

## **FORM 5 MICROPROCESSOR-BASED RECLOSER CONTROL TECHNICAL SPECIFICATIONS**

### **INTRODUCTION**

This specification describes the features of the Kyle® Type Form 5 microprocessor-based recloser control which shall provide the intelligence to supervise a Cooper Power Systems three-phase recloser. The control shall be interchangeable with Form 3A, FXA/B or Form 4C controls and their associated reclosers including the WE-VWE group and VSA-VSO group.

### **STANDARDS**

The Form 5 Control has been designed and tested in accordance with the following standards as applicable:

*ANSI/IEEE C37.60-1981.* American National Standards Requirements for Overhead, Padmounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems.

*C37.61 (ANSI), 321-1973 (IEEE).* IEEE Standard Guide for the Application, Operation and Maintenance of Automatic Circuit Reclosers.

*C37.90.1-1989 (ANSI/IEEE).* American National Standard Guide for Surge Withstand Capability (SWC) Tests.

*IEC-68-2-30.* International Electromechanical Commission Standard for Basic Environmental Testing Procedure - Damp Heat, Steady State.

*C.37.90.2-1993 (ANSI/IEEE).* Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference.

*IEC 801-2, -3, -4, -5.* International Electromechanical Commission Standards.

*KYLE SPEC 574.* Surge Withstand Capability Testing of Electronic Controls.

*NSTA Standard ASTM D-999.* Vibration/shock (Transportation spec)  
Amplitude = 1 inch.  
Frequency = Adjusted for 1/16 inch bounce of packaged control.

### **FEATURES**

The Form 5 control shall include a receptacle to easily connect a control cable to the recloser and can be located remotely from the recloser. The control shall be housed in a weatherproof steel cabinet with three-point latching system, padlockable internally hinged door and shall include a thermostatically-controlled heater.

The operating range of the control shall be -40°C to +65°C, ambient.

The design of the Form 5 control shall consist of modular construction to provide maximum flexibility. A standard module configuration shall include a Recloser Interface Module (RIF), CPU Module, Power Supply Module, Communication Interface Module (CIF) and Front Operating Module. Two customizable Discrete Interface Modules (DIF), Fiber-Optic/RS232 communication cards, and a 120Vac GFI outlet shall be provided as accessories to interface with customer equipment.

The operating power shall be supplied from an external 120Vac or 240Vac (two-wire or three-wire) 50 Hertz or 60 Hertz source. A 12 amp-hour battery shall be provided for back-up control operation in the event of loss of primary supply. The battery shall be capable of operating the control for a minimum of 36 hours with no external loads connected and the cabinet door closed (LED's and display turned off). If the primary supply has not been restored within the allowable discharge time of the battery, the control shall shut down automatically and an indication of loss of power shall be issued.

An auxiliary 12Vdc or 24Vdc supply shall be provided for user loads with a maximum peak load capability of 40 watts (1 sec) and a continuous average capacity of 3 watts. The feed shall be separately fused, preventing user loads from disabling the control.

The Form 5 control shall be equipped with three serial communication ports, with two of them factory configurable to either 2179 or DNP 3.0 protocol. Two ports shall be located on the Communication Interface Module (CIM) and have the capability to interface with both RS-232 or fiber-optic equipment. The third port shall interface via RS-232 and be mounted on the front panel to facilitate local integration and operation of the control.

Two serial communications protocols are supported in the Form 5 Control.  
They are:

- ◇ Cooper Power Systems 2179 Protocol  
Reference R280-90-12,  
Serial Communications Protocol  
Reference R280-90-13,  
Communications Point Database
- ◇ GE—Harris DNP3.0 Protocol  
Reference R280-90-14,  
Communications Point Database

A battery test feature shall be incorporated into the Form 5 control which will monitor and report the state of the battery. Monitored data shall include battery terminal voltage and battery current (charging and/or load). Battery test terminals shall also be provided for external testing.

The front operating panel shall include 15 push-button switches: one each for Trip to Lockout and Close (with cold load pickup) plus 13 overlay switches. Nine of these overlay switches shall be customizable to customer-specific configurations. A Hot Line Tag toggle switch shall be mounted on the front panel to disable all closing operations.

The Form 5 control front operating panel shall include 32 LED status indicators of which seven will be fixed, nine are associated with overlay switches and up to 16 customizable to customer specifications. The seven fixed displays shall indicate:

- ◇ Recloser Closed
- ◇ Recloser Open
- ◇ Control Lockout
- ◇ Control OK
- ◇ AC Power
- ◇ Above Min Trip
- ◇ Hot Line Tag

The front operating panel shall include a 4-line by 20-character backlit LCD display that shall allow customizable displays for viewing operational data of the control, accessed through two push-button overlays. The LCD shall include complete metering information, including all current, voltage, and power values, along with trip values for all profiles. The LCD panel shall be scrollable in both directions.

The control software shall have a customer-programmed security code to limit access of control programming functions to authorized personnel.

Four protection profiles shall be provided, each capable of fully specifying the operation of the control in overcurrent protection. The profiles shall be selected from front panel switches, Discrete Interface (DIF) modules or through interface software and serial communication ports.

Each profile shall allow 14 independent Time-Current Curve specifications:

- ◇ Four Phase Overcurrents
- ◇ Four Ground Overcurrents
- ◇ One Each for Phase and Ground Fast Trips Disabled
- ◇ One Each for Phase and Ground Hot Line Tag
- ◇ One Each for Phase and Ground Cold Load Pickup

The selected Time-Current Curves shall be chosen from a total of 20 curves located in the control at any one time. The 20-curve library shall be user selectable from a database of 41 time-current curves to permit implementation of any standard or modified curve. Time-current curves shall also be available through a TCC editor to allow users to design their own curves.

The Form 5 control software shall have the ability to permit altering of any of the following TCC modifications:

*TCC Multiplier:* Shift the TCC up or down in time by a selected multiplier. The multiplier can be selected from 0.01 to 2.0 times the selected TCC, in increments of 0.01.

*Constant Time Adder:* Adds a constant time value to the selected TCC. The time adder can be selected from 0.01 to 0.20 seconds, in increments of 0.01 seconds.

*Minimum Response Time:* Provides a fixed minimum response time, 0.013 to 1.0 seconds, in increments of 0.001 seconds.

*High Current Trip:* Provides a trip at a selectable current value and a selectable time. The high-current ratio is selectable from 1 to 31.5 in 0.001 increments and the trip time is selectable from 0.016 to 0.15 in increments of 0.001 seconds.

*Custom TCC Design:* Provides custom designed TCC's which can be created by data points (time and current) entered by the user.

A Sequence Coordination feature shall be included which allows the control to step through selected operations in the operating sequence without tripping. The number of Sequence Coordination Advances is programmable from 1 to 3 operations to provide trip coordination with a downline recloser. This feature shall be independently selectable for each protection profile.

The control shall include a Cold Load Pickup feature to prevent the control from tripping while energizing non-fault system loads. This feature shall have an independently programmable time current curve, reclose interval and number of operations to lockout for each protection profile.

A Hot Line Tag feature to block all closing operations for live-line work shall be included in the design of the Form 5 control as a standard feature. When selected, the control will use the programmed Hot Line Tag TCC for overcurrent protection operating on one shot to lockout. This feature shall be independently selectable for each protection profile.

The control shall include a Fast Trips Disabled feature to modify the protection such that all trip operations use the programmed Fast Trips Disabled TCC. This feature shall be independently selectable for each protection profile.

A Reclose Retry feature shall be included that issues multiple reclose attempts in the event control power is lost. A reclose signal shall be issued at programmable intervals for a programmable number of attempts. This feature shall be independently activated for each protection profile.

A High Current Lockout feature shall be included to automatically lockout the control when current exceeds a programmable level. The active shot numbers for the lockout shall be selectable for both phase and ground and are independently selected for each protection profile.

The control shall include a Sensitive Ground Fault Trip feature that will provide tripping of the recloser after a programmable, definite time for ground currents below normal ground minimum trip levels. The feature shall have

programmable operations to lockout and reclose intervals independent of the ground settings. This feature shall be independently selectable for each protection profile.

The control shall provide instantaneous and demand metering with programmable integration intervals for the following functions:

- ◇ Real, Reactive and Apparent Power for each phase and total.
- ◇ Power Factor for each phase and total.
- ◇ Voltage Magnitude for each phase.
- ◇ Current Magnitude for each phase and neutral.
- ◇ Positive and Negative Sequence Voltages (Magnitude and Phase).
- ◇ Positive, Negative and Zero Sequence Currents (Magnitude and Phase).

Comprehensive harmonic information shall be included for three-phase voltages and currents plus neutral current. The analysis shall include total harmonic distortion in percent of the fundamental frequency plus the percent contribution for each of the second through fifteenth harmonics. Graphing capabilities shall also be included.

Histogram data shall be provided which displays statistical information including time tagged Min/Max values. Each record shall have programmable limits and the ability to clear records to start gathering new information. The histogram data shall display the number of occurrences of a metered variable versus the value of the variable.

The Form 5 control shall include a fully configurable alarm system with the ability to select 40 of a possible 100 data and status alarms. Data alarms shall be included that compare metered values to preset limits for a selectable time delay. Status alarms shall operate when user-selected functions change state. Both alarm types shall also have the ability to initiate an event recorder incident and also initiate a data profile sample.

The control shall include a programmable data-profiler feature which enables data collection at user-selectable intervals. The profiler shall have the ability to graph the collected data to display a trend and a cyclic representation of the profile.

An Event Recorder shall be provided to record and store events in non-volatile memory. The recorder shall include information on the time and date of the event, event type and data pertinent to the occurrence. The events recorded include the following:

- ◇ Overcurrent Trip
- ◇ Supervisory Trip from Port X
- ◇ Supervisory Trip from Discrete I/O
- ◇ Supervisory Ground Trip Block
- ◇ Supervisory Close from Port X
- ◇ Supervisory Close from Discrete I/O
- ◇ Successful Reclose
- ◇ Overcurrent Lockout
- ◇ Supervisory Lockout from Port X
- ◇ Non-Reclose Lockout
- ◇ High Current Lockout
- ◇ Close Retry Lockout
- ◇ Yellow Handle Lockout
- ◇ Sensitive Ground Fault Lockout
- ◇ Sequence Coordination
- ◇ Reset
- ◇ Local Close (Front Op. Panel)
- ◇ Local Trip and Lockout (Front Op. Panel)
- ◇ Remote Lockout from Port X

- ◇ Remote Lockout from Discrete I/O
- ◇ Loss of AC Power (where applicable)
- ◇ Restoration of AC Power (where applicable)
- ◇ Hot Line Tag Close Attempt
- ◇ EPROM Failure
- ◇ Check Battery
- ◇ Failed to Close from Close Signal
- ◇ Communication Port 1 Error
- ◇ Communication Port 2 Error
- ◇ Communication Port 3 Error

The Form 5 control software shall be equipped with a Recloser Interrupting Duty Monitor. The Duty Monitor shall accumulate the summation of I1.5 for all interrupted currents on each interrupter. The feature shall permit programmable entries to preset the duty of an existing recloser.

Two Discrete Interface Modules shall be available for order as accessories. Each shall be fully customizable to user specifications and contain 12 status-type inputs and 12 control-type outputs. The I/O points shall accept externally-supplied voltage or can supply power to function internally from the control.

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