SYSTEM CENTURY® DCO

SYNCHRONOUS NETWORK CLOCK DESCRIPTION AND OSCILLATOR CALIBRATION

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1. INTRODUCTION

1.01 This section provides the procedure for calibrating the oscillators in the Synchronous Network Clocks (SNC), used in the SYSTEM CENTURY® Digital Central Office (DCO), upon initial connection to the SNC network, or if a fault is indicated by a visual indicator.

1.02 This section is reissued to incorporate addendum 1 to issue 1.

2. RELATED INFORMATION

2.01 General.

A Sales and Instructional Literature Index of latest available publications can be obtained from your Stromberg-Carlson sales representative or from Publications Services, Stromberg-Carlson Corporation, 400 Rinehart Road, Lake Mary, Florida 32746.

2.02 Related Section.

The following section is recommended for use with this document. To determine the actual section number of the *System Operators Manual*, refer to the *DCO Index of Related Sections* provided with your set of Stromberg-Carlson Practices (SCPs).

23-YYY-97 System Operators Manual

3. DESCRIPTION

3.01 General.

a. The SNC permits a digital central office (DCO) to have a direct digital connection to other DCOs in a synchronous digital network.

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Each redundant SNC, (X and Y) derives an 8-kHz clock from the 1.544-MHz bit stream (fig. 1) of a T-1 span line. This clock is used as the primary timing reference for the SNC. The output of the SNC (24.576 MHz) is used as the primary timing source for the DCO through the master clock generator.

b. The 8-kHz clock derived on each SNC is sent to the opposite SNC for use as a secondary timing reference. In addition to other circuitry, the A-side SNC also contains a highly stable oven-controlled voltage-controlled crystal oscillator (OCVCXO) that is used as a timing reference if both T-1 spans fail. At anytime, the OCVCXO can be accurately updated to either span line by a software command. Software also controls all time-source switchovers, as well as masking and clearing faults.

c. The bipolar to unipolar converter (fig. 1) is the interface between the T-1 span and the SNC. The converter provides transfer coupling for ground isolation between the span and a pair of differential receivers in the converter. One receiver is biased positively, and the other is biased negatively; clamping diodes provide over-voltage protection to the receivers. The receiver outputs are ORed to provide full-wave rectification of the bipolar input for compatibility with the bit sync clock.

d. The bit sync clock is synchronized to the 1.544-MHz bit stream output of the bipolar to unipolar converter. The bit sync clock output is a 3.088-MHz clock which, after being divided down to 8 kHz, is used as the primary timing reference on that SNC. The 8-kHz clock is also used as a secondary timing reference on the opposite SNC (fig. 2).

e. The span switch receives 8-kHz inputs from the bit sync clock on the same SNC, the bit sync clock on the opposite SNC, and the OCVCXO on the A-side SNC. Software control selects the span switch output from one of the above.

f. A second-order phase locked loop, consisting of a phase detector, low-pass filter, voltage controlled crystal oscillator (VCXO), and 3072 divider, is synchronized to the 8-kHz output of the span switch. The VCXO output (24.576 MHz) is the timing source for the associated DCO master clock generator. The 3072 divider is tapped at 48 kHz to synchronize the OCVCXO.

g. The OCVCXO is part of another phase locked loop that consists of a refresh control, phase detector, 4K digital memory, low-pass filter, and 3072 divider. This loop is synchronized to the 48 kHz of the second-order phase locked loop for 2 minutes after software initiation, and then the OCVCXO free runs at the frequency stored in the digital memory. The OCVCXO is used as a reference to monitor the output of the second-order phase locked loops on both SNCs.

h. The fault monitor generates an alarm if any of the following occur:

1. Drift rate between VCXO output and OCVCXO output is equal to or greater than 0.66 Hz.

2. OCVCXO is near end of voltage holding range, 2.7 V ±1.7 V.

3. VCXO fails.

4. OCVCXO fails.

3.02 Visual Indicators.

a. Mounted on the edge of the X SNC PWBA (A-Side) is an LED display that indicates the status of the X and Y synchronous network clocks under software control. The status can be changed manually at the console by specific codes input under the $SNCUTL command. Refer to the section titled *System Operators Manual*, referenced in paragraph 2.02. Table 1 lists the input codes, corresponding displays, and their meanings.

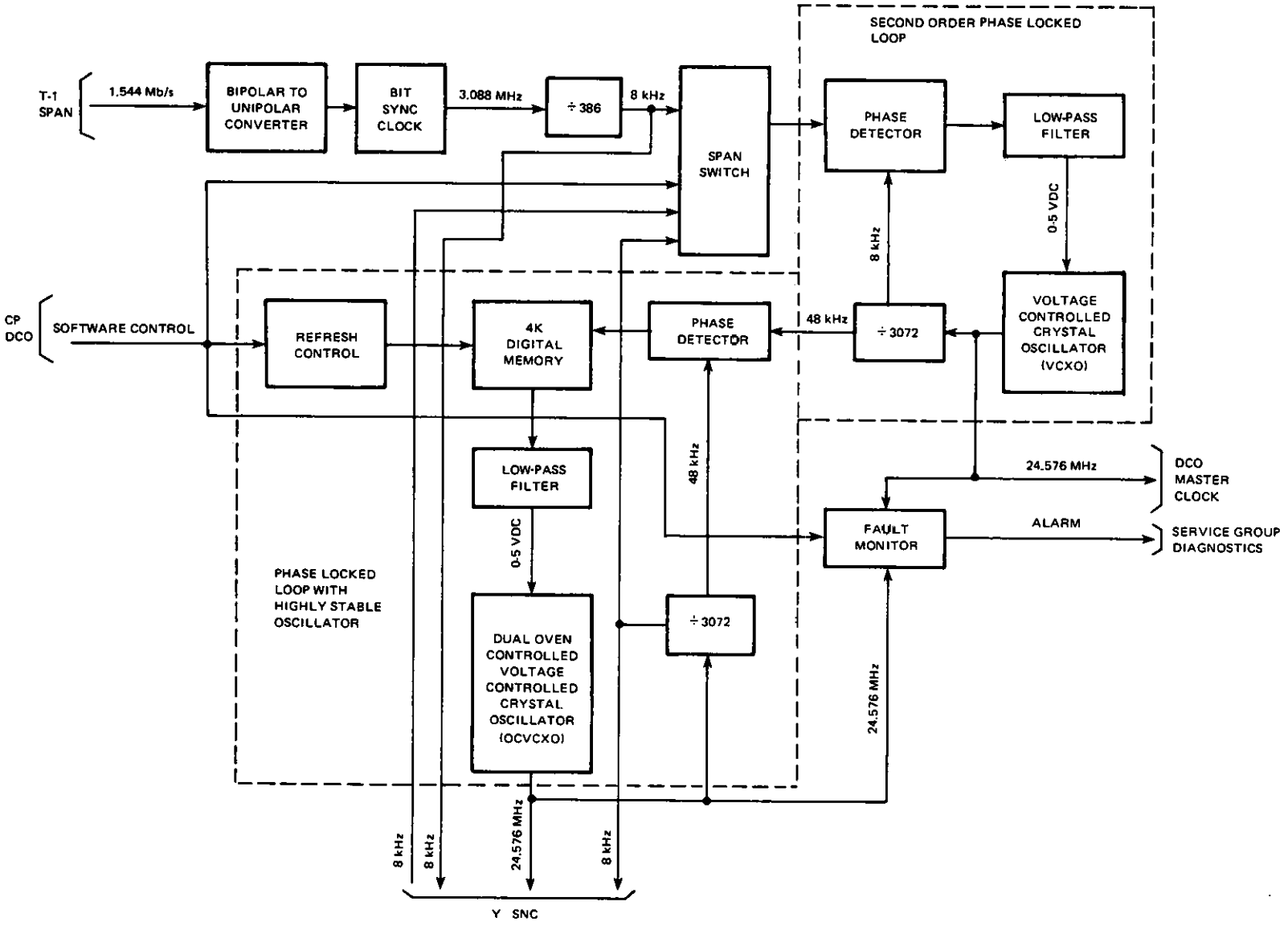


Figure 1. X Synchronous Network Clock (A-Side), Block Diagram

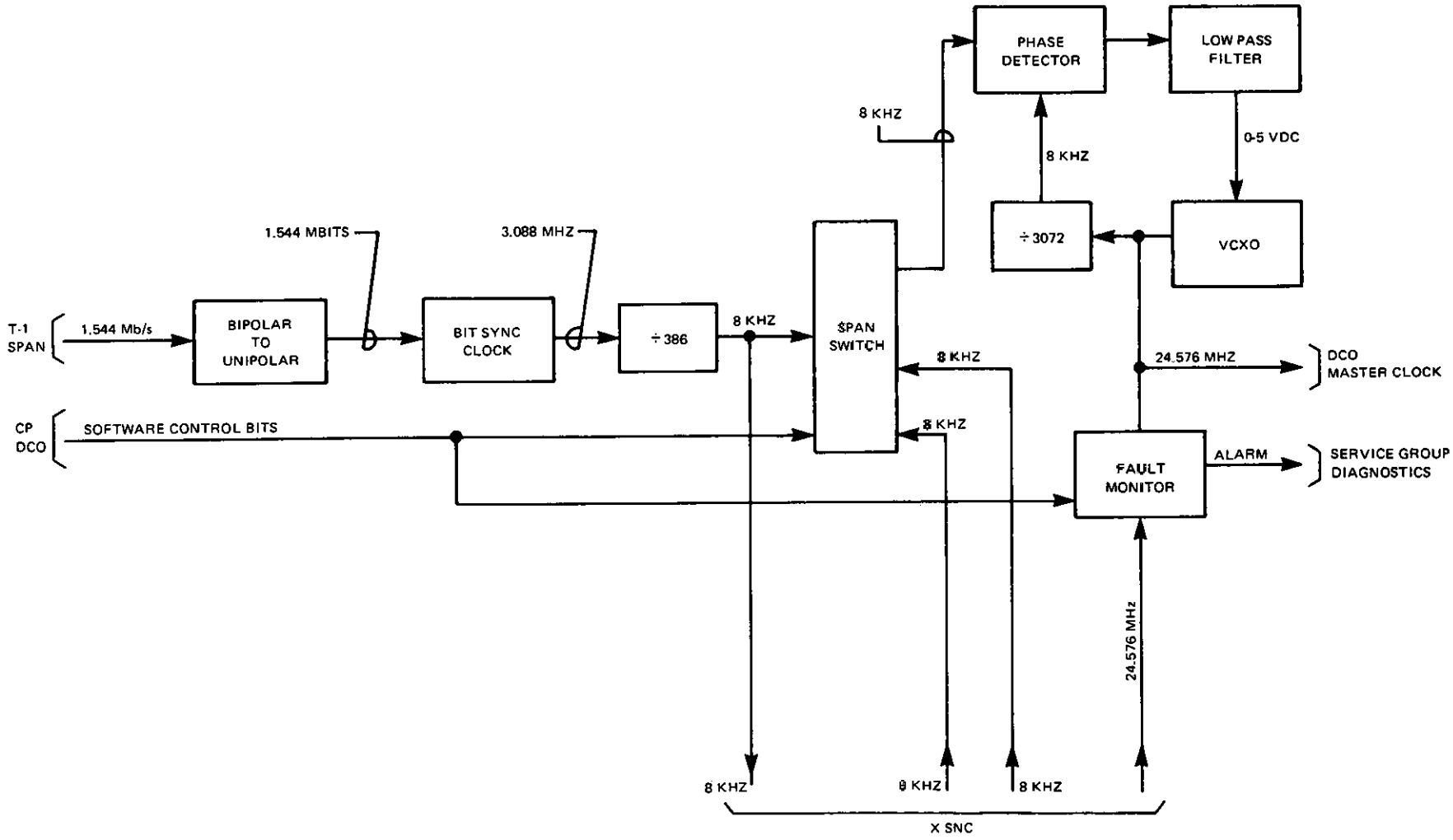


Figure 2. Y Synchronous Network Clock (B-Side), Block Diagram

Table 1. LED Display Interpretation, X SNC, (A-Side)

INPUT CODE ON CONSOLE	*LED DISPLAY*	*MEANING*
PP	4	X and Y SNCs Sync From Primary Spans
PS	5	X SNC Sync From Primary Span Y SNC Sync From Secondary Span
SP	6	X SNC Sync From Secondary Span Y SNC Sync From Primary Span
OS	7	X and Y SNC Sync From Internal Oscillators
RF	9	Oven Oscillator in Refresh State
FF	B	Force Faults
XR	C	Reset X SNC Fault, Set X SNC Mask
CX	D	Clear X SNC Mask
CY	E	Clear Y SNC Mask
YR	F	Reset Y SNC Fault, Set Y SNC Mask

b. Four red indicating lamps are also mounted on the edge of both X and Y SNC PWBAs (A and B side). These lamps light to indicate the faults listed in paragraph 3.01h. Table 2 lists the faults, the lamp that indicates the fault, and the corrective actions required for each fault.

Table 2. Fault Indicator Lamps, X and Y SNCs (A and B Sides)

LAMP LIGHTED	*FAULT INDICATED*	*CORRECTIVE ACTION*
1 (top)	Drift rate between VCXO output and OCVCXO output is equal to or greater than 0.66 Hz.	Check printout for fault report. If no printout, calibrate per paragraph 4.02 and 4.03.
2	OCVCXO is near end of voltage holding range, 2.7V, ±1.7V.	Recalibrate oven oscillator, paragraph 4.02.
3	VCXO output failed.	Replace PWBA on which lamp was lit, and calibrate small oscillator if Y PWBA (B-side) or both oscillators if X PWBA (A-side).
4 (bottom)	OCVCXO output failed.	Replace X SNC PWBA, (A-side), and calibrate both oscillators on X PWBA.

4. OSCILLATOR CALIBRATION PROCEDURE

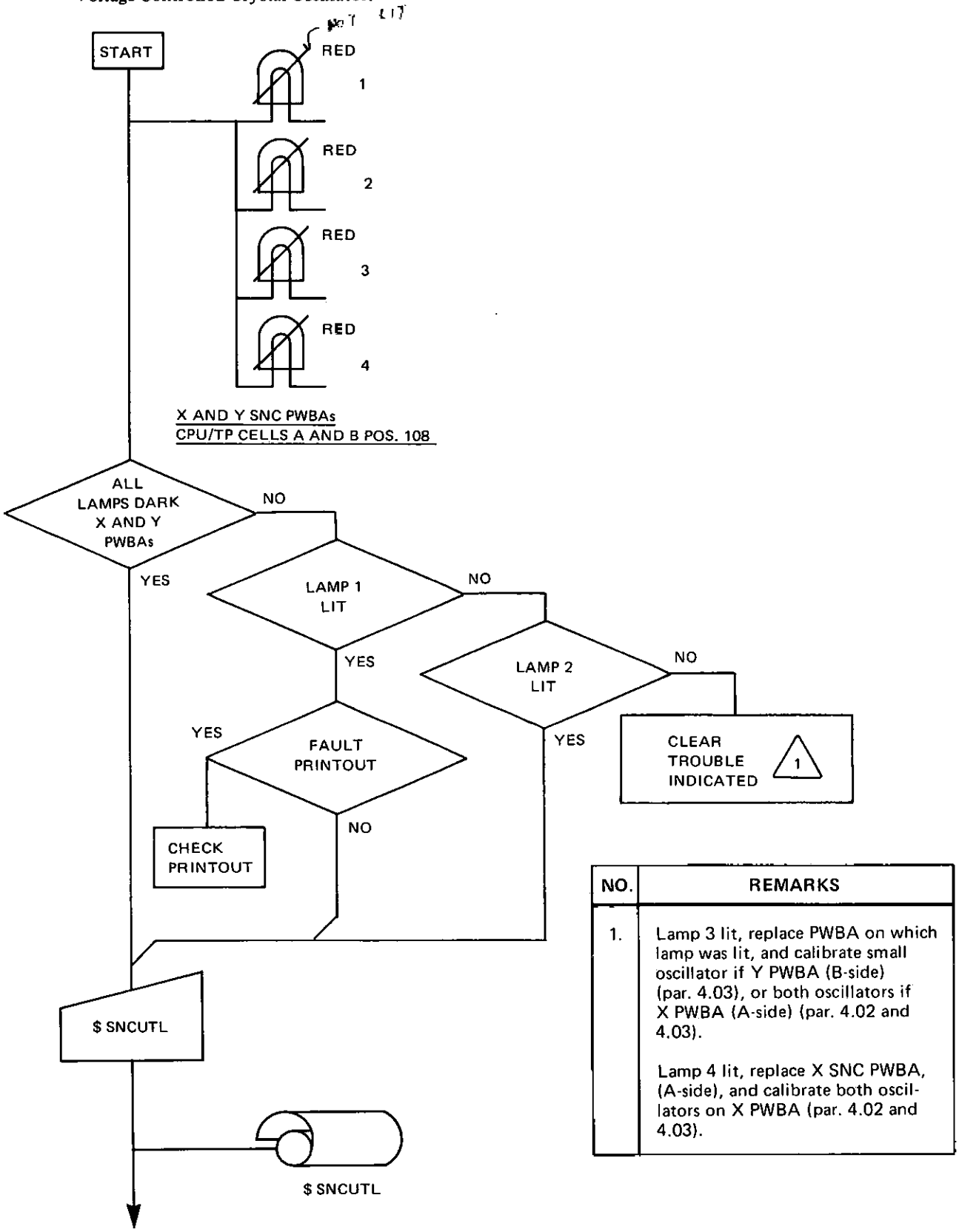
4.01 Test Equipment Required.

a. Voltmeter, Fluke 8000A or equivalent.

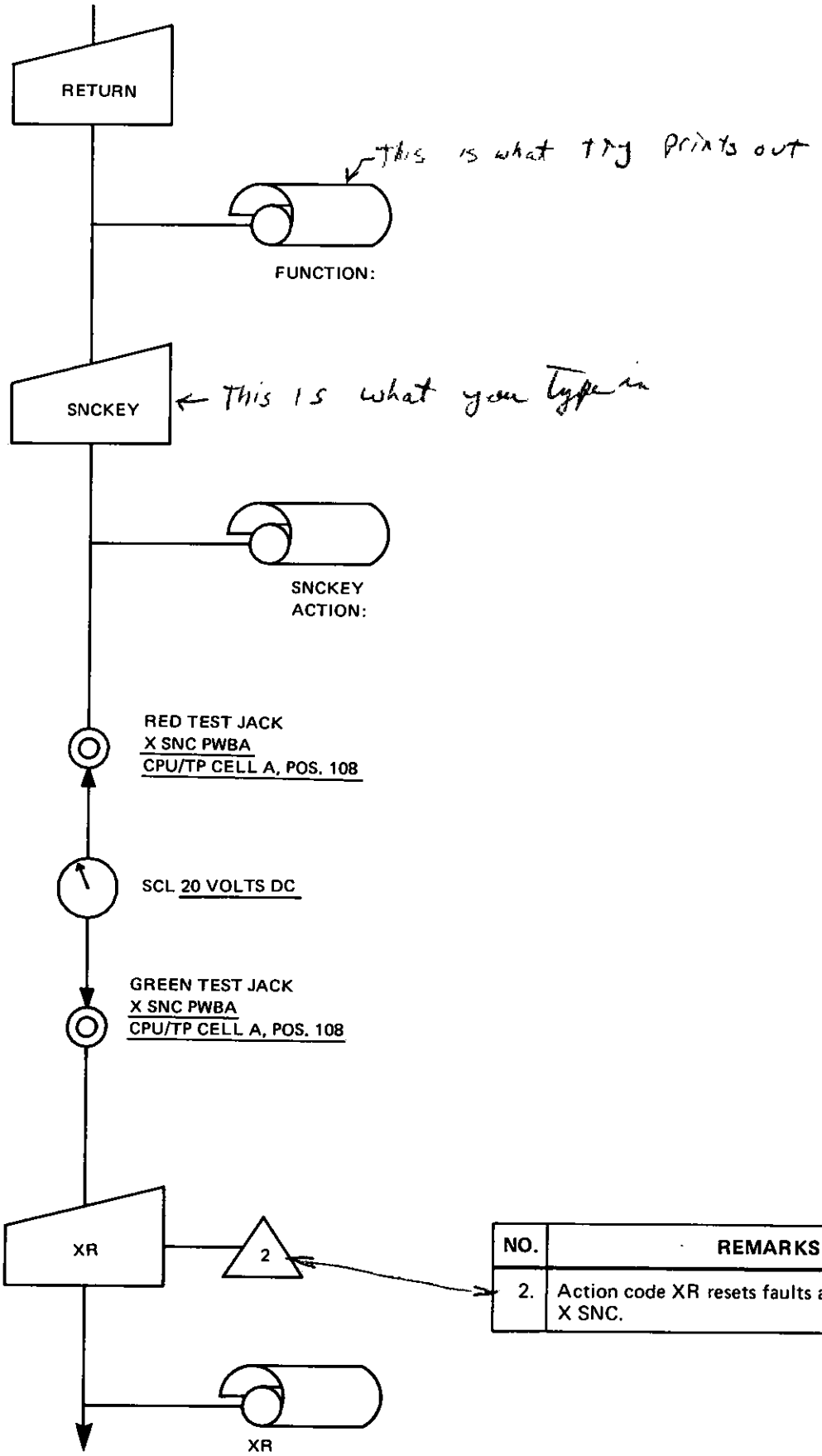
b. Miniature Screwdriver, 1/16-inch jewelers.

c. Dual-Trace Oscilloscope (optional) Tektronix 465, or equivalent.

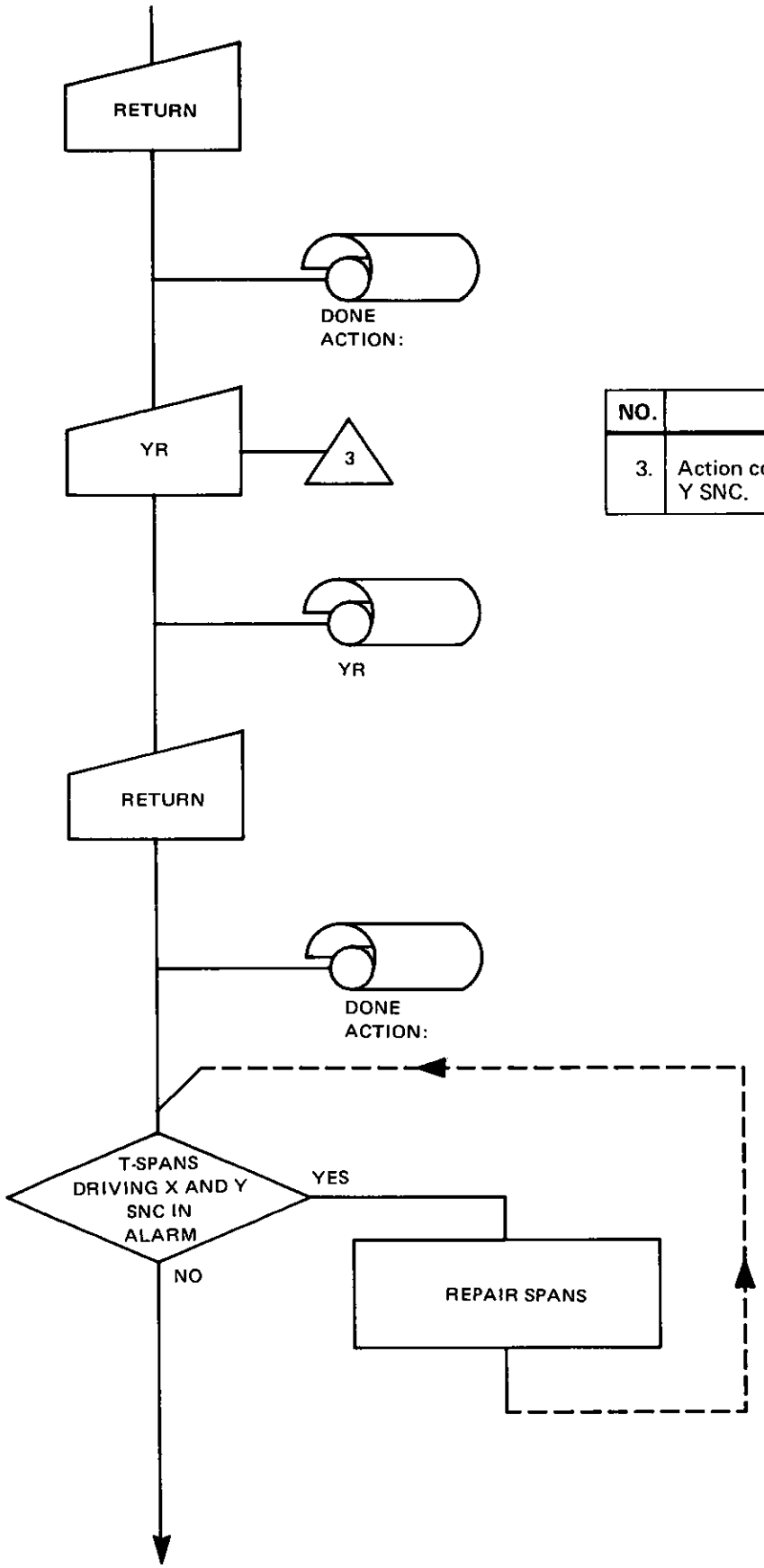
4.02 Calibration of the X SNC Oven-Controlled, Voltage-Controlled Crystal Oscillator.



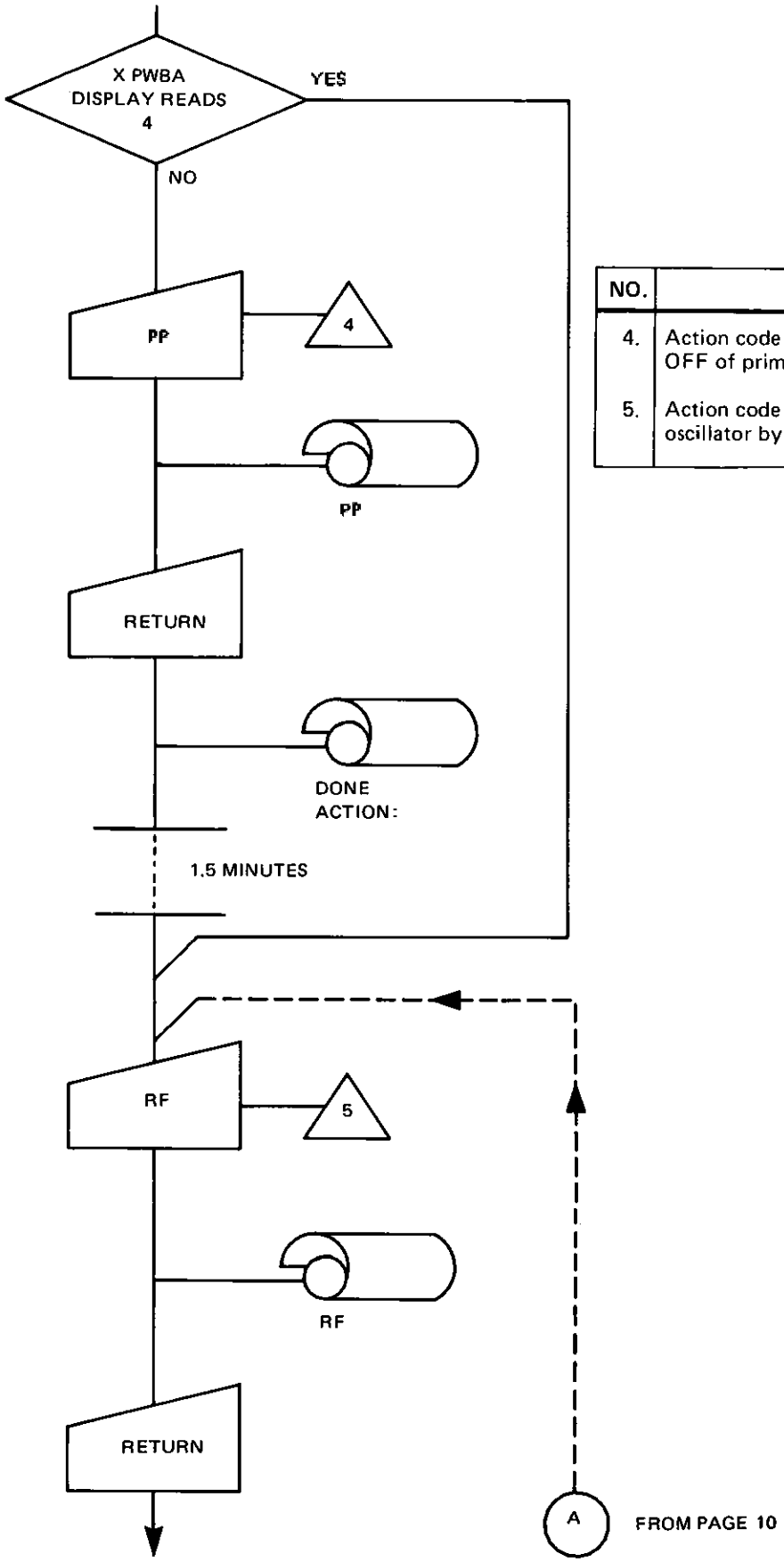
NO.	REMARKS
1.	Lamp 3 lit, replace PWBA on which lamp was lit, and calibrate small oscillator if Y PWBA (B-side) (par. 4.03), or both oscillators if X PWBA (A-side) (par. 4.02 and 4.03). Lamp 4 lit, replace X SNC PWBA, (A-side), and calibrate both oscillators on X PWBA (par. 4.02 and 4.03).



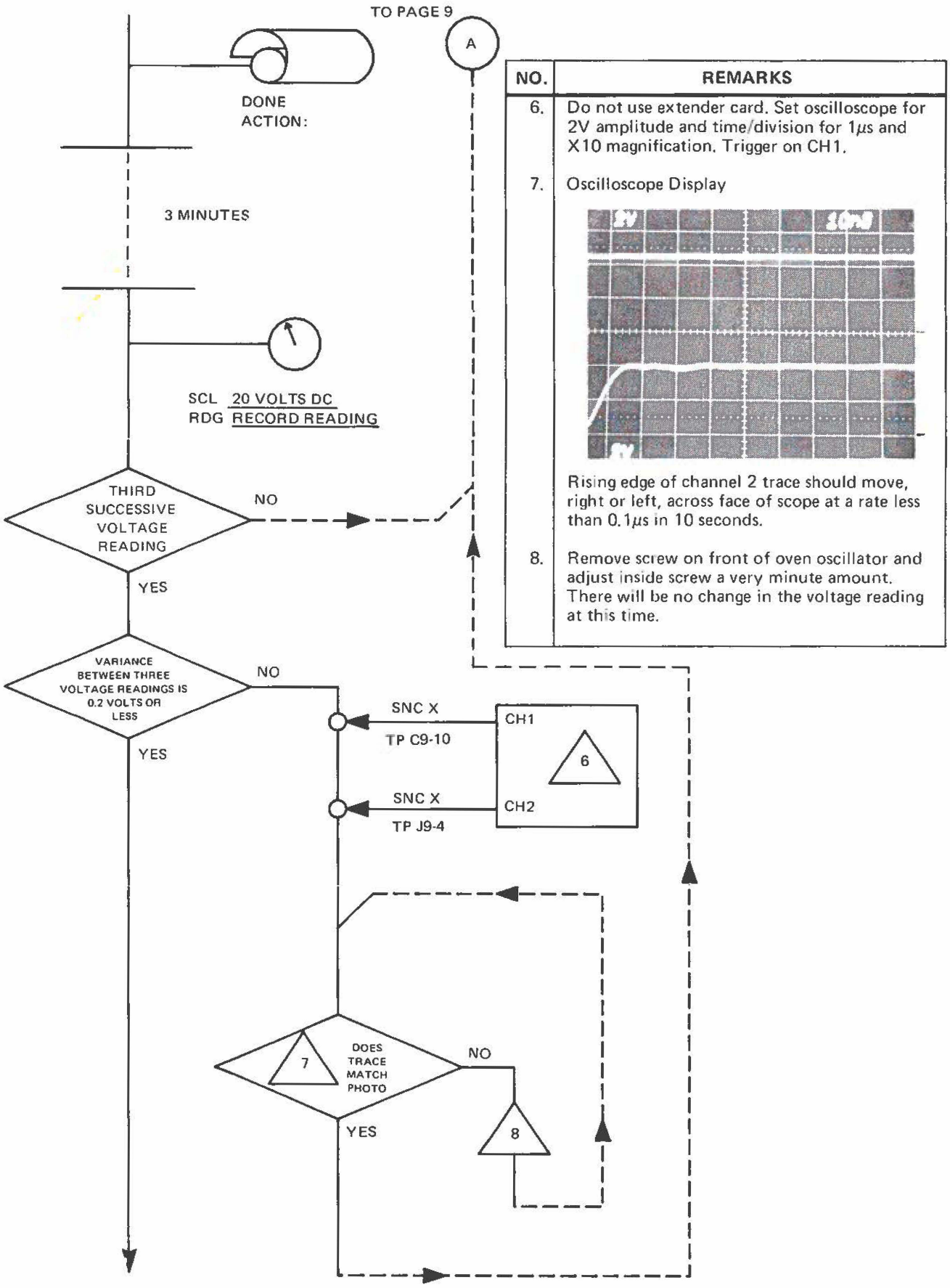
NO.	REMARKS
2.	Action code XR resets faults and sets mask for X SNC.



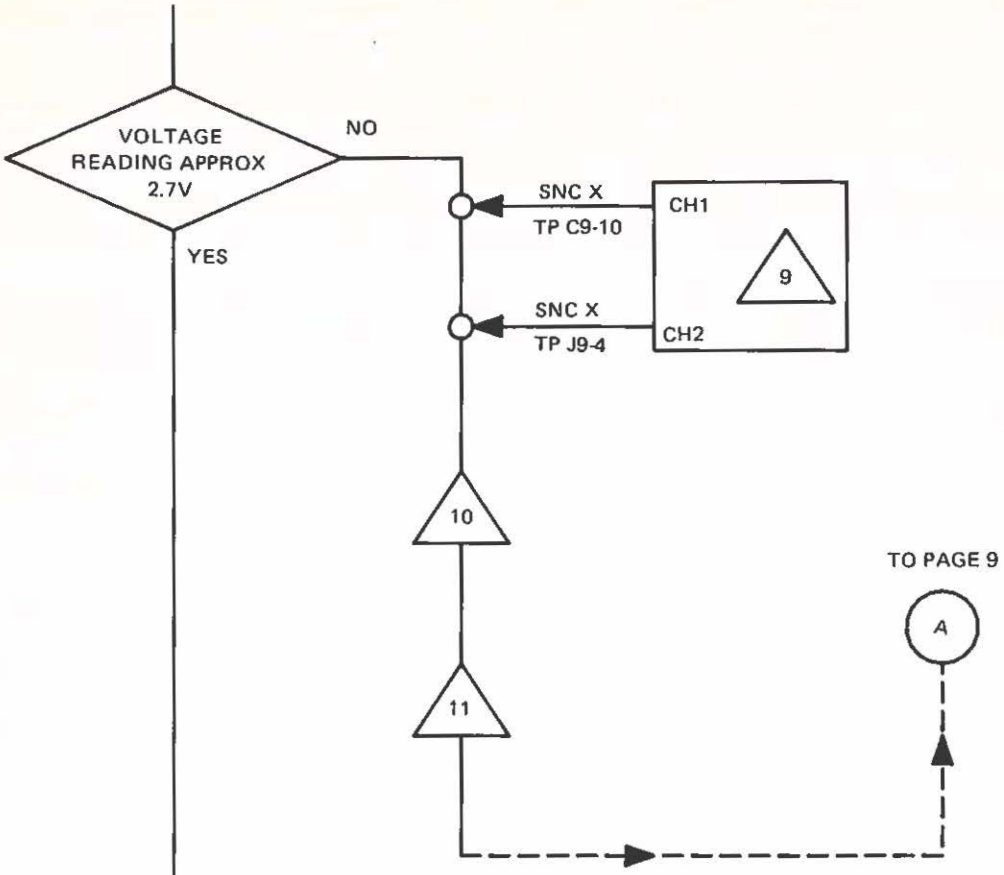
NO.	REMARKS
3.	Action code YR resets faults and sets mask for Y SNC.

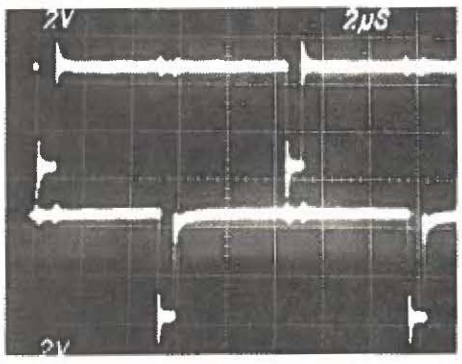


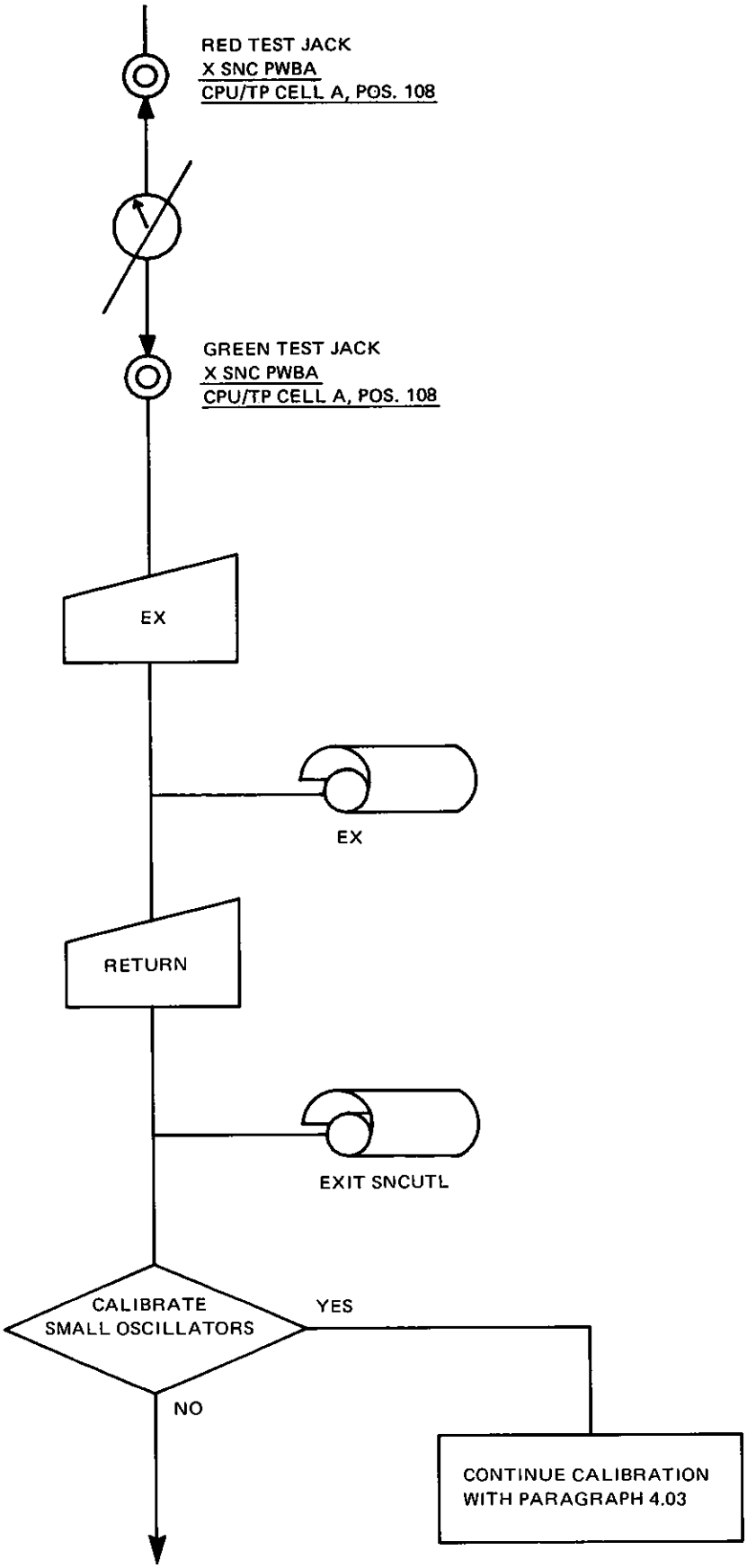
NO.	REMARKS
4.	Action code PP directs X and Y SNC to SYNC OFF of primary spans.
5.	Action code RF refreshes the oven controlled oscillator by updating the 4K memory.

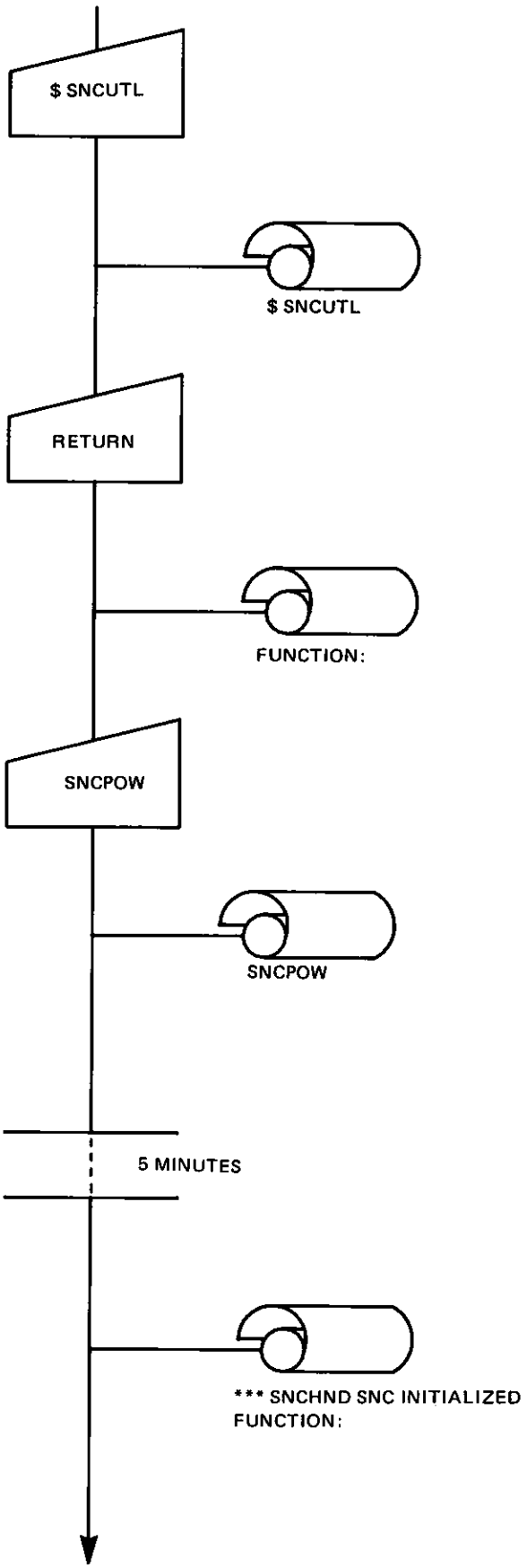


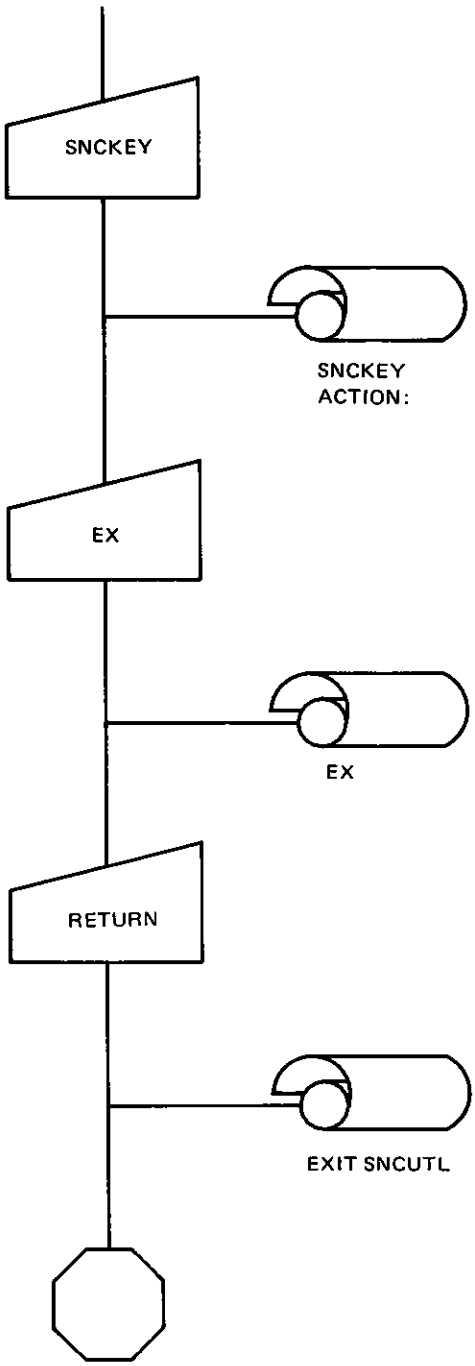
NO.	REMARKS
6.	Do not use extender card. Set oscilloscope for 2V amplitude and time/division for 1μs and X10 magnification. Trigger on CH1.
7.	Oscilloscope Display Rising edge of channel 2 trace should move, right or left, across face of scope at a rate less than 0.1μs in 10 seconds.
8.	Remove screw on front of oven oscillator and adjust inside screw a very minute amount. There will be no change in the voltage reading at this time.



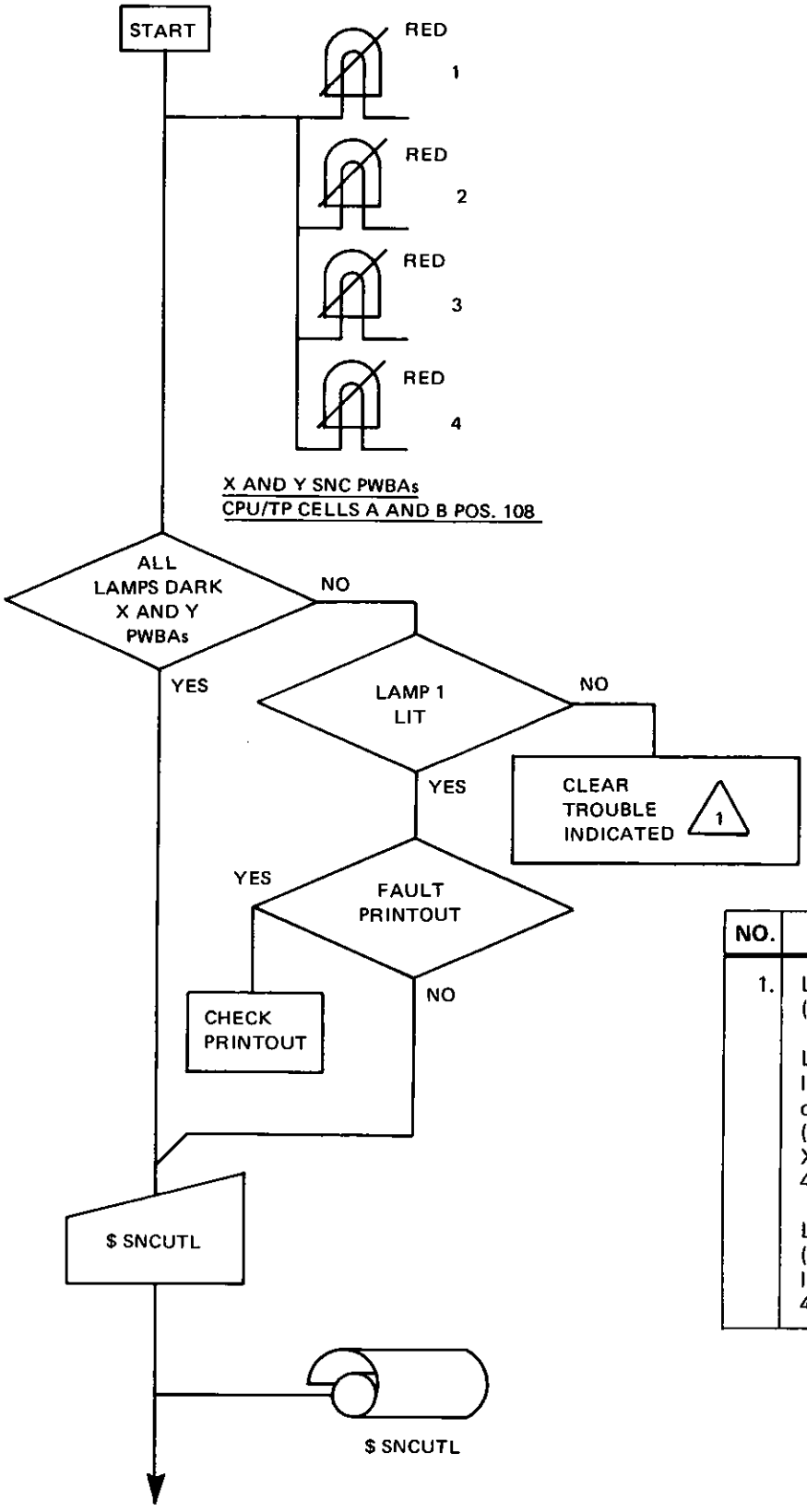
NO.	REMARKS
9.	Do not use extender card. Set oscilloscope for 2V amplitude and time/division for 2μs. Trigger on CH1.
10.	Oscilloscope Display  The rising edge of channel 2 trace should be leading or lagging the rising edge of channel 1 trace by approximately 90 °. Channel 2 trace should not be drifting at a rate greater than 50 ns in 10 seconds.
11.	Remove cover screw on oven oscillator and turn inside screw a very minute amount.


RED TEST JACK
X SNC PWBA
CPU/TP CELL A, POS. 108
GREEN TEST JACK
X SNC PWBA
CPU/TP CELL A, POS. 108
EX
EX
RETURN
EXIT SNCUTL
CALIBRATE
SMALL OSCILLATORS
YES
NO
CONTINUE CALIBRATION
WITH PARAGRAPH 4.03

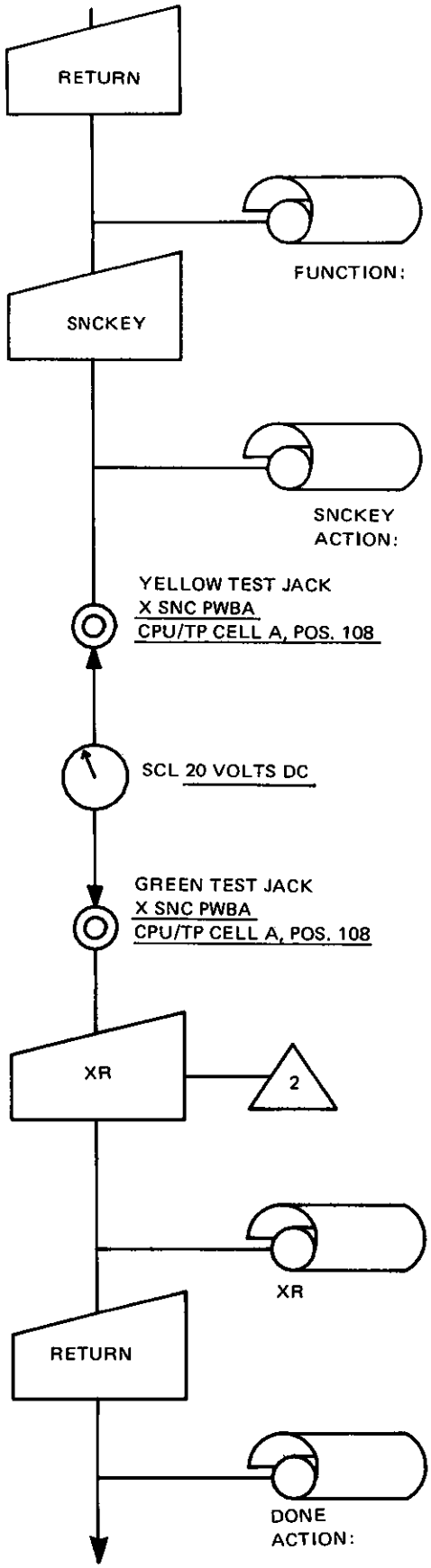

$ SNCUTL
$ SNCUTL
RETURN
FUNCTION:
SNCPOW
SNCPOW
5 MINUTES
*** SNCHND SNC INITIALIZED
FUNCTION:


SNCKEY
SNCKEY
ACTION:
EX
EX
RETURN
EXIT SNCUTL

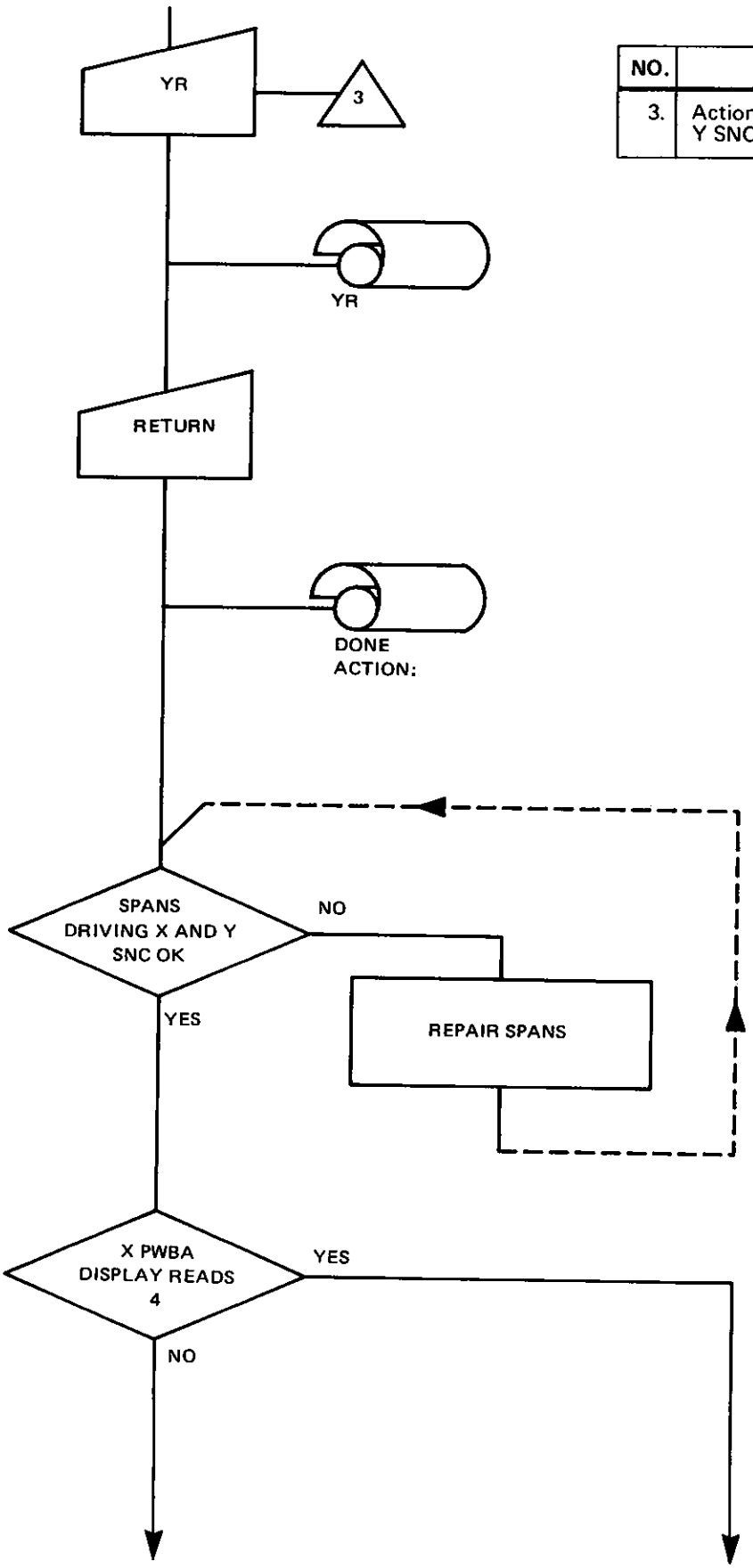
4.03 Calibration of the X and Y SNCs Voltage-Controlled Crystal Oscillators.



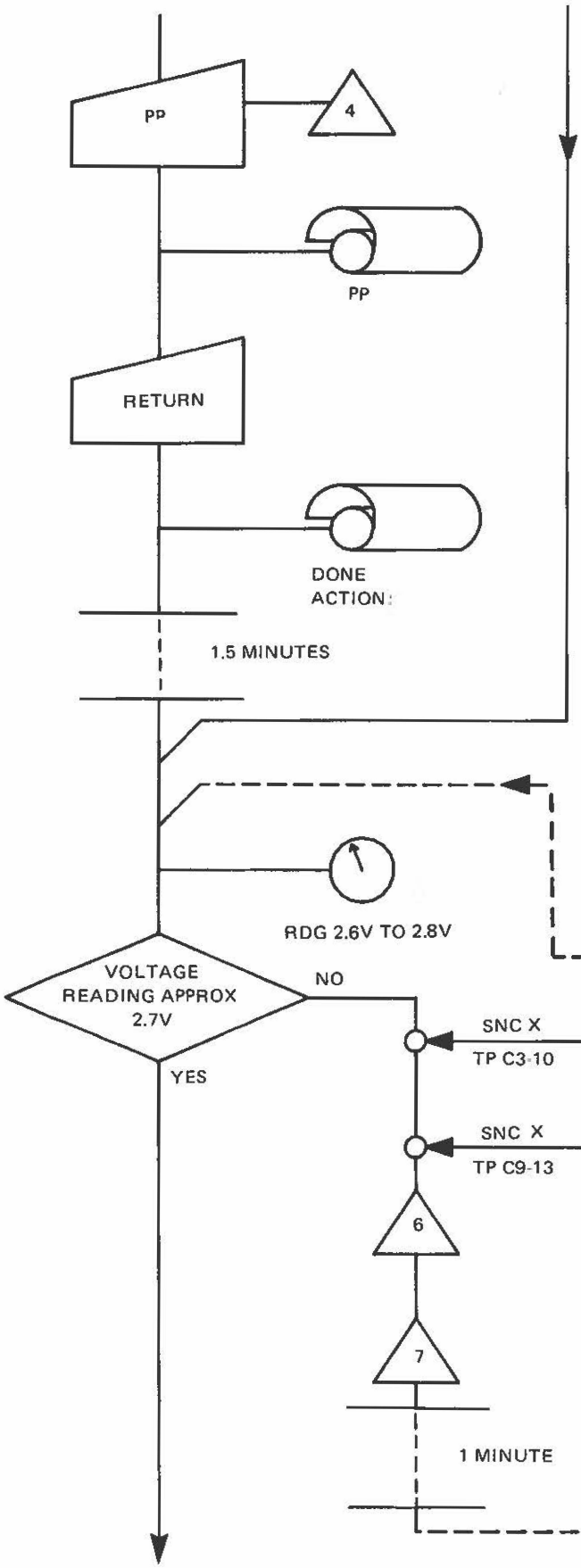
NO.	REMARKS
1.	Lamp 2 lit, calibrate oven oscillator (par. 4.02). Lamp 3 lit, replace PWBA on which lamp was lit, and calibrate small oscillator if Y PWBA (B-side) (par. 4.03), or both oscillators if X PWBA (A-side) (par. 4.02 and 4.03). Lamp 4 lit, replace X SNC PWBA, (A-side), and calibrate both oscillators on X PWBA (par. 4.02 and 4.03).

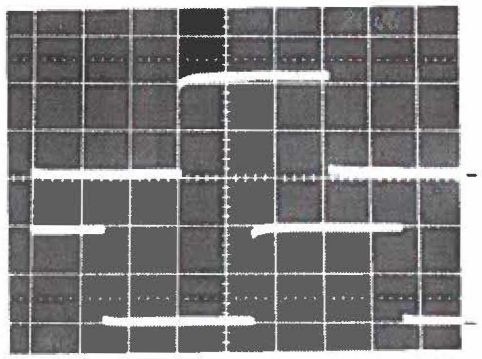


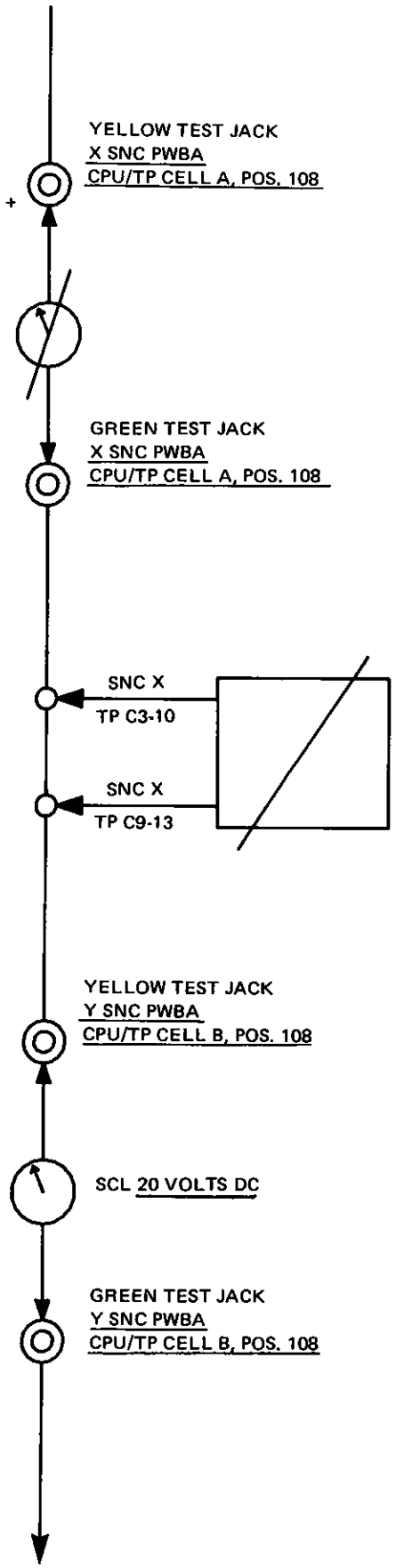
NO.	REMARKS
2.	Action code XR resets faults and sets mask for X SNC.

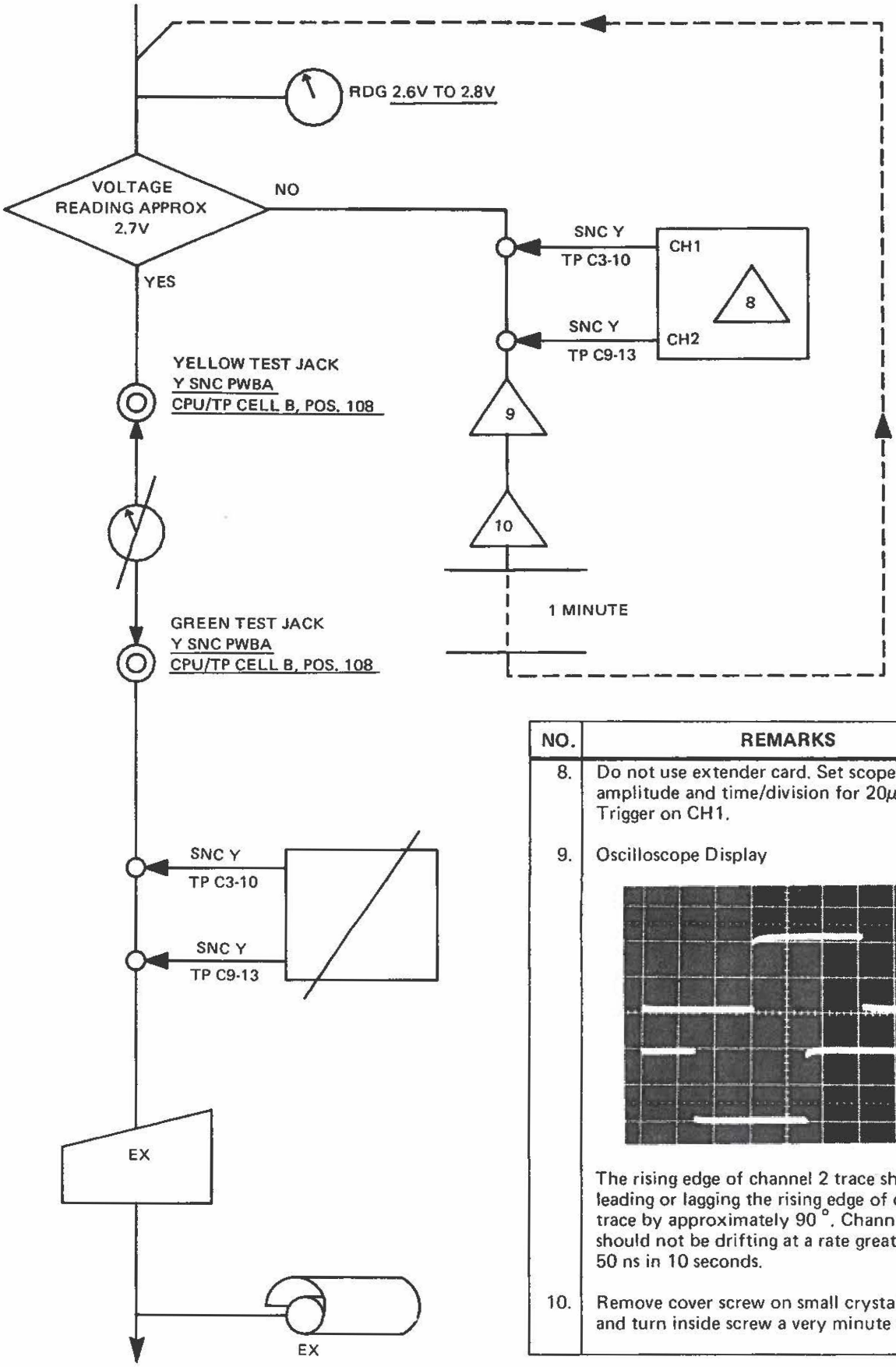


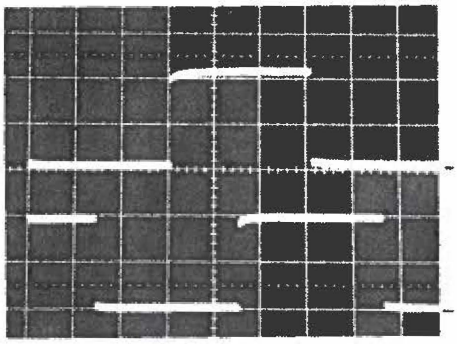
NO.	REMARKS
3.	Action code YR resets faults and sets mask for Y SNC.

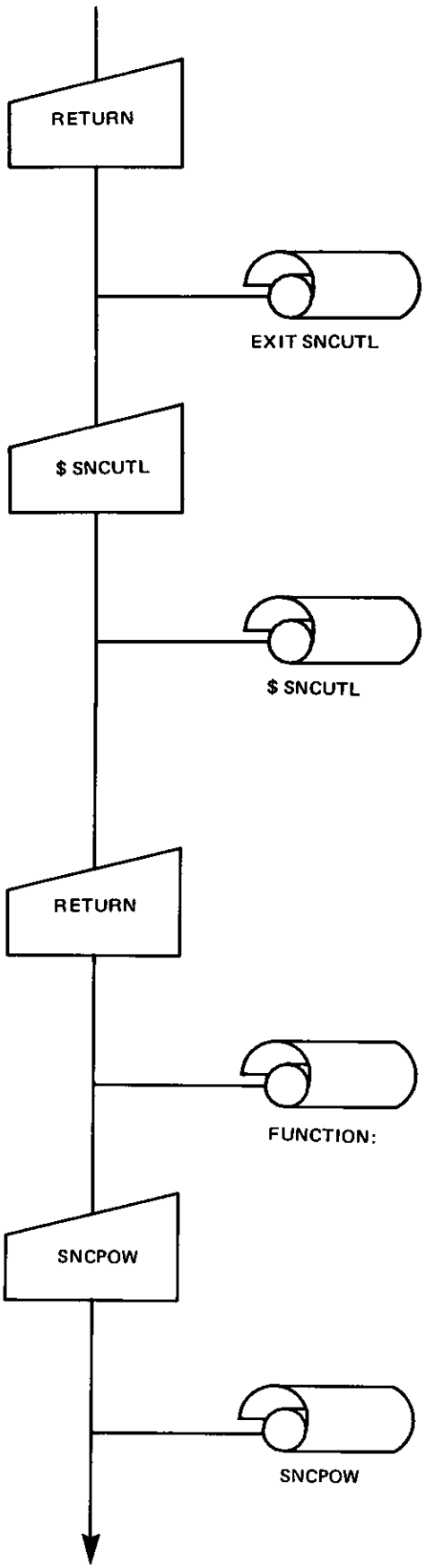


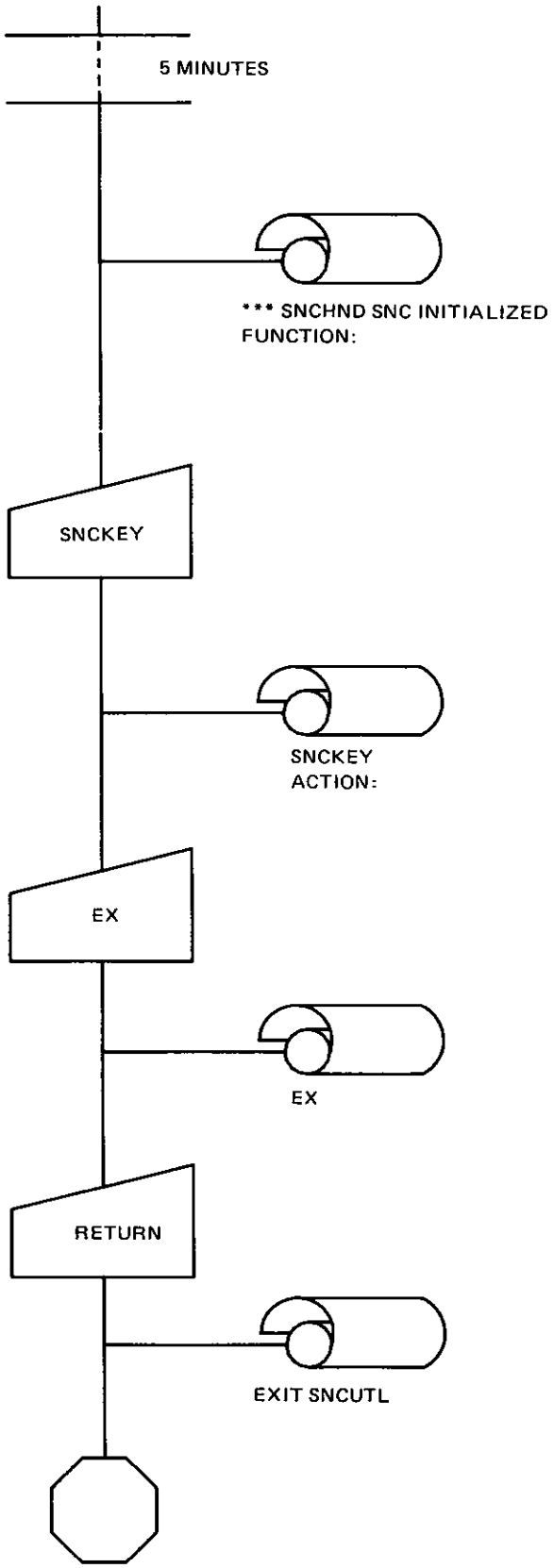
NO.	REMARKS
4.	Action code PP directs X and Y SNC to SYNC OFF of primary spans.
5.	Do not use extender card. Set scope for 2V amplitude and time/division for 20μs. Trigger on channel 1.
6.	Oscilloscope Display  The rising edge of channel 2 trace should be leading or lagging the rising edge of channel 1 trace by approximately 90°. Channel 2 trace should not be drifting at a rate greater than 50 ns in 10 seconds.
7.	Remove cover screw on small crystal oscillator and turn inside screw a very minute amount.


YELLOW TEST JACK
X SNC PWBA
CPU/TP CELL A, POS. 108
+
GREEN TEST JACK
X SNC PWBA
CPU/TP CELL A, POS. 108
SNC X
TP C3-10
SNC X
TP C9-13
YELLOW TEST JACK
Y SNC PWBA
CPU/TP CELL B, POS. 108
SCL 20 VOLTS DC
GREEN TEST JACK
Y SNC PWBA
CPU/TP CELL B, POS. 108



NO.	REMARKS
8.	Do not use extender card. Set scope for 2V amplitude and time/division for 20μs. Trigger on CH1.
9.	Oscilloscope Display  The rising edge of channel 2 trace should be leading or lagging the rising edge of channel 1 trace by approximately 90°. Channel 2 trace should not be drifting at a rate greater than 50 ns in 10 seconds.
10.	Remove cover screw on small crystal oscillator and turn inside screw a very minute amount.


RETURN
EXIT SNCUTL
$ SNCUTL
$ SNCUTL
RETURN
FUNCTION:
SNCPOW
SNCPOW


5 MINUTES
*** SNCHND SNC INITIALIZED
FUNCTION:
SNCKEY
SNCKEY
ACTION:
EX
EX
RETURN
EXIT SNCUTL

5. OSCILLATOR STABILIZATION

5.01 General.

The oven oscillator (OCVCXO) requires stabilization if power has been removed for a period of time, or the unit has been replaced. Paragraph 5.02 gives the procedure for stabilization. Table 3 gives a stabilization time period reference for operating ambient temperatures. The temperature ranges for the OCVCXO are:

Operating Ambient Temperature 40 °C to 50 °C (104 ° to 122 °F)
Operating Temperature Range 0 ° to 50 °C (32 ° to 122 °F)
Storage Temperature −55 °C to 85 °C (−67 ° to 185 °F)

Table 3. Restabilization Reference for Ambient Temperature

POWER OFF PERIOD (DAYS)	*TYPICAL RESTABILIZATION PERIOD (DAYS)*
1	2
3	4
7	7
21	14
90	21-28

NOTE. This table is to be used as a reference only. Restabilization time will vary with storage temperatures lower than ambient temperatures. This will require greater restabilization time.

5.02 Stabilization Procedure, X (Side-A) SNC PWBA (814545-526).

a. When the X SNC PWBA is replaced or power restored after a period of time off, the following steps must be done to stabilize and calibrate the oscillators:

1. At the console, under $SNCUTL, SNCKEY commands, enter code XR.
2. When prompted by ACTION, enter code YR.
3. When prompted by ACTION, enter code PP.
4. Wait 90 seconds.
5. Under ACTION, enter code RF.
6. Wait 3 minutes.
7. Calibrate X VCXO (refer to paragraph 4.03).
8. Exit from SNCUTL.
9. Allow X OCVCXO to stabilize for 24 hours.
10. At end of 24-hour period, calibrate X OCVCXO according to paragraph 4.02.
11. Check calibration of X OCVCXO and VCXO periodically (approximately every 4 days for stabilization periods of 7 to 28 days) or if fault indicator lamp 1 or 2 lights.
12. At end of the stabilization period, recalibrate X OCVCXO.

5.03 Replacement Procedure, Y (Side-B) SNC PWBA (814545-546).

When the Y SNC PWBA is replaced, do the calibration procedure given in paragraph 4.03.

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