

USING PROTEST II FOR DISTANCE RELAY TESTING

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by

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### I. INTRODUCTION

ProTest II™ is a hierarchical, menu-driven software system incorporating facilities for creating and storing relay test plans, running tests, outputting and archiving test data. System architecture includes recordkeeping functions which document: substation and location, protection terminal and relay function, test procedures, test instrument - to - relay - interconnections, relay identification, relay performance (including As Found/As Left data and test limits) and a free-form Notebook record which can be used for field test instructions and responses.

ProTest II™ supports a library of ProTestPLANS™ which are general purpose software packages, organized by IEEE Relay family. Each ProTestPLAN™ consists of a library of PRESETMACRO™ routines designed to simulate power system conditions for an IEEE relay family - combined with ACTIONMACROS™ which search for specific relay measuring characteristics. By selecting routines from the library and entering both PRESET and ACTION parameters and test limits, the user can configure comprehensive relay test plans which conform with company test practices.

The flexibility of both PRESETMACRO™ and ACTIONMACRO™ in each ProTestPLAN™ insures that all characteristics of an IEEE family of relays may be thoroughly examined. For example, the Z ProTestPLAN™ supports all distance relays; the Dynamic Z ProTestPLAN™ will increment the basic Z program to include Dynamic Testing.

### II. APPLICATION

ProTest II™ supports documentation for:

#### Location-based information

District  
Substation; name  
Terminal: circuit or function  
Primary system data; i.e. voltage and PT/CT ratios; nameplate I.D.  
Secondary protection scheme data: including measured line voltages, currents, phase relationships and functional performance.  
Operator comments, observations.

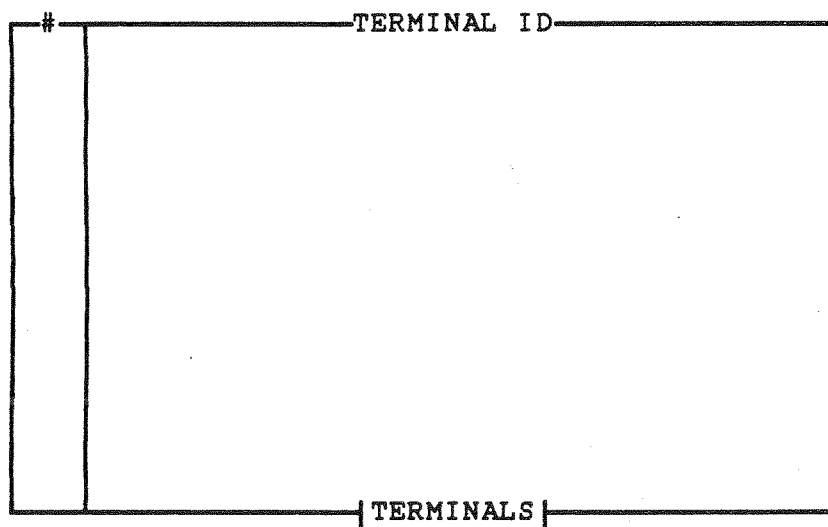
#### Relay-based information

Test documentation: number, revision code, date of revision, originator initials.  
Function: i.e., Zone 1-Distance, Phase A-T.O.C., etc.  
Identification: manufacturer, model/serial number  
Setting: for specific fault condition and +%/-% tolerance.  
Description: i.e., "induction-disc time overcurrent used to disconnect feeders when current exceeds a predetermined level.



tially accessible beginning with the Terminal Identification menu, level 1. Each data disk may support a Substation containing a number of terminals. The complement of relays in each Terminal is displayed in the Directory, level 2. The complete Test Plan for each relay is displayed in level 3. Each test of the Plan is available at level 4, the Test display.

LOCATION:



13:02:32

INSTRUCTIONS: Use function keys as shown

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
DIR	PASSWD	USER	HELP	ADD	DELETE		PRINT		DOS

TERMINAL IDENTIFICATION SCREEN; level 1  
FIGURE 2

This menu lists the protection terminals within that substation for which Relay Test Plans are stored.

Each Terminal is sequentially numbered for reference and identified by its name e.g., XYZ Line, Transformer Bank #1, Distribution Feeder A, etc. The next hierarchical level documents the complement of relays within each Terminal.

LOCATION:

#	RELAY ID	MFR	FUNCTION	TP #	R	ORIG	DATE	TYPE
DIRECTORY OF RELAYS								

10/16/1985 13:05:42

INSTRUCTIONS: Use function keys as shown

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
PLAN		USER	HELP	ADD	DELETE	COPY	PRINT	X-COPY	TERM

DIRECTORY OF RELAYS SCREEN; level 2  
FIGURE 3

The Directory sequentially lists all relays in a selected Terminal. For each relay, the manufacturer, identification number and relay nameplate function are listed. The test document number, revision, originator's initials and date are also listed to complete the information record for each relay. The "TYPE" column entry designates the ProTestPLAN required for the particular relay; i.e.: T-OC, Z, I, V, etc. The next level documents every test individually, for each relay listed in the Directory.



LOCATION:

RELAY ID			FUNCTION			TP #	R	OPERATOR:		
PRESET CONDITIONS						ACTION CONDITIONS				
SRC	CONNECT		TST	VALUE		FREQ		SENSE		
ASS	HI	LO	SRC	AMPL	PHASE	HZ				
			VA							
			VB							
			VC							
			I1							
			I2							
			I3							
			BAT							
			VDC							
			IDC							
			T/S							
SEN			ProTest MACRO							
PRESET: DELAY . SEC-ZERO X:										
ACTION: DELAY . SEC-ZERO X:										
SENSE: DELAY . SEC-DURATION. SEC										
			TEST :							

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

RELAY TEST SCREEN; level 4  
FIGURE 5

By selecting a ProTestMACRO™ from the Library, the test method and, therefore, the Test Screen will be defined. Parametric information for both PRESETMACRO and ACTIONMACRO fields define the relay-specific characteristics of each test. Expected results may be defined and +%/-% tolerance may be applied. When the test is RUN, the actual and expected results will be compared, percent error calculated and displayed together with PASS/FAIL. These data are then stored on the data disk for future use.

One basic format is used for the TEST SCREEN. It defines the connections for each relay terminal and assigns the Test Source to eliminate the need for instruction book references.

LOCATION:

RELAY ID	FUNCTION	TP #	R	OPERATOR:
ORIGINATOR				OPERATOR

Printer required

INSTRUCTIONS: Arrow keys select a record, function keys select an action

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	USER	HELP	DATA	PLOT		PRINT	MANUAL	PLAN

NOTEBOOK SCREEN; level 4  
FIGURE 6

A special Test Screen called NOTEBOOK may be used to communicate with test personnel. This free-form screen is divided into two fields: the ORIGINATOR field provides space for instructions to field test personnel. The USER field is unlocked and available to field personnel for recording: responses to questions, ancillary measurements or other comments appropriate to the particular relay. This information becomes part of the stored test record.

LOCATION:

RELAY ID \_\_\_\_\_ FUNCTION \_\_\_\_\_ TP # \_\_\_\_\_ R \_\_\_\_\_

OPERATOR:

PRESET CONDITIONS							ACTION CONDITIONS
SRC	CONNECT		TST	VALUE		FREQ	
ASS	HI	LO	SRC	AMPL	PHASE	HZ	
BAT	12	10	BAT	125.00	DC	DC	<p>//////// D A N G E R //////////</p> <p>When this test is run, the Battery Simulator is ON CONTINUOUSLY for the duration of the test plan.</p> <p>To turn voltage off, press F7 or F10.</p> <p>BATTERY SIMULATOR VOLTAGE</p> <div style="border: 1px solid black; display: inline-block; padding: 2px;">125</div> VOLTS DC
ProTest MACRO							
							TEST :

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	DATA	USER	HELP	MANUAL	PLOT		NEXT	PRINT	DONE

BATTERY SIMULATOR SCREEN; level 4  
FIGURE 7

For those microcomputer-based relays requiring full-time d.c. power, a variation of the Test Screen called Battery Simulator is provided. Its format is like all other test screens; however, when RUN as the first test of a Test Plan, the d.c. power is applied to the relay continuously until the last test is passed, completing the Test Plan - or until its operation is terminated by command.

The use of ProTest II to generate a Test Plan is limited in this paper to the Test display, level 4.

#### IV. OPERATION

All ProTestPLAN™ operations are accessed by function keys; these are defined at the bottom of each screen. Operations in the ORIGINATE mode are totally inclusive at all 4 levels. USER mode operation is limited to Selecting and Running tests. A number of function keys are reviewed at this time, prior to discussing Test Plan generation. The complete definition of function key operation is included in Appendix 1.

Requesting HELP by pressing function key 4 at the DIRECTORY, level 2, results in a listing of ProTestPLANS™. This establishes which relays may be tested based on which ProTestPLANS™ are available on disk.

In this paper, only Z ProTestPLAN™ functions are detailed.

Having previously selected the Z ProTestPLAN™ at level 2, requesting HELP at the TEST PLAN, level 3, results in this display of Z ProTestPLAN™ MACROS. These define the range of available test routines and those TEST screens designed to support each of them.

**Z PROTESTPLAN**  
**HELP - TEST PLAN, level 3**

<u>TEST FUNCTION</u>	<u>MACRO</u>	<u>DESCRIPTION</u>
Relay Power:	POWER	Battery Simulator - continuous dc voltage
Information:	NOTEBK	Free-form general info; user instructions/responses
Reach with Voltage:	RCHBSV	Fast search for unknown result
	RCHBOV	Fast search unknown result - reduced heating
	RCHLRV	Increase/decrease voltage until relay trips
	RCHPRV	Variable duty cycle pulses - low heating
Reach with Current:	RCHBSI	Fast search for unknown result
	RCHBOI	Fast search for unknown result - reduced heating
	RCHLRI	Increase/decrease current until relay trips
	RCHPRI	Variable duty cycle pulses - high I - low heating
MTA with Voltage	MAXTAV	Rotate phase angle - dropout lead/lag
MTA with Current	MAXTAI	Rotate phase angle - dropout lead/lag
Z Plot with Voltage:	ZPLBSV	Fast search characteristic unknown
	ZPLBOV	Fast search characteristic unknown - lo heating
	ZPLLRV	Increase/decrease volts to trip
	ZPLPRV	Lo heat pulses
Z Plot with Current:	ZPLBSI	Fast search characteristic unknown
	ZPLBOI	Fast search characteristic unknown - lo heating
	ZPLLRI	Increase/decrease current to trip
	ZPLPRI	Lo heat pulses
Offset Z Plot-Volts	ZOPLBV	Fast search - full offset characteristic unknown
	ZOPLBI	Fast search full offset characteristic unknown
Timing with Voltage	ZTIMEV	Apply voltage - measure operate time
	ZTIMEI	Apply current - measure operate time
Target Element:		
Pickup-with contact	DCRMPI	Linear ramp - stop on contact sense
	PULDCI	Single pulse limit test
Pickup-no contact	NOTEBK	Instruct user to perform manual test/record data
Instantaneous Elem:		
Pickup	PRAMPI	Variable duty cycle low heat pulses
	GONGOI	Single pulse limit test
Operate time	TIMEI	Apply current - measure time

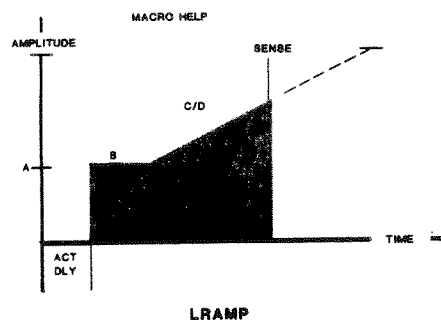
Other than Power and Notebook, each MACRO represents a variation on one of the basic search routines to permit a broad range of tests conforming with company practices. These search routines include:

- Linear Ramp
- Pulsed Ramp
- Binary Search
- Time
- Creep
- INDPU
- MTA

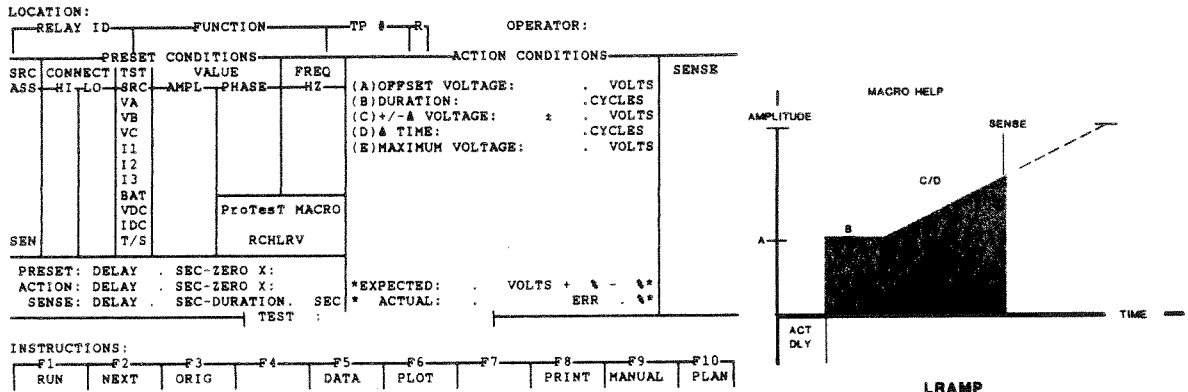
The linear ramp search is applied to current, voltage or phase angle by different MACROs. Figure 8 is an example of linear ramp, configured to execute a Reach test by using a current as the search parameter. Figure 9 also uses linear ramp, but voltage is the search parameter.

The graphics display the search function defined by the ACTION field.

LOCATION:		FUNCTION		TP #	R	OPERATOR:
RELAY ID		FUNCTION		TP #	R	OPERATOR:
PRESET CONDITIONS		ACTION CONDITIONS		SENSE		
SRC	CONNECT	TST	VALUE	FREQ		
ASS	HI	LO	SRC	AMPL	PHASE	HZ
	VA					
	VB					
	VC					
	I1					
	I2					
	I3					
	BAT					
	VDC					
	IDC					
	T/S					
SEN		ProTest MACRO		(A) OFFSET CURRENT: . AMPS (B) DURATION: . CYCLES (C) +/- A CURRENT: . AMPS (D) & TIME: . CYCLES (E) MAXIMUM CURRENT: . AMPS		
PRESET: DELAY . SEC		ZERO X:		* EXPECTED: . AMPS + % - %*		
ACTION: DELAY . SEC		ZERO X:		* ACTUAL: .		
SENSE: DELAY . SEC		DURATION: SEC		ERR . %*		
TEST :						
INSTRUCTIONS:						
F1	F2	F3	F4	F5	F6	F7
RUN	NEXT	ORIG		DATA	PLOT	
						F8
						PRINT
						F9
						MANUAL
						F10
						PLAN



"RCHLRI"  
FIGURE 8



"RCHLRV"  
FIGURE 9

Automating the test process using ProTest II™ permits a number of valuable test functions which are not possible in manually operated tests. The PULSED RAMP generates variable duty-cycle pulses in a linear ramp; it is used to minimize heating when testing at high currents; short-reach distance relays represent a typical application. BINARY SEARCH is another search function which locates the approximate REACH quickly, then ramps a voltage or current to establish REACH. This is particularly useful when testing a relay with unknown characteristics - or one which has exhibited a malfunction and the setting may have changed.

Appendix 2 lists all 2 ProTestPLAN™ MACROs, and includes each Test Screen with ACTIONMACRO™ graphics defining source operation.

PRESET and ACTION fields are described in the next section by referencing phasor relationships for a typical A-N fault.

### Generating Test Plans

The Test Screen is divided into two sections, PRESET and ACTION. The PRESET fields define the fault condition for which relay operation will be determined by the search function defined in the ACTION field. All phasor quantities may be defined, together with d.c. voltage requirements.

In the PRESET field, all 6 phasor quantities may be defined together with D.C. Sources and Delays.

Note the phasor notation VA, VB, VC, I1, I2, I3 have been assigned in the "TSC SRC" (Test Source) column. Relay terminals are noted in the "CONNECT" column. The "SRC ASS" (Source Assignment) field is defined by the test technician after the connections are made to the relay. By using the TEST SOURCE control on each F2000 test instrument, and toggling the appropriate power system phasor notation (VA, I1, etc.) based on the relay terminals to which the source is connected. The computer polls each instrument, then posts the assignment on the Test Screen.

The ACTION field parameters are filled-in, using the ACTIONMACRO graphics (on-line HELP) as a reference. That operation is shown in the next section.

LOCATION:

RELAY ID			FUNCTION			TP #	R	OPERATOR:		
PRESET CONDITIONS						ACTION CONDITIONS				
SRC ASS	CONNECT HI	LO	TST SRC	VALUE AMPL	PHASE	FREQ HZ				SENSE
			VA							
			VB							
			VC							
			I1							
			I2							
			I3							
			BAT							
			VDC							
			IDC							
			T/S							
SEN			ProTest MACRO							
PRESET: DELAY . SEC-ZERO X:			ACTION: DELAY . SEC-ZERO X:			SENSE: DELAY . SEC-DURATION. SEC				
			TEST :							

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TEST SCREEN  
FIGURE 10

Two examples of an A-N Fault are shown together with their tabulated phasor quantities. Figure 11 displays the use of an increasing current to SEARCH for REACH. Figure 12 shows a decreasing voltage to SEARCH for REACH. The PRESET field of the Test Screen containing the appropriate entries for each test are shown. These entries define the A-N fault condition. Entering "ACTION" in the parametric field for voltage/current as shown, indicates that the ACTION field describes the operation for that parameter!

In this case, the Linear Ramp search MACRO will be described since it most closely represents the manual routine of incrementing/decrementing a parameter.

LOCATION: W. S. U. CONFERENCE

RELAY ID		FUNCTION				
DISTANCE		ZONE 1				
PRESET CONDITIONS						
SRC	CONNECT	TST	VALUE	FREQ		
ASS	HI	LO	AMPL	PHASE	HZ	
VA	1	2	VA	30.0	000°	60.00
IV1	3	4	VB	69.7	-120°	60.00
IV2	5	6	VC	69.7	+120°	60.00
IH	7	8	I1	ACTION	-75°	60.00
			I2			
			I3			
			BAT			
			VDC			ProTest MACRO
			IDC			
SEN	9	10	T/S			RCHLRI

PRESET: DELAY 1.0SEC-ZERO X:SOURCE  
 ACTION: DELAY 2.0SEC-ZERO X:SOURCE  
 SENSE: DELAY0.1 SEC-DURATION.—SEC

A-N FAULT  
SEARCH-CURRENT

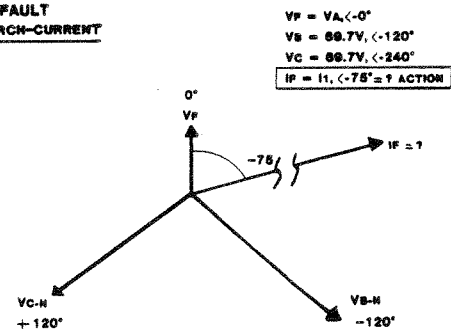


FIGURE 11

LOCATION: W. S. U. CONFERENCE

RELAY ID		FUNCTION				
DISTANCE		ZONE 1				
PRESET CONDITIONS						
SRC	CONNECT	TST	VALUE	FREQ		
ASS	HI	LO	SRC	AMPL	PHASE	HZ
VA	1	2	VA	ACTION	000°	60.00
IV1	3	4	VB	69.7	-120°	60.00
IV2	5	6	VC	69.7	+120°	60.00
IH	7	8	I1	18.5	-75°	60.00
			I2			
			I3			
			BAT			
			VDC			
			IDC			
SEN	9	10	T/S			
				ProTest MACRO		
				RCHLRV		

PRESET: DELAY 1.0SEC-ZERO X:SOURCE  
 ACTION: DELAY 2.0SEC-ZERO X:SOURCE  
 SENSE: DELAY 0.1 SEC-DURATION.—SEC

A-N FAULT  
SEARCH-VOLTAGE

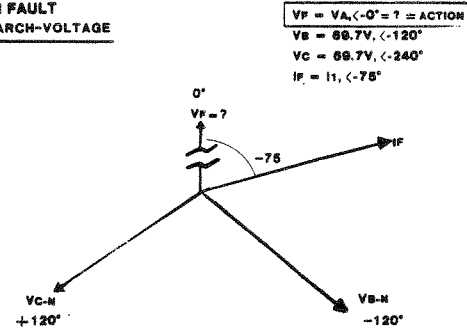


FIGURE 12

Figure 13 displays the ACTION screen for the Reach test using a Linear Ramp of Current, and includes a graphic representation of the ACTION parameter. Typical test values are entered for the current ACTIONMACRO. The MACRO is named RCHLRI.

ACTION CONDITIONS	
(A) OFFSET CURRENT:	4.2 AMPS
(B) DURATION:	63. CYCLES
(C) +/- δ CURRENT:	+ 0.1 AMPS
(D) δ TIME:	10. CYCLES
(E) MAXIMUM CURRENT:	40.0 AMPS

SENSE	
* EXPECTED:	18.5 AMPS +6 % -3 %*
* ACTUAL:	ERR . %*

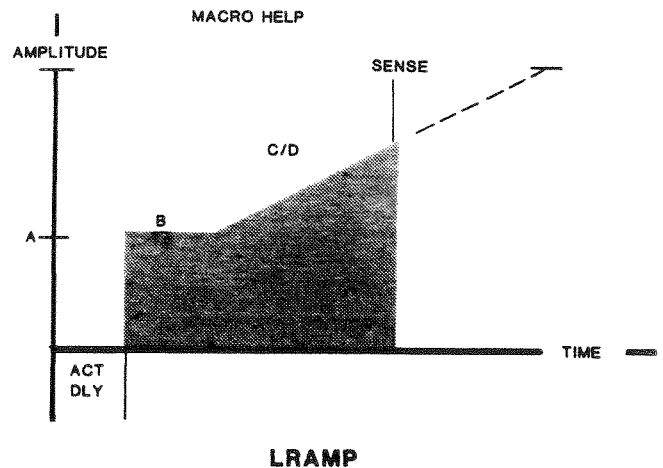


FIGURE 13

Figure 14 is also a Reach test, using a decreasing voltage -RCHLRV- together with the ACTION parameter graphics. Typical test values are entered for the voltage ACTIONMACRO.

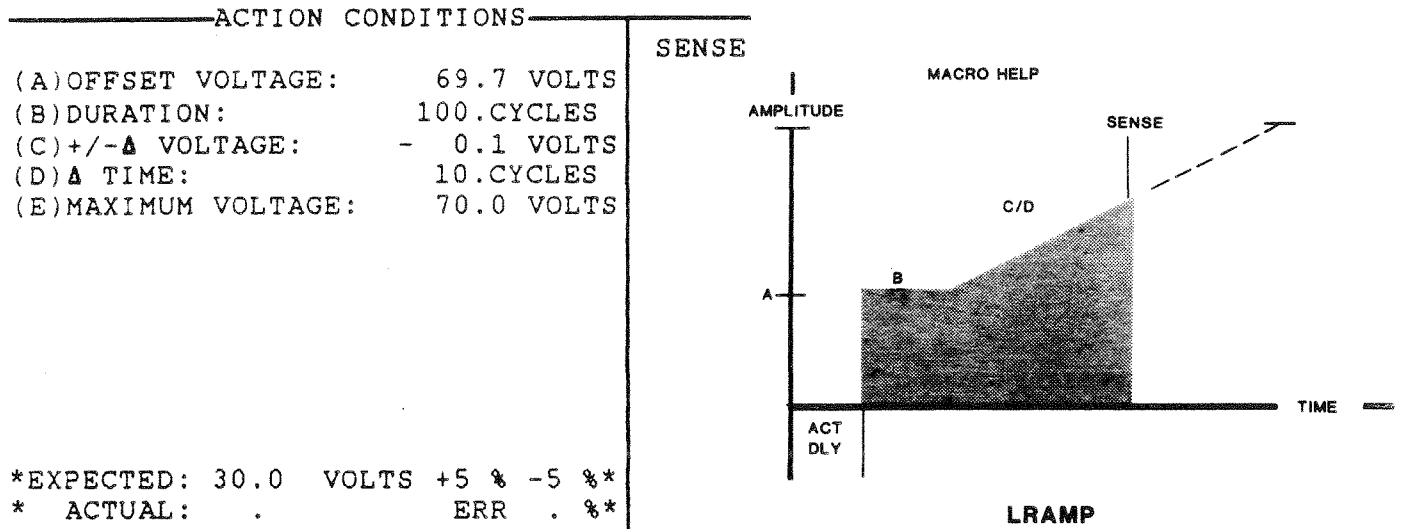


FIGURE 14

The complete test screen for both tests is shown in Figure 15. Note that the test screen provides relay-to-test instrument connections, source assignments and definition of the Sense (or Time) condition. Battery Simulator operation is displayed, if previously defined by the special Battery Simulator test screen and "RUN" prior to this test. Alternately BSIM may be used as a PRESET parameter.

The MACRO name selected by requesting HELP, and entering it in the DIRECTORY is carried to each Test Screen automatically for reference.



All single point tests may be assigned "EXPECTED" values and +/- tolerances. When the test is RUN, the ACTUAL value will be displayed together with % ERROR and PASS/FAIL.

LOCATION: W. S. U. CONFERENCE

OPERATOR: J. A. JODICE

RELAY ID		FUNCTION		TP #	R
DISTANCE		ZONE 1		12345	G
PRESET CONDITIONS				ACTION CONDITIONS	
SRC	CONNECT	TST	VALUE	FREQ	SENSE
ASS	HI	LO	AMPL	PHASE	
VA	1	2	VA 30.0	000°	60.00
IV1	3	4	VB 69.7	-120°	60.00
IV2	5	6	VC 69.7	+120°	60.00
IH	7	8	I1 ACTION	-75°	60.00
			I2		
			I3		
			BAT		
			VDC		
			IDC		
SEN	9	10	T/S		
			ProTest MACRO		
			RCHBSI		
PRESET: DELAY 1.0SEC-ZERO X:SOURCE					
ACTION: DELAY 2.0SEC-ZERO X:SOURCE				*EXPECTED: 18.5 AMPS + 6% -3 %*	
SENSE: DELAY 0.1 SEC-DURATION.—SEC				* ACTUAL: . ERR . %*	
TEST 1: A-N REACH					

INSTRUCTIONS:

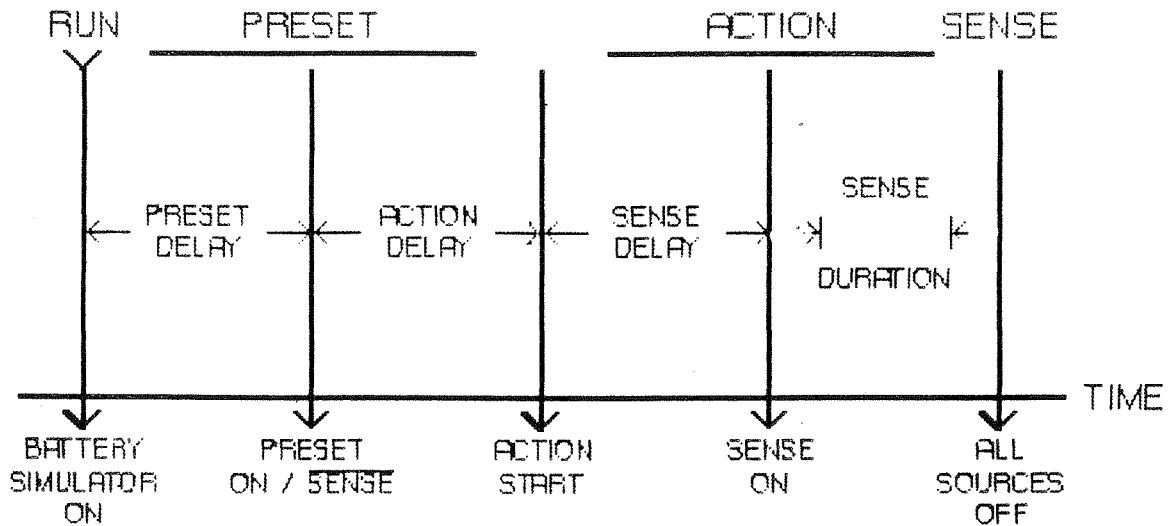
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

FIGURE 16

An example of another single point Reach test is shown in Figure 16. In this instance, current is the search parameter with the Binary Search ACTIONMACRO™. The graphics representing source operation for RCHBSI are shown in Appendix 2. Note that the Preset field is identical to that used for RCHLRI since the A-N fault condition is identical. A Reach test for any fault condition may be generated using a variety of ACTIONMACROS.

## V. RUNNING TESTS

Once the parametric data and the Source assignments have been entered on a Test screen, it is ready to RUN. The operator has all necessary information at his disposal: the Notebook may provide specific instructions and request information about a particular relay or measurement. The Test screen provides interconnecting information. When the RUN function key F10 is pressed, source operation follows this sequence for single point tests.



SOURCE OPERATION  
SINGLE-POINT TEST  
FIGURE 17

Variable time intervals may be specified between functional sections of a test.

If the Battery Simulator is used as a Preset, it will be turned on first, followed by all other Presets after the Preset Delay period. This allows a d.c. initializing interval for solid-state relays.

The Action Delay provides an interval of time during which the (fault) Presets may be applied as an a.c. initializing period.

The Sense Delay interval permits analysis of transient operation for all types of relays. It may be used in concert with Sense Duration. This test function may be used to insure relay operation occurs within the required interval, and that the output condition remains constant.

Multiple-point tests are a sequential group of single-point tests used to establish relay characteristics. A multiple-point REACH test results in data which can be plotted to display Reach Characteristic. Figure 18 displays source operation, where the search MACRO is repeated for each test angle. Preset and Action data are processed as in the previous examples with the exception of phase angle. The number of phase angles at which the Reach test is performed is specified by defining up to four arc segments. The total number of single-point Reach tests is 100, spread over four segments. Each segment may have varying resolution in phase angle beginning at 0.1°. This provides a high resolution characteristic in the areas of greatest concern and lower resolution where less critical performance will be plotted.

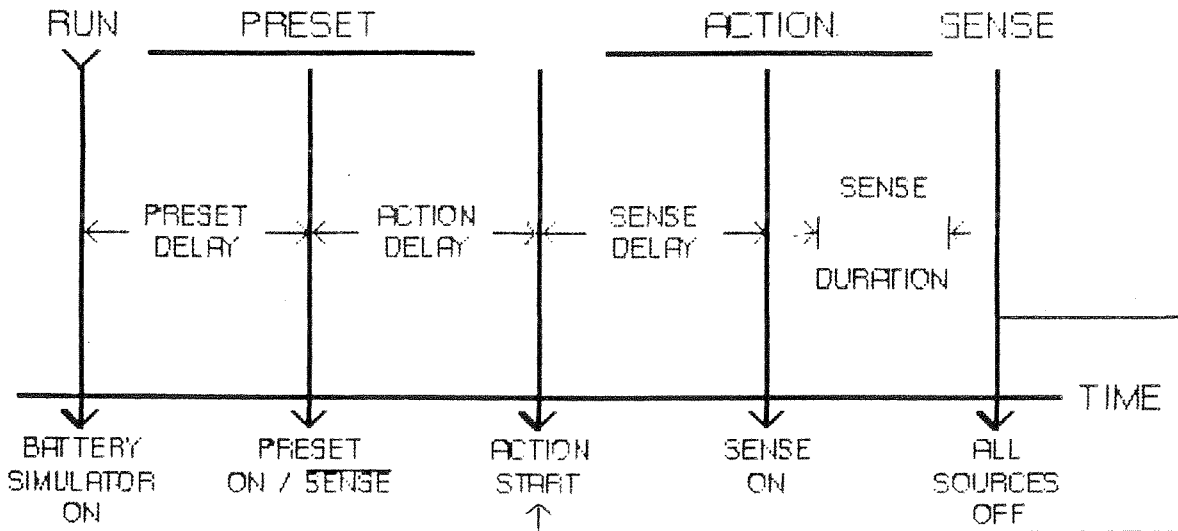


FIGURE 18

A Z characteristic test consists of two Test screens. The first screen incorporates the Preset and Action menus, together with a table which specifies arc segments. The ACTION field includes selection of an equation used to calculate Z.

The test record is displayed on a data screen; it includes the results of each of the single-point Reach tests prescribed by the four arc segments. These data also include the test angle, value of voltage or current determined by the Search MACRO and a calculated value for Z enabling a polar coordinate plot to be generated.

The ZPL MACRO operates using linear ramp, pulsed ramp and binary search. Specialized versions for fully offset characteristics and for determining maximum torque angle also incorporated in the MACRO library. See Appendix 2 for details of these Test Screens.

The interest in Dynamic performance of transmission relays continues to grow. Dynamic testing performed manually can be time

consuming, especially when time related performance for a large number of Reach angles is necessary. By expanding the scope of the ACTION field, a number of Dynamic tests may be performed.

LOCATION: Charles River Station - Walnut St. - Boston - Line : Doble 5

RELAY ID		FUNCTION		TP #	R	OPERATOR: J. A. Jodice	
ABCD-25N		Zone 1 - Distance		12345	D		

PRESET CONDITIONS							ACTION CONDITIONS			
SRC	CONNECT	TST	VALUE		FREQ	VALUE		ACTION DELAY: 5 SECS ZERO X (F7) : SYSTEM	TIMER TIME CONTACT O-C	
ASS	HI	LO	SRC	AMPL	PHASE	HZ	AMPL			PHASE
V1	1	2	VA	69.7 V	000°	60	20	-20°	RANGE: MS.	
V2	3	4	VB	69.7 V	-120°	60	69.7	-120°		
V3	5	6	VC	69.7 V	+120°	60	69.7	+120°		
IH	7	8	I1	3.95 A	-75°	60	8.21	-75°		
I1	9	10	I2	3.95 A	-195°	60	3.95	-195°		
I2	11	12	I3	3.95 A	+45°	60	3.95	+45°		
BAT	18	19	BAT	125 V	D.C.	D.C.				
TIM	21	22	T/S							
ProTest MACRO							** RESULTS **			
DYNAMIC-TIM							EXPECTED TIME : 25 MS.			
							TOLERANCE : +1% / -5%			
							ACTUAL TIME : 23.2 MS.			
							PASS/FAIL : PASS			

TEST #4 : A-N DYNAMIC

RUN 1 OF 5, 6-11-85 -0910

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	USER	HELP	DATA	PLOT	TOGGLE	PRINT	MANUAL	RUN

FIGURE 19

Figure 19 is a prototype of a Test Screen designed for measuring the operate time of three phase distance relays. The time-response to a change in stimulus from pre-fault (defined in the PRESET field) to post-fault (defined in the ACTION field), is measured. A MACRO for generating a characteristic plot of the dynamic response is planned, but has not yet been executed. It will follow the same basic structure of the Z PLOT MACRO; the plot will be expressed in conventional rectilinear form.

Archiving

Having selected a MACRO and configured a test to determine REACH by entering the parametric values, a "standardized" test is now established. A Test Plan consisting of a number of standardized REACH tests for all relay measurement functions may be configured to include A-N, B-N, C-N, A-B, B-C, C-A tests, each using the selected MACRO. This results in the "company standardized" Test Plan for a distance relay! Since the major difference between distance relays is the application which is reflected in different settings, the same, "standardized Test Plan" may be used for all relays. By changing parametric values and setting information, a new Test Plan may be generated.

Storing the "STANDARD" Distance Relay Test Plan on a "Standard Library Disk", then using the ProTest II™ XCOPY key to record it on a new data disk for another substation begins the process. Editing only those parameters unique to the functional application, generates a new Test Plan for an entirely different relay.

It is a simple extension of the standardized test procedure as manually applied to other relays of like type. COPY may be used for a Test, a complete relay Test Plan, or a Terminal. If duplicate protection systems exist at two substations, the complete disk may be copied.

The Copy function is being expanded for transmission of Test Plans and acquisition of test data (from remote locations) via modem.

## VI. CONCLUSION

As protective relay power system measurement functions grow in complexity, and new microcomputer designs emerge, more advanced methods are required for analysis, calibration and preventive maintenance.

### **Automated testing using ProTest II™ provides:**

- ...more comprehensive test routines
- ...better control of the testing process
- ...detailed test data and graphical representations of relay performance.

### **ProTest II™ testing means more information and better documentation at lower cost per preventive maintenance outage:**

- ...security of test method and data insure fewer errors

### **Storing Test Plans and data on disk provides new opportunities for preventive-maintenance management:**

- ...accurate date/time records
- ...transfer information to field locations and retrieve test data via modem
- ...develop maintenance data bases by direct retrieval of information.

These high levels of productivity can be achieved without computer operating experience using ProTest II™.

APPENDIX 1  
FUNCTION KEY OPERATION

A. TERMINAL

10/17/1985 16:44:00

INSTRUCTIONS: Arrow keys select a record, function keys select an action

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
DIR		ORIG					PRINT		DOS

TERMINAL - USER MODE FUNCTION KEYS

17:46:18

INSTRUCTIONS: Use function keys as shown

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
DIR	PASSWD	USER	HELP	ADD	DELETE		PRINT		DOS

TERMINAL - ORIGINATE MODE FUNCTION KEYS

The Terminal Selection Menu presents up to 14 terminal ID's, numbered 1 to 14, plus a set of function keys. When ProTest™ begins, it is in USER mode, limited to running test plans or displaying the results of previously run tests.

Function key actions are defined as follows:

USER MODE

**CURSOR CONTROL KEYS:** The arrow keys on the numeric keypad are used to move the cursor up and down, left and right. Except as otherwise indicated, they are the only keypad keys that are interpreted. As the cursor is moved from field-to-field on the screen, the field is highlighted to indicate that it is selected. (The cursor will position itself only on fields that are already defined or that are accessible for editing.)

**DIR:** A particular terminal is selected by positioning the cursor to the line containing the Terminal ID and pressing the DIR key. This brings up the display of the Directory of Relays for that terminal.

**ORIG:** Used to put ProTest™ into ORIGINATE mode. Response is to prompt for a password, if one exists on this data disk; the password is validated against the encrypted password stored on the data disk.

If the entered password is correct, ProTest™ enters ORIGINATE mode and the ORIG key display is replaced by USER and a complement of originate mode keys is displayed. If the password test fails, ProTest™ remains in user mode.

**PRINT:** Prints the list of Terminals.

**DOS:** Returns to the Disk Operating System.

## ORIGINATE MODE

(The user mode keys remain active, except ORIG.)

**CURSOR CONTROL KEYS:** The cursor is moved to the next directory name by the right-arrow or down-arrow key. It is moved to the previous line by the left-arrow or up-arrow key. As a line is identified by the cursor, it is highlighted to indicate which line is selected.

**ADD:** Text, terminated by carriage return, (CR), is inserted on the next available line to identify a new Terminal. A new line number is assigned and displayed automatically.

**NOTE:** As with all text fields, a field is selected by the position of the cursor, indicated by the fact that the field is highlighted. Hitting the first alphanumeric key opens the field for editing, and the characters entered replace what is shown on the screen. (CR) terminates the entry, permanently replacing the contents. The escape key (ESC) aborts the entry, restoring the previous data on the screen. The delete key (DEL) clears the field on the screen and opens the field for editing. If too many characters are entered in the field, a beep is sounded, the characters do not appear and an error message is displayed.

After a new Terminal has been named, an associated directory file is created. Typically, the text entered identifies the Substation and Terminal for which a Directory of test plans is to be created. The text entered will be carried forward and displayed as a heading on all test plans and test displays for this Terminal.

**DELETE:** To protect against accidental deletions, an "Are you sure? (Y/N)" prompt is issued, requiring response. Then the entire line marked by the cursor is deleted, along with the associated directory of test plans, all associated test plan files and individual test files (a potentially lengthy operation). The screen display and line numbering are then compacted.

**PASSWD:** Prompts for creation of a new password for the data disk, up to 10 characters, terminated by (CR). As the password is entered, it is not echoed. The originator is then requested to reenter the new password for verification; if it matches, the old password is replaced. (N.B.: this is the only time at which the password can be changed.)

**USER:** Returns to user mode, erasing the originator function keys.

B. DIRECTORY OF RELAYS

10/16/1985 17:57:55

INSTRUCTIONS: Use function keys as shown

F1 PLAN	F2	F3 ORIG	F4	F5	F6	F7	F8 PRINT	F9	F10 TERM
------------	----	------------	----	----	----	----	-------------	----	-------------

DIRECTORY OF RELAYS \_ USER MODE FUNCTION KEYS

10/16/1985 17:54:28

INSTRUCTIONS: Use function keys as shown

F1 PLAN	F2	F3 USER	F4 HELP	F5 ADD	F6 DELETE	F7 COPY	F8 PRINT	F9 X-COPY	F10 TERM
------------	----	------------	------------	-----------	--------------	------------	-------------	--------------	-------------

DIRECTORY OF RELAYS - ORIGINATE MODE FUNCTION KEYS

The second level of display is the Directory of Relays for a selected Terminal. If ProTest™ were put into ORIGINATE mode at the first level, the function keys displayed at the second level would also be for ORIGINATE mode. Otherwise, ProTest™ remains in USER mode. ORIGINATE mode may be entered by the same procedure described above; viz., hitting the ORIG key and entering the password.

The Directory of Relays inserts the text string contained in the Terminal Selection Menu on the LOCATION line. Up to 14 relay Test Plans are displayed. If more than 14 relays are required for this Terminal, they can be seen by scrolling the screen with the down-arrow cursor key or by paging the display with the PgDn key. A "More" message is displayed to indicate that more data can be seen by scrolling.

Function key actions are defined as follows:

USER MODE

CURSOR CONTROL KEYS: Down-arrow advances to the next line, up-arrow backs up to the previous line. As each line is selected, it is highlighted on the screen. (Right-arrow and left-arrow traverse from field-to-field on a line, rolling over to the next or previous line -- not particularly useful in user mode.)

If there are more than 14 test plans, down-arrow from the 14th line will scroll the plans up to reveal the 15th test plan. PgDn will bring up the next page of up to 14 test plans. Up-arrow will scroll backwards from line 1 of the display; PgUp will page backwards to the preceding page.

PLAN: The cursor is positioned to a line identifying a test plan and the PLAN key is hit to bring up the selected test plan display.

ORIG: Prompts for entry of the password and validates it. If successful, a complement of originate mode function keys is displayed.

PRINT: Prints the complete Directory of Relays.

TERM: Returns to the Terminal Selection Menu.

## ORIGINATE MODE

(User mode keys remain active, except for ORIG.)

CURSOR CONTROL KEYS: Same as in USER mode.

USER: Returns to user mode; changes USER key to ORIG and clears originate mode key display.

HELP: Displays a help screen.

ADD: Used to add a new relay to the Directory. A new line is added at the end of the list and is opened for data entry; the next sequential line number automatically posted. (If the end of the list is not currently on display, the page containing the end is presented.) Text data is entered into the selected field, terminated by (CR). If too many characters are entered, a beep and error message occur. After a field has been entered, the cursor advances to the next field on the line. The ADD operation completes when the last field on the selected line has been entered. The associated test plan file is then created on the data diskette.

DELETE: To prevent accidental deletion, a verification prompt is given and if approved, the entire line marked by the cursor is deleted, along with the associated test plan file and individual test files. The screen display and line numbering are then compacted.

COPY: A new line is added and the entire line marked by the cursor position is copied to the new line. A new line number is assigned, and the first field selected for editing.

XCOPY: Like COPY, but copies a relay test plan from a different terminal file on the same data diskette, or from a terminal file on a different data diskette. Prompts for whether the copy is from another diskette.

NOTE: When copying from another diskette, the ProTest™ system diskette must be removed and the source data diskette placed in drive A. To select the desired test plan to copy, the user steps through the Terminal Selection Display and the Directory of Relays on the source diskette, using the same function keys as before. However, only the function keys necessary to select the test plan and complete the copy are displayed. When XCOPY is complete, the source diskette is then removed and the ProTest system diskette replaced. The system prompts the user when to change the diskettes.

C. RELAY TEST PLAN

10/16/1985 18:07:57

INSTRUCTIONS: Use function keys as shown

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
TEST		ORIG					PRINT		DIR

TEST PLAN - USER MODE FUNCTION KEYS

10/16/1985 18:05:19

INSTRUCTIONS: Use function keys as shown

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
TEST		USER	HELP	ADD	DELETE	COPY	PRINT	SWAP	DIR

TEST PLAN - ORIGINATE MODE FUNCTION KEYS

The Test Plan display identifies the tests to be performed on a specific relay. For each test, it shows the test macro used, whether the results (including a possible data plot) are to be automatically printed when the test is RUN, and a pass/fail notation indicating whether a test has passed. A column specifies whether the test preset and action parameters are locked -- i.e., cannot be modified in user mode (YES means all parameters are locked, PSET means the presets are locked, and NO means that neither presets nor action parameters are locked). Room for a brief user note is also provided. Up to 14 tests can be displayed; if more are required, they are viewed by paging the display with the PdDn key or by scrolling with the down-arrow.

Function key actions are defined as follows:

USER MODE

CURSOR CONTROL KEYS: Down-arrow advances to the next line, up-arrow backs up to the previous line. As each line is selected, it is highlighted on the screen. (Right-arrow and left-arrow traverse from field-to-field on a line, rolling over to the next or previous line -- not particularly useful in user mode.)

If there are more than 14 tests, down-arrow from the 14th line will scroll the plans up to reveal the 15th test. PgDn will bring up the next page of up to 14 more tests. Up-arrow will scroll backwards from line 1 of the display; PgUp will page backwards to the preceding page.

TEST: Position for entry of the password and validates it. If successful, the complement of originate mode keys is displayed.

PRINT: Prints the complete test plan.

DIR: Returns to Directory of Relays display.

ORIGINATE MODE

(User mode keys are still active, except ORIG.)

CURSOR CONTROL KEYS: Right-arrow advances to the next field on the line, rolling over to the first field on the next line. As each field is selected, it is highlighted on the screen. Down-arrow moves to the same field in the next line, scrolling over to the first line of the next page from display line 14. Left-arrow and up-arrow work the same in the opposite direction. PgDn and PgUp are used to page through test when there are more than 14.

USER: Enters user mode, clears originate mode key display and shows ORIG on F3.

HELP: Brings up help display.

ADD: A new line at the end of the list is added and opened for data entry, and a next sequential line number automatically posted. (If the end of the list is not currently on display, the page containing the end is presented.) Text data are entered into the selected field, terminated by (CR). After a field has been entered, the cursor advances to the next field on the line. The ADD operation completes when the last field on the selected line has been entered. The associated test files are then created on the data diskette.

DELETE: After a verification prompt, the entire line marked by the cursor is deleted, along with all the associated test files. The screen display and line numbering are then compacted.

COPY: A new line is added at the end of the list and the entire line marked by the cursor position is copied to the last line. It can then be edited field-by-field.

SWAP: Prompts for the two line number to be swapped. The two lines are then swapped, thereby changing the order in which the two tests are listed. (An invalid line number terminates the command with an error message.)

D. RELAY TEST

INSTRUCTIONS: Arrow keys select a record, function keys select an action

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TEST - USER MODE FUNCTION KEYS

INSTRUCTIONS: Arrow keys select a record, function keys select an action

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	USER	HELP	DATA	PLOT		PRINT	MANUAL	PLAN

TEST - ORIGINATE MODE FUNCTION KEYS

A ProTestPLAN contains a set of relay test macros that can be configured to test any relay of a particular family. For example, there are many ways to perform a reach test for an impedance (Z) relay. To configure a specific test, a "fill-in-the-blanks" approach is used. The standard display for the MACRO named in the Test Plan is called up in ORIGINATE mode; the values for test stimuli, test limits, relay connections and ACTIONMACRO™ sequences are filled in on the screen. If test data are on file from a previous run of this test, the As Found results are displayed.

When a single point, Pass/Fail, test is first run, the test data are recorded and marked "As Found"; data from subsequent test runs are recorded until a PASS is noted, and that record becomes the "As Left" data. Additional single point test runs are recorded in a spare data slot, so that a total of 5 test results can be stored. If many runs are made before the test passes, the record contains the As Found, the first 2 reruns of the test, the passing or As Left value, and the latest subsequent run in the spare slot.

Function key actions are defined as follows:

#### USER MODE

**RUN:** Executes the test -- if the test has been fully defined and if a proper instrument configuration is available. If not, an error message is displayed and the command terminates. As the test progresses, result data are displayed and recorded in the data file. If the print option in the Test Plan is YES, a copy of the screen data, including a curve plot if appropriate, is spooled to the printer.

**NEXT:** Steps to the next sequential test in the test plan, bringing up the test display, eliminating the need to return to the Test Plan level to select the next test.

**ORIG:** Prompts for entry of the password and validates it. If successful, the ORIG key is replaced by USER, and the HELP key is displayed.

**DATA:** If more than one set of data are on file (e.g., an As Found and a later run), the DATA key is used to page forward through the recorded data from the As Found to later results, wrapping around to the As Found.

**MANUAL:** Normally, the test instrument is placed in Remote mode for operation from the PC. In the event of a problem or the need to adjust or calibrate the relay, the test instrument can be placed in Manual mode, enabling its front panel controls and effectively disconnecting from the PC. The Manual function key does this, and then displays REMOTE for the key. The same key toggles the status of all connected instruments between Remote and Manual.

**PLOT:** If a data plot is possible for the test results, the left side of the screen is cleared and a character graphic plot appears, overlaying the PRESET field. Any key then restores the test display.

PRINT: Prints the test screen display, all recorded test data and a plot if defined for this test.

PLAN: Returns to the Test Plan display, from which another test may be selected. If a test is running when the DONE key is hit, the test will be discontinued, the test instrument sources will be turned off and no data recorded for the run.

#### ORIGINATE MODE

(User mode keys remain active, except for ORIG.)

CURSOR CONTROL KEYS: Right-arrow advances to the next field on the display related to the data section where it is located. As each field is selected, it is highlighted on the screen. Down-arrow moves to an analogous field in the next line or onto another section of the screen. Left-arrow and up-arrow work the same in the opposite direction.

NOTE: Data are inserted or edited by selecting a field with the cursor and then entering data. Fields are restricted to data of a particular type, such as real numbers or text, and invalid data are not accepted. A field edit is terminated by (CR). Text or numeric data are entered with the keyboard; however, certain fields allow only a selection of options (e.g., Test I = Multiples or Test I = Amps) that are toggled by hitting the space bar. When a "toggle" field is selected by the cursor position, a prompt appears and directs use of the space bar to select an option. If no prior selection exists, the field initially appears blank -- the space bar then causes the first option to be displayed. The edit session is terminated by hitting the PLAN key, at which time the test data files are updated.

USER: Enters user mode, clears originate mode key display and shows ORIG on F3.

APPENDIX 2

Z PROTESTPLAN  
HELP - TEST PLAN, level 3

<u>NO.</u>	<u>TEST FUNCTION</u>	<u>MACRO</u>	<u>DESCRIPTION</u>
1	Relay Power:	POWER	Battery Simulator - continuous dc voltage
2	Information:	NOTEBK	Free-form general info; user instructions/responses
3	Reach with Voltage:	RCHBSV	Fast search for unknown result
4		RCHBOV	Fast search unknown result - reduced heating
5		RCHLRV	Increase/decrease voltage until relay trips
6		RCHPRV	Variable duty cycle pulses - low heating
7	Reach with Current:	RCHBSI	Fast search for unknown result
8		RCHBOI	Fast search for unknown result - reduced heating
9		RCHLRI	Increase/decrease current until relay trips
10		RCHPRI	Variable duty cycle pulses - high I - low heating
11	MTA with Voltage	MAXTAV	Rotate phase angle - dropout lead/lag
12	MTA with Current	MAXTAI	Rotate phase angle - dropout lead/lag
13	Z Plot with Voltage:	ZPLBSV	Fast search characteristic unknown
14		ZPLBOV	Fast search characteristic unknown - lo heating
15		ZPLLRV	Increase/decrease volts to trip
16		ZPLPRV	Lo heat pulses
17	Z Plot with Current:	ZPLBSI	Fast search characteristic unknown
18		ZPLBOI	Fast search characteristic unknown - lo heating
19		ZPLLRI	Increase/decrease current to trip
20		ZPLPRI	Lo heat pulses
21	Offset Z Plot-Volts	ZOPLBV	Fast search - full offset characteristic unknown
22		ZOPLBI	Fast search full offset characteristic unknown
23	Timing with Voltage	ZTIMEV	Apply voltage - measure operate time
24		ZTIMEI	Apply current - measure operate time
	Target Element:		
25	Pickup-with contact	DCRMPI	Linear ramp - stop on contact sense
26		PULDCI	Single pulse limit test
27	Pickup-no contact	NOTEBK	Instruct user to perform manual test/record data
	Instantaneous Elem:		
28	Pickup	PRAMPI	Variable duty cycle low heat pulses
29		GONGOI	Single pulse limit test
30	Operate time	TIMEI	Apply current - measure time (Not in Appendix

LOCATION:

RELAY ID	FUNCTION	TP #	R
----------	----------	------	---

OPERATOR:

PRESET CONDITIONS	ACTION CONDITIONS
-------------------	-------------------

SRC	CONNECT	TST	VALUE	FREQ
ASS	HI	LO	AMPL	PHASE
				HZ
BAT	12	10	BAT 125.00	DC
				DC
ProTest MACRO				

////// D A N G E R //

When this test is run, the Battery Simulator is ON CONTINUOUSLY for the duration of the test plan.

To turn voltage off, press F7 or F10.

BATTERY SIMULATOR VOLTAGE

125 VOLTS DC

TEST :

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	DATA	USER	HELP	MANUAL	PLOT		NEXT	PRINT	DONE

LOCATION:

RELAY ID	FUNCTION	TP #	R
ORIGINATOR			

OPERATOR:

OPERATOR

INSTRUCTIONS: Arrow keys select a record, function keys select an action

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	USER	HELP	DATA	PLOT		PRINT	MANUAL	PLAN

LOCATION:

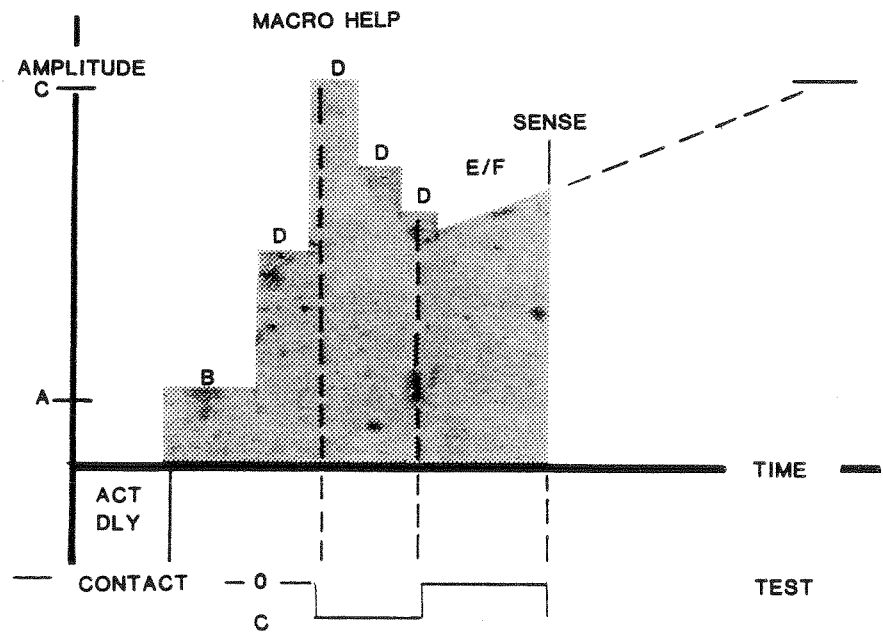
RELAY ID			FUNCTION			TP #	R	OPERATOR:		
PRESET CONDITIONS						ACTION CONDITIONS				
SRC	CONNECT		TST	VALUE		FREQ	(A) OFFSET VOLTAGE: . VOLTS (B) DURATION: . CYCLES (C) MAXIMUM VOLTAGE: . VOLTS (D) PULSE DURATION: . CYCLES (E) +/- Δ VOLTAGE: ± . VOLTS (F) Δ TIME: . CYCLES			SENSE
ASS	HI	LO	SRC	AMPL	PHASE	HZ				
			VA							
			VB							
			VC							
			I1							
			I2							
			I3							
			BAT	ProTest MACRO						
			VDC	RCHBSV						
			IDC							
SEN			T/S							
PRESET: DELAY . SEC-ZERO X:			ACTION: DELAY . SEC-ZERO X:			*EXPECTED: . VOLTS + % - %*				
SENSE: DELAY . SEC-DURATION. SEC						* ACTUAL: . ERR . %*				
TEST :										

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



BSRCH

LOCATION:

RELAY ID	FUNCTION	TP #	R
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OPERATOR:

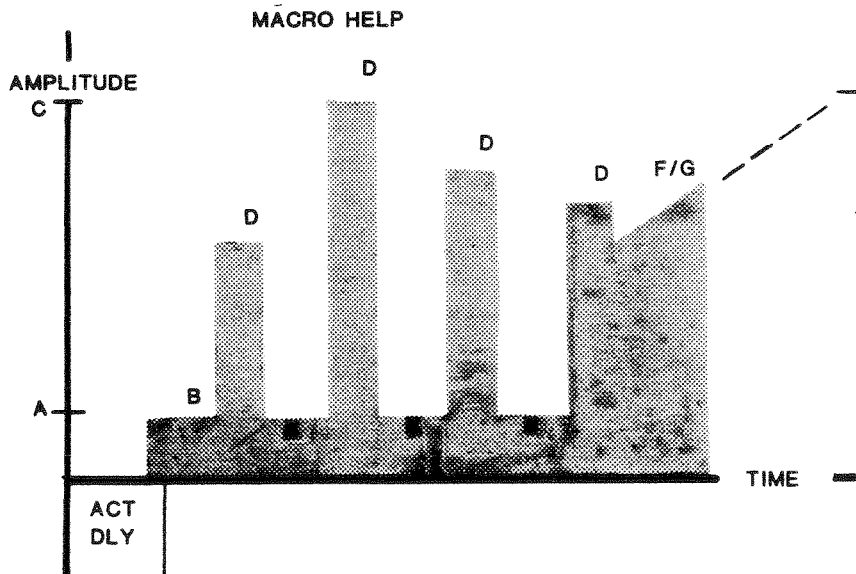
PRESET CONDITIONS							ACTION CONDITIONS		
SRC	CONNECT		TST	VALUE		FREQ	(A) OFFSET VOLTAGE:	. VOLTS	SENSE
ASS	HI	LO	SRC	AMPL	PHASE	HZ			
			VA				(B) DURATION:	. CYCLES	
			VB				(C) MAXIMUM VOLTAGE:	. VOLTS	
			VC				(D) PULSE DURATION:	. CYCLES	
			I1				(E) WAIT:	. CYCLES	
			I2				(E) +/- Δ VOLTAGE:	± . VOLTS	
			I3				(F) Δ TIME:	. CYCLES	
			BAT	ProTest MACRO					
			VDC	RCHBOV					
			IDC						
SEN			T/S						
PRESET: DELAY . SEC-ZERO X:									
ACTION: DELAY . SEC-ZERO X:							*EXPECTED: . VOLTS + % - %*		
SENSE: DELAY . SEC-DURATION. SEC							* ACTUAL: . ERR . %*		
TEST :									

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



BSRCHO



LOCATION:

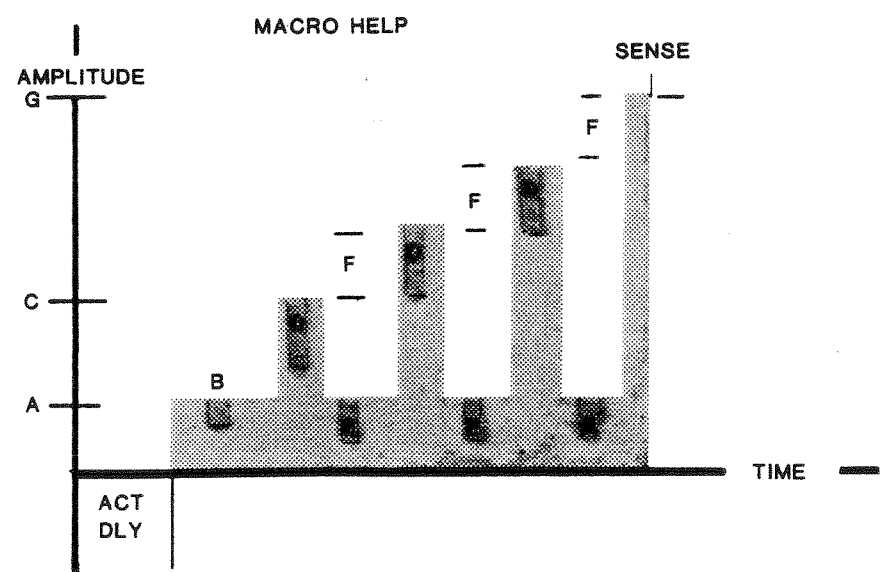
RELAY ID			FUNCTION			TP #	R	OPERATOR:			
PRESET CONDITIONS						ACTION CONDITIONS					
SRC	CONNECT		TST	VALUE		FREQ	(A) OFFSET VOLTAGE: . VOLTS (B) DURATION: . CYCLES (C) INITIAL VOLTAGE: . VOLTS (D) PULSE DURATION: . CYCLES (E) WAIT: . VOLTS (F) +/- Δ VOLTAGE: . VOLTS (G) MAXIMUM VOLTAGE: . VOLTS				SENSE
ASS	HI	LO	SRC	AMPL	PHASE	HZ					
			VA								
			VB								
			VC								
			I1								
			I2								
			I3								
			BAT								
			VDC	ProTest MACRO							
SEN			IDC	RCHPRV							
			T/S								
PRESET: DELAY . SEC-ZERO X:						*EXPECTED: . VOLTS + % - %*					
ACTION: DELAY . SEC-ZERO X:						* ACTUAL: . ERR . %*					
SENSE: DELAY . SEC-DURATION. SEC						TEST :					

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



**PRAMP**

LOCATION:

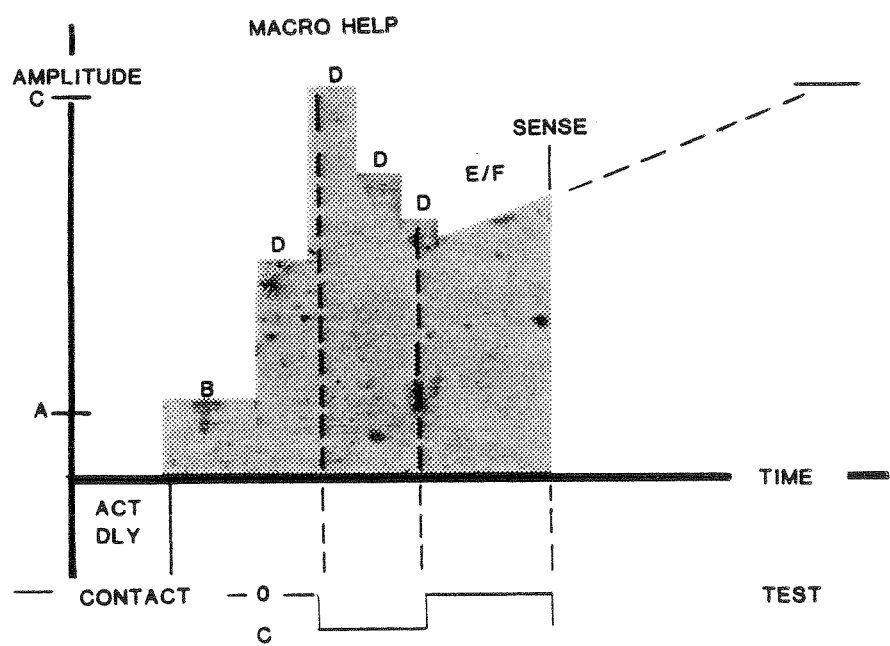
RELAY ID			FUNCTION			TP #	R	OPERATOR:		
PRESET CONDITIONS						ACTION CONDITIONS				
SRC	CONNECT		TST	VALUE		FREQ	(A) OFFSET CURRENT: . AMPS (B) DURATION: . CYCLES (C) MAXIMUM CURRENT: . AMPS (D) PULSE DURATION: . CYCLES (E) +/- Δ CURRENT: . AMPS (F) Δ TIME: . CYCLES			
ASS	HI	LO	SRC	AMPL	PHASE	HZ				
			VA							
			VB							
			VC							
			I1							
			I2							
			I3							
			BAT	ProTest MACRO						
			VDC	RCHBSI						
SEN			IDC							
			T/S							
PRESET: DELAY . SEC-ZERO X:						*EXPECTED: . AMPS + % - %*				
ACTION: DELAY . SEC-ZERO X:						* ACTUAL: . ERR . %*				
SENSE: DELAY . SEC-DURATION. SEC										
TEST :										

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON
EQUATION	V÷I / V÷2I / V÷I√3



BSRCH

LOCATION:

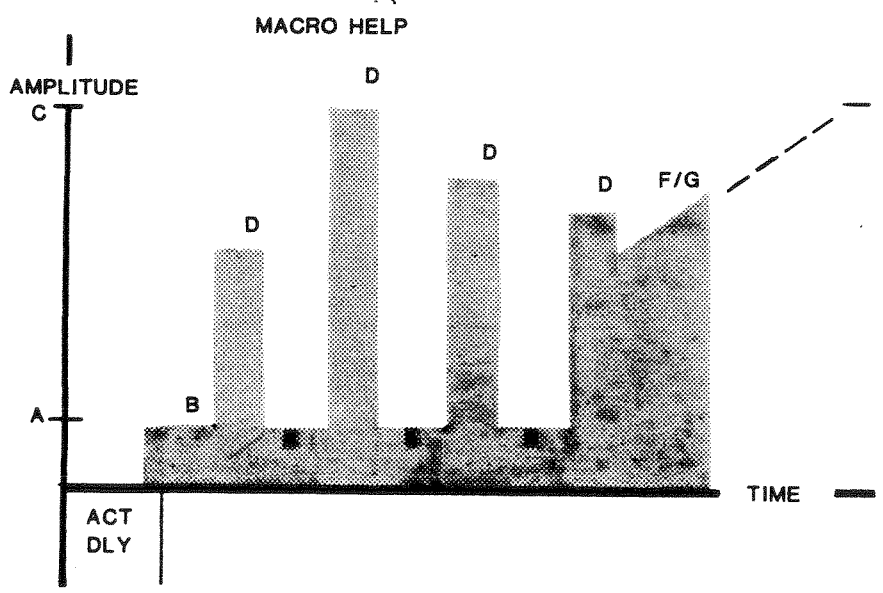
RELAY ID			FUNCTION			TP #	R	OPERATOR:				
PRESET CONDITIONS						ACTION CONDITIONS						
SRC	CONNECT		TST	VALUE		FREQ		(A) OFFSET CURRENT: . AMPS (B) DURATION: . CYCLES (C) MAXIMUM CURRENT: . AMPS (D) PULSE DURATION: . CYCLES (E) WAIT: . CYCLES (F) +/- Δ CURRENT: . AMPS (G) Δ TIME: . CYCLES			SENSE	
ASS	HI	LO	SRC	AMPL	PHASE	HZ						
			VA									
			VB									
			VC									
			I1									
			I2									
			I3									
			BAT	ProTest MACRO								
			VDC									
			IDC	RCHBOI								
			T/S									
SEN												
PRESET: DELAY . SEC-ZERO X:			ACTION: DELAY . SEC-ZERO X:			SENSE: DELAY . SEC-DURATION . SEC			*EXPECTED: . AMPS + % - %* *ACTUAL: . ERR . %*			
TEST :												

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



BSRCHO

LOCATION:

RELAY ID \_\_\_\_\_ FUNCTION \_\_\_\_\_ TP # \_\_\_\_\_ R \_\_\_\_\_

OPERATOR:

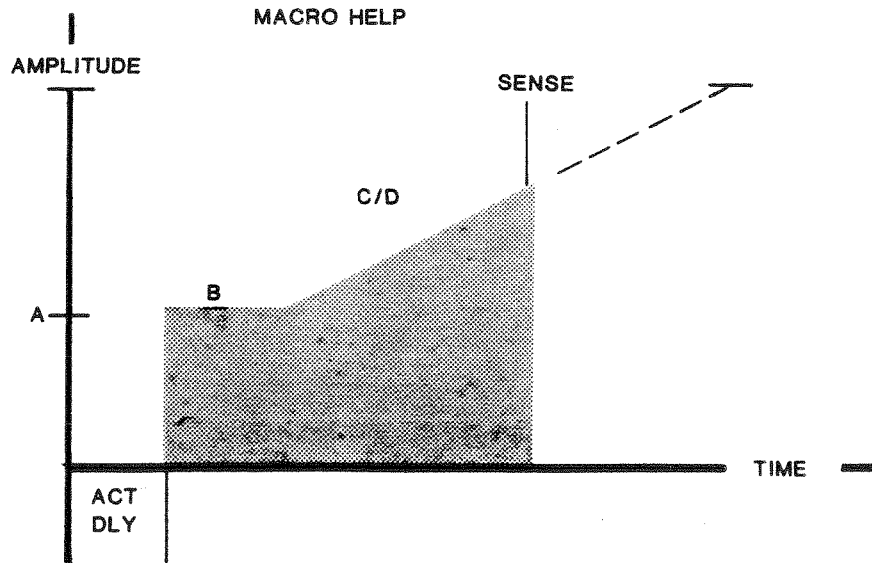
PRESET CONDITIONS						ACTION CONDITIONS		SENSE			
SRC ASS	CONNECT HI	LO	TST SRC	VALUE AMPL	PHASE	FREQ HZ	(A) OFFSET CURRENT:		(B) DURATION:	(C) +/- Δ CURRENT:	(D) Δ TIME:
			VA				. AMPS	. CYCLES	. AMPS	. CYCLES	. AMPS
			VB								
			VC								
			I1								
			I2								
			I3								
			BAT								
			VDC								
			IDC								
			T/S								
SEN						ProTest MACRO					
						RCHLRI					
PRESET: DELAY . SEC-ZERO X:											
ACTION: DELAY . SEC-ZERO X:								*EXPECTED: . AMPS + % - %*			
SENSE: DELAY . SEC-DURATION. SEC								* ACTUAL: . ERR . %*			
TEST :											

INSTRUCTIONS:

F1 RUN | F2 NEXT | F3 ORIG | F4 | F5 DATA | F6 PLOT | F7 | F8 PRINT | F9 MANUAL | F10 PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



**LRAMP**

LOCATION:

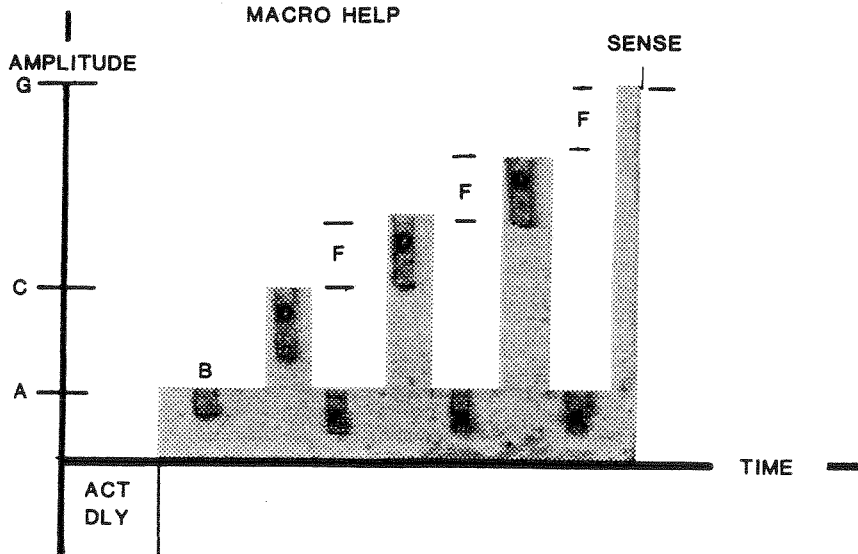
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PRESET CONDITIONS						ACTION CONDITIONS					
SRC	CONNECT		TST	VALUE		FREQ		(A) OFFSET CURRENT: . AMPS (B) DURATION: . CYCLES (C) INITIAL CURRENT: . AMPS (D) PULSE DURATION: . CYCLES (E) WAIT: . CYCLES (F) +/- Δ CURRENT: . AMPS (G) MAXIMUM CURRENT: . AMPS			SENSE
ASS	HI	LO	SRC	AMPL	PHASE	HZ					
SEN			VA								
			VB								
			VC								
			I1								
			I2								
			I3								
			BAT								
			VDC								
		IDC									
		T/S									
PRESET: DELAY . SEC-ZERO X:						*EXPECTED: . AMPS + % - %*					
ACTION: DELAY . SEC-ZERO X:						*ACTUAL: . ERR . %*					
SENSE: DELAY . SEC-DURATION. SEC						TEST :					

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



PRAMP

LOCATION:

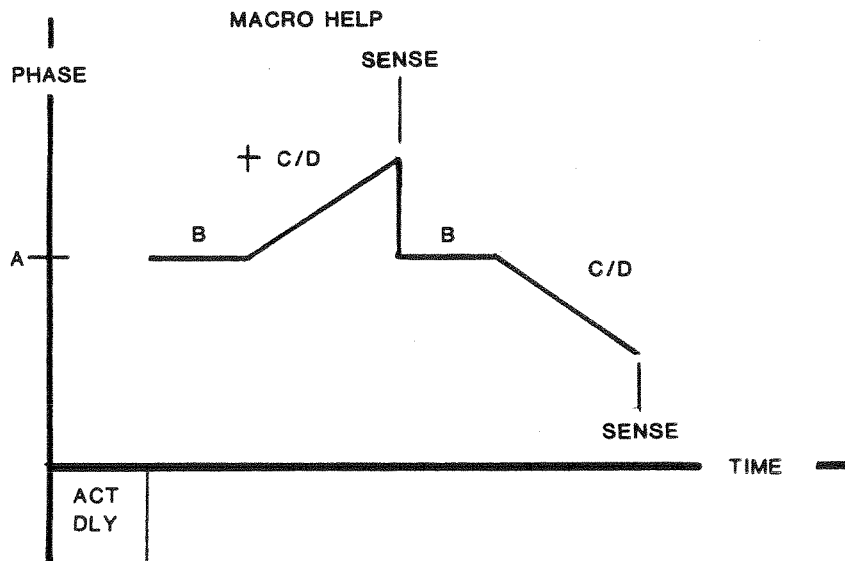
RELAY ID		FUNCTION			TP #	R	OPERATOR:			
PRESET CONDITIONS					ACTION CONDITIONS					
SRC	CONNECT		TST	VALUE		FREQ		SENSE		
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(A) LINE ANGLE: . DEGS			
			VA				(B) DURATION: . CYCLES			
			VB				(C) Δ ANGLE: . DEGS			
			VC				(D) Δ TIME: . CYCLES			
			I1							
			I2							
			I3							
			BAT							
			VDC							
			IDC							
			T/S							
SEN							*LEAD DROPOUT ANGLE: . DEGS*			
							**LAG DROPOUT ANGLE: . DEGS*			
							***MAX TORQUE ANGLE: . DEGS*			
							*TOLERANCE+/- . DEGS ERR . DEGS*			
PRESET: DELAY . SEC-ZERO X:										
ACTION: DELAY . SEC-ZERO X:										
SENSE: DELAY . SEC-DURATION. SEC										
					TEST :					

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	O -> C / C -> O
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



MTA

LOCATION:

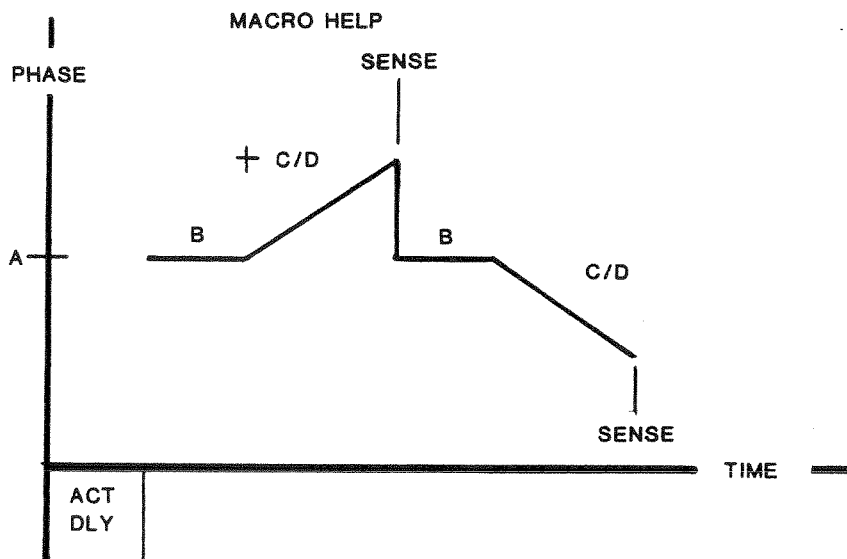
RELAY ID			FUNCTION			TP #	R	OPERATOR:			
PRESET CONDITIONS						ACTION CONDITIONS					
SRC	CONNECT		TST	VALUE		FREQ		(A) LINE ANGLE: . DEGS (B) DURATION: . CYCLES (C) Δ ANGLE: . DEGS (D) Δ TIME: . CYCLES  *LEAD DROPOUT ANGLE: . DEGS* **LAG DROPOUT ANGLE: . DEGS* ***MAX TORQUE ANGLE: . DEGS* *TOLERANCE+/- . DEGS ERR . DEGS*			
ASS	HI	LO	SRC	AMPL	PHASE	HZ					
			VA								
			VB								
			VC								
			I1								
			I2								
			I3								
			BAT								
			VDC								
			IDC								
SEN			T/S								
						ProTest MACRO					
						MAXTAI					
PRESET: DELAY . SEC-ZERO X:			ACTION: DELAY . SEC-ZERO X:			SENSE: DELAY . SEC-DURATION. SEC			TEST :		

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	O -> C / C -> O
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



MTA



LOCATION:

RELAY ID	FUNCTION	TP #	R
----------	----------	------	---

OPERATOR:

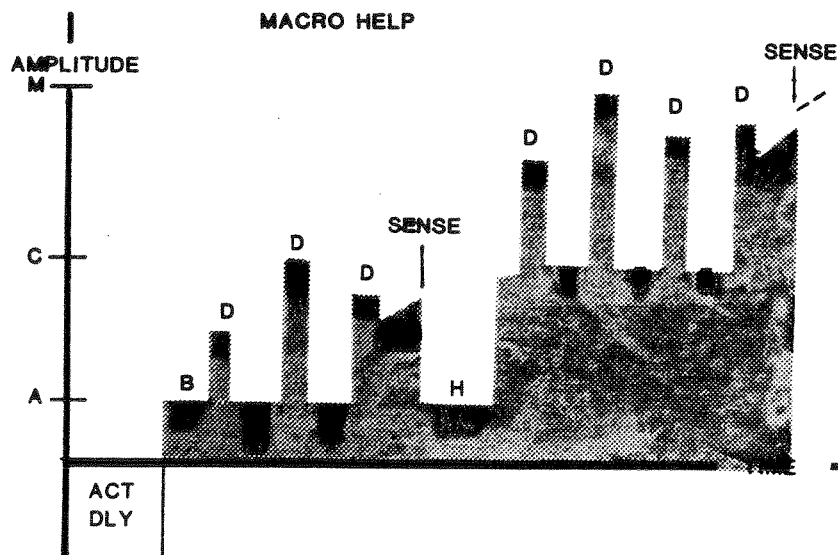
PRESET CONDITIONS							ACTION CONDITIONS				
SRC	CONNECT	TST	VALUE	FREQ							
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(A) OFFSET VOLTAGE:		VOLTS		
			VA				(B) DURATION:		. CYCLES		
			VB				(C) MAXIMUM VOLTAGE:		. VOLTS		
			VC				(D) PULSE DURATION:		. CYCLES		
			I1				(E) WAIT:		. CYCLES		
			I2				(F) +/- Δ VOLTAGE:		. VOLTS		
			I3				(G) Δ TIME:		. CYCLES		
			BAT				CHARACTERISTIC: LIMIT 100 POINTS				
			VDC				FROM	TO	DELTA		
			IDC				ANGLE	ANGLE	ANGLE		
			T/S								
SEN					ProTest MACRO	ZPLBOV					
PRESET: DELAY . SEC-ZERO X:							ARC A			DEGREES	EQUATION:
ACTION: DELAY . SEC-ZERO X:							ARC B			DEGREES	
SENSE: DELAY . SEC-DURATION. SEC							ARC C			DEGREES	SPECIFY:
							ARC D			DEGREES	
TEST :											

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON
EQUATION	V÷I / V÷2I / V÷I√3



ZOPLB



LOCATION:

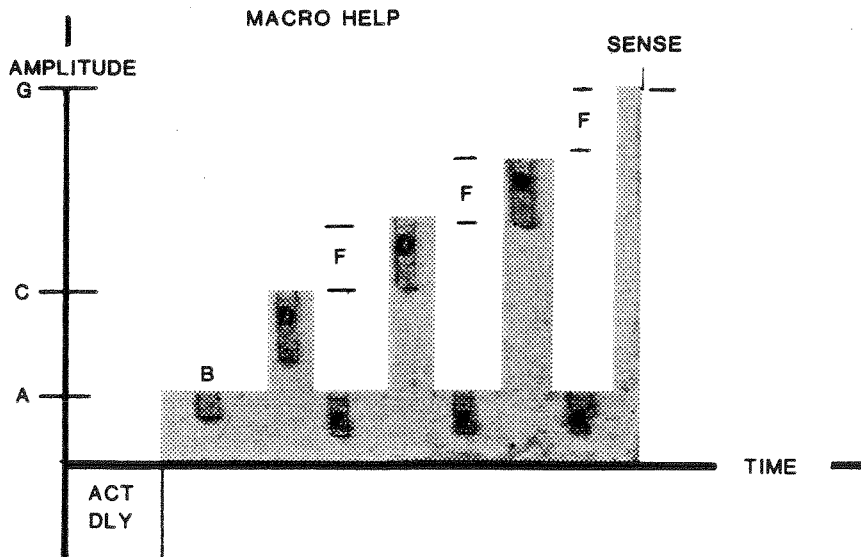
RELAY ID			FUNCTION			TP #	R <sub>1</sub>	OPERATOR:			
PRESET CONDITIONS						ACTION CONDITIONS					
SRC	CONNECT		TST	VALUE		FREQ		(A) OFFSET VOLTAGE: . VOLTS (B) DURATION: . CYCLES (C) INITIAL VOLTAGE: . VOLTS (D) PULSE DURATION: . CYCLES (E) WAIT: . CYCLES (F) +/- Δ VOLTAGE: . VOLTS (G) MAXIMUM VOLTAGE: . VOLTS  CHARACTERISTIC: LIMIT 100 POINTS FROM ANGLE   TO ANGLE   DELTA ANGLE ARC A DEGREES ARC B DEGREES ARC C DEGREES ARC D DEGREES  EQUATION: SPECIFY:			
ASS	HI	LO	SRC	AMPL	PHASE	HZ					
			VA								
			VB								
			VC								
			I1								
			I2								
			I3								
			BAT								
			VDC								
SEN			T/S	ProTest MACRO							
				ZPLPRV							
PRESET: DELAY . SEC-ZERO X:			ACTION: DELAY . SEC-ZERO X:			SENSE: DELAY . SEC-DURATION. SEC			TEST :		

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON
EQUATION	V÷I / V÷2I / V÷I√3



PRAMP



LOCATION:

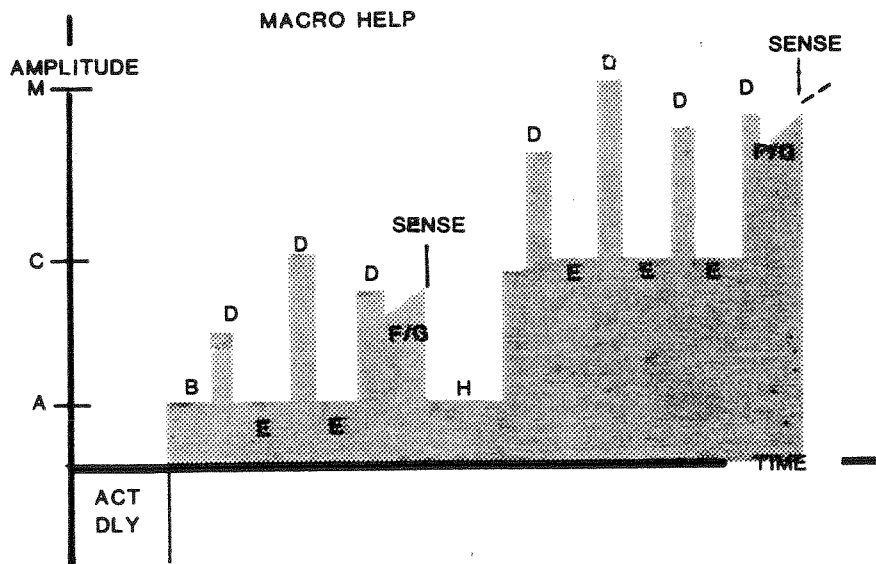
RELAY ID			FUNCTION			TP #	R	OPERATOR:				
PRESET CONDITIONS						ACTION CONDITIONS						
SRC	CONNECT		TST	VALUE		FREQ		(A) OFFSET CURRENT: . AMPS (B) DURATION: . CYCLES (C) MAXIMUM CURRENT: . AMPS (D) PULSE DURATION: . CYCLES (E) WAIT: . CYCLES (F) +/- Δ CURRENT: . AMPS (G) Δ TIME: . CYCLES			SENSE:	
ASS	HI	LO	SRC	AMPL	PHASE	HZ						
			VA									
			VB									
			VC									
			I1									
			I2									
			I3									
			BAT									
			VDC									
			IDC									
SEN			T/S									
						ProTest MACRO		CHARACTERISTIC: LIMIT 100 POINTS				
						ZPLB01		FROM	TO	DELTA		
								ANGLE	ANGLE	ANGLE		
											EQUATION:	
								ARC A			DEGREES	
								ARC B			DEGREES	
								ARC C			DEGREES	
								ARC D			DEGREES	
PRESET: DELAY . SEC-ZERO X:												
ACTION: DELAY . SEC-ZERO X:												
SENSE: DELAY . SEC-DURATION. SEC											SPECIFY:	
						TEST :						

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



ZOPLB

LOCATION:

RELAY ID \_\_\_\_\_ FUNCTION \_\_\_\_\_ TP # \_\_\_\_\_ R \_\_\_\_\_

OPERATOR:

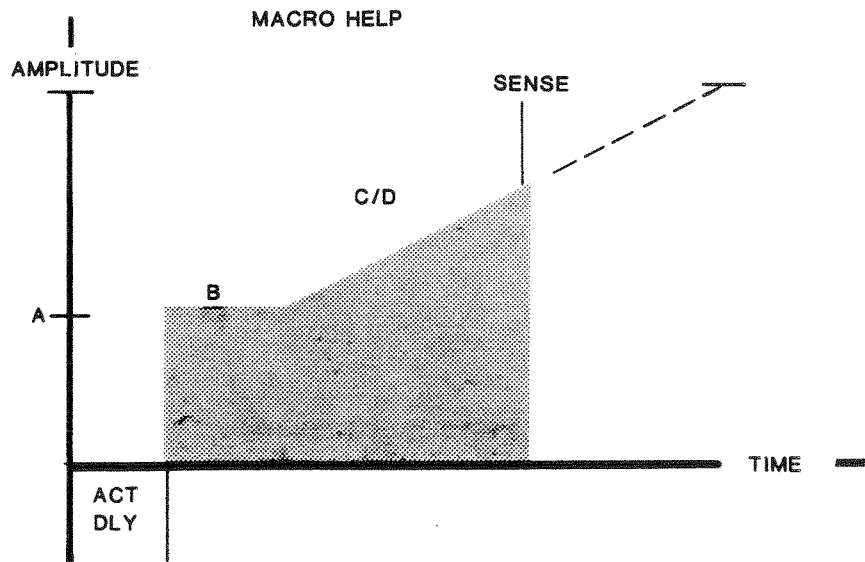
PRESET CONDITIONS						ACTION CONDITIONS				SENSE:	
SRC	CONNECT		TST	VALUE		FREQ					
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(A) OFFSET CURRENT: . AMPS				EQUATION:
			VA				(B) DURATION: . CYCLES				
			VB				(C) +/- Δ CURRENT: . AMPS				
			VC				(D) Δ TIME: . CYCLES				
			I1				(E) MAXIMUM CURRENT: . AMPS				
			I2								
			I3								
			BAT								
			VDC								
			IDC								
			T/S								
SEN							CHARACTERISTIC: LIMIT 100 POINTS				
							FROM	TO	DELTA		
							ANGLE	ANGLE	ANGLE		
							ARC A			DEGREES	
							ARC B			DEGREES	
							ARC C			DEGREES	
							ARC D			DEGREES	
PRESET: DELAY . SEC-ZERO X:											
ACTION: DELAY . SEC-ZERO X:											
SENSE: DELAY . SEC-DURATION. SEC											
TEST :											

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON
EQUATION	V÷I / V÷2I / V÷I√3



**LRAMP**

LOCATION:

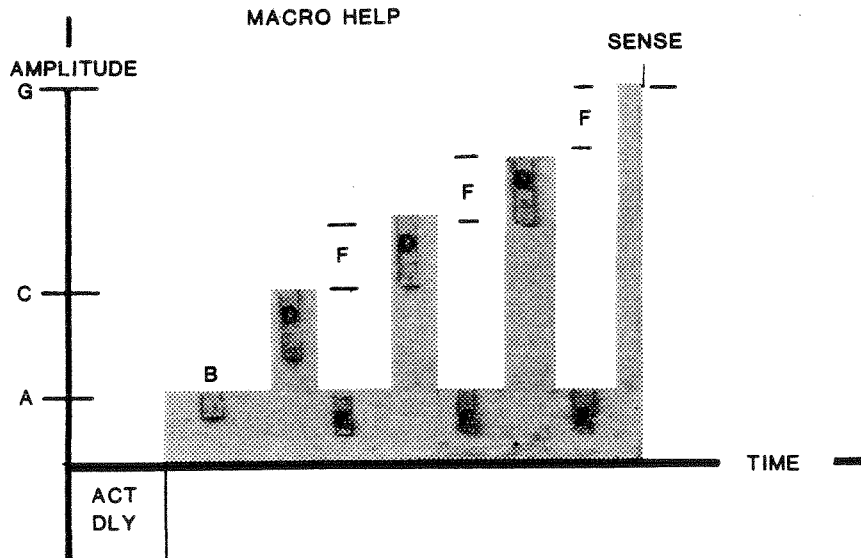
RELAY ID		FUNCTION			TP #	R	OPERATOR:			
PRESET CONDITIONS						ACTION CONDITIONS				
SRC	CONNECT		TST	VALUE		FREQ				
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(A) OFFSET CURRENT: . AMPS			
			VA				(B) DURATION: . CYCLES			
			VB				(C) INITIAL CURRENT: . AMPS			
			VC				(D) PAUSE DURATION: . CYCLES			
			I1				(E) WAIT: . CYCLES			
			I2				(F) +/- A CURRENT: . AMPS			
			I3				(G) MAXIMUM CURRENT: . AMPS			
			BAT	ProTest MACRO		CHARACTERISTIC: LIMIT 100 POINTS				
			VDC	ZPLPRI		FROM	TO	DELTA		
SEN			IDC			ANGLE	ANGLE	ANGLE		
			T/S							
PRESET: DELAY . SEC-ZERO X:						ARC A			DEGREES	EQUATION:
ACTION: DELAY . SEC-ZERO X:						ARC B			DEGREES	
SENSE: DELAY . SEC-DURATION. SEC						ARC C			DEGREES	SPECIFY:
						ARC D			DEGREES	
TEST :										

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON
EQUATION	V÷I / V÷2I / V÷I÷3



PRAMP

LOCATION:

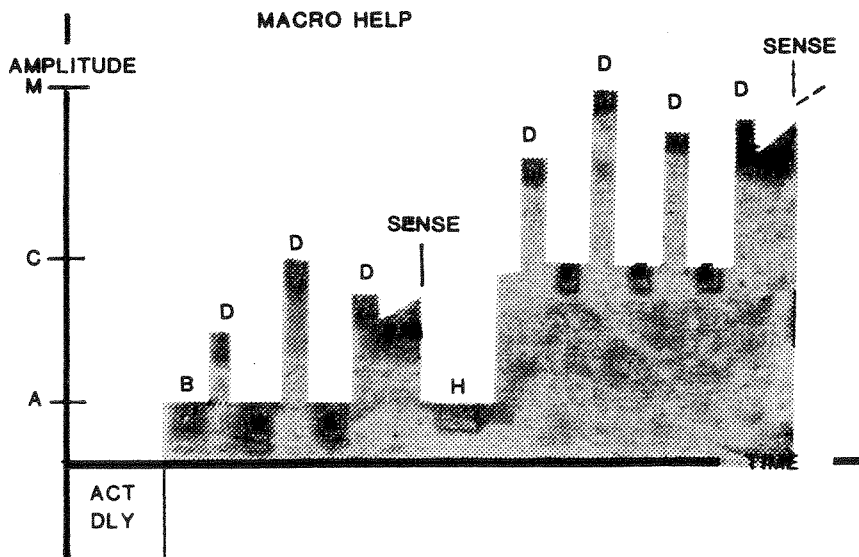
RELAY ID			FUNCTION			TP #	R	OPERATOR:			
PRESET CONDITIONS						ACTION CONDITIONS					
SRC	CONNECT		TST	VALUE		FREQ	(A) OFFSET VOLTAGE:			. VOLTS	SENSE:
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(B) DURATION OF (A):			. CYCLES	
			VA				(C) MAXIMUM #1 VOLTAGE:			. VOLTS	
			VB				(D) PAUSE DURATION:			. CYCLES	
			VC				(E) WAIT:			. CYCLES	
			I1				(F) +/- Δ VOLTAGE:			. VOLTS	
			I2				(G) Δ TIME:			. CYCLES	
			I3				(H) COOLOFF TIME:			. CYCLES	
			BAT				(M) MAXIMUM #2 VOLTAGE:			. VOLTS	
			VDC	ProTest MACRO			CHARACTERISTIC: LIMIT 50 ANGLES				
			IDC	ZOPLBV			FROM	TO	DELTA		
SEN			T/S				ANGLE	ANGLE	ANGLE		
PRESET: DELAY . SEC-ZERO X:						ARC A				DEGREES	
ACTION: DELAY . SEC-ZERO X:						ARC B				DEGREES	
SENSE: DELAY . SEC-DURATION. SEC						ARC C				DEGREES	
						ARC D				DEGREES	
TEST :											

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



ZOPLB

LOCATION:

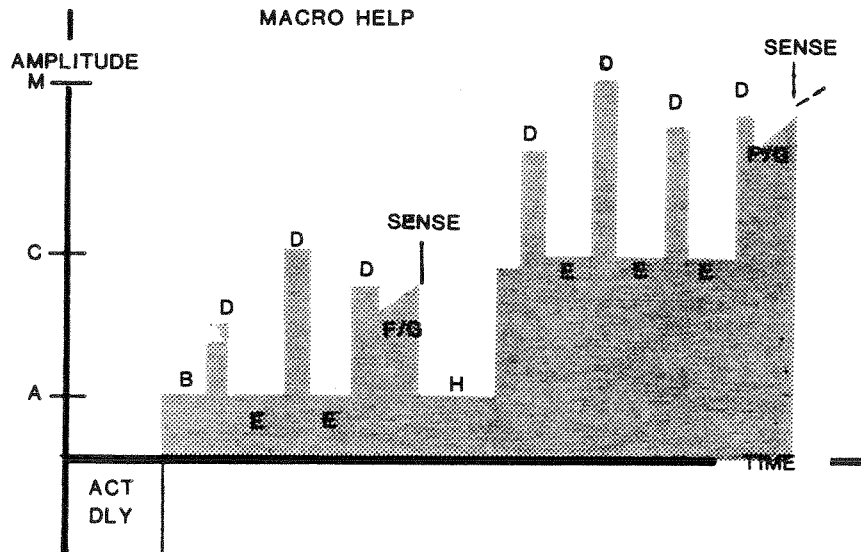
RELAY ID			FUNCTION			TP #	R	OPERATOR:			
PRESET CONDITIONS						ACTION CONDITIONS					
SRC	CONNECT		TST	VALUE		FREQ	(A) OFFSET CURRENT:			. AMPS	SENSE:
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(B) DURATION OF (A):			. CYCLES	
			VA				(C) MAXIMUM #1 CURRENT:			. AMPS	
			VB				(D) PAUSE DURATION:			. CYCLES	
			VC				(E) WAIT:			. CYCLES	
			I1				(F) +/- Δ CURRENT:			. AMPS	
			I2				(G) Δ TIME:			. CYCLES	
			I3				(H) COOLOFF TIME:			. CYCLES	
			BAT				(M) MAXIMUM #2 CURRENT			. AMPS	
			VDC				CHARACTERISTIC: LIMIT 50 ANGLES				
SEN			IDC	ProTest MACRO			FROM	TO	DELTA		
			T/S	ZOPLBI			ANGLE	ANGLE	ANGLE		
PRESET: DELAY . SEC-ZERO X:						ARC A				DEGREES	
ACTION: DELAY . SEC-ZERO X:						ARC B				DEGREES	
SENSE: DELAY . SEC-DURATION. SEC						ARC C				DEGREES	
						ARC D				DEGREES	
TEST :											

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



ZOPLB

LOCATION:

RELAY ID \_\_\_\_\_ FUNCTION \_\_\_\_\_ TP # \_\_\_\_\_ R \_\_\_\_\_

OPERATOR:

PRESET CONDITIONS						ACTION CONDITIONS		SENSE
SRC	CONNECT		TST	VALUE		FREQ		
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(A) OFFSET VOLTAGE:	. VOLTS
			VA				(B) DURATION:	. CYCLES
			VB				(C) TEST VOLTAGE:	. VOLTS
			VC				(D) MAXIMUM ON TIME:	. SECS
			I1					
			I2					
			I3					
			BAT					
			VDC					
			IDC					
TIM			T/S					
				ProTest MACRO				
				ZTIMEV				
PRESET: DELAY . SEC-ZERO X:						*EXPECTED: .		+ % - %*
ACTION: DELAY . SEC-ZERO X:						*ACTUAL: .		ERR . %*
SENSE: DELAY . SEC-DURATION. SEC						TEST :		

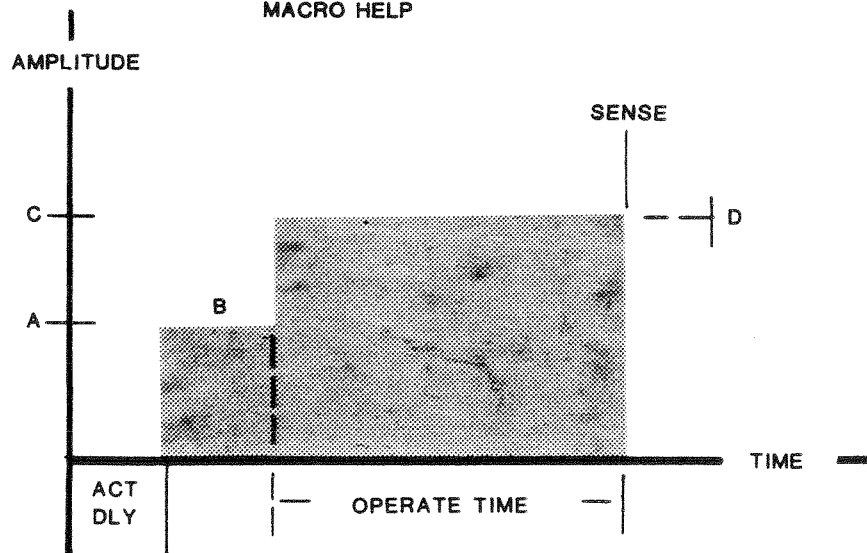
INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON

MACRO HELP



TIME

LOCATION:

RELAY ID \_\_\_\_\_ FUNCTION \_\_\_\_\_ TP # \_\_\_\_\_ R \_\_\_\_\_

OPERATOR:

PRESET CONDITIONS						ACTION CONDITIONS		SENSE
SRC	CONNECT		TST	VALUE		FREQ		
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(A) OFFSET CURRENT:	. AMPS
			VA				(B) DURATION:	. CYCLES
			VB				(C) TEST CURRENT:	. AMPS
			VC				(D) MAXIMUM ON TIME:	. SECS
			I1					
			I2					
			I3					
			BAT					
			VDC					
			IDC					
TIM			T/S					
				ProTest MACRO				
				ZTIMEI				
PRESET: DELAY . SEC-ZERO X:								
ACTION: DELAY . SEC-ZERO X:							*EXPECTED:	. + % - %*
SENSE: DELAY . SEC-DURATION. SEC							*ACTUAL:	. ERR . %*
TEST :								

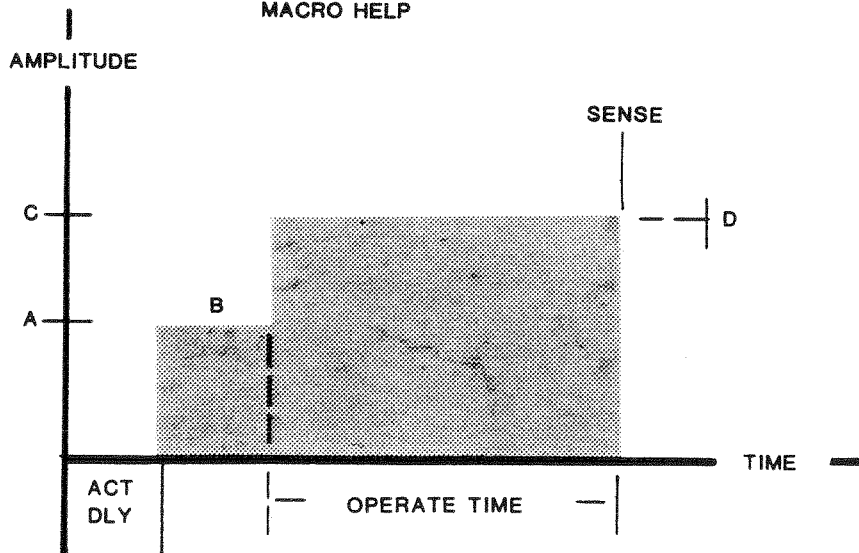
INSTRUCTIONS:

F1 RUN F2 NEXT F3 ORIG F4 F5 DATA F6 PLOT F7 F8 PRINT F9 MANUAL F10 PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON

MACRO HELP



TIME

LOCATION:

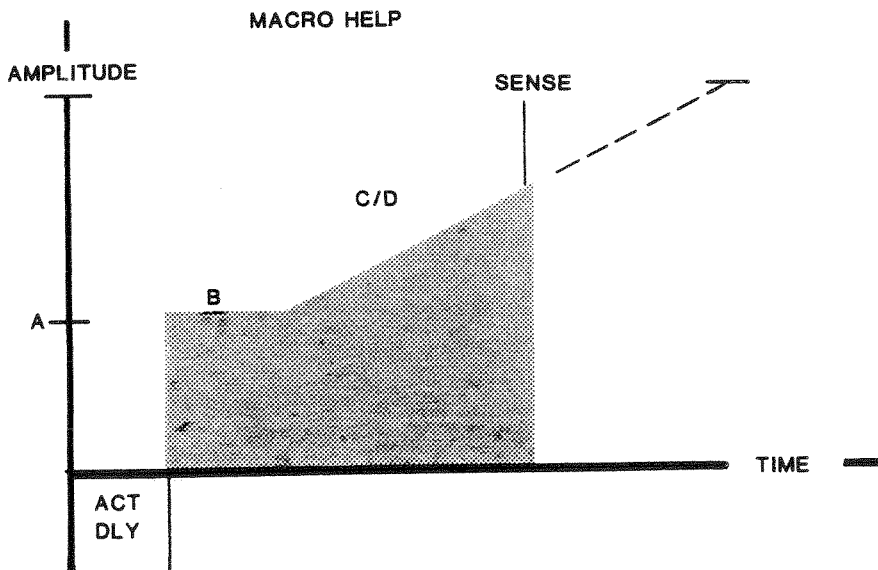
RELAY ID		FUNCTION			TP #	R	OPERATOR:			
PRESET CONDITIONS					ACTION CONDITIONS					
SRC	CONNECT	TST	VALUE		FREQ	(A) OFFSET CURRENT: . AMPS (B) DURATION: . CYCLES (C) +/- Δ CURRENT: . AMPS (D) Δ TIME: . AMPS (E) MAXIMUM CURRENT: . AMPS			SENSE	
ASS	HI	LO	SRC	AMPL	PHASE					HZ
			VA							
			VB							
			VC							
			I1							
			I2							
			I3							
			BAT	ProTest MACRO						
			VDC	DCRMPI						
			IDC							
			T/S							
SEN										
PRESET: DELAY . SEC-ZERO X:			ACTION: DELAY . SEC-ZERO X:			*EXPECTED: . AMPS + % - %*				
SENSE: DELAY . SEC-DURATION.. SEC						* ACTUAL: . ERR . %*				
TEST :										

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



**LRAMP**

LOCATION:

RELAY ID		FUNCTION			TP #	R	OPERATOR:		
PRESET CONDITIONS						ACTION CONDITIONS			
SRC	CONNECT		TST	VALUE		FREQ	(A) OFFSET CURRENT: . AMPS (B) DURATION: . CYCLES (C) TEST CURRENT: . AMPS (D) PULSE DURATION: . CYCLES		
ASS	HI	LO	SRC	AMPL	PHASE	HZ			
			VA						
			VB						
			VC						
			I1						
			I2						
			I3						
			BAT						
			VDC						
SEN			IDC	ProTest MACRO					
			T/S	PULDCI					
PRESET: DELAY . SEC-ZERO X:						* EXPECTED: . AMPS + % - %*			
ACTION: DELAY . SEC-ZERO X:						* ACTUAL: . ERR . %*			
SENSE: DELAY . SEC-DURATION. SEC									
TEST :									

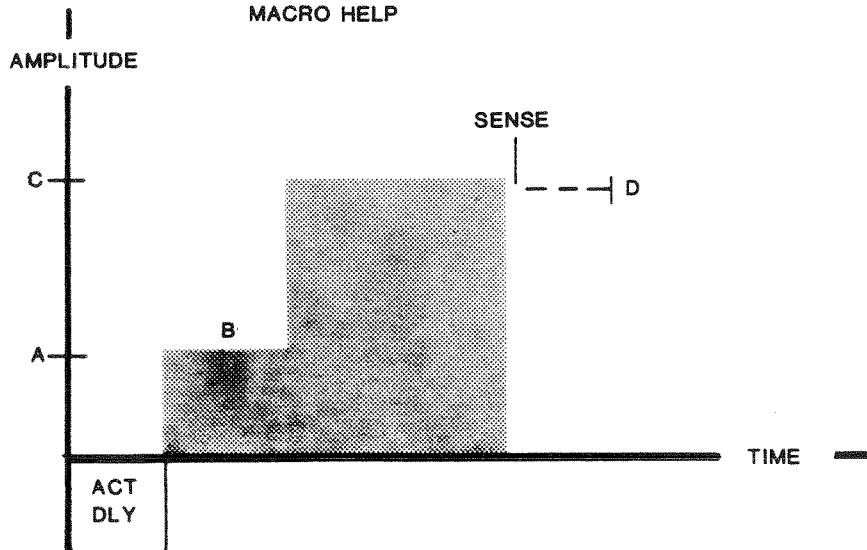
INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	O -> C / C -> O
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON

MACRO HELP



GONOGO

LOCATION:

RELAY ID \_\_\_\_\_ FUNCTION \_\_\_\_\_ TP # \_\_\_\_\_ R \_\_\_\_\_

OPERATOR:

PRESET CONDITIONS				ACTION CONDITIONS				
SRC	CONNECT		TST	VALUE	FREQ			SENSE
ASS	HI	LO	SRC	AMPL	PHASE	HZ	(A) OFFSET CURRENT: . AMPS	
			VA				(B) DURATION: . CYCLES	
			VB				(C) INITIAL CURRENT: . AMPS	
			VC				(D) PULSE DURATION: . CYCLES	
			I1				(E) WAIT: . CYCLES	
			I2				(F) +/- Δ CURRENT: ± . AMPS	
			I3				(G) MAXIMUM CURRENT: . AMPS	
			BAT	ProTest MACRO				
			VDC					
			IDC	PRAMPI				
			T/S					
SEN								
PRESET: DELAY . SEC-ZERO X:				* EXPECTED: . AMPS + % - %*				
ACTION: DELAY . SEC-ZERO X:				* ACTUAL: .				
SENSE: DELAY . SEC-DURATION. SEC				ERR . %*				

TEST :

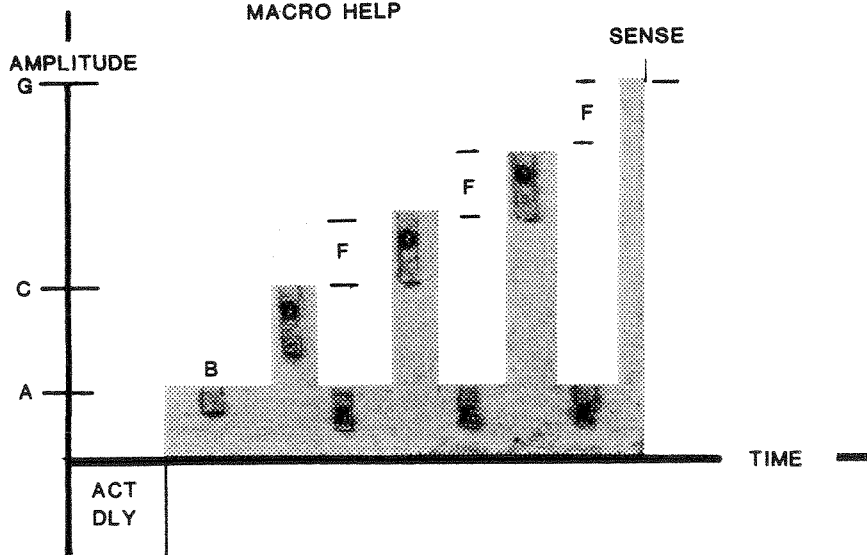
INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON

MACRO HELP



PRAMP

LOCATION:

RELAY ID \_\_\_\_\_ FUNCTION \_\_\_\_\_ TP # \_\_\_\_\_ R \_\_\_\_\_

OPERATOR:

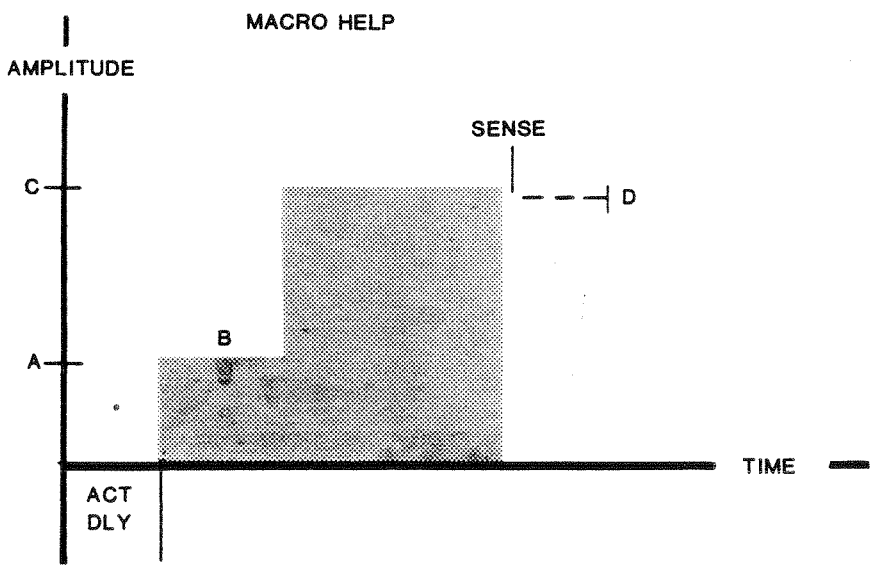
PRESET CONDITIONS							ACTION CONDITIONS		
SRC	CONNECT		TST	VALUE		FREQ	(A) OFFSET CURRENT:	. AMPS	SENSE
ASS	HI	LO	SRC	AMPL	PHASE	HZ			
			VA				(C) TEST CURRENT:	. AMPS	
			VB				(D) PULSE DURATION:	. CYCLES	
			VC						
			I1						
			I2						
			I3						
			BAT						
			VDC						
			IDC						
			T/S						
SEN									
							ProTest MACRO		
							GONGOI		
PRESET: DELAY . SEC-ZERO X:							* EXPECTED: . AMPS + % - %*		
ACTION: DELAY . SEC-ZERO X:							* ACTUAL: . ERR . %*		
SENSE: DELAY . SEC-DURATION. SEC									
TEST :									

INSTRUCTIONS:

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
RUN	NEXT	ORIG		DATA	PLOT		PRINT	MANUAL	PLAN

TOGGLE FIELDS

LABEL	CHOICES
FREQ	60.00 / 50.00
BAT	0.00 / 48.00 / 125.00 / 250.00
TIM	SEC / MSEC / CYCLES
ZERO X:	SOURCE / SYSTEM
SENSE	CONTACTS / AC VOLTS / DC VOLTS
CONTACTS	0 -> C / C -> 0
AC VOLTS	ON-OFF / OFF-ON
DC VOLTS	ON-OFF / OFF-ON



GONGO