‘ME09’
Air Circuit Breakers

Operating and Installation Instructions



‘ME09’

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THE COMPANIES POLICY IS ONE OF CONTINUOUS DEVELOPMENT AND IMPROVEMENT OF IT’S PRODUCTS AND THEREFORE THE RIGHT IS RESERVED TO SUPPLY PRODUCTS WHICH MAY DIFFER FROM THOSE DESCRIBED AND ILLUSTRATED IN THIS PUBLICATION.

Introduction

This manual is a guide to normal site installation, operation and maintenance procedures. 'ME09' circuit breakers should only be installed, operated and maintained by competent and properly authorised personnel.
If further information is required, concerning any aspect of operation or maintenance of 'ME09' circuit breakers, please contact:
AEG Power Management.
Tel: 400-820-5234

Quality Assurance
All 'ME09' circuit breakers have been designed and manufactured to the highest technical standards. Strict procedures, in compliance with ISO 9001, ensure first class product quality.

Options Check Sheet
This will be provided with each circuit breaker delivered, listing all optional features included on both circuit breaker and M-PRO protection unit. The check sheet will reflect all optional features

Serial Number
A dedicated serial number will be allocated to each circuit breaker manufactured. This will be located in two easily accessible positions:

(a) On the top face of one of the retractable lifting brackets (see Fig. 9 page 5).

(b) On the left side (viewed from front) of the front facia.

The serial number should be quoted in any communication concerning the circuit breaker.

Storage
Circuit breakers and cassettes should be stored in a clean and dry place and should be kept in their original packaging. It is not recommended to store breakers in corrosive environments above LC1 (sea salt mist) and G1 as per ANSI/ISA-S71.04-1985.

Ensure that closing springs are discharged and circuit breakers are in the OFF position while in storage.

Safety Precautions
It is recommended that the following precautions be included in any procedural instructions to personnel concerned with the handling, operation or maintenance of 'ME09' circuit breakers.

Before detailed inspection or any maintenance work is commenced:

- All electrical supplies to the circuit breaker should be switched off.

- The circuit breaker should be tripped to the OFF position and the closing springs discharged. This releases stored energy in the spring mechanisms thus eliminating risk of injury due to inadvertent tripping or closing during inspection and maintenance.
  While handling the breaker, care should be taken to avoid risk of injury from moving parts.

- Application of a cable/busbar lockable earthing device (optional accessory) may be advisable for additional safety during system maintenance.

The circuit breaker and its accessories must always be used within their designated ratings.

- Use of the specially designed circuit breaker handling truck (optional accessory) is recommended when removing the breaker from its cassette.

Neutral Pole CT
WARNING – When using an earth leg current transformer (supplied with Standby Earth Fault) the earth leg CT will be open circuited when the breaker is withdrawn from its cassette. Under certain circumstances current may still flow in the earth giving rise to a high induced voltage at the CT secondary terminals. As a safety precaution it is recommended, under such conditions, that a carriage switch be fitted in the cassette (see page 9) to enable short circuiting of the CT secondary terminals when the circuit breaker is withdrawn.

The circuit breaker and its accessories must always be used within their designated ratings.

Installing ‘ME09’ Circuit Breakers

Drawout type
Normally, drawout type circuit breakers will be delivered already mounted in cassettes.

Remove the breaker from its cassette using procedures described in the section ‘Withdrawal of ME09 Circuit Breaker’.

Position the cassette as required in the switchboard.

Note: The cassette may be lifted by hand but, if a handling truck or other lifting gear is employed, all four of the lifting holes provided at front and rear of the cassette should be used.

Position cassette in place and connect incomming and outgoing cables/busbars. When connecting busbars ensure there is minimal deflection/stress to the back of the cassette. Fix the cassette using 4 off M8 bolts to 25Nm at front and rear fixing points. Note, the cassette base before and after fixing must be flat and the frame square. Check that the safety shutters move freely after the fixing bolts have been fully tightened.

An earthing point is provided on the right hand side of each cassette (viewed from front).

Fixed type
Fasten the circuit breaker into position on a suitable support structure using 4 off M8 bolts to 25Nm.

Adequate clearance should be provided above the circuit breaker to permit removal of arc chutes and inspection of arcing contacts.

A clearly marked earthing point is provided on either side of the circuit breaker.

Operating ‘ME09’ Circuit Breakers

Closing procedure
Pull the orange charging handle out and down to charge the closing springs (requires approximately 7 movements of the handle to fully charge).

If a motorised spring charging unit is fitted, the springs will be automatically charged as soon as the motor is energised.

Pressing the ON pushbutton or energising the closing coil (if fitted) will close the circuit breaker.

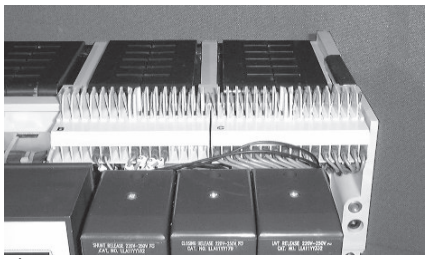
Closing cannot occur if:
- The OFF button is in a depressed position.
- The breaker is positioned anywhere between CONNECTED, TEST and DISCONNECTED positions.
- The M-PRO protection unit is at ‘Manual Reset’ and the reset button is protruding from the front facia. (Press the reset button to clear the breaker for closing).
- An undervoltage release is fitted but not energised.
- The breaker is in the TEST or CONNECTED position with the racking handle inserted.
- A key interlock (e.g. Castell etc.) or direct inter-breaker mechanical interlock is operating on the breaker.

Opening procedure
Pressing the OFF pushbutton or energising the shunt trip coil (if fitted) will open the breaker.

Tripping under fault conditions will be automatic depending on the protective device installed and its settings.

Secondary Circuit Isolation

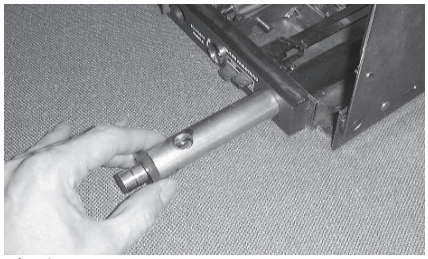
A set of 32 self-aligning secondary circuit isolating contacts are provided in two blocks, B and C, each clearly numbered 1 – 16 (note, for certain protection configurations, an additional A block is fitted). These are easily accessible at the top of the circuit breaker and ensure isolation of secondary circuits when ‘ME09’ is in the DISCONNECTED position.


Fig 1

Wiring terminals have a dual connecting facility to allow termination of secondary wiring by screw or spade connectors. The numbered terminals on blocks B and C relate to connection details shown on wiring diagrams in Section 3.

Withdrawal of ‘ME09’ Circuit Breaker

Ensure that the circuit breaker has been tripped, indicating OFF, and that the closing springs are fully discharged (If a motorised spring charging unit is fitted, rack the breaker to the ISOLATED position then close and trip the breaker to discharge closing springs).
Remove any padlocks from the racking panel.
Remove the racking handle from its stowage (Fig. 2).


Fig. 2

Remove the torque bar from inside the handle (Fig. 3)

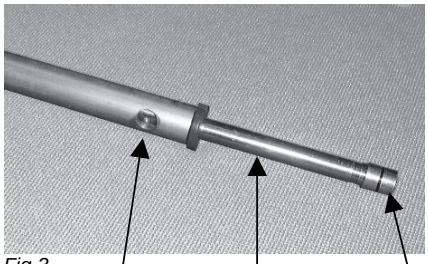


Fig 3

Insert the torque bar into the torque bar hole and secure it by fitting the securing screw as shown in figure 4.

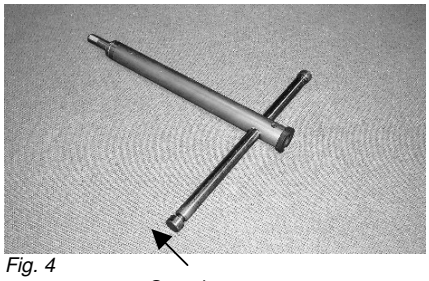


Fig. 4

Securing screw

Using a screwdriver, rotate the racking handle shutter drive, clockwise (Fig. 5).

Note: If the circuit breaker is closed, this action will cause it to trip.



Fig. 5

Insert the racking handle and rotate anti-clockwise until the position indicator moves from CONNECTED through TEST to DISCONNECTED.

Note:

- The circuit breaker cannot be operated:
  (a) between positions
  (b) in CONNECTED or TEST positions while the racking handle is inserted.
- The circuit breaker can be operated while DISCONNECTED with the handle in place.
- Removal of the handle automatically resets the racking handle shutter.

From the DISCONNECTED position, continue turning the racking handle anti-clockwise until reaching a positive stop.
Note: Ensure that the closing springs are fully discharged (spring charge indicator should show 'Discharged') before attempting to withdraw from the DISCONNECTED position.

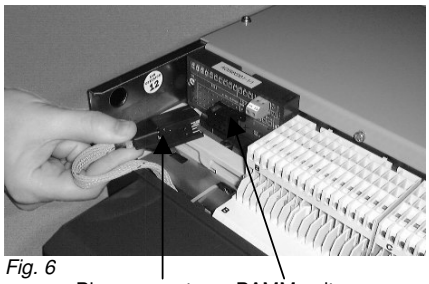


Fig. 6

Plug connector PAMM unit

If a PAMM unit is fitted, remove plug connection. (Fig. 6).
Using the side rail handles, pull the circuit breaker out until reaching a positive stop (Fig. 7).

The breaker is now in the maintenance position.

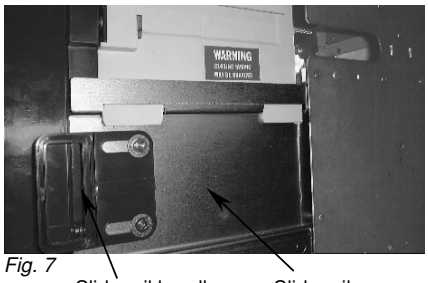


Fig. 7

Slide rail handle Slide rail

Removal of Circuit Breaker from cassette

Lift the circuit breaker clear of the slide rails using the hand grips on either side (Fig. 8).



Fig. 8

Hand grip

Lifting can be achieved utilising the retractable lifting eyes as in Figs 9 and 10.



Fig. 9

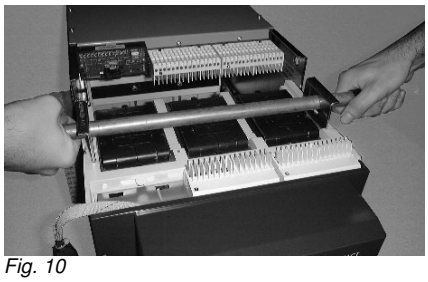


Fig. 10

Circuit breaker removal can be made easier by using a specifically designed lifting truck (Fig. 11). Contact the nearest sales office for availability.



Fig. 11

Caution:

- Do not allow the circuit breaker to impact onto a hard surface while handling.
- Dragging or sliding the circuit breaker across a hard or rough surface may damage some parts.

Mounting Circuit Breaker into Cassette

Ensure that the racking handle is disengaged and that the racking drive is in the reset position (Fig. 12). Fully extend the cassette slide rails until they reach a positive stop.
Using lifting methods previously described, lower the circuit breaker into position on the racking rails, ensuring that the sides of the breaker moulding engage with the slots in both racking rails (Fig. 13).

Note: During lifting, the breakers isolating contacts (clusters) should not be touched.

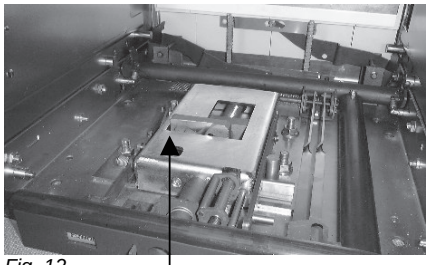


Fig. 12
Racking drive in reset position

Push the breaker into the cassette until reaching a positive stop. The breaker is now in the DISCONNECTED position.

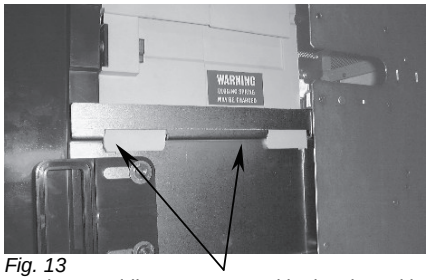


Fig. 13
Breaker moulding to engage with slots in racking rail

With a screwdriver, turn the racking handle shutter drive clockwise (Fig. 5), insert the racking handle and rotate clockwise to rack the circuit breaker into the cassette. As the breaker approaches the TEST position check the alignment of the fix and moving parts of the secondary circuit isolating contacts. Re-connect the PAMM manual disconnect at this stage where fitted.

Continue rotation of the racking handle clockwise until the position indicator first shows TEST and finally CONNECTED.

When approaching the CONNECTED position, effort to turn the racking handle will increase as the clusters on the breaker engage with the cassette mounted fixed contacts.

Note: If the breaker has been closed in the DISCONNECTED position, it will automatically trip before reaching TEST.

If a motor spring charge or undervoltage device is fitted, these may operate when approaching TEST position.

Remove and stow the racking handle. The breaker is now ready for normal operation.

Removing Circuit Breaker Facia

To remove the breakers front facia, first remove the four corner fixing screws and the charging handle grip (1 x cap head screw, Fig.14).



Fig 14

Pull charging handle whilst easing the facia upwards for removal (Fig 15).

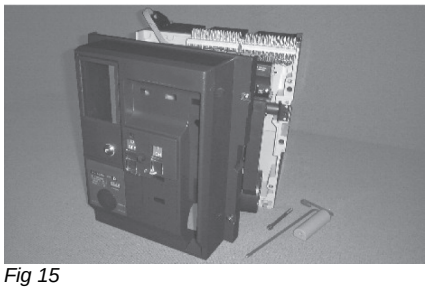


Fig 15

'ME09' ancillary equipment - Fitting instructions
Motorised spring charging unit
Ensure circuit breaker is open with springs discharged. For DC motors, fix motor filter in position shown (if supplied, Fig. 16) using the two fixing screws to a torque of 5Nm.

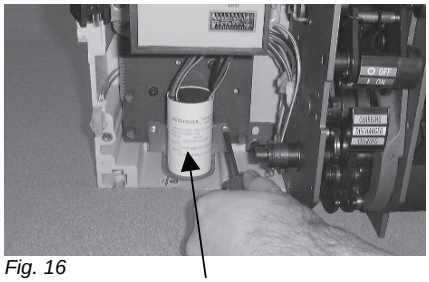
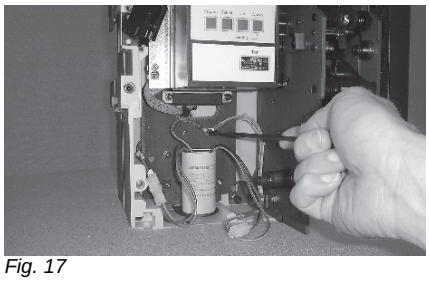


Fig. 16

Make plug connection between filter unit and supply.
Remove earth strap fixing and attach the additional motor filter ground wire to the base plate as shown (fig 17) to a torque of 7Nm.


Fig. 17

Orientate the motor unit as shown (Fig. 18), locating the gearbox bearing onto the protruding motor drive shaft, pushing it home until flush with the mechanism sideplate. If it does not move easily to the flush position, pull the charging handle gently down to ease movement.
Fix in position using three M5 bolts through holes provided in the gearbox endplate (tighten to 7Nm torque).

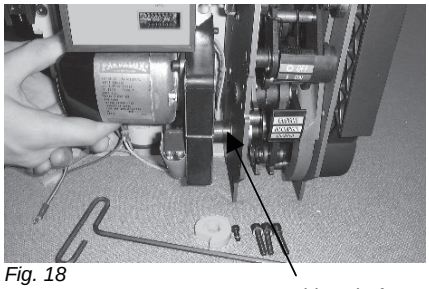


Fig. 18

Manually charge the closing springs and carefully locate the plastic switch actuator over the protruding drive shaft (Fig. 19), ensuring the switch operating arm is correctly positioned (switch arm should be in the 'cut out' portion of the motor switch actuator). Use a suitably sized washer and M4 bolt (into the shaft end) to fix actuator (tighten to 5Nm torque).

Connect modular plug from filter to motor unit.

Connect the remaining earth wire from the filter to the earth point on the rear of the motor body.

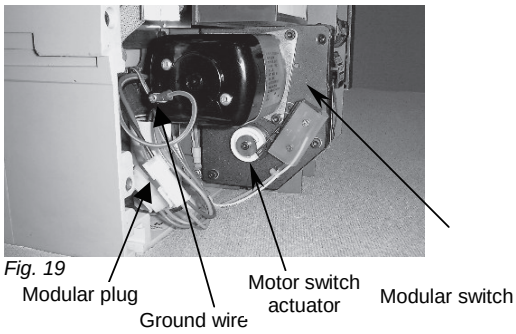


Fig. 19

Reverse the above procedure to remove the motor unit.

Shunt trip - Closing coil - Undervoltage release
The shunt trip and closing coils are clip-on devices and require no fasteners. The undervoltage release coil assembly similarly clips on, there is however an additional circuit board that needs mounting to the breaker mechanism.

Mounting positions of the three units which are not interchangeable and must be as in Fig. 20.

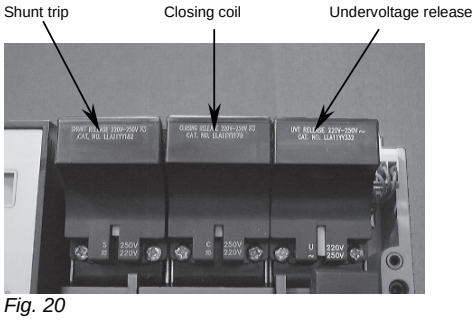
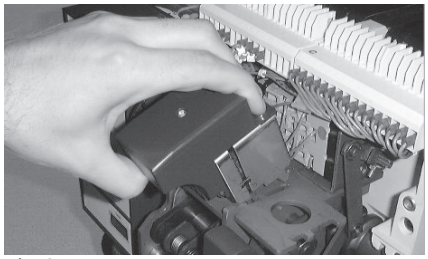


Fig. 20

To mount the coils, tilt the unit forward and engage front hooks into the top support plate. Next tilt backwards until the rear hooks engage in the slots and press down into position (Fig. 21).


Fig. 21

Connect the leads as in the schematic wiring diagram in section 3.
Note:
- Shunt trip has modular plug connector.
- Closing coil and Undervoltage release both have spade connectors to secondary isolating contacts.

To remove the coils, disconnect and tilt forward until rear hooks disengage then lift to release the front hooks.
Note, for undervoltage assemblies, fit the solenoid first.

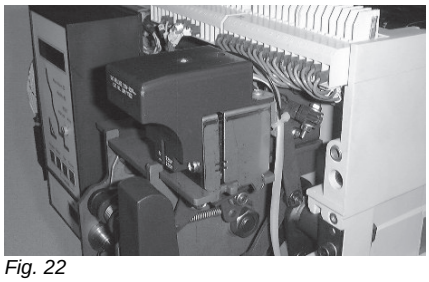


Fig. 22

Then secure the capacitor unit with 2 off M5 screws (screw length 10mm max. torque to 7Nm) and lock washers to the tapped holes in the mechanism side plate (Figs 22 & 23).

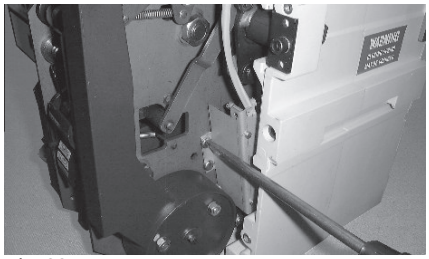


Fig. 23

Pushbutton padlocking

Denies unauthorised access to ON/OFF pushbuttons (Fig. 24).



Fig. 24

Raise the appropriate window(s) and pass padlock hasp through the locking eye.

Use padlock with hasp 8mm diameter maximum (6mm minimum).

To latch OFF pushbutton in depressed position
Depress the button fully and hold. Using a flat bladed screwdriver, turn the latch above the OFF button anti-clockwise through 90°.

Access to both pushbutton and latch can be denied by application of a padlock as above.

Circuit breaker security padlocking

To lock in the DISCONNECTED position for security.

With position indicator showing DISCONNECTED, remove racking handle from the operating position.
Pull the locking bar until the locking eye is exposed and hold while inserting padlock hasp.
Note: Up to three padlocks (required hasp diameter 6mm) may be applied for extra security (Fig. 25).

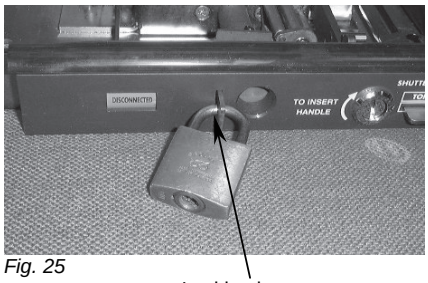


Fig. 25

Locking bar

Safety shutters

Security padlocking

Ensure the circuit breaker is DISCONNECTED and the racking handle removed.

Pull out TOP or BOTTOM shutter bar, or both as required,(Fig 26) to reveal the locking eye. Hold while inserting padlock(s). (Hasp diameter 8mm max - 6mm min).

Note that the “BUSBAR” and “CIRCUIT” designation labels provided are to be applied at installation.

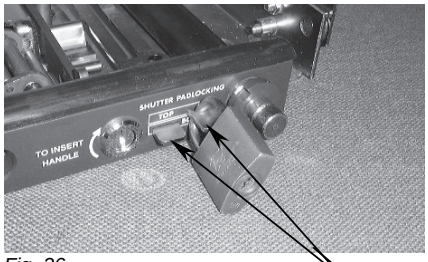


Fig. 26

Locking bars

Prop open feature

For use by trained personnel

To inspect the main fixed contacts each shutter (or both) may be propped open.

Warning. Unless previously isolated, the fixed contacts on the incoming side will be ‘live’.

Remove the circuit breaker from its cassette. Push the slide rail in until the mechanism opens the required shutter.

Note: Viewing the cassette from the front, the slide rail on the left opens the bottom shutter. The right hand rail opens the top shutter (Fig 27).

Top shutter propped open



Fig. 27

Slide rails

Pull the racking rails out to re-close the shutters.

Installing Carriage Switch

Fit carriage switch terminal block assembly to the left-hand side of the cassette (Fig. 28), using the fasteners supplied, to a torque of 5Nm. Stick the designator label next to terminal block assembly (Note: Two terminal locations are unused).

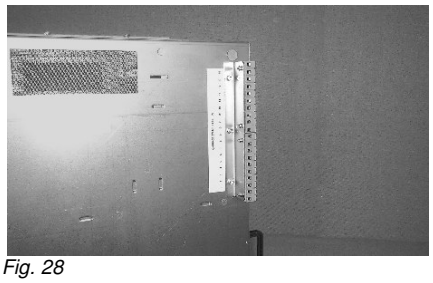


Fig. 28

Fit the 'flexform' grommet strip into the aperture in the lower left side of cassette (Fig. 30) and feed cables through. Position carriage switches to cassette floor over the two tapped holes and loosely fix with two M4 x 6mm screws (Fig 29).

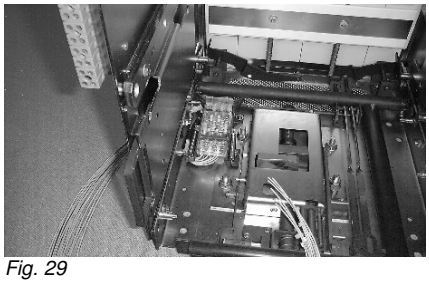


Fig. 29

Terminate the cables as shown. Each wire is identified with ferrules to match the terminal label (Fig. 31).

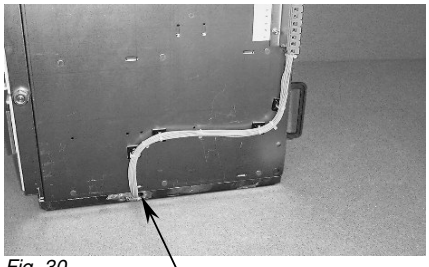


Fig. 30

'flexform' grommet strip



Fig. 31

Insert racking handle and rotate clockwise until the racking drive stops. The racking indicator will read CONNECTED. Place setting gauge in position and hold firmly against forward face of racking drive. Adjust the position of the carriage switch until the upright face on the clear plastic moulding is just in contact with the gauge (Fig 32). Fully tighten fixing screws to 5Nm.

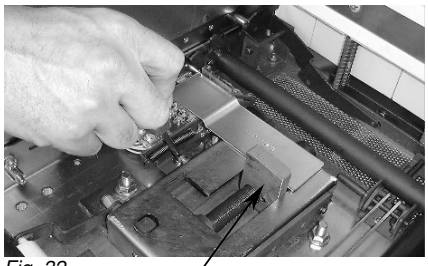


Fig. 32

Racking drive

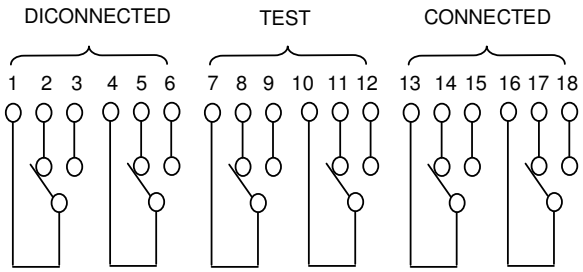


Fig. 33

The standard configuration is two switches for each position as illustrated above (Fig. 33).

Note, the carriage switch will maintain a disconnected indication even when the ACB is fully withdrawn or removed.

The 6 circuits may be re-configured by customer to give up to 3 at DISCONNECTED, 6 at TEST or 6 at CONNECTED - in any combination up to a 6 circuit maximum. Configuration procedure is as follows:

- Unhook the return springs, first from the carriage switch frame and then from the clear plastic moulding.
- Remove 2 off M4 x 6mm carriage switch fixing screws (if fitted to the cassette base) leaving the carriage switch held in position by the wiring.
- Lift the carriage switch slightly and slide out the moulding from the rear of the assembly.
- The trip pins on the moulding are snapped in from its **underside** and can be pushed out using fingers or an appropriate screwdriver in the slot between the retaining legs.
- Reconfigure by snapping the pins back into the required locations ensuring that the head on the trip pin is radially located in the adjacent slot (Fig. 33).
- Slide moulding fully back into carriage switch frame and reconnect the **left hand** return spring.

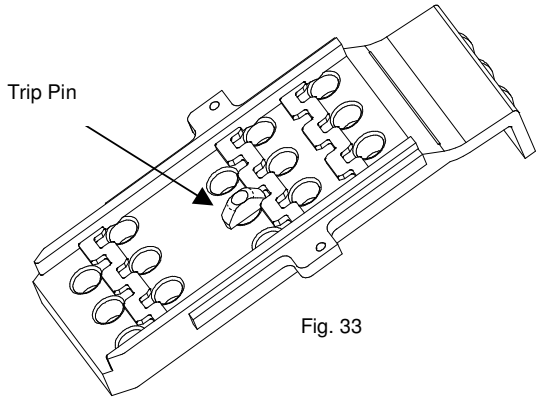


Fig. 33

- Reset the position of the carriage switch as described above.
- Reconnect the **right hand** return spring.

To fit Door Interlock

A door interlock mechanism may be fitted inside the cassette on the right for L/H hinged door or left for R/H hinged door. Specify whether door is L/H or R/H hinged when ordering.

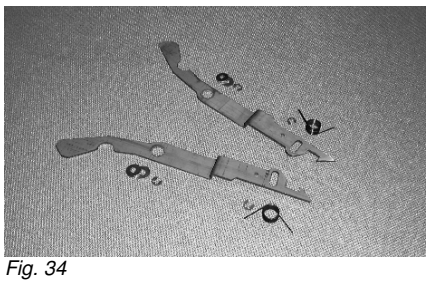


Fig. 34

Interlock Packs
Each pack contains - an interlock lever, a helical spring, washers and circlips, (Fig. 34 shows both L/H and R/H sets). A door bracket is also included (Fig. 35).



Fig. 35

Assembly
Place spring over the spring pin protruding from cassette side plate. Position interlock lever as shown. Ensure one end of spring locates below nut and the other rests over small boss on lever.
Holding lever in position - insert a circlip into the groove in the spring pin then fit two washers over fulcrum boss followed by a circlip to fix (Fig. 36).

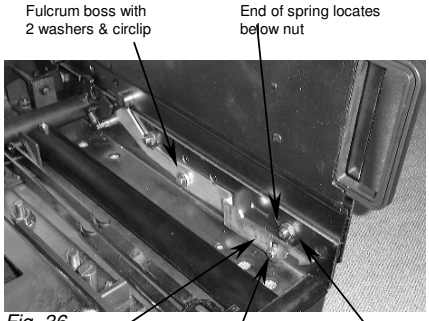


Fig. 36

Door bracket location detail below is for left hand hinged switch board doors (Fig. 37). Drill two holes in the door for M5 clearance.

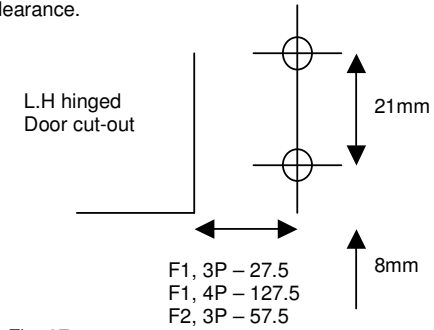


Fig. 37

Door bracket location detail below (Fig. 38) is for right hand hinged switch board doors. Drill two holes in the door for M5 clearance.

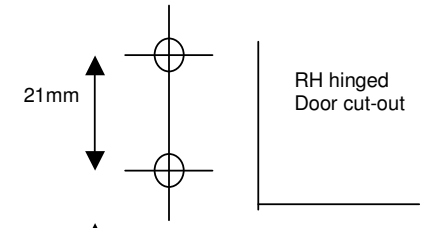


Fig. 38

Busbar/Cable Earthing

Optional pack to enable earthing of circuit breaker terminals on busbar or cable side contains:-

- Isolating contact (cluster) pliers for removal of the main isolating contacts.
- Earthing bar with spring pressured earth contact. The bar is reversible to fit top or bottom terminal sets.
- Necessary fixing bolts and washers.
- Anti-trip plate.

To earth the upper contact set:

(a) Remove the three upper contact clusters at the rear of the circuit breaker, using the cluster pliers provided (Fig. 39).

(b) Position earthing bar below the three exposed terminals and loosely tighten the M10 bolts (into the tapped earthing bar; one bolt per phase. Tighten to 30Nm.

Note: The spring loaded earthing contact should be facing left when viewed from rear (Fig. 39).

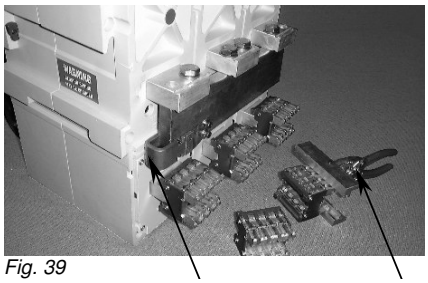


Fig. 39
Spring loaded earthing contact Cluster pliers

To earth the lower terminal set:

a) Remove lower cluster contacts, reverse the earthing bar so that the M10 tapped holes point downwards, apply bolts and washers as above.
b) The spring loaded earthing contact, still facing left, will locate in the same position whether upper or lower terminals are earthed and will engage with a fixed earthed contact block in the cassette when the breaker is racked to the CONNECTED position (Fig. 40).

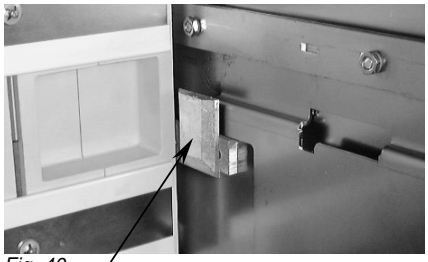
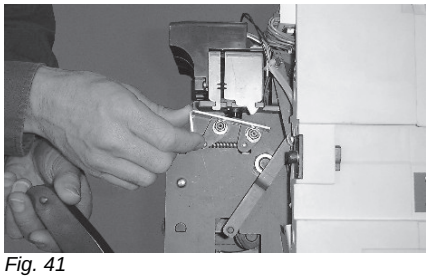
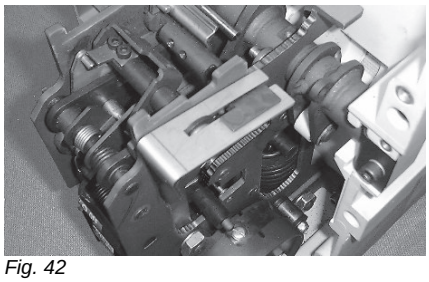


Fig. 40
Fixed earthing contact in cassette

Anti-trip plate
With upper/lower main terminals earthed (breaker CONNECTED) and the circuit breaker closed the anti-trip plate prevents the breaker tripping. To fit the anti-trip plate, first remove the breaker facia as described above. Slide anti-trip plate as shown (Figs 41 & 42) and re-fit facia.


Fig. 41


Fig. 42

To fit mechanical trip alarm

Remove the ACB fasia. Using a suitable nut runner, remove the lower right hand M-PRO fixing. Fit mechanical trip alarm as shown (Fig. 43). Ensure that the actuator arm of the micro switch is not behind the protruding pin.

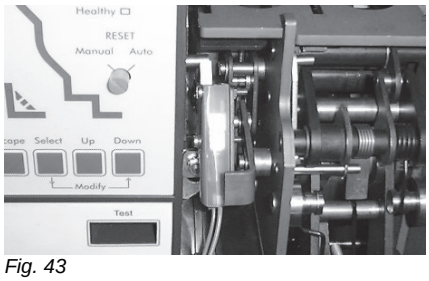
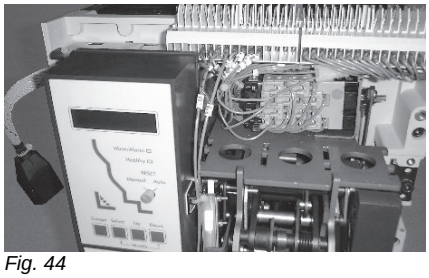


Fig. 43

Connect the wires via. the spade connectors to the respective locations of the secondary isolating contacts B7 and B8 (Fig. 44) and tie wrap them to the side of M-PRO. Replace facia.


Fig. 44

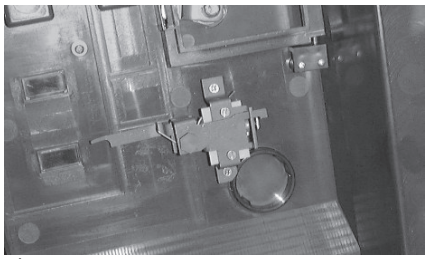
Mechanical Operations Counter

The optional pack contains an operations counter with fixing screws. The unit is fitted to the inside of the circuit breaker facia.

Mounting instructions:
- Remove facia from the circuit breaker.
- Position the operations counter (Fig. 45) over the two holes provided inside the cover, ensuring that the indicator face is aligned to show through the window provided in the cover .
- Fix in position using the screws provided.

When replacing the facia, the operating arm on the counter should engage with a small lever protruding from the circuit breaker mechanism.

Note: The operations counter cannot be reset.


Fig. 45

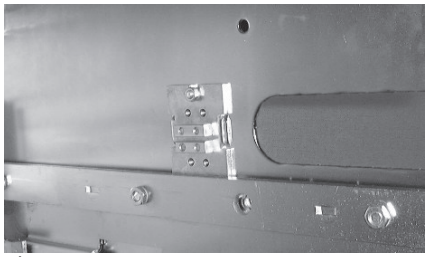
Breaker mis-insertion stop

This 'pin and gate' device prevents insertion of a circuit breaker into a cassette if the nominal rating of the breaker is incompatible with that of the cassette and its ancillary equipment.

Fig. 46 shows a pin block assembly mounted on the circuit breaker. It is fixed by replacing the corresponding hex. bolt with M6 x 150mm long for frame size two breakers & M6 x 115mm long for frame one (tighten to 11 Nm). Fig 47 shows the corresponding restrainer assembly mounted on the cassette by one M4 nut and lock washer. There are two of these assemblies, the other is fitted to the opposite side of the cassette.



Fig. 46
Pin block assembly


Fig. 47

Recommended configurations are provided with the mis-insertion device for the entire ME09 range.

Two-Breaker cable interlock.

Details are given to calculate the correct cable length. More information on three-breaker and other combinations of cable interlocks is available on request.

Vertically Mounted:

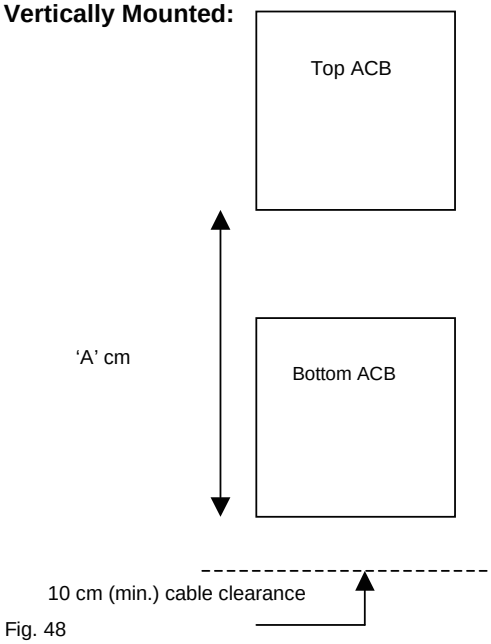


Fig. 48

Referring to Fig. 48, cassette pitch 'A' is from the bottom face of one cassette to the bottom face of the other. Dimension 'A' can be no less than 60 cm. Ensure that the minimum cable radius is not less than 125mm. Minimum cable length is A + 100 cm. Longer cables can be used, however, they must be free from obstruction and no longer than 3m.

Horizontally Mounted

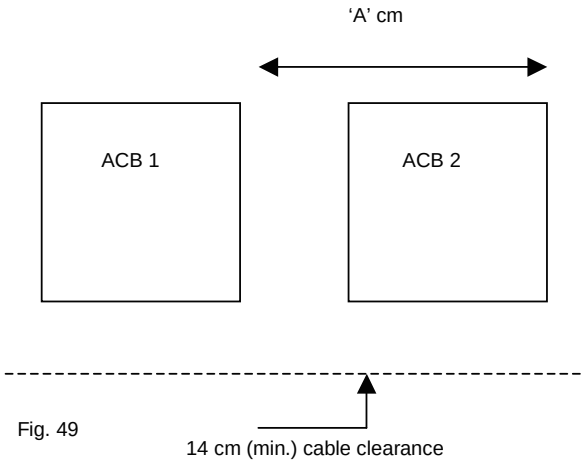


Fig. 49

Referring to Fig. 49, measure distance 'A' from the right hand face of one cassette to the right hand face of the other. Ensure that the minimum cable radius is not less than 125mm. Cable length is A + 67 cm. Longer cables can be used, however, they must be free from obstruction and no longer than 3m.

Routine inspection – Fixed or withdrawable ACB (types A, D & H)

Recommended annually or following interruption of a short circuit.

Arcing contact system

- Withdrawable breakers should be drawn out to the maintenance position.
- Remove arc chutes (Fig. 50).

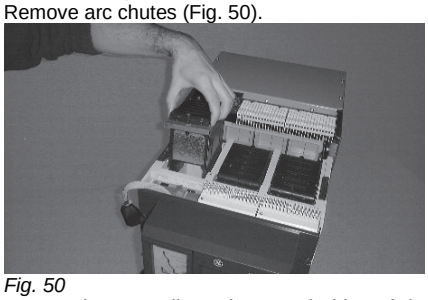


Fig. 50

- Inspect the arc splitter plates and sides of the mouldings for signs of wear or damage. Replace as necessary.

Note: Arc chutes on 'ME09' circuit breakers have a unique design feature. They are reversible to extend useful life. Reversal of the arc chutes during each routine inspection is recommended.

- With the breaker in the ON position, check the gaps between fixed and moving arcing contacts.
- If greater than 2.5mm, and there is no evidence of contact damage, loosen the fixed contact screw and adjust the gap to 2.5mm. Retighten the screw (12Nm torque).
- If excessive contact wear or damage is evident, both fixed and moving arcing contacts should be renewed and the gap set to 2.5mm.
- If the gap is less than 1mm, reset to achieve a gap between 2.5 and 1mm by adjusting the fixed contact as above. Should it not be possible to achieve at least a 1mm gap, the contact system should be renewed.
- Even if gaps are within operating tolerance (1mm - 2.5mm) always check contact screws for tightness to 12Nm torque.

Circuit Breaker operation

- Check ON and OFF action of the breaker manually and by remote means if appropriate.
- Check tripping action by means of the undervoltage, if fitted.
- Check that all indicators function correctly.
- Check number of operations, if counter is fitted, to the breakers specification.

Cassette checks

- Ensure the base of the cassette is clear of debris or foreign objects.
- Prop open the top and bottom shutters (procedure as described previously) and inspect the cassettes fixed contacts for excessive wear or damage.
- Check the operation of the carriage switch, if fitted, whilst racking the ACB into and out of CONNECTED position.

M-PRO protection

- Test operation of the circuit breaker against selected protection settings (refer to section 2) using an M-PRO Test Box (optional accessory).
- Continuity check the mechanical trip alarm, if fitted, whilst test box tripping the M-PRO.
- Check contact wear menu (for M-PRO 20/30/40), if initiated.
- Continuity check REF inter-trip, if fitted.

Isolating contacts (for withdrawable ACB's)

Remove the circuit breaker from cassette housing and place on a suitable working surface. Inspect the rear clusters contacts for signs of overheating and wear. Remove the cluster contacts using the special cluster pliers (part number LLA11YY207). Clean the isolating contacts and terminals with a soft clean cloth to remove any old grease or dirt and apply a thin film of BP white paraffin grease (grade 8802).

Recommended Tool Kit for Maintenance and Modification of ME09 Air Circuit Breaker

Cluster Pliers
Used for removal of primary isolating contacts during inspection and maintenance (Part number LLA11YY207).
Flat Bladed Screwdriver - 8 mm
Used for removal of front panel fixing screws and operation of racking shutter drive.
Allen key - 6 mm A/F
Used for removal of horizontal part of spring charging handle to allow complete removal of ACB front fascia.
Allen Key - 5 mm A/F
Used for removal of arc chutes during inspection and maintenance. Also used for removal or adjustment of fixed and moving arcing contacts.
Metric Feeler Gauges
Used for checking and adjusting arcing contact gap.
Posidrive number 2 screwdriver.
Used for removal of the Rogowski Coil and Power CT cover plate at the rear of ACB moving portion.
Nut Spinner - 7 mm A/F
Used for removal of M-PRO 4 mm fixing nuts.
Nut Spinner - 5.5 mm A/F
Used for removal of PAMM 3 mm fixing nuts.
Terminal Screwdriver
Used for removal of PAMM fixing screws and connection of wiring to Secondary Isolating Contact Terminals.
Allen Key 4 mm A/F
Used for removal of 3 off Motor and Gearbox 5 mm fixing screws.
Allen Key 3 mm A/F
Used for removal of Motor and Gearbox Limit Switch Cam 4 mm fixing screw.

ME09 Trouble Shooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Breaker Won't close	• Breaker is between CONNECTED, TEST and DISCONNECTED positions.	• Rack breaker to CONNECTED, TEST or DISCONNECTED remove racking handle and close ACB.
	• M-PRO has not been reset	• Push orange M-PRO button & close ACB.
	• UV fitted and not energised	• Energise UV and close ACB.
	• Castell or other interlocks are fitted	• Rotate and remove interlock key.
	• Racking handle is inserted	• Remove handel and close ACB.
	• Cable interlocks fitted	• Check operational diagram & trip the relevant ACB
Breaker closes then opens instantaneously	• M-PRO PAMM connector not inserted	• Insert PAMM connector to PAMM module.
	• M-PRO protection settings not set –	• Check that the protection limits have been set to match system loads. Check that inputs are set to normally closed trip without a signal applied
	• Remote Rogowski coil not fitted the correct way	• Re-position coil as illustrated in section 2.
Motor won't charge	Check that the motor actuator is fitted	Fit actuator (supplied with kit) see Fig 19.
DC closing coil or UV won't operate	Check the polarity of the connection to the secondary isolating contacts	Refer to section 3 wiring diagrams
Breaker won't rack into cassette	• Check that the breaker is pushed fully from the maintenance position to DISCONNECTED	• Push breaker into DISCONNECTED position.
	• Racking drive not reset	• Reset racking drive see fig 12.
Earth fault does not operate below 40% setting	For M-PRO 20/30/40: Check that APU is fitted and energised. M-PRO 17 does not support settings below 40%	Fit APU and energise. See section 3 for wiring diagram.
Cannot insert racking handle	Shutter padlocks fitted	Remove ALL padlocks
Breaker will not go into DISCONNECTED position	• Incorrect setting of mis-insertion stop.	• Reset mis-insertion device, see figs 46 & 47
	• Incorrect ACB for given cassette.	• Check that the ACB & cassette are the correct pair.
Protection unit healthy indicator not working	• Check that APU (if fitted) is energised	• Fit APU if not fittted
	• Insufficient primary current to power the unit	• M-PRO will power with 40% I_n single phase & 20% I_n 3 phase current.
M-PRO not displaying existing fault after tripping the breaker.	M-PRO set to auto reset – Fault still stored - check history of trips for fault type	Set M-PRO reset button to manuel.
MODBUS communications not responding	• Communication set up incorrectly..	• Document LLD11DD003 (available upon request) required to correctly define set up
	• M-PRO baud rate not compatible with host	• Set M-PRO baud rate to match host.

If problems persist please contact our After Sales Service Department.

M-PRO 17 Protection Unit

Front Panel

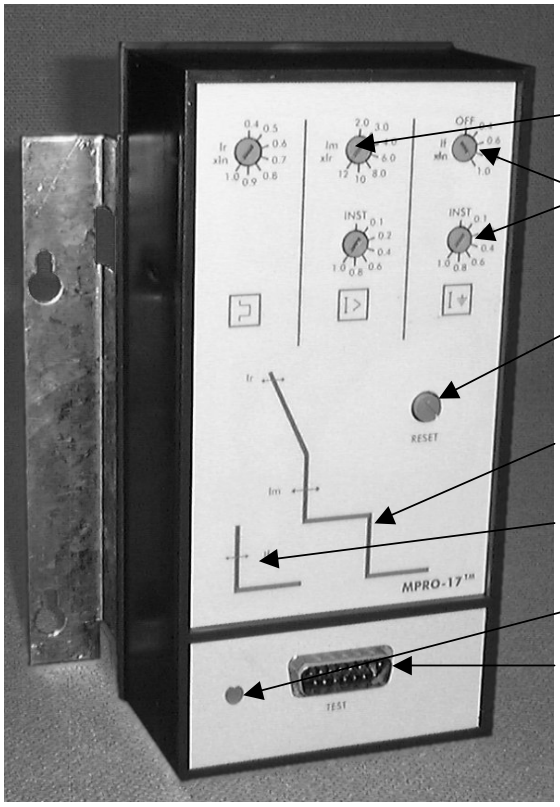
Healthy LED
A green 'healthy indicator' is continuously flashing at the pace of a 'heart beat' when the M-PRO is powered and the operation status is normal.

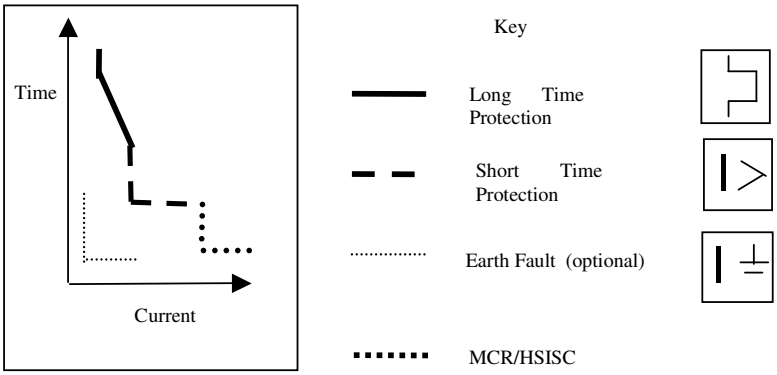
Reset button
Factory set to 'Manual' ('Auto' reset upon request.) In the event of a fault, M-PRO will trip the circuit breaker and the button will eject from its normally flush position.
The fault must be cleared and the button pushed to reset before the circuit breaker can be re-closed. If 'Auto', the reset button will remain in its flush position and, after clearance of the fault, M-PRO will reset itself to permit re-closure of the breaker.

Test port
A 15-way 'D' type test port at the bottom of the front panel accommodates a plug-in Test Box.

Adjustable slotted switches
An easy-to-use set of screwdriver adjustable rotary switches enables adjustment of the protection settings. Valid switch settings are in accordance with the front panel graduation marks and are defined by a positive 'click' action.
The long time protection pickup Ir, the short time pickup Im, the short time delay and optionally the earth fault Pickup If and earth fault delay.

Front Panel MIMIC
Mimic of the operating characteristic
The M-PRO17 provides long time protection, short time protection, making current release/high set instantaneous short circuit protection and earth fault protection. Protection is provided on all three phases and neutral (on four pole circuit breakers). The overall protection scheme is shown on the following diagram:





Protection Features

Long Time Protection
Long time protection is provided in accordance to the IEC 947-4 Class 20 curve; trip times are defined as:

Current at 1.5 x Ir	Current at 7.2 x Ir
480s (max)	20s (max)

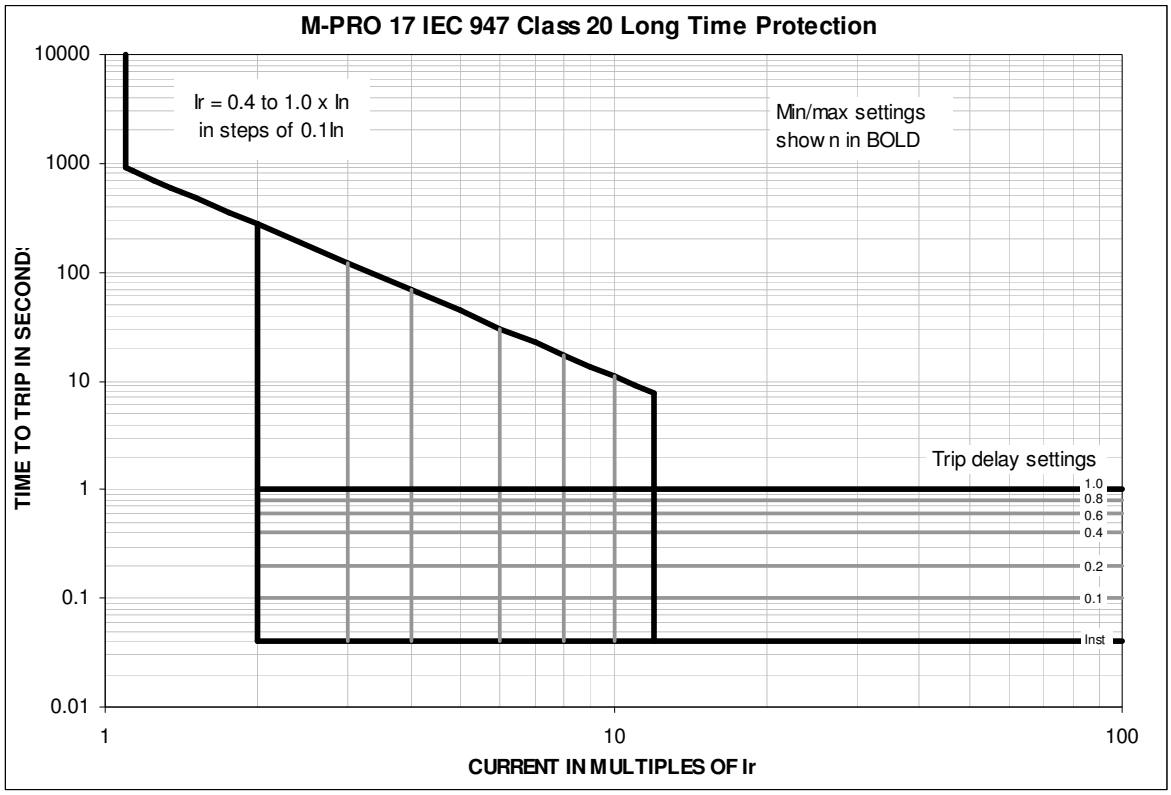
The pickup point, Ir is switch adjustable from 0.4 times the breaker rating (In) to 1.0 x In in steps of 0.1. There is a tolerance on the trip time of +0, -20% expressed in terms of current.

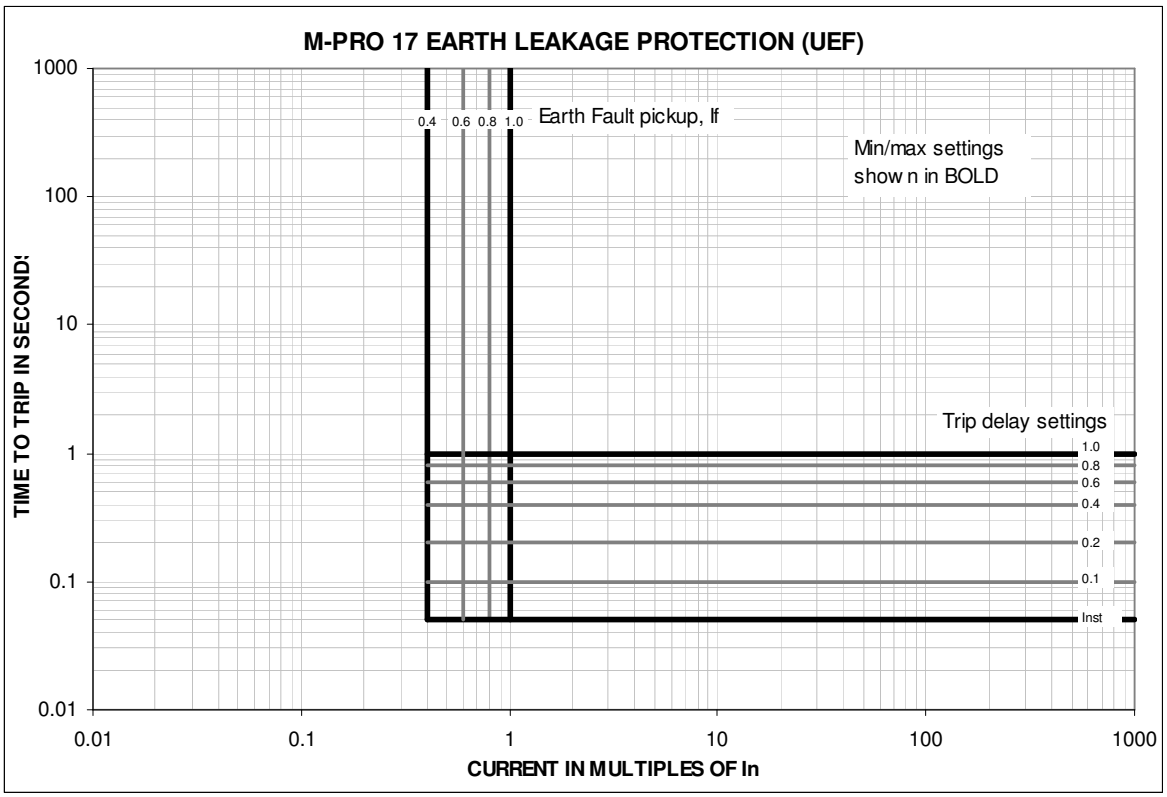
Short Time Protection
M-PRO 17 offers adjustable short time protection with selectable trip time delay. All the short time settings are configured via front panel switches. The pickup point is in terms of the long time setting Ir, and can be set to 2.0, 3.0, 4.0, 6.0, 8.0, 10.0 or 12.0 x Ir. Trip delays of INST, 0.1, 0.2, 0.4, 0.6, 0.8 and 1s are available. A setting of 'INST' causes M-PRO 17 to initiate an instantaneous trip in a minimum of 40ms.

Earth Fault Protection (OPTIONAL)
Earth fault current is measured by summing the current in all phases and neutral (where used) to give a value equal to the earth leakage current which is present downstream of the circuit breaker.
The M-PRO can be set to provide trip delays of INST, 0.1, 0.2, 0.4, 0.6, 0.8 and 1s, with pickup points or OFF, 0.4, 0.6, 0.8 and 1.0 x In, the breaker rating. This protection can be switched off when not required.
NB see section "Neutral Rogowski Coil Mounting Details" for external coil orientation.

Making-Current Release (MCR)/High-Set Instantaneous Short Circuit (HSISC) Protection
The M-PRO 17 will perform an instantaneous trip if the breaker is closed onto a fault exceeding its making-current capability.
When the circuit breaker is closed, it can carry a current equal to Icw. The M-PRO 17 will however perform an instantaneous trip if Icw is exceeded.

Both these thresholds are factory set and are not adjustable by the operator.

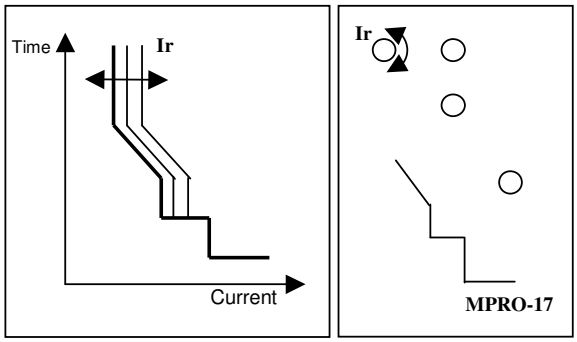



M-PRO 17 EARTH LEAKAGE PROTECTION (UEF)
1000
100
10
1
0.1
0.01
TIME TO TRIP IN SECOND!
0.4
0.6
0.8
1.0
Earth Fault pickup, If
Min/max settings
show n in BOLD
Trip delay settings
1.0
0.8
0.6
0.4
0.2
0.1
Inst
0.01
0.1
1
10
100
1000
CURRENT IN MULTIPLES OF In

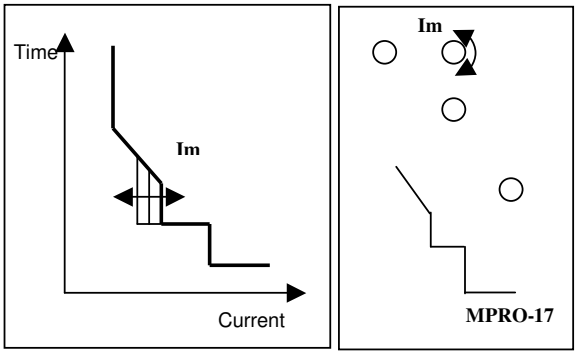
Operator Controls

All operator controls are presented on the M-PRO 17 front panel. The switches may be adjusted at any time, whether the breaker is open or closed, and powered or not.

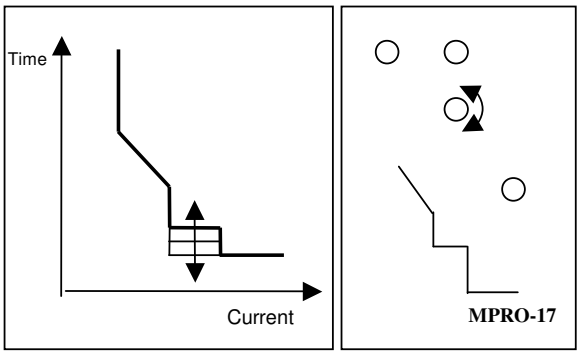
Setting Current (Ir)
This is the pick-up current for long-time protection. It is set as a fraction of the breaker rating (In) to values ranging from 0.4In to 1.0In in steps of 0.1In.



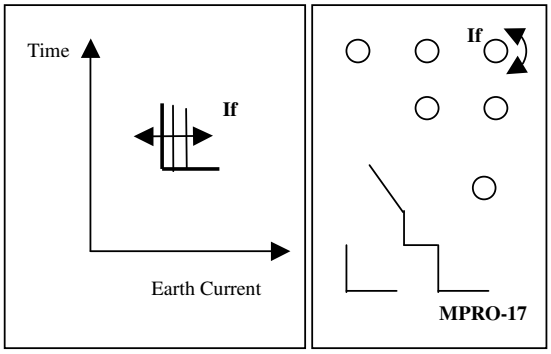
Short Time Pickup (Im)
This is the pick-up current for short time protection (Im). It is set as a multiple of the setting current (Ir). Switch positions are provided at 2.0xIr, 3.0xIr, 4.0xIr, 6.0xIr, 8.0xIr, 10xIr and 12xIr.



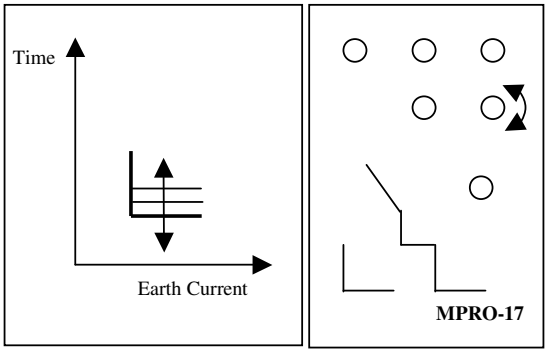
Short Time Delay
The short time delay can be set to instantaneous, 0.1s 0.2s, 0.4s, 0.6s, 0.8s or 1.0s



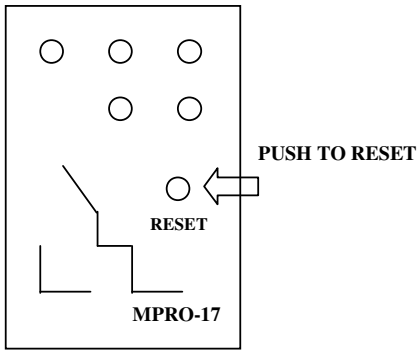
Earth Fault Pickup (If) - OPTIONAL
This is the pick-up current for earth fault protection. It is set as a fraction of the breakers rating (Ir). Switch positions are provided at OFF, 0.4In, 0.6In, 0.8In and 1.0In. The OFF position disables earth fault protection.



Earth Fault Delay - OPTIONAL
The fixed-time earth-fault delay can be set to instantaneous, 0.1s 0.2s, 0.4s, 0.6s, 0.8s or 1.0s



Reset
In the event of a fault, the M-PRO 17 will trip the breaker and the reset button will eject from its normally flush position. The reset button must be pushed home before the circuit breaker can be re-closed.



Front Panel

Liquid crystal display (LCD)
A two-line LCD screen displays menus, curve settings and circuit status data, as selected using the keypad.

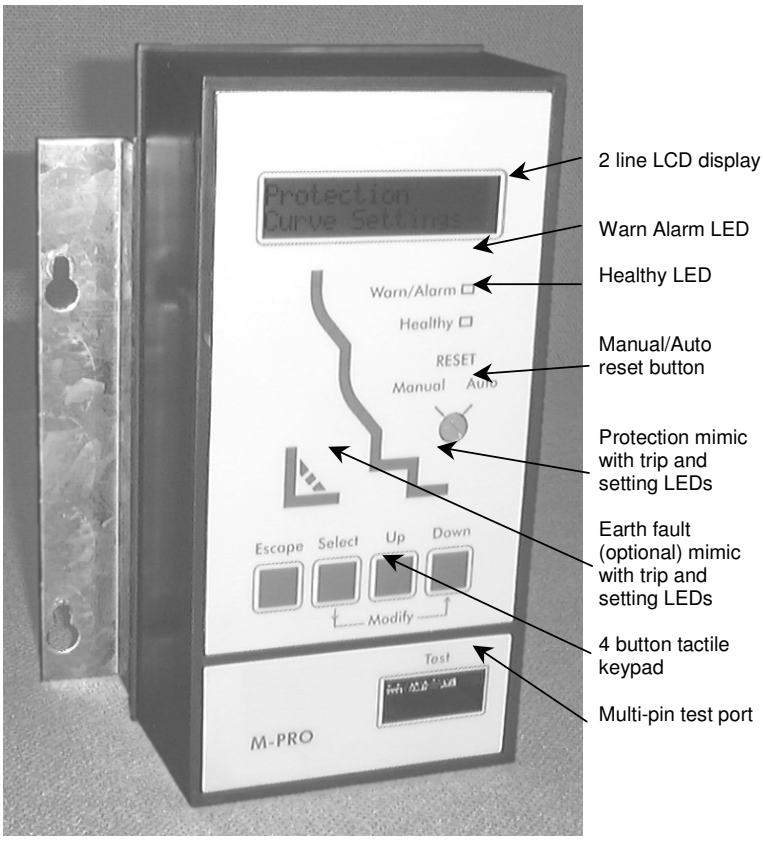
'Healthy' LED
A green LED is continuously lit whenever M-PRO is energised and the operational status is normal.

'Warn/Alarm' LED
The red LED will flash continuously in the event of a fault or circuit malfunction.

Mimic LED's
Seven red LEDs are set into the long time and short time protection curves mimic; two more in the are in earth fault mimic. As settings are selected from the menus, the LED in the appropriate mimic position will light
A fault will cause an LED in the mimic curve section appropriate to the type of fault (long time, short time or earth fault) to flash, together with the 'Warn/Alarm' LED, until the fault is cleared.

Manual/Auto reset
Set to 'Manual' or 'Auto' using a screwdriver. The selected position is indicated by an arrow on the reset button. In the event of a fault, M-PRO will trip the circuit breaker. If 'Manual' is selected, the button will eject from its normally flush position. The fault must be cleared and the button pushed to reset before the circuit breaker can be reclosed.
If 'Auto' is selected, the reset button will remain in its flush position and, after clearance of the fault, M-PRO will self reset to permit reclosure of the breaker.

Test port
A 16-pin test port at the bottom of the front panel accommodates a plug-in Power Box or Test Box.



Four-key tactile keypad
'Escape', 'Select', 'Up', and 'Down' keys are used to call up menus and circuit data for viewing on the LCD as well as to adjust relay settings and curve speeds.

Operation of the tactile keypad

UP -moves up ↑ the menu list in the level currently in use.

DOWN -moves down ↓ the menu list in the level currently in use.

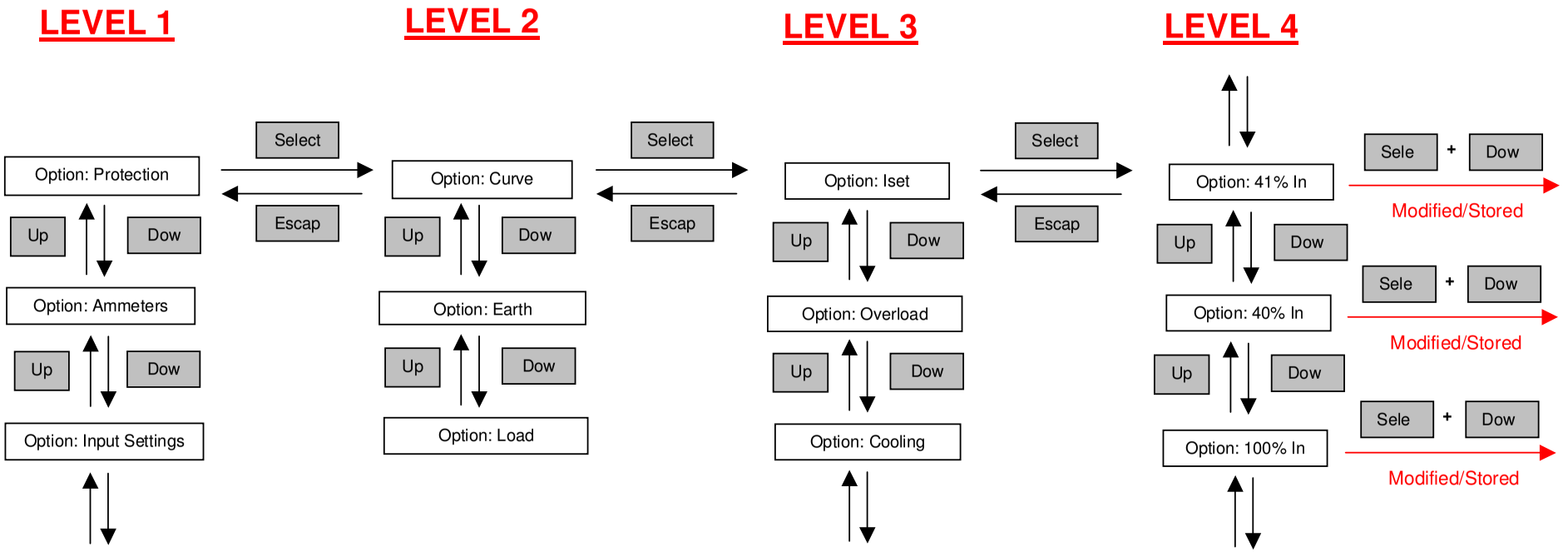
ESCAPE -moves ←out the level currently in use and into the next level above.

SELECT -moves → in to the next level below that which is currently in use.

MODIFY press and hold **SELECT** then **DOWN** to store the selected setting.

The example below shows how to scroll up and down the menu structure to select the pickup for long time protection. Referring to the menu structure below, the navigation table is a basic overview illustrating the operation of the keypad keys.

Navigation table



Note 1: For the final sub-menu, where the percentage is displayed, the options are scrolling; ie: from 40% to 100% can be achieved in one operation by pressing the down button.

Note2: Some options have to be purchased in order to be displayed The table below contains the menu structure of M-PRO and illustrates what options are available based on M-PRO type.

Menu Structure

There are four levels within the M-PRO menu structure, the main three are described below. Only those menus specified at the time of ordering will be factory set into M-PRO hence not all of the following menus will be available.

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu
Protection	Curve Settings	I set	e.g: 40% In
		Curve Type	e.g: Standard Inverse
		Curve Speed	e.g: Curve 6
		Cooling Time	e.g: Instantaneous
		Inverse Short Circuit Current	e.g: 4 x Iset
		Fixed Short Circuit Current	e.g: 6 x Iset
		Fixed Short Delay	e.g: 300ms
		Neutral Rating	e.g: Fully Rated
		Phase Rotation	e.g: RYB Clockwise
	Earth Protection[1,2]	REF Current	e.g: 10% In
		REF Alarm	e.g: ON
		UEF Current	e.g: 30% In
		UEF Trip Time	e.g: 400ms
		UEF Cropping	e.g: 2.5
		SEF Current	e.g: 50% In
		SEF Trip Time	e.g: 500ms
		SEF Cropping	e.g: 4
		SEF Intertrip	e.g: ON
	Load Monitoring[1,2]	Load Monitoring	e.g: Load shedding/pretrip alarm
		Start Shedding	e.g: 95% x Iset
		Stop Shedding	e.g: 80% x Iset
Ammeters	Red Ylw Blue (A)		
	Red Ylw Blue (% I set)		
	Neutral (% I set)		
	Highest Phase (A)		
	Peak RMS Phase (A)		
	SEF Current (A)		
	REF Current (A)		
	UEF Current (A)		
	Thermal Register (%)		
Input Settings[1,2]	Input 1	e.g: warn	
	Input 2	e.g: warn	
	Input 3	e.g: warn	
	Input 4	e.g: warn	
Faults	Existing Faults	e.g: No Faults	
	History of Trips	e.g: Overload Trip on Red	
System Status	Breaker Status	Breaker position	e.g: Closed
		Contact Life	e.g: 10%
		Total Life	e.g: 70%
		No. of Operations	e.g: 3020
	M-PRO Status	Powered Up Time	e.g: 500 minutes
	Software Status	Software Issue	e.g: 5201D06, 6A4AH
		EPROM Name	e.g: M-PRO 5201 D6
	PAMM Status	PAMM Identity	e.g: 40/F/A9A4701H
Communications[2]	Link Status	Baud Rate	e.g: 9600
		Link Scan Range	e.g: 0.01 to 0.03
		Link Scan Time	e.g: 44 seconds
		Link Timeouts	e.g: 2
		CRC Errors	e.g: 0
	Link Setup	Link Address	e.g: 3
		Baud Rate Setup	e.g: automatic
		Link Fail Action	e.g: warn
Test Mode (available when test box is inserted and switched on)	Fault Crnt Type	e.g: Over Current	
	Over Crnt Level	e.g: 2 x Iset	
	Earth Crnt Level	e.g: 20%	
	Activate Test	e.g: Start Test	

[1]Options for M-PRO 30

[2]Options for M-PRO 40

PAMM - A unique security feature

The Plant Associated Memory Module (PAMM), being mounted on the cassette (for withdrawable units) is independent of the withdrawable circuit breaker and M-PRO unit. All stored settings and data will be retained even when power is removed from the M-PRO unit. The PAMM will automatically assume the protection characteristics previously set, regardless of any substitution of either the original circuit breaker or M-PRO unit whether inadvertent or deliberate. This unique feature ensures that protective settings are always securely associated with the circuit characteristics for which they were chosen.

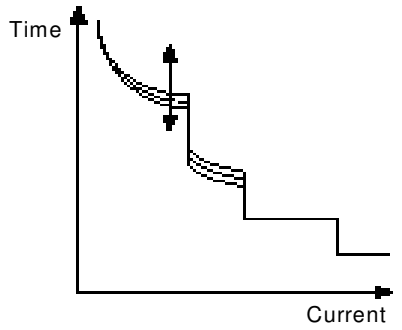
NOTE: PAMM / M-PRO systems are despatched with the protections settings at minimum and all memory related features reset (history of trips, operations counter etc.).

NOTE: For M-PRO's with normal operation below or close to 20% of the breaker rating it is recommended that an auxiliary power supply is fitted.

Protection Features

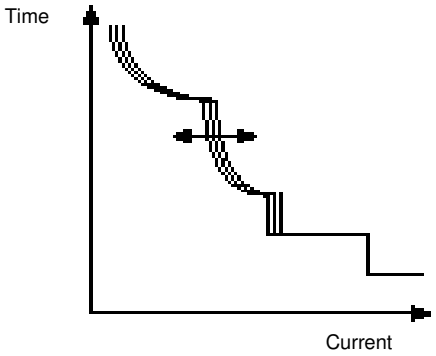
Most settings may be adjusted at any time as long as the M-PRO is powered up. If there is insufficient primary current or the breaker is open (assuming no auxiliary power supply) then a test box or battery box is required. Factory settings (e.g. breaker rating) and input settings may only be changed if the breaker is open, all other settings may be changed at any time.

Long Time (& Short Circuit) Curve Type and Speed



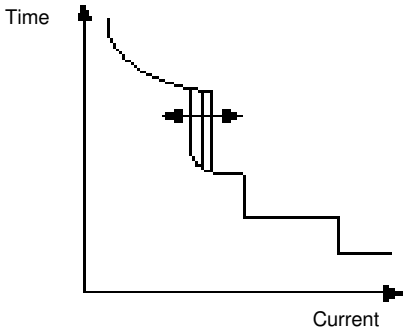
Operating time/current settings may be viewed on the LCD screen. Five types of long time curve are available for selection. 16 curve speeds are available for selection by the user. The Inverse Short Circuit characteristic is automatically set by selection of the long time curve and follows its parameters except that the speed is 10 times faster

Long Time Pick Up



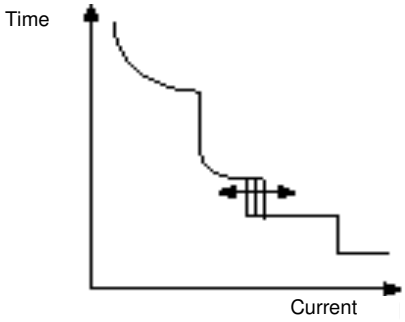
The pick-up value at which long time protection starts. Adjustable between 40% I_n - 100% I_n in 1% steps.
(I_n = Nominal current rating of circuit breaker).

Inverse Short Circuit Current



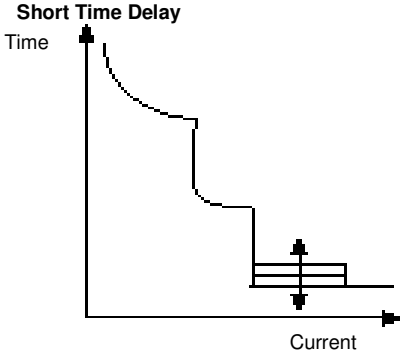
It is possible to select the current at which the inverse short circuit protection will take over from the long time protection. This current is adjustable in the following steps:
1.5, 2, 3, 4, 6, 8, 10 and 12 x Ir

Short Time Pick Up



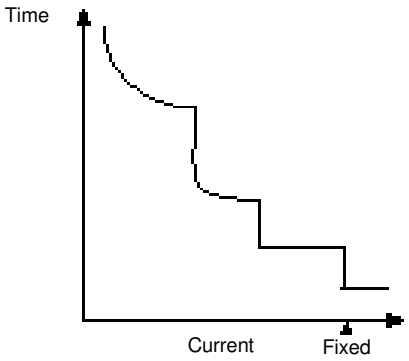
It is possible to select the current level at which the short time circuit protection will take over from the inverse time short circuit protection. The current pick-up is adjustable in the following steps:
1.5, 2, 3, 4, 6, 8, 10 and 12 x Ir

Short Time Delay

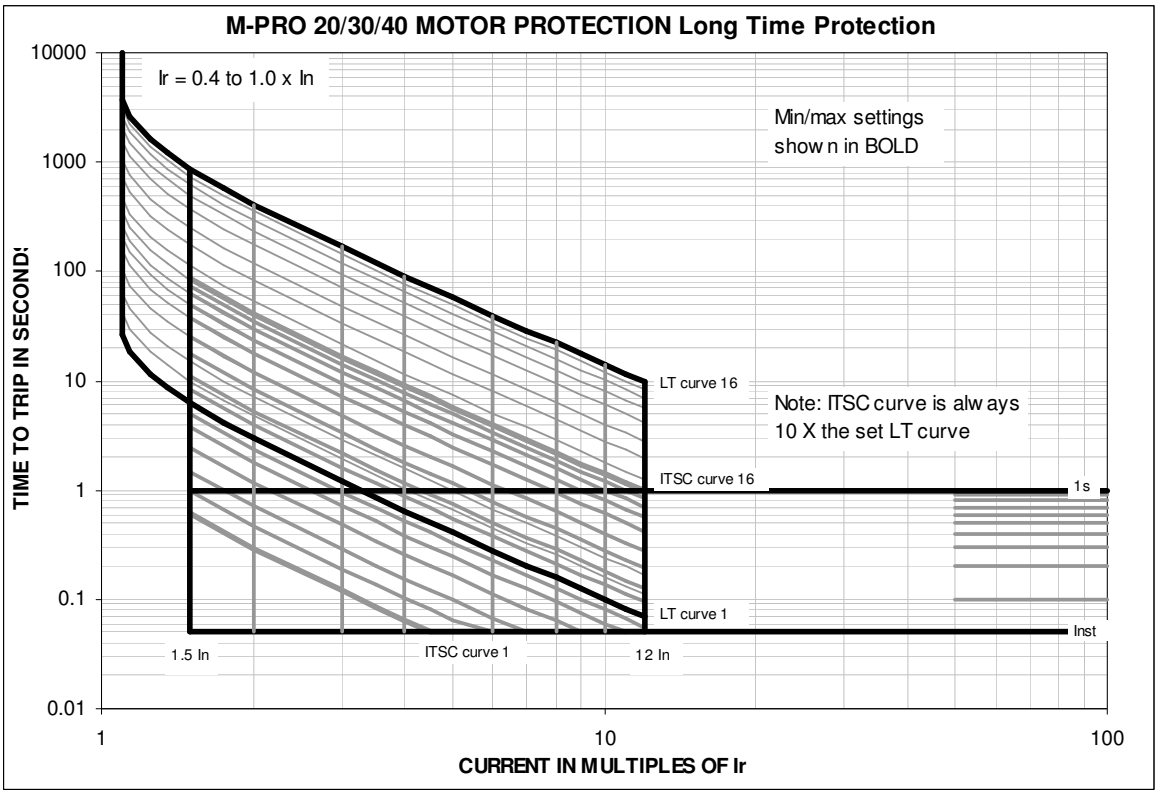


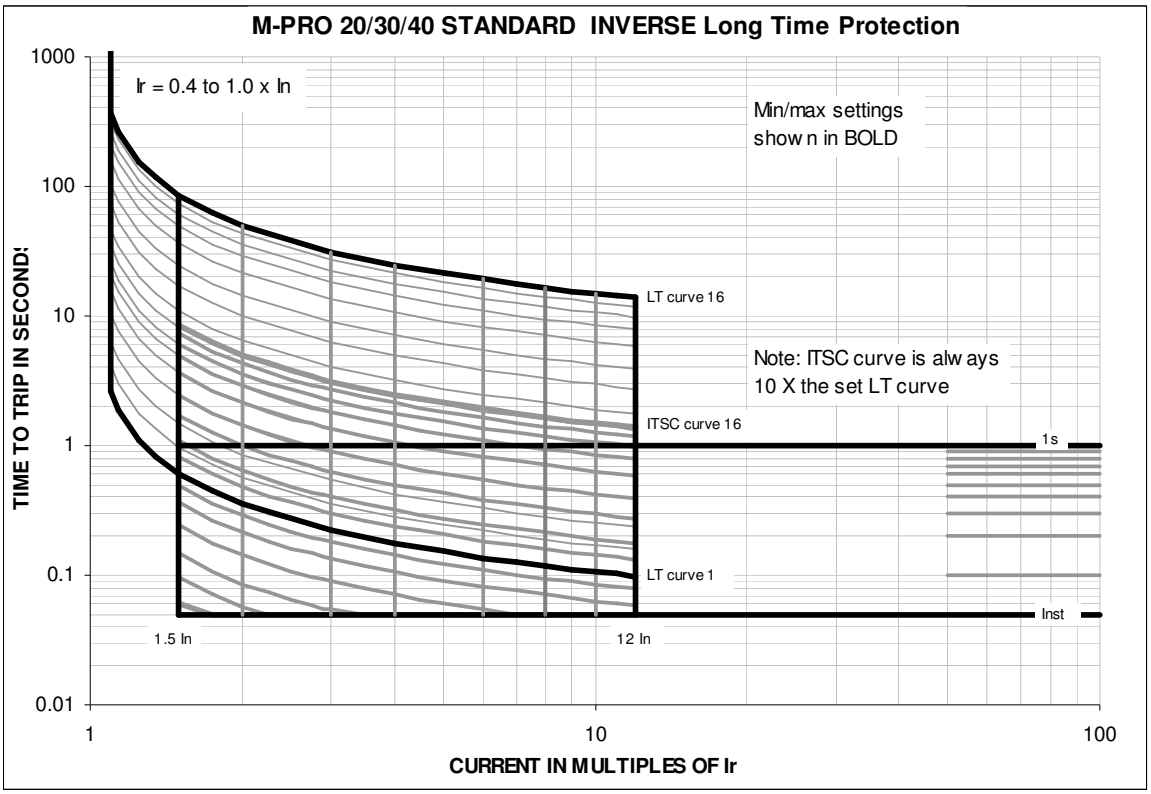
A short time circuit delay can be set on the M-PRO unit. Adjustable
steps are as follows: Instantaneous to 1 sec in steps of 0.1 sec.

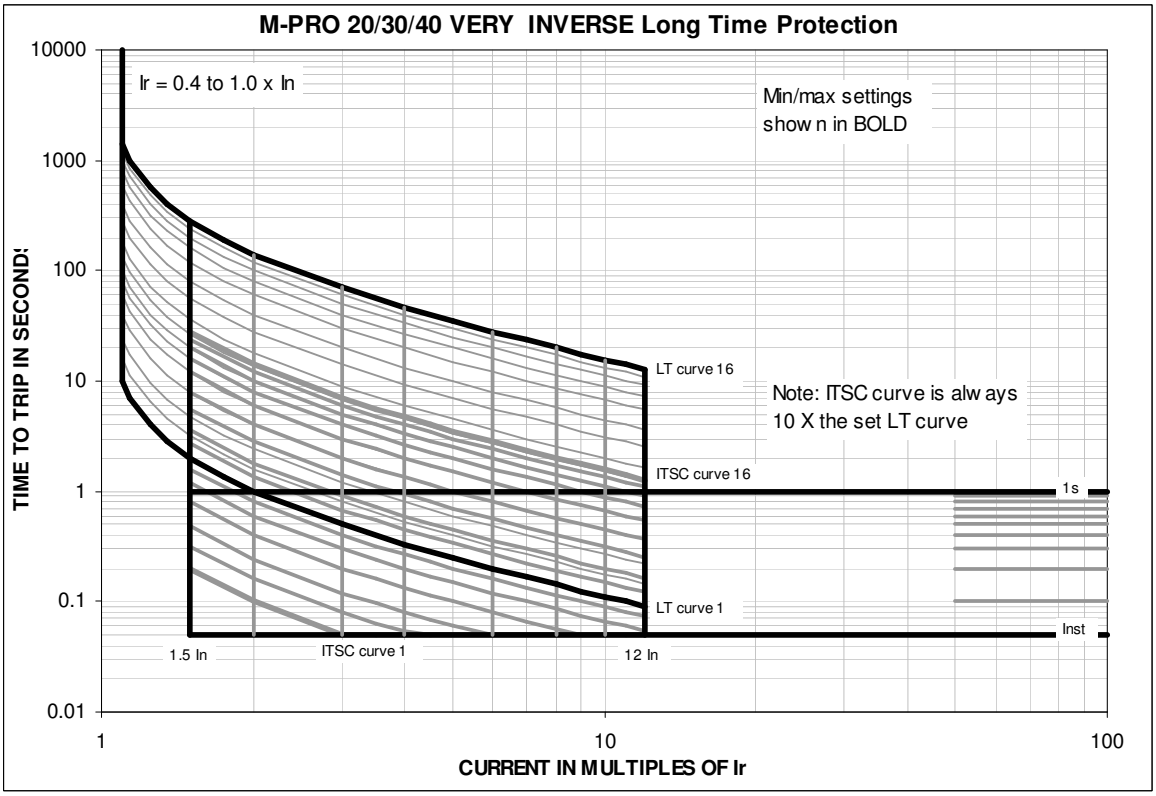
MCR/HSISC

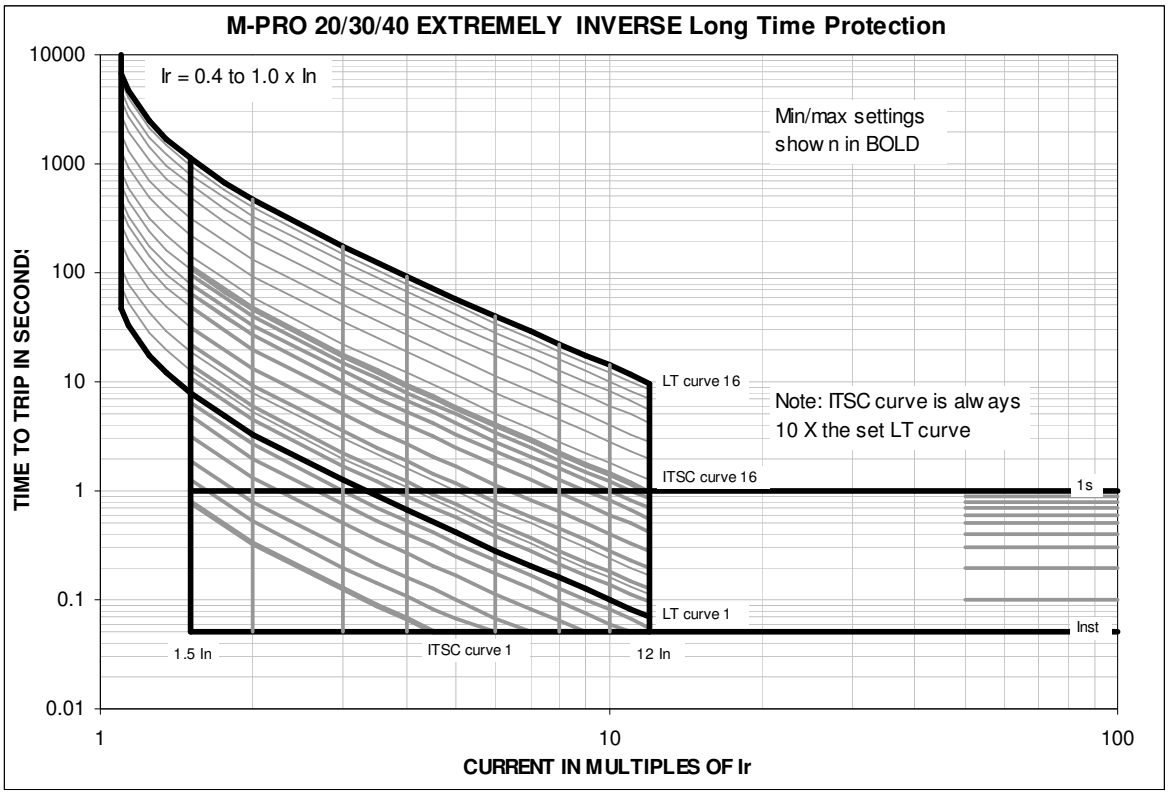


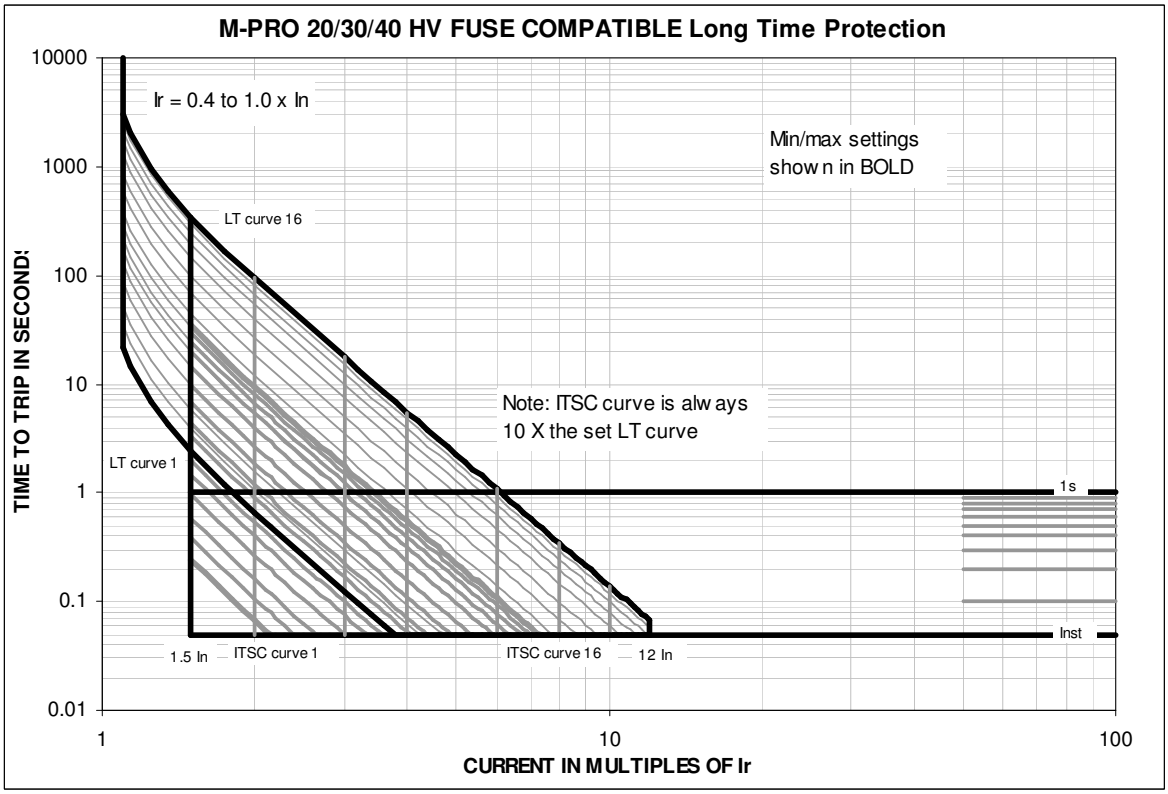
The Making Current Release (MCR) and High Set Instantaneous Short Circuit Protection (HSISC) are factory pre-set relative to the capacity of the circuit breaker to which the M-PRO is fitted.




M-PRO 20/30/40 STANDARD INVERSE Long Time Protection
Ir = 0.4 to 1.0 x In
Min/max settings
show n in BOLD
LT curve 16
Note: ITSC curve is alw ays
10 X the set LT curve
ITSC curve 16
1s
LT curve 1
Inst
1.5 In
12 In
1000
100
10
1
0.1
0.01
1
10
100
TIME TO TRIP IN SECOND
CURRENT IN MULTIPLES OF Ir


M-PRO 20/30/40 VERY INVERSE Long Time Protection
Ir = 0.4 to 1.0 x In
Min/max settings
show n in BOLD
LT curve 16
Note: ITSC curve is alw ays
10 X the set LT curve
ITSC curve 16
1s
LT curve 1
Inst
1.5 In
ITSC curve 1
12 In
10000
1000
100
10
1
0.1
0.01
1
10
100
TIME TO TRIP IN SECOND
CURRENT IN MULTIPLES OF Ir


M-PRO 20/30/40 EXTREMELY INVERSE Long Time Protection
Ir = 0.4 to 1.0 x In
Min/max settings
shown in BOLD
Note: ITSC curve is always
10 X the set LT curve
LT curve 16
ITSC curve 16
LT curve 1
1s
Inst
1.5 In
ITSC curve 1
12 In
TIME TO TRIP IN SECONDS
CURRENT IN MULTIPLES OF Ir
10000
1000
100
10
1
0.1
0.01
1
10
100


M-PRO 20/30/40 HV FUSE COMPATIBLE Long Time Protection
Ir = 0.4 to 1.0 x In
Min/max settings
shown in BOLD
LT curve 16
Note: ITSC curve is always
10 X the set LT curve
LT curve 1
1s
Inst
1.5 In
ITSC curve 1
ITSC curve 16
12 In
TIME TO TRIP IN SECONDS
CURRENT IN MULTIPLES OF Ir
10000
1000
100
10
1
0.1
0.01
1
10
100

Earth Fault Protection
Earth fault protection is available on M-PRO 30 and M-PRO 40 trip units. Any combination of unrestricted earth fault (UEF), restricted earth fault (REF) and standby earthfault (SEF) may be specified for factory configuration. Measurement is achieved by neutral Rogowski coil (mounted internally or externally) and/or earth leg CT. Details of standard circuit configurations and measurement device location are available on request.

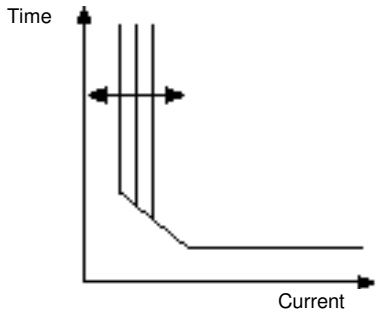
The tables below summarise the recommended measurement techniques:

3 – wire systems		
Earth fault protection required	**Rogowski coil mounting**	**CT mounting**
UEF	Not required	Not required
REF	Not required	Earth Leg
ELP	Not required	Earth Leg
UEF & REF	Not required	Earth Leg

A summary of the recommended measurement techniques for a 4-wire system is:

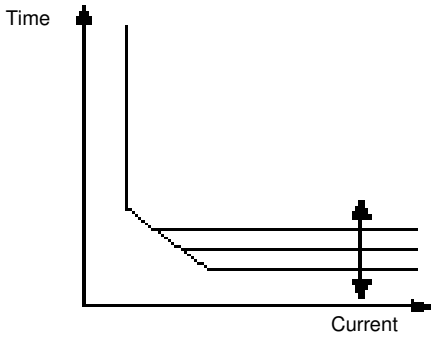
4 – wire systems		
Earth fault protection required	**Rogowski coil mounting**	**CT mounting**
UEF (option 1)	Unrestricted neutral	Not required
UEF (option 2)	Restricted neutral	Earth Leg
REF (option 1)	Restricted neutral	Not required
REF (option 2)	Unrestricted neutral	Earth Leg
ELP	Not required	Earth Leg
UEF & REF	Unrestricted neutral	Earth Leg
UEF & REF	Restricted neutral	Earth Leg

Earth Fault Current



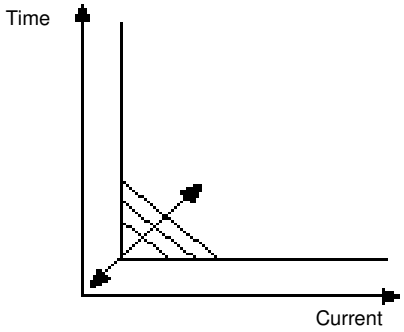
All earth fault protection pick-up levels are adjustable as follows: Off, 10 to 100% x In in steps of 1% of In. Earth fault current pick-up can be set for Restricted Earth Fault, Unrestricted Earth Fault and Standby Earth Fault depending on the options specified at the time of ordering.

Earth Fault Trip Time Delay



fixed time delay for earth fault protection can be set on the M-PRO. Adjustable steps are as follows: Instantaneous to 1 sec in steps of 0.1 sec.
Earth fault trip time delays apply only to Unrestricted Earth Fault and Standby Earth Fault. REF is factory set to instantaneous.

Earth Fault Cropping



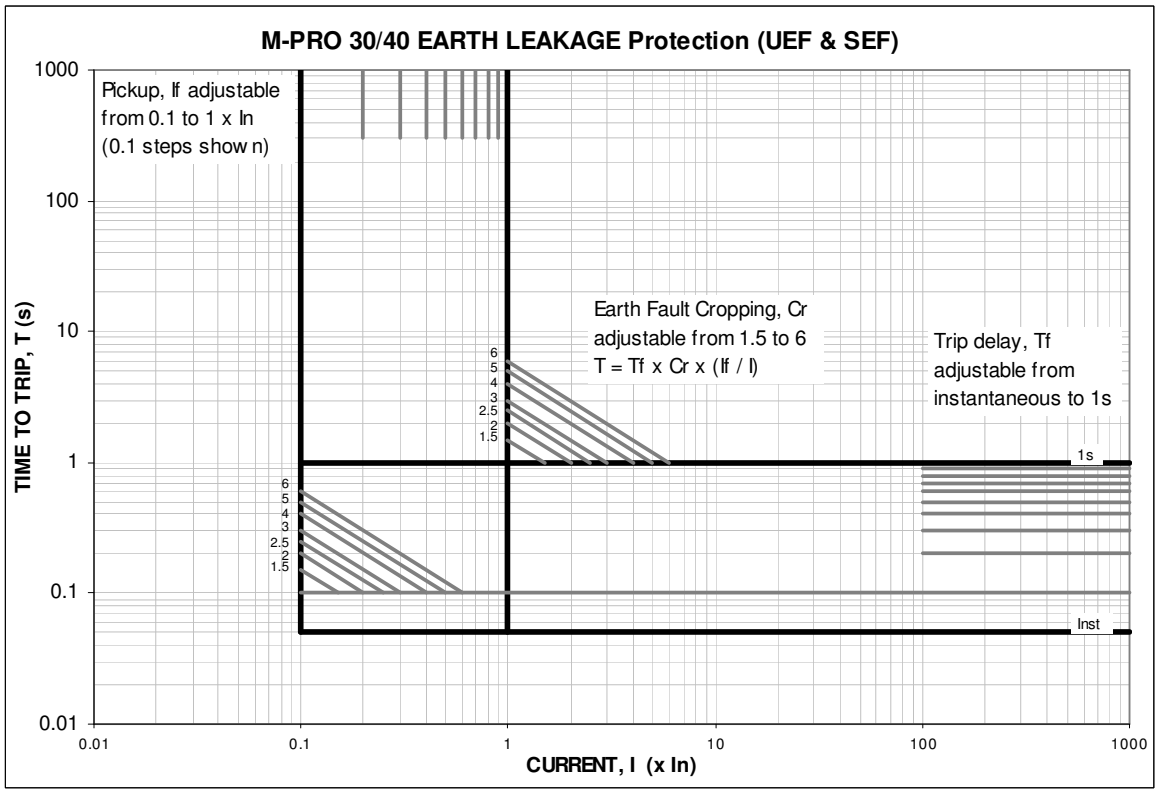
A cropping factor can be applied to the earth fault protection curves. The factor may be set by choosing the multiple, Cr of the pick-up current at which the fixed time delay operates. The tripping time is calculated as follows:

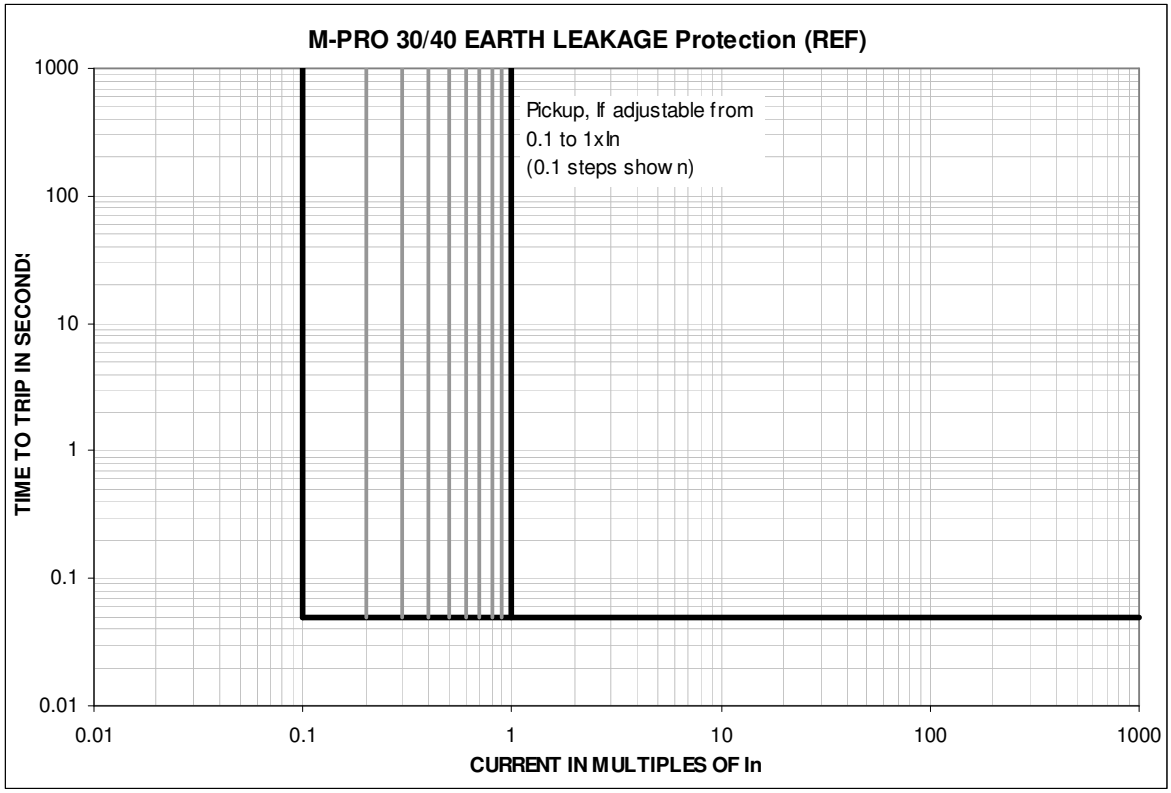
$$t = t_f \times C_r \times \frac{1_p}{I}$$

t = time to trip
t_f = fixed time delay
C_r = cropping multiple
I_p = pick-up current
I = measure current

Selectable settings for Cr are OFF, 1.5, 2, 2.5, 3, 4, 5 and 6.
Note that the cropping feature does not apply to instantaneous trips.
Earth Fault cropping applies only to Unrestricted Earth Fault and Standby Earth Fault.

Earth Fault Inter-trip and alarm contacts
Earth fault protection is available on M-PRO 30 and M-PRO 40 trip units; these units have digital outputs fitted as standard. All earth faults energise output 3, however restricted earth faults may be configured NOT to energise the output. This feature is useful for automatic changeover systems.
Restricted earth faults always energise digital output 4 to provide a means of inter-tripping the upstream (usually high voltage breaker). Standby earth faults may be configured to also activate this output.


M-PRO 30/40 EARTH LEAKAGE Protection (UEF & SEF)
Pickup, If adjustable from 0.1 to 1 x In (0.1 steps shown)
Earth Fault Cropping, Cr adjustable from 1.5 to 6
T = Tf x Cr x (If / I)
Trip delay, Tf adjustable from instantaneous to 1s
1s
Inst
TIME TO TRIP, T (s)
CURRENT, I (x In)
1000
100
10
1
0.1
0.01
0.01
0.1
1
10
100
1000


M-PRO 30/40 EARTH LEAKAGE Protection (REF)
Pickup, If adjustable from 0.1 to 1xIn (0.1 steps shown)
TIME TO TRIP IN SECONDS
CURRENT IN MULTIPLES OF In
1000
100
10
1
0.1
0.01
0.01
0.1
1
10
100
1000

Thermal Memory

This is the cooling time constant which is user selectable. It provides a direct relationship to the thermal content which will be decremented when measured current is less than Ir. Time constants available are:

Instant, 10 min, 20 min, 30 min, 45 min, 1 hour, 2 hours and 3 hours.

The time constant is the time taken for the thermal content to drop to 36.8% of its original value.

If thermal memory is not required, set cooling time to instant.

Note: For thermal memory operation an auxiliary power supply is required

Digital Inputs and Outputs
The M-PRO 30 and M-PRO 40 trip units have four volt free relay outputs, which are rated at:

24/48Vdc	1A resistive	0.3A inductive
110Vdc	0.5A resistive	0.1A inductive
110/220Vac	1A	

The usage of these outputs is defined below:

M-PRO 30:
Output 1 - Maintenance output is opened if any of the following faults occur:
- processor malfunction
- primary contact maintenance alarm
- digital input active

Note - this is a normally closed output with the M-PRO powered up and healthy. The contacts open on power down.

Output 2 - Load monitoring output indicates that pre-trip warn or load shedding is active
Note - this is a normally open output.
Output 3 - M-PRO initiated trip output indicates that the M-PRO has opened the breaker due to a trip condition. This output is reset when the trips are reset. If the breaker is already open and a trip is initiated (e.g. test box trips) then the output will not be activated. The user may configure the M-PRO such that restricted earth faults will not activate this output.
Note - this is a normally open output.
Output 4 - HV inter-trip output is closed to initiate a trip of the HV breaker. This will be used for restricted and standby earth fault protection. The user may disable the inter-trip feature for standby earth faults.
Note - this is a normally open output.

M-PRO 40:
Output 1 - ACB close. This output changes state momentarily to operate the closing coil, so that the ACB can be closed via the serial link (the maintenance information indicated on output 1 on the M-PRO 30 will be sent down the serial link on the M-PRO 40). It is assumed that the breaker's closing coil is wired through this output.
Note - this is a normally open output.
Output 2 - As M-PRO 30
Output 3 - ACB open. The output will momentarily operate on 'command to open' from the serial link. (The trip status information conveyed by this output on M-PRO 30 is available down the serial link on M-PRO 40). It is assumed that the breaker's shunt trip coil is wired through this output.
Note - this is a normally open output.
Output 4 - As M-PRO 30

An auxiliary power supply is required for correct operation of the digital outputs as all the outputs will be opened when the M-PRO powers down.
The outputs are updated every 100ms.

Load Monitoring
Load monitoring gives an indication when overloading of the circuit is imminent. M-PRO provides two alternative types of load monitoring - (a) pre-trip warning (b) load shedding.

Pre-trip warning is initiated when M-PRO detects an overload current greater than 1.1 x Ir and the thermal register is greater than 60%. The thermal register within M-PRO indicates the relative thermal state of the circuit breaker; a trip is initiated when the thermal register reaches 115%. The pre-trip warning is normally displayed on the LCD, the red 'Warn/Alarm' LED will flash, and digital output 2 is activated (when fitted). If the 'communications' feature has been specified for (M-PRO 40) the warnings can be transmitted down the serial link.

Load shedding levels start and stop shedding, are user settable. Start shedding level is adjustable between the following values:

25% to 100% Ir in steps of 5%.

The stop shedding level is adjustable between the following values:

20% to 95% Ir in steps of 5%.

the result of starting and stop shedding are indicated both locally and reflected in the switching of digital output 2.

Communications
M-PRO 40 offers communications via and RS485 serial link connected via the PAMM. Two or 4-wire operation is supported though 4-wire operation is preferred. Up to 100 M-PRO units may be 'daisy-chained' together on one network. All breaker information is available on the link and is communicated using the Modbus RTU protocol at either 9600 or 19200 baud. An auxiliary power supply is required for the M-PRO 40. Detailed information is available on request.

Operating M-PRO 20/30/40

When M-PRO is first energised:
The green 'Healthy' LED will light indicating that (a) power is present, (b) The unit is functioning normally. This will remain lit at all times when M-PRO is energised unless a fault is present. Refer to M-PRO menu structure when the instructions below are carried out.

If the Ammeters option has been specified, the LCD screen will display the RMS phase currents. For example:
Refer to M-PRO menu structure. Phase current measurement in Amps – level 2.

Red	Ylw	Blue
680	700	806A

If Ammeters has not been specified, M-PRO will be in the Faults mode and the LCD display will read:
Refer to M-PRO menu structure. Existing faults indication – level 3.

Existing faults
No faults

The following will explain how to set the M-PRO to a short time delay of 0.8 sec.
For the other settings, the procedure is EXACTLY the same. Refer to the menu structure above.

- First step, go to the **protection** menu

If the M-PRO was displaying the ammeters page, you will have to:

	Press	and the M-PRO will display
	Escape	M – P R O 20 Ammeters
Then	Up	M – P R O 20 Protection

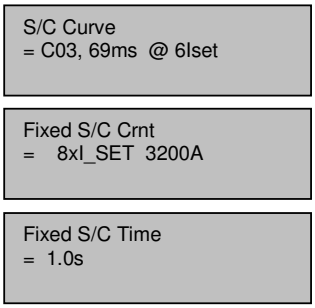
If the M-PRO was displaying the Fault page, you will have to:

	Press	and the M-PRO will display
	Escape	Faults Existing faults
then	Escape	M – P R O 20 Faults
then	Up	M – P R O 20 Ammeters
then	Up	M – P R O 20 Protection

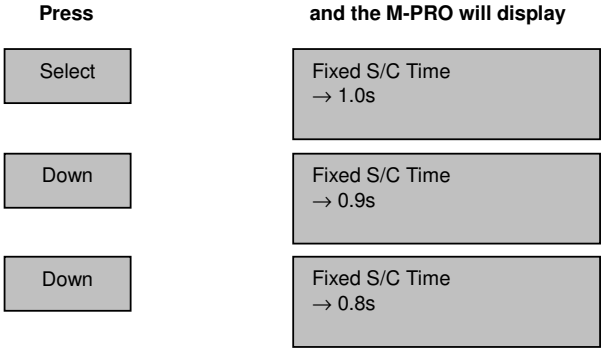
- Then go to the **Fixed S/C Time** sub-menu

	Press		and the M-PRO will display
	Select		M – P R O 20 Curve Settings
then	Select		I_SET = 50%I_N = 400A
Then	Down	7 times	Curve Type =EI (Gen. Purpose)
			O/L Curve = C03, 8.00s @ 2 Iset
			Cooling time =Instant
			Inverse S/C Crnt = 4xI_SET 1600A

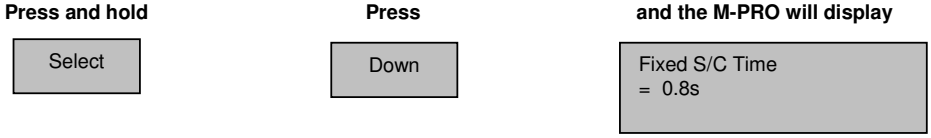
Assuming the M-PRO was originally configured as 800A with a 50% Iset



- At this stage, **select** the appropriate setting (Note, the presently stored setting has an equals sign before it. Upon selection, this changes as illustrated):



- And then, **modify** the settings in order to save it in the M-PRO as follows (Note, after modifying the setting, an equals precedes the stored value):



M-PRO Test Box

The M-PRO test box may be used as a means of powering up an M-PRO, simulating faults by secondary and tertiary injection or for performing a forced trip of the breaker. All usage should adhere to the connection procedure below.



Connection

Ensure that the battery is fully charged before attempting any work that may require an extended operating period. Full charge of a flat battery should be achieved in an 8 hour charging period. To maintain the battery life span it is not advisable to charge a battery that still holds a charge, so always allow the battery to discharge fully before re-charging.

Turn the Test Box on using the "Power On/Off" button; the lamp above the switch should illuminate. Connect the Test Box to the M-PRO via the front panel connector (located behind the access door on the breaker facia). Do not test the M-PRO with the charger still connected, as this will disable power to the M-PRO.

Note: should the "Battery Low" warning light illuminate at any time then there is approximately 20 minutes of usage left in the battery before power will be removed from the M-PRO.

Re-charging

Ensure that the ambient temperature is between +15ºC and +50ºC. With the Test Box unplugged from M-PRO, connect the charger unit via the charger socket at the top of the test unit. The "Battery Charging" lamp should illuminate. Wait a few seconds and ensure that the lamp remains illuminated as there can be enough power in the charger to illuminate this lamp for a short period of time even with the mains supply off.

Calibration

The equipment does not require calibration. It is recommended that the general condition and functionality be checked before each usage. Particular attention must be paid to the presence and condition of the polarising pin in the M-PRO 20/30/40 rectangular connector. **The M-PRO power supply may be damaged if the test connector is mis-inserted.** The M-PRO 17 D-type connector does not require a polarising pin.

Over current and earth fault tests (M-PRO 20/30/40 only)

With the test box in this mode (O/C & E/F lamp illuminated) it causes the M-PRO to tertiary inject itself with the configured current and fault type. Having turned the test box on and selected "O/C & E/F" the remainder of the operation is performed on the M-PRO itself.

Application notes 29 and 30, available on request, provide a walk-through example of using the test box.

Turn the test box on and connect to the M-PRO.

Press the "Trip Enable" button if it is required that the full breaker functionality is to be tested. The "Test Mode" menu will now be active on the M-PRO (the bottom-most level 1 menu item). From the 'Fault Current Type' menu select the test that is required (overcurrent or various earth faults).

The next menu sets the fault current level (in terms of Iset for overcurrent and In for earth faults). Make a note of the protections settings on the M-PRO and set the current to test the required part of the configured curve. Calculate the expected trip time using the graphs included in this manual or using the Excel spreadsheet available on request. The M-PRO long time and inverse time short circuit menus state the trip time and 2*Iset and 6*Iset respectively, use these injection levels to save calculating trip times.

Having defined the tests, use the 'Activate Test' menu to select 'Start Test'.

After allowing sufficient time for the test to run the ACB should trip. We can check if the test is running correctly by viewing the thermal register and highest phase entry on those ACB's configured with ammeters. The thermal register will be at 0% under normal load conditions, but immediately the overcurrent region is entered the register will start counting up to a value of 115% at which point the ACB should trip.

Once the ACB trips the M-Pro will default to the existing faults display. The time to trip may be checked by viewing the history of trips display. A 'T' is displayed next to the trip history entry to show that the test was configured to trip the breaker.

In the case of M-PRO 30 the volt free trip initiated output 3 should also have changed state from normally open to closed.

Finally, return to the 'Activate Test' menu and select 'Stop Test', and reset the fault.

Testing of earth faults follows the same procedure, note that the HV inter-trip output 4 should change state if testing REF trips (and SEF if configured for inter-trip).

NOTE it is important to 'stop' the tests and clear the trips before unplugging the test box. Failure to do this may cause the breaker to trip on power-up in reaction to uncleared existing faults.

If the above tests are made with "Trip Enable" turned off on the test box then the breaker will not trip and the outputs will not change state. The existing faults message and history of trip menus will react as normal as will the reported trip time. The history of trips entry will show the symbol 'N' to show the test was a 'none trip test'.

MCR/HSISC Tests

These tests use secondary injection. A DC signal is imposed on the Rogowski input circuits of the M-PRO. Red, yellow and blue phases may be tested individually. The neutral phase does not offer this protection.

The Making Current Release (MCR) is set to 50kA as standard and is active only whilst the ACB is open/closing, and switches off when closed and latched.

The High Set Instantaneous Short Circuit (HSISC) is set to 65kA or 80kA as standard and is active whilst the ACB is closed and latched.

With the ACB open, the test box on and connected; turn "Trip Enable" on and select the "MCR/HS *Phase*" test.

Start the test by pressing the "Test Now" button on the test box.

Immediately the M-Pro recognises the fault it will try to fire the sensitive trip and will default to the 'Existing Faults' display, reporting 'MCR Trip on TEST'. The trip level can be checked by viewing the history of trips display.

The M-PRO 30 volt free tripped initiated output 3 should also have changed state from normally open to closed.

We can now close the ACB, which will reset the fault and repeat the test above for HSISC.

Force Trip

The final test available on the test box. This test is a quick way of tripping the breaker in order to test the mechanical operation and reset mechanism.

To perform a forced trip, turn the test box on, connect to M-Pro, turn "Trip Enable" on and select "Force Trip".

Pressing the "Test Now" button will cause the M-PRO to initiate a trip, reporting the trip as normal (the fault level reported in the trip history is the highest phase current at the time the trip was initiated).

A forced trip clears itself on removal of the test box. There is no need to clear the existing fault as is necessary for the other tests.

Powering M-PRO

The test box may be used as a simple power box to facilitate viewing of faults (e.g. after a trip) or the history of trips. The feature may also be required for changing protection settings. For setting of the inputs, outputs and re-configuring the factory settings, the breaker must be open. In this case some form of external power is mandatory (power box, APU or test box).

Neutral Rogowski Coil Mounting Details

The external neutral Rogowski mounting kit comes complete with three glass fibre brackets, two fixing screws, two plastic ties, one 2m length of twisted pair extension lead and one neutral Rogowski coil.

The mounting bracket has been designed to fit a number of standard neutral bar arrangements.

Frame 1 ME09 ACB's are provided with frame 1 external neutral Rogowski coils. Likewise fame 2 ME09 ACB's are provided with frame 2 external Rogowski coils. In situations were the frame 1 Rogowski coil will not fit the required neutral bar arrangement a frame 2 coil can be provided, but an additional spill current of up to 4% at In will be introduced. The error also applies to neutral phase current measurement. This may result in instability on through fault and earth fault, hence loss of co-ordination or nuisance tripping.

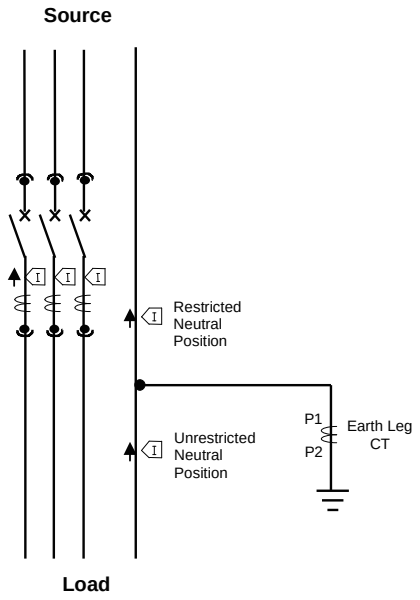
The neutral Rogowski coil should be fitted in the correct location with respect to the neutral earth connection (restricted or unrestricted neutral). For further configuration details consult application note APP001 available from AEG Power Management. The coil should be positioned with the arrow facing the direction as defined below. The end connectors marked +ve and -ve should be terminated at the A block.

Using a longer extension lead than that provided may result in EMI effecting the performance of the M-PRO.

Measurement Device Connection		
	Neutral Rogowski	Earth Leg CT
M-PRO 17	A8 (+)	Not Available
	A9 (-)	Not Available
M-PRO 30/40	A14 (+)	B3 (S1)
	A15 (-)	B4 (S2)

Incoming supply is connected to the top terminals.

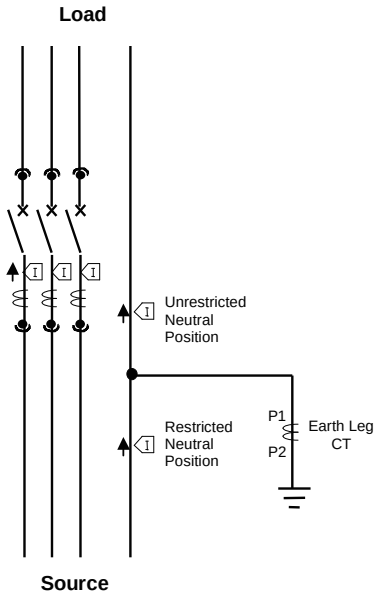
Arrow on the Rogowski Coil points to the SOURCE.



The Rogowski Coil is secured onto mounting bracket with cable ties (position coil centrally on clamp).

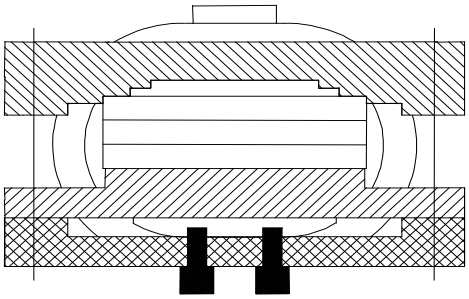
Incoming supply is connected to the bottom terminals.

Arrow on the Rogowski coil points to the LOAD.



Frame 1 neutral Rogowki coil
will clamp on to copper sizes:

40mm x 4 – 25mm
50mm x 4 – 25mm
60mm x 4 – 25mm
70mm x 4 – 25mm



Frame 2 neutral Rogowki coil
will clamp on to copper sizes:

40mm x 4 – 25mm
50mm x 4 – 25mm
60mm x 4 – 25mm
70mm x 4 – 25mm
80mm x 4 – 25mm
90mm x 4 – 22mm

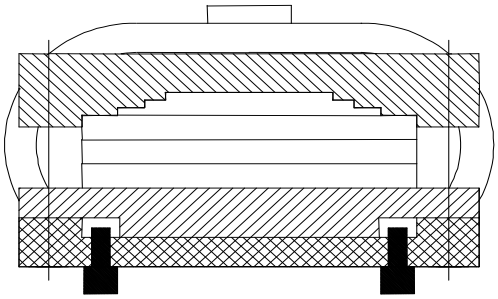
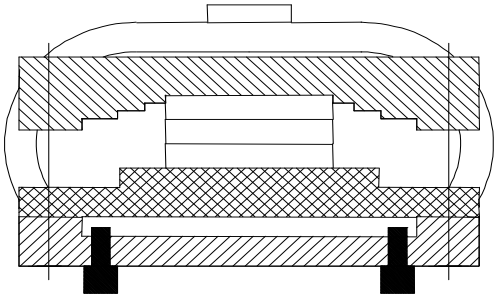
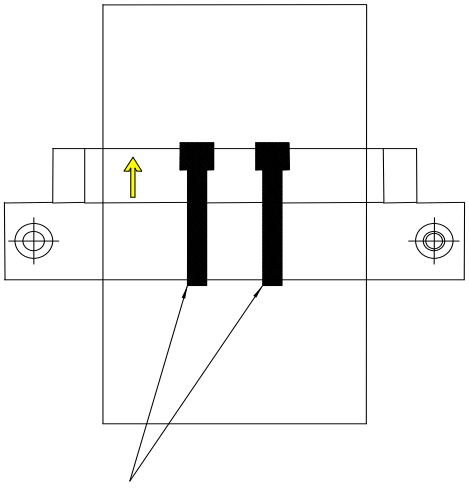
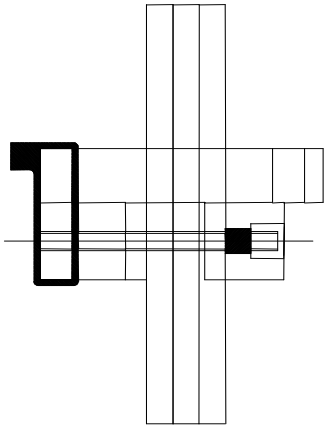


Illustration of frame 2 neutral Rogowski coil secured onto mounting bracket 3 off bars at 6.3mm x 40mm.





Rogowski coil secured onto mounting bracket with cable ties, coil positioned centrally on clamp. (Note the coil orientation arrow location)

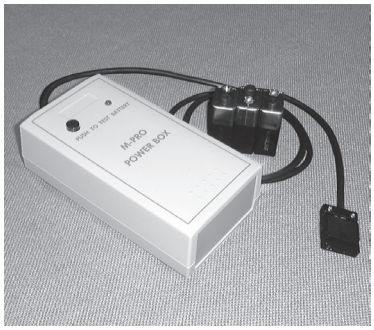


Frame 1 Rogowki coil -
side view showing cable ties.

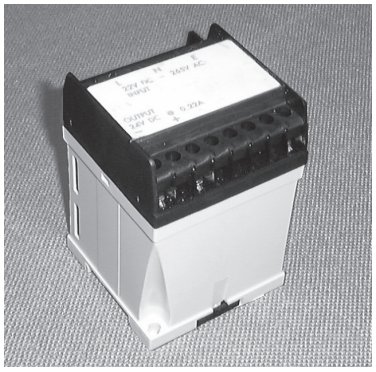
M-PRO Optional Accessories

M-PRO 20/30/40: plug-in portable Power Box
Adjustments to settings and curve selection may only be done when the circuit breaker is open. If there is no permanent auxiliary power source, a portable Power Box may be used to energise the M-PRO unit this, for this purpose.

Power is provided by three 9V PP3 non-rechargeable batteries and the Power Box is easily plugged into a test port on the front of the M-PRO unit.



For all models of M-PRO: Auxiliary Power Unit
This may be permanently fitted within the circuit breaker cubicle to ensure that M-PRO is powered independently and continuously at all times. The Power Unit will accept any input supply voltage between 24V and 264V AC or DC.



The recommended backup protection is a AEG Power Management HRC fuse link Type NIT4 with Type RS20 fuse holder. For more detailed installation and electrical specification refer to APP034 available from AEG Power Management.

Note: It is not recommended to supply M-PRO with any alternative power supply unit.

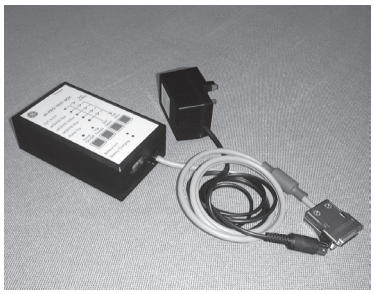
Plug-in portable Test Unit
This permits secondary injection testing of all the protection features provided by the M-PRO unit with the circuit breaker open or closed.

All selected settings may be verified and tests made to trip the circuit breaker or not as required (if 'no trip' is selected M-PRO will indicate actual tripping time). A 'force trip' facility is provided to check that the ability of M-PRO to cause an actual trip remains unimpaired.

The Test Unit incorporates a set of rechargeable batteries for which a charger unit is supplied as standard.

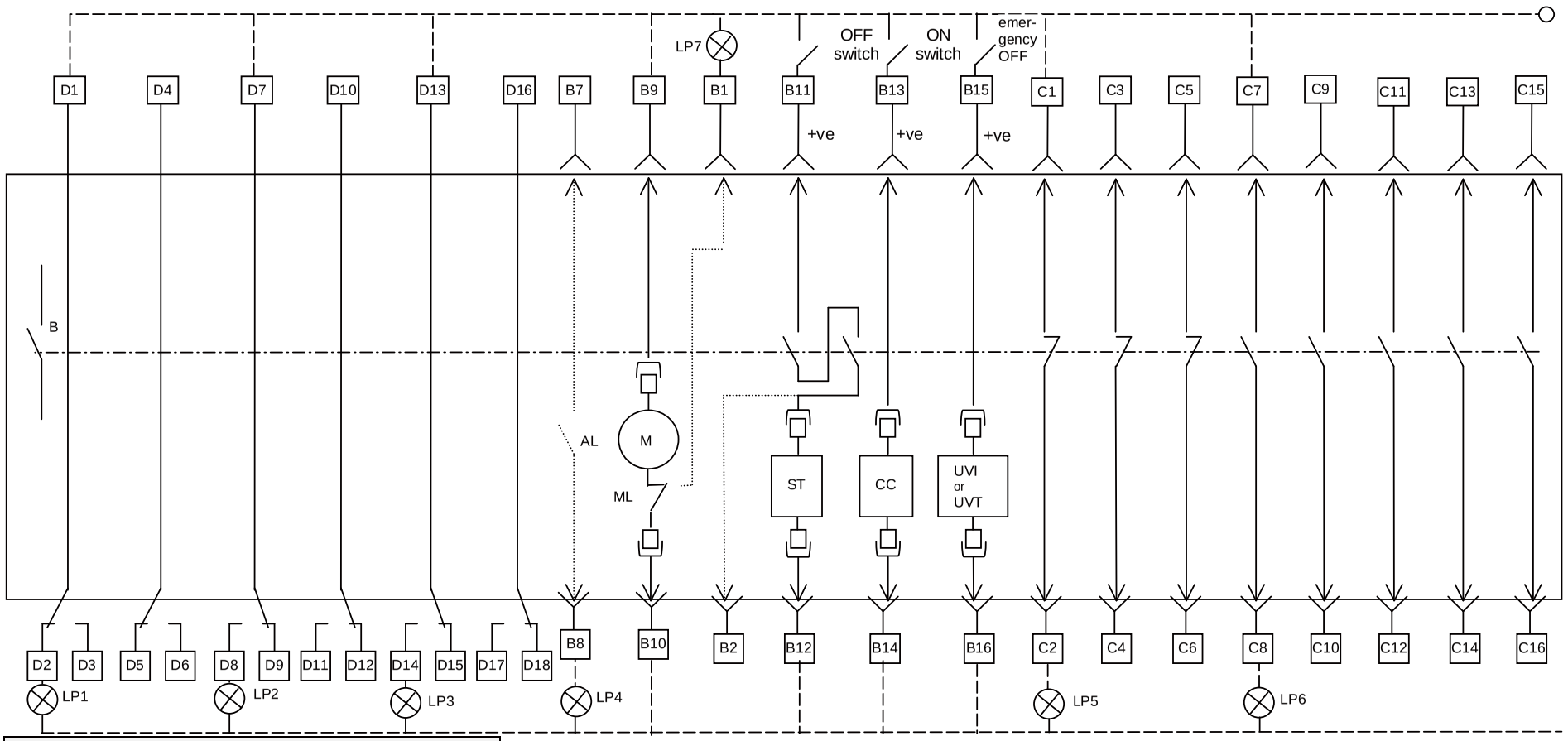


M-PRO 20/30/40 test box



M-PRO 17 test box

SECTION 3 ME09 Wiring Diagram



----------	Customer Supplied External Wiring (example)
.....	Optional Factory Internal Wiring

B1 to B16	Automatic disconnect L.T. Blocks
C1 to C16	Automatic disconnect L.T. Blocks
D1 to D6	Carriage switch blocks for disconnected position
D7 to D12	Carriage switch blocks for test position
D13 to D18	Carriage switch blocks for connected position

LP1	Disconnected indication
LP2	Test indication
LP3	Connected indication
LP4	ACB tripped indication
LP5	ACB OFF indication

CC	Closing coil
UVI	Undervoltage release
UVT	Time delayed undervoltage release
AL	M-PRO trip alarm (N/O)
B	ACB main contacts

LP6	ACB ON indication
LP7	Closing springs charged indication
ML	Charging motor limit switch
M	Closing spring charging motor
ST	Shunt trip

Connections for M-PRO 40

Location	Terminal	Function
PAMM	A1	OUTPUT 4, normally open volt free contact: Operates when the REF (or SEF) element trips the ACB. This is used to trip an upstream HV breaker.
PAMM	A2	
PAMM	A3	OUTPUT 3, normally open volt free contact: Used to control shunt trip to open the ACB via serial link.
PAMM	A4	
PAMM	A5	OUTPUT 2, normally open volt free contact: Load monitoring output will indicate that pre-trip warn or load shedding is active.
PAMM	A6	
PAMM	A7	OUTPUT 1, normally open volt free contact: Used to control closing coil, facilitating closure of ACB via serial link.
PAMM	A8	
PAMM	A9	Input 4
PAMM	A10	Input 3
PAMM	A11	Input 2
PAMM	A12	Input 1
PAMM	A13	Input common
PAMM	A14	Remote Rogowski coil – positive
PAMM	A15	Remote Rogowski coil – negative
PAMM	A16	Host serial link – screen connection
PAMM	A17	Host serial link – M-PRO Tx positive
PAMM	A18	Host serial link – M-PRO Tx negative
PAMM	A19	Host serial link – M-PRO Rx positive
PAMM	A20	Host serial link – M-PRO Rx negative
LT 'B' block	B3	Earth leg CT input – non polarised
LT 'B' block	B4	
LT 'B' block	B5	Auxiliary power supply input – positive
LT 'B' block	B6	Auxiliary power supply input – negative

Connections for M-PRO 30

Location	Terminal	Function
PAMM	A1	OUTPUT 4, normally open volt free contact: Operates when the REF (or SEF) element trips the ACB. This is used to trip an upstream HV breaker.
PAMM	A2	
PAMM	A3	OUTPUT 3, normally open volt free contact: Operates when M-Pro has opened the ACB due to a trip condition.
PAMM	A4	
PAMM	A5	OUTPUT 2, normally open volt free contact: Load monitoring output operates if pre-trip alarm or load shedding limits are exceeded.
PAMM	A6	
PAMM	A7	OUTPUT 1, normally closed volt free contact, opens under the following conditions: Microprocessor malfunction, primary contact maintenance alarm or a digital input is active.
PAMM	A8	
PAMM	A9	Input 4
PAMM	A10	Input 3
PAMM	A11	Input 2
PAMM	A12	Input 1
PAMM	A13	Input common
PAMM	A14	Remote Rogowski coil – positive
PAMM	A15	Remote Rogowski coil – negative
LT 'B' block	B3	Earth leg CT input – non polarised
LT 'B' block	B4	
LT 'B' block	B5	Auxiliary power supply input – positive
LT 'B' block	B6	Auxiliary power supply input – negative

Connections for M-PRO 20

Location	Terminal	Function
PAMM	A14	Remote Rogowski coil – positive
PAMM	A15	Remote Rogowski coil – negative
LT 'B' block	B5	Auxiliary power supply input – positive
LT 'B' block	B6	Auxiliary power supply input – negative

Connections for M-PRO 17

Location	Terminal	Function
LT 'A' block	A8	Remote Rogowski coil – positive
LT 'A' block	A9	Remote Rogowski coil – negative
LT 'B' block	B5	Auxiliary power supply input - positive
LT 'B' block	B6	Auxiliary power supply input - negative