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Westinghouse Astronuclear Laboratory

Operational Manual for Test Stand Control
System Pulse Calibrator

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Operational Manual for Test Stand Control
System Pulse Calibrator

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OPERATIONAL MANUAL
FOR
TEST STAND CONTROL SYSTEM PULSE CALIBRATOR

1.0 GENERAL

1.1 Introduction

This operational manual contains the general description, theory of operation, alignment procedures, maintenance and repair data for the ETS-1 Pulse Calibrator.

1.2 Description

The ETS-1 Pulse Calibrator is a rack-mounted, wholly self-contained, transistorized instrument. It generates a pulse voltage waveform similar to the current waveform from a BF3 counter. The frequency range is from 0.01H_z to 1mH_z .

1.2.1 Controls

The following controls are provided:

- a. Frequency multiplier selector
- b. Fine frequency adjust
- c. Amplitude adjust
- d. LOCAL-REMOTE pushbutton switch

1.2.2 Construction

Figure 1 is a photograph of the front panel of the Pulse Calibrator, showing the location of the controls. Figure 2 is a top view photograph of the Pulse Calibrator showing details of component location and wiring. The component panel showing test jack location can be seen at the front of the drawer.

Figure 1

Front Panel View of Pulse Calibrator

Figure 2
Top View of Pulse Calibrator

2.0 INSTALLATION

2.1 Incoming Inspection

The equipment was carefully inspected both mechanically and electrically before shipment. It should be physically free of marks, dents, or scratches and should be in perfect electrical order upon receipt. To confirm this, the equipment should be inspected for physical damage from transit and tested for electrical performance using the procedure of Section 5.0. If there is damage or deficiency, repairs should be made before final use.

2.2 Mounting

The following procedure should be used for the proper installation. Mount the removable part of the chassis guides at the desired selected level in a standard 19 inch rack. WANL Drawing 937J793 gives the mounting dimensions, plan view, and construction details of the chassis, panel, and connectors.

3.0 PRINCIPLES OF OPERATION

The Pulse Calibrator generates voltage pulses of about 100 nanoseconds width from 0.01 Hz to 1 mHz. (One Hz equals one cycle per second. Amplitude is variable from 0 to more than 0.5 volts.) The pulses are turned on either from the front panel switch in the LOCAL position or from the LRE Remote Switch 06A3510. Application of a 28VDC signal from the LRE Panel provides indication of the remote mode on the Pulse Calibrator front panel. Provision is made for remote indication of the remote mode on the LRE REMOTE CAL LIGHT 06ABDS10. Further description with reference to the Pulse Calibrator Schematic

Diagram 978 D772 follows below:

3.1 Pulse Generator

3.1.1 Module G1 consists of a WAVETEK Model 101AC Function Generator adjusted for square wave output. Principles of operation of the square wave generator are detailed in the WAVETEK Model 101AC Instruction Manual.

3.1.2 The output of Module G1 is fed into a shaping network comprised of Capacitor C1, diodes CR2 and CR3, and Resistor R1. Capacitor C1 and Resistor R1 form a differentiating circuit. Diode CR3 permits Capacitor C1 to be charged only by negative wave fronts so that the output pulses are of negative polarity. Diode CR2 allows Capacitor C1 to discharge when positive wave fronts are applied. The output of the Pulse Calibrator is taken from jack J3 at the rear of the drawer, and is available at jack J4 on the Component Panel at the front of the drawer.

3.2 LOCAL-REMOTE Operation

3.2.1 LOCAL turn-on of the Pulse Calibrator can be selected by operating switch S1 to LOCAL position. LOCAL lamp DS1A is lit in this mode

3.2.2 REMOTE turn-on of the Pulse Calibrator is selected by applying 28VDC through LRE Remote Switch 06A3510 to Relay K1. Diode CR1 provides transient suppression. When Relay K1 is operated, closure of Contacts K1A and K1B applies the AC line voltage; closure of Contact K1C provides indication on the Pulse Calibrator of the REMOTE mode; closure of Contact K1D provides for remote indication of the REMOTE mode.

3.2.3 Fuse F1 opens the high side of the AC line when a fault occurs and provides blown fuse indication on the front panel.

4.0 OPERATING INSTRUCTIONS

After installing the Pulse Calibrator according to procedures detailed under Installation Instructions, a mechanical and electrical checkout should be made. Controls, adjustments, and operational test procedures follow here:

4.1 Controls-Operational and Semi-Permanent

Access to alignment controls is limited because of the location of all operating controls, except the power switch, on a component panel inside the Pulse Calibrator. Indicating lamps are located on the front panel.

4.2 Front Panel

4.2.1 Indicating Lamps

One Switch-Light Assembly, located at upper-left, with split lens indicates when instrument power is energized either by local and/or remote command.

4.2.2 Fuse

One 0.1 ampere fuse and associated indicating lamp is accessible at the low-left center of the panel face.

4.2.3 Switch

The power switch is part of the Switch-Light Assembly located at upper-left (see Section 4.2.1, above).

4.3 Component Panel

Three test jacks are located on the component panel. These are designated as follows:

TP1	+28V
TP2	28V RET.
J4	PULSE OUTPUT

4.4 Operational Checkout

4.4.1 Test Equipment Needed

- a. Simpson 269 Voltmeter
- b. Tektronix 585 Oscilloscope or equivalent

4.4.2 Mechanical Checkout

Before application of primary power for the electrical checkout, examine gear carefully for mechanical rigidity of all mounted components, connectors, knobs, and the like.

4.4.3 Electrical Checkout

Turn on power and allow equipment to warm up for a minimum of 30 minutes.

4.4.4 Voltmeter Checks

Connect the Simpson 269 voltmeter between jacks TP1 and TP2 and check for presence of 28VDC.

4.4.5 Connect the oscilloscope to jack J4, and adjust AMPLITUDE to the required value.

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4.4.6 Adjust FREQ. CPS Control and FINE FREQ. CPS to give desired pulse repetition rate.

4.4.7 The Pulse Calibrator is ready for use after above adjustments have been completed. Remove the meter and oscilloscope test leads from the test jacks and close the drawer.

5.0 MAINTENANCE

5.1 Preventive Maintenance

The equipment is designed so that no special maintenance procedures are required, other than the normal good housekeeping rules used for similar type electronic equipment. Good housekeeping practices include periodic dusting, cleaning, inspection, and the like.

5.2 Corrective Maintenance

If there is any apparent or suspected failure or improper functioning of the equipment, it should be checked out in accordance with Test Specification T-711853. Also, refer to the Wavetek Model 101-AC Instruction Manual for corrective maintenance peculiar to the function generator Module G1.

6.0 DRAWING LIST

937J793 - Assembly-Pulse Calibrator

978D772 - Schematic Diagram-Pulse Calibrator

928F755 - Wiring-Pulse Calibrator

7.0 TEST SPECIFICATION AND PROCEDURE

Each unit has been tested in accordance with the procedures and must comply with the limits of WANL Specification Number T-711853. Specification Number T-711853 is included as part of this manual.

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TEST SPECIFICATION NUMBER T-711853

TITLE

Acceptance Test Specification and Procedure

PULSE CALIBRATOR ETS-1 TSCS

DATE: February, 1966

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ACCEPTANCE TEST SPECIFICATION
REACTOR SETUP PANEL-LRE CONSOLE

1.0 SCOPE

This document contains the requirements for the acceptance testing of the Pulse Calibrator (WANL Drawing 937J793) part of the ETS-1 Test Stand Control System.

2.0 REQUIREMENTS

2.1 The acceptance test shall consist of the following:

- 2.1.1 Visual Examination - To be performed by Quality Control.
- 2.1.2 Weights and Dimensions - To be performed by Quality Control.
- 2.1.3 Insulation Resistance - To be performed by Quality Control.
- 2.1.4 Functional Test - To be performed by Instrumentation and Control and witnessed by Quality Control.

2.2 The acceptance test shall be performed in the order of and as specified in the procedure. Discrepancies found during the visual examination shall be corrected and reinspected before performing the functional test. Failure or inability to obtain a required measurement during formal functional testing shall result in establishing a "hold" on the test. The failure or inadequacy shall be recorded by Quality Control and shall be reviewed by the WANL Engineering Review Board (ERB). The equipment shall be repaired and sections of the test repeated as determined by the ERB. Visual examination shall be

performed on the reworked or repaired areas before resuming testing.

3.0 APPLICABLE DOCUMENTS

- 3.1 Drawing 937J793 XE Pulse Calibrator Assembly Drawing, Rev. _____
- 3.2 Drawing 978D772 Schematic Diagram XE Pulse Calibrator, Rev. _____
- 3.3 Drawing 928F755 Wiring Diagram - Pulse Calibrator, Rev. _____
- 3.4 NDC-118A NERVA Design Criteria ETS-1 TSCS (AGC)

4.0 EQUIPMENT REQUIRED

- 4.1 Multimeter (Simpson 269 or equivalent)
- 4.2 Oscilloscope (Tektronix 585 or equivalent)
- 4.3 Counter (Hewlett-Packard 5223L or equivalent)
- 4.4 Megohmmeter -(General Radio Megger Type 1862-B or equivalent)

5.0 ACCEPTANCE TEST PROCEDURE, PULSE CALIBRATOR

5.1 Visual Examination

The equipment under test shall be presented in its final form together with the applicable schematic, wiring diagram, and assembly drawing. The visual examination shall consist of the following parts:

5.1.1 Workmanship, Assembly, and Fit

The inspector shall inspect the equipment for workmanship to WANL requirements, and to assure that the overall chassis is of the proper dimensions per the assembly drawing, Westinghouse Drawing Number 937J793.

Workmanship OK _____

5.1.2 Materials, Parts, and Finishes

The equipment shall be inspected to assure that the materials, parts, and finishes are in accordance with the applicable assembly drawings. Incoming inspection records on materials, parts, and finishes shall be utilized to determine conformance to the assembly drawings where possible.

Materials OK _____

5.1.3 Treatment for Prevention of Corrosion

The equipment shall be inspected to assure that the coatings for prevention of corrosion have not been

impaired during the manufacturing cycle.

Treatment OK _____

5.1.4 Safety Requirements

The equipment shall be inspected to insure that no safety hazard, such as sharp edges, etc., exist on the equipment which are potential hazards to personnel operating or maintaining the equipment.

Safety OK _____

5.1.5 Marking

The markings of the equipment shall be inspected to ensure conformance to the applicable drawings and to assure that they are acceptable as to performance and readability.

Marking OK _____

5.1.6 Visual Examination Review

After the visual examination of the equipment has been completed, all deficiencies shall be reviewed by WANL Engineering and Quality Control and corrected by one of the following methods:

- a. Drawing changes where drawing deficiencies are noted.
- b. Design changes if necessitated.
- c. Rework of the parts affected.

5.2 Weights and Dimensions

5.2.1 The unit shall be weighed and the weight shall be recorded.

Weight _____ lbs.

5.2.2 The unit shall be measured and the overall dimensions of width, height, and depth recorded.

Width _____ in.

Height _____ in.

Depth _____ in.

5.3 Insulation Resistance

5.3.1 Apply a test voltage of 500 VDC between chassis and Connector J3 shell with all external leads tied to circuits common, except the chassis ground, Pin E of Connector J1 using a Megger, General Radio 1862-B or equal. The insulation resistance shall be greater than 10 megohms.

Insulation Resistance _____ megohms

5.4 Functional Tests

5.4.1 Application of Power

Connect the Pulse Calibrator in the test set-up of Figure 1. Apply power, 115VAC, and allow the equipment to warm up for a minimum of 30 minutes.

5.4.2 Pulse Characteristics

5.4.2.1 Rise Time. Connect the oscilloscope to test point J4. Adjust pulse calibrator amplitude to a convenient level. Set pulse calibrator fine frequency control dial to "1.0" and frequency range switch to ".01". Measure rise time (time required for pulse to rise from 0.1 to 0.9 of maximum value assuming monotonic response). Repeat measurement for each range switch position through "X100K". Rise time should be less than 100 nanoseconds.

Range	Rise Time
X .01	_____
X 0.1	_____
X 1.	_____
X 10	_____
X 100	_____
X 1K	_____
X 10K	_____
X 100K	_____

5.4.2.2 Tail Duration. Measure the time required for the pulse to fall from maximum value to 0.1 maximum for range switch settings from X .01 to X100K. Duration time shall be less than 300 nanoseconds.

Range	Duration (nanoseconds)
X .01	_____
X 0.1	_____
X 10	_____
X 100	_____
X 1K	_____
X 10K	_____
X 100K	_____

5.4.2.3 Undershoot. Measure peak value of waveform crossing below baseline (scope zero) for range switch settings from X .01 to X1 100K. Undershoot should be less than 5% of peak value of pulse. Record data.

Range	Undershoot (%)
X .01	_____
X 0.1	_____
X 1	_____
X 10	_____
X 100	_____
X 1K	_____
X 10K	_____
X 100K	_____

5.4.2.4 Ringing. Measure amplitude of ringing (see sketch below) if observable on pulse waveform. Peak value of ringing should be less than 10% of pulse peak amplitude.

Range	Ring (%)
X .01	_____
X 0.1	_____
X 1	_____
X 10	_____
X 100	_____
X 1K	_____
X 10K	_____
X 100K	_____

5.4.2.5 Amplitude. Measure range of amplitude adjustment by variation of control. Amplitude should vary smoothly from zero to maximum. Maximum amplitude (control full clockwise) should be greater than 0.5 volt.

Amplitude Variation _____

Range	Amplitude (volts)
X .01	_____
X 0.1	_____
X 1	_____
X 10	_____
X 100	_____
X 1K	_____
X 10K	_____
X 100K	_____

5.4.3 Frequency Range

Connect the counter to J3. Set pulse calibrator dial multiplier to X.01. Adjust the fine frequency dial to 1. Allow the counter to accumulate at least 100 counts for a given sample.

Compute frequency. Repeat frequency measurement at each major division through 10 of the fine frequency dial.

5.4.3.1 Repeat above frequency test for all dial multiplier settings. Record data on next page.

5.4.4 Non-Linearity

Plot data of Paragraph 5.4.3 (dial setting versus frequency) for each dial multiplier setting. Measure maximum deviation from an ideal straight line drawn between points corresponding to dial settings of 1 and 100. Calculate deviation as a percentage of full scale. Non-linearity should be less than 10% FS. Record data on pages following.

5.4.5 Repeatability

After equipment has operated for at least one (1) hour repeat tests of Paragraphs 5.4.3 and 5.4.4. Compute change based on difference between data of Paragraph 5.4.3 and Paragraph 5.4.4 at corresponding points. Change any point should be less than 10% F.S. Record data on pages following.

5.4.6 Remote Energization

With equipment turned off (lamp DS1A not lit) connect the Simpson 269 meter across pins E and F

5.4.3 Data - Frequency vs control setting.

RANGE	DIAL									
	1	2	3	4	5	6	7	8	9	10
X.01										
X.1										
X1										
X10										
X100										
X1K										
X10K										
X100K										

5.4.4 Data- % Non-linearity vs control setting.

RANGE	DIAL									
	1	2	3	4	5	6	7	8	9	10
X.01										
X.1										
X1										
X10										
X100										
X1K										
X10K										
X100K										

5.4.5 Data - % Change vs control setting.

RANGE	DIAL									
	1	2	3	4	5	6	7	8	9	10
X.01										
X.1										
X1										
X10										
X100										
X1K										
X10K										
X100K

FIGURE 1 - PULSE CALIBRATOR TEST SETUP (T-711853)

of plug J2. Set the Simpson 269 meter to the highest ohms scale. Indicated ohms should be greater than 10^8 . Close switch S1 (see Figure 1) on test set-up. Lamp DS1B should light, and ohm meter reading indicate a short.

Indicated ohms_____

Lamp DS1B Lights_____

Ohm Meter Indicates Short_____

5.4.7 Fuse Light Operation

Pull fuse F1 and close switch S1 of Figure 1; fuse indicator lamp should light.

Fuse indicator lamp lit_____

5.4.8 DS1A Light Operation

Apply 28VDC to J1-A(+) and J1-B(-).

5.4.8.1 Measure 28 volts between TP1 (+) and TP2(-).

Volts_____

5.4.8.2 With pulse calibrator switch S1 open, local lamp DS1A should be out.

DS1A Out_____

5.4.8.3 With pulse calibrator switch S1 closed, local lamp DS1A should be lit.

DS1A Lit_____