

Service Information

S225-11-6

Tap-Changer Diagnostics

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PRODUCT INFORMATION

Introduction

Tap-Changer Motor Trouble Diagnostics Output (TCMT): A Status Indication/Alarm introduced with the January 2009 release of the Leader/Follower version of CL-6 firmware (rev 1.06.20). TCMT will detect and notify you of impending mechanical problems with your voltage regulator.

An active status of this output indicates a problem preventing the tap-changer motor from performing or completing (or the control not sensing) an operation either called for by an Automatic Regulation Tapping request or a Remote Manual Tapping request received through Digital SCADA communications. Problem detection includes but is not limited to the following:

- Blown motor fuse
- Failed/failing motor capacitor
- Failed/failing tap-changer motor
- Stalled tap-changer motor
- Faulty motor signal output wiring
- Failed/failing holding switch circuit
- Failed/failing control motor circuit components
- Incorrect setting of controls tap-changer configuration (FC049)

This Output is available through SCADA or separately as a configured CL-6 Alarm State as defined in this document.

A Read This Manual First

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment

Additional Information

These instructions cannot cover all details or variations in the equipment, procedures, or process described nor provide directions for meeting every possible contingency during installation, operation, or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the user's purpose, please contact your Cooper Power Systems sales representative.

Quality Standards

ISO 9001 Certified Quality Management System





Cooper Power Systems products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Cooper Power Systems employees involved in product design, manufacture, marketing and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high-voltage lines and equipment and support our "Safety For Life" mission.

SAFETY INFORMATION

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians, who are familiar with this equipment should install, operate and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, clampstick, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

A DANGER:

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

A WARNING:

Indicates a hazardous situation which, if not avoided, could result In death or serious injury.

A CAUTION:

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

CAUTION: Indicates a hazardous situation which, if not avoided, could result in equipment damage only.

Safety Instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

A DANGER:

Hazardous voltage. Contact with high voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment.

A WARNING:

Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage.

A WARNING:

This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply may result in death, severe personal injury and equipment damage.

A WARNING:

Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage.

SETUP PROCEDURE

SCADA Reporting

Called "Motor Trouble", this DNP Status (Object 1/2, factory Mapped Index 090, Internal Absolute point #103) can be read/ reported from the control and can be included in any custom user defined map. Factory configured mapping is shown here.

🕻 DNP Data Dictionary Mappin	gs - User 1			
General Object 1/2	Object 10/12	Object 20/2	22 Object 30/32	Object 40/41
Description 086 PE_ALT_PROFILE_STATE 087 INTERVAL_OPS_ENABLE 088 DST_FEATURE_STATE 089 DST_ACTIVE_STATE 097 LOOPSHARE_ENABLE_SI 098 LOOPSHARE_LOSS_OF_C 090 LOOPSHARE_LOSS_OF_C 100 LEADER_FOLLOWER_UT 101 LEADER_FOLLOWER_UT 102 TAP_TO_NEUTRAL_ACTI* 103 MOTOR_TROUBLE_STAT 104 LOOPSHARE_ACTIVE_ST.	Above >> Below >> << Remove Remove All	™map Abs 080 081 LED. 081 082 LED. 082 083 LED. 083 084 LED. 084 085 LED. 085 086 PE/ 086 087 INTE 087 088 DST 083 102 TAP 091 103 MOT 091 099 LOO	Description USSCRIPTION USSCRI	CIS CIS CIS CIS CIS CIS CIS CIS
ок				

DNP Data Dictionary Mappings, User 1.

There are two things to note when using SCADA communication to monitor the Motor Trouble State:

- **1.** The DNP Status is not dependent upon being configured as an Alarm to be read/reported through DNP communications.
- 2. The status will become active any time the control sends a tap command and it is not successfully completed. The status will not clear until the control sends a tap command and the regulator completes a successful tapping operation. While the status is active, the control will continue to send a tapping command every 30 seconds as long as the sense voltage remains out of band.

Configuring the Status Alarm

Called "Motor Trouble", this Status Alarm can generate Events, System Profile snapshots, and report an alarm state. In the example below, this Alarm feature is configured to:

- Illuminate the Red Alarm LED on the CL-6 front panel, (assigning a priority value between 1 and 50, has the effect of 1. illuminating the alarm LED when the status item is active).
- Record a time and date stamped Event in the Event Recorder. 2.
- 3. Record a System Profile Snapshot in the Data Profiler.

🕻 Alarm Configuration		
Status	Da	ata
(0010) Supervisory ACTIVE (0100) Reverse Power Flow (0101) No Input Voltage (0102) No Output Voltage (0110) Tap at Neutral (0120) Voltage Limit ON (0121) Tapping BLOCKED (0122) Voltage Reduction ON (0125) ARL AltConfig ACTIVE (0128) PMT Mode A in Progress (0129) PMT Mode B in Progress (0130) Set Default Time (0140) Power Up Error	<pre>(0123) Motor T Add >> < Remove Remove All </pre>	rouble
Properties: (0123) Motor Trouble-		Status & Data
Priority 1	Record Event When 🔽 Active 🔽 Inac	tive Delete All
Alarm Delay (sec) 0	Record Profile When 🔽 Active 🔲 Inac	tive Read All
🗖 Alarm On Low		Send All
ок		
Figure 2.		

Alarm Configuration.

4. Report the Alarm state through DNP for a standard Class 0 Static scan and/or a Class 1 Event scan.

🕻 DNP Data Dictionary Mappings -	User 2		
General Object 1/2	Object 10/12	Object 20/22 Object 30/32	Object 40/41
^Abs Description 000 NULL 001 BANDWIDTH_LOW 002 BANDWIDTH_HIGH 003 VUIMITINS_LOW 004 VLIMITINS_LOW 005 VRED_ACTIVE 006 REGULATION_STATE 007 PWR_DIR_IND 008 PWR_DIR 009 CONTROL_PWR_DIR 011 AUTO SWITCH	Above >> Below >> << Remove Remove All	'Map Abs Description 005 006 REGULATION_STATE 006 015 SVCALC_ENABLE 007 009 CONTROL_PWR_DIR 008 007 PWR_DIR_IND 009 008 PWR_DIA 010 012 VRED1_ACTIVE 011 013 VRED2_ACTIVE 012 011 AUTO_SWITCH 013 014 SUPERVISORY 014 103 MOTOR_TROUBLE_STATE 015 076 LED01_ALARM Copy Copy ^Class 015 076 014 013 MOTOR_TROUBLE_STATE 015 076 LED01_ALARM Copy ^Class 0 Only Class 0 0 Class 1 Class 1 Class 2 Class 3	Cis 0,1 0,1 0,1 0,1 0,1 0,1 0,1 0,1 0,1 0,1
ок			

DNP Data Dictionary Mappings, User 2.



Diagnostic Output Supplementary Settings

1. For both native SCADA reporting and Status Alarm Indication, in order to prevent false-positives due to the tapchanger being at the limits (Hard position indicator limit switches are factory set to 16 Raise and 16 Lower), the Soft-ADD-AMP[™] Feature must be enabled and the limits set to match the position indicator limit switches.

🕻 All Settings			
<u>Cir</u> Send <u>All</u> Chq <u>Poll</u>			_
Basic Ctl SettingsForwardSet Voltage120.0Bandwidth2.0Time Delay45LDC Resist0.0LDC React0.0	Configuration Identification 12345 Configuration (0) Wye (or Star) Operating Mode (0) Sequential (Std)	SOFT-ADD-AMP Mode [*] (1) On Upper Limit [*] (16) R Lower Limit [*] (16) L Voltage Limiter	Adv Features Event Recorder (1) On v Data Profiler (1) On v Status Alarms (0) Off v Data Alarms (0) Off v
Reverse Sensing Mode(0) Locked ForwardReverse Threshold1.0ReverseSet Voltage120.0	Sys Line Voltage7200PT Ratio60.0CT Rating200Demand Interval15.0Src Side Calc(1) 0n v	Mode (0) Off High Volt Limit 130.0 Low Volt Limit 105.0	Histograms (0) Off v PMT Mode A State (0) Off v Time Delay (days) 7
Bandwidth 2.0 Time Delay 45 LDC Resist 0.0 LDC React 0.0 Blocking Status	Regulator Type (1) B Load Tap Changer Type (0) Cooper QD8 TPI Sense Method (0) Incremental	Mode(0) UffLocal Reduction0.0Remote Set #10.0Remote Set #20.0Remote Set #30.0# Pulse Steps0& Red. Per Step0.0	PMT Mode B State (0) Off Time Delay (days) 1 Start Time 22:00 Stop Time 02:00 Max Deviation 8 Start Time 7
UJ Normal	Security Override (0) Standard	Tap To Neutral State (0) Off	Designation (0) Off V

All Settings.

2. For Status Alarm Indication, Status Alarms must be enabled in the control:

🕻 All Settings			
<u>Cir</u> Send <u>All</u> Cha <u>Poll</u>			
Basic Ctl Settings	Configuration	SOFT-ADD-AMP	Adv Features
Forward	Identification 12345	Mode (1) On 🔽	Event Recorder (1) On 💌
Set Voltage 120.0	Configuration	Upper Limit (16) R 🗸	Data Profiler (1) On 🗸
Time Delay 45	UJ Wye (or Star)	Lower Limit (.16)	Status Alarms * 11100 V
LDC Resist 0.0	Operating Mode		
LDC React 0.0	(0) Sequential (Std) 🛛 👻	Voltage Limiter	Data Alarms (0) Off 💙
Reverse Sensing Mode	Sys Line Voltage 7200	Mode (0) Off 🛛 🗸	Histograms 🛛 (0) Off 🔽
(0) Locked Forward 🛛 👻	PT Ratio 60.0	High Volt Limit 130.0	PMT Mode A
Reverse Threshold 1.0	CT Rating 200	Low Volt Limit 105.0	State MODE V
Reverse	Demand Interval 15.0	Voltage Reduction	Time Delau (daus) 7
Set Voltage 120.0	Src Side Calc (1) Un 🞽	Mode (0) Off	
Time Delau 45	Regulator Type (1) B 🛛 💙	Local Beduction 0.0	
LDC Resist 0.0	Load Tap Changer Type	Remote Set #1 0.0	
LDC React 0.0	(0) Cooper QD8	Remote Set #2 0.0	Time Delay (days) 7
	TPI Sense Method	Remote Set #3 0.0	Start Time 22:00
Blocking		# Pulse Steps 0	Stop Time 02:00
Status	(c) morener (c)	% Red. Per Step 0.0	Max Deviation 8
(0) Normal 🛛 👻	Security Override	Tap To Neutral	Lurrent Limit (%) 50
	(0) Standard 💌	State (0) Off 🗸	Designation (0) Off 💌



PROACTIVE TESTING OF THE MOTOR CIRCUIT

The Tap-Changer Motor Trouble Problem Diagnostics Output (TCMT) can be combined with the Preventative Maintenance Tapping (PMT[™]) feature to regularly test the motor circuit. By setting up the TCMT and then enabling PMT Mode A configured with a 1 day countdown timer, as shown in Figure 6, the control will exercise the motor circuit a minimum of once a day. The complete operation takes less than 1.5 seconds to perform with a Quik-Drive[™] (QD) Tap-Changer on a Cooper Power Systems Voltage Regulator.

🕻 All Settings				
Cir Send All Ch	na <u>Poll</u>			
Basic Ctl Settings		Configuration	SOFT-ADD-AMP	Adv Features
Forward Set Voltage	120.0	Configuration	Mode (1) On	Event Recorder (1) On 💟
Bandwidth	2.0	(0) Wye (or Star)	Upper Limit (16) R	Data Profiler (1) On 💟
Time Delay	45	Operating Mode	Lower Limit (-16) L	Status Alarms (1) On 🔽
LDC React	0.0	(0) Sequential (Std) 🛛 👻	Voltage Limiter	Data Alarms (0) Off 🔽
Reverse Sensing M	lode	Sys Line Voltage 7200	Mode (0) Off 🛛 🔽	Histograms (0) Off 💌
(3) Bi-Directional	×	PT Ratio 60.0	High Volt Limit 130.0	PMT Mode A
Reverse Threshold	1 1.0	Demand Interval 15.0	Low Volt Limit 105.0	State * 110n 💌
Set Voltage	120.0	Src Side Calc (1) On 🔽	Voltage Reduction	Time Delay (days) 1
Bandwidth	2.0	Regulator Type (1) B	Mode (0) Off	PMT Mode B
Time Delay	45	Load Tap Changer Type	Local Reduction 3.0 Remote Set #1 0.0	State (0) Off 🔽
LDC React	0.0	(0) Cooper QD8	Remote Set #2 0.0	Time Delay (days) 7
		TPI Sense Method	Remote Set #3 0.0	Start Time 22:00
Blocking		(0) Incremental	# Pulse Steps 0	Stop Time U2:00
(0) Normal	~		aneu. rei step 0.0	Current Limit (%) 50
(-),		Security Override	Tap To Neutral	Designation (0) Off
		(0) Standard 🛛 👻	State (0) Off 💌	
Eiguro 6				

All Settings.



PMT also includes the added benefit of insuring that along with the base Tap-Changer Movable Contact operation (PMT Mode A), the Tap-Changer Reversing Switch is also operated (PMT Mode B). PMT Mode B can be enabled using the steps in Figure 7.

🕻 All Settings								
Clr Send All Chq Poll								
Basic Ctl Settings Forward Set Voltage 120.0 Bandwidth 2.0 Time Delay 45 LDC Resist 0.0 LDC React 0.0 Reverse Sensing Mode [3] Bi-Directional Reverse Threshold 1.0	Configuration Identification 12345 Configuration (0) Wye (or Star) Operating Mode (0) Sequential (Std) Sys Line Voltage 7200 PT Ratio 60.0 CT Rating 200 Demand Interval 15.0	SOFT-ADD-AMP Mode (1) On Upper Limit (16) R Lower Limit (·16) L Voltage Limiter Mode (0) Off High Volt Limit 130.0 Low Volt Limit 105.0	Adv Features Event Recorder (1) On v Data Profiler (1) On v Status Alarms (1) On v Data Alarms (0) Off v Histograms (0) Off v PMT Mode A State (1) On v					
HeverseSet Voltage120.0Bandwidth2.0Time Delay45LDC Resist0.0LDC React0.0	Src Side Calc (1) On V Regulator Type (1) B V Load Tap Changer Type (0) Cooper QD8 V TPL Sense Method	Voltage ReductionMode(0) OffLocal Reduction3.0Remote Set #10.0Remote Set #20.0Remote Set #30.0	Time Delay (days) 1 PMT Mode B State * 110n v Time Delay (days) 1 Start Time *01:00					
Blocking Status (0) Normal	(0) Incremental	# Pulse Steps 0 % Red. Per Step 0.0 Tap To Neutral State	Stop Time0 2 : 0 0Max Deviation8Current Limit (%)50Designation(0) 0 ff					
Figure 7. All Settinas.								

When PMT Mode B is active, unless the normal tap-changer operation has caused the mechanism to cycle through neutral at least once during the day, the control is going to run it up one step past neutral and then back to its original position (on Cooper Power Systems QD mechanisms the operation time is less than 5 seconds). In this example, the operation will take place between 1:00 and 2:00 AM as long as the load current of the system does not exceed 50% of rated value.

Contact your Cooper Power Systems representative to answer questions or assist with implementing Tap-Changer Motor Trouble Diagnostics (TCMT) Outputs.



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