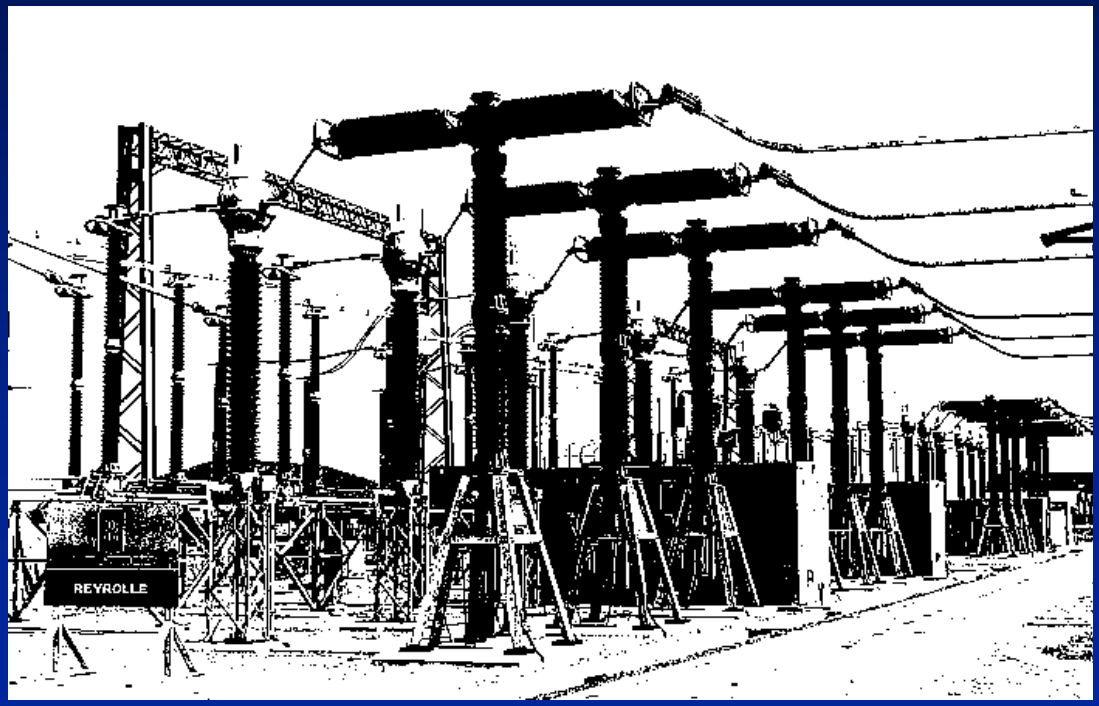
Breaker Condition Monitoring

Development and Applications



CIRCUIT BREAKER TESTING AND MONITORING

- Off line testing
- On line testing(periodic)
- Continuous monitoring

SYSTEM RELIABILITY

- Proper Breaker Operation
- Maintenance when required
  - Contact wear
  - Mechanism problems

PAST PRACTICE MAINTENANCE

- Manufacturer or user schedule
  - Elapsed time
  - Number of operations
- Breaker mis-operation

OFF LINE TESTING

- Contact timing and synchronization
- Mechanical travel distance and velocity tests
- Contact resistance tests

DIGITAL TECHNOLOGY

- Main & resistive contacts
- Coil current profile
- Breaker travel distance
- Velocity
- Overshoot
- Rebound
- Dynamic contact resistance
- Station battery response

Hathaway

FIGURE 1

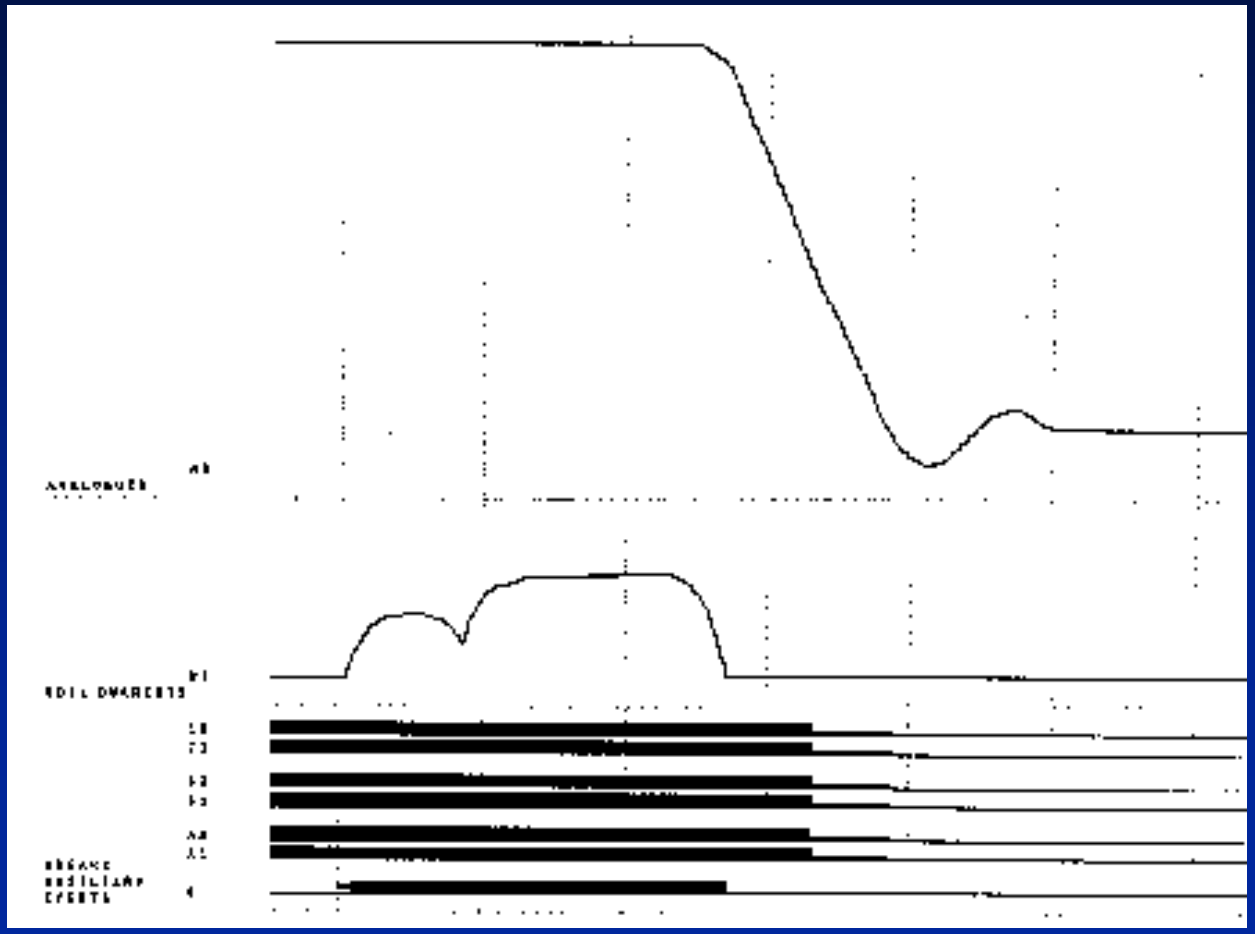


FIGURE 1 CONT'D

- Displacement of main contact
- Trip coil characteristics
- Each phase main/resistive contact status
- Trip initiate signal

Hathaway

FIGURE 2 ON PAGE THREE

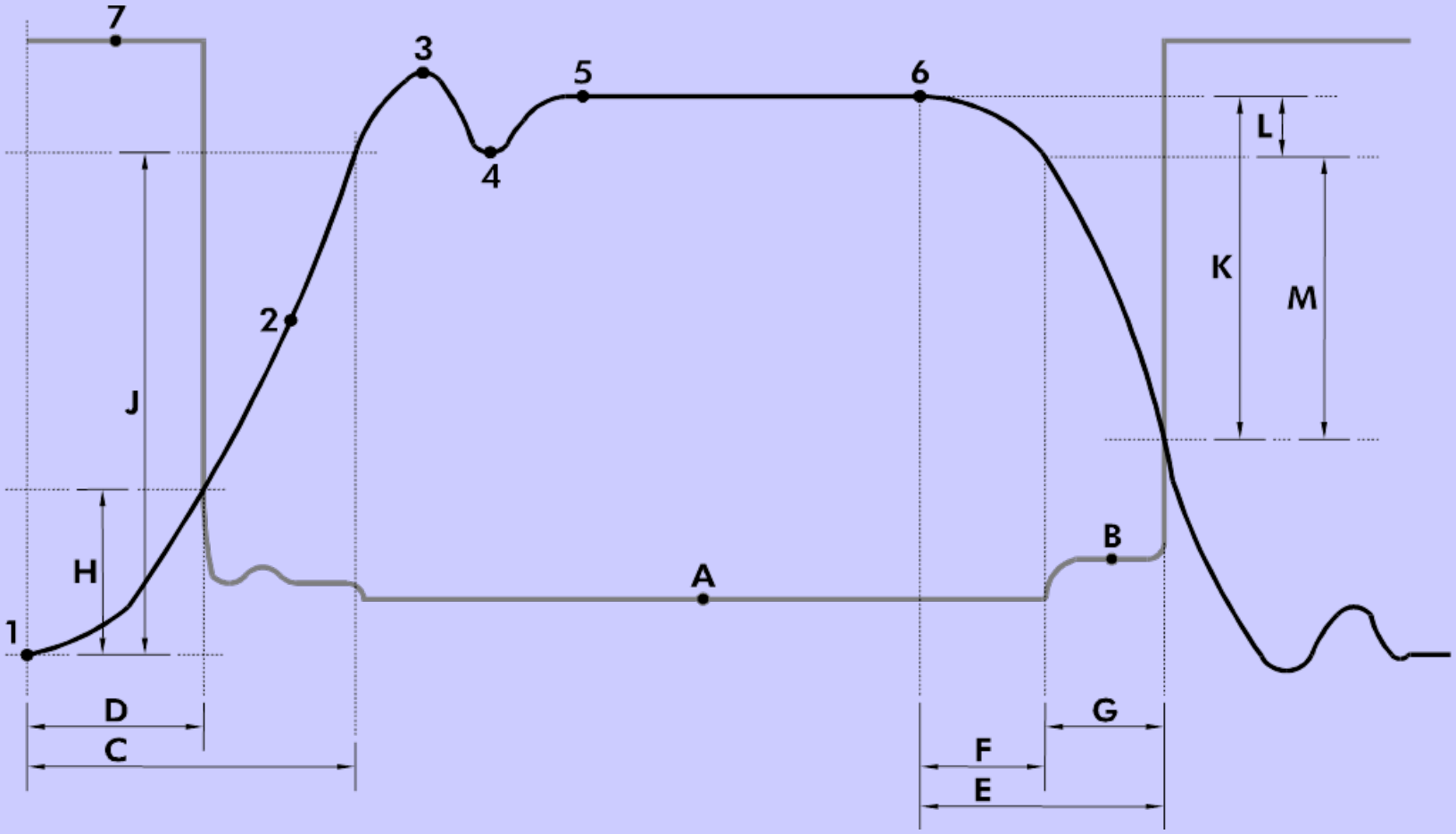
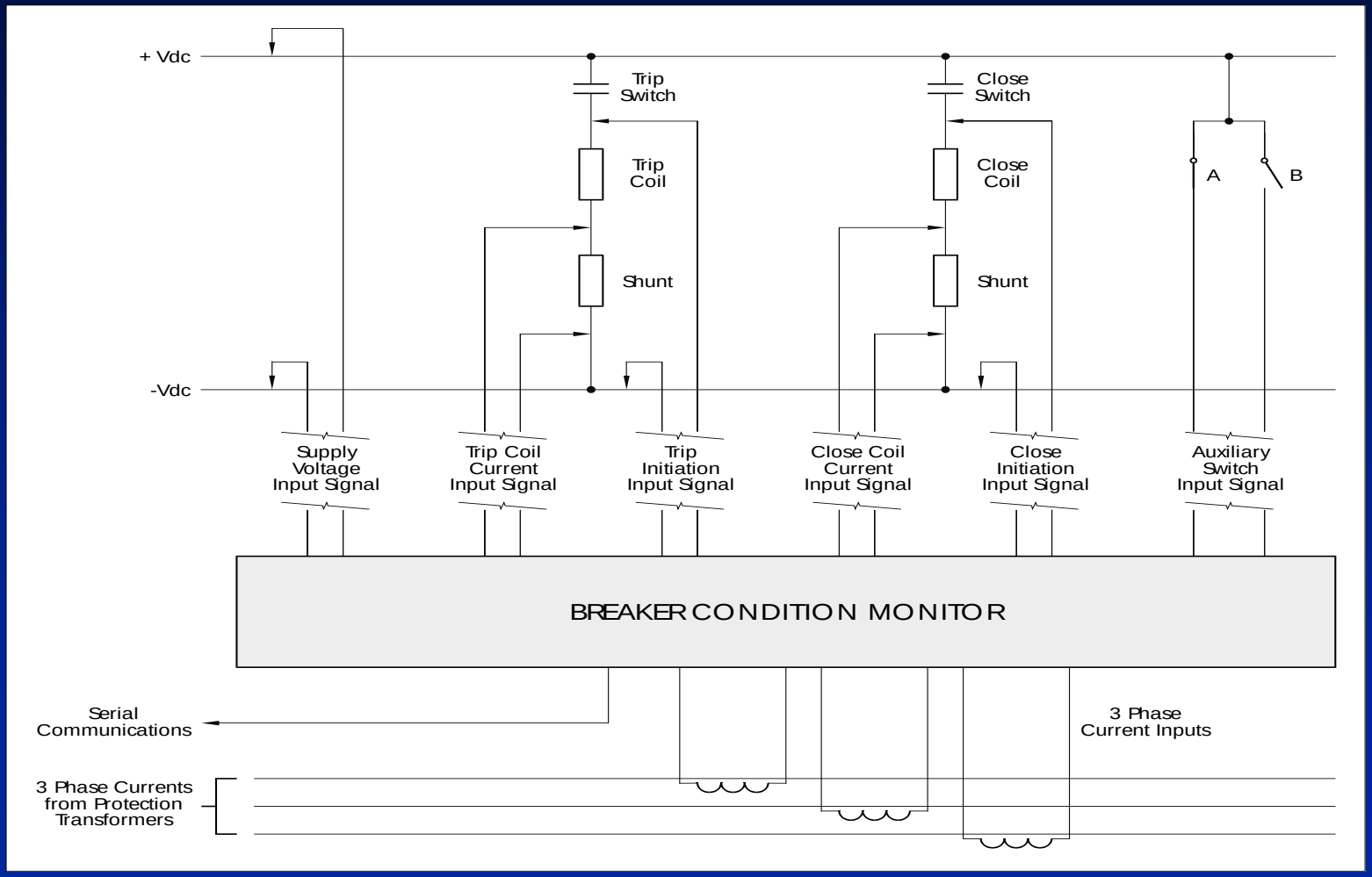


FIGURE 2 CONT'D

- *A* *Main contact resistance.*
- *B* *Arcing contact resistance.*
- *C* *Time for Main contacts to make.*
- *D* *Time for Arcing contacts to make.*
- *E* *Time for Arcing contacts to break.*
- *F* *Time for Main contacts to break.*
- *G* *Time Arcing contacts made.*
- *H* *Distance for Arcing contacts to make.*
- *J* *Distance for Main contacts to make.*
- *K* *Distance for Arcing contacts to break.*
- *L* *Distance for Main contacts to break (wipe of Main contact).*
- *M* *Distance Arcing contacts made (wipe of Arcing contact).*

- *1* *Start of mechanism movement for Closing sequence.*
- *2* *Travel curve.*
- *3* *Mechanism Overtravel for Closing sequence.*
- *4* *Mechanism Rebound for Closing Sequence.*
- *5* *Mechanism fully Closed position.*
- *6* *Start of mechanism movement for Opening sequence.*
- *7* *Contact resistance waveform.*

ON LINE MONITORING



PERIODIC ON LINE TESTING

- Wiring harness permanent connection
- Portable recorder
- Scheduled test or on demand
- Compare to previous breaker operations

Problems detected include……..

- Burned or damaged trip coils
- Sticking coil armatures
- Mal-adjusted trip latches
- Slow breaker mechanisms
- Auxiliary contacts out of adjustment
- Battery charging and dc supply problems

CONTINUOUS ONLINE MONITORING

- Compare to fingerprint reference
- Fault current magnitude and time
- Summation of contact duty
- Alarm operation
- Software for archive to memory

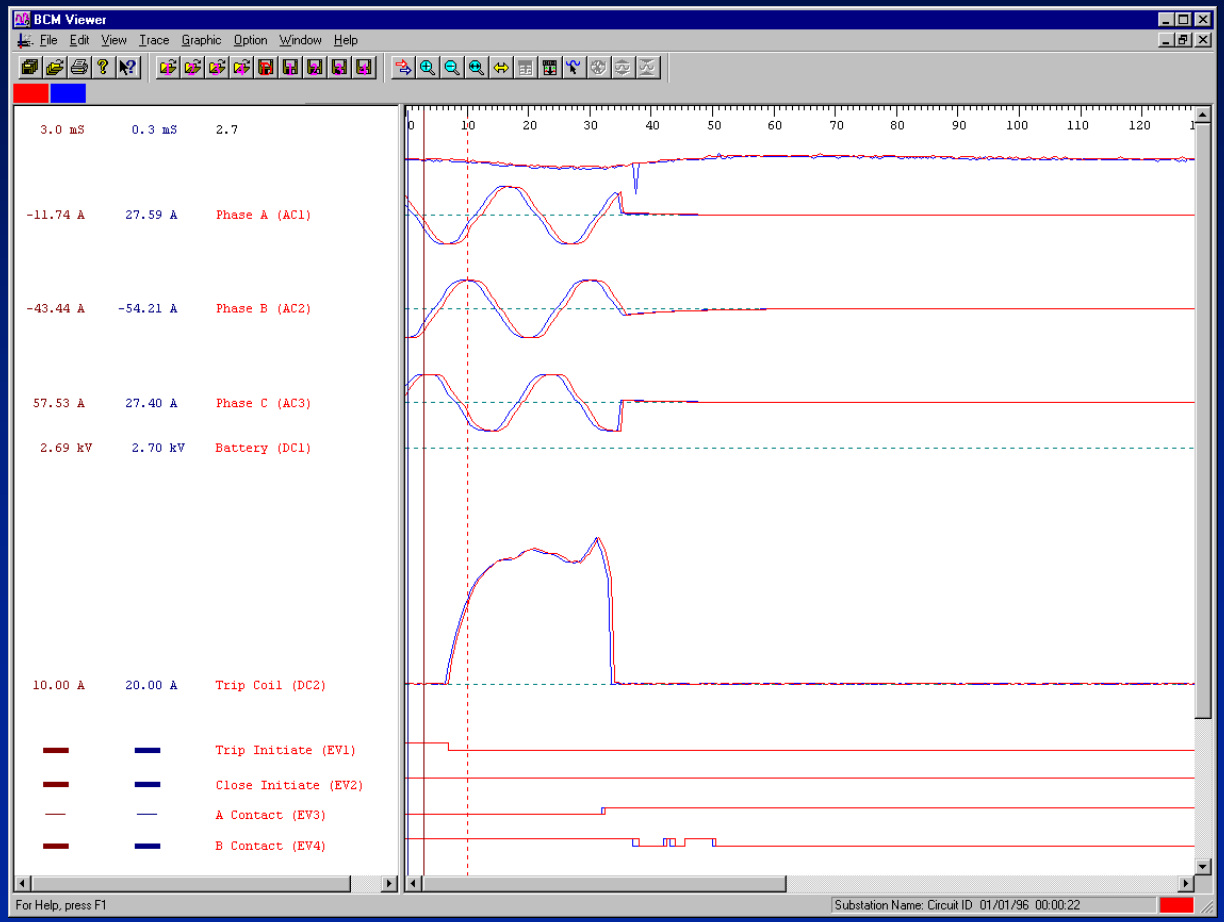
PROGRAMMABLE LIMIT ALARMS

- Response time (trip until “A” opens)
- Operate time(“A” contact until “B” contact)
- Battery voltage dip
- Coil current profile
- Primary contact accumulated duty
- Breaker malfunction
- Monitor malfunction

COMMUNICATIONS

- RS 232
  - Modem to remote master station
  - Direct connect to local PC
- RS 485
  - Interconnect monitors

BCM 200 records in Replay Plus



SUMMARY

ON LINE/ OFF LINE/ CONTINUOUS

- Keep breaker in service until maintenance required
- Continuous permits alarming when limits exceeded
- Continuous provides for archiving in data base
- System Reliability