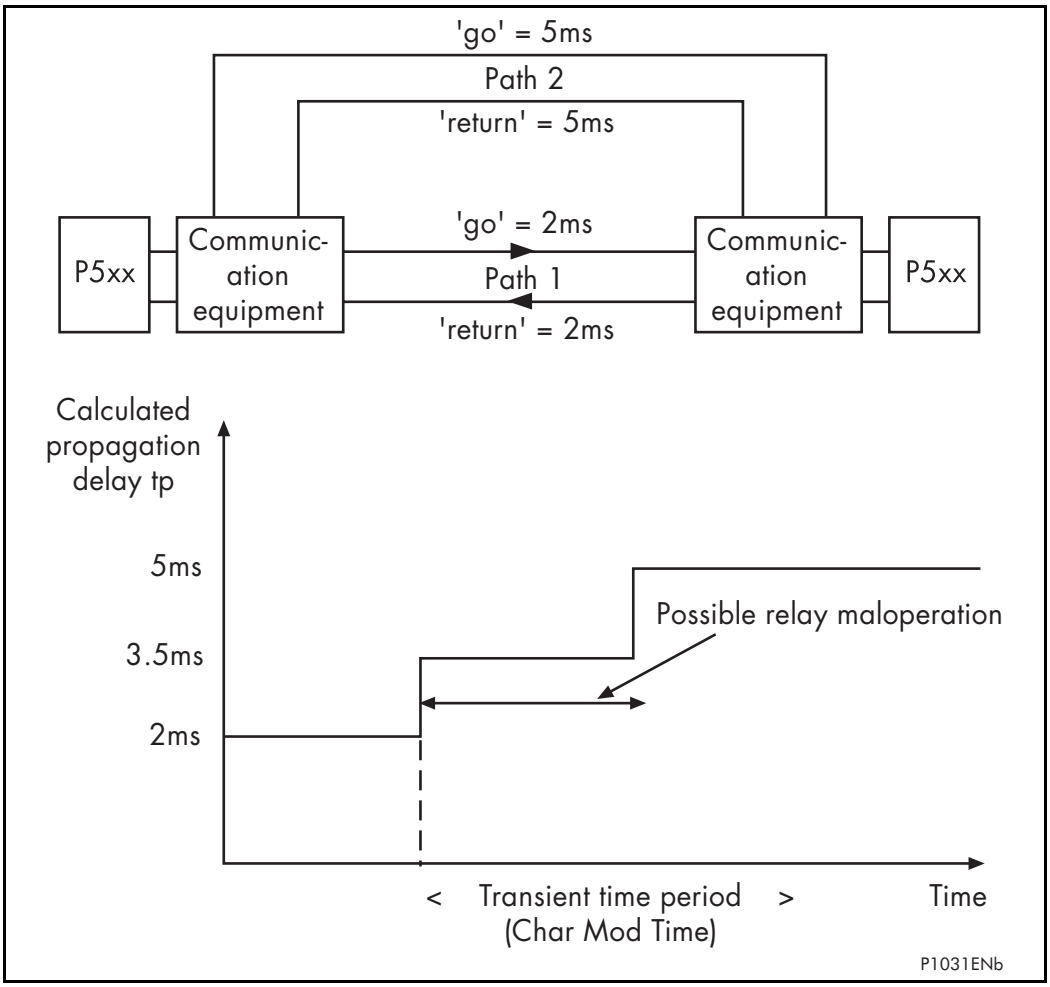


Figure 78: Switched communication network

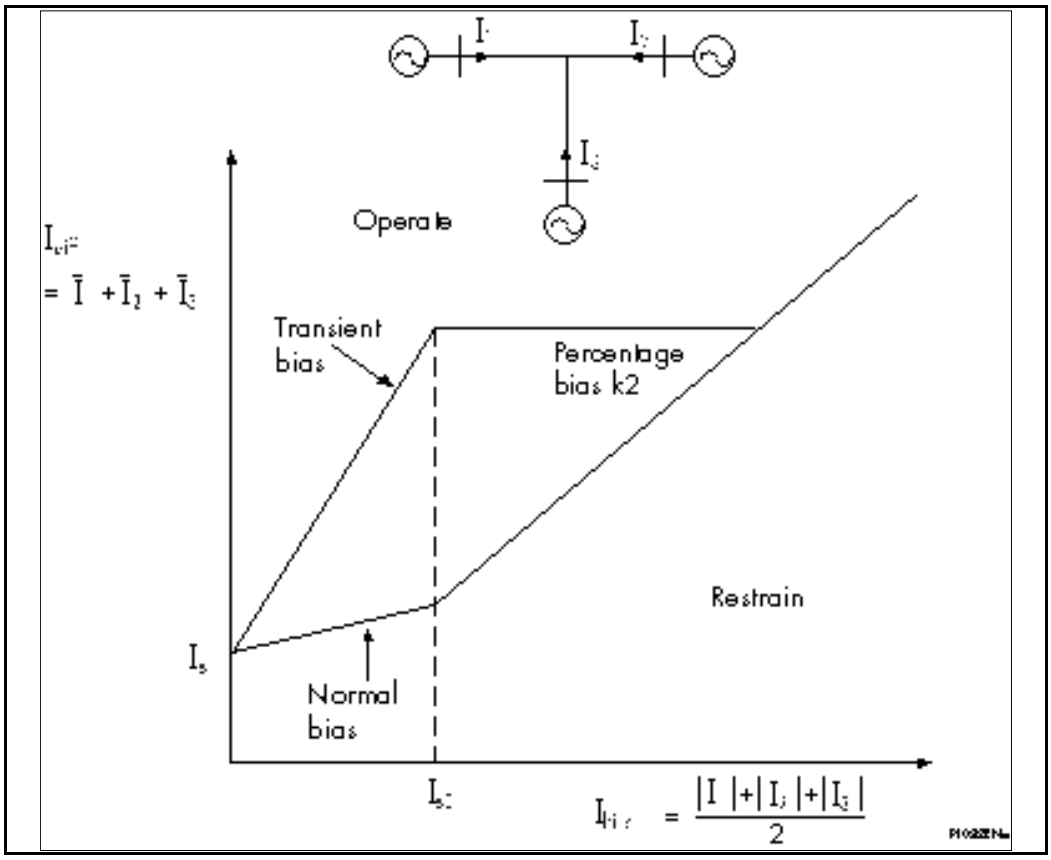


Figure 79: Transient bias characteristic

2.1.13 Unconditioned 2 Wire Pilot Communications for Distances Greater than 1.2 km

When communicating via a pair of unconditioned pilots for distances greater than 1.2 km, a leased line or baseband modem can be used. For maximum security and performance it is strongly recommended that a screened twisted pair of 0.5 mm (or greater) conductors are used. When choosing between leased line or baseband modems the following aspects should be considered:

- Leased line modems have a maximum transmission speed of 19.2 kbit/sec., whereas baseband modems can transmit at 64 kbit/sec.
- Baseband modems have longer re-training times, typically between 10 to 60 s. If the connection between is temporarily lost, the protection communications will be interrupted until the re-training period has elapsed.
- Since baseband modems use synchronous communication protocols, there is typically a 20% performance gain over leased line modems that use asynchronous protocols.

Modems tested:

- Keymile LineRunner DTM modem with G703 interface.

Type	Max distance (km)	Recommended data rate (kbit/sec)	Typical re-train time (seconds)
"Campus" 1092A (Obsolete)	17.2	64	10
LineRunner DTM	19.8	64	44

2.2 InterMiCOM

2.2.1 Protection Signaling

In order to achieve fast fault clearance and correct discrimination for faults anywhere within a high voltage power network, it is necessary to signal between the points at which protection relays are connected. Two distinct types of protection signaling can be identified:

Unit protection schemes:

In these schemes the signaling channel is used to convey analog data representative of the power system between relays. Typically current magnitude and/or phase information is communicated between line ends to enable a unit protection scheme to be implemented. These unit protection schemes are not covered by InterMiCOM or InterMiCOM^{64}. Instead, the MiCOM P52x and P54x range of current differential and phase comparison relays are available for unit applications.

Teleprotection - channel aided schemes:

In channel-aided schemes the signaling channel is used to convey simple ON/OFF commands from a local protection device to a remote device to provide some additional information to be used in the protection scheme operation. The commands can be used to accelerate in-zone fault clearance and/or prevent out-of-zone tripping.

The InterMiCOM application is an effective replacement to the traditional hardwired logic and communication schemes used by protection relays for such teleprotection signaling.

The MiCOM Px4x series products have a grouping of internal digital signals known as the digital data bus, DDB, that are used to implement the protection scheme logic. A number of these DDB signals are reserved as inputs and outputs for the InterMiCOM application. These are mapped using the programmable scheme logic (PSL) support tool. The InterMiCOM application provides a means of transferring the status of these mapped DDB signals between the protection relays using dedicated full-duplex communications channels.

2.2.2 InterMiCOM Variants

There are 2 different types of integrated InterMiCOM teleprotection available in the MiCOM P54x relays:

- An optical fiber implementation, InterMiCOM^{64} - designed, primarily, to work over fiber optic and multiplexed digital communications channels with data rates of 56/64 kbit/s. A total of sixteen InterMiCOM^{64} commands (16 inputs and 16 outputs) are available in the P54x. These are arranged as two groups of 8 bits each, and are referred to as Channel 1 and Channel 2. Three InterMiCOM^{64} scheme arrangements are possible:
- Two-terminal with a single communications link
- Two-terminal with a dual redundant communications link (sometimes referred to as **hot standby**)
- Three terminal (or triangulated) scheme
- An electrical implementation of InterMiCOM, realised over an EIA(RS)232 medium typically for MODEM applications and referred to as MODEM InterMiCOM for ease of differentiation with InterMiCOM^{64}. MODEM InterMiCOM supports two-terminal applications with a single communications channel. Eight MODEM InterMiCOM commands can be transmitted between the line ends.

Provided the correct hardware options have been specified, it is possible to configure the P54x to operate using either InterMiCOM^{64} or MODEM InterMiCOM or both. The selection is made under the CONFIGURATION column of the menu software.

2.2.3 InterMiCOM Features

The different requirements of applications that use teleprotection signaling for direct acting, permissive, or blocking schemes are all catered for by InterMiCOM.

Communications are supervised and alarms and signal defaults can be defined to give controlled actions in the event of communications signals being distorted or unavailable.

Communications statistics and loopback features are available to help with commissioning and testing purposes.

Both, InterMiCOM[64] and MODEM InterMiCOM teleprotection provide the ideal means to configure the schemes in the MiCO*Mho* P443/P446 relay. The selection between the two will generally depend on communications media availability, system configuration, distances, cost issues and utility practice.

2.2.4 Definition of Teleprotection Commands

Three generic types of teleprotection command can be defined. These are Intertripping, Permissive signaling, and Blocking. All teleprotection signals are initiated in a transmitting relay but, according to the application, the receiving relay may condition the signal according to the scheme requirements:

Intertripping — In intertripping (also called direct or transfer tripping) applications, the command is not supervised at the receiving end by any protection relay and its receipt causes direct circuit breaker operation. Since no checking of the received signal by another protection element is performed, it is essential that any noise on the signaling channel is not interpreted as being a valid signal when the command isn't being transmitted. For an intertripping scheme, therefore, the primary requirement of the signaling channel is security.

Permissive — In permissive applications, tripping is only permitted when the command coincides with a protection operation at the receiving end. Since the receiver applies a second independent check before tripping, the signaling channel for a permissive scheme does not have to be quite as secure as for an intertripping scheme, but it may need to be faster.

Blocking — In blocking applications, tripping occurs when a protection element picks up in a receiving relay whilst no signal is received from a remote relay. In such schemes, when the command is received, the protection element is blocked even if a protection element picks up. Since the signal is used to prevent tripping, it is a requirement that the signal should be available whenever possible, and that it should be received as quickly as possible. The requirements of a blocking channel are, therefore, to be fast and to be dependable.

The requirements for the three channel types are represented pictorially in Figure 81.

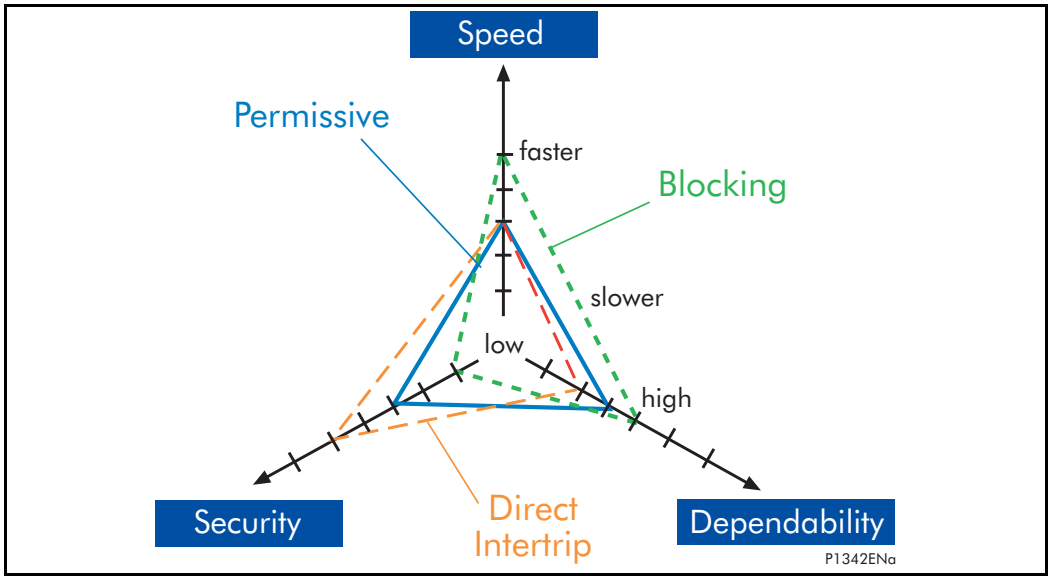


Figure 81: Pictorial comparison of operating modes

This diagram shows that a blocking signal should be fast and dependable; a direct intertrip signal should be very secure; and a permissive signal is an intermediate compromise of speed, security and dependability.

In MODEM InterMiCOM applications, selected signaling bits within each message can be conditioned to provide optimal characteristics for each type of the three teleprotection command types.

In InterMiCOM^{64} applications, the framing and error checking of a single command message is sufficient to meet the security of a permissive application, whilst the speed is sufficiently fast to meet the needs of a blocking scheme. Accordingly in InterMiCOM^{64} applications, there is no differentiation between blocking commands or permissive commands, so that only signals being used for direct intertripping with higher security requirements need to be differentiated from those in permissive (or blocking) schemes.

2.3 MODEM InterMiCOM, EIA(RS)232 InterMiCOM or Copper InterMiCOM

2.3.1 Communications Media

MODEM InterMiCOM is capable of transferring up to eight commands over one communication channel. Due to recent expansions in communication networks, most signaling channels are now digital schemes utilizing multiplexed communications links and for this reason, MODEM InterMiCOM provides a standard EIA(RS)232 output using digital signaling techniques. This digital signal can then be converted using suitable devices to a range of different communications media as required. The EIA(RS)232 output may alternatively be connected to MODEMs for use over analogue links.

Regardless of whether analogue or digital systems are being used, all the requirements of teleprotection commands are described by an international standard, IEC60834-1:1999, and MODEM InterMiCOM is compliant with the essential requirements of this standard. This standard describes the speed requirements of the commands as well as the security (defined in terms of probability of unwanted commands being received) and dependability (defined in terms of the probability of missing commands).

2.3.2 General Features and Implementation

InterMiCOM provides eight commands over a single communications link, with the mode of operation of each command being individually selectable within the **IM# Cmd Type** cell. **Blocking** mode provides the fastest signaling speed (available on commands 1 - 4), **Direct Intertrip** mode provides the most secure signaling (available on commands 1 - 8) and **Permissive** mode provides secure, dependable signaling (available on commands 5 - 8). Each command can also be disabled so that it has no effect in the logic of the relay.

Since many applications involve commands being sent over a multiplexed communications channel, it is necessary to ensure that only data from the correct relay is used. The relays in the scheme must be programmed with a unique pair of addresses that correspond with each other in the **Source Address** and **Receive Address** cells. For example, at the local end relay, if the **Source Address** is set to 1, the **Receive Address** at the remote end relay must also be set to 1. Similarly, if the remote end relay has a **Source Address** set to 2, the **Receive Address** at the local end must also be set to 2. The two pairs of addresses should be set to be different in any scheme to avoid the possibility of incorrect operation during inadvertent loopback connections, and any schemes sharing the same communications services should be set to have different address pairs in order to avoid any problems caused by inadvertent cross-channel connections.

Noise on the communications should not be interpreted as valid commands by the relay. For this reason, InterMiCOM uses a combination of unique pair addressing described above, basic signal format checking and an 8-bit Cyclic Redundancy Check (CRC) according to the security requirements of the commands. The CRC calculation is performed at both the sending and receiving end relays for each message and both must match in order to assure the security of the **Direct Intertrip** commands.

An alarm is provided if noise on the communications channel becomes excessive.

During periods of excessive noise, it is possible that the synchronization of the message structure will be lost and accurate decoding of the messages may not be possible. Predictable operation of InterMiCOM is assured during such noisy periods by means of the **IM# FallBackMode** cell. The status of the last received valid command can be maintained until a new valid message is received by setting the **IM# FallBackMode** cell to **Latched**. Alternatively, a known fallback state can be assigned to the command by setting the **IM# FallBackMode** cell to **Default**. In this latter case, the time period between communication disruption and the default state being restored will need to be set in the **IM# FrameSynTim** cell and the default value will need to be set in **IM# DefaultValue** cell. Upon subsequent receipt of a valid message, all the timer periods will be reset and the new valid command states will be used.

If there is a total communications failure, the relay will use the fallback (failsafe) strategy as described above. Total failure of the channel is considered when no message data is received for four power system cycles or if there is a loss of the DCD line.

2.3.3 EIA(RS)232 Physical Connections

MODEM InterMiCOM on the Px4x relays is implemented using a 9-pin **D** type female connector (labeled SK5) located at the bottom of the Second Rear communication board. This connector on the Px40 relay is wired in DTE (Data Terminating Equipment) mode, as indicated below:

Pin	Acronym	InterMiCOM Usage
1	DCD	**Data Carrier Detect** is only used when connecting to modems otherwise this should be tied high by connecting to terminal 4
2	RxD	**Receive Data**
3	TxD	**Transmit Data**
4	DTR	**Data Terminal Ready** is permanently tied high by the hardware since InterMiCOM requires a permanently open communication channel
5	GND	**Signal Ground**
6	Not used	-
7	RTS	**Ready To Send** is permanently tied high by the hardware since InterMiCOM requires a permanently open communication channel
8	Not used	-
9	Not used	-

Dependant upon whether a direct or modem connection between the two relays in the scheme is being used, the required pin connections are described as follows:

2.3.4 Direct Connection

EIA(RS)232 is only suitable for short transmission distances due to the signaling levels used and the connection shown below is limited to less than 15 m. This limit may be overcome by introducing suitable signal converters as described in the following sections:

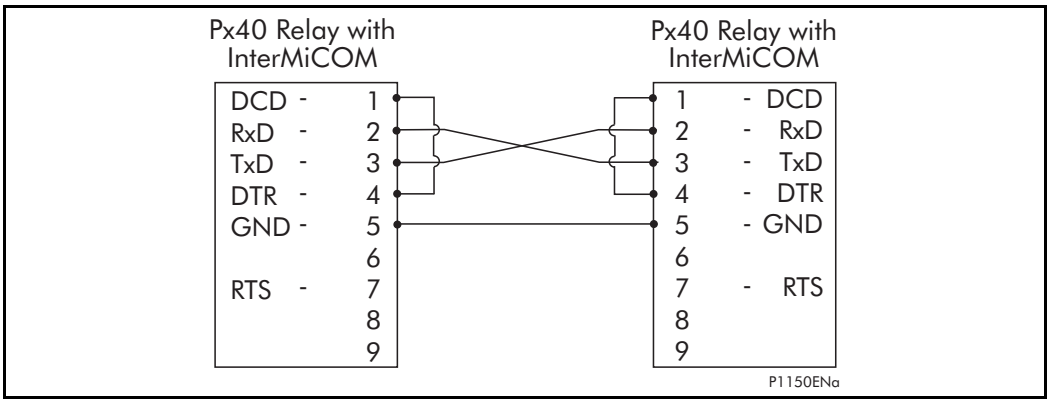


Figure 82: Direct connection within the local substation

The connection configuration shown in Figure 82 should also be used when connecting to equipment that does not implement control the DCD line.

2.3.5 EIA(RS)232 Modem Connection

To achieve longer distance communication, modems may be used, in which the case the following connections should be made.

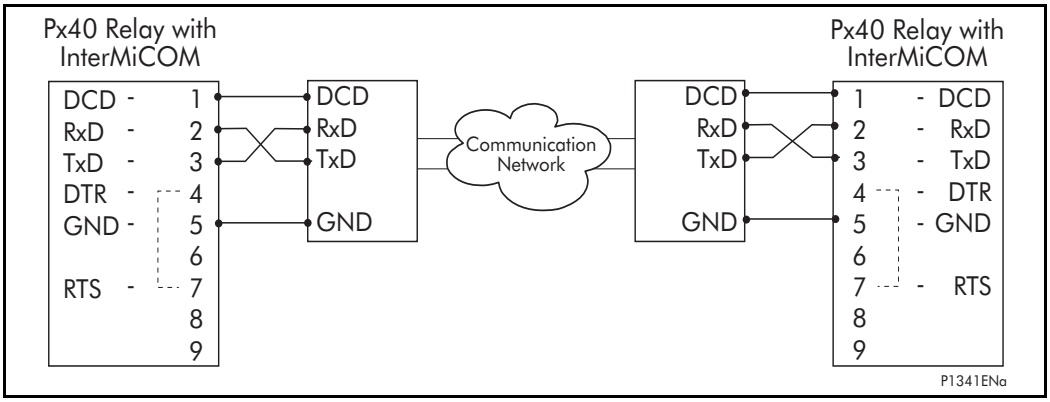


Figure 83: InterMiCOM teleprotection via a MODEM link

This type of connection should be used when connecting to multiplexers which provide an EIA(RS)232 channel with the ability to control the DCD line. With this type of connection it should be noted that the maximum distance between the Px40 relay and the modem should not exceed 15 m, and that a baud rate suitable for the communications path used should be selected.

2.3.6 RS422 Connection

An RS232 to RS422 converter such as Schneider Electric CK212 may be employed to enable MODEM InterMiCOM to be applied if 4-wire pilots are available for signaling as shown in the example below.

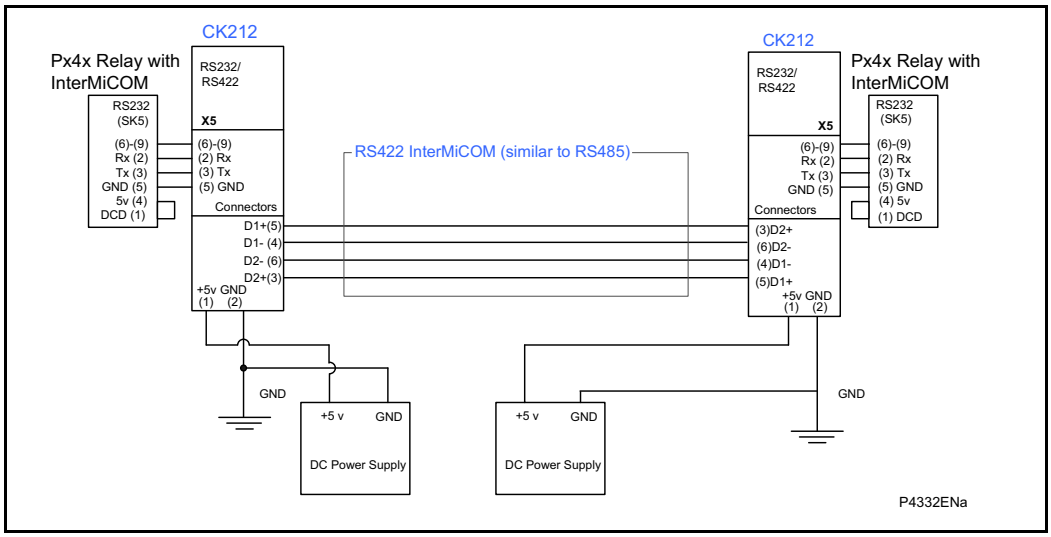


Figure 84: MODEM InterMiCOM teleprotection via a RS422 protocol

Using an appropriate converter, pilots of up to 1.2km in length can be used, depending on the converter performance.

In this case, the maximum distance between the Px40 relay and the converter should not exceed 15 m.

2.3.7 Fiber Optic Connection

Although InterMiCOM[64] is the recommended variant of InterMiCOM for use with optical fiber connections, MODEM InterMiCOM may also be applied over optical fibers by means of EIA(RS)232 to fiber optic converters. In this the case the following connections should be made:

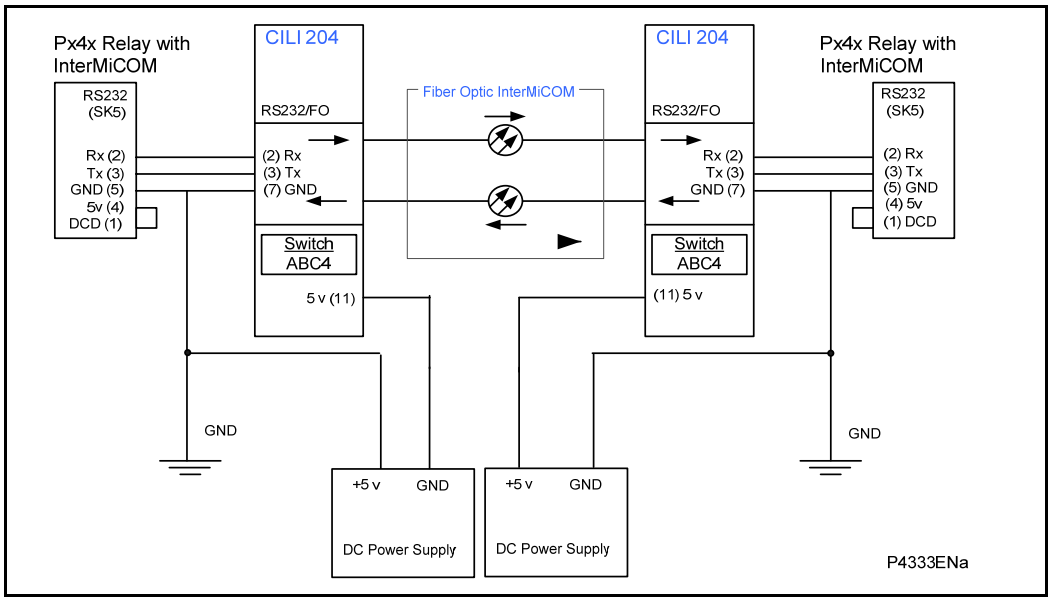


Figure 85: MODEM InterMiCOM teleprotection via fiber optic

The overall fiber length that can be achieved depends on the converter performance.

In this case, the maximum distance between the Px40 relay and the converter should not exceed 15 m.

2.3.8 InterMiCOM Functional Assignment

The settings to control the mode of the intertrip signals are made using the relay's menu software. In addition to this, it is necessary to assign InterMiCOM input and output signals in the relay Programmable Scheme Logic (PSL) editor. Two icons are provided on the PSL editor of MiCOM S1 (S1 Studio) for **Integral tripping In** and **Integral tripping out** which can be used to assign the eight intertripping commands. The example shown in figure 48 shows a **Control Input_1** connected to the **Intertrip O/P1** signal which would then be transmitted to the remote end. At the remote end, the **Intertrip I/P1** signal would then be assigned within the PSL. In this example, we can see that when intertrip signal 1 is received from the remote relay, the local end relay would operate an output contact, R1.

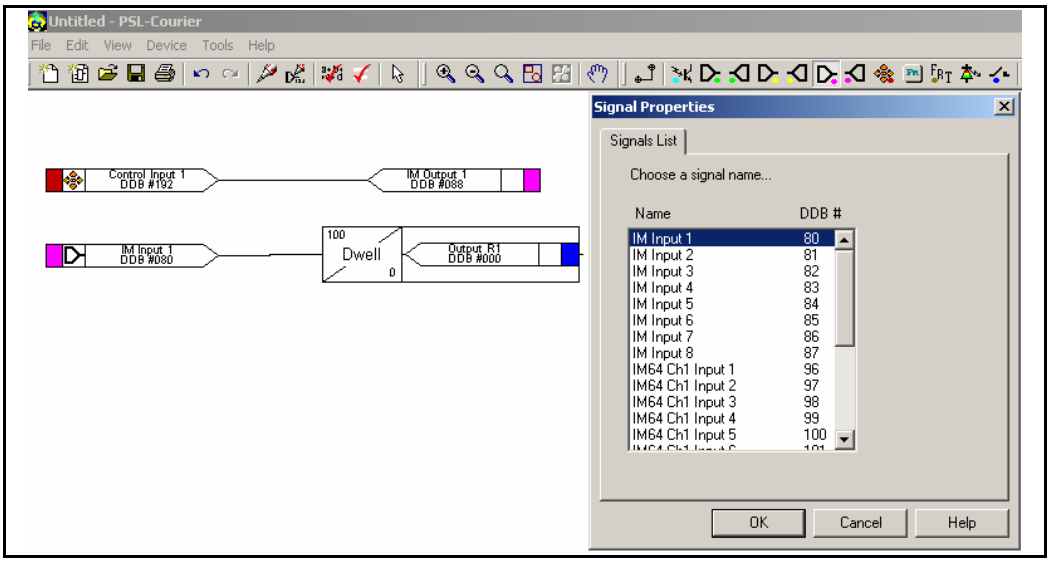


Figure 86: Example assignment of signals within the PSL

Note: When an InterMiCOM signal is sent from the local relay, only the remote end relay will react to this command. The local end relay will only react to InterMiCOM commands initiated at the remote end and received locally, and vice-versa. InterMiCOM can, therefore, be described as a duplex teleprotection system.

2.3.9 InterMiCOM Statistics and Diagnostics

MODEM InterMiCOM channel statistics and diagnostics are available via the menu software. These can be hidden, according to preference, by setting the **Ch Statistics** and/or **Ch Diagnostics** cells to **Invisible**. All channel statistics are reset when the relay is powered up, or by user selection by means of the **Reset Statistics** cell.

3.8 Read Only Mode

With IEC 61850 and Ethernet/Internet communication capabilities, security has become a pressing issue. The Px40 relay provides a facility to allow the user to enable or disable the change in configuration remotely. This feature is available only in relays with Courier, Courier with IEC 60870-5-103 and Courier with IEC 61850 protocol options. It has to be noted that in IEC 60870-5-103 protocol, Read Only Mode function is different from the existing Command block feature.

3.8.1 Protocol/port Implementation:

3.8.1.1 IEC 60870-5-103 Protocol on Rear Port 1:

The protocol does not support settings but the indications, measurands and disturbance records commands are available at the interface.

Allowed:

Poll Class 1 (read spontaneous events)

Poll Class 2 (read measurands)

GI sequence (ASDU7 'Start GI', Poll Class 1)

Transmission of Disturbance Records sequence (ASDU24, ASDU25, Poll Class 1)

Time Synchronization (ASDU6)

General Commands (ASDU20), namely:

INF23 activate characteristic 1

INF24 activate characteristic 2

INF25 activate characteristic 3

INF26 activate characteristic 4

Blocked:

Write parameter (=change setting) (private ASDUs)

General Commands (ASDU20), namely:

INF16 auto-recloser on/off

INF19 LED reset

Private INFs (e.g. CB open/close, control inputs)

3.8.1.2 Courier Protocol on Rear Port 1/2 and Ethernet

Allowed:

Read settings, statuses, measurands

Read records (event, fault, disturbance)

Time Synchronization

Change active setting group

Blocked:

Write settings

All controls, including:

Reset Indication (Trip LED)

Operate control inputs

CB operations

Auto-reclose operations

Reset demands

Clear event/fault/maintenance/disturbance records

Test LEDs & contacts

3.8.1.3 IEC 61850

Allowed:

Read statuses, measurands

Generate reports

Extract disturbance records

Time synchronization

Change active setting group

Blocked:

All controls, including:

Enable/disable protection

Operate control inputs

CB operations (Close/Trip, Lock)

Reset LEDs

3.8.2 Courier Database Support

Three new settings, one for each remote communications port at the back of the relay are created to support the enabling and disabling of the Read Only mode at each port.

The **NIC Read Only** setting will apply to all the communications protocols (including the Tunnelled Courier) that are transmitted via the Ethernet Port. Their default values are **Disabled**.

The DNP3 communication interface that do not support the feature will ignore these settings.

3.8.3 New DDB Signals

The remote Read Only mode is also available in the PSL via three dedicated DDB signals:

- RP1 Read Only
- RP2 Read Only
- NIC Read Only

Through careful scheme logic design, the activations of these Read Only signals can be facilitated via Opto Inputs, Control Inputs and Function Keys.

These DDBs are available in every build, however they are effective only in Courier, IEC 60870-5-103 build and in latest IEC 61850 (firmware version 57 onwards). The setting cells are not available in DNP3.0.

APPLICATION NOTES (P54x/EN AP/Ja4)

2.1.4 Transformers in zone applications (P543 and P545 models)

In applying the well established principles of differential protection to transformers, a variety of considerations have to be taken into account. These include compensation for any phase shift across the transformer, possible unbalance of signals from current transformers either side of windings, and the effects of the variety of earthing and winding arrangements. In addition to these factors, which can be compensated for by correct application of the relay, the effects of normal system conditions on relay operation must also be considered. The differential element must restrain for system conditions which could result in maloperation of the relay, such as high levels of magnetizing current during inrush conditions.

In traditional transformer feeder differential schemes, the requirements for phase and ratio correction were met by correct selection of line current transformers. In the P543 and P545, software interposing CTs (ICTs) are provided which can give the required compensation. The advantage of having replica interposing CTs is that it gives the P54x relays the flexibility to cater for line CTs connected in either star or delta, as well as being able to compensate for a variety of system earthing arrangements. The P543 and P545 relays also include a magnetizing inrush restraint and blocking facility.

Note: The P544 and P546 relays do not include any of the above features, except CT ratio mismatch compensation, and as such would not be suitable for the protection of in-zone transformer feeders.

2.1.4.1 Magnetizing Inrush Stabilization (P543 and P545)

When a transformer is first energized, a transient magnetizing current flows, which may reach instantaneous peaks of 8 to 30 times the full load current. The factors controlling the duration and magnitude of the magnetizing inrush are:

- Size of the transformer bank
- Size of the power system
- Resistance in the power system from the source to the transformer bank
- Residual flux level
- Type of iron used for the core and its saturation level.
- There are three conditions which can produce a magnetizing inrush effect:
- First energization
- Voltage recovery following external fault clearance
- Sympathetic inrush due to a parallel transformer being energized.

Figure 1 shows under normal steady state conditions the flux in the core changes from maximum negative value to maximum positive value during one half of the voltage cycle, which is a change of 2.0 maximum.

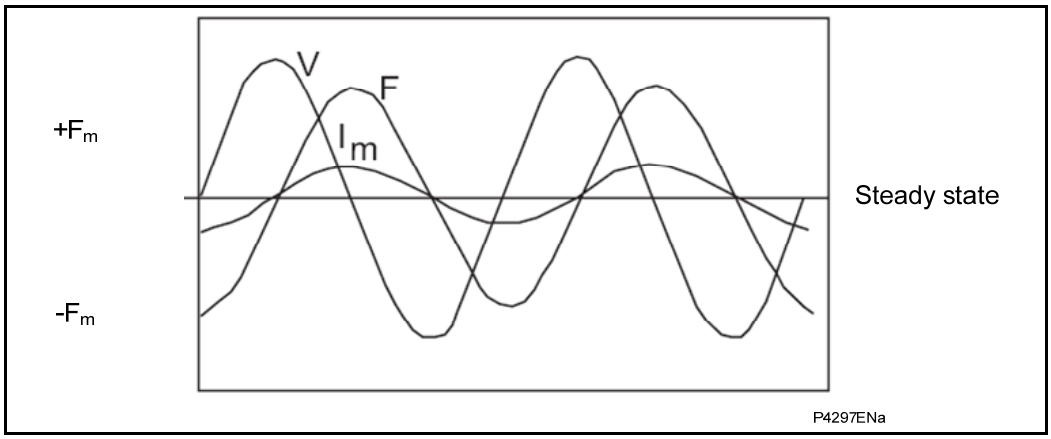


Figure 1: Steady state magnetizing inrush current

If the transformer is energized at a voltage zero when the flux would normally be at its maximum negative value, the flux will rise to twice its normal value over the first half cycle of voltage. To establish this flux, a high magnetizing inrush current is required. The first peak of this current can be as high as 30 times the transformer rated current. This initial rise could be further increased if there was any residual flux in the core at the moment the transformer was energized.

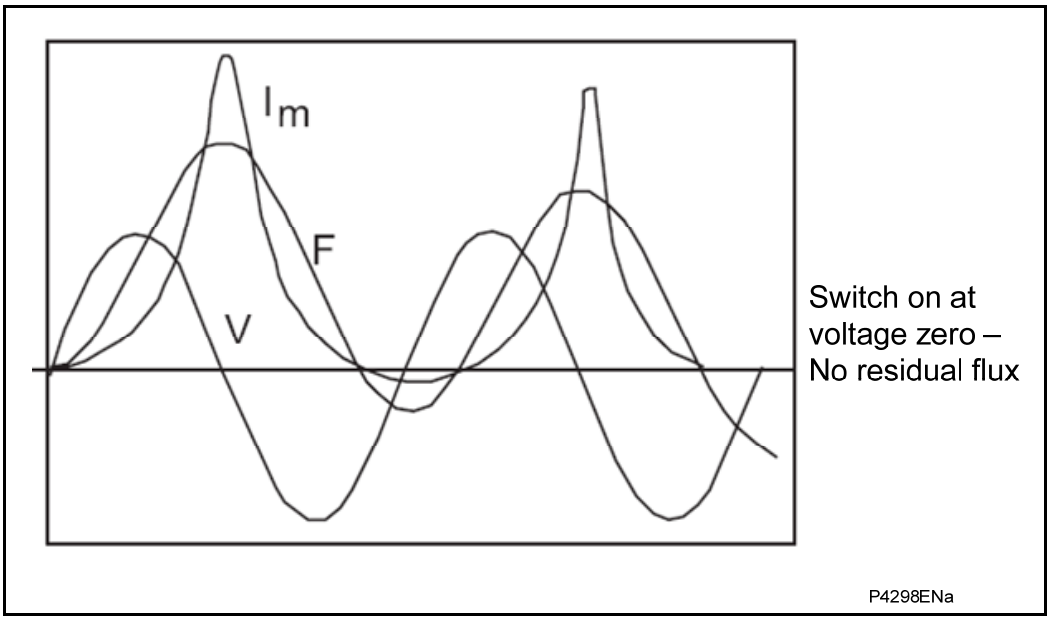


Figure 2: Magnetizing inrush current during energization

As the flux enters the highly saturated portion of the magnetizing characteristic, the inductance falls and the current rises rapidly. Magnetizing impedance is of the order of 2000% but under heavily saturated conditions this can reduce to around 40%, which is an increase in magnetizing current of 50 times normal. This figure can represent 5 or 6 times normal full load current.

Analysis of a typical magnitude inrush current wave shows (fundamental = 100%):

Component	-DC	2nd H	3rd H	4th H	5th H	6th H	7th H
	55%	63%	26.8%	5.1%	4.1%	3.7%	2.4%

The offset in the wave is only restored to normal by the circuit losses. The time constant of the transient can be quite long, typically 0.1 second for a 100 KVA transformer and up to 1 second for larger units. The initial rate of decay is high due to the low value of air core reactance. When below saturation level, the rate of decay is much slower. The following graph shows the rate of decay of the DC offset in a 50 Hz or 60 Hz system in terms of amplitude reduction factor between successive peaks.

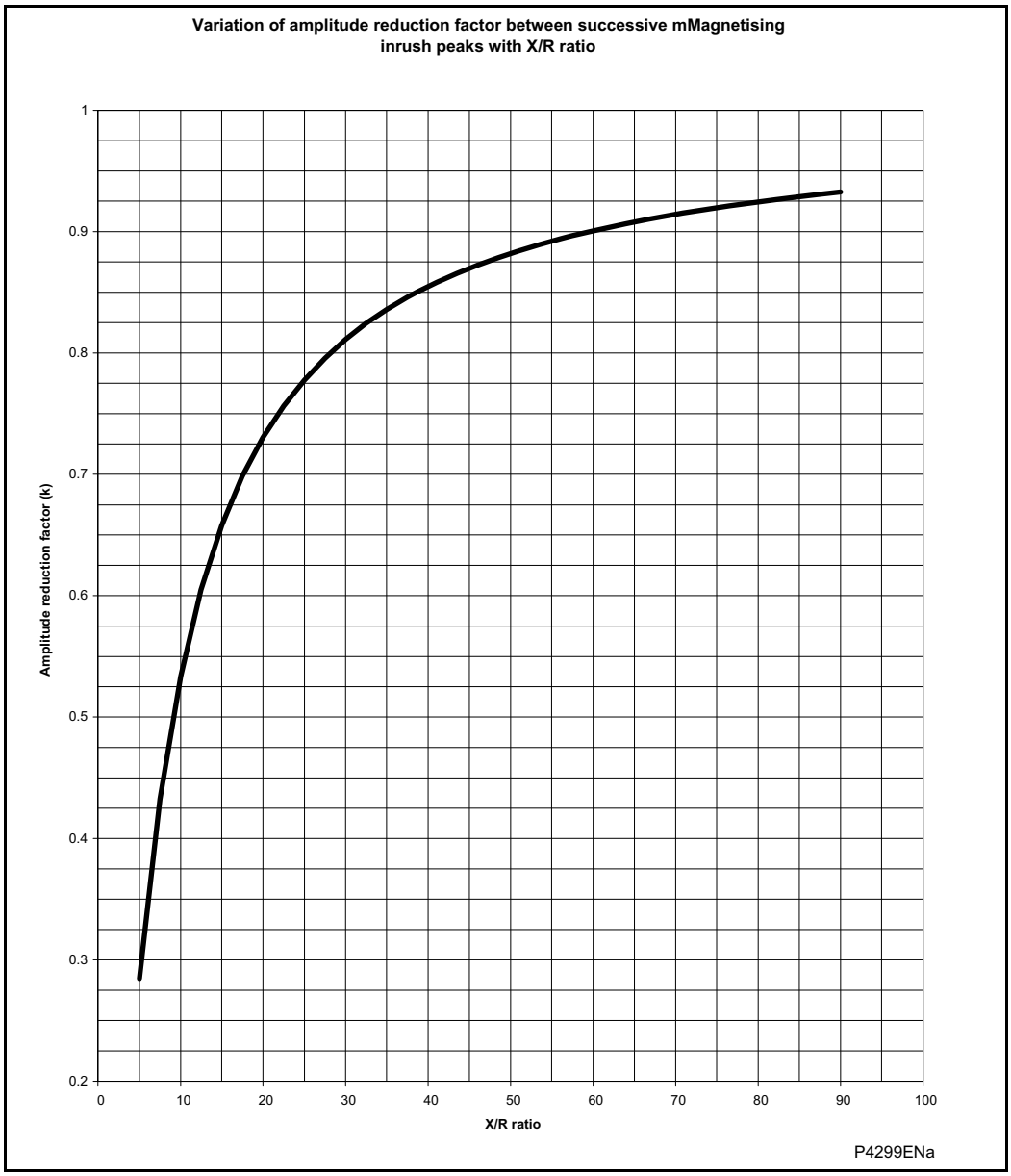


Figure 3: Variation of amplitude reduction factor

The magnitude of the inrush current is limited by the air core inductance of the windings under extreme saturation conditions. A transformer with concentric windings will draw a higher magnetizing current when energized from the LV side, since this winding is usually on the inside and has a lower air core inductance. Sandwich windings have approximately equal magnitude currents for both LV and HV. Resistance in the source will reduce the magnitude current and increase the rate of decay.

The magnetizing inrush phenomenon is associated with a transformer winding which is being energized where no balancing current is present in the other winding(s). This current appears as a large operating signal for the differential protection. Therefore, special measures are taken with the relay design to ensure that no maloperation occurs during inrush. The fact that the inrush current has a high proportion of harmonics having twice the system frequency offers a possibility of stabilization against tripping by the inrush current.

The P543 and P545 relay provides a choice between harmonic restraint and blocking by setting option, both providing stability during transformer inrush conditions.

To select second harmonic Restraint or Blocking option, set the cell [3312: Inrush Restraint] under the **GROUP 1 PHASE DIFF** menu heading to Restraint or Blocking. Second harmonic restraints or blocking provide security during transformer energization.

2.1.4.2 Second Harmonic Restraint (P543 and P545)

The magnetizing inrush current contains a high percentage of second harmonic. The P543 and P545 relays filter out this component of the waveform and use it as an additional bias quantity. The total bias used by the relay will therefore be a combination of the average load current on the line plus a multiple of the second harmonic component of the current. The multiplying factor which is used to ensure stability is controlled by the setting cell [3314: Ih(2) Multiplier] under the **GROUP 1 PHASE DIFF** menu heading provided the setting cell [3312: Inrush Restraint] is set to Restraint .

This multiplier is used in additional bias calculation as per following formula:

IF Inrush Restraint setting is set to Restraint

Additional bias = Ih(2) Multiplier * 1.414 * largest 2nd harmonic current

ELSE

Additional bias = 0

In the above equation second harmonic current is derived from Fourier filtering techniques.

Where P543 and P545 relays are used and inrush restrain function is enabled, it must be ensured that this function is enabled at each end to avoid possible maloperation.

2.1.4.3 Second Harmonic Blocking (P543 and P545)

To select second harmonic blocking option, set the cell [3312: Inrush Restraint] under the **GROUP 1 PHASE DIFF** menu heading to **Blocking**.

Second harmonic blocking provides security during transformer energization.

For each phase, if the level of phase current is above 5% In, and if the ratio of second harmonic current ,Ih(2) to fundamental in the line is above the settings at cell [3320: Ih(2) >%] then inrush conditions shall be detected which sets the appropriate phase block, to block local and remote ends.

Users can choose to apply Cross blocking or independent blocking by choosing the appropriate setting at cell [3321: Ih(2) CrossBlock] under the **GROUP 1 PHASE DIFF** menu heading. If **Ih(2) CrossBlock** is set to **Disabled** then independent blocking is used.

If independent blocking is enabled only the affected phase is blocked at all ends. If cross blocking is enabled all phases are blocked at all ends.

2.1.4.4 Fifth Harmonic Blocking (P543 and P545)

The fifth Harmonic blocking feature is available for possible use to prevent unwanted operation of the low set differential element under transient overfluxing conditions.

When overfluxing occurs, the transformer core becomes partially saturated and the resultant magnetizing current waveforms increase in magnitude and become harmonically distorted. Such waveforms have a significant fifth harmonic content, which can be extracted and used as a means of identifying the abnormal operating condition.

The fifth harmonic blocking threshold is adjustable between 5 - 100%. The threshold should be adjusted so that blocking will be effective when the magnetizing current rises above the chosen threshold setting of the low-set differential protection.

For example, when a load is suddenly disconnected from a power transformer the voltage at the input terminals of the transformer may rise by 10-20% of the rated value. Since the voltage increases, the flux, which is the integral of the excitation voltage, also increases. As a result, the transformer steady state excitation current becomes higher. The resulting excitation current flows in one winding only and therefore appears as differential current which may rise to a value high enough to operate the differential protection. A typical differential current waveform during such a condition is shown in Figure 4. A typical setting for **Ih(5)%>** is 35%

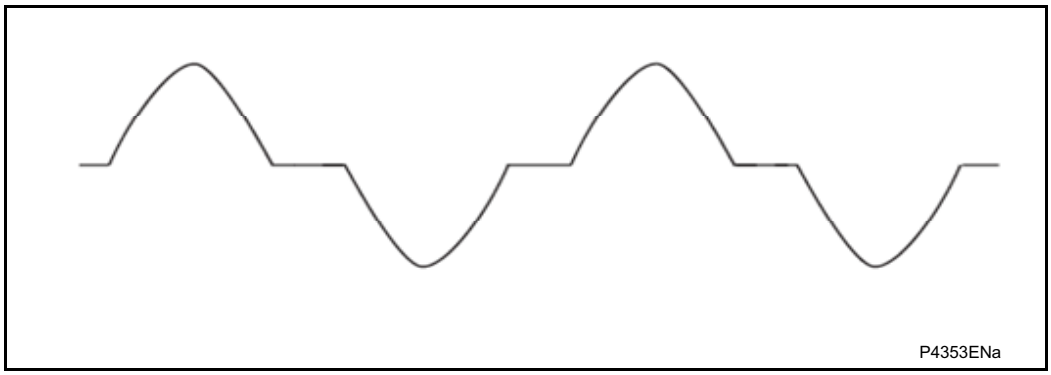


Figure 4: Typical overflux current waveform

To offer some protection against damage due to persistent overfluxing that might be caused by a geomagnetic disturbance, the fifth harmonic blocking element can be routed to an output contact using an associated timer. Operation of this element could be used to give an alarm to the network control centre. If such alarms are received from a number of transformers, they could serve as a warning of geomagnetic disturbance so that operators could take some action to safeguard the power system. Alternatively this element can be used to initiate tripping in the event of prolonged pick up of a fifth harmonic measuring element. It is not expected that this type of overfluxing condition would be detected by the AC overfluxing protection. This form of time delayed tripping should only be applied in regions where geomagnetic disturbances are a known problem and only after proper evaluation through simulation testing.

The P543 and P545 determine the fundamental components and the fifth harmonic components from the line currents and provide fifth harmonic blocking option when the setting cell [3312: Inrush Restraint] under the **GROUP 1 PHASE DIFF** menu is set to **Blocking**.

For each phase, if the level of phase current is above 5% In, and if the ratio of fifth harmonic current, Ih(5) to fundamental in the line is above the settings at cell [3328: Ih(5) >%] then the overfluxing conditions shall be detected which sets the appropriate phase block, to block local and remote ends.

Users can choose to apply Cross blocking or independent blocking by choosing the appropriate setting at cell [3329: Ih(5) CrossBlock] under the **GROUP 1 PHASE DIFF** menu heading. If **Ih(5) CrossBlock** is set to **Disabled** then independent blocking is used.

If independent blocking is enabled only the affected phase is blocked at all ends. If cross blocking is enabled all phases are blocked at all ends.

2.1.4.7 High Set Differential Setting (P543 and P545)

When **Inrush Restraint** is set to Restraint or Blocking, a high set differential protection becomes active. This is provided to ensure rapid clearance for heavy internal faults with saturated CTs. Because high set is not restrained by magnetizing inrush, hence the setting must be set such that it will not operate for the largest inrush currents expected. It is difficult to accurately predict the maximum anticipated level of inrush current. Typical waveforms peak values are of the order of 8-10x rated current. A worst case estimation of inrush could me made by dividing the transformer full load current by the per unit leakage reactance quoted by the transformer manufacturer.

2.8.4 Restricted Earth Fault Protection

Earth faults occurring on a transformer winding or terminal may be of limited magnitude, either due to the impedance present in the earth path or by the percentage of transformer winding that is involved in the fault. It is common to apply standby earth fault protection fed from a single CT in the transformer earth connection - this provides time-delayed protection for a transformer winding or terminal fault. In general, particularly as the size of the transformer increases, it becomes unacceptable to rely on time delayed protection to clear winding or terminal faults as this would lead to an increased amount of damage to the transformer. A common requirement is therefore to provide instantaneous phase and earth fault protection. Applying differential protection across the transformer may fulfill these requirements. However, an earth fault occurring on the LV winding, particularly if it is of a limited level, may not be detected by the differential relay, as it is only measuring the corresponding HV current. Therefore, instantaneous protection that is restricted to operating for transformer earth faults only is applied. This is referred to as restricted earthfault protection (REF).

When applying differential protection such as REF, some suitable means must be employed to give the protection stability under external fault conditions, therefore ensuring that relay operation only occurs for faults on the transformer winding / connections.

Two methods are commonly used; bias or high impedance. The biasing technique operates by measuring the level of through current flowing and altering the relay sensitivity accordingly. The high impedance technique ensures that the relay circuit is of sufficiently high impedance such that the differential voltage that may occur under external fault conditions is less than that required to drive setting current through the relay.

The REF protection in the P54x relays can be configured to operate as high impedance element. Following sections describe the application of the relay for high impedance element.

Note: The high impedance REF element of the relay shares the same CT input as the SEF protection. Hence, only one of these elements may be selected.

2.8.4.1 Setting Guidelines for High Impedance Restricted Earth Fault (REF)

From the **SEF/REF options** cell, **Hi Z REF** must be selected to enable this protection. The only setting cell then visible is **IREF>Is**, which may be programmed with the required differential current setting. This would typically be set to give a primary operating current of either 30% of the minimum earth fault level for a resistance earthed system or between 10 and 60% of rated current for a solidly earthed system.

The primary operating current (Iop) will be a function of the current transformer ratio, the relay operating current (IREF>Is1), the number of current transformers in parallel with a relay element (n) and the magnetizing current of each current transformer (Ie) at the stability voltage (Vs). This relationship can be expressed in three ways:

1. To determine the maximum current transformer magnetizing current to achieve a specific primary operating current with a particular relay operating current:

$$I_e < \frac{1}{n} \times \left(\frac{I_{op}}{\text{CT ratio}} - \text{IREF} > \text{Is} \right)$$

2. To determine the minimum relay current setting to achieve a specific primary operating current with a given current transformer magnetizing current.

$$[\text{IREF} > \text{Is}] < \left(\frac{I_{op}}{\text{CT ratio}} - nI_e \right)$$

2.8.4.2 Use of METROSIL Non-Linear Resistors

Metrosils are used to limit the peak voltage developed by the current transformers under internal fault conditions, to a value below the insulation level of the current transformers, relay and interconnecting leads, which are normally able to withstand 3000 V peak.

The following formulae should be used to estimate the peak transient voltage that can be produced for an internal fault. The peak voltage produced during an internal fault will be a function of the current transformer kneepoint voltage and the prospective voltage that would be produced for an internal fault if current transformer saturation did not occur.

$$Vp = 2\sqrt{2V_k (V_f - V_k)}$$

$$Vf = I'f (Rct + 2RL + RST)$$

Where:
- Vp = Peak voltage developed by the CT under internal fault conditions
- Vk = Current transformer kneepoint voltage
- Vf = Maximum voltage that would be produced if CT saturation did not occur
- I'f = Maximum internal secondary fault current
- Rct = Current transformer secondary winding resistance
- RL = Maximum lead burden from current transformer to relay
- RST = Relay stabilizing resistor

When the value given by the formulae is greater than 3000 V peak, metrosils should be applied. They are connected across the relay circuit and serve the purpose of shunting the secondary current output of the current transformer from the relay in order to prevent very high secondary voltages.

Metrosils are externally mounted and take the form of annular discs. Their operating characteristics follow the expression:

$$V = CI^{0.25}$$

Where:
- V = Instantaneous voltage applied to the non-linear resistor (metrosil)
- C = Constant of the non-linear resistor (metrosil)
- I = Instantaneous current through the non-linear resistor (metrosil)

With a sinusoidal voltage applied across the metrosil, the RMS current would be approximately 0.52 x the peak current. This current value can be calculated as follows:

Where: Vs(rms)= rms value of the sinusoidal voltage applied across the metrosil.

This is due to the fact that the current waveform through the metrosil is not sinusoidal but appreciably distorted.

For satisfactory application of a non-linear resistor (metrosil), it's characteristic should be such that it complies with the following requirements:

3. At the relay voltage setting, the non-linear resistor (metrosil) current should be as low as possible, but no greater than approximately 30 mA rms for 1 A current transformers and approximately 100 mA rms for 5 A current transformers.

4. At the maximum secondary current, the non-linear resistor (metrosil) should limit the voltage to 1500 V rms or 2120 V peak for 0.25 second. At higher relay voltage settings, it is not always possible to limit the fault voltage to 1500V rms, so higher fault voltages may have to be tolerated.

The following tables show the typical Metrosil types that will be required, depending on relay current rating, REF voltage setting etc.

5. Metrosil Units for Relays with a 1 Amp CT
6. The Metrosil units with 1 Amp CTs have been designed to comply with the following restrictions:
7. At the relay voltage setting, the Metrosil current should be less than 30 mA rms.
8. At the maximum secondary internal fault current the Metrosil unit should limit the voltage to 1500 V rms if possible.

The Metrosil units normally recommended for use with 1Amp CT's are as shown in the following table:

Relay voltage setting	Nominal characteristic		Recommended Metrosil type	
	C	β	Single pole relay	Triple pole relay
Up to 125 V rms 125 to 300 V rms	450 900	0.25 0.25	600 A/S1/S256 600 A/S1/S1088	600 A/S3/1/S802 600 A/S3/1/S1195

Note: Single pole Metrosil units are normally supplied without mounting brackets unless otherwise specified by the customer.

Metrosil units for relays with a 5 amp CT

These Metrosil units have been designed to comply with the following requirements:

9. At the relay voltage setting, the Metrosil current should be less than 100 mA rms (the actual maximum currents passed by the units shown below their type description.
10. At the maximum secondary internal fault current the Metrosil unit should limit the voltage to 1500 V rms for 0.25 secs. At the higher relay settings, it is not possible to limit the fault voltage to 1500 V rms hence higher fault voltages have to be tolerated (indicated by *, **, ***).
11. The Metrosil units normally recommended for use with 5 Amp CTs and single pole relays are as shown in the following table:

Secondary internal fault current	Recommended Metrosil type			
	Relay voltage setting			
Amps rms	Up to 200 V rms	250 V rms	275 V rms	300 V rms
50 A	600 A/S1/S1213 C = 540/640 35 mA rms	600 A/S1/S1214 C = 670/800 40 mA rms	600 A/S1/S1214 C =670/800 50 mA rms	600 A/S1/S1223 C = 740/870* 50 mA rms
100 A	600 A/S2/P/S1217 C = 470/540 70 mA rms	600 A/S2/P/S1215 C = 570/670 75 mA rms	600 A/S2/P/S1215 C =570/670 100 mA rms	600 A/S2/P/S1196 C =620/740* 100 mA rms
150 A	600 A/S3/P/S1219 C = 430/500 100 mA rms	600 A/S3/P/S1220 C = 520/620 100 mA rms	600 A/S3/P/S1221C = 570/670** 100 mA rms	600 A/S3/P/S1222C =620/740*** 100 mA rm
	Note:	*2400 V peak	**2200 V peak	***2600 V peak

In some situations single disc assemblies may be acceptable, contact Schneider Electric for detailed applications.

12. The Metrosil units recommended for use with 5 Amp CTs can also be applied for usewith triple pole relays and consist of three single pole units mounted on the same central stud but electrically insulated from each other. To order these units please specify **Triple pole Metrosil type**, followed by the single pole type reference.

13. Metrosil units for higher relay voltage settings and fault currents can be supplied if required.
14. To express the protection primary operating current for a particular relay operating current and with a particular level of magnetizing current.

I_{op} = (CT ratio) x (IREF > Is + nI_C)

To achieve the required primary operating current with the current transformers that are used, a current setting (IREF>Is) must be selected for the high impedance element, as detailed in expression (ii) above. The setting of the stabilizing resistor (RST) must be calculated in the following manner, where the setting is a function of the required stability voltage setting (Vs) and the relay current setting (IREF>Is).

$$Rst = \frac{Vs}{IREF>Is} = \frac{I_F (R_{CT} + 2R_L)}{I_{REF} > I_s}$$

Note: The above formula assumes negligible relay burden.

The stabilizing resistor that can be supplied is continuously adjustable up to its maximum declared resistance.

2.17 Integral Intertripping

The MiCOM P54x supports integral intertripping in the form of InterMiCOM. InterMiCOM can be realized using an auxiliary EIA(RS)232 connection (MODEM InterMiCOM), or it can be realised by means of an integral optical fiber communication connection (fiber InterMiCOM, or InterMiCOM64). EIA(RS)232 (MODEM) InterMiCOM provides a single, full duplex communication channel, suitable for connection between two MiCOM P54x. The fiber InterMiCOM (InterMiCOM64) can provide up to two full-duplex communications channels. It can be used to connect two MiCOM P54x using a single channel, or redundancy can be added by using dual communications. Alternatively, InterMiCOM64 can be used to connect three MiCOM P54x devices in a triangulated scheme for the protection of Teed feeders. MODEM InterMiCOM and InterMiCOM64 are completely independent. They have separate settings, are described by separate DDB signals.

As a general rule, where possible, InterMiCOM64 would be preferable from an application point of view since it is faster, and based on optical fibers it has high immunity to electro-magnetic interference. If the high speed communication channel requirement of InterMiCOM64 cannot be provided, EIA(RS)232 provides a cost effective alternative.

Because of the differences between the implementation of EIA(RS)232 InterMiCOM and InterMiCOM64, the settings associated with each implementation are different. Refer to *P54x/EN ST* for details of all settings. There are settings to prevent inadvertent cross-connection or loopback of communications channels (address settings), settings to accommodate different channel requirements (baud rate, clock source, channel selection) as well as the different settings used for channel quality monitoring and signal management actions in the event of channel failures.

The received InterMiCOM signals are continually monitored for quality and availability. In the event of quality or availability of the received signals falling below set levels, then an alarm can be raised.

Note: An alarm indicating the signaling has failed, refers only to the incoming signals. The remote relay will monitor the other direction of the communications link for quality of transmission. If indication of the quality of the signal transmitted from the local relay for reception at the remote relay is required, then one of the InterMiCOM command channels can be used to reflect this back.

2.17.1 EIA(RS)232 InterMiCOM (**"Modem InterMiCOM"**)

The settings necessary for the implementation of MODEM InterMiCOM are contained within two columns of the relay menu structure. The first column entitled **INTERMICOM COMMS** contains all the information to configure the communication channel and also contains the channel statistics and diagnostic facilities. The second column entitled **INTERMICOM CONF** selects the format of each signal and its fallback operation mode.

The settings required for the InterMiCOM signaling are largely dependant upon whether a direct or indirect (modem/multiplexed) connection between the scheme ends is used.

Direct connections will either be short metallic or dedicated fiber optic based (by means of suitable EIA 232 to optical fiber converters) and hence can be set to have the highest signaling speed of 19200b/s. Due to this high signaling rate, the difference in operating speed between the direct, permissive and blocking type signals is so small that the most secure signaling (direct intertrip) can be selected without any significant loss of speed. In turn, since the direct intertrip signaling requires the full checking of the message frame structure and CRC checks, it would seem prudent that the **IM# Fallback Mode** be set to Default with a minimal intentional delay by setting **IM# FrameSyncTim** to 10 msecs. In other words, whenever two consecutive messages have an invalid structure, the relay will immediately revert to the default value until a new valid message is received.

For indirect connections, the settings that can be applied will become more application and communication media dependent. As for the direct connections, consider only the fastest baud rate but this will usually increase the cost of the necessary modem/multiplexer. In addition, devices operating at these high baud rates may suffer from **data jams** during periods of interference and in the event of communication interruptions, may require longer re-synchronization periods. Both of these factors will reduce the effective communication speed thereby leading to a recommended baud rate setting of 9.6 kbit/s. As the baud rate decreases, the communications will become more robust with fewer interruptions, but the overall signaling times will increase.

Since it is likely that slower baud rates will be selected, the choice of signaling mode becomes significant. However, once the signaling mode has been chosen it is necessary to consider what should happen during periods of noise when message structure and content can be lost. If **Blocking** mode is selected, only a small amount of the total message is actually used to provide the signal, which means that in a noisy environment there is still a good likelihood of receiving a valid message. In this case, it is recommended that the **IM# Fallback Mode** is set to **Default** with a reasonably long **IM# FrameSyncTim**. A typical default selection of Default = 1 (blocking received substitute) would generally apply as the failsafe assignment for blocking schemes.

If **Direct Intertrip** mode is selected, the whole message structure must be valid and checked to provide the signal, which means that in a very noisy environment the chances of receiving a valid message are quite small. In this case, it is recommended that the **IM# Fallback Mode** is set to **Default** with a minimum **IM# FrameSyncTim** setting i.e. whenever a non-valid message is received, InterMiCOM will use the set default value. A typical default selection of Default = 0 (intertrip NOT received substitute) would generally apply as the failsafe assignment for intertripping schemes.

If **Permissive** mode is selected, the chances of receiving a valid message is between that of the **Blocking** and **Direct Intertrip** modes. In this case, it is possible that the **IM# Fallback Mode** is set to **Latched**. The table below highlights the recommended **IM# FrameSyncTim** settings for the different signaling modes and baud rates:

Baud rate	Minimum recommended "IM# FrameSyncTim" Setting		Minimum setting (ms)	Maximum setting (ms)
	Direct intertrip mode	Blocking mode		
600	100	250	100	1500
1200	50	130	50	1500
2400	30	70	30	1500
4800	20	40	20	1500

Baud rate	Minimum recommended "IM# FrameSyncTim" Setting		Minimum setting (ms)	Maximum setting (ms)
9600	10	20	10	1500
19200	10	10	10	1500

Note: No recommended setting is given for the Permissive mode since it is anticipated that **Latched** operation will be selected. However, if **Default mode** is selected, the **IM# FrameSyncTim** setting should be set greater than the minimum settings listed above. If the **IM# FrameSyncTim** setting is set lower than the minimum setting listed above, there is a danger that the relay will monitor a correct change in message as a corrupted message.

A setting of 25% is recommended for the communications failure alarm.

4.4 Read Only Mode

With IEC 61850 and Ethernet/Internet communication capabilities, security has become a pressing issue. The Px40 relay provides a facility to allow the user to enable or disable the change in configuration remotely.

Read Only mode can be enabled/disabled for the following rear ports:

- Rear Port 1 - IEC 60870-5-103 and Courier protocols
- Rear Port 2 (if fitted) - Courier protocol
- Ethernet Port (if fitted) - Courier protocol (**tunnelled**)

PROGRAMMABLE LOGIC (P54x/EN MR/Ba4)

1.7 Description of logic nodes

Note: Where applicable. Not all nodes appear in every product variant.

DDB no.	English text	Source	Description
0	Output R1	Output Conditioner	Assignment of signal to drive output Relay 1
31	Output R32	Output Conditioner	Assignment of signal to drive output Relay 32
32	Input L1	Opto Input	From opto input 1 - when opto energized
55	Input L16	Opto Input	From opto input 24 - when opto energized
63	Input L24	Opto Input	From opto input 32 - when opto energized
64 to 79	Not used		
80	IM Input 1	InterMiCOM	InterMiCOM Input 1 - is driven by a message from the remote line end
87	IM Input 8	InterMiCOM	InterMiCOM Input 8 - is driven by a message from the remote line end
88	IM Output 1	InterMiCOM	InterMiCOM Output 1 - mapping what will be sent to the remote line end
95	IM Output 8	InterMiCOM	InterMiCOM Output 8 - mapping what will be sent to the remote line end
96	IM64 Ch1 Input 1	IM64	IM64 Ch1 input 1 - is driven by a message from the remote line end
103	IM64 Ch1 Input 8	IM64	IM64 Ch1 input 8 - is driven by a message from the remote line end
104	IM64 Ch2 Input 1	IM64	IM64 Ch2 input 1 - is driven by a message from the remote line end
111	IM64 Ch2 Input 8	IM64	IM64 Ch2 input 8 - is driven by a message from the remote line end
112	IM64 Ch1 Output 1	PSL	IM64 Ch1 output 1 - mapping what will be sent to the remote line end
119	IM64 Ch1 Output 8	PSL	IM64 Ch1 output 8 - mapping what will be sent to the remote line end

DDB no.	English text	Source	Description
120	IM64 Ch2 Output 1	PSL	IM64 Ch2 output 1 - mapping what will be sent to the remote line end
127	IM64 Ch2 Output 8	PSL	IM64 Ch2 output 8 - mapping what will be sent to the remote line end
128	Relay Cond 1	PSL	Input to relay 1 output conditioner
159	Relay Cond 32	PSL	Input to relay 32 output conditioner
160	Timer in 1	PSL	Input to auxiliary timer 1
175	Timer in 16	PSL	Input to auxiliary timer 16
176	Timer out 1	Auxiliary Timer	Output from auxiliary timer 1
191	Timer out 16	Auxiliary Timer	Output from auxiliary timer 16
192	Control Input 1	Control Input Command	Control input 1 - for SCADA and menu commands into PSL
223	Control Input 32	Control Input Command	Control input 32 - for SCADA and menu commands into PSL
256	Virtual Output 1	PSL	Virtual output 1 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices
287	Virtual Output32	PSL	Virtual output 32 - allows user to control a binary signal which can be mapped via SCADA protocol output to other devices
288	SG-opto Invalid	Group Selection	Setting group selection opto inputs have detected an invalid (disabled) settings group
289	Prot'n Disabled	Commissioning Test	Protection disabled - typically out of service due to test mode
290	Static Test Mode	Commissioning Test	Static test mode option bypasses the delta phase selectors, power swing detection and reverts to conventional directional line and cross polarization to allow testing with test sets that can not simulate a real fault
291	Test Loopback	C Diff	Loopback test in service (external or internal)
292	Test IM64	C Diff	Indication that relay is in test mode
293	VT Fail Alarm	VT Supervision	VTS indication alarm- failed VT (fuse blow) detected by VT supervision
294	CT Fail Alarm	CT Supervision	CTS indication alarm (CT supervision alarm) In the cases of two CTs: - If standard CTS is used, this indication is ON in case of failure on any of the CTs - If Diff CTS is used this indication is ON in case of failure on CT1
295	CT2 Fail Alarm	CT Supervision	CT2S indication alarm (CT supervision alarm). This indication is ON If Diff CTS is used and there is a failure on CT2 P544 and P546 only
296	Remote CT Alarm	CT Supervision	CTS remote indication alarm (CT supervision alarm)
297	Power Swing	Powerswing Blocking	Powerswing blocking will block any distance zone selected in the setting file
298	CB Fail Alarm	CB Fail	Circuit breaker fail alarm
299	CB Monitor Alarm	CB Monitoring	This alarm indicates that DDB I ^ Maint. Alarm (1106) or DDB CB OPs Maint. (1108) or DDB CB Time Maint. (1110)
300	CB Lockout Alarm	CB Monitoring	This alarm indicates that DDB I ^ Lockout Alarm (1107) or DDB CB Ops Lock (1109) or DDB CB Time lockout (1111)
301	CB Status Alarm	CB Status	Indication of problems by circuit breaker state monitoring - example defective auxiliary contacts
302	CB Trip Fail	CB Control	Circuit breaker failed to trip (after a manual/operator) trip command

DDB no.	English text	Source	Description
303	CB Close Fail	CB Control	Circuit breaker failed to close (after a manual/operator or auto-reclose close command)
304	Man CB Unhealthy	CB Control	Manual circuit breaker unhealthy output signal indicating that the circuit breaker has not closed successfully after a manual close command. (A successful close also requires The circuit breaker healthy signal to reappear within the "healthy window" timeout)
305	No C/S Man Close	CB Control	Indicates that the check synchronism signal has failed to appear for a manual close
306	A/R Lockout	Auto-reclose	Indicates an auto-reclose lockout condition - no further auto-reclosures possible until resetting
307	A/R CB Unhealthy	Auto-reclose	Auto-reclose circuit breaker unhealthy signal, output from auto-reclose logic. Indicates during auto-reclose in progress, if the circuit breaker has to become healthy within the circuit breaker healthy time window
308	A/R No Checksync	Auto-reclose	Indicates during auto-reclose in progress, if system checks have not been satisfied within the check synchronizing time window
309	System Split	Check sync	System split alarm - will be raised if the system is split (remains permanently out of synchronism) for the duration of the system split timer
310	GPS Alarm	C Diff	Indicates that GPS is lost
311	Signaling fail	C Diff	If a differential protection communication path has remained failed for a period which is longer than the “Comms Fail Timer”, this alarm is ON
312	Comm Delay Alarm	C Diff	If successive calculated propagation delay times exceed time delay setting “Comm Delay Tol”, this alarms is ON
313	C Diff Failure	C Diff	It indicates that differential protection communications are completely lost and therefore C diff does not work
314	IM64 SchemeFail		It indicates that communications between relays are completely lost and therefore IM64 does not work
315	IEEE C37.94 Fail	C Diff	It will appear in case of at least one of the following: CH1 (or CH2) loss of signal, CH1 (or CH2) PATH_YELLOW or CH1 (or CH2) BAD_RX_N
316	C Diff Inhibited	C Diff	Indicate that a differential protection has been inhibited
317	Aid 1 Chan Fail	PSL	Aided channel scheme 1 - channel out of service indication, indicating channel failure
318	Aid 2 Chan Fail	PSL	Aided channel scheme 2 - channel out of service indication, indicating channel failure
319	F out of Range	Frequency Tracking	Frequency out of range alarm
320	CB2 Fail Alarm	CB2 Fail	Circuit breaker 2 fail alarm. P544 and P546 only
321	CB2 Monitor Alm	CB2 Monitoring	This alarm indicates that DDB CB2 I ^ Maint. Alarm (1113) or DDB CB2 OPs Maint. (1115) or DDB CB2 Time Maint. (1117) P544 and P546 only
322	CB2 Mon LO Alarm	CB2 Monitoring	This alarm indicates that DDB CB2 I ^ Lockout Alarm (1114) or DDB CB Ops Lock (1116) or DDB CB Time lockout (1118) P544 and P546 only

DDB no.	English text	Source	Description
323	CB2 Status Alarm	CB2 Status	Indication of problems by circuit breaker 2 state monitoring - example defective auxiliary contacts P544 and P546 only
324	CB2 Trip Fail	CB2 Control	Circuit breaker 2 failed to trip (after a manual/operator) trip command P544 and P546 only
325	CB2 Close Fail	CB2 Control	Circuit breaker 2 failed to close (after a manual/operator or auto-reclose close command) P544 and P546 only
326	Man CB2 Unhealthy	CB2 Control	Manual circuit breaker unhealthy output signal indicating that the circuit breaker 2 has not closed successfully after a manual close command. (A successful close also requires The circuit breaker healthy signal to reappear within the "healthy window" timeout) P544 and P546 only
327	NoCS CB2ManClose	CB2 Control	Indicates that the check synchronism signal has failed to appear for a manual close P544 and P546 only
328	AR CB2 Lockout	CB2 Auto-reclose	Indicates an auto-reclose lockout condition - no further auto-reclosures possible until resetting P544 and P546 only
329	AR CB2 Unhealthy	CB2 Auto-reclose	Auto-reclose circuit breaker unhealthy signal, output from auto-reclose logic. Indicates during auto-reclose in progress, if the circuit breaker has to become healthy within the circuit breaker healthy time window P544 and P546 only
330	AR CB2 No C/S	CB2 Auto-reclose	Indicates during auto-reclose in progress, if system checks have not been satisfied within the check synchronizing time window P544 and P546 only
331	Invalid AR Mode	Auto-reclose	AR Mode selected via optos is not supported P544 and P546 only
332 to 333	Not used		
334	Main Prot. Fail	Co-processor Interface	Indicates a failure in differential or distance or DEF
335	Config Error	C Diff	In three ended schemes on power up, the relays check to see if one of them should be configured out. Under some circumstances it is possible for them to fail to resolve this in which case they produce the DDB_CONFIGURATION_ERROR alarm
336	Re-Config Error	C Diff	Indicates that RESTORE or RECONFIGURE or CONFIGURE operations have failed
335 to 336	Not used		
337	Comms Changed	C Diff	This is an alarm which indicates that C3794 comms have been changed to standard or vice versa and relay must be rebooted
338 to 343	Not used		
344	SR User Alarm 1	PSL	Triggers user alarm 1 message to be alarmed on LCD display (self-resetting)
347	SR User Alarm 4	PSL	Triggers user alarm 4 message to be alarmed on LCD display (self-resetting)
348	MR User Alarm 5	PSL	Triggers user alarm 5 message to be alarmed on LCD display (manual-resetting)

DDB no.	English text	Source	Description
351	MR User Alarm 8	PSL	Triggers user alarm 8 message to be alarmed on LCD display (manual-resetting)
352	Battery Fail	Self Monitoring	Front panel miniature battery failure - either battery removed from slot, or low voltage
353	Field Volts Fail	Self Monitoring	48 V field voltage failure
354	Rear Comm 2 Fail	Self Monitoring	Comm2 hardware failure - second rear communications board
355	GOOSE IED Absent		The IED is not subscribed to a publishing IED in the current scheme
356	NIC Not Fitted		Ethernet board not fitted
357	NIC No Response		Ethernet board not responding
358	NIC Fatal Error		Ethernet board unrecoverable error
359	NIC Soft. Reload		Ethernet problem
360	Bad TCP/IP Cfg.		Ethernet problem
361	Bad OSI Config.		Ethernet problem
362	NIC Link Fail		Ethernet link lost
363	NIC SW Mis-Match		Ethernet board software not compatible with main CPU
364	IP Addr Conflict		The IP address of the IED is already used by another IED
365	IM Loopback	InterMiCOM	EIA(RS)232 InterMiCOM indication that Loopback testing is in progress
366	IM Message Fail	InterMiCOM	EIA(RS)232 InterMiCOM Message Failure alarm. Setting that is used to alarm for poor channel quality. If during the fixed 1.6 s rolling window the ratio of invalid messages to the total number of messages that should be received (based upon the 'Baud Rate' setting) exceeds the above threshold, a 'Message Fail' alarm will be issued
367	IM Data CD Fail	InterMiCOM	EIA(RS)232 InterMiCOM Data Channel Detect Fail i.e. modem failure
368	IM Channel Fail	InterMiCOM	EIA(RS)232 InterMiCOM Channel Failure alarm. No messages were received during the alarm time setting
365 to 368	Not used		
369	Backup setting	Self Monitoring	This is an alarm that is ON if any setting fail during the setting changing process. If this happens, the relay will use the last known good setting
370 to 383	Not used		
384	Block Zone 1 Gnd	PSL	Zone 1 ground basic scheme blocking
385	Block Zone 1 Phs	PSL	Zone 1 phase basic scheme blocking
386	Block Zone 2 Gnd	PSL	Zone 2 ground basic scheme blocking
387	Block Zone 2 Phs	PSL	Zone 2 phase basic scheme blocking
388	Block Zone 3 Gnd	PSL	Zone 3 ground basic scheme blocking
389	Block Zone 3 Phs	PSL	Zone 3 phase basic scheme blocking
390	Block Zone P Gnd	PSL	Zone P ground basic scheme blocking
391	Block Zone P Phs	PSL	Zone P phase basic scheme blocking
392	Block Zone 4 Gnd	PSL	Zone 4 ground basic scheme blocking
393	Block Zone 4 Phs	PSL	Zone 4 phase basic scheme blocking
394	Aid1 InhibitDist	PSL	Block distance aided scheme 1 tripping
395	Aid1 Inhibit DEF	PSL	Block DEF aided scheme 1 tripping
396	Aid1 Inhibit DIR	PSL	Block Delta directional aided scheme 1 tripping
397	Aid2 InhibitDist	PSL	Block distance aided scheme 2 tripping
398	Aid2 Inhibit DEF	PSL	Block DEF aided scheme 2 tripping
399	Aid2 Inhibit DIR	PSL	Block Delta directional aided scheme 2 tripping

DDB no.	English text	Source	Description
400	Time Synch	PSL	Time synchronism by opto pulse
401	I>1 Timer Block	PSL	Block phase overcurrent stage 1 time delayed tripped trip
402	I>2 Timer Block	PSL	Block phase overcurrent stage 2 time delayed tripped trip
403	I>3 Timer Block	PSL	Block phase overcurrent stage 3 time delayed trip
404	I>4 Timer Block	PSL	Block phase overcurrent stage 4 time delayed trip
405	IN>1 Timer Block	PSL	Block standby earth fault stage 1 time delayed trip
406	IN>2 Timer Block	PSL	Block standby earth fault stage 2 time delayed trip
407	IN>3 Timer Block	PSL	Block standby earth fault stage 3 time delayed trip
408	IN>4 Timer Block	PSL	Block standby earth fault stage 4 time delayed trip
409	ISEF>1 Timer Blk	PSL	Block sensitive earth fault stage 1 time delayed trip
410	ISEF>2 Timer Blk	PSL	Block sensitive earth fault stage 2 time delayed trip
411	ISEF>3 Timer Blk	PSL	Block sensitive earth fault stage 3 time delayed trip
412	ISEF>4 Timer Blk	PSL	Block sensitive earth fault stage 4 time delayed trip
413	Not used		
414	V<1 Timer Block	PSL	Block phase undervoltage stage 1 time delayed trip
415	V<2 Timer Block	PSL	Block phase undervoltage stage 2 time delayed trip
416	V>1 Timer Block	PSL	Block phase overvoltage stage 1 time delayed trip
417	V>2 Timer Block	PSL	Block phase overvoltage stage 2 time delayed trip
418	VN>1 Timer Block	PSL	Block residual overvoltage stage 1 time delayed trip
419	VN>2 Timer Block	PSL	Block residual overvoltage stage 2 time delayed trip
420	CB1 Aux 3ph(52-A)	PSL	52-A (CB closed) CB auxiliary input (3 phase)
421	CB1 Aux A(52-A)	PSL	52-A (CB A phase closed) CB auxiliary
422	CB1 Aux B(52-A)	PSL	52-A (CB B phase closed) CB auxiliary
423	CB1 Aux C(52-A)	PSL	52-A (CB C phase closed) CB auxiliary
424	CB1 Aux 3ph(52-B)	PSL	52-B (CB open) CB auxiliary input (3 phase)
425	CB1 Aux A(52-B)	PSL	52-B (CB A phase open) CB auxiliary input
426	CB1 Aux B(52-B)	PSL	52-B (CB B phase open) CB auxiliary input
427	CB1 Aux C(52-B)	PSL	52-B (CB C phase open) CB auxiliary input
428	CB2 Aux 3ph(52-A)	PSL	52-A (CB2 closed) CB2 auxiliary input (3 phase) P544 and P546 only
429	CB2 Aux A(52-A)	PSL	52-A (CB2 A phase closed) CB2 auxiliary P544 and P546 only
430	CB2 Aux B(52-A)	PSL	52-A (CB2 B phase closed) CB2 auxiliary P544 and P546 only
431	CB2 Aux C(52-A)	PSL	52-A (CB2 C phase closed)CB2 auxiliary P544 and P546 only
432	CB2 Aux 3ph(52-B)	PSL	52-B (CB2 open) CB2 auxiliary input (3 phase) P544 and P546 only

DDB no.	English text	Source	Description
433	CB2 Aux A(52-B)	PSL	52-B (CB2 A phase open) CB2 auxiliary input P544 and P546 only
434	CB2 Aux B(52-B)	PSL	52-B (CB2 B phase open) CB2 auxiliary input P544 and P546 only
435	CB2 Aux C(52-B)	PSL	52-B (CB2 C phase open) CB2 auxiliary input P544 and P546 only
436	CB Healthy	PSL	Circuit breaker healthy (input to auto-recloser - that the CB1 has enough energy to allow re-closing)
437	CB2 Healthy	PSL	Circuit breaker healthy (input to auto-recloser - that the CB2 has enough energy to allow re-closing) P544 and P546 only
438	MCB/VTS	PSL	VT supervision input - signal from external miniature circuit breaker showing MCB tripped
439	Trip CB	PSL	Initiate tripping of circuit breaker from a manual command
440	Close CB	PSL	Initiate closing of circuit breaker from a manual command
441	Init Trip CB2	PSL	Initiate tripping of circuit breaker 2 from a manual command P544 and P546 only
442	Init Close CB2	PSL	Initiate closing of circuit breaker 2 from a manual command P544 and P546 only
443	Reset Close Dly	PSL	Reset manual circuit breaker close time delay
444	Reset Relays/LED	PSL	Reset latched relays & LEDs (manual reset of any lockout trip contacts, auto-reclose lockout, and LEDs)
445	Reset Thermal	PSL	Reset thermal state to 0%
446	Reset (CB1) Lockout	PSL	Manual control to reset auto-recloser from lockout
447	Reset CB (1) Data	PSL	Reset circuit breaker maintenance values
448	BAR (P543 and P545) Block CB1 AR (P544 and P546)	PSL	Block the Auto-reclose function (CB1 only in P544 and P546) from an external input
449	En 1pole reclose	PSL	Enable 1 pole reclose from an external input P543/P545 only
450	En 3pole reclose	PSL	Enable 3 pole reclose from an external input P543/P545 only
451	Pole Discrepancy (CB1)	PSL	Pole discrepancy (from external detector) - input used to force a 2nd single pole trip to move to a 3 pole auto-reclose cycle
452	Loopback Mode	PSL	To enable loopback mode via opto input
453	Perm Intertrip		Permissive intertrip mapping what will be sent to the remote line end
454	Stub Bus Enabled		To enable stub bus protection in relays with two CT inputs. When enabled, all current values transmitted to the remote relays, and all those received from remote relays, are set to zero. Differential intertrip signals are not sent The protection provides differential protection for the stub zone
455	Inhibit C Diff		When linked to an opto input, inhibits differential relay at the local end and send an inhibit command to the remote end

DDB no.	English text	Source	Description
456	Recon Interlock		This must be energized (along with DDB 455 - inhibit C Diff) at the time that a relay configuration is changed from 3 ended to 2 ended scheme. This usually should be driven from a 52-B contact of the CB connected to the line end that is taken out of service
457	Prop Delay Equal	PSL	If a P54x relay working with GPS sample synchronization loses GPS and there is a further switch in the protection communications network, the relay becomes Inhibit. If GPS become active again, the relay will automatically reset. But if not, the user can remove the inhibited condition by energizing this DDB signal as long as it is ensured that propagation delay times are equal
458	Inhibit WI	PSL	Inhibit weak infeed aided scheme logic
459	Test Mode	PSL	Commissioning tests - automatically places relay in test mode
460	103 Command Blocking	PSL	For IEC-870-5-103 protocol only, used for "Command Blocking" (relay ignores SCADA commands)
461	103 Monitor Blocking	PSL	For IEC-870-5-103 protocol only, used for "Monitor Blocking" (relay is quiet - issues no messages via SCADA port)
462	Not used		
463	Inhibit I>1	PSL	Inhibit stage 1 overcurrent protection
464	Inhibit I>2	PSL	Inhibit stage 2 overcurrent protection
465	Inhibit I>3	PSL	Inhibit stage 3 overcurrent protection
466	Inhibit I>4	PSL	Inhibit stage 4 overcurrent protection
467	Inhibit IN>1	PSL	Inhibit stage 1 earth fault protection
468	Inhibit IN>2	PSL	Inhibit stage 2 earth fault protection
469	Inhibit IN>3	PSL	Inhibit stage 3 earth fault protection
470	Inhibit IN>4	PSL	Inhibit stage 4 earth fault protection
471	Inhibit V<1	PSL	Inhibit stage 1 undervoltage protection
472	Inhibit V<2	PSL	Inhibit stage 2 undervoltage protection
473	Inhibit V>1	PSL	Inhibit stage 1 overvoltage protection
474	Inhibit V>2	PSL	Inhibit stage 2 overvoltage protection
475	Inhibit VN>1	PSL	Inhibit stage 1 residual overvoltage protection
476	Inhibit VN>2	PSL	Inhibit stage 2 residual overvoltage protection
477	Not used		
478	Inhibit Thermal	PSL	Inhibit thermal overload protection
479	Inhibit CB Status	PSL	Inhibit circuit breaker state monitoring (no alarm for defective/stuck auxiliary contact)
480	Inhibit CB Fail	PSL	Inhibit circuit breaker fail protection
481	Inhibit OpenLine	PSL	Broken conductor protection
482	Inhibit VTS	PSL	Inhibit VT supervision (including turn OF MCB's) via PSL
483	Inhibit CTS	PSL	Inhibit CT supervision (both differential and standard CTS) via PSL
484	InhibitChecksync	PSL	Inhibit checksync
485	Inhibit TOR	PSL	Inhibit trip on reclose (TOR)
486	Inhibit SOTF	PSL	Inhibit switch onto fault (SOTF)
487	Disable Diff CTS	PSL	To disable differential CTS via PSL
488	Set SOTF	PSL	To enable SOTF logic by an external pulse. When this input is energized by en external pulse, SOTF becomes enabled during "SOTF Pulse" time setting

DDB no.	English text	Source	Description
489	AR Reset Z1 EXT	Zone 1 Extension Scheme	AR reset Z1X reach back to Z1 reach in Z1 extension scheme
490	Reset Zone 1 Ext	PSL	Reset zone Z1X back to Z1 reach using logic input (i.e. case when external AR and Z1 extension scheme are used)
491	Inhibit LoL	PSL	Inhibit Loss of Load scheme function
492	Aided 1 COS/LGS	PSL	Aided 1 channel out of service signal (COS) or loss of guard signal (LGS) in distance unblocking schemes. This signal is normally driven from an opto input on conventional channels or from InterMiCOM
493	Aided1 Scheme Rx	PSL	Aided channel 1 - external signal received, for input to distance fixed scheme logic
494	Aided 1 Receive	Aided Scheme Logic	Aided channel 1 - internal signal received generated in the signal receive logic
495	Not used		
496	Aid1 Block Send	PSL	Prevent sending by customized logic - aided scheme 1
497	Aid1 Custom Send	PSL	Programmable send logic for special customized scheme (aided channel 1)
498	Aided 1 Send	Aided Scheme Logic	Aided channel 1 send - internal send signal generated in signal send logic
499	Aid1 Custom T In	PSL	When using a custom programmable aided scheme 1, the user is able to include a current reversal guard timer. Energizing this DDB will additionally start this timer, from PSL
500	Aid1 CustomT Out	Aided Scheme Logic	When using customized aided scheme 1, this signal is used to indicate any additional condition that should be treated as permission for an aided trip (for example a permissive signal received could be connected, or a blocking signal could be inverted and then connected)
501	Aid1 Trip Enable	Aided Scheme Logic	Aided scheme 1 trip enable - this is a permissive signal used to accelerate zone 2, or a blocking signal which has been inverted. It is a signal output, part-way through the internal fixed logic of aided schemes
502	Aid1 Custom Trip	PSL	Aid1 custom trip enable
503	Aid 1 Dist Trip	Aided Scheme Logic	Aided scheme 1 distance trip command (output from aided tripping logic)
504	Aid 1 Delta Trip	Aided Scheme Logic	Aided Scheme 1 Delta Directional Trip command (output from Aided tripping logic)
505	Aid 1 DEF Trip	Aided Scheme Logic	Aided scheme 1 DEF trip command (output from aided tripping logic)
506	Aided 2 COS/LGS	PSL	Aided 2 channel out of service signal (COS) or loss of guard signal (LGS) in distance unblocking schemes. This signal is normally driven from an opto input on conventional channels or from InterMiCOM
507	Aided2 Scheme Rx	PSL	Aided channel 2 - external signal received, for input to distance fixed scheme logic
508	Aided 2 Receive	Aided Scheme Logic	Aided channel 2 - internal signal received generated in the signal receive logic
509 to 511	Not used		
512	Aid2 Block Send	PSL	Prevent sending by customized logic - aided scheme 2
513	Aid2 Custom Send	PSL	Programmable send logic for special customized scheme (aided channel 2)
514	Aided 2 Send	Aided Scheme Logic	Aided channel 2 send - internal send signal generated in signal send logic

DDB no.	English text	Source	Description
515	Aid2 Custom T In	PSL	When using a custom programmable aided scheme 2, the user is able to include a current reversal guard timer. Energizing this DDB will additionally start this timer, from PSL
516	Aid2 CustomT Out	Aided Scheme Logic	When using customized aided scheme 2, this signal is used to indicate any additional condition that should be treated as permission for an aided trip (for example a permissive signal received could be connected, or a blocking signal could be inverted and then connected)
517	Aid2 Trip Enable	Aided Scheme Logic	Aided scheme 2 trip enable - this is a permissive signal used to accelerate zone 2, or a blocking signal which has been inverted. It is a signal output, part-way through the internal fixed logic of aided schemes
518	Aid2 Custom Trip	PSL	Aid2 custom trip enable
519	Aid 2 Dist Trip	Aided Scheme Logic	Aided scheme 2 distance trip command (output from aided tripping logic)
520	Aid 2 Delta Trip	Aided Scheme Logic	Aided Scheme 2 Delta Directional Trip command (output from Aided tripping logic)
521	Aid 2 DEF Trip	Aided Scheme Logic	Aided scheme 2 DEF trip command (output from aided tripping logic)
522	Any Trip	Trip Conversion Logic	Any trip signal - can be used as the trip command in three-pole tripping applications
523	Trip Output A (CB1)	Trip Conversion Logic	Trip signal for phase A - used as a command to drive trip A output contact(s). Takes the output from the internal trip conversion logic
524	Trip Output B (CB1)	Trip Conversion Logic	Trip signal for phase B - used as a command to drive trip B output contact(s). Takes the output from the internal trip conversion logic
525	Trip Output C (CB1)	Trip Conversion Logic	Trip signal for phase C - used as a command to drive trip C output contact(s). Takes the output from the internal trip conversion logic
526	Trip 3ph (CB1)	Trip Conversion Logic	3 phase trip command
527	2/3 Ph Fault	Trip Conversion Logic	2 or 3 phase fault indication - used to flag whether the fault is polyphase. Typically used to control auto-reclose logic, where auto-reclosing is allowed only for single phase faults
528	3 Ph Fault	Trip Conversion Logic	3 phase fault indication. Typically used to control auto-reclose logic, where auto-reclosing is blocked for faults affecting all three phases together
529	Trip Inputs 3Ph (CB1)	PSL	Trip 3 phase - input to trip latching logic
530	Trip Inputs A	PSL	A phase trip - input to trip conversion logic. Essential to ensure correct single or three pole trip command results (e.g. converts a 2 pole trip to 3 phase)
531	Trip Inputs B	PSL	B phase trip - input to trip conversion logic. Essential to ensure correct single or three pole trip command results (e.g. converts a 2 pole trip to 3 phase)
532	Trip Inputs C	PSL	C phase trip - input to trip conversion logic. Essential to ensure correct single or three pole trip command results (e.g. converts a 2 pole trip to 3 phase)
533	Force 3Pole Trip (CB1)	PSL	Force any trip which is issued to always be 3 pole (trip conversion - used in single pole trip applications, to signal when single pole tripping and re-closing is either unwanted, or impossible)

DDB no.	English text	Source	Description
534	External Trip3ph (or CB1 Ext Trip3Ph)	PSL	External trip 3 phase - allows external protection to initiate breaker fail, circuit breaker condition monitoring statistics, and internal auto-reclose (if enabled)
535	External Trip A (or CB1 Ext Trip A)	PSL	External trip A phase - allows external protection to initiate breaker fail, circuit breaker condition monitoring statistics, and internal auto-reclose (if enabled)
536	External Trip B (or CB1 Ext Trip B)	PSL	External trip B phase - allows external protection to initiate breaker fail, circuit breaker condition monitoring statistics, and internal auto-reclose (if enabled)
537	External Trip C (or CB1 Ext Trip C)	PSL	External trip C phase - allows external protection to initiate breaker fail, circuit breaker condition monitoring statistics, and internal auto-reclose (if enabled)
538	CB2 Ext Trip3ph	PSL	External trip 3 phase - allows external protection to initiate breaker 2 fail P544 and P546 only
539	CB2 Ext Trip A	PSL	External trip A phase - allows external protection to initiate breaker 2 fail P544 and P546 only
540	CB2 Ext Trip B	PSL	External trip B phase - allows external protection to initiate breaker 2 fail P544 and P546 only
541	CB2 Ext Trip C	PSL	External trip C phase - allows external protection to initiate breaker 2 fail P544 and P546 only
542	SG Select x1	PSL	Setting group selector X1 (low bit)-selects SG2 if only DDB 542 signal is active. SG1 is active if both DDB 542 & DDB 543=0 SG4 is active if both DDB 542 & DDB 543=1
543	SG Select 1x	PSL	Setting group selector 1X (high bit)-selects SG3 if only DDB 543 is active. SG1 is active if both DDB 542 & DDB 543=0 SG4 is active if both DDB 542 & DDB 543=1
544	Clear Statistics	PSL	To reset all statistics values cumulated on the relay. If mapped, the input for this signal could come from a command of the remote end (DDB 1020 - clear stats cmd -) via IM64
545 to 549	Not used		
550	Inhibit Predictive OST	PSL	Block predictive out of step tripping command
551	Predictive OST	PSL	Predictive out of step trip
552	Inhibit OST	PSL	Block out of step tripping command
553	OST	PSL	Out of step trip
554	Start Z5	PSL	Positive sequence impedance is detected in Z5
555	Start Z6	PSL	Positive sequence impedance is detected in Z6
556	CNV Active	Distance Basic Scheme	Level detector Current No Volts (CNV) exceeded
557	TOR Trip CNV	Distance Basic Scheme	Trip on Reclose trip due to Current No Volts (CNV) level detectors
558	SOTF Trip CNV	Distance Basic Scheme	Switch on to Fault trip due to Current No Volts (CNV) level detectors
559	Fast OV PHA	Distance Basic Scheme	Phase A Fast Overvoltage level detector used by Current No Volts (CNV)
560	Fast OV PHB	Distance Basic Scheme	Phase B Fast Overvoltage level detector used by Current No Volts (CNV)
561	Fast OV PHC	Distance Basic Scheme	Phase C Fast Overvoltage level detector used by Current No Volts (CNV)

DDB no.	English text	Source	Description
562	I2> Inhibit	PSL	Inhibit Neg Sequence overcurrent protection
563	I2>1 Tmr Blk	PSL	Block Neg Sequence overcurrent stage 1 time delayed trip
564	I2>2 Tmr Blk	PSL	Block Neg Sequence overcurrent stage 2 time delayed trip
565	I2>3 Tmr Blk	PSL	Block Neg Sequence overcurrent stage 3 time delayed trip
566	I2>4 Tmr Blk	PSL	Block Neg Sequence overcurrent stage 4 time delayed trip
567	I2>1 Start	Neg Sequence overcurrent	1st stage Neg Sequence overcurrent start
568	I2>2 Start	Neg Sequence overcurrent	2nd stage Neg Sequence overcurrent start
569	I2>3 Start	Neg Sequence overcurrent	3rd stage Neg Sequence overcurrent start
570	I2>4 Start	Neg Sequence overcurrent	4th stage Neg Sequence overcurrent start
571	I2>1 Trip	Neg Sequence overcurrent	1st stage Neg Sequence overcurrent trip
572	I2>2 Trip	Neg Sequence overcurrent	2nd stage Neg Sequence overcurrent trip
573	I2>3 Trip	Neg Sequence overcurrent	3rd stage Neg Sequence overcurrent trip
574	I2>4 Trip	Neg Sequence overcurrent	4th stage Neg Sequence overcurrent trip
575	Not used		
576	AR Trip Test	Commissioning Test	Auto-reclose trip test cycle in progress. Indication that a manually-initiated test cycle is in progress P543 and P545 only
577	AR Trip Test A	Commissioning Test	Auto-reclose trip test A phase. Indication that a manually-initiated test cycle is in progress
578	AR Trip Test B	Commissioning Test	Auto-reclose trip test B phase. Indication that a manually-initiated test cycle is in progress
579	AR Trip Test C	Commissioning Test	Auto-reclose trip test C phase. Indication that a manually-initiated test cycle is in progress
580	AR Init 3Ph	Auto-Reclose	Initiate 3 phase auto-reclose (signal to an external re-closer) P543 and P545 only
581	Not used		
582	Diff Trip	C Diff	Current differential trip
583	Diff Trip A	C Diff	Current differential A phase trip
584	Diff Trip B	C Diff	Current differential B phase trip
585	Diff Trip C	C Diff	Current differential C phase trip
586	Diff InterTrip	C Diff	Current differential intertrip
587	Diff InterTrip A	C Diff	Current differential A phase intertrip
588	Diff InterTrip B	C Diff	Current differential B phase intertrip
589	Diff InterTrip C	C Diff	Current differential C phase intertrip
590	Perm InterTrip	C Diff	Permissive intertrip
591	Stub Bus Trip	C Diff	Stub bus trip
592	df/dt> Inhibit	PSL	Inhibit df/dt protection
593	df/dt>1 Tmr Blk	PSL	Block df/dt Stage 1 Timer
594	df/dt>2 Tmr Blk	PSL	Block df/dt Stage 2 Timer
595	df/dt>3 Tmr Blk	PSL	Block df/dt Stage 3 Timer
596	df/dt>4 Tmr Blk	PSL	Block df/dt Stage 4 Timer
597	df/dt>1 Start	df/dt protection	df/dt Stage 1 Start

DDB no.	English text	Source	Description
598	df/dt>2 Start	df/dt protection	df/dt Stage 2 Start
599	df/dt>3 Start	df/dt protection	df/dt Stage 3 Start
600	df/dt>4 Start	df/dt protection	df/dt Stage 4 Start
601	df/dt>1 Trip	df/dt protection	df/dt Stage 1 Trip
602	df/dt>2 Trip	df/dt protection	df/dt Stage 2 Trip
603	df/dt>3 Trip	df/dt protection	df/dt Stage 3 Trip
604	df/dt>4 Trip	df/dt protection	df/dt Stage 4 Trip
605	Not used		
608	Zone 1 Trip	Distance Basic Scheme	Zone 1 trip
609	Zone 1 A Trip	Distance Basic Scheme	Zone 1 A phase trip
610	Zone 1 B Trip	Distance Basic Scheme	Zone 1 B phase trip
611	Zone 1 C Trip	Distance Basic Scheme	Zone 1 C phase trip
612	Zone 1 N Trip	Distance Basic Scheme	Zone 1 N trip
613	Zone 2 Trip	Distance Basic Scheme	Zone 2 trip
614	Zone 2 A Trip	Distance Basic Scheme	Zone 2 A phase trip
615	Zone 2 B Trip	Distance Basic Scheme	Zone 2 B phase trip
616	Zone 2 C Trip	Distance Basic Scheme	Zone 2 C phase trip
617	Zone 2 N Trip	Distance Basic Scheme	Zone 2 N trip
618	Zone 3 Trip	Distance Basic Scheme	Zone 3 trip
619	Zone 3 A Trip	Distance Basic Scheme	Zone 3 A phase trip
620	Zone 3 B Trip	Distance Basic Scheme	Zone 3 B phase trip
621	Zone 3 C Trip	Distance Basic Scheme	Zone 3 C phase trip
622	Zone 3 N Trip	Distance Basic Scheme	Zone 3 N trip
623	Zone P Trip	Distance Basic Scheme	Zone P trip
624	Zone P A Trip	Distance Basic Scheme	Zone P A phase trip
625	Zone P B Trip	Distance Basic Scheme	Zone P B phase trip
626	Zone P C Trip	Distance Basic Scheme	Zone P C phase trip
627	Zone P N Trip	Distance Basic Scheme	Zone P N trip
628	Zone 4 Trip	Distance Basic Scheme	Zone 4 trip
629	Zone 4 A Trip	Distance Basic Scheme	Zone 4 A phase trip
630	Zone 4 B Trip	Distance Basic Scheme	Zone 4 B phase trip
631	Zone 4 C Trip	Distance Basic Scheme	Zone 4 C phase trip
632	Zone 4 N Trip	Distance Basic Scheme	Zone 4 N phase trip
633	Aided 1 Trip A	Aided Scheme Logic	Aided channel scheme 1 trip A phase
634	Aided 1 Trip B	Aided Scheme Logic	Aided channel scheme 1 trip B phase
635	Aided 1 Trip C	Aided Scheme Logic	Aided channel scheme 1 trip C phase
636	Aided 1 Trip N	Aided Scheme Logic	Aided channel scheme 1 trip involving ground (N)
637	Aid 1 WI Trip A	Aided Scheme Logic	Aided scheme 1 weak infeed trip phase A
638	Aid 1 WI Trip B	Aided Scheme Logic	Aided scheme 1 weak infeed trip phase B
639	Aid 1 WI Trip C	Aided Scheme Logic	Aided scheme 1 weak infeed trip phase C
640	Aid1 Delta Tr3Ph	Aided Scheme Logic	Aided scheme 1 Delta directional Trip 3 Phase
641	Aid1 DEF Trip3Ph	Aided Scheme Logic	Aided 1 directional earth fault scheme trip 3 phase
642	Aid1 WI Trip 3Ph	Aided Scheme Logic	Aided channel scheme 1 - weak infeed logic trip 3 phase
643	Aided 2 Trip A	Aided Scheme Logic	Aided channel scheme 2 trip A phase
644	Aided 2 Trip B	Aided Scheme Logic	Aided channel scheme 2 trip B phase
645	Aided 2 Trip C	Aided Scheme Logic	Aided channel scheme 2 trip C phase
646	Aided 2 Trip N	Aided Scheme Logic	Aided channel scheme 2 trip involving ground (N)
647	Aid 2 WI Trip A	Aided Scheme Logic	Aided scheme 2 weak infeed trip phase A

DDB no.	English text	Source	Description
648	Aid 2 WI Trip B	Aided Scheme Logic	Aided scheme 2 weak infeed trip phase B
649	Aid 2 WI Trip C	Aided Scheme Logic	Aided scheme 2 weak infeed trip phase C
650	Aid2 Delta Tr3Ph	Aided Scheme Logic	Aided scheme 2 Delta directional Trip 3 Phase
651	Aid2 DEF Trip3Ph	Aided Scheme Logic	Aided 2 directional earth fault scheme trip 3 phase
652	Aid2 WI Trip 3Ph	Aided Scheme Logic	Aided channel scheme 2 - weak infeed logic trip 3 phase
653	Not used		
654	Loss of Load Trip	Loss of Load Logic	Loss of load trip
655	I>1 Trip	Overcurrent	1st stage phase overcurrent trip 3 phase
656	I>1 Trip A	Overcurrent	1st stage phase overcurrent trip phase A
657	I>1 Trip B	Overcurrent	1st stage phase overcurrent trip phase B
658	I>1 Trip C	Overcurrent	1st stage phase overcurrent trip phase C
659	I>2 Trip	Overcurrent	2nd stage phase overcurrent trip 3 phase
660	I>2 Trip A	Overcurrent	2nd stage phase overcurrent trip phase A
661	I>2 Trip B	Overcurrent	2nd stage phase overcurrent trip phase B
662	I>2 Trip C	Overcurrent	2nd stage phase overcurrent trip phase C
663	I>3 Trip	Overcurrent	3rd stage phase overcurrent trip 3 phase
664	I>3 Trip A	Overcurrent	3rd stage phase overcurrent trip phase A
665	I>3 Trip B	Overcurrent	3rd stage phase overcurrent trip phase B
666	I>3 Trip C	Overcurrent	3rd stage phase overcurrent trip phase C
667	I>4 Trip	Overcurrent	4th stage phase overcurrent trip 3 phase
668	I>4 Trip A	Overcurrent	4th stage phase overcurrent trip phase A
669	I>4 Trip B	Overcurrent	4th stage phase overcurrent trip phase B
670	I>4 Trip C	Overcurrent	4th stage phase overcurrent trip phase C
671	IN>1 Trip	Earth Fault	1st stage stand by earth fault (SBEF) protection trip
672	IN>2 Trip	Earth Fault	2nd stage stand by earth fault (SBEF) protection trip
673	IN>3 Trip	Earth Fault	3rd stage stand by earth fault (SBEF) protection trip
674	IN>4 Trip	Earth Fault	4th stage stand by earth fault (SBEF) protection trip
675	ISEF>1 Trip	Sensitive Earth Fault	1st stage Sensitive Earth Fault (SEF) protection trip
676	ISEF>2 Trip	Sensitive Earth Fault	2nd stage Sensitive Earth Fault (SEF) protection trip
677	ISEF>3 Trip	Sensitive Earth Fault	3rd stage Sensitive Earth Fault (SEF) protection trip
678	ISEF>4 Trip	Sensitive Earth Fault	4th stage Sensitive Earth Fault (SEF) protection trip
679	Broken Wire Trip	Broken Conductor	Broken conductor trip
680	Thermal Trip	Thermal Overload	Thermal overload trip
681	Not Used		
682	IREF> Trip	Sensitive Earth Fault	Restricted Earth Fault (REF) protection trip
683	V<1 Trip	Undervoltage	Undervoltage stage 1, three phase trip
684	V<1 Trip A/AB	Undervoltage	Undervoltage stage 1 A/AB phase trip
685	V<1 Trip B/BC	Undervoltage	Undervoltage stage 1 B/BC phase trip
686	V<1 Trip C/CA	Undervoltage	Undervoltage stage 1 C/CA phase trip
687	V<2 Trip	Undervoltage	Undervoltage stage 2, three phase trip
688	V<2 Trip A/AB	Undervoltage	Undervoltage stage 2 A/AB phase trip
689	V<2 Trip B/BC	Undervoltage	Undervoltage stage 2 B/BC phase trip
690	V<2 Trip C/CA	Undervoltage	Undervoltage stage 2 C/CA phase trip
691	V>1 Trip	Overvoltage	Overvoltage stage 1, three phase trip

DDB no.	English text	Source	Description
692	V>1 Trip A/AB	Overvoltage	Overvoltage stage 1 A/AB phase trip
693	V>1 Trip B/BC	Overvoltage	Overvoltage stage 1 B/BC phase trip
694	V>1 Trip C/CA	Overvoltage	Overvoltage stage 1 C/CA phase trip
695	V>2 Trip	Overvoltage	Overvoltage stage 2, three phase trip
696	V>2 Trip A/AB	Overvoltage	Overvoltage stage 2 A/AB phase trip
697	V>2 Trip B/BC	Overvoltage	Overvoltage stage 2 B/BC phase trip
698	V>2 Trip C/CA	Overvoltage	Overvoltage stage 2 C/CA phase trip
699	Pole Discrepancy (CB1)	Pole Discrepancy	Pole discrepancy signal to force a three pole trip conversion, if the relay detects one pole dead, and no auto-reclose in progress
700	VN>1 Trip	Residual overvoltage	Residual overvoltage stage 1 trip
701	VN>2 Trip	Residual Overvoltage	Residual overvoltage stage 2 trip
702	Fault REC TRIG	PSL	Trigger for fault recorder
703	Not used		
704	TOR Trip Zone 1	Trip on Close	TOR trip zone 1 (trip on reclose)
705	TOR Trip Zone 2	Trip on Close	TOR trip zone 2
706	TOR Trip Zone 3	Trip on Close	TOR trip zone 3
707	TOR Trip Zone 4	Trip on Close	TOR trip zone 4
708	TOR Trip Zone P	Trip on Close	TOR trip zone P
709	SOTF Trip Zone 1	Trip on Close	SOTF trip zone 1 (switch on to fault)
710	SOTF Trip Zone 2	Trip on Close	SOTF trip zone 2
711	SOTF Trip Zone 3	Trip on Close	SOTF trip zone 3
712	SOTF Trip Zone 4	Trip on Close	SOTF trip zone 4
713	SOTF Trip Zone P	Trip on Close	SOTF trip zone P
714 to 735	Not used		
736	Any Start		Any start
737	Differential Start	C Diff	Current differential start
738	Differential Start A	C Diff	Current differential A phase start
739	Differential Start B	C Diff	Current differential B phase start
740	Differential Start C	C Diff	Current differential C phase start
741	Zone 1 A Start	Distance Basic Scheme	Zone 1 A phase start
742	Zone 1 B Start	Distance Basic Scheme	Zone 1 B phase start
743	Zone 1 C Start	Distance Basic Scheme	Zone 1 C phase start
744	Zone 1 N Start	Distance Basic Scheme	Zone 1 ground element start
745	Zone 2 A Start	Distance Basic Scheme	Zone 2 A phase start
746	Zone 2 B Start	Distance Basic Scheme	Zone 2 B phase start
747	Zone 2 C Start	Distance Basic Scheme	Zone 2 C phase start
748	Zone 2 N Start	Distance Basic Scheme	Zone 2 ground element start
749	Zone 3 A Start	Distance Basic Scheme	Zone 3 A phase start
750	Zone 3 B Start	Distance Basic Scheme	Zone 3 B phase start
751	Zone 3 C Start	Distance Basic Scheme	Zone 3 C phase start
752	Zone 3 N Start	Distance Basic Scheme	Zone 3 N start
753	Zone P A Start	Distance Basic Scheme	Zone P A phase start
754	Zone P B Start	Distance Basic Scheme	Zone P B phase start
755	Zone P C Start	Distance Basic Scheme	Zone P C phase start
756	Zone P N Start	Distance Basic Scheme	Zone P N start
757	Zone 4 A Start	Distance Basic Scheme	Zone 4 A phase start
758	Zone 4 B Start	Distance Basic Scheme	Zone 4 B phase start
759	Zone 4 C Start	Distance Basic Scheme	Zone 4 C phase start
760	Zone 4 N Start	Distance Basic Scheme	Zone 4 N start
761	I>1 Start	Overcurrent	1st stage overcurrent start 3 phase
762	I>1 Start A	Overcurrent	1st stage overcurrent start phase A

DDB no.	English text	Source	Description
763	I>1 Start B	Overcurrent	1st stage overcurrent start phase B
764	I>1 Start C	Overcurrent	1st stage overcurrent start phase C
765	I>2 Start	Overcurrent	2nd stage overcurrent start 3 phase
766	I>2 Start A	Overcurrent	2nd stage overcurrent start phase A
767	I>2 Start B	Overcurrent	2nd stage overcurrent start phase B
768	I>2 Start C	Overcurrent	2nd stage overcurrent start phase C
769	I>3 Start	Overcurrent	3rd stage overcurrent start 3 phase
770	I>3 Start A	Overcurrent	3rd stage overcurrent start phase A
771	I>3 Start B	Overcurrent	3rd stage overcurrent start phase B
772	I>3 Start C	Overcurrent	3rd stage overcurrent start phase C
773	I>4 Start	Overcurrent	4th stage overcurrent start 3 phase
774	I>4 Start A	Overcurrent	4th stage overcurrent start phase A
775	I>4 Start B	Overcurrent	4th stage overcurrent start phase B
776	I>4 Start C	Overcurrent	4th Stage overcurrent start phase C
777	IN>1 Start	Earth Fault	1st stage stand by earth fault (SBEF) overcurrent start
778	IN>2 Start	Earth Fault	2nd stage stand by earth fault (SBEF) overcurrent start
779	IN>3 Start	Earth Fault	3rd stage stand by earth fault (SBEF) overcurrent start
780	IN>4 Start	Earth Fault	4th stage stand by earth fault (SBEF) overcurrent start
781	ISEF>1 Start	Sensitive Earth Fault	1st stage Sensitive Earth Fault (SEF) overcurrent start
782	ISEF>2 Start	Sensitive Earth Fault	2nd stage Sensitive Earth Fault (SEF) overcurrent start
783	ISEF>3 Start	Sensitive Earth Fault	3rd stage Sensitive Earth Fault (SEF) overcurrent start
784	ISEF>4 Start	Sensitive Earth Fault	4th stage Sensitive Earth Fault (SEF) overcurrent start
785	Thermal Alarm	Thermal Overload	Thermal overload alarm
786,787	Not used		
788	V<1 Start	Undervoltage	Undervoltage stage 1, three phase start
789	V<1 Start A/AB	Undervoltage	Undervoltage stage 1, A phase start
790	V<1 Start B/BC	Undervoltage	Undervoltage stage 1, B phase start
791	V<1 Start C/CA	Undervoltage	Undervoltage stage 1, C phase start
792	V<2 Start	Undervoltage	Undervoltage stage 2, three phase start
793	V<2 Start A/AB	Undervoltage	Undervoltage stage 2, A phase start
794	V<2 Start B/BC	Undervoltage	Undervoltage stage 2, B phase start
795	V<2 Start C/CA	Undervoltage	Undervoltage stage 2, C phase start
796	V>1 Start	Overvoltage	Overvoltage stage 1, three phase start
797	V>1 Start A/AB	Overvoltage	Overvoltage stage 1, A phase start
798	V>1 Start B/BC	Overvoltage	Overvoltage stage 1, B phase start
799	V>1 Start C/CA	Overvoltage	Overvoltage stage 1, C phase start
800	V>2 Start	Overvoltage	Overvoltage stage 2, three phase start
801	V>2 Start A/AB	Overvoltage	Overvoltage stage 2, A phase start
802	V>2 Start B/BC	Overvoltage	Overvoltage stage 2, B phase start
803	V>2 Start C/CA	Overvoltage	Overvoltage stage 2, C phase start
804	VN>1 Start	Residual Overvoltage	Residual overvoltage stage 1 start
805	VN>2 Start	Residual Overvoltage	Residual overvoltage stage 2 start
806 to 828	Not used		
829	VA< Start	Poledead	Phase A undervoltage level detector used in the pole dead logic. Detectors have a fixed threshold: undervoltage pickup 38.1 V-drop off 43.8 V

DDB no.	English text	Source	Description
830	VB< Start	Poledead	Phase B undervoltage level detector used in the pole dead logic. Detectors have a fixed threshold: undervoltage pickup 38.1 V-drop off 43.8 V
831	VC< Start	Poledead	Phase C undervoltage level detector used in the pole dead logic. Detectors have a fixed threshold: undervoltage pickup 38.1 V-drop off 43.8 V
832	VTS Fast Block	VT Supervision	VT supervision fast block - blocks elements which would otherwise maloperate immediately a fuse failure event occurs
833	VTS Slow Block	VT Supervision	VT supervision slow block - blocks elements which would otherwise maloperate some time after a fuse failure event occurs
834	Bfail1 Trip 3ph (CB1)	CB Fail	tBF1 trip 3Ph - three phase output from circuit breaker failure logic, stage 1
835	Bfail2 Trip 3ph (CB1)	CB Fail	tBF2 trip 3Ph - three phase output from circuit breaker failure logic, stage 2
836	CB2 Fail1 Trip	CB Fail	tBF1 trip 3Ph - three phase output from circuit breaker failure 2 logic, stage 1 P544 and P546 only
837	CB2 Fail2 Trip	CB Fail	tBF2 trip 3Ph - three phase output from circuit breaker failure 2 logic, stage 2 P544 and P546 only
838	Control Trip (CB1)	CB Control	Control trip - operator trip instruction to the circuit breaker, via menu, or SCADA. (Does not operate for protection element trips)
839	Control Close (CB1)	CB Control	Control close command to the circuit breaker. Operates for a manual close command (menu, SCADA), and additionally is driven by the auto-reclose close command
840	Control Trip CB2	CB Control	Control trip - operator trip instruction to the circuit breaker 2, via menu, or SCADA. (Does not operate for protection element trips) P544 and P546 only
841	Control Close CB2	CB Control	Control close command to the circuit breaker 2. Operates for a manual close command (menu, SCADA) P544 and P546 only
842	Close in Prog (CB1)	CB Control	Control close in progress - the relay has been given an instruction to close the circuit breaker, but the manual close timer delay has not yet finished timing out
843	Block Main Prot	Auto-Reclose	Auto-reclose block main protection
844	AR 3pole in prog (CB1)	Auto-Reclose	Auto-reclose 3 pole in progress (dead time is running)
845	AR 1pole in prog (CB1)	Auto-Reclose	Single pole auto-reclose in progress (dead time is running)
846	Seq Counter = 0	Auto-Reclose	Auto-reclose sequence counter is at zero - no previous faults have been cleared within recent history. The sequence count is at zero because no reclaim times are timing out, and the auto-recloser is not locked out. The recloser is awaiting the first protection trip, and all programmed cycles are free to follow
847	Seq Counter = 1	Auto-Reclose	The first fault trip has happened in a new auto-reclose sequence. Dead time 1, or reclaim time 1 are in the process of timing out
848	Seq Counter = 2	Auto-Reclose	Auto-reclose sequence counter is at 2. This means that the initial fault trip happened, and then another trip followed, moving the counter on to 2

DDB no.	English text	Source	Description
849	Seq Counter = 3	Auto-Reclose	Auto-reclose sequence counter is at 3. This means that the initial fault trip happened, and then 2 trips followed, moving the counter on to 3
850	Seq Counter = 4	Auto-Reclose	Auto-reclose sequence counter is at 4. This means that the initial fault trip happened, and then 3 trips followed, moving the counter on to 4
851	Reserved		
852	Successful Close (CB1)	Auto-Reclose	Successful re-closure indication. The circuit breaker was re-closed by the AR function, and stayed closed. This indication is raised at the expiry of the reclaim time
853	3P Dead Time IP	Auto-Reclose	3 pole Auto-reclose dead time in progress P544 and P546 only
854	Auto Close (CB1)	Auto-Reclose	Auto-reclose command to the circuit breaker
855	CB2 AR 1p InProg	Auto-reclose CB2	Single pole auto-reclose in progress (dead time is running) CB2 P544 and P546 only
856	A/R Status 3P	Auto-Reclose	3 Pole auto-recloser in service - the auto-reclose function has been enabled either in the relay menu, or by an opto input P544 and P546 only
857	AR Status 1P	Auto-Reclose	Single pole auto-recloser in service - the auto-reclose function has been enabled either in the relay menu, or by an opto input P544 and P546 only
858	Force 3 pole (CB1)	Auto-Reclose	Due to the sequence count reached, lockout, or any outage of the internal auto-recloser - this signal instructs any other trips to be forced to three pole trips
859	AR Blocked	Auto-Reclose	It indicates that AR has been blocked (ex. from external input BAR)
860	Lockout Alarm (CB1)	CB Control	Composite lockout alarm - circuit breaker locked out due to auto-recloser, or condition monitoring reasons
861	GPSAlarm Instant	C Diff	Instantaneous GPS Alarm initiated immediately on loss of the GPS 1 pulse per second input signal
862 to 863	Not used		
864	IA< Start	Undercurrent	A phase undercurrent level detector pickup (detects low current). It is used for breaker failure in models with one CT input and also it is used for fault record reset (as the sum CTs in models with two CTs)
865	IB< Start	Undercurrent	B phase undercurrent level detector pickup (detects low current). It is used for breaker failure in models with one CT input and also it is used for fault record reset (as the sum CTs in models with two CTs)
866	IC< Start	Undercurrent	C phase undercurrent level detector pickup (detects low current). It is used for breaker failure in models with one CT input and also it is used for fault record reset (as the sum CTs in models with two CTs)
867	CB1 IA< Start	Undercurrent	A phase undercurrent level detector pickup (detects low current in CT1). It is used for breaker failure in models with two CT inputs P544 and P546 only
868	CB1 IB< Start	Undercurrent	B phase undercurrent level detector pickup (detects low current in CT1). It is used for breaker failure in models with two CT inputs P544 and P546 only

DDB no.	English text	Source	Description
869	CB1 IC< Start	Undercurrent	C phase undercurrent level detector pickup (detects low current in CT1). It is used for breaker failure in models with two CT inputs P544 and P546 only
870	CB2 IA< Start	Undercurrent	A phase undercurrent level detector pickup (detects low current in CT2). It is used for breaker failure in models with two CT inputs P544 and P546 only
871	CB2 IB< Start	Undercurrent	B phase undercurrent level detector pickup (detects low current in CT2). It is used for breaker failure in models with two CT inputs P544 and P546 only
872	CB2 IC< Start	Undercurrent	C phase undercurrent level detector pickup (detects low current in CT2). It is used for breaker failure in models with two CT inputs P544 and P546 only
873	ISEF< Start	Undercurrent	SEF undercurrent level detector pickup (detects low current in CT SEF)
874 to 875	Not used		
876	Z1X Active	Zone 1 Extension Scheme	Zone 1 extension active - zone 1 is operating in its reach extended mode
877	TOC Active	Trip on Close	Trip on close functions (either SOTF or TOR) active. These elements are in-service for a period of time following circuit breaker closure
878	TOR Active	Trip on Close	Trip on re-close protection is active - indicated TOC delay timer has elapsed after circuit breaker opening, and remains in-service on auto-reclosure for the duration of the trip on close window
879	SOTF Active	Trip on Close	Switch on to fault protection is active - in service on manual breaker closure, and then remains in-service for the duration of the trip on close window
880	SysChks Inactive (CB1)	Check Sync	System checks inactive (output from the check synchronism, and other voltage checks)
881	CS1 Enabled (CB1)	PSL	Check sync. stage 1 enabled
882	CS2 Enabled (CB1)	PSL	Check sync. stage 2 enabled
883	Check Sync 1 OK (CB1)	Check Sync	Check sync. stage 1 OK
884	Check Sync 2 OK (CB1)	Check Sync	Check sync. stage 2 OK
885	SysSplit Enabled	PSL	System split function enabled P543 and P545 only
886	Live Bus (CB1)	Voltage Monitoring	Indicates live bus condition is detected
887	Dead Bus (CB1)	Voltage Monitoring	Indicates dead bus condition is detected
888	Live Line	Voltage Monitoring	Indicates live line condition is detected
889	Dead Line	Voltage Monitoring	Indicates dead line condition is detected
890	All Poles Dead	Pole Dead Logic	Pole dead logic detects 3 phase breaker open
891	Any Pole Dead	Pole Dead Logic	Pole dead logic detects at least one breaker pole open
892	Pole Dead A	Pole Dead Logic	Phase A pole dead
893	Pole Dead B	Pole Dead Logic	Phase B pole dead
894	Pole Dead C	Pole Dead Logic	Phase C pole dead
895	Reserved		
896	Reserved		
897	AR Check Sync OK	PSL	Input to the auto-reclose logic to indicate system in synchronism

DDB no.	English text	Source	Description
898	Ctl Check Sync	PSL	Input to the circuit breaker control logic to indicate manual check synchronization conditions are satisfied
899	AR Sys Checks OK	PSL	Input to the auto-reclose logic to indicate system checks conditions are satisfied
900	CB1 Ext CS OK	Check sync	External check-sync is OK for CB1 P544 and P546 only
901	CB2 Ext CS OK	Check sync	External check-sync is OK for CB2 P544 and P546 only
902	Not used		
903	CB(1) Open 3 ph	CB Status	Circuit breaker is open, all three phases
904	CB(1) Open A ph	CB Status	Circuit breaker A phase is open
905	CB(1) Open B ph	CB Status	Circuit breaker A phase is open
906	CB(1) Open C ph	CB Status	Circuit breaker A phase is open
907	CB(1) Closed 3 ph	CB Status	Circuit breaker is closed, all three phases
908	CB(1) Closed A ph	CB Status	Circuit breaker A phase is closed
909	CB(1) Closed B ph	CB Status	Circuit breaker B phase is closed
910	CB(1) Closed C ph	CB Status	Circuit breaker C phase is closed
911	CB2 Open 3 ph	CB Status	Circuit breaker 2 is open, all three phases P544 and P546 only
912	CB2 Open A ph	CB Status	Circuit breaker 2 A phase is open P544 and P546 only
913	CB2 Open B ph	CB Status	Circuit breaker 2 A phase is open P544 and P546 only
914	CB2 Open C ph	CB Status	Circuit breaker 2 A phase is open P544 and P546 only
915	CB2 Closed 3 ph	CB Status	Circuit breaker 2 is closed, all three phases P544 and P546 only
916	CB2 Closed A ph	CB Status	Circuit breaker 2 A phase is closed P544 and P546 only
917	CB2 Closed B ph	CB Status	Circuit breaker 2 B phase is closed P544 and P546 only
918	CB2 Closed C ph	CB Status	Circuit breaker 2 C phase is closed P544 and P546 only
919	Inhibit Cmp V1>1	PSL	Inhibit the first stage compensated overvoltage element
920	Inhibit Cmp V1>2	PSL	Inhibit the second stage compensated overvoltage element
921	Cmp V1>1 Tim Blk	PSL	Block the first stage compensated overvoltage element
922	Cmp V1>2 Tim Blk	PSL	Block the second stage compensated overvoltage element
923	V1>1 Cmp Start	Overvoltage	1st stage compensated overvoltage start signal
924	V1>2 Cmp Start	Overvoltage	2nd stage compensated overvoltage start signal
925	V1>1 Cmp Trip	Overvoltage	1st stage compensated overvoltage trip signal
926	V1>2 Cmp Trip	Overvoltage	2nd stage compensated overvoltage trip signal
927	Not used		
928	CTS Block	CT Supervision	Standard or differential CT supervision block (current transformer supervision)
929	CTS Block Diff	CT Supervision	Differential CT supervision block (current transformer supervision)
930	CTS Restrain	CT Supervision	Differential CT supervision restrain (current transformer supervision)

DDB no.	English text	Source	Description
931	CT1 L i1>	CT Supervision	Positive sequence current in local end CT1 exceed CTS i1> setting
932	CT2 L i1>	CT Supervision	Positive sequence current in local end CT2 exceed CTS i1> setting
933	CT1 R1 i1>	CT Supervision	Positive sequence current in remote 1 end CT1 exceed CTS i1> setting
934	CT2 R1 i1>	CT Supervision	Positive sequence current in remote 1 end CT2 exceed CTS i1> setting
935	CT1 R2 i1>	CT Supervision	Positive sequence current in remote 2 end CT1 exceed CTS i1> setting
936	CT2 R2 i1>	CT Supervision	Positive sequence current in remote 2 end CT2 exceed CTS i1> setting
937	CT1 L i2/i1>	CT Supervision	i2/i1 ratio in local end CT1 exceed CTS i2/i1> setting
938	CT2 L i2/i1>	CT Supervision	i2/i1 ratio in local end CT2 exceed CTS i2/i1> setting
939	CT1 R1 i2/i1>	CT Supervision	i2/i1 ratio in remote 1 end CT1 exceed CTS i2/i1> setting
940	CT2 R1 i2/i1>	CT Supervision	i2/i1 ratio in remote 1 end CT2 exceed CTS i2/i1> setting
941	CT1 R2 i2/i1>	CT Supervision	i2/i1 ratio in remote 2 end CT1 exceed CTS i2/i1> setting
942	CT2 R2 i2/i1>	CT Supervision	i2/i1 ratio in remote 2 end CT2 exceed CTS i2/i1> setting
943	CT1 L i2/i1>>	CT Supervision	i2/i1 ratio in local end CT1 exceed CTS i2/i1>> setting
944	CT2 L i2/i1>>	CT Supervision	i2/i1 ratio in local end CT2 exceed CTS i2/i1>> setting
945	CT1 R1 i2/i1>>	CT Supervision	i2/i1 ratio in remote 1 end CT1 exceed CTS i2/i1>> setting
946	CT2 R1 i2/i1>>	CT Supervision	i2/i1 ratio in remote 1 end CT2 exceed CTS i2/i1>> setting
947	CT1 R2 i2/i1>>	CT Supervision	i2/i1 ratio in remote 2 end CT1 exceed CTS i2/i1>> setting
948	CT2 R2 i2/i1>>	CT Supervision	i2/i1 ratio in remote 2 end CT2 exceed CTS i2/i1>> setting
949 to 951	Not used		
952	Faulted Phase A	PSL	Faulted phase A - must be assigned, as this sets the start flag used in records, and on the LCD display
953	Faulted Phase B	PSL	Faulted phase B - must be assigned, as this sets the start flag used in records, and on the LCD display
954	Faulted Phase C	PSL	Faulted phase C - must be assigned, as this sets the start flag used in records, and on the LCD display
955	Faulted Phase N	PSL	Faulted phase N (fault involves ground) - must be assigned, as this sets the start flag used in records, and on the LCD display
956	Started Phase A	PSL	Started phase A - must be assigned, as this sets the start flag used in records, and on the LCD display
957	Started Phase B	PSL	Started phase B - must be assigned, as this sets the start flag used in records, and on the LCD display
958	Started Phase C	PSL	Started phase C - must be assigned, as this sets the start flag used in records, and on the LCD display
959	Started Phase N	PSL	Started phase N (fault involves ground) - must be assigned, as this sets the start flag used in records, and on the LCD display
960	Zone1 AN Element	Distance Elements	Zone 1 AN ground fault element
961	Zone1 BN Element	Distance Elements	Zone 1 BN ground fault element

DDB no.	English text	Source	Description
962	Zone1 CN Element	Distance Elements	Zone 1 CN ground fault element
963	Zone1 AB Element	Distance Elements	Zone 1 AB phase fault element
964	Zone1 BC Element	Distance Elements	Zone 1 BC phase fault element
965	Zone1 CA Element	Distance Elements	Zone 1 CA phase fault element
966	Zone2 AN Element	Distance Elements	Zone 2 AN ground fault element
967	Zone2 BN Element	Distance Elements	Zone 2 BN ground fault element
968	Zone2 CN Element	Distance Elements	Zone 2 CN ground fault element
969	Zone2 AB Element	Distance Elements	Zone 2 AB phase fault element
970	Zone2 BC Element	Distance Elements	Zone 2 BC phase fault element
971	Zone2 CA Element	Distance Elements	Zone 2 CA phase fault element
972	Zone3 AN Element	Distance Elements	Zone 3 AN ground fault element
973	Zone3 BN Element	Distance Elements	Zone 3 BN ground fault element
974	Zone3 CN Element	Distance Elements	Zone 3 CN ground fault element
975	Zone3 AB Element	Distance Elements	Zone 3 AB phase fault element
976	Zone3 BC Element	Distance Elements	Zone 3 BC phase fault element
977	Zone3 CA Element	Distance Elements	Zone 3 CA phase fault element
978	ZoneP AN Element	Distance Elements	Zone P AN ground fault element
979	ZoneP BN Element	Distance Elements	Zone P BN ground fault element
980	ZoneP CN Element	Distance Elements	Zone P CN ground fault element
981	ZoneP AB Element	Distance Elements	Zone P AB phase fault element
982	ZoneP BC Element	Distance Elements	Zone P BC phase fault element
983	ZoneP CA Element	Distance Elements	Zone P CA phase fault element
984	Zone4 AN Element	Distance Elements	Zone 4 AN ground fault element
985	Zone4 BN Element	Distance Elements	Zone 4 BN ground fault element
986	Zone4 CN Element	Distance Elements	Zone 4 CN ground fault element
987	Zone4 AB Element	Distance Elements	Zone 4 AB phase fault element
988	Zone4 BC Element	Distance Elements	Zone 4 BC phase fault element
989	Zone4 CA Element	Distance Elements	Zone 4 CA phase fault element
990 to 995	Not used		
996	DEF Forward	Directional Earth Fault	DEF forward (directional earth fault aided scheme detector)
997	DEF Reverse	Directional Earth Fault	DEF reverse (directional earth fault aided scheme detector)
998	Delta Dir FWD AN	Delta Directional Element	Delta directional scheme forward AN detection
999	Delta Dir FWD BN	Delta Directional Element	Delta directional scheme forward BN detection
1000	Delta Dir FWD CN	Delta Directional Element	Delta directional scheme forward CN detection
1001	Delta Dir FWD AB	Delta Directional Element	Delta directional scheme forward AB detection
1002	Delta Dir FWD BC	Delta Directional Element	Delta directional scheme forward BC detection
1003	Delta Dir FWD CA	Delta Directional Element	Delta directional scheme forward CA detection
1004	Delta Dir Rev AN	Delta Directional Element	Delta directional scheme reverse AN detection
1005	Delta Dir Rev BN	Delta Directional Element	Delta directional scheme reverse BN detection
1006	Delta Dir Rev CN	Delta Directional Element	Delta directional scheme reverse CN detection
1007	Delta Dir Rev AB	Delta Directional Element	Delta directional scheme reverse AB detection
1008	Delta Dir Rev BC	Delta Directional Element	Delta directional scheme reverse BC detection

DDB no.	English text	Source	Description
1009	Delta Dir Rev CA	Delta Directional Element	Delta directional scheme reverse CA detection
1010	Phase Select A	Phase Selector	Phase selector - phase A pickup
1011	Phase Select B	Phase Selector	Phase selector - phase B pickup
1012	Phase Select C	Phase Selector	Phase selector - phase C pickup
1013	Phase Select N	Phase Selector	Phase selector - neutral indication
1014	P Swing Detector	Powerswing Blocking	Power swing detected
1015	PSB Fault	Powerswing Blocking	Power swing block fault
1016	Ih(2) Loc Blk A	Inrush Detector	2nd harmonic current ratio exceeds threshold on phase A (may be used to block any instantaneous distance elements that reach through the reactance of a power transformer)
1017	Ih(2) Loc Blk B	Inrush Detector	2nd harmonic current ratio exceeds threshold on phase B (may be used to block any instantaneous distance elements that reach through the reactance of a power transformer)
1018	Ih(2) Loc Blk C	Inrush Detector	2nd harmonic current ratio exceeds threshold on phase C (may be used to block any instantaneous distance elements that reach through the reactance of a power transformer)
1019	Ih(2) Loc Blk N	Inrush Detector	2nd harmonic current ratio exceeds threshold on neutral current measurement (may be used to block any instantaneous distance elements that reach through the reactance of a power transformer)
1020	Clear Stats Cmd	PSL	This is an indication of the command “Clear Statistics” available in the PSL. This DDB could be used to reset statistics at the remote end (via IM64) by linking it to DDB 544 - clear statistics - at the remote end
1021	Ih(2) Rem Blk A	SW	Indication that remote end phase A is blocked by 2nd harmonic
1022	Ih(2) Rem Blk B	SW	Indication that remote end phase B is blocked by 2nd harmonic
1023	Ih(2) Rem Blk C	SW	Indication that remote end phase C is blocked by 2nd harmonic
1021 to 1023	Not used		
1024	LED1 Red	Output Conditioner	Programmable LED 1 red is energized
1025	LED1 Grn.	Output Conditioner	Programmable LED 1 green is energized
1038	LED8 Red	Output Conditioner	Programmable LED 8 red is energized
1039	LED8 Grn.	Output Conditioner	Programmable LED 8 green is energized
1040	FnKey LED1 Red	Output Conditioner	Programmable function key LED 1 red is energized
1041	FnKey LED1 Grn.	Output Conditioner	Programmable function key LED 1 green is energized
1058	FnKey LED10 Red	Output Conditioner	Programmable function key LED 10 red is energized
1059	FnKey LED10 Grn.	Output Conditioner	Programmable function key LED 10 green is energized
1060	LED1 Con R	PSL	Assignment of input signal to drive output LED 1 red
1061	LED1 Con G	PSL	Assignment of signal to drive output LED 1 green. To drive LED 1 yellow DDB 676 and DDB 677 must be driven at the same time
1074	LED8 Con R	PSL	Assignment of signal to drive output LED 8 red
1075	LED8 Con G	PSL	Assignment of signal to drive output LED 8 green. To drive LED 8 yellow DDB 690 and DDB 691 must be active at the same time

DDB no.	English text	Source	Description
1076	FnKey LED1 ConR	PSL	Assignment of signal to drive output function key LED 1 red. This LED is associated with function key 1
1077	FnKey LED1 ConG	PSL	Assignment of signal to drive output function key LED 1 green. This LED is associated with function key 1. To drive function key LED, yellow DDB 692 and DDB 693 must be active at the same time
1094	FnKey LED10 ConR	PSL	Assignment of signal to drive output function key LED 10 red. This LED is associated with function key 10
1095	FnKey LED10 ConG	PSL	Assignment of signal to drive output function key LED 10 green. This LED is associated with function key 10. To drive function key LED1 yellow, DDB 710 and DDB 711 must be active at the same time
1096	Function Key 1	Function Key	Function key 1 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress
1105	Function Key 10	Function Key	Function key 10 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress
1106	I^ Maint. Alarm (CB1)	CB Monitoring	Broken current maintenance alarm - circuit breaker cumulative duty alarm set-point
1107	I^ Lockout Alarm (CB1)	CB Monitoring	Broken current lockout alarm - circuit breaker cumulative duty has been exceeded
1108	CB OPs Maint. (CB1)	CB Monitoring	No of circuit breaker operations maintenance alarm - indicated due to circuit breaker trip operations threshold
1109	CB OPs Lockout (CB1)	CB Monitoring	No of circuit breaker operations maintenance lockout - excessive number of circuit breaker trip operations, safety lockout
1110	CB Op Time Maint (CB1)	CB Monitoring	Excessive circuit breaker operating time maintenance alarm - excessive operation time alarm for the circuit breaker (slow interruption time)
1111	CB Op Time Lockout (CB1)	CB Monitoring	Excessive circuit breaker operating time lockout alarm - excessive operation time alarm for the circuit breaker (too slow interruption)
1112	Fault Freq. Lock (CB1)	CB Monitoring	Excessive fault frequency lockout alarm
1113	CB2 I^ Maint	CB2 Monitoring	Broken current maintenance alarm - circuit breaker cumulative duty alarm set-point CB2 P544 and P546 only
1114	CB2 I^ Lockout	CB2 Monitoring	Broken current lockout alarm - circuit breaker cumulative duty has been exceeded CB2 P544 and P546 only
1115	No.CB2 OPs Maint	CB2 Monitoring	No of circuit breaker operations maintenance alarm - indicated due to circuit breaker trip operations threshold CB2 P544 and P546 only
1116	No.CB2 OPs Lock	CB2 Monitoring	No of circuit breaker operations maintenance lockout - excessive number of circuit breaker trip operations, safety lockout CB2 P544 and P546 only
1117	CB2 Time Maint	CB2 Monitoring	Excessive circuit breaker operating time maintenance alarm - excessive operation time alarm for the circuit breaker (slow interruption time) CB2 P544 and P546 only

DDB no.	English text	Source	Description
1118	CB2 Time Lockout	CB2 Monitoring	Excessive circuit breaker operating time lockout alarm - excessive operation time alarm for the circuit breaker (too slow interruption) CB2 P544 and P546 only
1119	CB2FaultFreqLock	CB2 Monitoring	Excessive fault frequency lockout alarm CB2 P544 and P546 only
1120	SignalFail Ch1Rx	C Diff	Reception of messages on channel 1 has stopped
1121	SignalFail Ch1Tx	C Diff	Transmission of messages on channel 1 has stopped
1122	Ch 1 GPS Fail	C Diff	It indicates that GPS sampling synchronization (for protection purposes) running on channel 1 is lost
1123	Ch1 Mux Clk	Fiber Monitor Bits	This is an alarm that appears if the channel 1 baud rate is outside the limits 52 Kbis/s or 70 Kbits/s
1124	Ch1 Signal Lost	Fiber Monitor Bits	Mux indicates signal lost over channel 1
1125	Ch1 Path Yellow	Fiber Monitor Bits	One way communication. Local relay that is sending over Ch1 indicates that remote end is not receiving
1126	Ch1 Mismatch RxN	Fiber Monitor Bits	Indication of mismatch between Ch1 N*64kbits/s setting and Mux
1127	Ch1 Timeout	Fiber Monitor Bits	Indication that no valid message is received over channel 1 during ‘Channel Timeout’ window
1128	Ch1 Degraded	Fiber Monitor Bits	Indicates poor channel 1 quality
1129	Ch1 Passthrough	Fiber Monitor Bits	Ch1 data received via Ch 2 in 3 ended configuration - self healing indication -
1130	SignalFail Ch2Rx	C Diff	Reception of messages on channel 2 has stopped
1131	SignalFail Ch2Tx	C Diff	Transmission of messages on channel 1 has stopped
1132	Ch 2 GPS Fail	C Diff	It indicates that GPS sampling synchronization (for protection purposes) running on channel 2 is lost
1133	Ch2 Mux Clk	Fiber Monitor Bits	This is an alarm that appears if the channel 2 baud rate is outside the limits 52Kbis/s or 70 Kbits/s
1134	Ch2 Signal Lost	Fiber Monitor Bits	Mux indicates signal lost over channel 2
1135	Ch2 Path Yellow	Fiber Monitor Bits	One way communication. Local relay that is sending over Ch2 indicates that remote end is not receiving
1136	Ch2 Mismatch RxN	Fiber Monitor Bits	Indication of mismatch between InterMiCOM64 Ch 2 setting and Mux
1137	Ch2 Timeout	Fiber Monitor Bits	Indication that no valid message is received over channel 2 during ‘Channel Timeout’ window
1138	Ch2 Degraded	Fiber Monitor Bits	Indicates poor channel 2 quality
1139	Ch2 Passthrough	Fiber Monitor Bits	Ch2 data received via Ch 1 in 3 ended configuration - self healing indication -
1140 to 1148	Hidden		
1149	F<1 Timer Block	PSL	Block Underfrequency Stage 1 Timer
1150	F<2 Timer Block	PSL	Block Underfrequency Stage 2 Timer
1151	F<3 Timer Block	PSL	Block Underfrequency Stage 3 Timer
1152	F<4 Timer Block	PSL	Block Underfrequency Stage 4 Timer
1153	F>1 Timer Block	PSL	Block Overfrequency Stage 1 Timer
1154	F>2 Timer Block	PSL	Block Overfrequency Stage 2 Timer
1155	F<1 Start	Frequency Protection	Underfrequency Stage 1 Start
1156	F<2 Start	Frequency Protection	Underfrequency Stage 2 Start

DDB no.	English text	Source	Description
1157	F<3 Start	Frequency Protection	Underfrequency Stage 3 Start
1158	F<4 Start	Frequency Protection	Underfrequency Stage 4 Start
1159	F>1 Start	Frequency Protection	Overfrequency Stage 1 Start
1160	F>2 Start	Frequency Protection	Overfrequency Stage 2 Start
1161	F<1 Trip	Frequency Protection	Underfrequency Stage 1 Trip
1162	F<2 Trip	Frequency Protection	Underfrequency Stage 2 Trip
1163	F<3 Trip	Frequency Protection	Underfrequency Stage 3 Trip
1164	F<4 Trip	Frequency Protection	Underfrequency Stage 4 Trip
1165	F>1 Trip	Frequency Protection	Overfrequency Stage 1 Trip
1166	F>2 Trip	Frequency Protection	Overfrequency Stage 2 Trip
1167	Inhibit F<1	PSL	Inhibit stage 1 Underfrequency protection
1168	Inhibit F<2	PSL	Inhibit stage 2 Underfrequency protection
1169	Inhibit F<3	PSL	Inhibit stage 3 Underfrequency protection
1170	Inhibit F<4	PSL	Inhibit stage 4 Underfrequency protection
1171	Inhibit F>1	PSL	Inhibit stage 1 Overfrequency protection
1172	Inhibit F>2	PSL	Inhibit stage 2 Overfrequency protection
1173 to 1175	Not used		
1176	HMI Access Lvl 1		It indicates that level access 1 for HMI interface is enabled
1177	HMI Access Lvl 2		It indicates that level access 2 for HMI interface is enabled
1178	FPort AccessLvl1		It indicates that level access 1 for the front port interface is enabled
1179	FPort AccessLvl2		It indicates that level access 2 for the front port interface is enabled
1180	RPrt1 AccessLvl1		It indicates that level access 1 for the rear port 1 interface is enabled
1181	RPrt1 AccessLvl2		It indicates that level access 2 for the rear port 1 interface is enabled
1182	RPrt2 AccessLvl1		It indicates that level access 1 for the rear port 2 interface is enabled
1183	RPrt2 AccessLvl2		It indicates that level access 2 for the rear port 2 interface is enabled
1184	Monitor Bit 1	Commissioning Test	Monitor port signal 1 - allows mapped monitor signals to be mapped to disturbance recorder or contacts
1191	Monitor Bit 8	Commissioning Test	Monitor port signal 8
1192	Hidden		
1193	Not used		
1194	PSL Int 1	PSL	PSL internal node
1293	PSL Int 100	PSL	PSL internal node
1294	VTS Ia>	VT Supervision	“VTS I> Inhibit “ setting has been exceeded in phase a
1295	VTS Ib>	VT Supervision	“VTS I> Inhibit “ setting has been exceeded in phase b
1296	VTS Ic>	VT Supervision	“VTS I> Inhibit “ setting has been exceeded in phase c
1297	VTS Va>	VT Supervision	Va has exceed 30 volts (drop off at 10 volts)
1298	VTS Vb>	VT Supervision	Vb has exceed 30 volts (drop off at 10 volts)
1299	VTS Vc>	VT Supervision	Vc has exceed 30 volts (drop off at 10 volts)
1300	VTS I2>	VT Supervision	“VTS I2> Inhibit “ setting has been exceeded
1301	VTS V2>	VT Supervision	V2 has exceed 10 volts
1302	VTS Ia delta>	VT Supervision	Superimposed phase a current has exceed 0.1 In
1303	VTS Ib delta>	VT Supervision	Superimposed phase b current has exceed 0.1 In

DDB no.	English text	Source	Description
1304	VTS Ic delta>	VT Supervision	Superimposed phase c current has exceed 0.1 In
1305 to 1363	Not used		
1364	CB1 Pre-Lockout		Output from CB1 monitoring logic
1363 to 1374	Not used		
1375	Teleprotection Disturbed		This is an output signal available in the PSL, that could be mapped to “C Diff Failure” for IEC 870-5-103
1376	I>> Back Up Supervision		This applies only if distance primary FUN is selected (in IEC 870-5-103) This signal is ON if an overcurrent stage is selected to be enabled on VTS and distance is blocked by VTS
1377	O/C Trip By VTS		This applies only if distance primary FUN is selected (in IEC 870-5-103) This signal is ON if DDB 1376 is ON and one of the overcurrent stages set to be enabled on VTS condition trips
1378	Teleprot Tx		This applies only if distance primary FUN is selected (in IEC 870-5-103) This is an output signal available in the PSL, which could be mapped to a signal send of one of the two teleprotection channels
1379	Teleprot Rx		This applies only if distance primary FUN is selected (in IEC 870-5-103) This is an output signal available in the PSL, which could be mapped to a signal receive of one of the two teleprotection channels
1380	Group Warning		This is an output signal available in the PSL, which can be mapped in IEC 870-5-103 to a minor defect which does not shut down the main protection
1381	Group Alarm		This is an output signal available in the PSL, which can be mapped in IEC 870-5-103 to a major problem normally linked to the watchdog
1382	AR On Pulse		This is an output signal available in the PSL, which can be mapped to enable AR via pulse
1383	AR OFF Pulse		This is an output signal available in the PSL, which can be mapped to disable AR via pulse
1384	AR Enable		This is an output signal available in the PSL, which can be mapped to enable AR
1385	AR In Service		Auto-reclose in service
1386	MaxCh1 PropDelay		Setting MaxCh 1 PropDelay has been exceeded
1387	MaxCh2 PropDelay		Setting MaxCh 2 PropDelay has been exceeded
1388	MaxCh1 Tx-RxTime		Setting MaxCh1 Tx-RxTime has been exceeded
1389	MaxCh2 Tx-RxTime		Setting MaxCh2 Tx-RxTime has been exceeded
1390 to 1403	Not used		
1404	VTS Blk Distance	VTS Logic	Signal from the VTS logic that can be used to block operation of the distance elements
1405 to 1407	Not used		

DDB no.	English text	Source	Description
1408	CB2 Lead	Auto-reclose	If setting "Leader Select By:" = Opto, then preferred leader CB is CB1 if input DDB "CB2 LEAD" is low, or CB2 if DDB "CB2 LEAD" is high. P544 and P546 only
1409	Follower AR 1P	Auto-reclose	If setting "Foll AR Mode" = Opto, then if input DDB "FARSP" is high, the follower CB is enabled for single phase autoreclose, if "FARSP" is low, the follower CB is NOT enabled for single phase autoreclose.D2215 P544 and P546 only
1410	Follower AR 3P	Auto-reclose	If setting "Foll AR Mode" = Opto, then if input DDB "FAR3P" is high, the follower CB is enabled for three phase autoreclose, if "FAR3P" is low, the follower CB is NOT enabled for three phase autoreclose. P544 and P546 only
1411	CB2 AR 3p InProg	Auto-reclose	Autoreclose in progress CB2 P544 and P546 only
1412	En CB2 Independ	Auto-reclose	DDB mapped in PSL from opto or comms input. A signal from an autoreclose scheme on an adjacent circuit having shared control of CB2, to allow the "Independent Follower time" to start. (see description for DDB "CB2 Indep Init A" or "CB2 Indep Init B" or "CB2 Indep Init C"). P544 and P546 only
1413 to 1416	Not used		
1417	Ext Rst CB2 AROK	PSL	DDB mapped in PSL from opto or comms input. This input DDB is used when required to reset any CB2 Successful Autoreclose" signal. P544 and P546 only
1418	Ext Rst CB2Shots	PSL	DDB mapped in PSL from opto or comms input. This input DDB is used when required to reset the CB2 cumulative "Shots" counters. P544 and P546 only
1419	Rst CB2 CloseDly	PSL	DDB mapped in PSL. Reset Manual CB2 Close Timer Delay (stop & reset Manual Close Delay time for closing CB2). P544 and P546 only
1420	Inhibit AR	PSL	DDB mapped in PSL from opto or comms input. External signal to inhibit autoreclose. P544 and P546 only
1421	Block CB2 AR	PSL	DDB mapped in PSL from opto or comms input. External signal to force CB2 autoreclose to lockout. P544 and P546 only
1422	Rst CB2 Lockout	PSL	DDB mapped in PSL from opto or comms input. Reset Lockout Opto Input to reset CB2 Lockout state P544 and P546 only
1423	MCB/VTS CS2	PSL	DDB mapped in PSL from opto input (Bus2 VT secondary MCB tripped or VT fail detected by external VTS scheme), or signal from host relay VTS scheme P544 and P546 only
1424	Inhibit LB2	PSL	DDB mapped in PSL from opto input (external signal to inhibit Live Bus 2 function) P544 and P546 only

DDB no.	English text	Source	Description
1425	Inhibit DB2	PSL	DDB mapped in PSL from opto input (external signal to inhibit Dead Bus 2 function) P544 and P546 only
1426	CB2 CS1 Enabled	PSL	DDB mapped in PSL from opto input or logic DDBs (enable CS2-1 check synchronism function) P544 and P546 only
1427	CB2 CS2 Enabled	PSL	DDB mapped in PSL from opto input or logic DDBs (enable CS2-2 check synchronism function) P544 and P546 only
1428	CB2 In Service		Signal from CB In Service logic, indicating that CB2 is "In Service", i.e. can be initiated to autoreclose, P544 and P546 only
1429	CB2 NoAR	Autoreclose	CB2 not available for autoreclose P544 and P546 only
1430	Not used		
1431	Leader CB2	Autoreclose	CB2 set as leader P544 and P546 only
1432	Follower CB1	Autoreclose	CB1 set as follower P544 and P546 only
1433	Follower CB2	Autoreclose	CB2 set as follower P544 and P546 only
1434	CB2 AR Init	Autoreclose	Indicates initiation of a CB2 autoreclose cycle P544 and P546 only.
1435	CB2 ARIP	Autoreclose	CB2 autoreclose cycle in progress P544 and P546 only
1436	Not used		
1437	Differential High Start	C Diff	Current differential High Set start
1438	Differential High Start A	C Diff	Current differential High Set A phase start
1439	Differential High Start B	C Diff	Current differential High Set B phase start
1440	Differential High Start C	C Diff	Current differential High Set C phase start
1441	CB2 Failed AR		CB2 autoreclose failed due to persistent fault P544 and P546 only
1442	DTOK CB2L 1P		Output DDB indicates conditions to enable CB2 lead single phase autoreclose dead time to run are satisfied P544 and P546 only
1443	DTOK CB2L 3P		Output DDB indicates conditions to enable CB2 lead three phase autoreclose dead time to run are satisfied P544 and P546 only
1444	CB2 3P DTime		Indicates CB2 three phase autoreclose dead time running P544 and P546 only
1445	En CB2 Follower		Indicates conditions are satisfied to enable CB2 follower sequence P544 and P546 only
1446	1P Follower Time		Indicates a single pole autoreclose follower time is running (either CB) P544 and P546 only
1447	3P Follower Time		Indicates a three pole autoreclose follower time is running (either CB) P544 and P546 only

DDB no.	English text	Source	Description
1448	Auto Close CB2		Signal from autoreclose logic to initiate CB2 close via “CB2 CB Control” P544 and P546 only
1449	Set CB2 Close		Indicates a CB2 Auto Close signal has been issued P544 and P546 only
1450	CB2 Control		Output DDB can be applied to inhibit CB2 reclose by adjacent scheme until local autoreclose scheme confirms it is OK to close CB2 P544 and P546 only
1451	CB2 Succ 1P AR		CB2 successful single phase AR P544 and P546 only
1452	CB2 Succ 3P AR		CB2 successful three phase AR P544 and P546 only
1453	CB2 Close inProg		CB2 Manual Close initiated – awaiting Man Close Delay time P544 and P546 only
1454	CB2 Fast SCOK		OK to reclose CB2 with sync check without waiting for dead time to complete P544 and P546 only
1455	CB2L SCOK		System conditions OK to reclose CB2 as leader when dead time complete P544 and P546 only
1456	CB2F SCOK		System conditions OK to reclose CB2 when follower time complete P544 and P546 only
1457	Not used		
1458	CB2 Man SCOK		System conditions OK to manually close CB2 P544 and P546 only
1459	CB2 Fail Pr Trip		signal to force CB2 AR lockout if CB2 fails to trip when protection operates P544 and P546 only
1460	Not used		
1461	Live Bus 2		Indicates Bus 2 input is live, i.e. voltage >= setting "Live Bus 2" P544 and P546 only
1462	Dead Bus 2		Indicates Bus 2 input is dead i.e. voltage < setting "Dead Bus 2" P544 and P546 only
1463	CB2 CS2 OK		CB2 close with synchronism check type 2 is permitted (setting CS2-2 = Enabled), and Line and Bus 2 voltages satisfy relay settings for CB2 synchronism check type 2 P544 and P546 only
1464	CB1 CS2 SlipF>		Line-Bus 1 slip freq > SlipFr 1-2 setting (frequency difference (slip) between line voltage and bus 1 voltage is greater than maximum slip permitted for CB1 synchronism check type 2) P544 and P546 only
1465	CB1 CS2 SlipF<		Line-Bus 1 slip freq < SlipFr 1-2 setting (frequency difference (slip) between line voltage and bus 1 voltage is within the permitted range for CB1 synchronism check type 2) P544 and P546 only

DDB no.	English text	Source	Description
1466	CB2 CS1 SlipF>		Line-Bus 2 slip freq > SlipFr 2-1 setting (frequency difference (slip) between line voltage and bus 2 voltage is greater than maximum slip permitted for CB2 synchronism check type 1) P544 and P546 only
1467	CB2 CS1 SlipF<		Line-Bus 2 slip freq < SlipFr 2-1 setting (frequency difference (slip) between line voltage and bus 2 voltage is within the permitted range for CB2 synchronism check type 1) P544 and P546 only
1468	CB2 CS2 SlipF>		Line-Bus 2 slip freq > SlipFr 2-2 setting (frequency difference (slip) between line voltage and bus 2 voltage is greater than maximum slip permitted for CB2 synchronism check type 2) P544 and P546 only
1469	CB2 CS2 SlipF<		Line-Bus 2 slip freq < SlipFr 2-2 setting (frequency difference (slip) between line voltage and bus 2 voltage is within the permitted range for CB2 synchronism check type 2) P544 and P546 only
1470	CB2 CS1 VL>VB		Voltage magnitude difference between Line V and Bus2 V is greater than setting "VDiff2-1" (line V > Bus V) P544 and P546 only
1471	CB2 CS2 VL>VB		Voltage magnitude difference between Line V and Bus2 V is greater than setting "VDiff2-1" (line V > Bus V) P544 and P546 only
1472	CB2 CS1 VL<VB		Voltage magnitude difference between Line V and Bus2 V is greater than setting "VDiff2-1" (line V < Bus V) P544 and P546 only
1473	CB2 CS2 VL<VB		Voltage magnitude difference between Line V and Bus2 V is greater than setting "VDiff2-1" (line V < Bus V) P544 and P546 only
1474	CB2 CS1 FL>FB		Frequency difference between Line V and Bus2 V is greater than setting "SlipFr2-1" (line freq > Bus freq) P544 and P546 only
1475	CB2 CS2 FL>FB		Frequency difference between Line V and Bus2 V is greater than setting "SlipFr2-2" (line freq > Bus freq)+D2253
1476	CB2 CS1 FL<FB		Frequency difference between Line V and Bus2 V is greater than setting "SlipFr2-1" (line freq < Bus freq) P544 and P546 only
1477	CB2 CS2 FL<FB		Frequency difference between Line V and Bus2 V is greater than setting "SlipFr2-2" (line freq < Bus freq) P544 and P546 only
1478	CB2 CS1 AngHigh+		Line/Bus2 phase angle in range: +Angle 2-1 to +180deg (anticlockwise from Vbus) P544 and P546 only
1479	CB2 CS1 AngHigh-		Line/Bus2 phase angle in range: -Angle 2-1 to -180deg (clockwise from Vbus) P544 and P546 only
1480	CB2 CS2 AngHigh+		Line/Bus2 phase angle in range: +Angle 2-2 to +180deg (anticlockwise from Vbus) P544 and P546 only

DDB no.	English text	Source	Description
1481	CB2 CS2 AngHigh-		Line/Bus2 phase angle in range: -Angle 2-2 to -180deg (clockwise from Vbus) P544 and P546 only
1482	CB2 CS AngRotACW		Line freq > (Bus2 freq + 0.001 Hz) (Line voltage vector rotating anticlockwise relative to VBus2) P544 and P546 only
1483	CB2 CS AngRotCW		Bus2 freq > (Line freq + 0.001 Hz) (Line voltage vector rotating clockwise relative to VBus2) P544 and P546 only
1484	SChksInactiveCB2		Output from CB2 system check logic: indicates system checks for CB2 are disabled (setting "System Checks CB2" = Disabled or global setting "System Checks" = Disabled) P544 and P546 only
1485	AR Force CB2 3P	Autoreclose	This DDB is set when the autoreclose logic has determined that single pole tripping/autoreclosing is not permitted for CB2. It can be applied in PSL when required to force trip conversion logic for internal and/or external protection to three phase trip mode for CB2. P544 and P546 only
1486	Not used		
1487	Not used		
1488	En CB1 Follower		Indicates conditions are satisfied to enable CB1 follower sequence P544 and P546 only
1489 to 1492	Not used		
1493	CB1 CS2 FL>FB		Frequency difference between Line V and Bus1 V is greater than setting "SlipFr1-2" (line freq > Bus freq) P544 and P546 only
1494	CB1 CS2 FL<FB		Frequency difference between Line V and Bus1 V is greater than setting "SlipFr1-2" (line freq < Bus freq) P544 and P546 only
1495	CB1 CS2 AngHigh+		Line/Bus1 phase angle in range: +Angle 1-2 to +180deg (anticlockwise from Vbus) P544 and P546 only
1496	CB1 CS2 AngHigh-		Line/Bus1 phase angle in range: -Angle 1-2 to -180deg (clockwise from Vbus) P544 and P546 only
1497	Lead AR 1P	PSL	If setting "Lead AR Mode" = Opto, then if input DDB "LARSP" is high, the leader CB is enabled for single phase autoreclose, if "LARSP" is low, the leader CB is NOT enabled for single phase autoreclose. P544 and P546 only
1498	Lead AR 3P	PSL	If setting "Lead AR Mode" = Opto, then if input DDB "LAR3P" is high, the leader CB is enabled for three phase autoreclose, if "LAR3P" is low, the leader CB is NOT enabled for three phase autoreclose. P544 and P546 only
1499	CB2 Trip AR MemA		CB2 A Ph trip & AR initiation memory P544 and P546 only
1500	CB2 Trip AR MemB		CB2 B Ph trip & AR initiation memory P544 and P546 only

DDB no.	English text	Source	Description
1501	CB2 Trip AR MemC		CB2 C Ph trip & AR initiation memory P544 and P546 only
1502 to 1503	Not used		
1504	Init APh AR Test	PSL	DDB mapped in PSL from opto or comms input. Input high-low operation will initiate APh test trip & autoreclose cycle P544 and P546 only
1505	Init BPh AR Test	PSL	DDB mapped in PSL from opto or comms input. Input high-low operation will initiate BPh test trip & autoreclose cycle P544 and P546 only
1506	Init CPh AR Test	PSL	DDB mapped in PSL from opto or comms input. Input high-low operation will initiate CPh test trip & autoreclose cycle P544 and P546 only
1507	Init 3P AR Test	PSL	DDB mapped in PSL from opto or comms input. Input high-low operation will initiate 3Ph test trip & autoreclose cycle P544 and P546 only
1508	Ext Fault APh	PSL	DDB mapped in PSL from opto or comms input: indicates external protection operated for fault involving A phase P544 and P546 only
1509	Ext Fault BPh	PSL	DDB mapped in PSL from opto or comms input: indicates external protection operated for fault involving B phase P544 and P546 only
1510	Ext Fault CPh	PSL	DDB mapped in PSL from opto or comms input: indicates external protection operated for fault involving C phase P544 and P546 only
1511 to 1516	Not used		
1517	Ext Rst CB1 AROK	PSL	DDB mapped in PSL from opto or comms input. This input DDB is used when required to reset any CB1 "Successful Autoreclose" signal. P544 and P546 only
1518	Ext Rst CB1Shots	PSL	DDB mapped in PSL from opto or comms input. This input DDB is used when required to reset the CB1 cumulative "Shots" counters. P544 and P546 only
1519 to 1520	Not used		
1521	MCB/VTS CS1	PSL	DDB mapped in PSL from opto input (Bus1 VT secondary MCB tripped or VT fail detected by external VTS scheme), or signal from host relay VTS scheme P544 and P546 only
1522	Inhibit LL	PSL	DDB mapped in PSL from opto input (external signal to inhibit Live Line function) P544 and P546 only
1523	Inhibit DL	PSL	DDB mapped in PSL from opto input (external signal to inhibit Dead Line function) P544 and P546 only
1524	Inhibit LB1	PSL	DDB mapped in PSL from opto input (external signal to inhibit Live Bus 1 function) P544 and P546 only
1525	Inhibit DB1	PSL	DDB mapped in PSL from opto input (external signal to inhibit Dead Bus 1 function) P544 and P546 only

DDB no.	English text	Source	Description
1526	CB1 In Service		CB1 In Service (can be initiated for autoreclose) P544 and P546 only
1527	Not used		
1528	CB1 NoAR	Autoreclose	CB1 not available for autoreclose P544 and P546 only
1529	Not used		
1530	Leader CB1	Autoreclose	CB1 set as leader P544 and P546 only
1531 to 1534	Not used		
1535	CB1 Trip AR MemA		A Ph trip & AR initiation memory P544 and P546 only
1536	CB1 Trip AR MemB		B Ph trip & AR initiation memory P544 and P546 only
1537	CB1 Trip AR MemC		C Ph trip & AR initiation memory P544 and P546 only
1538 to 1540	Not used		
1541	AR Start	Autoreclose	Any AR initiation signal present P544 and P546 only
1542	ARIP	Autoreclose	Any AR cycle in progress P544 and P546 only
1543	CB1 AR Init	Autoreclose	CB1 AR cycle initiation P544 and P546 only
1544	CB1 ARIP	Autoreclose	CB1 AR cycle in progress P544 and P546 only
1545	Not used		
1546	SC Count>Shots		Sequence counts greater than shots P544 and P546 only
1547	Evolve 3Ph		Convert SPAR to 3PAR. DDB mapped to give 100ms pulse to CB1 Trip 3Ph and CB2 Trip 3Ph outputs P544 and P546 only
1548 to 1549	Not used		
1550	CB1 Failed AR		CB1 AR failed due to persistent fault P544 and P546 only
1551	DTOK All		Enabling condition for any dead time P544 and P546 only
1552	DTOK CB1L 1P		required for CB1 lead SPAR D Time P544 and P546 only
1553	DTOK CB1L 3P		required for CB1 lead 3PAR D Time P544 and P546 only
1554	1P DTime		Single pole dead time in progress P544 and P546 only
1555	OK Time 3P		OK to start 3PAR dead time P544 and P546 only
1556	3P DTime1		3Phase dead time 1 running P544 and P546 only
1557	3P DTime2		3Phase dead time 2 running P544 and P546 only
1558	3P DTime3		3Phase dead time 3 running P544 and P546 only
1559	3P DTime4		3Phase dead time 4 running P544 and P546 only

DDB no.	English text	Source	Description
1560	CB1 3P DTime		CB1 3PAR dead time running P544 and P546 only
1561	1PF TComp		Either CB SP follower time complete P544 and P546 only
1562	3PF TComp		Either CB 3P follower time complete P544 and P546 only
1563	Indep 1PF TComp		Either CB independent SP follower time complete P544 and P546 only
1564	Indep 3PF TComp		Either CB independent 3P follower time complete P544 and P546 only
1565	Set CB1 Close		DDB (Optional PSL mapping to indication) P544 and P546 only
1566	CB1 Control		Inhibits CB1 reclose by adjacent scheme P544 and P546 only
1567	1P Reclaim Time		Single Ph AR reclaim time running P544 and P546 only
1568	1P Reclaim TComp		Single Ph AR reclaim time complete P544 and P546 only
1569	3P Reclaim Time		Three Ph AR reclaim time running P544 and P546 only
1570	3P Reclaim TComp		Three Ph AR reclaim time complete P544 and P546 only
1571	CB1 Succ 1P AR		CB1 successful single phase AR P544 and P546 only
1572	CB1 Fast SCOK		OK to reclose CB1 with sync check without waiting for dead time to complete P544 and P546 only
1573	CB1L SCOK		System conditions OK to reclose CB1 when dead time complete P544 and P546 only
1574	CB1 Man SCOK		System conditions OK to manually close CB1 P544 and P546 only
1575	CB1 Fail Pr Trip		signal to force CB1 AR lockout P544 and P546 only
1576	Not used		
1577	CB2 CS1 OK		CS2-1 is enabled and Line and Bus 2 voltages meet CS2-1 settings P544 and P546 only
1578	CB1 CS1 SlipF>		Line-Bus 1 slip freq > SlipFr 1-1 setting P544 and P546 only
1579	CB1 CS1 SlipF<		Line-Bus 1 slip freq < SlipFr 1-1 setting P544 and P546 only
1580	CS VLine<		Line Volts < CS UV setting P544 and P546 only
1581	CS VLine>		Line Volts > CS OV setting P544 and P546 only
1582	CS VBus1<		Bus1 Volts < CS UV setting P544 and P546 only
1583	CS VBus1>		Bus1 Volts > CS OV setting P544 and P546 only
1584	CS VBus2<		Bus2 Volts < CS UV setting P544 and P546 only

DDB no.	English text	Source	Description
1585	CS VBus2>		Bus2 Volts > CS OV setting P544 and P546 only
1586	CB1 CS1 VL>VB		Line V > (Bus1 V + [VDiff1-1]) P544 and P546 only
1587	CB1 CS2 VL>VB		Line V > (Bus1 V + [VDiff1-2]) P544 and P546 only
1588	CB1 CS1 VL<VB		Bus1 V > (Line V + [VDiff1-1]) P544 and P546 only
1589	CB1 CS2 VL<VB		Bus1 V > (Line V + [VDiff1-2]) P544 and P546 only
1590	CB1 CS1 FL>FB		Line F > (Bus1 F + [SlipFr1-1]) P544 and P546 only
1591	CB1 CS1 FL<FB		Bus1 F > (Line F + [SlipFr1-1]) P544 and P546 only
1592	CB1 CS1 AngHigh+		Line/Bus1 phase angle in range: +Angle 1-1 to +180deg P544 and P546 only
1593	CB1 CS1 AngHigh-		Line/Bus1 phase angle in range: -Angle 1-1 to -180deg P544 and P546 only
1594	CB1 CS AngRotACW		Line freq > (Bus1 freq + 0.001Hz) (CS1 Angle Rotating Anticlockwise) P544 and P546 only
1595	CB1 CS AngRotCW		Bus1 freq > (Line freq + 0.001Hz) (CS1 Angle Rotating Clockwise) P544 and P546 only
1596	Not used		
1597	Rst CB2 Data		Rst CB2 All Val P544 and P546 only
1598	CB2 Pre-Lockout		Output from CB2 monitoring logic
1599	CB2 LO Alarm		CB2 LO Alarm P544 and P546 only
1600	CB2 Trip 3ph	Trip Conversion Logic	3 Phase Trip 2 P544 and P546 only
1601	CB2 Trip OutputA	Trip Conversion Logic	A Phase Trip 2 P544 and P546 only
1602	CB2 Trip OutputB	Trip Conversion Logic	B Phase Trip 2 P544 and P546 only
1603	CB2 Trip OutputC	Trip Conversion Logic	C Phase Trip 2 P544 and P546 only
1604	Force 3PTrip CB2	PSL	External input via DDB to force host relay trip conversion logic to issue a three phase trip signal to CB2 for all faults P544 and P546 only
1605	Enable AR CB2		External input via DDB to enable CB2, if "in service", to be initiated for autoreclosing by an AR initiation signal from protection. DDB input defaults to high if not mapped in PSL, so CB2 AR initiation is permitted. P544 and P546 only
1606	Pole Discrep.CB2	PSL	Pole Discrepancy P544 and P546 only
1607	Pole Discrep.CB2	Pole discrepency	Pole Discrepancy P544 and P546 only
1608	CB2 Trip I/P 3Ph	PSL	Trip 3 Phase - Input to Trip Latching Logic P544 and P546 only

DDB no.	English text	Source	Description
1609	AR Enable CB1		External input via DDB mapped in PSL to enable CB1, if "in service", to be initiated for autoreclosing by an AR initiation signal from protection. DDB input defaults to high if not mapped in PSL, so CB1 AR initiation is permitted. P544 and P546 only
1610 to 1615	Not used		
1616	PSL Int 101	PSL	PSL internal node
1665	PSL Int 150	PSL	PSL internal node
1666	Ih(5) Loc Blk A	SW	5th harmonic current ratio exceeds threshold on phase A
1667	Ih(5) Loc Blk B	SW	5th harmonic current ratio exceeds threshold on phase B
1668	Ih(5) Loc Blk C	SW	5th harmonic current ratio exceeds threshold on phase C
1669	Ih(5) Rem Blk A	SW	Indication that remote end phase A is blocked by 5th harmonic
1670	Ih(5) Rem Blk B	SW	Indication that remote end phase B is blocked by 5th harmonic
1671	Ih(5) Rem Blk C	SW	Indication that remote end phase C is blocked by 5th harmonic
1672 to 1695	Not used		
1696	IEC Usr 01 Open	PSL	IEC 61850 User Dual Point Status 1 Open
1697	IEC Usr 01 Close	PSL	IEC 61850 User Dual Point Status 1 Close
1710	IEC Usr 08 Open	PSL	IEC 61850 User Dual Point Status 8 Open
1711	IEC Usr 08 Close	PSL	IEC 61850 User Dual Point Status 8 Close
1712 to 1727	Not Used		
1728	Quality VIP 1		GOOSE virtual input 1 - provides the Quality attributes of any data object in an incoming GOOSE message
1759	Quality VIP 32		GOOSE virtual input 32 - provides the Quality attributes of any data object in an incoming GOOSE message
1760	PubPres VIP 1		GOOSE virtual input 1- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.
1791	PubPres VIP 32		GOOSE virtual input 32- indicates if the GOOSE publisher responsible for publishing the data that derives a virtual input is present.

MEASUREMENTS AND RECORDING (P54x/EN MR/Ba4)

1.4.1 Measured Voltages and Currents

The relay produces both phase to ground and phase to phase voltage and current values. They are produced directly from the DFT (Discrete Fourier Transform) used by the relay protection functions and present both magnitude and phase angle measurement for each individual CT.

Currents mentioned above can be seen on the Measurement 1 column. P54x also shows local and remote currents in Measurement 3 column. These currents have the same treatment as the currents used for differential protection purposes.

1.4.8 Measurement Display Quantities

There are four **Measurement** columns available in the relay for viewing of measurement quantities. These can also be viewed with MiCOM S1 Studio (see MiCOM Px40 - Monitoring section of the MiCOM S1 Studio User Manual) and are shown below:

MEASUREMENTS 1		MEASUREMENTS 2		MEASUREMENTS 3		MEASUREMENTS 4	
IA Magnitude	0 A	A Phase Watts	0 W	IA Local	0 A	Ch 1 Prop Delay	
IA Phase Angle	0 deg	B Phase Watts	0 W	IA Angle Local	0 deg	Ch 2 Prop Delay	
IB Magnitude	0 A	C Phase Watts	0 W	IB Local	0 A	Ch1 Rx Prop Delay	
IB Phase Angle	0 deg	A Phase VArs	0 Var	IB Angle Local	0 deg	Ch1 Tx Prop Delay	
IC Magnitude	0 A	B Phase VArs	0 Var	IC Local	0 A	Ch2 Rx Prop Delay	
IC Phase Angle	0 deg	C Phase VArs	0 Var	IC Angle Local	0 deg	Ch2 Tx Prop Delay	
IN Derived Mag.	0 A	A Phase VA	0 VA	IA remote 1	0 A	Channel 1 Status	
IN Derived Angle	0 deg	B Phase VA	0 VA	IA Ang remote 1	0 deg	Channel 2 Status	
ISEF Magnitude	0 A	C Phase VA	0 VA	IB remote 1	0 A	IM64 Rx Status	
ISEF Angle	0 deg	3 Phase Watts	0 W	IB Ang remote 1	0 deg	STATISTICS	
I1 Magnitude	0 A	3 Phase VArs	0 VAr	IC remote 1	0 A	Last Reset on	
I2 Magnitude	0 A	3 Phase VA	0 VA	IC Ang remote 1	0 deg	Date/Time	
I0 Magnitude	0 A	3Ph Power Factor	0	IA remote 2	0 A	Ch1 No.Vald Mess	
IA RMS	0 A	APh Power Factor	0	IA Ang remote 2	0 deg	Ch1 No.Err Mess	
IB RMS	0 A	BPh Power Factor	0	IB remote 2	0 A	Ch1 No.Errored s	
IC RMS	0 A	CPh Power Factor	0	IB Ang remote 2	0 deg	Ch1 No.Sev Err s	
IN RMS	0 A	3Ph WHours Fwd	0 Wh	IC remote 2	0 A	Ch1 No. Dgraded m	
VAB Magnitude	0 V	3Ph WHours Rev	0 Wh	IC Ang remote 2	0 deg	Ch2 No.Vald Mess	
VAB Phase Angle	0 deg	3Ph VArHours Fwd	0 VArh	IA Differential	0 A	Ch2 No.Err Mess	
VBC Magnitude	0 V	3Ph VArHours Rev	0 VArh	IB Differential	0 A	Ch2 No.Errored s	
VBC Phase Angle	0 deg	3Ph W Fix Demand	0 W	IC Differential	0 A	Ch2 No.Sev Err s	
VCA Magnitude	0 V	3Ph VArs Fix Dem.	0 VAr	IA Bias	0 A	Ch2 No. Dgraded m	
VCA Phase Angle	0 deg	IA Fixed Demand	0 A	IB Bias	0 A	Max Ch 1 Prop Delay	
VAN Magnitude	0 V	IB Fixed Demand	0 A	IC Bias	0 A	Max Ch 2 Prop Delay	
VAN Phase Angle	0 deg	IC Fixed Demand	0 A			Max Ch1 TxRx Time	
VBN Magnitude	0 V	3 Ph W Roll Dem.	0 W			Max Ch2 TxRx Time	
VBN Phase Angle	0 deg	3Ph VArs Roll Dem.	0 VAr			Clear Statistics	
VCN Magnitude	0 V	IA Roll Demand	0 A				
VCN Phase Angle	0 deg	IB Roll Demand	0 A				
		IC Roll Demand	0 A				
		3Ph W Peak Dem.	0 W				
V1 Magnitude	0 V	3Ph VAr Peak Dem.	0 VAr				
V2 Magnitude	0 V	IA Peak Demand	0 A				
V0 Magnitude	0 V	IB Peak Demand	0 A				
VAN RMS	0 V	IC Peak Demand	0 A				
VBN RMS	0 V	Reset Demand	No				
VCN RMS	0 V						
VAB RMS	0 V						
VBC RMS	0 V						
VCA RMS	0 V						
Frequency							
CB1 CS Volt Mag	0 V						
CB1 CS Volt Ang	0 deg						
CB1 Bus-Line Ang	0 deg						
CB1 CS Slip Freq							
IM Magnitude	0 A						
IM Phase Angle	0 deg						
I1 Magnitude	0 A						

MEASUREMENTS 1		MEASUREMENTS 2		MEASUREMENTS 3		MEASUREMENTS 4	
I1 Phase Angle	0 deg						
I2 Magnitude	0 A						
I2 Phase Angle	0 deg						
I0 Magnitude	0 A						
I0 Phase Angle	0 deg						
V1 Magnitude	0 V						
V1 Phase Angle	0 deg						
V2 Magnitude	0 V						
V2 Phase Angle	0 deg						
V0 Magnitude	0 V						
V0 Phase Angle	0 deg						
CB2 CS Volt Mag	0 V						
CB2 CS Volt Ang	0 deg						
CB2 Bus-Line Ang	0 deg						
CB2 CS Slip Freq							
VRem Magnitude	0 V						
VRem Phase Ang	0 deg						
IA CT1 Magnitude	0 A						
IA CT1 Phase Ang	0 deg						
IB CT1 Magnitude	0 A						
IB CT1 Phase Ang	0 deg						
IC CT1 Magnitude	0 A						
IC CT1 Phase Ang	0 deg						
IA CT2 Magnitude	0 A						
IA CT2 Phase Ang	0 deg						
IB CT2 Magnitude	0 A						
IB CT2 Phase Ang	0 deg						
IC CT2 Magnitude	0 A						
IC CT2 Phase Ang	0 deg						

FIRMWARE AND SERVICE MANUAL VERSION HISTORY (P54x/EN VH/I84)

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
01	A	A	Feb 2000	First release to production	V1.07 or Later	TG8613A
02	A	A	Mar 2000	✓ PSB. Three settings added to set zone 6 to increase flexibility ✓ Protection address. Universal address added ✓ SEF & EF. Polarizing voltage setting range increased ✓ Thermal. Setting range increased ✓ Trip conversion logic. 3 DDB signals added to simplify logic for users ✓ Distance. Min polarizing voltage increased to prevent tripping for close up three phase faults ✓ Check sync. angle measurement improved ✓ PSB. Text for power swing indication improved ✓ Include pole discrepancy logic to P543 ✓ Susceptance setting corrected	V1.08 or Later	TG8613B
03	A	A	May 2000	✓ German text changed ✓ Spanish text changed ✓ Changes to DDB names & properties ✓ Improvements in auto-reclose and reset from lockout code ✓ Changes to pole dead & trip conversion logic ✓ Changes to P544 circuit breaker fail logic ✓ Added DDB for CS103 test mode ✓ Recommend upgrading to 03B software or later	V1.09 or Later	TG8613B

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
03 Cont.	B	A	Feb 2002	✓ All builds released for maintenance upgrades ✓ Resolved possible reboot caused by disturbance recorder ✓ Resolved possible reboot caused by invalid MODBUS requests ✓ Resolved a loss of measurements (column 3 & 4) problem that can occur in 3 terminal applications ✓ Problem whereby MiCOM S1 could only set group 1 line length corrected ✓ Fixed capacitive charging current compensation in P544 ✓ Corrected P544 display of phase C current phase angle ✓ IDMT curves improvements ✓ Removed rounding error in calculation of tp ✓ Menu dependence using ripple bit corrected ✓ Directional/non-direction earth fault fixed ✓ Battery fail alarm improvements ✓ Power measurements read over MODBUS may be incorrect ✓ Resolved problem caused by rapid changing self resetting alarm resetting the relay when read key pressed ✓ Prevented software errors from clearing event log	V1.09 or Later	TG8613B
04	A	A	Aug 2000	✓ Trip conversion logic moved from internal fixed logic to PSL	V1.10 or Later	TG8613B
	B	A	Mar 2001	Only P543 CS103 builds released ✓ Improvements to the CS103 time synchronization	V1.10 or Later	TG8613B
	C	A	Jun 2001	Only P543 CS103 builds released. Based on 04B ✓ Resolved a loss of measurements (columns 3 & 4) problem that can occur in 3 terminal applications	V1.10 or Later	TG8613B
	D	A	Jun 2001	Only P543 CS103 build released. Based on 04C ✓ Prevents a reboot on power-up when battery is removed	V1.10 or Later	TG8613B

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
05	A	A	Sep 2000	Internal release for validation only ✓ Includes DNP3.0 ✓ Courier bay module compatibility modification ✓ MODBUS bay module compatibility modification ✓ Distance - Z3 selectable forward/reverse ✓ Spanish text corrected ✓ Menu dependence using ripple bit corrected ✓ MODBUS problem reading negative values of fault location corrected ✓ RDF file modified ✓ Directional/non-direction earth fault fixed ✓ Battery fail alarm corrected ✓ Very low fault location could be shown incorrectly as negative × Some MODBUS address changed	V2.0 or Later	TG8613B
	B	A	Oct 2000	Released to production ✓ Includes all of 05A changes ✓ Requirement to use relays 8, 9 & 10 for Trip A, B & C removed ✓ MODBUS communication problem when used with P140 fixed ✓ Power measurements read over MODBUS may be incorrect ✓ MODBUS status register reports disturbance records incorrectly following power cycle	V2.0 or Later	TG8613B
	C	A	Mar 2001	Only P543 & P544 builds released for customer tests ✓ PSB now works with single pole open	V2.0 or Later	TG8613B
	D	A	May 2001	Only P543 & P544 builds released for customer tests ✓ Distance directional line fixed at -30° ✓ PSB block issued when impedance passes into any Z1, Z2 or Z3 ✓ PSB unblock via negative sequence current now done via PSL	New PSL will be required	-

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
05 Cont.	E	A	Jun 2001	All builds released to production. Based on 05B software ✓ Resolved a loss of measurements (column 3 & 4) problem that can occur in 3 terminal applications × Recommended upgrading to 05K or later	V2.0 or Later	TG8613B
	F	A	Sep 2001	All builds released to production. Based on 05E software ✓ Problem whereby MiCOM S1 could only set group 1 line length corrected ✓ Fixed capacitive charging current compensation in P544 ✓ Corrected P544 display of phase C current phase angle ✓ IDMT curves improvements ✓ Removed rounding error in calculation of tp ✓ Fixed problems caused by changes to DNP3.0 address × Recommended upgrading to 05K or later	V2.0 or Later	TG8613B
	G	A	Jan 2002	All builds except MODBUS released to production. Based on 05F software ✓ Resolved possible reboot caused by disturbance recorder × Problem in MODBUS build which can cause a reboot × Recommended upgrading to 05K or later	V2.0 or Later	TG8613B
	H	A	Jan 2002	All builds released to production. Based on 05G software ✓ Resolved possible reboot caused by invalid MODBUS requests × Recommended upgrading to 05K or later	V2.0 or Later	TG8613B
	I	A	Oct 2002	Limited release - not released to production. Based on 05H software ✓ Correct the format used to display frequency over the MODBUS interface × Recommended upgrading to 05K or later	V2.0 or Later	TG8613B

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
05 Cont.	J	A	Nov 2002	All builds released to production. Based on 05I software ✓ Resolved incorrect operation of C diff failure alarm in 3 terminal schemes ✓ Correct operation of capacitive charging current compensation in 3 terminal schemes ✓ Resolved problem which caused short duration current differential trips in some applications ✗ Recommended upgrading to 05K or later	V2.0 or Later	TG8613B
	K	A	Feb 2003	All builds released to production. Based on 05I software ✓ Resolved problem with IEC 60870-5-103 time synchronization	V2.0 or Later	TG8613B
	L	A	Jan 2004	Maintenance release based on 05K (not formally released) ✓ Prevents compressed disturbance recorder stalling ✓ Prevent a maintenance record when reading from an inaccessible MODBUS register	V2.0 or Later	TG8613B
	M	A	Jun 2004	Maintenance release based on 05L ✓ Improved self-checking of analogue data acquisition ✓ Improved self checking of SRAM ✓ Reception of MODBUS frame improved ✓ Rejection of spurious messages injected onto RS485 network improved ✓ Permissive intertrip in dual redundant schemes corrected	V2.0 or Later	TG8613B
	N	A	Jun 2005	Maintenance release based on 05M ✓ Changed MODBUS driver	V2.0 or Later	TG8613B

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
06	A	A	May 2001	Internal Release for validation only - runs on phase 1 hardware with an old co-processor board ✓ In non GPS mode the char modification timer has been made visible in P545/6 ✓ The char modification timer setting was not being seen by the co-processor board ✓ GPS detected flag was not cleared when switching from GPS to non GPS mode ✓ Equal prop delay command was not resetting inhibit following a comms. switch ✓ Problem displaying Rx & Tx when comms. path was short fixed ✓ Note: Non of the above are relevant to software in production	-	-
	B	A	Jun 2001	Internal release for validation only - runs on phase 1 hardware with an old co-processor board ✓ Prevent loss of measurements in 3 ended schemes ✓ Added a 1s drop off timer to C diff inhibit ✓ Changed max value of char mod timer to 2s ✓ Increased number of PSL timers to 16 (all models) ✓ Corrected PSL default reference ✓ Added a setting to P543/5 AR to select which edge of trip initiates AR ✓ Added 3 DDB signals to block distance ✓ Removed force 3 pole trip DDB ✓ Note: Non of the above are relevant to software in production	-	-
07	A	A	Feb 2002	Limited release (P543 only) - not released to production. Based on 05K software ✓ Additional check sync signals added to PSL	V2.08 or Later	-

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
10	A	B	Feb 2001	Internal release for validation only - runs on phase 1 hardware with a modified co-processor board to accept a 1pps input ✓ GPS synchronization ✓ Flexible intertripping ✓ Signaling message format changed ✓ Models 5 & 6 (but limited to 16 optos & 14 relays) ✓ Remains of neutral C diff removed ✓ Event optimization & filtering ✓ Watt hour measurement correction ✓ Addition of digital opto filtering control ✓ Changes & additions to error codes ✓ Increase in protection signaling address ✓ DDB increased in size to 1022 and also support functions changed ✓ Support for universal optos (model number suffix B) ✓ Support for new output relays added	No official release to support this version. Will need V2 to extract PSL files	-

Relay type: P54x …						
Software version		Hardware suffix	Original date of issue	Description of changes	S1 compatibility	Technical documentation
Major	Minor					
10 Cont.	A	B	Feb 2001	✓ Internal loopback setting added (not full functional) ✓ PSL references added ✓ Reset LEDs DDB name change ✓ Text for cells 0F20 - 0F2F changed ✓ Problem whereby MiCOM S1 could only set group 1 line length corrected ✓ Control inputs added ✓ Restore defaults now restores DNP3.0 cells correctly ✓ Prevent non DNP3.0 builds generating fatal error when S1 request DNP3.0 upload ✓ MODBUS enabling/disabling of IRIG-B now works ✓ Courier/MODBUS event bit functionality corrected × DNP3.0 & MODBUS address are compatible but there are several new ones × Software is not compatible with previous software (signaling message)	No official release to support this version. Will need V2 to extract PSL files	-
	B	B	Apr 2001	Internal release for validation only - runs on phase 1 hardware with a modified co-processor board to accept a 1pps input ✓ Fixed a reset indications problem in CS103 build ✓ Fixed a problem with P544 display of phase C current phase angle ✓ Setting relay address via rear port corrupted other setting ranges	As per 10A	-

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
10 Cont.	C	B	May 2001	Internal release for validation only - runs on phase 2 hardware with a new co-processor board ✓ Support for new co-processor board added ✓ In non GPS mode the char modification timer has been made visible in P545/6 ✓ The char modification timer setting was not being seen by the co-processor board ✓ GPS detected flag was not cleared when switching from GPS to non GPS mode ✓ Equal prop delay command was not resetting inhibit following a comms. switch ✓ Problem displaying Rx & Tx when comms. path was short fixed ✓ Opto filtering corrected ✓ Note: Non of the above are relevant to software in production	As per 10A	-
	D	B	Jun 2001	Internal release for validation only - runs on phase 2 hardware with a new co-processor board ✓ Prevent loss of measurements in 3 ended schemes ✓ Added a 1s drop off timer to C diff inhibit ✓ Changed max value of char mod timer to 2s ✓ Increased number of PSL timers to 16 (all models) ✓ Corrected PSL default reference ✓ Added a setting to P543/5 AR to select which edge of trip initiates AR ✓ Added 3 DDB signals to block distance ✓ Removed force 3 pole trip DDB ✓ Resolved problem caused by rapid changing self resetting alarm resetting the relay when read key pressed ✓ Note: Non of the above are relevant to software in production	V2.01b (not issued)	-

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
10 Cont.	E	B	Jul 2001	Internal release for validation only - runs on phase 2 hardware with a new co-processor board ✓ Fixed capacitive charging current compensation in P544 & P546 ✓ Fixed fast operating times for IDMT at a particular multiply of setting ✓ Added MODBUS control of opto filter cell ✓ Removed the quick start up for GPS because it was causing general startup problems ✓ Fixed the GPS inhibit in dual redundant mode ✓ Fixed an error in GPS synchronization when a timer wraps round ✓ Fixed comms. delay equal command in 3 terminal schemes ✓ CS103 time sync modified not to generate courier events ✓ Note: Non of the above are relevant to software in production	V2.01b (not issued)	-

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
10 Cont.	F	B		Internal release for validation only - runs on phase 2 hardware with a new co-processor board ✓ Added CS103 private codes ✓ Added uncompressed disturbance recorder to CS103 build ✓ Added translations for filter control ✓ Fixed the GI list for P545 & P546 ✓ Fixed the incorrect response in three terminal mode with GPS present and running on a split path followed by a power cycle at one end ✓ Fixed the occasional incorrect calculation of tp being caused by rounding errors ✓ Fixed the incorrect response in dual redundant schemes with GPS failure followed by a switch to a split path on one channel and a comms. failure on the other ✓ Prevented software errors from clearing event log ✓ Unextracted disturbance records now set the courier status flag on power up ✓ Added support for MODBUS function code 7 ✓ Corrected the MODBUS status bit 0 ✓ Corrected the OTEV bit in the status of fault in IEC60870-5-103 × Menu text files do not contain the additional translations ✓ Note: Non of the above are relevant to software in production	V2.01b (not issued)	-

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
11	A	B	Sep 2001	First phase 2 release to production ✓ Includes all of 10F ✓ Added CS103 monitor/command blocking ✓ PSB now uses 6 comparators ✓ Distance directional line fixed at -30° ✓ PSB block issued when impedance passes into any Z1, Z2 or Z3 ✓ PSB unblock via negative sequence current now done via PSL ✓ Modified co-processor initiation to run on 1 wait state (memory access problem) ✓ Fixed a problem with P545 & P546 opto & relay labels in disturbance record ✓ Fixed the GPS inhibit ✓ × Recommended upgrading to 11G or later	V2.03 or Later	P54x/EN T/D11
	B	B	Oct 2001	All builds released to production. Based on 11A software ✓ Modified the co-processor start-up routine to work with alternative types of SRAM ✓ Improved response to a CS103 poll class 1 when monitor blocked was active ✓ Resolved a time alignment problem which resulted in C diff failure alarms being raised ✓ Corrected some MODBUS address for P545 & P546 ✓ Fixed a problem with the relays response to MODBUS commands read coils and read inputs ✓ Fixed an incorrect response to a DNP3.0 command ✓ Recommended upgrading to 11G or later	V2.03 or Later	P54x/EN T/D11

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
11 Cont.	C	B	Dec 2001	All builds released to production. Based on 11B software ✓ Fixed a problem in P541 & P542 CS103 builds where the voltage and power measurements were not being marked as invalid ✓ Fixed a problem in P544 & P546 where the SEF current measurement was incorrect when set to 1A & 60 Hz ✗ Recommended upgrading to 11G or later	V2.03 or Later	P54x/EN T/D11
	D	B	Jan 2002	All builds released to production. Based on 11C software ✓ Resolved possible reboot caused by disturbance recorder ✓ Resolved possible reboot caused by invalid MODBUS requests ✓ Resolved problem when internal loopback was selected with external clocks ✓ Resolved a problem which caused the loss of IEC 60870-5-103 class 1 messages ✗ Recommended upgrading to 11G or later	V2.03 or Later	P54x/EN T/D11
	E	B	Oct 2002	All builds released to production. Based on 11D software ✓ Resolved incorrect operation of C diff failure alarm in 3 terminal schemes ✓ Correct operation of capacitive charging current compensation in 3 terminal schemes ✓ Resolved problem which caused short duration GPS failure alarms ✗ Recommended upgrading to 11G or later	V2.03 or Later	P54x/EN T/D11

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
11 Cont.	F	B	Feb 2003	All builds ready. Based on 11E software ✓ Resolved several problems related to the IEC 60870-5-103 protocol ✓ Resolved problem which may cause short duration current differential trips ✓ Corrected the format used to display frequency over the MODBUS interface ✗ Recommended upgrading to 11G or later	V2.03 or Later	P54x/EN T/D11
	G	B	May 2003	All builds ready. Based on 11F software ✓ Changes to clock recovery circuits to improve operation with multiplexers. ✓ PSL logic for user defined intertrips corrected P545 & P546 ✓ Permissive intertrip in dual redundant schemes corrected ✓ Prevented unwanted comms. delay alarms	V2.03 or Later	P54x/EN T/D11
	H	B	Sept 2003	All builds ready. Based on 11G software ✓ Prevents compressed disturbance recorder stalling ✓ Prevents CS103 reporting more non-compressed disturbance records than actually present	V2.03 or Later	P54x/EN T/D11

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
11 Cont.	I	B	Oct 2004	All builds released to production. Based on 11G software ✓ Improved self-checking of analogue data acquisition ✓ Differential intertrip in IEC 60870-5-103 reported with correct FAN ✓ SRAM self checking added to co-processor board ✓ Reception of MODBUS frame improved ✓ Rejection of spurious messages injected onto RS485 network improved ✓ Improved self checking of SRAM ✓ Fixed an incorrect response of the summertime time bit in IEC 60870-5-103 protocol ✓ Prevented incorrect behavior of P545/P546 when one relay is energized when there is noise on the signaling channel ✓ Status of local GPS reported incorrectly in dual redundant schemes ✓ Setting "Char Mod Time" was missing on P541 - P544 ✓ Prevent a maintenance record when reading from an inaccessible MODBUS register ✓ Prevents relay crashing when phase 2 software used with phase 1 optos ✓ Cell 0709 now replies OK change	V2.03 or Later	P54x/EN T/D11
	J	B	Jul 2005	All builds released to production. Based on 11I software ✓ Changed MODBUS driver	V2.03 or Later	P54x/EN T/D11

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
12	A	B	Mar 2002	Released for validation testing only ✓ 2nd rear comms. added ✓ Alarms increased to 64 with user programmable alarms ✓ Enhancements and corrections to CS103 ✓ Prevented additional events being generated on power up ✓ French language text improvements ✓ Prevent a maintenance record when reading from an inaccessible MODBUS register ✓ Setting “Char Mod Time” was missing on P541 - P544 ✓ Prevents relay crashing when phase 2 software used with phase 1 optos ✓ Cell 0709 now replies OK change ✓ Maximum pre-trigger time for disturbance recorder in IEC 870-103-5 builds reduced to allow extraction via rear port	V2.05 or Later	P54x/EN T/E21
	B	B	Nov 2002	All builds released to production. Based on 12A software ✓ Resolved incorrect operation of C diff failure alarm in 3 terminal schemes ✓ Correct operation of capacitive charging current compensation in 3 terminal schemes ✓ Resolved problem which caused short duration GPS failure alarms ✓ Resolved problem selecting setting group via optos ✓ Resolved a circuit breaker lockout problem ✓ Corrected the thermal measurement displayed when thermal protection is disabled ✓ Spanish text for user defined alarms contained an extra letter ✓ Blocked overcurrent elements now generate events ✓ Correct DNP3.0 operation of object 10	V2.05 or Later	P54x/EN T/E21

Relay type: P54x …							
Software version		Hardware suffix	Original date of issue	Description of changes		S1 compatibility	Technical documentation
Major	Minor						
12 Cont.	B	B	Nov 2002	Resolved problem with P541 & P542 IEC 60870-5-103 builds not running		V2.05 or Later	P54x/EN T/E21
				Resolved a problem with IEC 60870-5-103 class 1 polling	✓		
				Resolved a problem with IEC 60870-5-103 ASDU2 events which occurred prior to a start event	✓		
				Correct the format used to display frequency over the MODBUS interface	✓		
				Resolved problem related to incorrect CB trip/close commands via MODBUS	✓		
				Resolved problem related to CB trip/close commands via MODBUS being accepted when not selected	✓		
				Resolved a problem which prevented protection setting being saved after control and support setting had been saved	✓		
				Corrected the saving of fault locator settings in groups 2, 3, 7 & 4 when made via user interface	✓		
				Added object 10 to DNP3.0 class 0 poll	✓		
				Corrected the way DNP3.0 handled the season bit in the time & date	✓		
				Recommended upgrading to 12D or later	×		

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
12 Cont.	C	B	Mar 2003	All builds released to production. Based on 12B software ✓ Resolved several problems related to the IEC 60870-5-103 protocol ✓ Resolved problem which may cause short duration current differential trips ✓ Improved self diagnostics relating to input module clock ✓ Modified courier block transfer mechanism so it can handle more than 255 blocks ✓ Intermittent loss of data from 2nd rear comms. port corrected ✓ PSL logic for user defined intertrips corrected P545 & P546 ✓ Permissive intertrip in dual redundant schemes corrected ✗ Recommended upgrading to 12D or later	V2.05 or Later	P54x/EN T/E21
	D	B	Jun 2003	All builds released to production. Based on 12C software ✓ Changes to clock recovery circuits to improve operation with multiplexers ✓ Prevented unwanted comms. delay alarms	V2.05 or later	P54x/EN T/E21
	E	B	Sept 2003	All builds released to production. Based on 12D software ✓ Prevents compressed disturbance recorder stalling ✓ Correction to operation of reset relays/LEDs opto ✓ Prevents CS103 reporting more non-compressed disturbance records than actually present	V2.05 or later	P54x/EN T/E21
	F	B	Jun 2004	Not released to production. Supplied to one customer. Based on 12E software ✓ Improved self-checking of analogue data acquisition ✓ Differential intertrip in IEC 60870-5-103 reported with correct FAN	V2.05 or Later	P54x/EN T/E21

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
12 Cont.	G	B	Oct 2004	All builds released to production. Based on 12E software ✓ Improved self-checking of analogue data acquisition ✓ Differential intertrip in IEC 60870-5-103 reported with correct FAN ✓ SRAM self checking added to co-processor board ✓ Reception of MODBUS frame improved ✓ Rejection of spurious messages injected onto RS485 network improved ✓ Improved self checking of SRAM ✓ Fixed an incorrect response of the summertime time bit in IEC 60870-5-103 protocol ✓ Prevented incorrect behavior of P545/P546 when one relay is energized when there is noise on the signaling channel ✓ Status of local GPS reported incorrectly in dual redundant schemes	V2.05 or Later	P54x/EN T/E21
	H	B	May 2005	All builds released to production. Based on 12G software ✓ Changed MODBUS driver	V2.05 or Later	P54x/EN T/E21
	I	B	May 2006	All builds released to production. Based on 12G software ✓ Improvements to the distance protection	V2.05 or Later	P54x/EN T/E21

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
13	A	B	Apr 2004	All builds released to production. Based on 12E software ✓ Control inputs enhancements including non-volatile, latched, pulsed and support for DNP3.0 pulsed. ✓ Enhanced DNP3.0 ✓ Distance Residual compensation angle range extended ✓ Display of number of good messages via MODBUS is corrected ✓ Prevented DNP3.0 time sync causes relay to reboot when IRIG-B is active ✓ Improved self-checking of analogue data acquisition ✓ Improved self checking of SRAM ✓ Added TRIP & ALARM to MODBUS status word ✓ Addition of MODBUS only setting to allow transmission of IEC time format in reverse IEC byte order ✓ Reception of MODBUS frame improved ✓ Rejection of spurious messages injected onto RS485 network improved ✓ Handling of FAN in IEC 60870-5-103 improved ✓ Differential intertrip in IEC 60870-5-103 reported with correct FAN	V2.10 or later	P54x/EN T/E21
	B	B	Aug 2004	All builds released to production. Based on 13A software ✓ SRAM self checking added to co-processor board ✓ Fault location & cumulative broken current measurements reported over DNP3.0 ✓ Accuracy of MODBUS time sync improved ✓ Invalid MODBUS register 4x00966 removed ✓ Reception of MODBUS frame improved	V2.10 or Later (DNP3.0 files) different to 13A	P54x/EN T/E21

Relay type: P54x …						
Software version		Hardware suffix	Original date of issue	Description of changes	S1 compatibility	Technical documentation
Major	Minor					
13 Cont.	C	B	Oct 2004	All builds released to production. Based on 13B software ✓ Resolved a problem relating to co-processor SRAM checking ✓ Fixed an incorrect response of the summertime time bit in IEC 60870-5-103 protocol ✓ Prevented incorrect behavior of P545/P546 when one relay is energized when there is noise on the signaling channel ✓ Status of local GPS reported incorrectly in dual redundant schemes	V2.10 or Later (DNP3.0 files) different to 13A	P54x/EN T/E21
	D	B	Mar 2005	All builds released to production. Based on 13C software ✓ Correction to single pole auto-reclose ✓ Remapped fun/inf. 192/130 in P543 & P545 ✓ Display of no. valid messages on LCD corrected ✓ DNP3.0 improved binary scanning ✓ Operation of CB maintenance alarm corrected ✓ Corrections to allow extended courier characters to be used in string setting cells for courier and MODBUS ✓ Corrected default display of neutral current for 5A CTs ✓ Prevented a reboot for DNP3.0 versions when control & support settings are changed rapidly ✓ Changes to co-processor start-up to eliminate a timing problem	V2.10 or Later (DNP3.0 files) different to 13A	P54x/EN T/E21
	E	B	Apr 2005	All builds released to production. Based on 13D software ✓ Changed MODBUS driver	V2.10 or Later (DNP3.0 files) different to 13A	P54x/EN T/E21

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
13 Cont.	F	B	Jun 2006	All builds released to production. Based on 13E software ✓ Improvements to the distance protection ✓ Add interframe gap to DNP3.0 ✓ Corrections to IRIG-B ✓ Vector group compensations for YY2 and YY10 corrected ✓ Corrected reporting of distance & C diff stars over CS103 ✓ Reports the correct COT for reset LEDs command sent via S1 ✓ Corrected a problem which occurs when two relays power up when one is configured out	V2.10 or Later (DNP3.0 files) different to 13A	P54x/EN T/E21
16	A	B	Jul 2006	Release of P543 CS103 for Germany only. Based on 13F ✓ CS103/Auto-reclose modifications	Patch for V2.12	P54x/EN T/E21

Relay type: P54x …						
Software version		Hardware suffix	Original date of issue	Description of changes	S1 compatibility	Technical documentation
Major	Minor					
20	A	G	Nov 2002	Internal release for validation only - runs on phase 2 processor board. Based on 12B ✓ UCA2 option added ✓ Russian text added (not complete) ✓ Added fault location to for IEC 60870-5-103 ✓ Added TRIP & ALARM to MODBUS status word ✓ Distance direction setting added ✓ Distance residual compensation angle range extended ✓ Indication of password status on DDB (code added but not run) ✓ Improvements to auto-reclose ✓ Alarms increased to 96 ✓ Corrected the response to courier SEND EVENT ✓ Improved self diagnostics relating to input module clock ✓ Removed the setting for IEC 60870-5-103 over fiber when hardware not present ✓ Resolved problem related to CB trip/close commands via MODBUS being accepted when not selected ✓ Corrected the saving of fault locator settings in groups 2, 3 & 4 when made via user interface ✓ Added object 10 to DNP3.0 class 0 poll ✓ Corrected the way DNP3.0 handled the season bit in the time & date	-	-

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
20 Cont.	B	G	Apr 2003	Internal release for validation only. Based on 20A ✓ Enhanced check synchronization feature ✓ Control inputs enhancements including non-volatile, latched, pulsed and support for DNP3.0 pulsed ✓ BBRAM used in disturbance recorder optimized ✓ Resolved several problems related to the IEC 60870-5-103 protocol ✓ Resolved problem which may cause short duration current differential trips ✓ Improved self diagnostics relating to input module clock ✓ Modified courier block transfer mechanism so it can handle more than 255 blocks	-	-
	B	G	Apr 2003	✓ PSL logic for user defined intertrips corrected P545 & P546 ✓ Permissive intertrip in dual redundant schemes corrected ✓ Operation of manual reset alarms corrected ✓ A number of bug fixes relating to CPU2	-	-
	C	G	Apr 2003	Internal release for validation only. Based on 20B ✓ CB control via hot keys ✓ A number of bug fixes relating to CPU2	-	-

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
20 Cont.	D	G	Jul 2003	Internal release for validation only. Based on 20C ✓ Changes to clock recovery circuits to improve operation with multiplexers ✓ Prevented unwanted comms. delay alarms ✓ Enhanced auto-reclose feature added ✓ Alarms handled better in CS103 GI ✓ Time synchronization via opto added ✓ Platform alarms copied to DDB ✓ Correction to operation of reset relays/LEDs opto. ✓ Backup protection run if co-processor fails to start up on power on ✓ Correction to cell 0B25 ✓ A number of bug fixes relating to CPU2	V2.09 or Later	P54x/EN T/F32
	E	G	Oct 2003	Limited release for NiCAP + selected others ✓ Extraction of disturbance recorder over MODBUS added ✓ Resolve nucleus missing HISR problems ✓ Enhancements to IDMT curves ✓ Display of number of good messages via MODBUS is corrected ✓ A number of bug fixes relating to CPU2	V2.09 or Later	P54x/EN T/F32

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
20 Cont.	F	G	Feb 2004	Release to production ✓ UCA2: Increase max. pending requests & max. connected clients ✓ Enhanced DNP3.0 ✓ Prevented DNP3.0 time sync causes relay to reboot when IRIG-B is active ✓ Corrected cause of transmission which may be returned for "Fault Location" ✓ Prevents relay rebooting during EMC ANSI fast transient and IEC high frequency ✓ A number of bug fixes relating to CPU2	V2.09 or Later	P54x/EN T/F32
	G	G	Jun 2004	Release to production. Based on 20F software ✓ Prevented repeated downloads of GSL files without Ethernet card restart rebooting Ethernet card ✓ Correction to uploading of disturbance records over UCA2 ✓ Corrected operation of Ethernet card link LED for 10 Base-FL ✓ Closed UCA2 association after "dirty" client disconnection ✓ Made UCA2 disturbance record directory service compatible with PACiS ✓ Corrected under and over voltage blocking of check sync ✓ Improved self-checking of analogue data acquisition ✓ Handling of FAN in IEC 60870-5-103 improved ✓ Differential intertrip in IEC 60870-5-103 reported with correct FAN ✓ Prevented C diff fail alarm occurs before signaling fail alarm for loss of communications ✓ Improved self checking of SRAM	V2.09 or Later	P54x/EN T/G42

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
20 Cont.	H	G	Oct 2004	Release to production. Based on 20G software ✓ SRAM self checking added to co-processor board ✓ Fixed an incorrect response of the summertime time bit in IEC 60870-5-103 protocol ✓ Prevented incorrect behavior of P545/P546 when one relay is energized when there is noise on the signaling channel ✓ Status of local GPS reported incorrectly in dual redundant schemes ✓ Accuracy of MODBUS time sync improved ✓ Fixed an incorrect response of the summertime time bit in IEC 60870-5-103 protocol ✓ Prevented Ethernet card restarting after approximately 20 hours when no connection made ✓ Improvements to time sync for courier, CS103 and DNP3.0 ✓ Invalid MODBUS register 4x00966 removed	V2.09 or Later	P54x/EN T/G42
	I	G	Nov 2004	Release to production. Based on 20G software ✓ Display of no. valid messages on LCD corrected ✓ Operation of CB maintenance alarm corrected ✓ Corrections to allow extended courier characters to be used in string setting cells for courier and MODBUS ✓ Corrected default display of neutral current for 5A CTs ✓ Prevented a reboot for MODBUS versions during event extraction when messages where close together ✓ Correction to prevent the 2nd rear comms. locking up	V2.09 or Later	P54x/EN T/G42
	J	G	Apr 2006	Release to production. Based on 20G software ✓ Correction to IEEE/US inverse reset setting ✓ Changes to co-processor start-up to eliminate a timing problem	V2.09 or Later	P54x/EN T/G42

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
20 Cont.	K	G	Apr 2006	Release to production. Based on 20G software ✓ Improvements to the distance protection ✓ Add interframe gap to DNP3.0 ✓ Corrections to IRIG-B ✓ Vector group compensations for YY2 and YY10 corrected ✓ Corrected reporting of distance & C diff stars over CS103 ✓ Reports the correct COT for reset LEDs command sent via S1 ✓ Corrected a problem which occurs when two relays power up when one is configured out	V2.09 or Later	P54x/EN T/G42
	L	G		P545 Release to Production. Based on 20K software. ✓ Resolved a problem which interrupted the UCA2 communications periodically ✓ Resolved a problem relating to CT Ratio's not being restored when restoring default settings ✓ Resolved a problem with the Disturbance Recorder which saturates for High current levels into 5A CT. ✓ Resolved problem with relay recognising non zero entry in 14th position of model number	V2.09 or Later	P54x/EN T/G42
	M	G	Nov 2009	Release to Production. Based on 20L software. ✓ Improvements to the GPS code ✓ Improvements in the clock recover circuits used by the Differential Comms ✓ Correction to the way latched LED/Relays are cleared ✓ Correction to autoreclose operation for switch on to fault condition ✓ Prevented CB Operating Time displaying 4.295Ms ✓ Bug Fixes	V2.09 or Later	P54x/EN T/G42

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
20 Cont.	N	G		Release to Production. Based on 20M software. ✓ Prevented the Differential protection inhibiting in three terminal schemes when GPS is enabled and loopback mode selected ✓ Fault locator measurements in ohms corrected when 5A CT used or displayed in primary.	V2.09 or Later	P54x/EN T/G42
30	A	J	Sep 2004	Released to selected customers only. Based on 20G ✓ Interface to optical multiplexer (IEEE standard C37.94) ✓ SRAM checking in co-processor ✓ Dual range optos ✓ AREVA livery & software changes ✓ Extended residual angle in fault locator to match distance ✓ Rename GOOSE signals in line with P443 ✓ Add virtual signals, control inputs & user alarms to DR in line with P443 ✓ Relay settings shall be stored in FLASH EEPROM instead of EEPROM memory ✓ Extend range of time dial to line up with P140 ✓ Accuracy of MODBUS time sync improved ✓ Invalid MODBUS register 4x00966 removed ✓ Improvements to time sync for courier, CS103 and DNP3.0 ✓ Addition of MODBUS only time and date format setting to common courier settings for access from the other interfaces ✓ Vector group compensations for YY2 and YY10 corrected ✓ Prevented Ethernet card restarting after approximately 20 hours when no connection made ✓ Prevented incorrect behavior of P545/P546 when one relay is energized when there is noise on the signaling channel	V2.09 or Later (No language file support)	P54x/EN T/G42

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
30 Cont.	B	J	Nov 2004	Released to production but held. Based on 30A ✓ Courier, MODBUS & DNP3.0 communications over Fiber added	V2.11 or Later	P54x/EN T/H53
	C	J	Nov 2004	Released to production. Based on 30B ✓ Correction to prevent the 2nd rear comms. locking up ✓ Correction to prevent the front panel UI and comms. lockup after continued operation ✓ Changes to co-processor start-up to eliminate a timing problem	V2.11 or Later	P54x/EN T/H53
	D	J	Dec 2004	Released to production. Based on 30C ✓ Improvements to operation when subjected to multiple communication switches when operating in non-GPS mode	V2.11 or Later	P54x/EN T/H53
	E	J	Jan 2005	Released to production. Based on 30D ✓ VTS enhanced to restore 3 software version 20 performance for three pole tripping whist keeping the improvements for 1 pole tripping added at 30B	V2.11 or Later	P54x/EN T/H53
	F	J	Mar 2005	Released to production. Based on 30E ✓ Enhancements to the current differential performance under switched communication channels ✓ Correction to the CS103 mapping for platform alarms	V2.11 or Later	P54x/EN T/H53
	G	J	Apr 2006	Released to production. Based on 30E ✓ Correction to IEEE/US Inverse reset setting	V2.11 or Later	P54x/EN T/H53
	H	J	Apr 2006	Limited release P542 DNP3.0 to a customer ✓ Add interframe gap to DNP3.0	V2.11 or Later	P54x/EN T/H53

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
30 Cont.	I	J	May 2005	Released to production. Based on 30G ✓ Improvements to the distance protection ✓ Add interframe gap to DNP3.0 ✓ Corrections to IRIG-B ✓ Vector group compensations for YY2 and YY10 corrected ✓ Corrected reporting of distance & C diff stars over CS103 ✓ Reports the correct COT for reset LEDs command sent via S1 ✓ Corrected a problem which occurs when two relays power up when one is configured out ✓ Modification to allow individual MODBUS register access	V2.11 or Later	P54x/EN T/H53
40	A	K	May 2006	Release of P543, P544, P545 & P546 without distance protection ✓ CTS ✓ Definitive time directional negative sequence overcurrent I2> ✓ GPS synchronization of current differential in all models ✓ P543 and P545 now facilitate in zone transformer-feeder applications ✓ All models support ABC and ACB phase rotation ✓ Standard and Inverted CT polarity setting for each set of CTs in the relay ✓ User interface with tri colored LED and function keys ✓ InterMiCOM64 ✓ Voltage protection ✓ Backwards compatibility mode	Patch for V2.12	P54x/EN M/I64

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
41	C	K	Jul 2006	Release of P543, P544, P545 & P546 without distance protection based on 40A ✓ IEC 61850-8-1 ✓ High break options ✓ Demodulated IRIG-B options ✓ Reduction of distance minimum reach settings to 0.05 ohm ✓ Permissive trip reinforcement ✓ Poledead modifications for Hydro Quebec ✓ CS103/auto-reclose modifications	Patch for V2.12	P54x/EN M/J74
41	D	K	Aug 2006	Release of P543, P544, P545 & P546 without distance protection based on 41C ✓ Prevents a possible reboot 15 minutes after browsing the front courier port but not making a setting change i.e. browsing using PAS&T. ✓ Extended GOOSE Enrolment Capability ✓ Correction to ICD files, Enumeration (value) and Fixed data Mapping	Patch for V2.12	P54x/EN M/J74
41	E	K	Nov 2006	Release of P543, P544, P545 & P546 without distance protection based on 41D ✓ Prevent a reboot in 61850 builds when NIC link is inactive and avalanche of DDB activity. ✓ Correctly report a fatal error generated by the sampling call-back ✓ Correct the operation of the GOOSE messaging and a problem with the download of an IED Configuration file. ✓ Correct the operation of the check sync. ✓ Correct the operation of the overcurrent reset curves. ✓ Removed check on the14th position of model number ✓ Fixed Telegrams for public inf 64-67 ✓ SOTF can operate even when it is disabled	Patch for V2.12	P54x/EN M/J74

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
41	F	K	May 2007	Release of P543, P544, P545 & P546 without distance protection based on 41E ✓ Prevent a fatal error from an incorrect DNP address in not using DNP evolutions platform. ✓ Default setting for 450B 'I< Current Set' reduced to 50mA ✓ French Translations for DDBs 1368-1371corrected ✓ Fun & INF values related to CS103 Command Blocking corrected ✓ Angle for negative sequence phase overcurrent setting corrected ✓ Corrected operation when using MiCOM S1 is used to activate Settings group by right clicking on the group. ✓ Corrected the latching of Function Key DDB signals on relay power up ✓ Corrected Disturbance recorder scaling to prevent high current levels into 5A CT causing the Disturbance Recorder to saturate ✓ Restring defaults appears not to change the 1/5A CT selection ✓ Corrected the performance of the IM64 Direct mode ✓ CB control via Direct access does not work with 2CB versions of P540D ✓ Autoreclose dead time/close cycle continues even if AR switched out of service ✓ Ch2 Statistics may not be displayed	Patch for V2.12	P54x/EN M/J74
41	G	K		P543, P544, P545 & P546 non 61850 builds without distance protection based on 41F was approved for release but withdrawn before release. ✓ Corrections to enable/disable of Autoreclose	Patch for V2.12	P54x/EN M/J74
41	H	K	May 2007	Release of P543, P544, P545 & P546 without distance protection based on 41G ✓ Corrections to enable/disable of Autoreclose	Patch for V2.12	P54x/EN M/J74

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
42	A	K		Release of P543, P544, P545 & P546 without distance protection ✓ Chinese interface ✓ Replacing the existing DNP3 with the DNP3 evolutions ✓ Replacement of existing negative sequence overcurrent with multi stage (2 IDMT + 2 DT) negative sequence overcurrent. ✓ Addition of IDG curve, commonly used in Sweden, to Earth Fault & Sensitive Earth Fault (involves moving settings) ✓ Reduction of all TMS step sizes to 0.005 ✓ Addition of Channel propagation delay Statistics and Alarms ✓ Changes to CTS so both techniques can be selected together ✓ Regrouping of CTS settings ✓ Addition of four stages of under frequency protection and two stages of Overfrequency protection ✓ Addition of df/dt protection ✓ Changes to Under and Overvoltage to enable each stage to be independently set ✓ Extensions to the checksync VT position setting ✓ Changes to Permissive Inter Trip (PIT) logic to enable the user to select either local or remote current to be used. ✓ Includes local time zone settings for Date & Time ✓ Reduced minimum setting for IN> I2pol Set ✓ Addition of propagation delay times to Fault Record ✓ Default setting for 450B 'I< Current Set' reduced to 50mA. ✓ Enhancement to self checking of output relays ✓ Change tunnelled courier address to follow the 1st Rear Port's KBUS or CS103 address.	Patch for V2.12	P54x_EN_MJ74 + addendum P54x_EN_AD_J84

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
42	B	K	July 2007	Release of P543, P544, P545 & P546 without distance protection based on 42A. ✓ Improvements to VTS ✓ Corrections to enable/disable of Autoreclose ✓ Resolved a problem relating to CT Ratio's not being restored when restoring default settings ✓ Resolved a problem with the Disturbance Recorder which saturates for High current levels into 5A CT.	Patch for V2.12	P54x_EN_MJ74 + addendum P54x_EN_AD_J84
42	D	K	Dec 2007	Release of P543, P544, P545 & P546 without distance protection based on 42B. ✓ Fixed a number of 61850/Goose problems ✓ Minor correction to fault record ✓ Corrections to over voltage stage 2 inhibit ✓ Fixed the max prop alarm ✓ Corrected some DDB German text	Patch for V2.12	P54x_EN_MJ74 + addendum P54x_EN_AD_J84
42	E	K	May 2008	Release of P543, P544, P545 & P546 without distance protection based on 42D. ✓ Fixed a number of 61850 problems ✓ Improved co-processor error reporting ✓ Fixed Inhibit CB Fail Protection in P544/6	Patch for V2.12	P54x_EN_MJ74 + addendum P54x_EN_AD_J84
42	F	K		Not released to production. Based on 42E. ✓ Correction to autoreclose operation for switch on to fault condition ✓ Prevented CB Operating Time displaying 4.295Ms ✓ Bug fixes	Patch for V2.12	P54x_EN_MJ74 + addendum P54x_EN_AD_J84
42	G	K	Oct 2008	Release of P543, P544, P545 & P546 without distance protection based on 42F. ✓ Correction to the distance cross polarising when the memory expires	Patch for V2.12	P54x_EN_MJ74 + addendum P54x_EN_AD_J84

Relay type: P54x …						
Software version		Hardware suffix	Original date of issue	Description of changes	S1 compatibility	Technical documentation
Major	Minor					
42	H	K	Sept 2009	Release of P543, P544, P545 & P546 without distance protection based on 42G. ✓ Corrected some menu translations ✓ Corrected Breaker Fail - WI Aided1 trips so they can be disabled via setting "WI Prot Reset" ✓ Timestamp in fault record adjusted for the local time setting. ✓ Corrected P543 default PSL ✓ Corrections to the Current Differential Inhibit when the GPS synchronisation is disabled ✓ Corrected Thermal State measurement via DNP3 ✓ Correction to the way latched LED/Relays are cleared ✓ Correction to Negative sequence overcurrent settings when 5A input used ✓ Correction to P545/P541 compatibility when used in transformer compensation mode ✓ Improvements to the GPS code ✓ Prevented CTS generating events when CTS is disabled ✓ Prevent Z5 from setting slow swing when PSB is disabled ✓ Fixed problem which prevented residual overvoltage from initiating CB Fail ✓ Various improvements to DNP, CS103 & IEC61850 protocols ✓ Bug fixes	Patch for V2.12	P54x_EN_MJ74 + addendum P54x_EN_AD_J84

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
44	A	K	Mar 2008	Release of P543, P544, P545 & P546 without distance protection based on 42D. ✓ Positional information added to PSL. ✓ DNP 3.0 Over Ethernet protocol added. ✓ Extended I/O – status inputs increased from 24 to 32. ✓ Compensated overvoltage protection added ✓ IEC-103 Generic Services Measurements added ✓ Set/Reset Latch Logic Gates added to PSL ✓ Fault record to include current differential currents recorded at the time of the current differential trip in addition to the existing data from 1 cycle later. ✓ Fault record increased max number of fault records to 15 ✓ GPS Alarm modifications ✓ DNP enhancements for SSE ✓ Bug fixes	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94
44	B	K	Jun 2008	Release of P543, P544, P545 & P546 without distance protection based on 44A. ✓ Fixed a number of 61850 problems ✓ Improved co-processor error reporting ✓ Fixed Inhibit CB Fail Protection in P544/6 ✓ Corrected some French and German text ✓ Prevented CB Operating Time displaying 4.295Ms ✓ Fixed a problem which prevented extraction of dnp3 setting files from dnp3 over Ethernet variants.	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
44	D	K	Jan 2009	Release of P543, P544, P545 & P546 without distance protection based on 44B. ✓ Corrections to the Current Differential Inhibit when the GPS synchronization is disabled ✓ Corrected Thermal State measurement via DNP3 ✓ Timestamp in fault record adjusted for the local time setting. ✓ Corrected Breaker Fail - WI Aided1 trips so they can be disabled via setting "WI Prot Reset"	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94
44	E	K	Mar 2009	Release of P543, P544, P545 & P546 without distance protection based on 44D. ✓ Prevents the loss of IEC61850 messages and fixed the handling of the ACD flag during GI. ✓ Improved the Ethernet card boot code	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94
44	F	K	Sept 2009	Release of P543, P544, P545 & P546 without distance protection based on 44E. ✓ Corrected some menu translations ✓ Corrected P543 default PSL ✓ Correction to the way latched LED/Relays are cleared ✓ Correction to Negative sequence overcurrent settings when 5A input used ✓ Correction to P545/P541 compatibility when used in transformer compensation mode ✓ Improvements to the GPS code ✓ Prevented CTS generating events when CTS is disabled ✓ Fixed problem which prevented residual overvoltage from initiating CB Fail ✓ Various improvements to DNP, CS103 & IEC61850 protocols ✓ Bug fixes	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94

Relay type: P54x …							
Software version		Hardware suffix	Original date of issue	Description of changes	S1 compatibility		Technical documentation
Major	Minor						
45	B	K	Mar 2009	Release of P543, P544, P545 & P546 without distance protection based on 44E. ✓ Autoreclose, Check Sync and CB Monitoring added to P544 & P546	Patch for V2.14 Studio ftp server		P54x/EN M/KA4
45	C	K	May 2009	Release of P543, P544, P545 & P546 without distance protection based on 45B. ✓ Improvements to the Ethernet card startup and configuration ✓ Correction to Negative sequence overcurrent settings when 5A input used ✓ Correction to P545/P541 compatibility when used in transformer compensation mode ✓ Correction to the way latched LED/Relays are cleared ✓ Corrections to menu text ✓ Improvements to the GPS code ✓ Bug Fixes	Patch for V2.14 Studio ftp server		P54x/EN M/KA4
45	D	K	Oct 2009	Release of P543, P544, P545 & P546 without distance protection based on 45C. ✓ Improvements to the GPS code ✓ Improvements to the GPS code ✓ Improvements in the clock recover circuits used by the Differential Comms ✓ Bug Fixes	Patch for V2.14 Studio ftp server		P54x/EN M/KA4

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
47	A	K		Release of P543, P544, P545 & P546 without distance protection based on 45D. ✓ IEC-61850 phase 2 and 2.1 implemented ✓ Application for Inzone Transformers (2nd and 5th Harmonic Blocking/restraint) ✓ Differential Highset can be disabled when Inrush protection is enabled ✓ Restricted Earth Fault Protection (REF) ✓ Modification to Char Mod timer functionality ✓ Separate measurements for each set of CT's ✓ Interrupt Driven InterMiCOM in all models ✓ Read Only Mode	Patch for V2.14 Studio ftp server	P54x/EN M/KA4 + addendum P54x/EN AD/KB4
47	B	K	Jan 2010	Release of P543, P544, P545 & P546 without distance protection based on 47A. ✓ Prevented the Differential protection inhibiting in three terminal schemes when GPS is enabled and loopback mode selected ✓ Fault locator measurements in ohms corrected when 5A CT used or displayed in primary. ✓ Frequency measurement in DNP3 fault record corrected	Patch for V2.14 Studio ftp server	P54x/EN M/KA4 + addendum P54x/EN AD/KB4
50	A	K	May 2006	Release of P543, P544, P545 & P546 with distance protection ✓ Distance protection from P443 ✓ DEF from P443 ✓ Aided distance & DEF schemes from P443 ✓ CTS	Patch for V2.12	P54x/EN M/I64

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
50 Cont.	A	K	May 2006	✓ Definitive time directional negative sequence overcurrent I2> ✓ GPS synchronization of current differential in all models ✓ P543 and P545 now facilitate in zone transformer-feeder applications ✓ All models support ABC and ACB phase rotation ✓ Standard and inverted CT polarity setting for each set of CTs in the relay ✓ User interface with tri colored LED and function keys ✓ InterMiCOM64 ✓ Voltage protection ✓ Backwards compatibility mode	Patch for V2.12	P54x/EN M/I64
51	C	K	Jul 2006	Release of P543, P544, P545 & P546 with distance protection based on 50A ✓ IEC 61850-8-1 ✓ High break options ✓ Demodulated IRIG-B options ✓ Reduction of distance minimum reach settings to 0.05 ohm ✓ Permissive trip reinforcement ✓ Poledead modifications for Hydro Quebec ✓ CS103/auto-reclose modifications ✓ Out of step tripping	Patch for V2.12	P54x/EN M/J74
	D	K	Aug 2006	Release of P543, P544, P545 & P546 with distance protection based on 51C ✓ Prevents a possible reboot 15 minutes after browsing the front courier port but not making a setting change i.e. browsing using PAS&T. ✓ Extended GOOSE Enrolment Capability ✓ Correction to ICD files, Enumeration (value) and Fixed data Mapping	Patch for V2.12 V2.13 or Later	P54x_EN_MJ74

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
51 Cont.	E	K	Nov 2006	Release of P543, P544, P545 & P546 with distance protection based on 51D ✓ Prevent a reboot in 61850 builds when NIC link is inactive and avalanche of DDB activity. ✓ Correctly report a fatal error generated by the sampling call-back ✓ Correct the operation of the GOOSE messaging and a problem with the download of an IED Configuration file. ✓ Correct the operation of the check sync. ✓ Correct the operation of the overcurrent reset curves. ✓ Removed check on the14th position of model number ✓ Fixed Telegrams for public inf 64-67 ✓ SOTF can operate even when it is disabled	Patch for V2.12 V2.13 or Later	P54x_EN_MJ74

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
51	F	K	May 2007	Release of P543, P544, P545 & P546 non 61850 builds with distance protection based on 51E ✓ Prevent a fatal error from an incorrect DNP address in not using DNP evolutions platform. ✓ Default setting for 450B 'I< Current Set' reduced to 50 mA ✓ French Translations for DDBs 1368-1371corrected ✓ Dependencies for cells 3242 & 3245 corrected ✓ Fun & INF values related to CS103 Command Blocking corrected ✓ Angle for negative sequence phase overcurrent setting corrected ✓ Corrected operation when using MiCOM S1 is used to activate Settings group by right clicking on the group. ✓ Corrected the latching of Function Key DDB signals on relay power up ✓ Corrected Disturbance recorder scaling to prevent high current levels into 5A CT causing the Disturbance Recorder to saturate ✓ Restring defaults appears not to change the 1/5A CT selection ✓ Corrected the performance of the IM64 Direct mode ✓ CB control via Direct access does not work with 2CB versions of P540D ✓ Autoreclose dead time/close cycle continues even if AR switched out of service ✓ Distance setting are not updated in simple setting mode in setting groups other than the active one ✓ Ch2 Statistics may not be displayed	Patch for V2.12 V2.13 or Later	P54x_EN_MJ74
51	G	K		P543, P544, P545 & P546 non 61850 builds with distance protection based on 51F was approved for release but withdrawn before release. ✓ Corrections to enable/disable of Autoreclose	Patch for V2.12	P54x_EN_MJ74

Relay type: P54x …						
Software version		Hardware suffix	Original date of issue	Description of changes	S1 compatibility	Technical documentation
Major	Minor					
51	H	K	July 2007	Release of P543, P544, P545 & P546 non 61850 builds with distance protection based on 51G. ✓ Corrected power swing detection when both distance and current differential enabled ✓ Corrections to enable/disable of Autoreclose	Patch for V2.12	P54x_EN_MJ74

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
52	A	K		Release of P543, P544, P545 & P546 with distance protection ✓ Chinese interface ✓ Replacing the existing DNP3 with the DNP3 evolutions ✓ Addition of a current but no volts trip option to Switch on to Fault and Trip on Reclose feature (SOTF/TOR) ✓ Replacement of existing negative sequence overcurrent with multi stage (2 IDMT + 2 DT) negative sequence overcurrent. ✓ Addition of IDG curve, commonly used in Sweden, to Earth Fault & Sensitive Earth Fault (involves moving settings) ✓ Reduction of all TMS step sizes to 0.005 ✓ Addition of Channel propagation delay Statistics and Alarms ✓ Changes to CTS so both techniques can be selected together ✓ Regrouping of CTS settings ✓ Addition of four stages of under frequency protection and two stages of Overfrequency protection ✓ Addition of df/dt protection ✓ Changes to Under and Overvoltage to enable each stage to be independently set ✓ Extensions to the checksync VT position setting ✓ Replacing fixed Trip on Close (TOC) Delay with a setting ✓ Improvements to slow power swing detection ✓ Changes to distance count strategy to restore the same operating time when phase differential protection is enabled ✓ Changes to Permissive Inter Trip (PIT) logic to enable the user to select either local or remote current to be used. ✓ Includes local time zone settings for Date & Time	Patch for V2.14	P54x_EN_MJ74 + addendum P54x_EN_AD_J84

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
52	A	K		✓ Addition of flexible settings for distance quadrilateral top line ✓ Reduced minimum setting for IN> I2pol Set ✓ Addition of propagation delay times to Fault Record ✓ Default setting for 450B 'I< Current Set' reduced to 50mA. ✓ Enhancement to self checking of output relays ✓ Change tunnelled courier address to follow the 1st Rear Port's KBUS or CS103 address.		
52	B	K	July 2007	Release of P543, P544, P545 & P546 with distance protection based on 52A. ✓ Phase comparison protection P547 added to range ✓ Improvements to VTS ✓ Improvements to slow power swing detection ✓ Corrected power swing detecting when both distance and current differential enabled ✓ Corrections to enable/disable of Autoreclose ✓ Resolved a problem relating to CT Ratio's not being restored when restoring default settings ✓ Resolved a problem with the Disturbance Recorder which saturates for High current levels into 5A CT.		P54x_EN_AD_J84
52	C	K	July 2007	Release of P543, P544, P545 & P546 with distance protection based on 52B. ✓ Tilt angle of ground quadrilateral Characteristic corrected ✓ Minor correction to fault record ✓ Corrections to over voltage stage 2 inhibit	Patch for V2.14	P54x_EN_MJ74 + addendum P54x_EN_AD_J84

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
52	D	K	Dec 2007	Release of P543, P544, P545 & P546 with distance protection based on 52C. ✓ Fixed a number of 61850/Goose problems ✓ Fixed a problem in P547 related o the transient starters ✓ Fixed the max prop alarm ✓ Corrected some DDB German text ✓ Fixed a problem with week infeed inhibit ✓ Fixed a SOTF problem when there is a short duration pre-fault ✓ Fixed a primary scaling issue relating to Zone 5 & 6	Patch for V2.14	P54x_EN_MJ74 + addendum P54x_EN_AD_J84
52	E	K	May 2008	Release of P543, P544, P545 & P546 with distance protection based on 52D. ✓ Fixed a number of 61850 problems ✓ Improved co-processor error reporting ✓ Fix to Blocking scheme ✓ Fixed Inhibit CB Fail Protection in P544/6	Patch for V2.14	P54x_EN_MJ74 + addendum P54x_EN_AD_J84
52	F	K		Not released to production. Based on 52E. ✓ Correction to autoreclose operation for switch on to fault condition ✓ Prevented CB Operating Time displaying 4.295Ms ✓ Bug fixes	Patch for V2.14	P54x_EN_MJ74 + addendum P54x_EN_AD_J84
52	G	K	Oct 2008	Release of P543, P544, P545 & P546 with distance protection based on 52F. ✓ Correction to the distance cross polarising when the memory expires	Patch for V2.14	P54x_EN_MJ74 + addendum P54x_EN_AD_J84

Relay type: P54x …							
Software version		Hardware suffix	Original date of issue	Description of changes		S1 compatibility	Technical documentation
Major	Minor						
52	H	K	Sept 2009	Release of P543, P544, P545 & P546 with distance protection based on 52G. ✓ Corrected some menu translations ✓ Corrected Breaker Fail - WI Aided1 trips so they can be disabled via setting "WI Prot Reset" ✓ Timestamp in fault record adjusted for the local time setting. ✓ Corrections to the Current Differential Inhibit when the GPS synchronisation is disabled ✓ Corrected Thermal State measurement via DNP3 ✓ Correction to the way latched LED/Relays are cleared ✓ Correction to Negative sequence overcurrent settings when 5A input used ✓ Correction to P545/P541 compatibility when used in transformer compensation mode ✓ Improvements to the GPS code ✓ Prevented CTS generating events when CTS is disabled ✓ Prevent Z5 from setting slow swing when PSB is disabled ✓ Resolved problem in P543/P545 which prevent correct reporting of fault record over 61850 ✓ Fixed problem which prevented residual overvoltage from initiating CB Fail ✓ Various improvements to DNP, CS103 & IEC61850 protocols ✓ Bug fixes	Patch for V2.14	P54x_EN_MJ74 + addendum P54x_EN_AD_J84

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
54	A	K	Mar 2008	Release of P543, P544, P545 & P546 with distance protection based on 52D. ✓ Positional information added to PSL. ✓ DNP 3.0 Over Ethernet protocol added. ✓ Extended I/O – status inputs increased from 24 to 32. ✓ Compensated overvoltage protection added ✓ IEC-103 Generic Services Measurements added ✓ Set/Reset Latch Logic Gates added to PSL ✓ Improved Sensitivity Range for DEF ✓ Fault record to include current differential currents recorded at the time of the current differential trip in addition to the existing data from 1 cycle later. ✓ Fault record increased max number of fault records to 15 ✓ GPS Alarm modifications ✓ Scheme Delta from P443 included ✓ DNP enhancements for SSE ✓ Bug fixes	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94
54	B	K	June 2008	Release of P543, P544, P545 & P546 with distance protection based on 54A. ✓ Fixed a number of 61850 problems ✓ Improved co-processor error reporting ✓ Fix to Blocking scheme ✓ Fix for DEF reverse operation ✓ Fixed Inhibit CB Fail Protection in P544/6 ✓ Corrected some French and German text ✓ Prevented CB Operating Time displaying 4.295Ms ✓ Fixed a problem which prevented extraction of dnp3 setting files from dnp3 over Ethernet variants. ✓ Bug fixes	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
54	C	K	June 2008	Release of P543 & P545 with distance protection based on 54B. ✓ Correction to autoreclose operation for switch on to fault condition	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94
54	D	K	Jan 2009	Release of P543, P544, P545 & P546 with distance protection based on 54C. ✓ Correction to the distance cross polarizing when the memory expires ✓ Corrections to the Current Differential Inhibit when the GPS synchronization is disabled ✓ Corrected Thermal State measurement via DNP3 ✓ Timestamp in fault record adjusted for the local time setting. ✓ Corrected Breaker Fail - WI Aided1 trips so they can be disabled via setting "WI Prot Reset"	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94
54	E	K	March 2009	Release of P543, P544, P545 & P546 with distance protection based on 54D. ✓ Prevents the loss of IEC61850 messages and fixed the handling of the ACD flag during GI. ✓ Improved the Ethernet card boot code	Patch for V2.14 First release of Studio	P54x_EN_MJ74 + addendum P54x_EN_AD_J94

Relay type: P54x …							
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**		**Technical documentation**
Major	**Minor**						
54	F	K	Sept 2009	Release of P543, P544, P545 & P546 with distance protection based on 54E. ✓ Corrected some menu translations ✓ Correction to the way latched LED/Relays are cleared ✓ Correction to Negative sequence overcurrent settings when 5A input used ✓ Correction to P545/P541 compatibility when used in transformer compensation mode ✓ Improvements to the GPS code ✓ Prevented CTS generating events when CTS is disabled ✓ Prevent Z5 from setting slow swing when PSB is disabled ✓ Resolved problem in P543/P545 which prevent correct reporting of fault record over 61850 ✓ Fixed problem which prevented residual overvoltage from initiating CB Fail ✓ Various improvements to DNP, CS103 & IEC61850 protocols ✓ Bug fixes	Patch for V2.14 First release of Studio		P54x_EN_MJ74 + addendum P54x_EN_AD_J94
55	B	K	March 2009	Release of P543, P544, P545 & P546 with distance protection based on 54E ✓ Autoreclose, Check Sync and CB Monitoring added to P544 & P546	Patch for V2.14 Studio ftp server		P54x/EN M/KA4

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
55	C	K	May 2009	Release of P543, P544, P545 & P546 with distance protection based on 55B ✓ Improvements to the Ethernet card startup and configuration ✓ Correction to Negative sequence overcurrent settings when 5A input used ✓ Correction to P545/P541 compatibility when used in transformer compensation mode ✓ Correction to the way latched LED/Relays are cleared ✓ Corrections to menu text ✓ Improvements to the GPS code ✓ Bug Fixes	Patch for V2.14 Studio ftp server	P54x/EN M/KA4
55	D	K	October 2009	Release of P543, P544, P545 & P546 with distance protection based on 55D ✓ Improvements to the GPS code ✓ Correction to slow power swing configuration ✓ Improvements in the clock recover circuits used by the Differential Comms ✓ Prevent Z5 from setting slow swing when PSB is disabled ✓ Bug Fixes	Patch for V2.14 Studio ftp server	P54x/EN M/KA4

Relay type: P54x …						
Software version		**Hardware suffix**	**Original date of issue**	**Description of changes**	**S1 compatibility**	**Technical documentation**
Major	**Minor**					
57	A	K		Limited Release of P543, P544, P545 & P546 with distance protection based on 55D ✓ IEC-61850 phase 2 and 2.1 implemented ✓ Application for Inzone Transformers (2nd and 5th Harmonic Blocking/restraint) ✓ Differential Highset can be disabled when Inrush protection is enabled ✓ Restricted Earth Fault Protection (REF) ✓ Modification to Char Mod timer functionality ✓ Separate measurements for each set of CT's ✓ Interrupt Driven InterMiCOM in all models ✓ Read Only Mode	Patch for V2.14 Studio ftp server	P54x/EN M/KA4 + addendum P54x/EN AD/KB4
57	B	K	January 2010	Release of P543, P544, P545 & P546 with distance protection based on 57A ✓ Prevented the Differential protection inhibiting in three terminal schemes when GPS is enabled and loopback mode selected ✓ Fault locator measurements in ohms corrected when 5A CT used or displayed in primary. ✓ Frequency measurement in DNP3 fault record corrected	Patch for V2.14 Studio ftp server	P54x/EN M/KA4 + addendum P54x/EN AD/KB4

Setting File Software Version	Relay Software Version																				
	01	02	03	04	05	07	11	12	13	14	15	20	30	40	41	50	51	52	54	55	57
01	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
02	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
03	×	×	✓	1	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
04	×	×	×	✓	2	2	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
05	×	×	×	×	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
07	×	×	×	×	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
11	×	×	×	×	×	×	✓	✓	2	2	×	2	×	×	×	×	×	×	×	×	×
12	×	×	×	×	×	×	✓	✓	2	2	×	2	×	×	×	×	×	×	×	×	×
13	×	×	×	×	×	×	✓	✓	✓	2	×	2	×	×	×	×	×	×	×	×	×
14	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×
15	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×
20	×	×	×	×	×	×	×	×	×	×	×	✓	3	×	×	×	×	×	×	×	×
30	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×
40	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	4	×	×	×	×	×
41	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	4	×	×	×	×
50	×	×	×	×	×	×	×	×	×	×	×	×	×	5	×	✓	×	×	×	×	×
51	×	×	×	×	×	×	×	×	×	×	×	×	×	×	5	×	✓	×	×	×	×
52	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	3	×	×
54	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×
55	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×
57	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓

1. Compatible except for Disturbance recorder digital channel selection
2. Additional functionality added such that setting files from earlier software versions will need additional settings to be made
3. Compatible except for Disturbance recorder digital channel selection & settings for additional functionality will be missing
4. Compatible except for the Disturbance recorder digital channel selection and the distance settings
5. Compatible except for Disturbance recorder digital channel selection & the setting file contains a large number of Distance setting which will each produce an error on download

PSL File Software Version	Relay Software Version																				
	01	02	03	04	05	07	11	12	13	14	15	20	30	40	41	50	51	52	54	55	57
01	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
02	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
03	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
04	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
05	×	×	×	×	✓	1	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
07	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
11	×	×	×	×	×	×	✓	✓	✓	×	×	1	1	×	×	×	×	×	×	×	×
12	×	×	×	×	×	×	×	✓	✓	×	×	1	1	×	×	×	×	×	×	×	×
13	×	×	×	×	×	×	×	×	✓	×	×	1	1	×	×	×	×	×	×	×	×
14	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×	×
15	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×	×	×
20	×	×	×	×	×	×	×	×	×	×	×	✓	1	×	×	×	×	×	×	×	×
30	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×	×	×	×
40	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	2	×	×	×	×	×
41	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	2	×	×	×	×
50	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×
51	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×
52	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×
54	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×
55	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×
57	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓

1. Additional DDBs were added such that PSL files from earlier software versions will not be able to access them
2. Additional DDB for the Distance protection will not be included

Menu Text File Software Version	Relay Software Version																							
	01	02	03	04	05	07	11	12	13	14	15	20	30	40	41	50	51	52	54	55	57			
01	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
02	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
03	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
04	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
05	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
07	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
11	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
12	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
13	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
14	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
15	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗			
20	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗			
30	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗			
40	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗			
41	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗			
50	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗			
51	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗			
52	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗			
54	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗			
55	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✗			
57	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓			

Menu text remains compatible within each software version but is NOT compatible across different versions

Customer Care Centre

http://www.schneider-electric.com/sites/corporate/en/support/contact/customer-care-contact.page

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