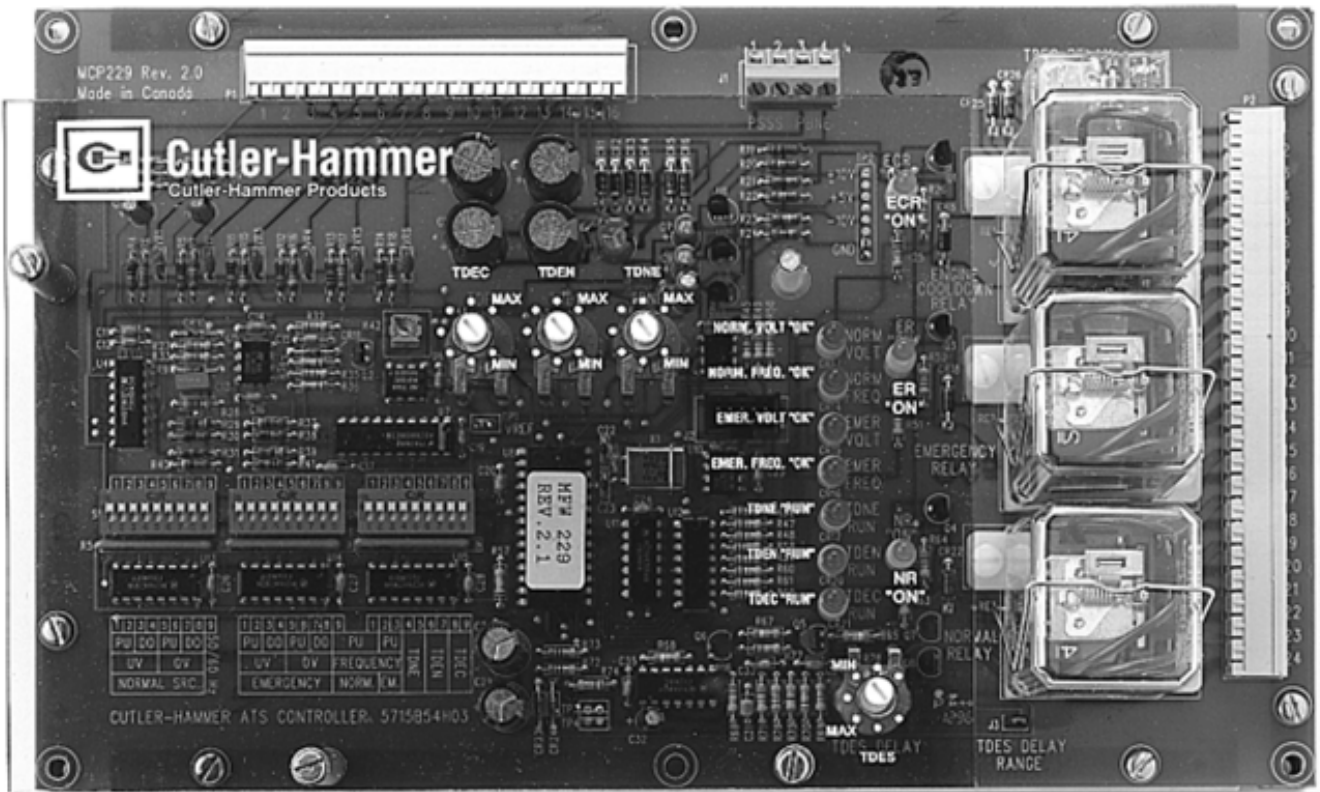




Instructions for Cutler-Hammer Microprocessor Based Logic Control Panel



 **WARNING**

READ AND UNDERSTAND THE INSTRUCTIONS CONTAINED HEREINAFTER BEFORE ATTEMPTING TO UNPACK, ASSEMBLE, OPERATE OR MAINTAIN THIS EQUIPMENT.

HAZARDOUS VOLTAGES ARE PRESENT INSIDE TRANSFER SWITCH ENCLOSURES THAT CAN CAUSE DEATH OR SEVERE PERSONAL INJURY. FOLLOW PROPER INSTALLATION, OPERATION AND MAINTENANCE PROCEDURES TO AVOID THESE VOLTAGES.

ALL POSSIBLE CONTINGENCIES WHICH MAY ARISE DURING INSTALLATION, OPERATION OR MAINTENANCE, AND ALL DETAILS AND VARIATIONS OF THIS EQUIPMENT DO NOT PURPORT TO BE COVERED BY THESE INSTRUCTIONS. IF FURTHER INFORMATION IS DESIRED BY PURCHASER REGARDING HIS PARTICULAR INSTALLATION, OPERATION OR MAINTENANCE OF PARTICULAR EQUIPMENT, CONTACT A CUTLER-HAMMER REPRESENTATIVE.

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SECTION 1 EQUIPMENT DESCRIPTION & OPERATION

1.1 GENERAL INFORMATION

Cutler-Hammer's brand of Automatic Transfer Switch Single Board Controller is a microcontroller-based transfer switch logic control package. The hardware and software of the controller contains the intelligence and supervisory circuits that constantly monitor the condition of the power sources. It provides the intelligence necessary for the operation of the transfer switch. The single board controller may be used as a replacement for the solid state logic control panel in existing older versions of the Cutler-Hammer Transfer Switches.

1.2 SPECIFICATIONS

The ATS controller has an operating temperature range of -20 degrees C to +75 degrees C.

The controller circuit board is protected by an insulating conformal coating.

The specifications under normal operating conditions are:

- Tolerance for voltage sensing function: $\pm 2\%$ of setting.
- Tolerance for frequency sensing function: ± 0.2 Hz of setting.
- Accuracy of time delay range: $\pm 2\%$ of setting.
- Dial settings for delay time are $\pm 5\%$ of indication.

1.3 OVERALL FUNCTIONAL DESCRIPTION

There are four main groups of functions included in the ATS single board controller.

1.3.1 VOLTAGE SENSING FUNCTIONS

Choices of voltage sensing functions are selectable for Normal and Emergency power sources as follows by means of factory programming.

- 1-phase or 3-phase sensing

Dip switches are used to select the pickup and dropout points for Normal undervoltage and Emergency undervoltage functions.

For undervoltage sensing function:

- Available pickup settings: 85%, 90%, 95%, and 100% of normal.

- Available dropout settings: 5%, 10%, 15%, and 20% below pickup setting.

1.3.2 FREQUENCY SENSING FUNCTIONS

The controller can be programmed to include underfrequency sensing for the Normal and Emergency power sources. Dip switches are used to select the normal frequency of the power sources and the pickup points. The normal frequency settings are 50 Hz or 60 Hz. The dropout points are fixed at 2 Hz differential.

Available pickup settings for the under frequency function are:

- at 60 Hz nominal = 56, 57, 58, 59 Hz
- at 50 Hz nominal = 46, 47, 48, 49 Hz.

1.3.3 TIME DELAY FUNCTIONS

The controller is factory programmed to include four different time delay functions. Each function has different timing ranges and can be adjusted by moving the appropriate dip switches or jumper (**Figure 1.1**).

TDNE, TDEN, and TDEC (Dip Switches)

- 0.1 sec. to 60 sec.
- 10 sec. to 10 min.
- 1 min. to 60 min.
- 3 min. to 200 min.

The controller is programmed for the TDES function. There are two different time ranges that can be selected by using a jumper.

- 0 sec. to 20 sec. (jumper installed)
- 20 sec. to 40 sec. (jumper removed)

1.3.4 ON-BOARD INDICATORS

Ten LED type indicators are installed on the controller's circuit board for the following functions:

Norm Volt	LED 'on' indicates the voltage level of the normal power source is within preset limits.
Norm Freq	LED 'on' indicates the frequency of the normal power source is within preset limits.
	LED 'flashing' indicates the frequency of the normal power source is out of preset limits.

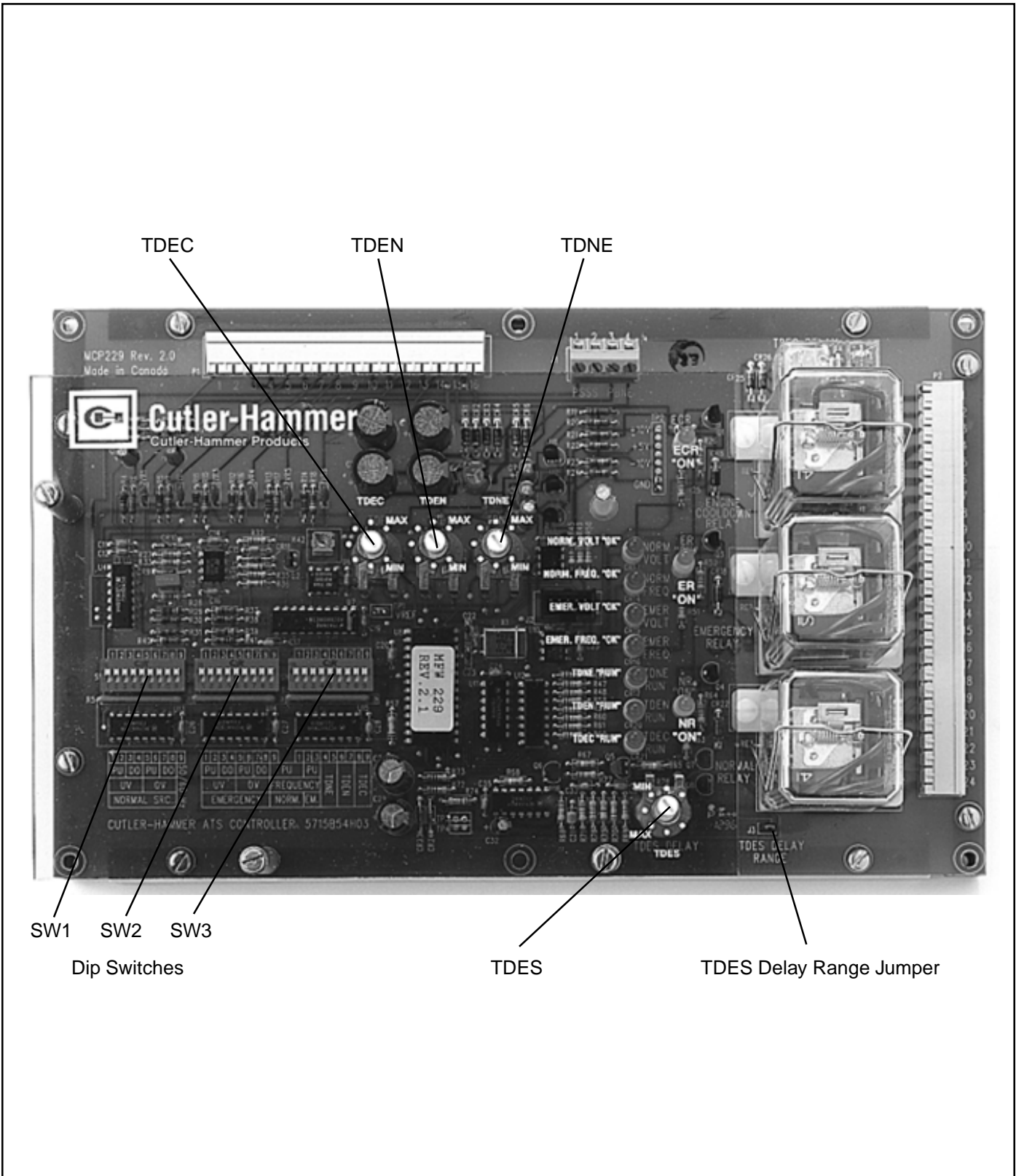


Figure 1.1 Microprocessor-based logic control panel

	LED 'off' indicates the normal frequency sensing option is not installed.
Emer. Volt	LED 'on' indicates the voltage level of the Emergency power source is within preset limits.
Emer. Freq	LED 'on' indicates the frequency of the Emergency power source is within preset limits.
	LED 'flashing' indicates the frequency of the Emergency power source is out of preset limits.
	LED 'off' indicates the emergency frequency sensing option is not installed.
TDNE RUN	LED 'flashing' indicates TDNE time delay function is in progress.
TDEN RUN	LED 'flashing' indicates TDEN time delay function is in progress.
TDEC RUN	LED 'flashing' indicates TDEC time delay function is in progress.
NR ON	LED 'on' indicates the normal output relay 'NR' is energized.
ER ON	LED 'on' indicates the emergency output relay 'ER' is energized.
ECR ON	LED 'on' indicates the engine cool-off output relay 'ECR' is energized.

1.4 ON-BOARD PROGRAMMABLE OPTIONS

ATS single board controller can be pre-programmed in the factory with the following ATS control functions on board:

1. Undervoltage sensing on Normal power source
2. Underfrequency sensing on Normal power source
3. Undervoltage sensing on Emergency power source
4. Underfrequency sensing on Emergency power source
5. Time Delay Normal to Emergency
6. Time Delay Emergency to Normal
7. Time Delay Engine Cool Down
8. Preferred Source Selection

If a Cutler-Hammer transfer switch has been installed in the field, any of these options/functions can be added on site by using the factory programmed 'Option Key.' Once the choice options are activated by the installed 'Option Key', the parameter of each function can be setup by positioning the DIP switches labeled SW1, SW2, and SW3 on the controller circuit board. This allows easy field modification of the control parameter settings at the user's discretion.

Both the pickup and dropout values of the sensing functions and the timing ranges of the time delay functions may be easily changed by following the instructions provided in the later sections of this instruction leaflet.

Controllers shipped from the factory are programmed to the user's original specification or to the standard pickup and dropout values as follows:

Function	Pickup	Dropout
Undervoltage	90%	80%
Underfrequency (60Hz)	58 Hz	56 Hz
Underfrequency (50Hz)	48 Hz	46 Hz

Operating Note

If the controller is to be used as a replacement for the solid state logic control package in an existing Cutler-Hammer transfer switch, please check the style number labeled on the transformer module. You will also need retrofit instructions available from the factory.



IF THE CONTROLLER IS TO BE USED FOR THREE-PHASE SENSING, YOU MUST ENSURE THAT THE SENSING SIGNALS (NORMAL OR EMERGENCY) ARE FED BY A THREE-PHASE TRANSFORMER PACKAGE. ON THE CUTLER-HAMMER BRAND THREE-PHASE UNITS, THE STANDARD IS THREE-PHASE SENSING ON NORMAL, AND SINGLE-PHASE SENSING ON EMERGENCY.

THREE-PHASE SENSING ON EMERGENCY IS AVAILABLE ONLY AS A FACTORY-INSTALLED OPTION. If in doubt, please contact the factory for assistance.

1.5 INSTRUCTIONS FOR DIP SWITCH SETTINGS

The DIP switches located and accessed from the bottom left portion of the control board must be properly set according to application requirements. The three DIP switches are labeled from left to right as SW1, SW2, and SW3. All switches are turned **ON** or **OFF** by sliding the switch. As you face the DIP switches, slide:

- To the TOP to turn the switch **ON**
- To the BOTTOM to turn the switch **OFF**

Always look for the **ON** and **OFF** designations on the hardware or printed circuit board to be sure you are setting the switches correctly.

Table 1 shows the selection grouping that can be provided by the three DIP switches.

DIP Switch	Switch Position	Description
SW1	1	Pickup and dropout values for the normal source UNDERVOLTAGE SENSING. Refer to Table 2.
	2	
	3	
	4	
	5	Not Used.
	6	
	7	
	8	
	9	Line frequency selection ON=60Hz OFF=50Hz.
SW2	1	Pickup and dropout values selection for the emergency power source UNDERVOLTAGE SENSING. Refer to Table 3.
	2	
	3	
	4	
	5	Not Used.
	6	
	7	
	8	
	9	Pickup and dropout values selection for the normal power source.
SW3	1	Underfrequency sensing. Refer to Table 4.
	2	Pickup and dropout values selection for the emergency power source. Underfrequency sensing. Refer to Table 5.
	3	
	4	Delay timing ranges selection for TDNE function. Refer to Table 6.
	5	
	6	Delay timing selection for TDEN function. Refer to Table 7..
	7	
	8	Delay timing ranges selection for TDEC function. Refer to Table 8.
	9	

Table 1 Selection grouping provided by the three DIP switches

Pickup (%)	Dropout (%)	SW1-1	SW1-2	SW1-3	SW1-4
100	95	ON	ON	ON	ON
	90	ON	ON	OFF	ON
	85	ON	ON	ON	OFF
	80	ON	ON	OFF	OFF
95	90	OFF	ON	ON	ON
	85	OFF	ON	OFF	ON
	80	OFF	ON	ON	OFF
	75	OFF	ON	OFF	OFF
90	85	ON	OFF	ON	ON
	80	ON	OFF	OFF	ON
	75	ON	OFF	ON	OFF
	70	ON	OFF	OFF	OFF
85	80	OFF	OFF	ON	ON
	75	OFF	OFF	OFF	ON
	70	OFF	OFF	ON	OFF
	65	OFF	OFF	OFF	OFF

Table 2 Parameters for programming undervoltage pickup and dropout for normal power source

Pickup (%)	Dropout (%)	SW1-5	SW1-6	SW1-7	SW1-8
105	110	ON	ON	ON	ON
	115	ON	ON	OFF	ON
	120	ON	ON	ON	OFF
	125	ON	ON	OFF	OFF
110	115	OFF	ON	ON	ON
	120	OFF	ON	OFF	ON
	125	OFF	ON	ON	OFF
	130	OFF	ON	OFF	OFF
115	120	ON	OFF	ON	ON
	125	ON	OFF	OFF	ON
	130	ON	OFF	ON	OFF
	135	ON	OFF	OFF	OFF
120	125	OFF	OFF	ON	ON
	130	OFF	OFF	OFF	ON
	135	OFF	OFF	ON	OFF
	140	OFF	OFF	OFF	OFF

Table 3 Parameters for programming undervoltage pickup and dropout for emergency power source

Pickup (%)	Dropout (%)	SW 1-5	SW 1-6	SW 1-7	SW 1-8
105	110	ON	ON	ON	ON
	115	ON	ON	OFF	ON
	120	ON	ON	ON	OFF
	125	ON	ON	OFF	OFF
110	115	OFF	ON	ON	ON
	120	OFF	ON	OFF	ON
	125	OFF	ON	ON	OFF
	130	OFF	ON	OFF	OFF
115	120	ON	OFF	ON	ON
	125	ON	OFF	OFF	ON
	130	ON	OFF	ON	OFF
	135	ON	OFF	OFF	OFF
120	125	OFF	OFF	ON	ON
	130	OFF	OFF	OFF	ON
	135	OFF	OFF	ON	OFF
	140	OFF	OFF	OFF	OFF

Table 4 Parameters for underfrequency sensing program for normal power source (standard feature)

Pickup (Hz)	Dropout (Hz)	Dipswitch SW2-9	Dipswitch SW3-1
60Hz SW1-9=ON			
59	57	ON	ON
58	56	OFF	ON
57	55	ON	OFF
56	54	OFF	OFF
50Hz SW1-9=OFF			
49	47	ON	ON
48	46	OFF	ON
47	45	ON	OFF
46	44	OFF	OFF

Table 5 Parameters for programming underfrequency pickup and dropout for emergency power source (standard feature)

RANGE	SW3-4	SW3-5
0.10 sec. to 60 sec.	ON	ON
10 sec. to 10 min.	OFF	ON
1 min to 60 min.	ON	OFF
3 min. to 200 min.	OFF	OFF

Table 6 Range selection for time delay normal to emergency

RANGE	SW3-6	SW3-7
0.10 sec. to 60 sec.	ON	ON
10 sec. to 10 min.	OFF	ON
1 min to 60 min.	ON	OFF
3 min. to 200 min.	OFF	OFF

Table 7 Range selection for time delay emergency to normal

RANGE	SW3-8	SW3-9
0.10 sec. to 60 sec.	ON	ON
10 sec. to 10 min.	OFF	ON
1 min to 60 min.	ON	OFF
3 min. to 200 min.	OFF	OFF

Table 8 Range selection for time delay engine cool down

	120	208	220	240	380	400	415	480	600	
65%	78	135	143	156	247	260	270	312	390	
70%	84	146	154	168	266	280	291	336	420	
75%	90	156	165	180	285	300	311	360	450	
80%	96	166	176	192	304	320	332	384	480	Std. UV Dropout
85%	102	177	187	204	323	340	353	408	510	
90%	108	187	198	216	342	360	374	432	540	Std. UV Pickup
95%	114	198	209	228	361	380	394	456	570	
100%	120	208	220	240	380	400	415	480	600	

Table 9 Normal system voltage

NOTE: Table 9 serves as a quick reference for finding the actual voltage level that relates to the percentage of the normal system voltage.

1.6 Adding Extra On-Board Programmable Options

When desired, extra on-board programmable control options can be added to a Cutler-Hammer Transfer Switch with the single board controller. Installable on-board options are:

1. Underfrequency sensing on Normal power source.
2. Time Delay Normal to Emergency.
3. Time Delay Emergency to Normal.
4. Time Delay Engine Cool Down.
5. Preferred Source Selection.

After receiving the factory programmed 'Option Key,' which contains the choice option(s) and the associated parts, if required, turn off the Normal power source and make sure to disable the Emergency power source by turning the generator set start control to manual. Plug the 'Option Key' into the 10-pin socket (J2) that is located in the center of the controller circuit board. The key is not polarized and can be plugged in either way. Install any extra parts if supplied. Turn the Normal power source back on. The new option function(s) will be programmed into the single board controller.

Note: *The DIP switches located and accessed from the bottom left portion of the control board must be properly set according to application requirements for the added control option(s). Please refer to the table 1 (page 8) that contains the instructions for DIP switch settings.*

SECTION 2 TESTING AND PROBLEM SOLVING

2.1 TESTING

After the transfer switch equipment is initially installed or during planned outages, the installation should be tested to ensure that all equipment operates properly. This attention to detail will help to avoid unexpected malfunctions. Mechanical and/or electrical tests should be performed as described in this section.

The frequency of subsequent testing should be based on recommendations of the generator set manufacturer. Use the test switch to check the electrical operation of the switch. **ALWAYS RETURN THE SWITCH TO THE AUTO POSITION AFTER THE TEST IS COMPLETE.**



HIGH VOLTAGES ASSOCIATED WITH OPERATIONAL TRANSFER SWITCH EQUIPMENT PRESENT A SHOCK HAZARD THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION TO AVOID TOUCHING ELECTRICAL CONNECTIONS WHENEVER INSPECTING OR TESTING THE EQUIPMENT.

IN ADDITION, IMPROPER OPERATION OF THE GENERATOR SET PRESENTS A HAZARD THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. OBSERVE ALL SAFETY PRECAUTIONS IN YOUR GENERATOR SET OPERATIONS AND INSTALLATION MANUALS.

2.2 MECHANICAL AND/OR ELECTRICAL TESTING

Energize the transfer switch equipment as described in the following Paragraphs 2.2.1 through 2.2.4. Insure that all safety precautions are taken and that all WARNINGS and CAUTIONS are observed.

2.2.1 NO VOLTAGE STEPS

WITH NO VOLTAGE AVAILABLE ON EITHER POWER SOURCE, PROCEED AS FOLLOWS:

Step 1: Check to make sure that both the normal and emergency power switching devices are in the **OPEN** position. The switching devices can be put into the **OPEN** position see appropriate transfer switch information bulletin.

- Step 2: Check to make sure the test selector switch, if provided, is in the **AUTO** position.
- Step 3: The generator engine start controls should be in the **OFF** position to prevent an undesired start.
- Step 4: Preset all timing circuits in keeping with timing instructions as outlined in the appropriate transfer switch information bulletin.
- Step 5: Check all transfer switch loads to ensure that they are ready to be energized.

2.2.2 CONNECTING POWER SOURCES

- Step 1: Close the Normal power source upstream protection device.
- The normal power switching device should close.
- Step 2: Connect the engine start battery cable.
- Step 3: With the emergency generator in the **OFF** position close the Emergency power source upstream protective device, assuming such a device is used.

Note: *At this point and prior to making any attempt to energize the transfer switch equipment, the engine-driven generator should be operated. If necessary, the voltage regulator on the generator should be adjusted according to the manufacturer's recommendations. The automatic transfer switch equipment will respond only to the rated voltage and frequency indicated on the switch rating nameplate.*

- Step 4: Reclose any generator engine-start controls opened as a result of actions taken in Step 3, Paragraph 2.2.1.
- Step 5: Where required, use an accurate voltmeter to check phase-to-phase and phase-to-neutral voltages present at the transfer switch normal, emergency, and/or load terminals.

2.2.3 OPERATIONAL CHECKS

- Step 1: Check to ensure that the normal switching device is in the **CLOSED** position. This should have been done in Step 1a, Paragraph 2.2.2.
- Step 2: Initiate an automatic transfer operation from the Normal to Emergency power source by moving the test selector switch from the **AUTO** to the **TEST** position.
- After the Time Delay Engine Starting (TDES), has timed out, the engine should start, run, and build up to normal voltage and frequency.

- b) The transfer switch will transfer to the Emergency power source (normal switching device opens and emergency switching device closes) after the Time Delay Normal to Emergency (TDNE), times out.

Step 3: Initiate an automatic transfer operation back to the Normal power source by moving the test selector switch from the **TEST** to the **AUTO** position.

- a) After the Time Delay Emergency to Normal (TDEN) has timed out, the transfer switch will transfer back to the Normal power source (emergency switching device opens and normal switching device closes).
- b) The Time Delay for Engine Cool-Off (TDEC) option will allow the engine to run unloaded for a preset time after transfer to Normal power source is completed.

2.2.4 ALTERNATE TESTS

1. Alternate operational tests may be possible depending upon the options provided with any given transfer switch. Refer to the schematic diagram provided with the transfer switch equipment along with the specification nameplate to determine the exact options provided.
2. If the transfer switch is operated manually with the Normal power source connected and available, it will cycle back to Normal power source, since it is the preferred source. The transfer switch is designed for safe manual transfer.

2.3 PROBLEM SOLVING



WARNING

HAZARDOUS VOLTAGES IN AND AROUND TRANSFER SWITCH EQUIPMENT DURING THE PROBLEM SOLVING PROCESS CAN CAUSE PERSONAL INJURY AND/OR DEATH. AVOID CONTACT WITH ANY VOLTAGE SOURCE WHILE PROBLEM SOLVING.



WARNING

ONLY PROPERLY TRAINED PERSONNEL FAMILIAR WITH THE TRANSFER SWITCH EQUIPMENT AND ITS

ASSOCIATED EQUIPMENT SHOULD BE PERMITTED TO PERFORM THE PROBLEM SOLVING FUNCTION. IF AN INDIVIDUAL DOES NOT FEEL QUALIFIED TO PERFORM THE PROBLEM SOLVING FUNCTION, THE INDIVIDUAL SHOULD NOT ATTEMPT ANY OF THESE PROCEDURES.

A basic problem-solving effort is the first step to take prior to calling for assistance. Frequently, the effort will successfully address most problems encountered. The problem-solving procedure is presented in the respective instruction book as observed problem symptoms and one or more possible solution steps. Remember, only qualified individuals familiar with the transfer switch equipment and the system in which it is applied should attempt these problem-solving procedures.

If a problem persists after having completed the problem-solving procedure, contact a Cutler-Hammer representative for further assistance. When calling for assistance, the following is the minimum information required to properly address the need:

1. General Order of transfer switch
2. Catalog Number of transfer switch
3. Actual location of transfer switch (type of facility, address etc.)
4. Company name
5. Name and position of individual representing company
6. Basic description of situation as it exists
7. Any results of problem solving steps taken and/or readings taken

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