MiCOM P841

Multifunction Line Terminal IED

Figure 1: Front view of P841-B

The MiCOM P841 is a device for 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. 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 capability of the devices are extremely versatile, for instance managing leader-follower reclosing schemes in case of dual breaker applications. Single pole and three-pole breaker operation is supported, with independent supervision and condition monitoring statistics per pole possible. Trip circuit supervision, control, and interlocking schemes can be designed in graphical support software.

Ancillary applications include use of the 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.

CUSTOMER BENEFITS

- Single box solution
- Readily interfaces to SCADA protocols and IEC 61850
- Clear annunciation on tricolor LEDs
- Programmable function keys
- Application flexibility

KEY FEATURES

Adapted to Suit Different Substation and Circuit Topologies
- Single circuit breaker applications (P841 model A).
- Breaker and a half, double bus or ring bus with dual breaker control (P841 model B).

Proven Autoreclose Schemes, with Synchrocheck and Voltage Supervison Internal
- Dual breaker leader follower schemes, with three VT references provided in P841-B.

Transmission-Class Circuit Breaker Failure Protection

Integrated Directionalized Protection for the Circuit

Programmable Scheme Logic
- Customizes the device to meet the exact protection and control scheme requirements of the bay
- Fast, deterministic processing of all changes. No elongation of time even with increasing logic population.

Schneider Electric

FUNCTIONS OVERVIEW

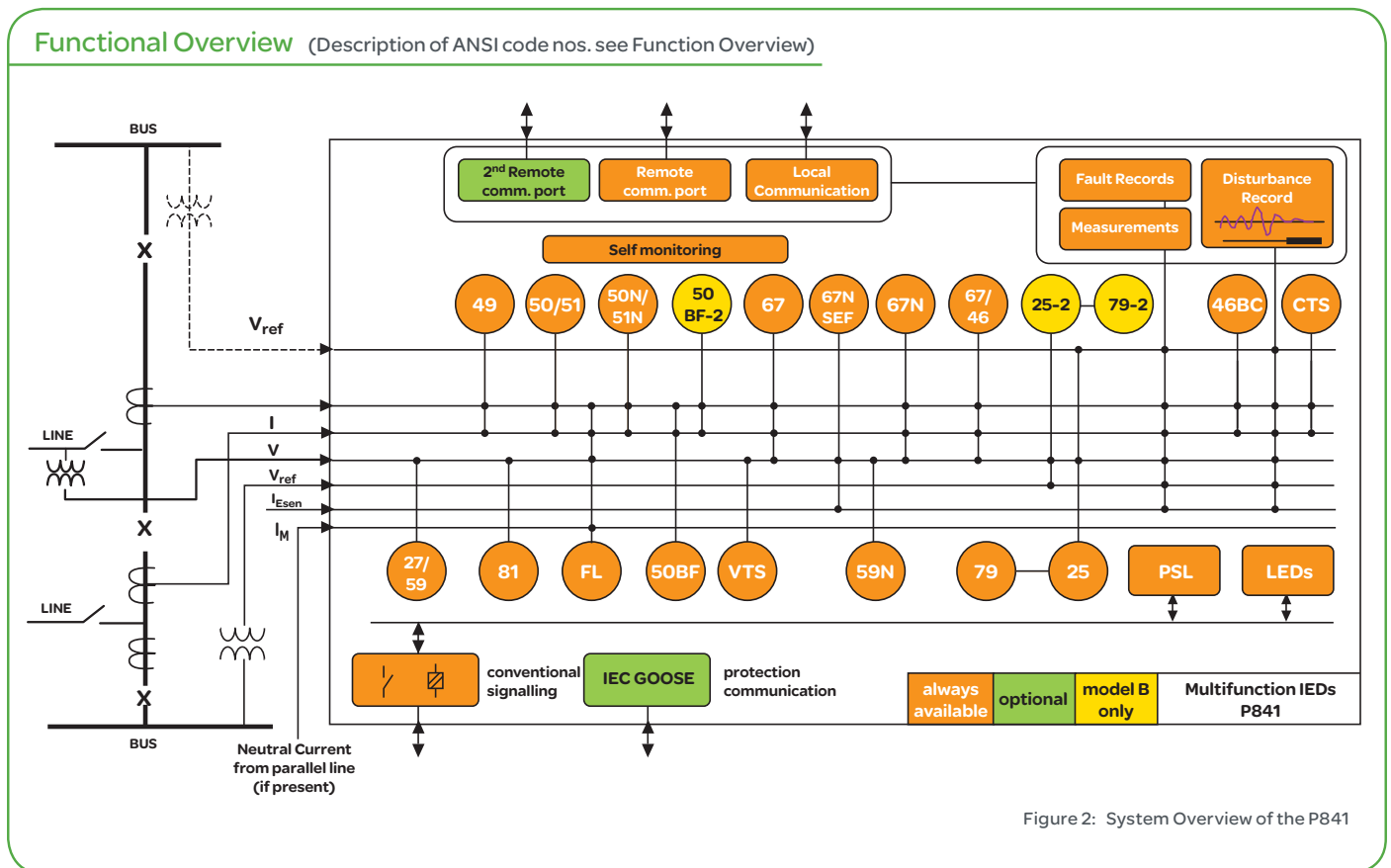| ANSI	IEC 61850	Features	P841-A	P841-B
	OptGGIO	Opto coupled logic inputs	16	24
	RlyGGIO	Relay output contacts	14	32
		High speed, high break contacts available	Optional	
	FnkGGIO	Function keys	10	10
	LedGGIO	Programmable LEDs (R-red, G-green, Y-yellow)	18R/G/Y	18R/G/Y
		Two breaker configurations		●
50BF	RBRF	High speed breaker fail (CBs controlled)	1	1 or 2
79	RREC	Autoreclose (CBs controlled)	1	1 or 2
25	RSYN	Check synchronizing	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/67N	EfdPTOC / RDIR	Earth/ground overcurrent stages	4	4
51N/67N/SEF	SenPTOC / RDIR	Sensitive earth fault (SEF)	4	4
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)	●	●

APPLICATION

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

Choose the P841-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 full width 80TE.

The MiCOM 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 setting.

Functional Overview (Description of ANSI code nos. see Function Overview)

Figure 2: System Overview of the P841

MiCOM P841:
The perfect complement
to MiCOM main protection

AUTORECLOSE AND CHECK SYNCHRONISM

Standard Autoreclose Features

Both P841 models offer high speed transmission-class autoreclose, settable for single or three 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.

• Three 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 three 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 Healthy - 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.

• Reset Lockout - User Interface, CB Close, Select NonAuto, DDB Signal, Time Delay.

• AR Inhibit - Time delay after manual closing during which autoreclose is not permitted.

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 three 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 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.

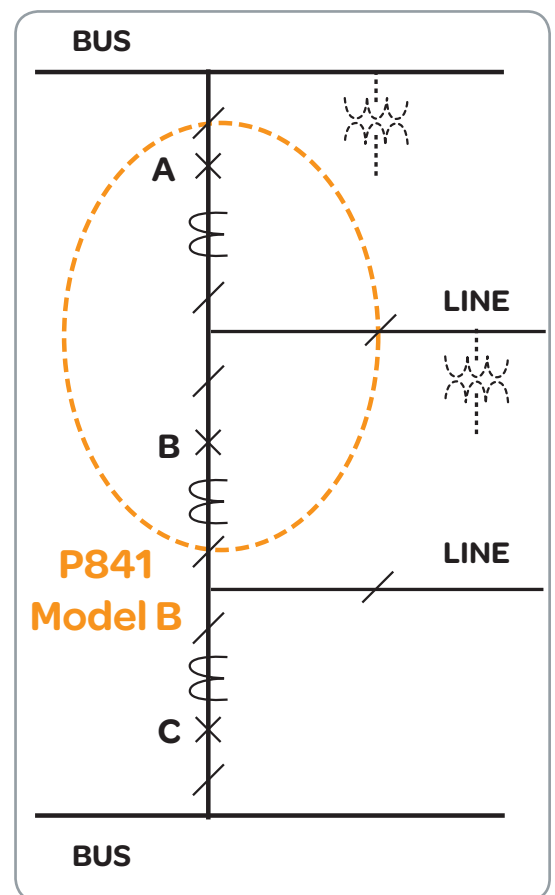• Independent lockout and reset per breaker.

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.

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.
- Phase under and 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 undervoltage, 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.

SUPERVISORY FUNCTIONS

Voltage transformer supervision is provided to detect loss of one, two or three VT signals for line VTs. Current transformer supervision is provided to detect loss of phase CT input signals.
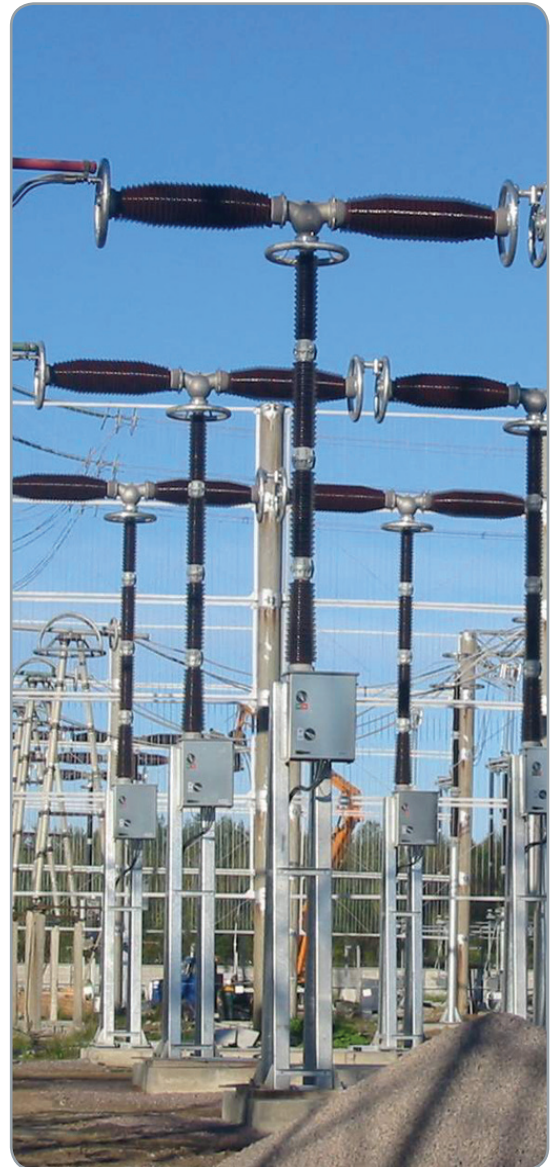
Reclosing, synchronism, breaker fail and back-up: all in one IED

CONTROL

User Interface
Integrated user function keys and tri-color programmable LEDs provide a cost-effective solution for full feeder scheme applications. The ten function keys operate in two modes, normal and toggled, with an associated LED for clear indication of the logic status. Typical control, maintenance, and commissioning options are initiated directly from simple key presses, rather than the need to navigate a menu.

Hotkey Menu
Trip and close commands are facilitated from front panel "hotkeys", to allow direct CB control without the need to navigate a menu. Other in/out, on/off and enable/disable controls are easily programmed.

Programmable Scheme Logic
Powerful graphical logic allows the user to customize the protection and control functions. The gate logic includes OR, AND and majority 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 MiCOM S1 Studio PC software, as shown in Figure 4. The relay outputs may be configured as latching (eg "Lockout") or self-reset.

PASSWORD PROTECTION

Password protection may be independently applied to the front user interface, front communications port and rear communications port.

Two levels of password protection are available providing access to the controls and settings respectively.
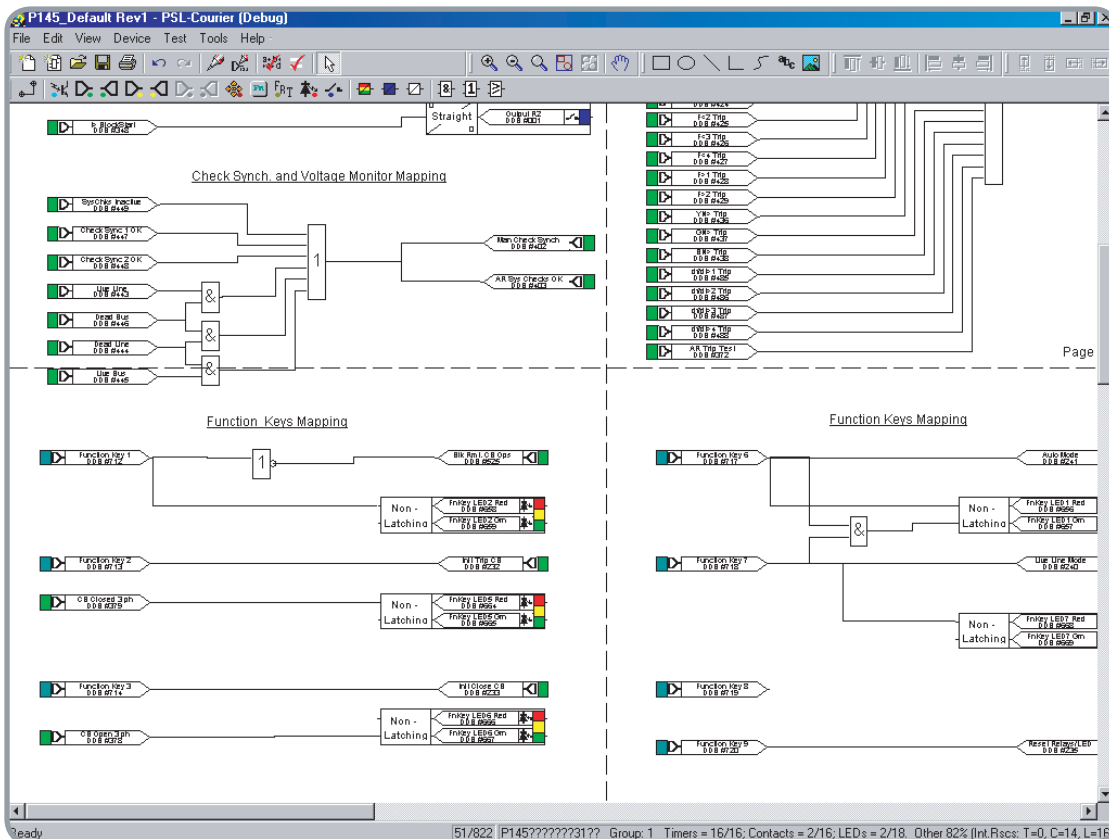

Figure 4 Programmable Scheme Logic editor

MEASUREMENTS AND RECORDING

Power System Measurements (MMXU)

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

Fault Location

A fault location algorithm provides distance to fault in miles, kilometres, ohms or percentage of line length. The proven algorithm used tolerates pre-faults loading and fault arc resistance.

Event Records

Up to 512 time-tagged event records are stored in battery backed memory, and can be extracted using the communication ports or viewed on the front panel display.

An optional modulated or demodulated IRIG-B port is available for accurate time synchronization.

Fault Records

The last 15 faults are stored:

• Indication of the faulted phase

• Protection operation

• Active setting group

• Fault location (distance to fault)

• Relay and CB operating time

• Pre-fault and fault currents, voltages and frequency.

Disturbance Records

The internal disturbance recorder has 12 analogue channels, 32 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 the remote communications and saved in the COMTRADE format. These records may be examined using MiCOM S1 Studio or any suitable software program.

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

COMMUNICATION TO REMOTE OPERATORS AND SUBSTATION AUTOMATION

The wide range of communication options, including IEC61850, provides interfacing to almost any type of Substation Automation System or SCADA System.

Two auxiliary communication ports are available; a rear port providing remote communications and a front port providing local communications. An additional, second rear port can be ordered as an option. Any of the following rear port protocols can be chosen at the time of ordering:

• Courier/K-Bus,

• IEC60870-5-103,

• DNP3.0 (EIA-485 or Ethernet)

• IEC61850

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.

DEVICE TRACK RECORD - HIGH SPEED TRANSMISSION AUTORECLOSE

- Fast breaker fail - imports scheme experience from **MiCOM P821**

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

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

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