



AQ 200 series

Motor protection and control

05/2020

AQ 200 series – Full range for electrical utility and industry



AQ-210 frame
for mid-range applications



AQ-250 frame
for high-range applications

Ease of use

Superior usability

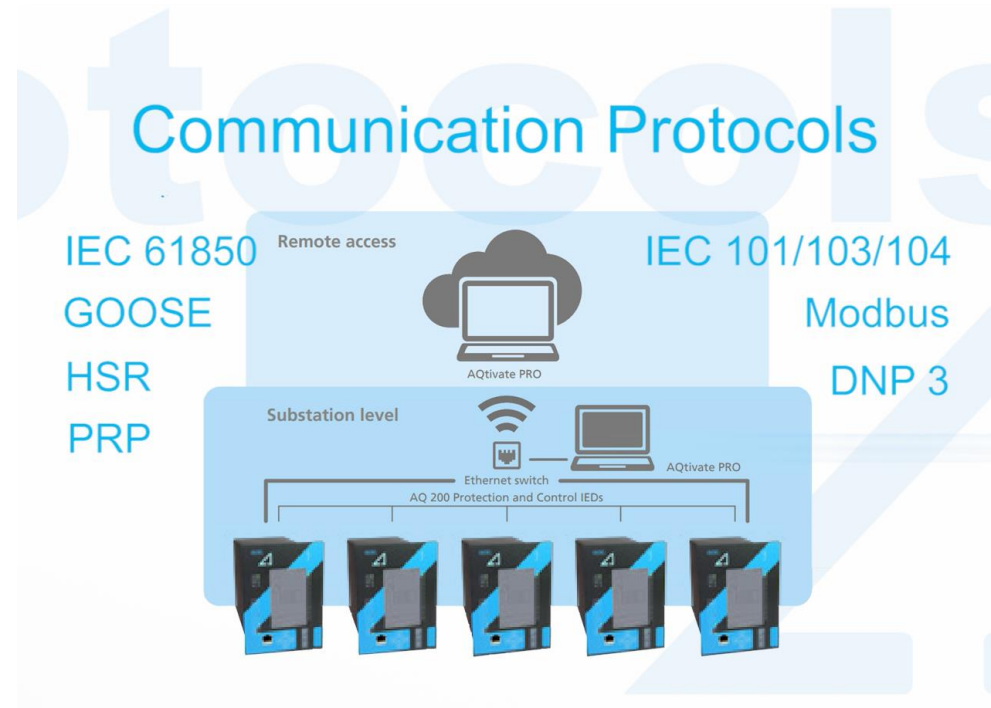
- High resolution 7" color display extensive information directly from screen
- 12 programmable function buttons
- 4 fixed and 16 programmable alarm leds
- Intuitive, easy to use setting software
- Extensive log information (e.g. setting change tracking)
- Downloading of files to the relay 60MB memory (commissioning report, manual...)



Communication

All protocols included in delivery

- IEC 61850 with Ed.1 & Ed.2
- GOOSE
- IEC 103
- IEC 101
- IEC 104
- DNP 3 and DNP 3 over TCP
- Modbus RTU/TCP
- SPA



Motor protection IEDs

Complete asynchronous and synchronous motor management



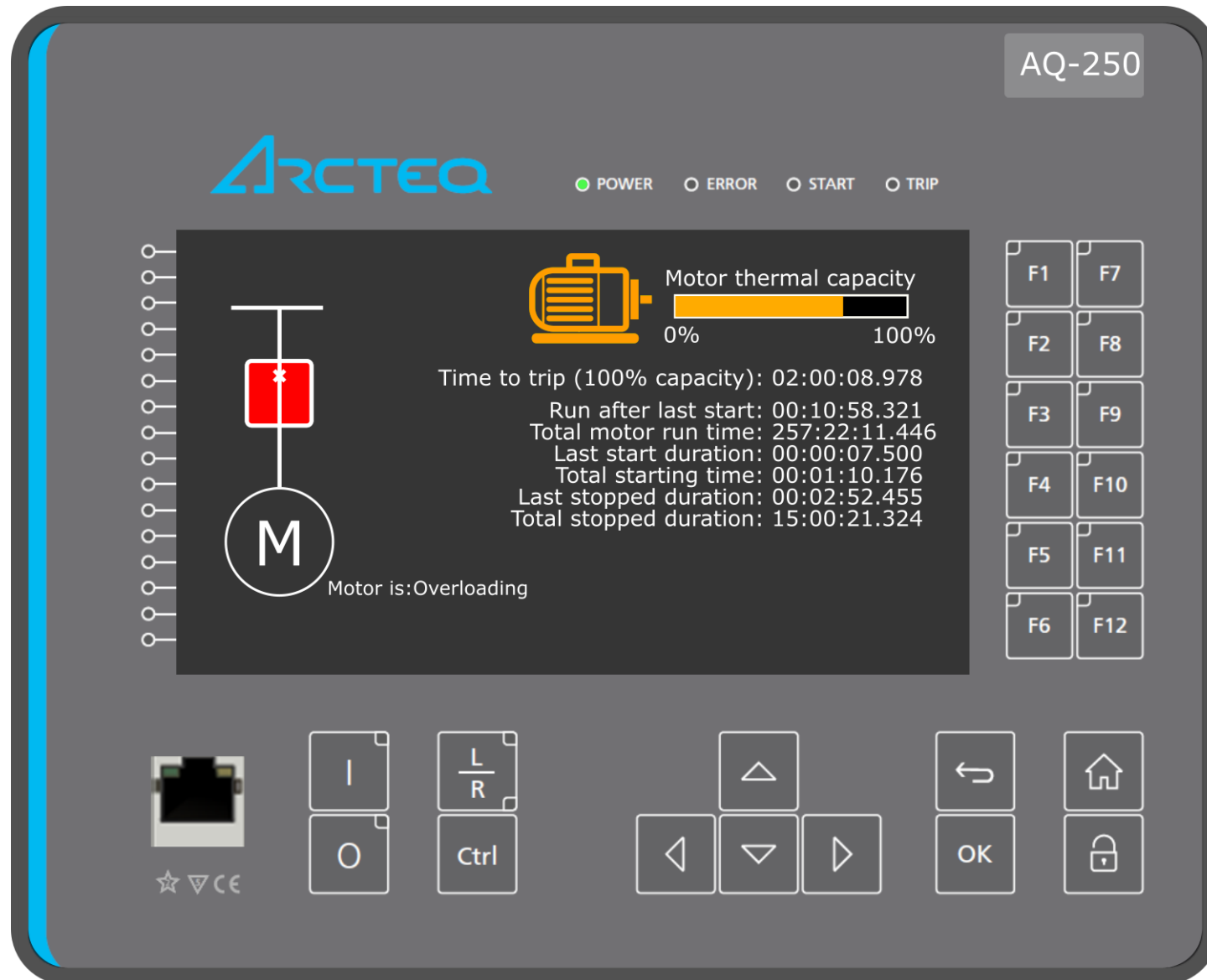
Use AQ-M25x color display for important motor data



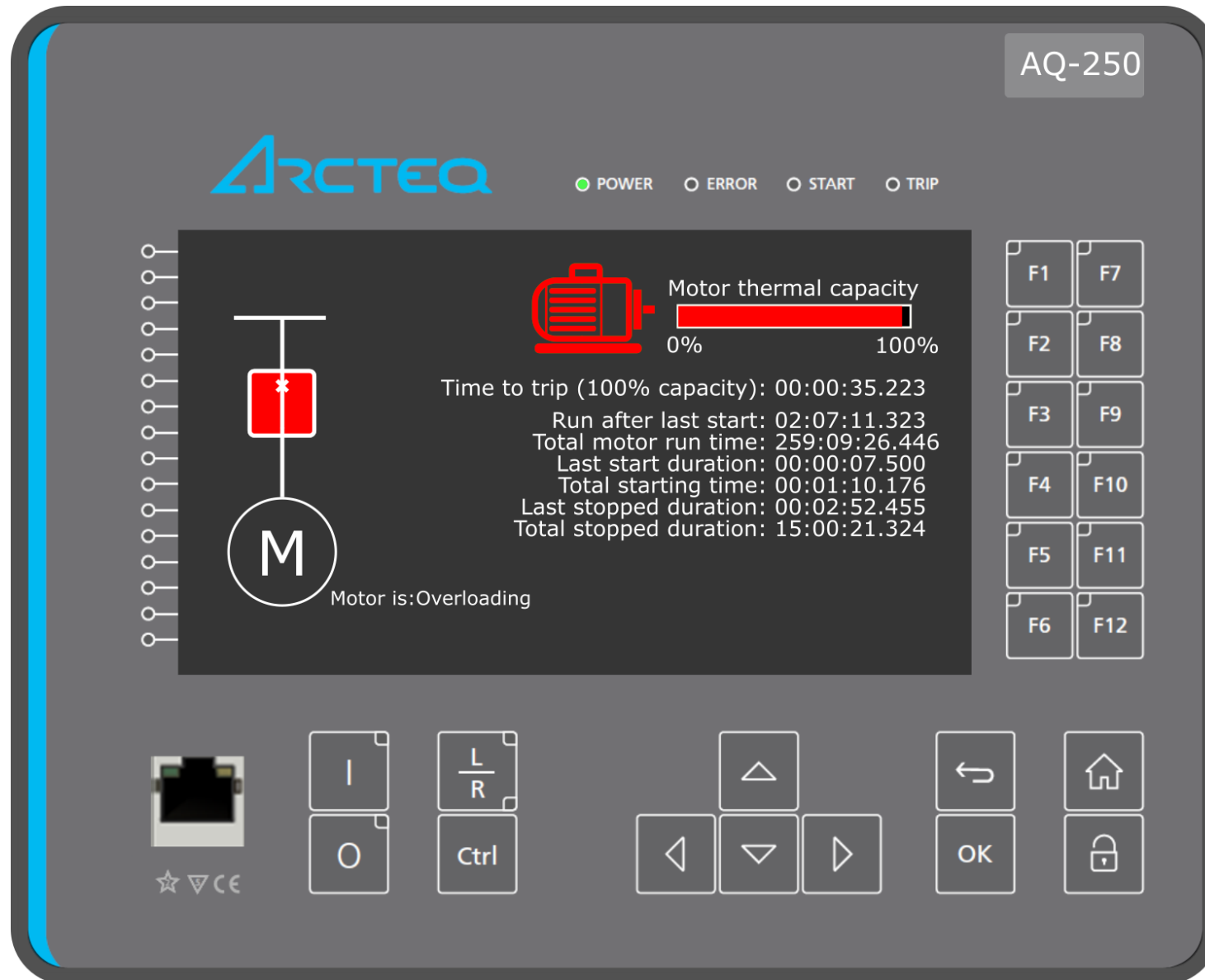
Use AQ-M25x color display for important motor data



Use AQ-M25x color display for important motor data



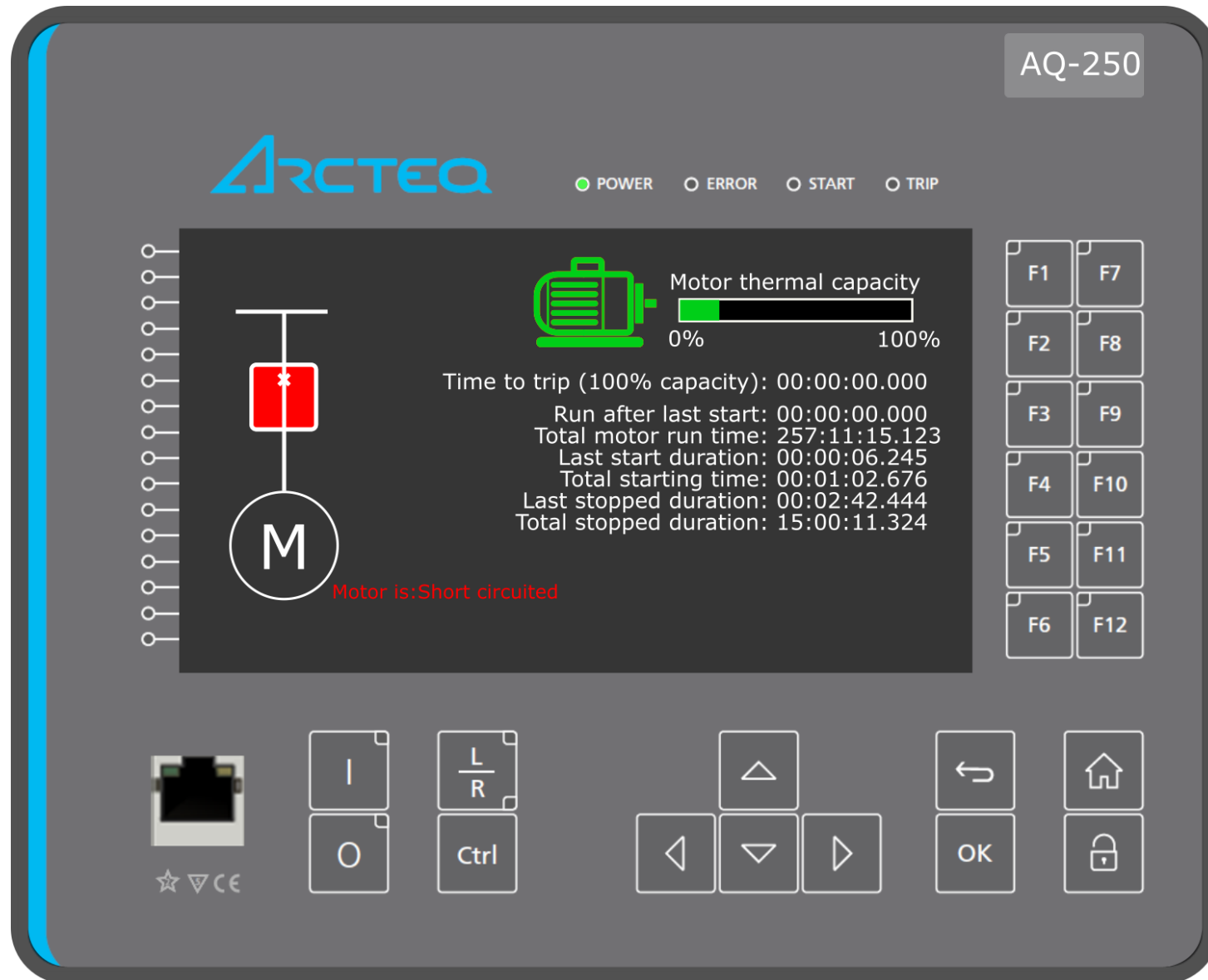
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Use AQ-M25x color display for important motor data



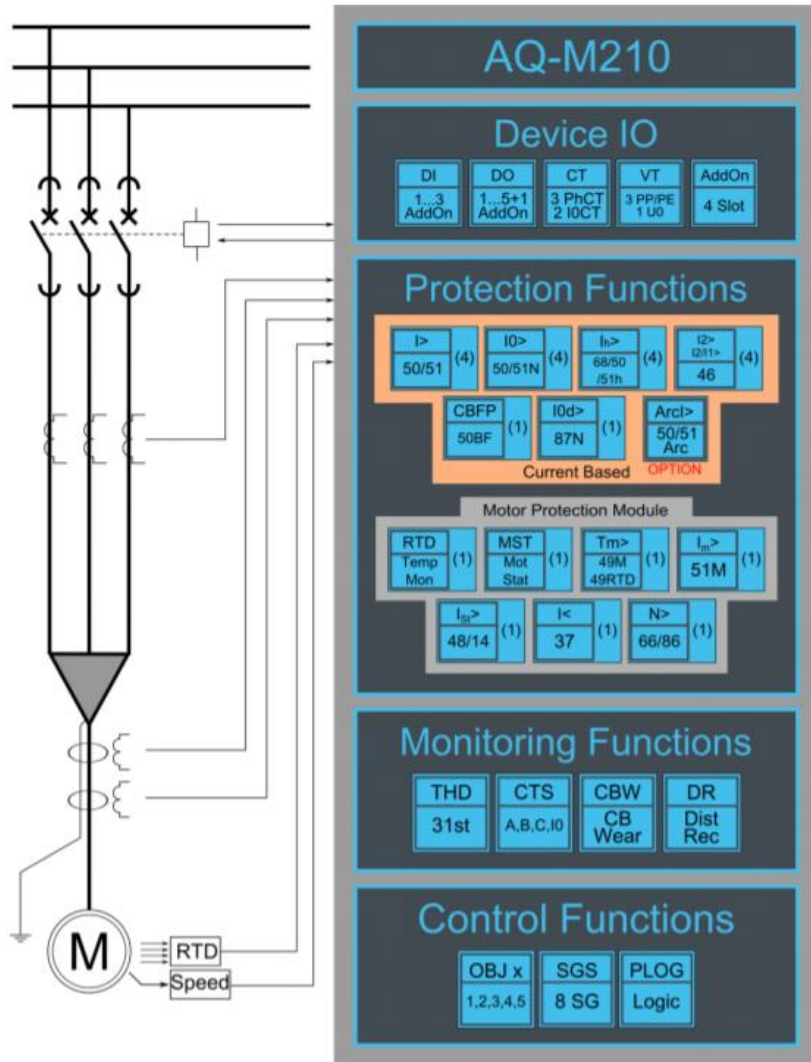
Use AQ-M25x color display for important motor data



Motor protection IEDs

Arcteq motor protection IEDs are optimized for total management of medium and large or important asynchronous and synchronous motors. Typical application range is 200kW – 10 MW (250 to 13,000Hp).

AQ M210 – Motor protection IED



Current based motor protection with extendable I/O and communication

Protection functions

- Three-phase overcurrent, 4 stages INST, DT or IDMT (50/51)
- Earth-fault (sensitive), 4 stages INST, DT or IDMT (50/51N)
- Harmonic overcurrent, 4 stages INST, DT or IDMT (50/51H, 68)
- Current unbalance, 4 stages INST, DT or IDMT (46/46R/46L)
- Cable end differential (87N)
- Motor thermal overload (49M)
- Motor start-up / locked rotor supervision with speed switch (48, 14)
- Restart inhibit / frequent starts (66/86)
- Undercurrent/loss of load (37)
- Mechanical jam (51M)
- Breaker failure protection (50BF/52BF)
- Arc protection (option) (50ARC/50NARC)

Measuring and monitoring

- Phase and residual currents (IL1, IL2, IL3, I01, I02)
- Current THD and harmonics (up to 31st)
- Circuit breaker wear (CBW)
- Disturbance recorder (3.2 kHz)
- Current transformer supervision (CTS)
- Trip circuit supervision (TCS)

Control

- Controllable objects: 5
- 8 setting groups

Hardware

- Current inputs: 5
- Digital inputs: 3 (standard)
- Output relays: 5+1 (standard)

Options (4 slots)

- Digital inputs optional: +8/16/24/32
- Digital outputs optional: +5/10/15/20
- Arc protection (12 sensors +2xHSO +BI)
- 2 x mA input + 6-8 x RTD input
- Communication media (specified below)

Event recording

- Non-volatile disturbance records: 100
- Non-volatile event records: 15000

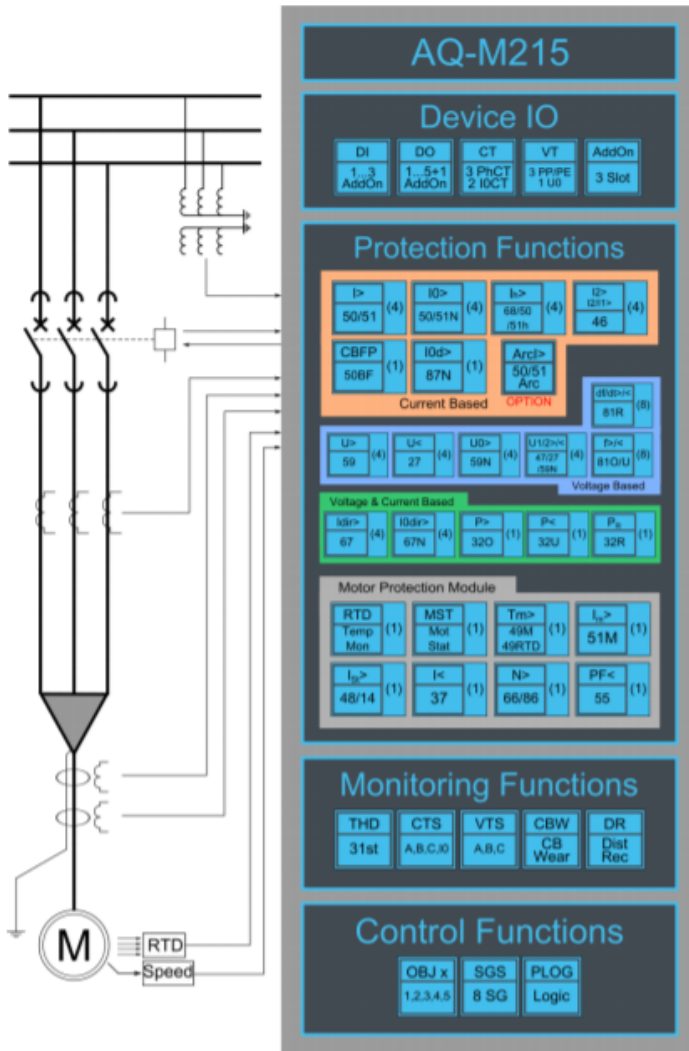
Communication media

- RJ 45 Ethernet 100Mb (front standard)
- RJ 45 Ethernet 100Mb and RS 485 (rear standard)
- Double LC Ethernet with HSR/PRP (option)
- Double ST or RJ 45 Ethernet (option)
- RS232 + serial fibre PP/PG/GP/GG (option)

Communication protocols standard

- IEC 61850
- IEC 60870-5-103/101/104
- Modbus RTU, Modbus TCP/IP
- DNP 3.0, DNP 3.0 over TCP/IP
- SPA

AQ M215 / M255 – Motor protection IED



Motor management with full measurements together with extendable I/O and communication

Protection functions

- Three-phase overcurrent, 4 stages INST, DT or IDMT (50/51)
- Earth-fault (sensitive), 4 stages INST, DT or IDMT (50/51N)
- Directional overcurrent, 4 stages INST, DT or IDMT (67)
- Directional (sensitive) earth-fault, 4 stages INST, DT or IDMT (67N)
- Harmonic overcurrent, 4 stages INST, DT or IDMT (50/51H, 68)
- Current unbalance, 4 stages INST, DT or IDMT (46/46R/46L)
- Cable end differential (87N)
- Motor thermal overload (49M)
- Motor start-up / locked rotor supervision with speed switch (48, 14)
- Restart inhibit / frequent starts (66/86)
- Undercurrent/loss of load (37)
- Mechanical jam (51M)
- Overvoltage, 4 stages INST, DT or IDMT (59)
- Undervoltage, 4 stages INST, DT or IDMT (27)
- Zero sequence overvoltage, 4 stages INST, DT or IDMT (59N)
- Negative/positive sequence overvoltage, 4 stages INST, DT or IDMT (47)
- Over/under frequency, 8 stages INST or DT (81O/81U)
- Over/Under/Reverse power (32/37/32R)
- Power factor protection (55)
- Breaker failure protection (50BF/52BF)
- Arc protection (optional) (50ARC/50NARC)

Measuring and monitoring

- Phase and residual currents (IL1, IL2, IL3, IO1, IO2)
- Voltage measurements (UL1-UL3, U12-U31, U0, SS)
- Current and voltage THD and harmonics (up to 31st)
- Frequency (f)
- Power (P, Q, S, pf)
- Energy (E+, E-, Eq+, Eq-)
- Circuit breaker wear (CBW)
- Disturbance recorder (3.2 kHz)
- Current transformer supervision (CTS)
- Fuse failure (VTS)
- Trip circuit supervision (TCS)

Control

- Controllable objects: 5
- 8 setting groups

Hardware

- Current inputs: 5
- Voltage inputs: 4
- Digital inputs: 3 (standard)
- Output relays: 5+1 (standard)

Options (3 slots)

- Digital inputs optional: +8/16/24
- Digital outputs optional: +5/10/15
- Arc protection (12 sensors +2xHSO +BI)
- 2 x mA input + 6-8 x RTD input
- Communication media (specified below)

Event recording

- Non-volatile disturbance records: 100
- Non-volatile event records: 15000

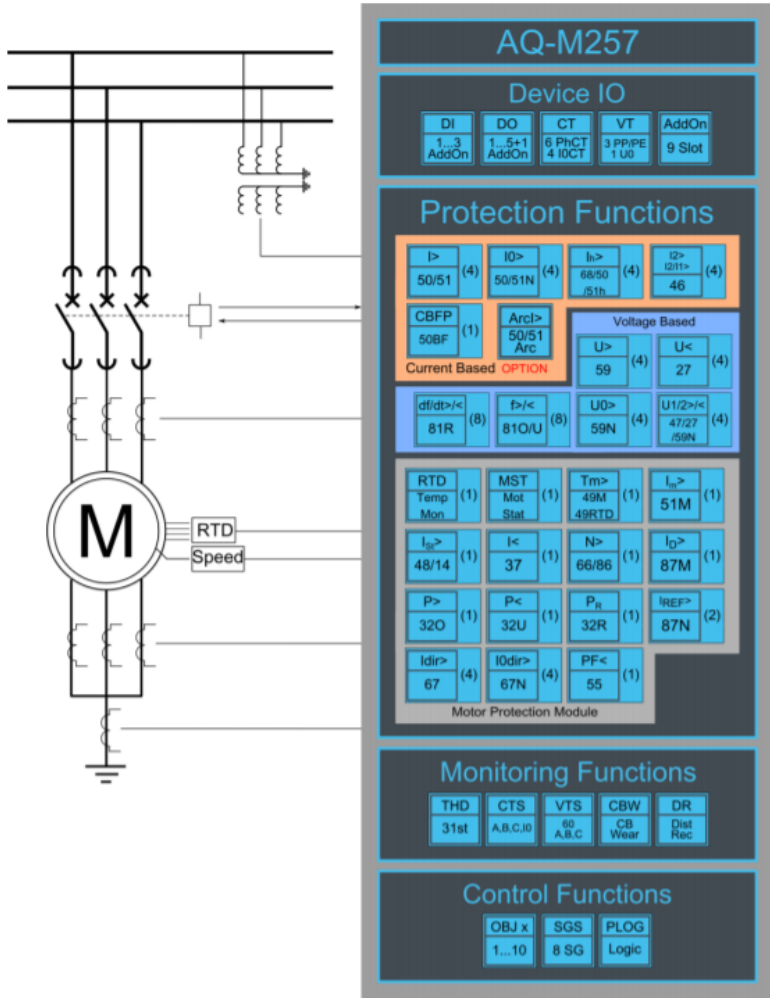
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Communication protocols standard

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AQ-M257 Motor protection IED



Motor management with differential protection either on flux balance (3CT) or 6 CT principle.

Protection functions

- Motor differential (87M)
- Three-phase overcurrent, 4 stages INST, DT or IDMT (50/51)
- Earth-fault (sensitive), 4 stages INST, DT or IDMT (50/51N)
- Directional overcurrent, 4 stages INST, DT or IDMT (67)
- Directional (sensitive) earth-fault, 4 stages INST, DT or IDMT (67N)
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- Current unbalance, 4 stages INST, DT or IDMT (46/46R/46L)
- Cable end differential (87N)
- Motor thermal overload (49M)
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- Energy (E+, E-, Eq+, Eq-)
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Event recording

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- Non-volatile event records: 15000

Communication media

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Thermal protection 49M

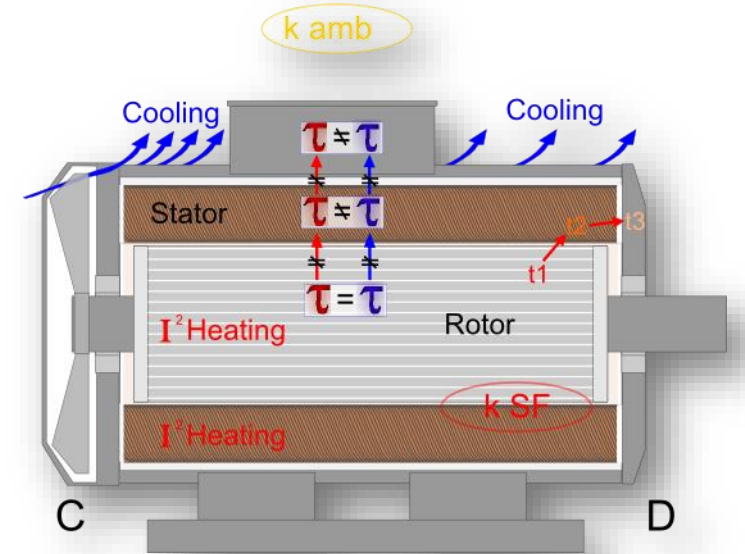
Optimal thermal protection is obtained by combining RTD monitoring and sophisticated motor thermal imaging. Using RTDs alone relies on exact hot-spot location. Thermal protection with memory and multiple dynamic time constants provide accurate protection especially in case of pumping loads. Estimated (learned) settings provide for adaptive settings.

Thermal protection 49M

- TRMS based protection
- Includes total load memory as per IEC 60255-8
- Ambient temperature correction factor
- Negative sequence current correction factor
- Used thermal capacity displayed
- Time to trip displayed
- Specifically developed for pumping loads
- Integrated cable short circuit protection with instant tripping if above locked rotor current.

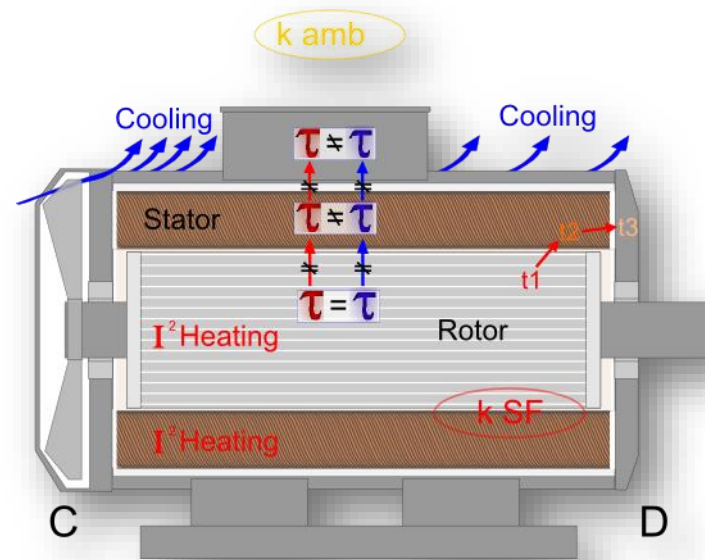
Thermal protection 49M

- Single or multiple time constant operation
- Long Heat (cold/hot)
- Short Heat (cold/hot) – locked rotor
- Long Cool (run/stop)
- Short Cool (same for cold and hot motor)



Thermal protection 49M

- Use of dynamic time constants switch constants based on actual motor status for more accurate thermal imaging
- Status is based on set/measured locked rotor currents

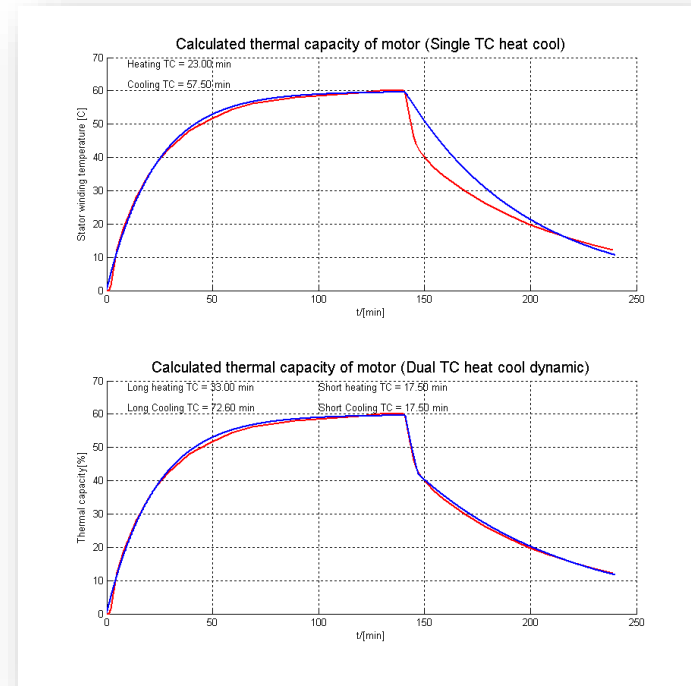


Thermal protection 49M

- Estimated time constants for easy and adaptive settings
 - Short heat COLD time constant calculated from given LRC and cold safe stall time
 - Short heat HOT time constant calculated from given LRC and hot safe stall time
 - Short and long cooling time constants estimated during motor stopped condition (learned)

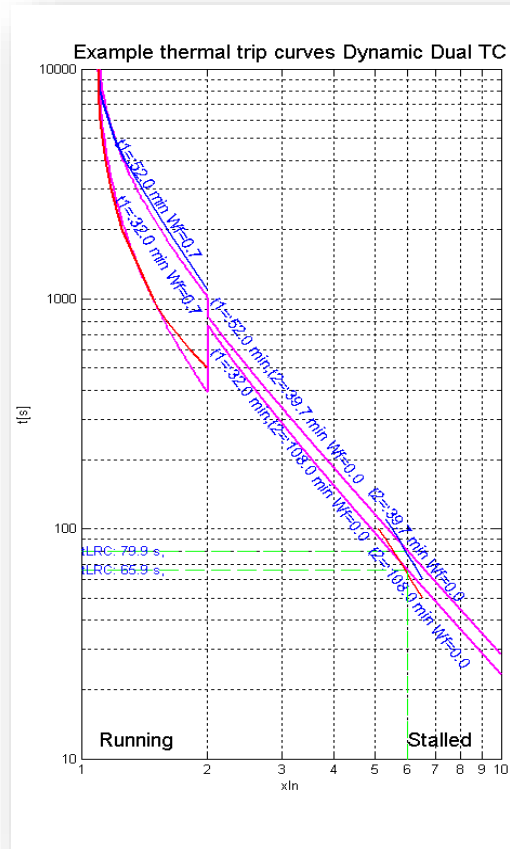
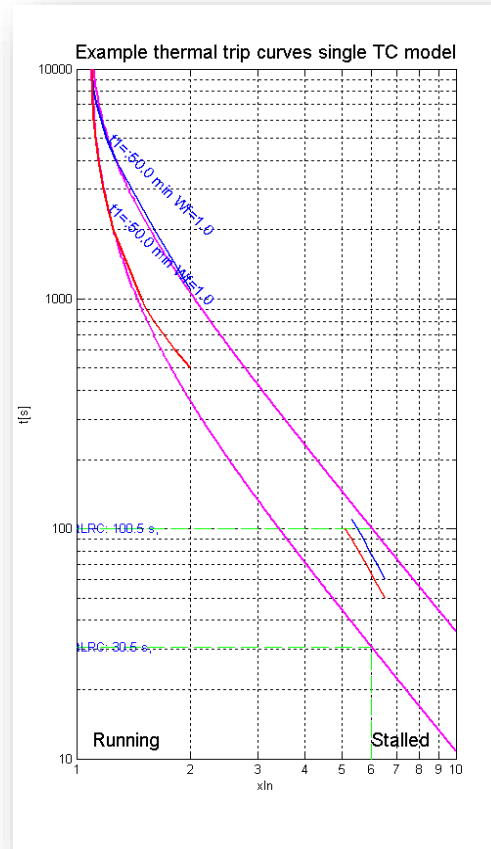
Thermal protection 49M

- Dual time constant prevents overprotection



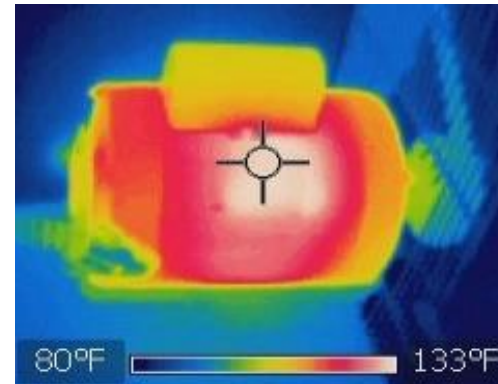
Thermal protection 49M

- Dual dynamic time constant for exact fit

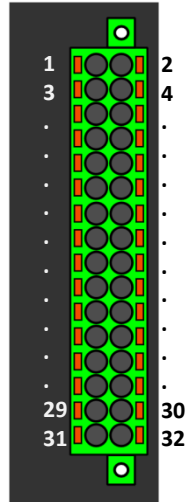


RTD readings

- Rotor measurement difficult due to rotation
- Stator, bearing and ambient readings typical
- Max 16 RTD inputs either internally or externally
- Max 4mA inputs

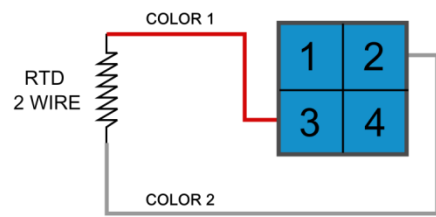
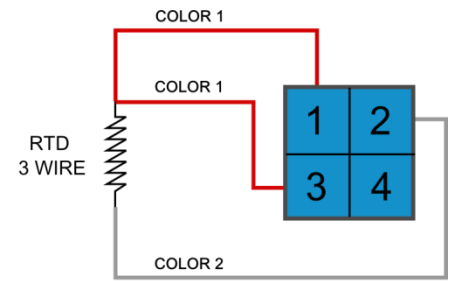
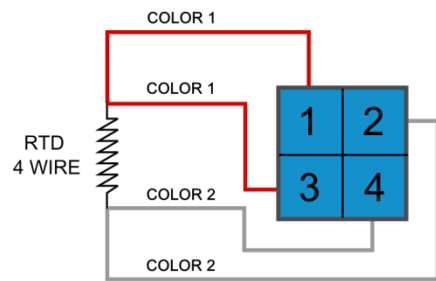


RTD Readings – internal card

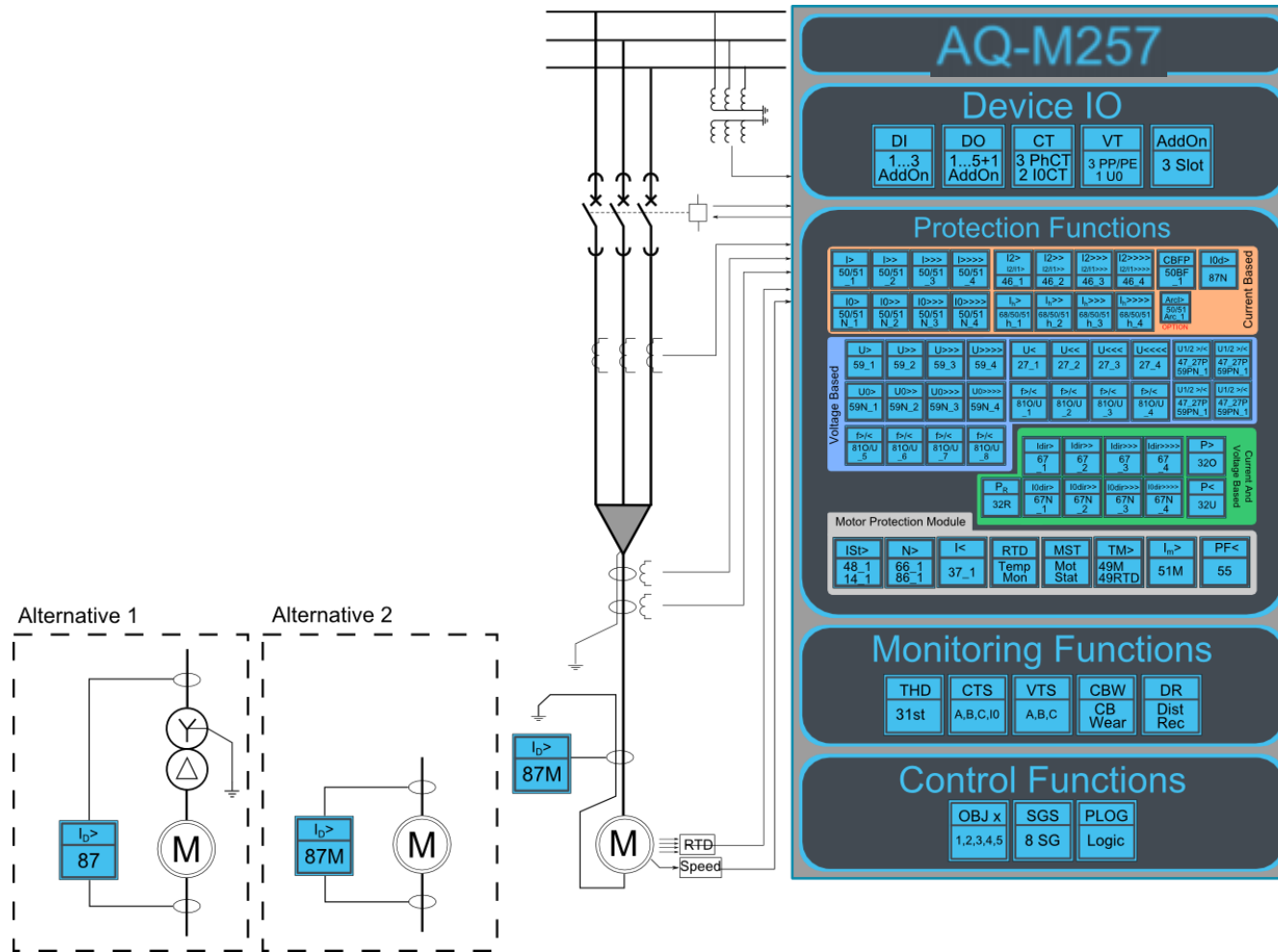


RTD input card includes 8 RTD inputs for temperature measurement. Supported RTD sensors are Pt100, 250, 1000 and Ni, Co

SlotX 1-4	RTD1
SlotX 5-8	RTD2
SlotX 9-12	RTD3
SlotX 13-16	RTD4
SlotX 17-20	RTD5
SlotX 21-24	RTD6
SlotX 25-28	RTD7
SlotX 29-32	RTD8



Motor differential 87M

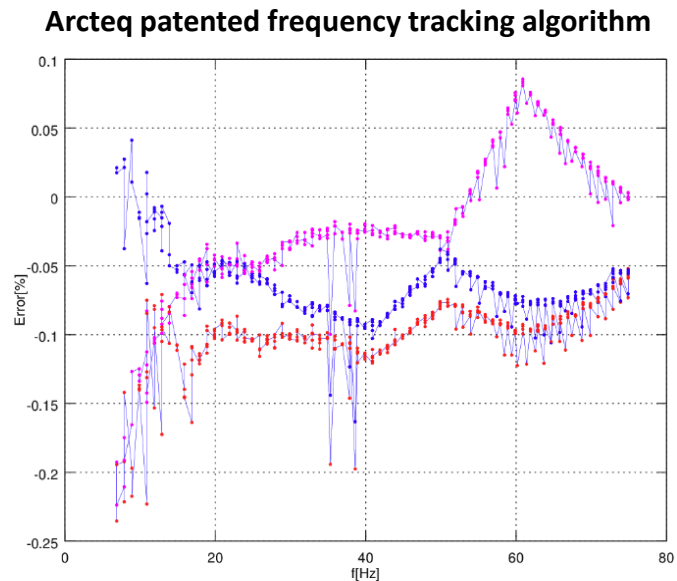


Measurements and monitoring

Arcteq IEDs provide complementary value adding features such as accurate power measurements and motor statistics information.

Measurements

- Accurate measurement and protection at 6...75Hz
- Power and energy measurement class 0.2S
- No loss of function in protection even if used with soft starters or variable frequency drives



Motor statistics

MSTAT

Motor Status [MST]

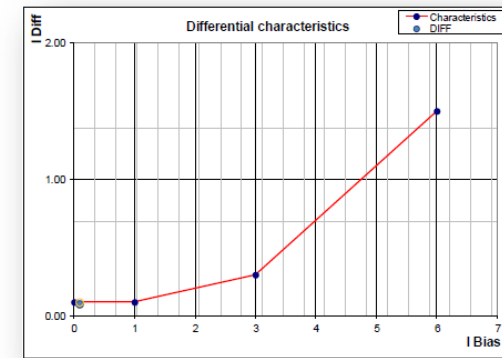
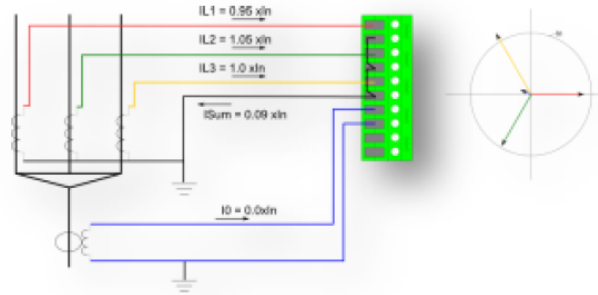
INFO REGISTERS IO EVENTS

Statistics

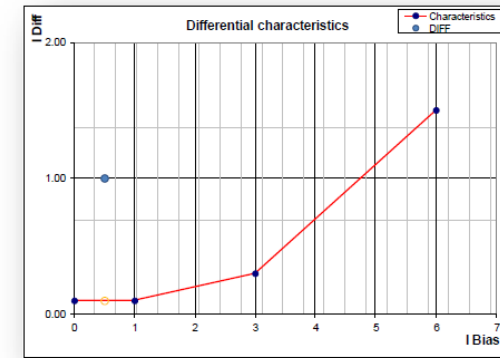
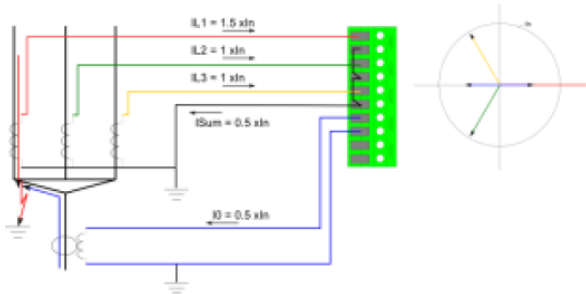
Times motor started	0
Times motor starts succeed	0
Times motor stopped	6
Clear statistics	-
Run after last start	00:00:00.000
Total motor run time	00:00:00.000
Last start duration	00:00:00.000
Total starting time	00:00:00.000
Last stopped duration	00:10:21.025
Total stopped time	00:36:55.770
Clear total times	-

Application: Sensitive cable end differential protection

- Normal measurement without compensation

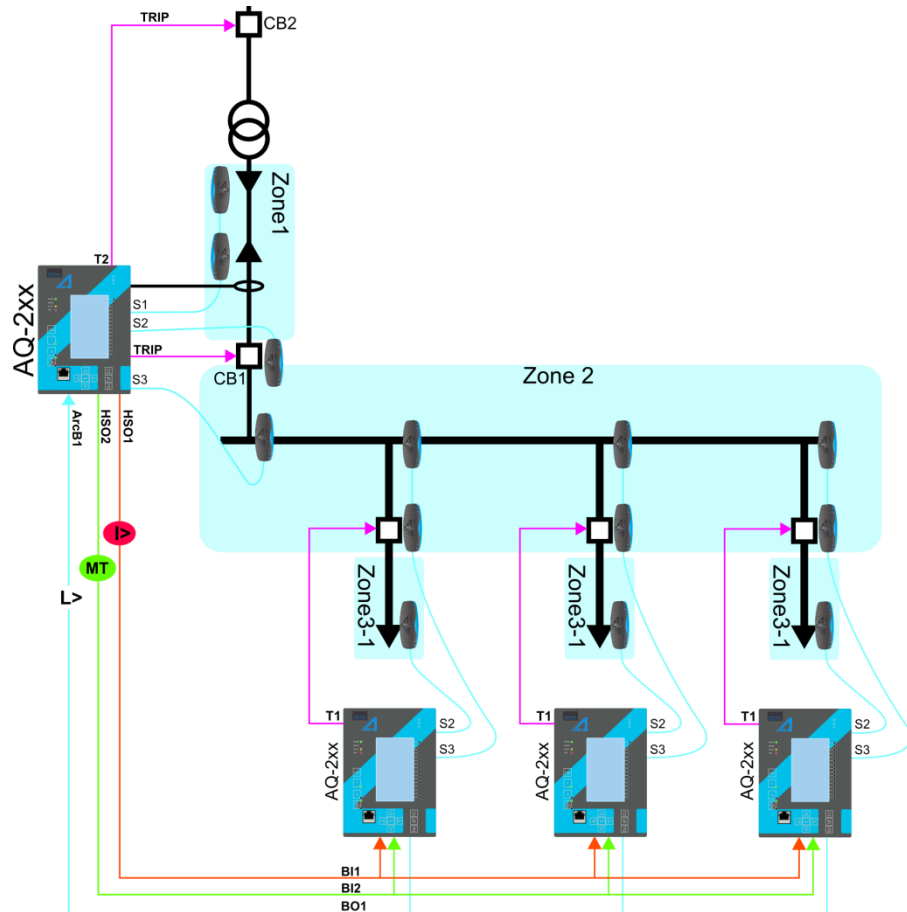


- Fault seen by IED, with compensated measurement



Proactive protection! Most of the starting arcing faults are in cable compartment!

Application: Integrated Arc protection



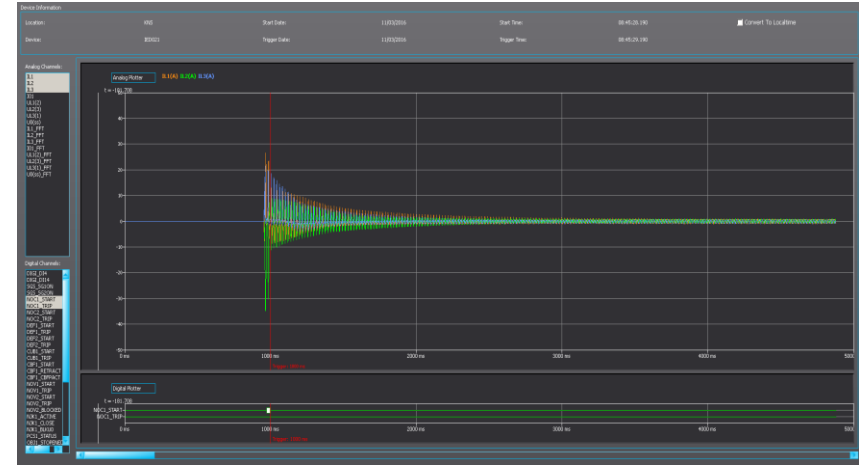
- 4 - 10 millisecond operation time as a system with light and current criteria (when high speed output is used).
- Configurable with AQ200 setting tool.
- 12 sensors to four channels (3 in series) and cable draws up to 200 meters.

High memory capacity

- 100 pcs 5 s disturbance records (8 analogue and 26 Binary channels)
- 15 000 events including setting change log
- 12 fault registers per each protection stage
- 60 Mb user defined space

All non-volatile information stored in Flash memory

→ No battery or capacitor back-up



Overcurrent I> 50/51 [NOC1]				
REGISTERS: Overcurrent I>				
Operation event register				
Event	Time	Fault type	Phase A pretrg curr	
1	Trip ON	24.02.2016 18:53:34.400	A-B-C	0.799680
2	Trip ON	24.02.2016 12:43:56.527	A-B-C	0.799690
3	Trip ON	24.02.2016 12:32:26.063	A-B-C	7.597303
4	Trip ON	24.02.2016 12:32:07.131	A-B-C	1.199844
5	Trip ON	24.02.2016 12:31:06.003	A-B-C	1.199844
6	Trip ON	24.02.2016 12:31:05.058	A-B-C	1.199843
7	Start ON	24.02.2016 10:55:45.451	A-B-C	0.000000

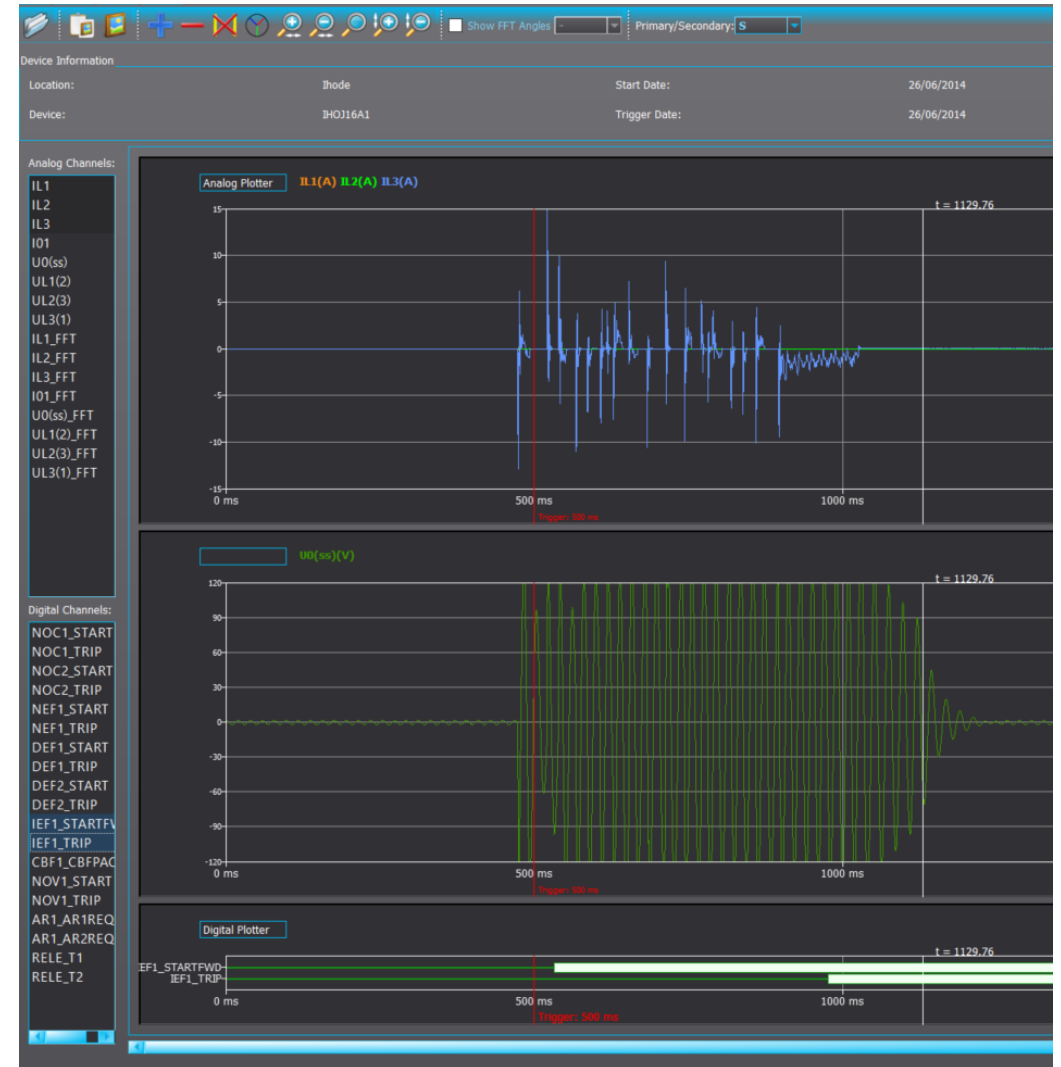
Event History			
Live events:			
Seq	Code	Name	Timestamp
Show New Events Only			
Show All Events			
Historical events:			
Seq	Code	Name	Timestamp
4480	448	CTRL: Ctrl state REMOTE	29.03.2016 14:59:45.702
4479	2945	OBJ: Object Open	29.03.2016 14:59:41.039
4478	646	DIG: DI 4 On	29.03.2016 14:59:41.033
4477	649	DIG: DI 5 Off	29.03.2016 14:59:41.018
4476	449	CTRL: Ctrl state LOCAL	29.03.2016 14:58:53.277
4475	448	CTRL: Ctrl state REMOTE	29.03.2016 14:58:52.269
4474	449	CTRL: Ctrl state LOCAL	29.03.2016 14:58:51.261
4473	448	CTRL: Ctrl state REMOTE	29.03.2016 14:58:49.243
4472	446	CTRL: Ctrl state LOCAL	29.03.2016 14:58:48.235

Disturbance recorder

Powerful fault analysis

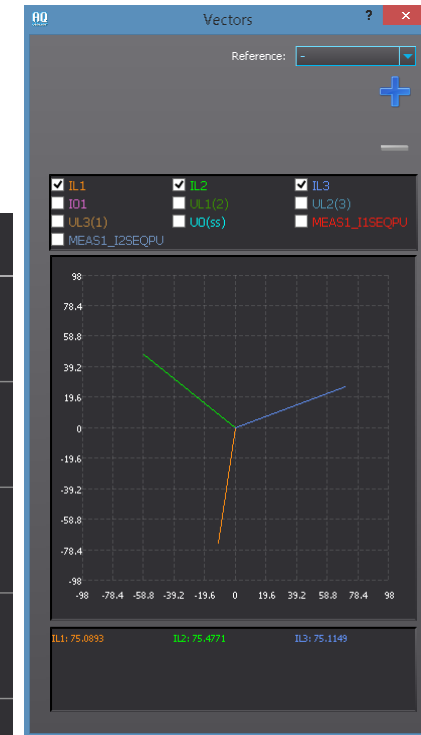
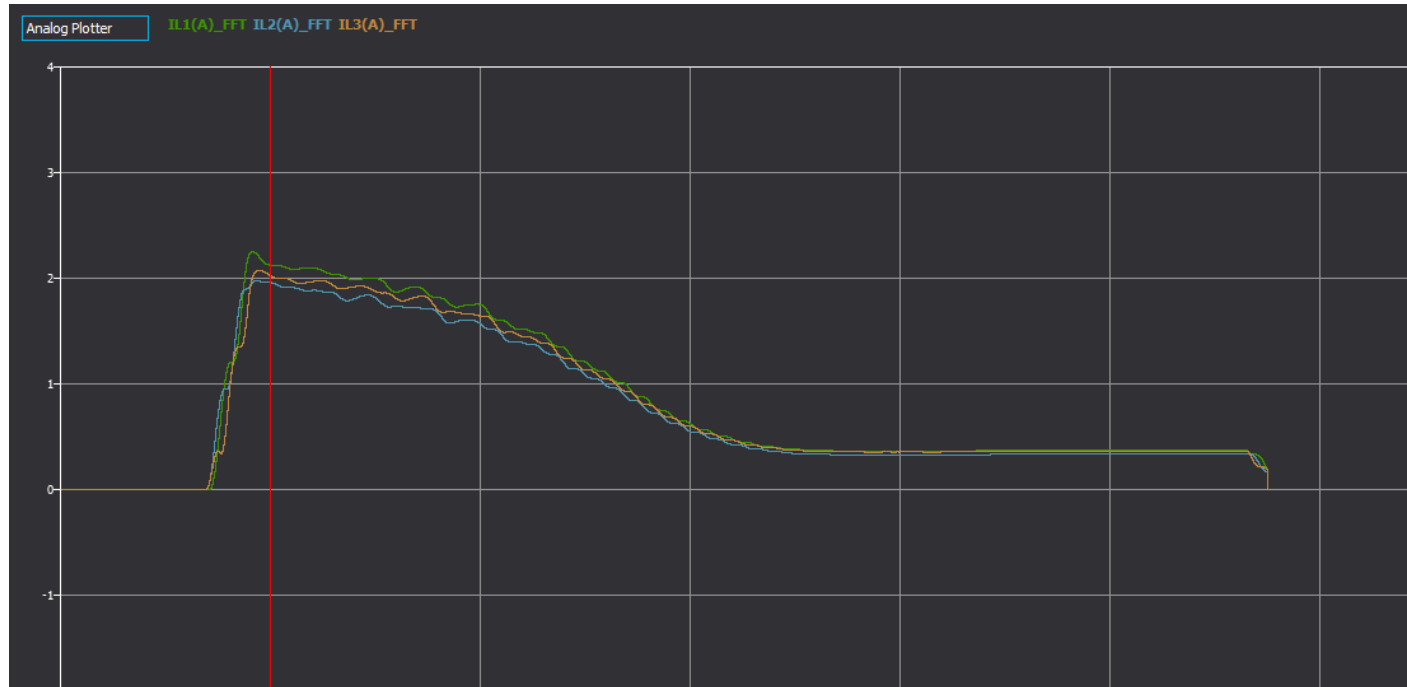
Disturbance recorder setting examples

Samples per cycle	64	64	64
Analogue channels	8	8	8
Digital channels	24	24	24
Record duration	5s	10s	60s
Total number of records	100	52	8



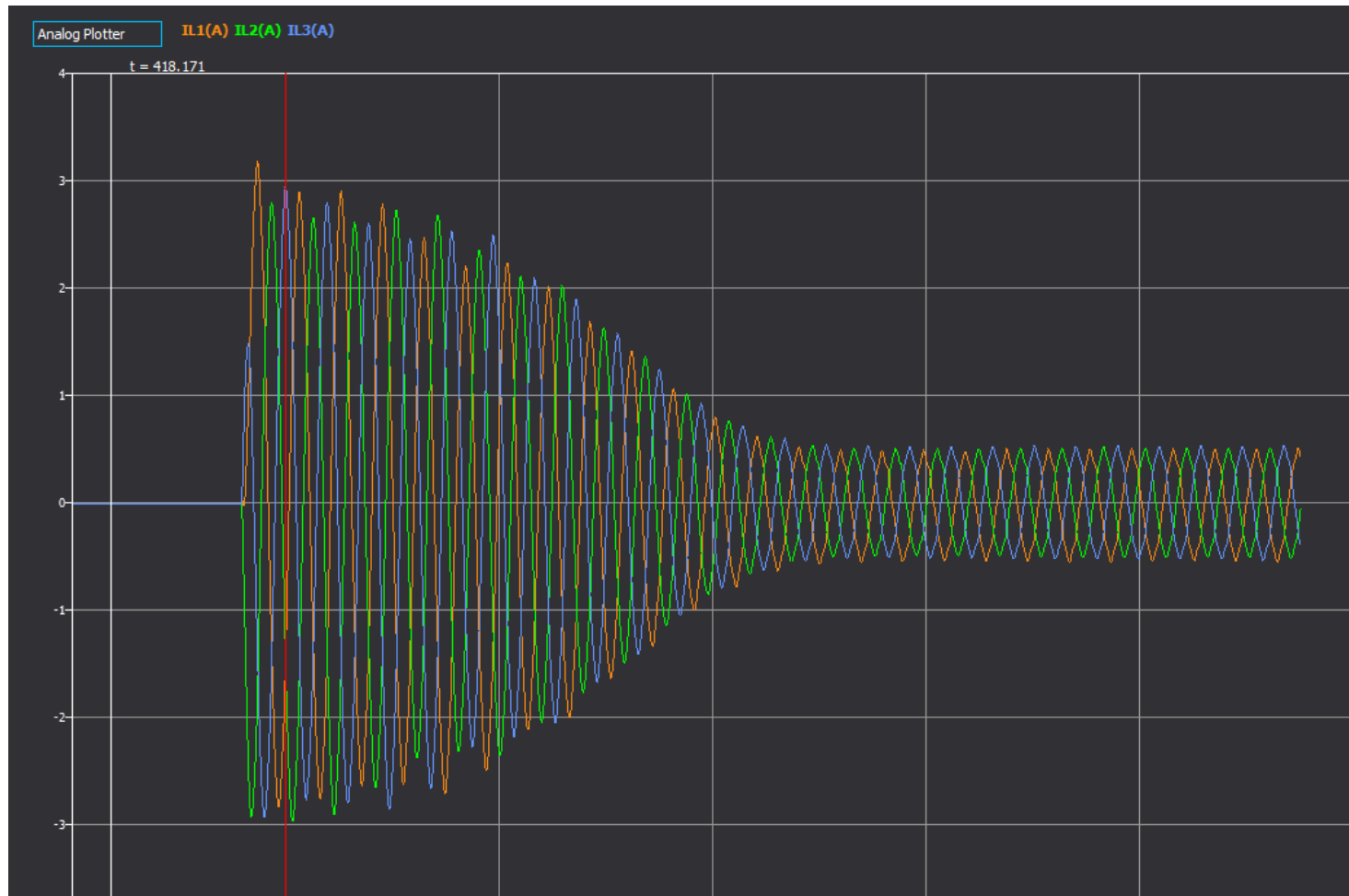
Disturbance recorder

- Lower sampling used for motor start record



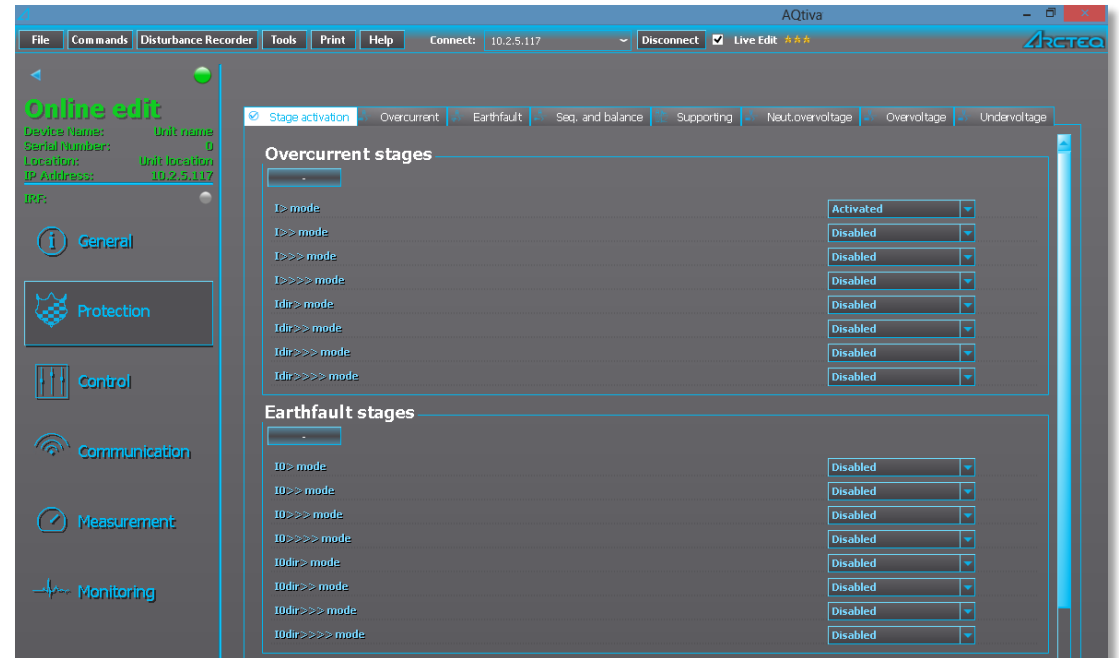
Disturbance recorder

- Higher sampling for high harmonic content recording (up to 31st harmonic)



AQtivate 200 setting tool

- Free of charge
- Easy to use
- Ethernet connection to IED
- On-line / Off-line modes
- Clear Menu structure
- Instant download of settings
 - All IED settings ~ 5 second
- Logic programming feature
 - Templates / macros
- MIMIC diagram
- Communication parameters
- AQviewer software module for disturbance recorder analysis



AQtivate 200 integrated MIMIC tool

- Advanced HMI designer integrated in AQtivate 200
- Create own personal mimic with up to 10 controllable objects
- Build up any mimic with freely configurable objects and use of full color PNG pictures
- Add up to 10 measurements

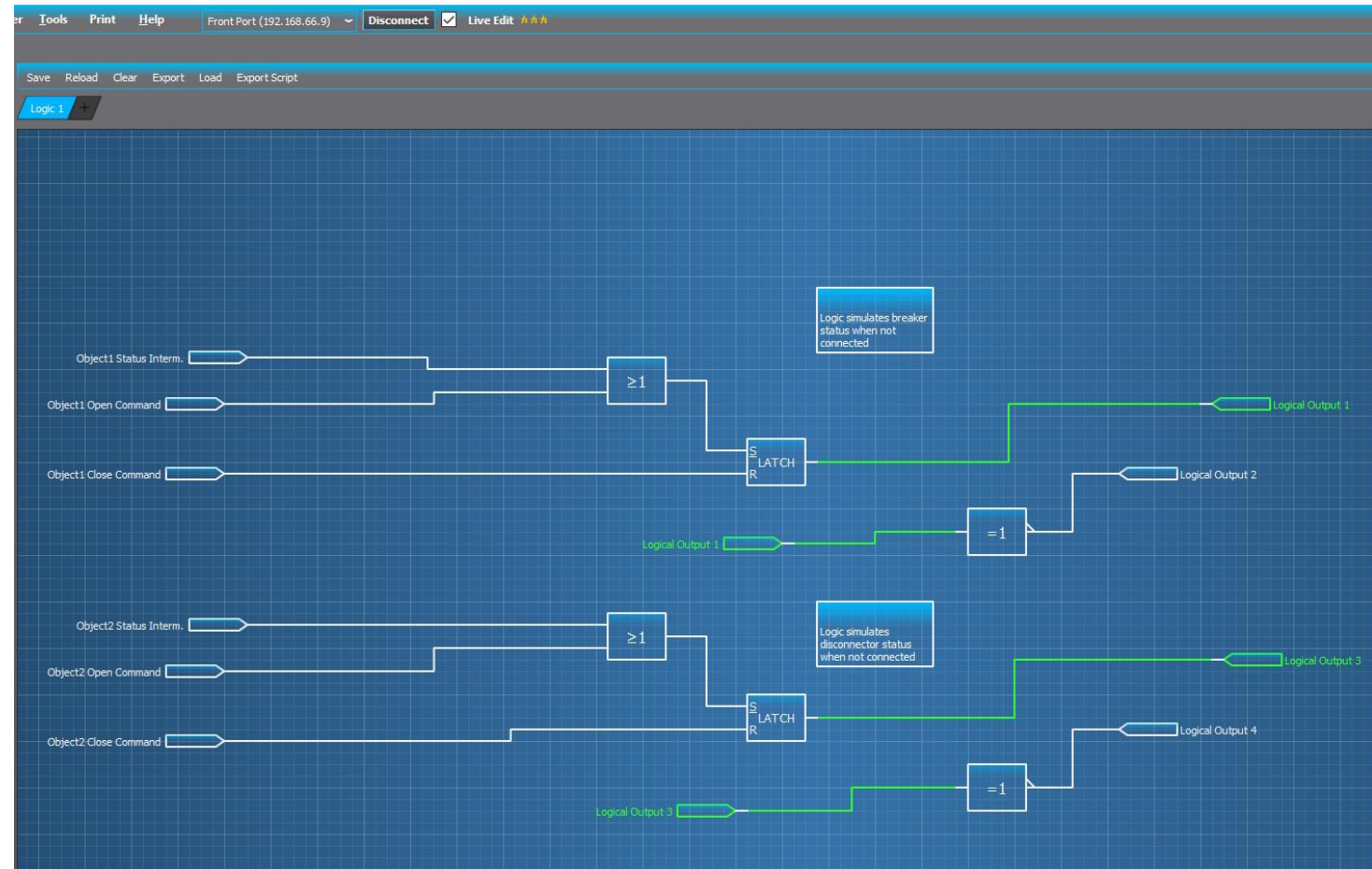
The screenshot displays the AQtivate 200 MIMIC tool interface. The main window shows a circuit diagram with a 3LN busbar and a circuit breaker (Q9). A yellow box highlights the configuration panel for the circuit breaker, listing parameters: IL1: Pri.Pha.curr.IL1, IL2: Pri.Pha.curr.IL2, IL3: Pri.Pha.curr.IL3, I01: Pri.Res.curr.I01, UL12: System volt UL12 mag(kV), P: 3PH Active power (P), Q: 3PH Reactive power (Q), and S: 3PH Apparent power (S).

The bottom panel, titled "HMI Designer", shows a character map (IEC) and a list of objects (Object1 to Object5) with their respective symbols (Withdrawable CB, Circuit breaker). The central area displays a circuit diagram with objects placed on it. The right panel shows configuration options for the objects, including "Use measurements" and "Position (X,Y)" settings. A table lists the measurement parameters for IL1, IL2, and IL3, with dropdown menus for selecting the measurement type (e.g., Pri.Pha.curr.IL1).

Parameter	Condition	Value
Object1 Break	==	Open

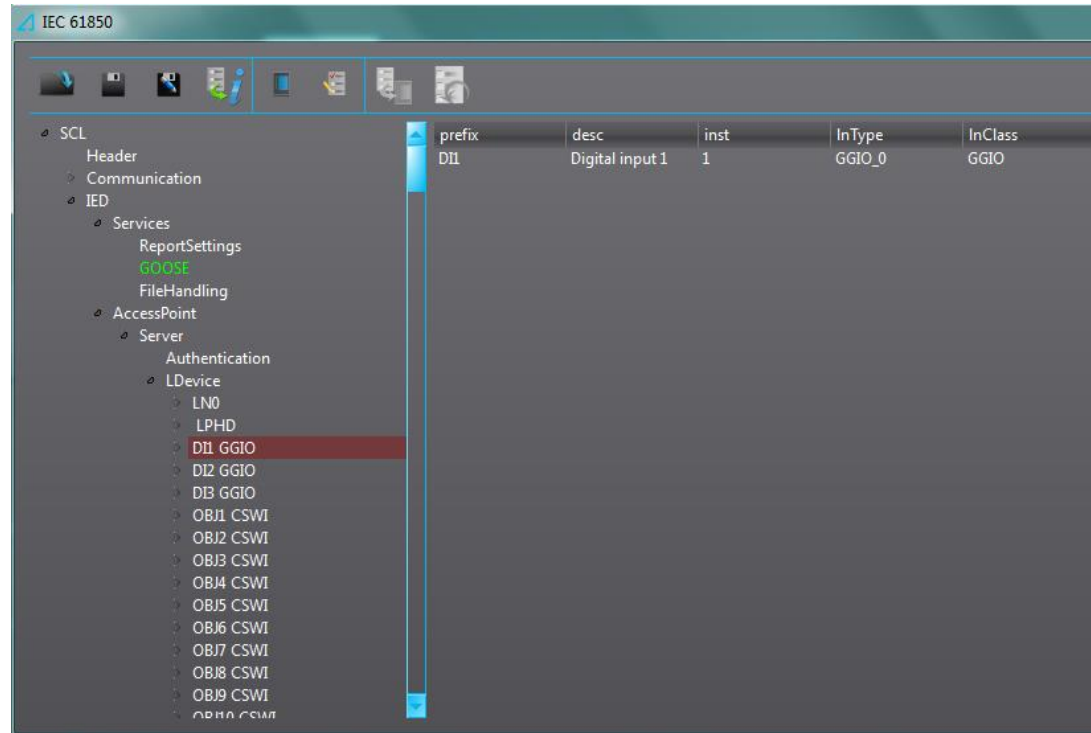
AQtivate 200 integrated logic tool

- Advanced and flexible logic editor integrated in AQtivate 200
- Add Notes to remind future users about the purpose of created logic
- Program cycle 5ms for fast protection logic
- Online indication of active/de-active signals

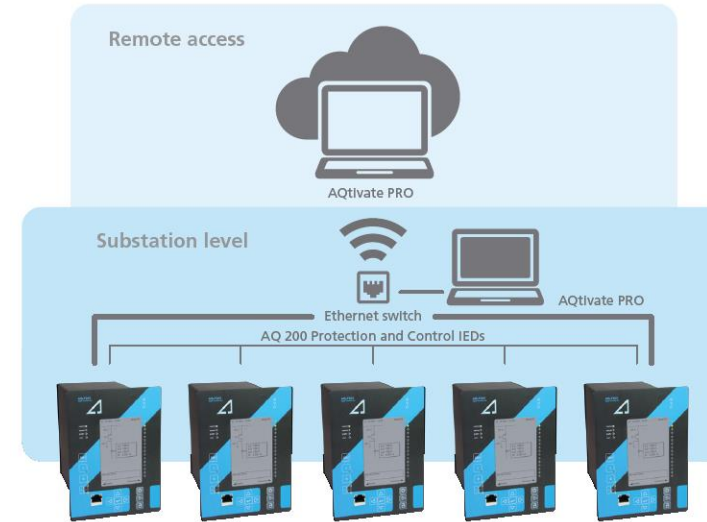
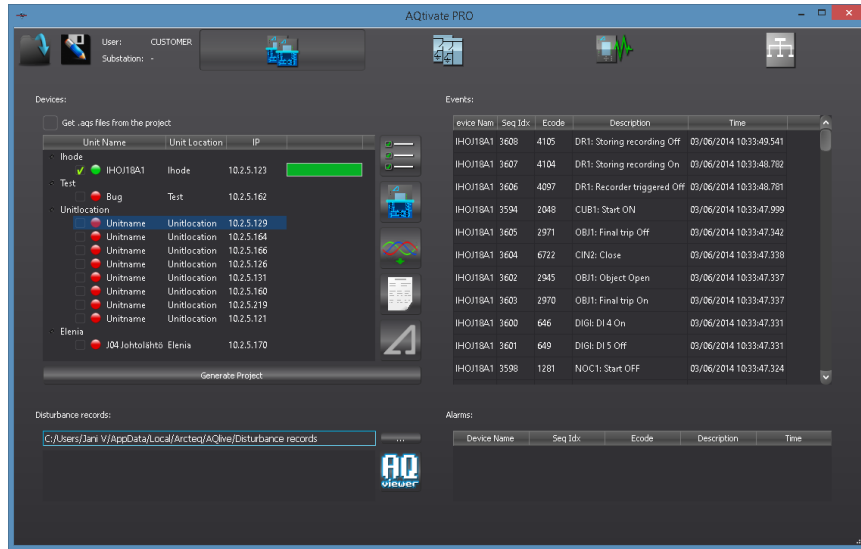


AQtivate 200 communication

- All IEC 61850 configuration in AQtivate 200
- CID file
- GOOSE
- Other protocol maps integrated in AQtivate 200



AQtivate PRO substation management

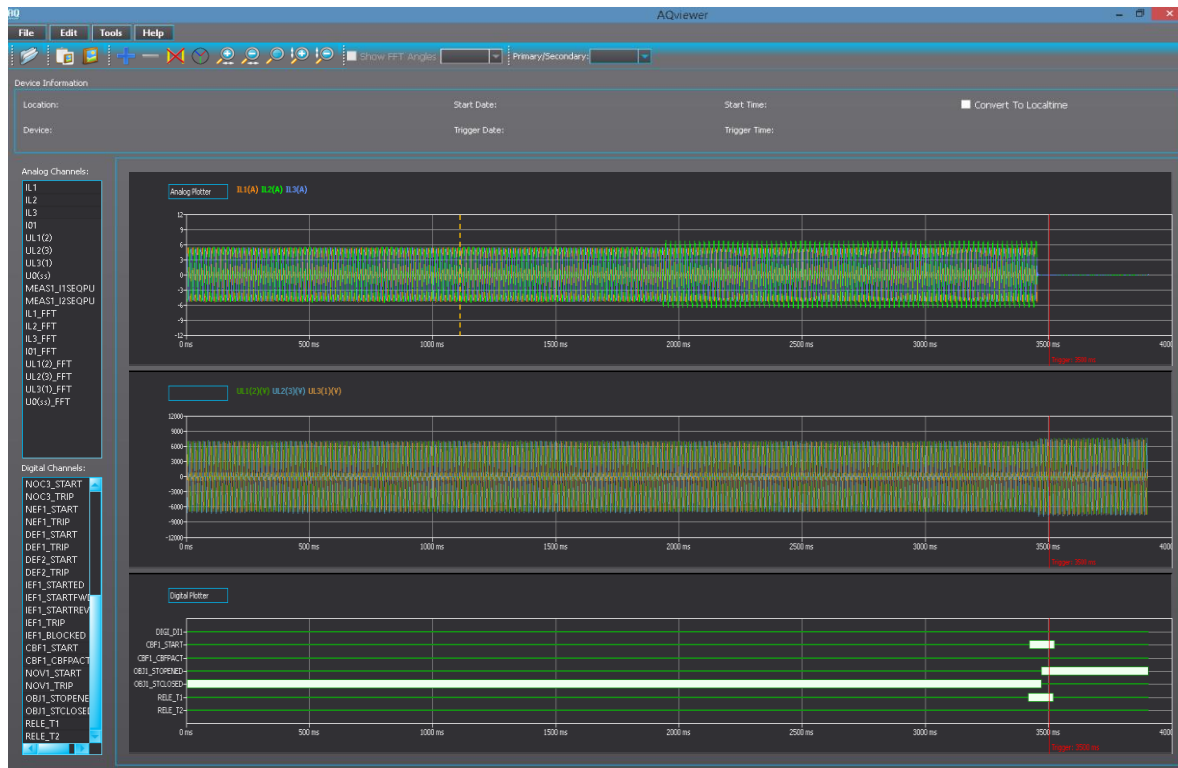


- Ethernet based communication

- Total substation management solution with measurement trend displays, automatic disturbance recorder download and remote setting ability with fault register access.
- Switchgear control.
- Savings in engineering time and improves protection site testing quality with reduced cost.
- Automatic detection of Arcteq IEDs in the network. Fast setup.

AQviewer and comtrade files

- Analyze signals of comtrade files by using AQviewer which is integrated tool of AQtivate 200.



Conclusions

- Complete motor management solutions with ease of use in focus
- Sophisticated thermal model with dynamic and estimated time constants. Integrated cable short circuit protection.
- Motor statistics information for preventive maintenance
- Intuitive displays with motor status and time to trip information
- Class 0.2S measurements at 6-75 Hz with up to 31st harmonic
- Powerful disturbance recorder
- Full range of communication protocols
- Easy to use software tools



RELAYABLE
POWER