Kelman Profile P2
Test and Interpretation of Test Results
When the system is powered up the main menu is displayed. This provides the user with three options as shown below.

- Perform a breaker test -
- View previous tests -
- Examine system setup parameters -
- Examine memory status -

**Main Display**
In the AUX Menu you can:

- Set the Display Level
- Set the Date and Time
- Set the Trigger Level
To get the most accurate results this level should be set to as low a value as possible. The default setting is 0.2A. This should be ideal for most applications, however if there are unwanted signals superimposed on the dc current it may be necessary to raise the trigger level above the 'noise floor' to get reliable results. If the trigger level is too high, no record will be generated on breaker operation.
Testing a Circuit Breaker
P2 Interface Unit

A - Mains power connection.
B - Power ON/OFF switch.
C - Operational mode switch.
D - Three clip-on CT connections for ‘on-line’ test.
E - Three input voltage connections & common for ‘off-line’ test.
F - Umbilical lead connection to Profile handset.
Three Phase Testing Energized
Three Phase Testing De-energized
<table>
<thead>
<tr>
<th>SUBSTATION</th>
<th>123456789012345678901</th>
</tr>
</thead>
<tbody>
<tr>
<td>BKRTYPE</td>
<td></td>
</tr>
<tr>
<td>BKRID</td>
<td>123456789012345678901</td>
</tr>
<tr>
<td>TEST NO</td>
<td>108 T</td>
</tr>
</tbody>
</table>

Press OK to enter the text.

Running the Test
• The Profile P2 will automatically correct for small offset signals from the dc current probe, however if the offset is too large the display will prompt the user to adjust the thumbwheel on the Probe until the display reads 0. Press OK to continue.
• The Profile P2 is now armed and ready to record the current profile when the breaker is operated electrically.
The operation can be initiated in several ways, all of which will provide acceptable results. For example:

- Local push button control at the breaker.
- Remote control via SCADA.
- Manual trip initiation from protection relay(s).
- Electrical jumper at the breaker.
What can we analyse from profiling a circuit breaker

- Detect if the circuit breaker operating time is outside limits due to the Trip/Close coil or main mechanism
- The state of ‘health’ of Close and Trip coil mechanisms
- The condition of the DC supply and associated wiring
- The presence of ‘sticky’ or faulty circuit breaker auxiliary contacts
Sample Test Result
### List of the Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ltch</td>
<td>Time when the trip latch mechanism is released (ms)</td>
</tr>
<tr>
<td>Bffr</td>
<td>Time when the striker pin reaches the end of its motion (ms)</td>
</tr>
<tr>
<td>Acon</td>
<td>Time when the auxiliary contacts interrupt the trip coil current (ms)</td>
</tr>
<tr>
<td>End</td>
<td>Time when the trip coil current reaches zero (ms)</td>
</tr>
<tr>
<td>Mcon</td>
<td>Time of transition of the main interrupter contacts</td>
</tr>
<tr>
<td>Ipk1</td>
<td>Amplitude of first current peak (A dc)</td>
</tr>
<tr>
<td>Iplt</td>
<td>Maximum current during record (A dc)</td>
</tr>
<tr>
<td>Vini</td>
<td>Initial voltage before breaker operation (V dc)</td>
</tr>
<tr>
<td>Vmin</td>
<td>Minimum voltage during breaker operation (V dc)</td>
</tr>
</tbody>
</table>
(A) Coil energised, plunger actuated
(C,D) Plunger strikes latch
(E) Plunger strikes buffer
(F) Main contacts open
(G) Auxiliary contacts open
(H) Trip coil de-energised
The current draw of trip coil can be separated into two parts, the electrical and the mechanical as shown above; 0 to E: electrical, E to H: mechanical.

The first part, electrical portion, is the time the coil armature is moving to make contact with the trip latch. This is seen by the hump that is produced in the DC current trace. If there is a problem with the coil or the trip latch, this will be seen as an extended time for the first hump to occur. The second part of the current draw, mechanical portion, is the time that the mechanism moves until auxiliary contact opens to drop out the trip coil.

Poor bearings in the trip latch, for example, will produce an extended electrical portion of the travel. If there is a problem with the breaker mechanical assembly, this will be indicated by an extended amount of time after the trip latch is actuated. Poor lubrication of the mechanism, for example, will slow down the breaker and produce a slow second half of the DC current trace.

The main contact time is determined by when current is no longer sensed by the AC clamp during the test. A slow breaker will be indicated by increased main contact opening times. The battery voltage drop during the test can indicate problems with the station battery, breaker wiring, or trip coils. Excessive amounts of voltage drop during a test will indicate that there is a problem in the DC system. Determining whether the Profile P3 traces are normal requires knowing the manufacturers specs for the breaker under test.
• Normally the inductance in most electrical circuits is fixed

• Trip Coil is an electro-magnetic circuit which has inductance and resistance in the electrical part.

• As the plunger moves causing an increase in the inductance in the electrical circuit

• As the rate of change of inductance increases then the rate of change of current must decrease

Theory of Trip Coil Profiling
(A) Coil energised, plunger actuated
(A) Coil energised, plunger actuated
(A) Coil energised, plunger actuated
(C, D) Plunger strikes latch

Current (Amps)

Time (ms)

max

I_{pk1}
(A) Coil energised, plunger actuated
(C,D) Plunger strikes latch
(E) Plunger strikes buffer

Current (Amps)

Time (ms)
(A) Coil energised, plunger actuated
(C,D) Plunger strikes latch
(E) Plunger strikes buffer
(F) Main contacts open
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(H) Trip coil de-energised
<table>
<thead>
<tr>
<th>COIL PROFILE SECTION</th>
<th>DESCRIPTION</th>
<th>REASON FOR DEVIATION FROM STANDARD</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero to A Energising of Trip Coil</td>
<td>Problem with electrical characteristics of trip coil or supply voltage</td>
<td>Circuit Breaker fitted with incorrect trip coil (should operate at 85% nominal)</td>
<td></td>
</tr>
<tr>
<td>A-B-C Striker pin travels and contact is made with trip bar</td>
<td>Restrictive forces impede travel of Striker pin</td>
<td>Oil &amp; greases providing a dashpoint action Insufficient lubricant Misalignment of coil</td>
<td></td>
</tr>
<tr>
<td>C-D Striker pin making contact with trip bar &amp; overcoming inertia of latch</td>
<td>Increased resistance of trip bar/latch mechanism</td>
<td>Incorrect adjustment of latching mechanism Inadequate lubrication</td>
<td></td>
</tr>
<tr>
<td>D-E Striker pin, trip bar and latch move together. E represents point at which Striker Pin hits buffer</td>
<td>The trip bar is restricted throughout its travel</td>
<td>Misalignment of trip bar and striker pin guide Guide wear causing striker pin to make partial contact</td>
<td></td>
</tr>
<tr>
<td>E-F Coil only operation. Coil current saturates (Iplt or Imax)</td>
<td>Problem with electrical characteristics of trip coil or supply voltage</td>
<td>Insufficient supply voltage Associated coil wiring</td>
<td></td>
</tr>
<tr>
<td>F-G Coil stays saturated until it is de-energized by Auxiliary Contacts (ACon)</td>
<td>High impedance on supply voltage Fluctuations around G Poor lubrication of the mechanism</td>
<td>Coil can’t saturate due to high impedance on supply voltage that causes voltage drop on system Fluctuations around G: Sticky or failing Auxiliary contacts Dirt on the Auxiliary Contacts</td>
<td></td>
</tr>
</tbody>
</table>
Increased Trip Latch Friction
Main Bearing Problems
Dirt on the Auxiliary Contacts

Current dip removed after cleaning aux contacts

Current reduced in first trip
Burned-out Trip Coil
NO Trip