

# MiCOM Agile P841

## Multifunction Line Terminal IED

The MiCOM Agile P841 provides control and backup protection in transmission feeder bays. Models exist for single breaker applications and where two circuit breakers feed each line – such as in breaker and a half or ring bus topologies.

### Control and Backup Protection

In all applications, supervision of correct breaker functioning and management of autoreclose cycles for power restoration after a fault are critical. Internal circuit breaker fail elements, autoreclose control and check synchronism ensure that these primary goals are achieved.

The logic capabilities of the devices are extremely versatile, for instance managing leader-follower reclosing schemes in case of dual breaker applications. Single-pole and 3-pole breaker operation is supported, with independent supervision and condition monitoring statistics per pole. Trip circuit supervision, control and interlocking schemes can be designed in graphical support software.

Ancillary applications include use of the MiCOM Agile P841 for binary I/O concentration, disturbance recording, or as a gateway to SCADA. Multiple protection elements are provided, such as directional overcurrent, earth fault, voltage and frequency. This allows deployment as a back-up IED in transmission applications, or as the main 2 protection solution for subtransmission.

### Key Features

#### Circuit Breaker Control

Adapted to suit different substation and circuit topologies:

- Single circuit breaker applications (P841 model A)
- Breaker and a half, double bus or ring buswith dual breaker control (P841 model B)

#### Integrated directional protection for the circuit

#### Multi-shot autoreclosure with check synchronism

- Single circuit breaker applications (P841-A model)
- Breaker and a half, or mesh feeding with two sets of CT inputs per end with settable independent CT ratios (P841-B model)

#### Improved system stability by CB failure fast reset element (< 0.75 cycle)



## Key Benefits

- Single-box solution
- Readily interfaces to SCADA protocols and IEC 61850
- Clear annunciation on tricolor LEDs
- Programmable function keys
- Application flexibility
- Readily interfaces with multiple automation protocols, including IEC 61850 MiCOM Agile P40 series extends IEC 61850-8-1 station bus to include Parallel Redundancy Protocol (PRP), which offers a vendor-interoperable solution to implement redundant communications. It has the advantage of taking zero time to recover from a failure, as parallel alternative paths are continually operative. This compares to 25ms or more healing time for legacy techniques such as RSTP



## Functional Overview

ANSI	IEC 61850	FEATURES	P841-A	P841-B
	OptGGIO	Opto coupled logic inputs	16	24
	RlyGGIO	Relay output contacts	14	32
		High speed, high break contacts available	Optional	
	FnkGGIO	Function keys	10	10
	LedGGIO	Programmable LEDs (R-red, G-green, Y-yellow)	18R/G/Y	18R/G/Y
		Two breaker configurations		*
50BF	RBRF	High speed breaker fail (CBs controlled)	1	1 or 2
79	RREC	Autoreclose (CBs controlled)	1	1 or 2
25	RSYN	Check synchronising	1	2
		Clockwise and anticlockwise phase rotation	*	*
	PTRC	Single and 3-pole modes	*	*
50/51/67	OcpPTOC / RDIR	Phase overcurrent stages	4	4
50N/51N/7N	EfdPTOC / RDIR	Earth/ground overcurrent stages	4	4
51N/67N/SEF	SenEftPTOC	Sensitive earth fault (SEF)	4	4
64	SenRefPDIF	High-impedance restricted earth fault protection	*	*
67/46	NgcPTOC/ RDIR	Negative sequence overcurrent	*	*
46BC		Broken conductor	*	*
49	PTTR	Thermal overload	*	*
27	PTUV	Undervoltage protection stages	2	2
59	PhsPTOV	Overvoltage protection stages	2	2
59N	ResPTOV	Residual voltage protection stages	2	2
81U, 81O, 81R	PTUF/PTOF	Under/overfrequency and ROCOF protection	*	*
		Alternative setting groups	4	4
FL	RFLO	Fault locator	*	*
		Fault records	15	15
SOE		Event records	512	512
	RDRE	Fault waveform disturbance records	*	*
VTS		Voltage transformer supervision	*	*
CTS		Current transformer supervision	*	*
	XCBR	Circuit breaker condition monitoring	1	1 or 2
TCS		Trip circuit supervision	*	*
		Graphical programmable scheme logic (PSL)	*	*

**P841**  
The perfect complement to  
MiCOM Agile main protection

## System Overview

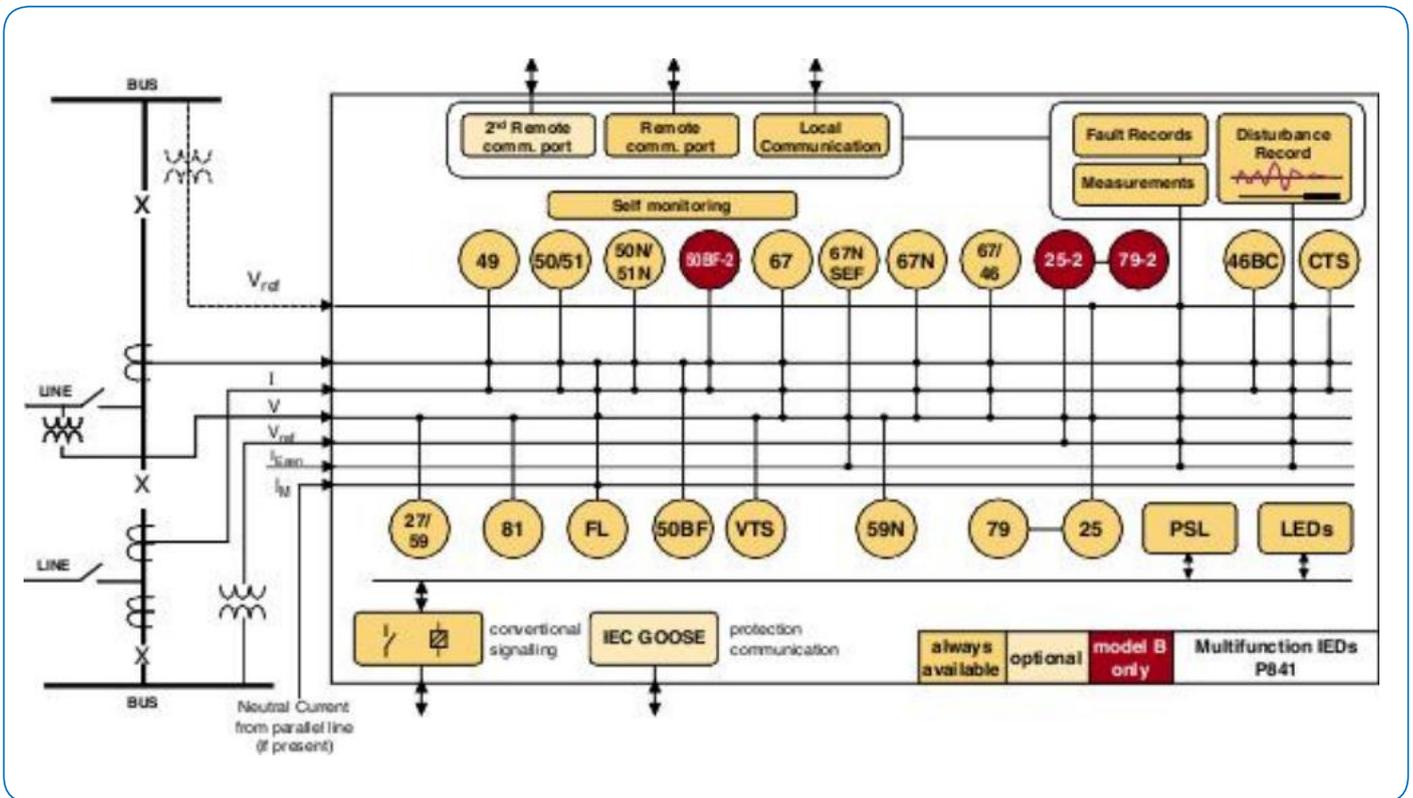


FIGURE 2. System overview of the MiCOM Agile P841

## APPLICATION

The **P841 model A (P841-A)** is used where only one circuit breaker feeds a line. There will be a 3-phase breaker (or 3 x single-pole units) in this application and a requirement of no more than one set of 3-phase CT inputs, one 3-phase VT and a single check synchronising function via an extra single phase VT.

Choose the **P841 model B** in breaker and a half or ring-bus applications, where control and monitoring of two breakers is required. This allows dual protection and reclosing logic, including positive identification of any failed breaker and leader-follower reclosing schemes.

Model B may also be used in single breaker mode to provide a higher binary I/O count. Model A is in a smaller 60TE case, with model B in a full width 80TE.

The MiCOM Agile P841 is supplied with a full suite of protection and control functions as standard. The configuration column of the menu is used to control which functions the user requires in the intended application and which may be disabled.

Disabled functions are completely removed from the menu to simplify settings.



## Autoreclose and Check Synchronism

### Standard Autoreclose Features

Both P841 models offer high speed transmission-class autoreclose, settable for single or 3-pole tripping schemes. The main application possibilities are listed below:

- Single-pole autoreclose - One single-pole shot, followed by up to three 3-pole shots with independent dead times
- 3-pole autoreclose - Up to 4 shots, independent dead times.
- BAR for 2 and 3-phase faults - Logic to decide whether A/R should proceed for multiphase faults
- Unlatching - Safety interlock to ensure the CB was closed prior to the A/R sequence.
- Dead Time Start - Protection Operation, Protection Reset, CB Trip or Dead Line.
- AR in progress - Segregated indication that a single-pole (1P) or 3-pole (3P) cycle is in progress
- Discrimination timer - To decide whether a fault affecting another phase during the single-pole dead time is an evolution of the trip, or is a new fault appearance.
- CB health - Energy monitor to check that the breaker is OK to perform a close.

- Reclaim timer
- A/R successful - Indication of a successful close.
- Sequence counter - Status indication, so that special protection logic may be assigned for each reclose shot number

### Check Synchronism

Check synch time - A wait period for check synch to pick up, if not already OK at the end of the dead time.

Delta V, delta f, angle, t - Four conditions possible: voltage magnitude difference, slip frequency, angle and time.

CS voltage window - Limiting the CS function to operate only when line and bus voltages are within a specific range.

Dead/Live Line/Bus - All setting permutations of dead and live (hot) reclosing: DLLB, LLDB, LLLB, DLDB.

AR immediate - Fast closing possible, without waiting for the expiry of the dead time. Allows reclosing if the remote end closes successfully first.

Check on shot 1 - To decide whether a high speed 3-pole reclose (shot 1) can happen without a synchrocheck. This assumes the dead time is short, and no drift out of phase could have occurred.

## Dual Breaker Reclosure and Check Synchronism

The following additional features are offered in P841 model B, to permit two breaker reclosing in a leader-follower scheme:

Two CB Control - CB1 and CB2 are assigned. The user selects which is the leader and which is the follower breaker.

- Individual selection of recloser on or off
- Follower action - Follows successful close of the leader, reclosing after a settable delay. Alternatively the follower may wait to be closed manually
- Independent lockout and reset per breaker

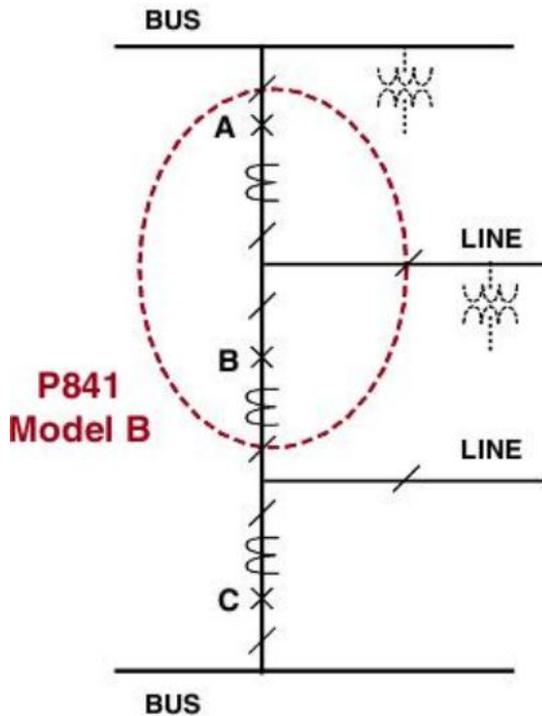


FIGURE 3. Dual breaker example application with P841-B, control of breakers A and B

## Circuit Breaker Fail

The breaker failure protection may be initiated from internal protection within the P841 and also from external devices. Where external feeder or busbar protection is applied to trip the two breakers independently, the P841-B has the ability to initiate the CBF scheme on a per breaker basis. Retripping and backtripping schemes are supported as the P841 uses a two-stage philosophy, all with fast-acting undercurrent checks (<0.75 cycles).

## Other Protection Elements

Four stages of both phase and earth (ground) fault protection are provided with a choice of standard IEC and ANSI/IEEE IDMT curves, instantaneous and definite-time operation.

Negative sequence overcurrent and SEF (0.5% In sensitivity) are also available. High-impedance earth fault is provided for sensitive protection against ground faults.

Phase under / overvoltage protection functions are available in addition to residual overvoltage.

Broken conductor – detects the percentage phase unbalance due to an open phase condition.

A thermal replica provides alarm and trip stages, to warn and protect in the event of prolonged circuit overloading.

Two stages each are available for phase overvoltage, phase under-voltage and residual overvoltage (neutral displacement).

Four stages of underfrequency and two stages of overfrequency are provided, plus rate of change of frequency. This permits load shedding and restoration schemes to be implemented.

## IEC 61850-9-2 Process Bus Interface

An optional process bus interface is available, allowing the relay to receive current and voltage sampled data from non-conventional instrument transformers such as optical and Rogowski devices. In other digital substation architectures, the 9-2 data is generated by merging units in the yard, which digitise conventional 1 A/5 A and 100/120 V secondaries, for safer and more economical cross-site communication to IEDs by fibre optic. GE's -9-2 implementation has been designed to be especially resilient and reliable in the presence of "noise", such as latency, jitter or missing/suspect data.

## Supervisory Functions

### VT Supervision (fuse fail)

Voltage transformer supervision is provided to detect loss of one, two or three VT signals for line VTs.

### CT Supervision

Current transformer supervision is provided to detect loss of phase CT input signals.

**P841**  
Reclosing, synchronism, breaker  
fail and back-up: All in one IED

## Control

### Function Keys

Trip and close commands are facilitated from front panel hotkeys, to allow direct CB control without the need to navigate to a menu. Other in/out, on/off and enable/disable controls are easily programmed (up to 10 F-keys).

### Single Breaker Autoreclose

With check synchronism (P841-A), the user may select a single, two, three or four shot autoreclose cycle.

### Dual Breaker Autoreclose

With check synchronism (P841-B), the following additional features are offered in P841-B, to permit two breaker reclosing in a leader-follower scheme:

- Two CB Control - CB1 and CB2 are assigned. The user selects which is the leader and which is the follower breaker
- Individual selection of recloser on or off
- Follower action - Follows successful close of the leader
- Reclosing after a settable delay

Alternatively the follower may:

- Wait to be closed manually
- Independent lockout and reset per breaker

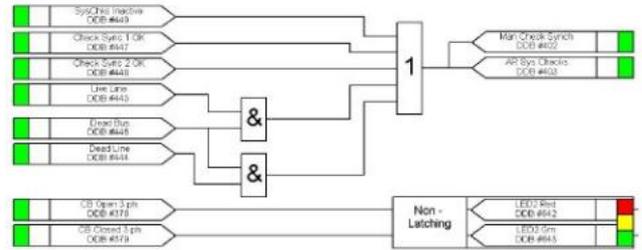


FIGURE 4 Programmable scheme logic

### Programmable Scheme Logic

Powerful graphical logic allows the user to customize the protection and control functions (See Figure 4).

The gate logic includes 32 timers, OR, AND, MAJORITY and set/reset latch logic gate functions, with the ability to invert the inputs and outputs and provide feedback.

The system is optimized to ensure that the protection outputs are not delayed by the PSL operation.

The programmable scheme logic is configured using the graphical S1 PC software, as shown in Figure 8.

The relay outputs may be configured as latching ("Lockout") or self-reset.

All aspects of MiCOM P40 IED configuration are managed using the MiCOM S1 Agile software (see Figure 5).



FIGURE 5 MiCOM S1 Agile: A powerful and intuitive PC-toolsuite

### Measurement and Recording Facilities

All event, fault and disturbance records are time tagged to a resolution of 1 ms. An optional IRIG-B port is available for accurate time synchronisation.

### Power System Measurements

Instantaneous and time integrated voltage, current and power measurements are provided. These may be viewed in primary, or secondary values.



## Quality Built-in (QBi)

GE's QBi initiative has deployed a number of improvements to maximise field quality. Harsh environmental coating is applied to all circuit boards to shield them from moisture and atmospheric contamination. Transit packaging has been redesigned to ISTA standard, and the third generation of CPU processing boosts not only performance, but also reliability

## Communications with Remote Operators and Substation Automation

The wide range of communication options, including IEC 61850, provides interfacing with almost any type of substation automation system or SCADA system.

The following protocols are available:

- Courier/K-Bus
- IEC 60870-5-103
- DNP 3.0 (EAI-485 or ethernet)
- IEC 61850

Redundant Ethernet is available, optionally managed by the market's fastest recovery time protocols: 'self-healing' ring and 'dual homing' star, allowing bumpless redundancy.

IEC 62439 PRP and RSTP are also available, offering multi-vendor interoperability.

## Second Rear Courier Port

The optional second port is designed typically for dialup modem access by protection engineers/operators, when the main port is reserved for SCADA traffic.

## Disturbance records

The internal disturbance recorder has 12 analog channels, 64 digital and 1 time channel. Approximately 50 records of 1 s duration can be stored. All channels and the trigger source are user configurable. Disturbance records can be extracted from the relay via remote communications and saved in the COMTRADE format.

## Plant Supervision

### Trip Circuit Supervision

Supervision of the trip circuit can be implemented using optocoupled inputs and the programmable scheme logic.

### CB State Monitoring

An alarm will be generated if there is a discrepancy between the open and closed CB auxiliary contacts.

### Circuit Breaker Condition Monitoring

- Monitoring the number of breaker trip operations
- Recording the sum of broken current quantity (simulating wear, or "interruption duty")
- Monitoring the breaker operating time

## Device track record - high speed transmission autoreclose

High performance transmission reclose, evolving from predecessor LFAA, KAVR and KVTR devices. Over 12,000 relays delivered since launch

Fast breaker fail - imports scheme experience from MCTI and MiCOM Agile P821

Built on the MiCOM Agile Px40 transmission platform. Sister IEDs: MiCOMho P44y subcycle distance, P54x differential and P547 phase comparison

P841-B scheme - full functionality available as stand-alone, or integrated inside P446 distance relay, or in P544 and P546 line differential

## MiCOM P40 AGILE

GE's philosophy is one of continuous improvement in our products and solutions. Our emphasis on communication in MiCOM has become a focus which secures leadership in the digital substation. To mark this phase of evolution, the P40 Agile livery is applied to the range. P40 Agile is a mark of performance and quality, proudly available from GE, and only from GE.



For more information please contact  
GE Power  
Grid Solutions

### Worldwide Contact Center

Web: [www.GEGridSolutions.com/contact](http://www.GEGridSolutions.com/contact)  
Phone: +44 (0) 1785 250 070

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Imagination at work