MODEL 112 CALIBRATION PROCEDURE

EQUIPMENT REQUIRED:

1. Voltmeter, 1% accuracy, 1mv resolution (WAVETEK Model 201 or equivalent).

*2. Oscilloscope, Tektronix 530 Series or equivalent.

*3. Plug-in, Tektronix type W or equivalent.

4. Plug-in, Tektronix type CA or equivalent.

5. Frequency counter, 5 digit resolution.

6. Distortion analyzer Hewlett/Packard Model 330C or equivalent.

7. Two 50Ω cables with BNC connectors, 50n termination.

*If Tektronix scope and type W plug-in are not available, any peak reading device with an accuracy of 1% or better can be used.

Remove cover from instrument.

Set mode switch on continuous.

POWER SUPPLY BOARD

Bypass capacitors, Cl and C2, are located in the bottom of the instrument and are filter capacitors for the +6 volt and -6 volt power supplies. C2, the capacitor toward the rear of the instrument, is in the +6 volt supply, and the other is in the -6 volt supply. The capacitor leads are convenient voltage test points. Connect an appropriate measuring device between the end marked t of C2 and circuit ground. Adjust R24 for +6.00 volts ±1mv. Move the measuring device to Cl between the end marked - and circuit ground. Adjust R9 for -6. 00 volts ±1mv. To compensate for the effects of interaction, repeat these adjustments.

There is no adjustment in the t and -24 volt supplies.

Typical 120 cycle ripple, ±6 volt supplies is less than 25mv.

Typical 120 cycle ripple, ±24 volt supplies is less than 500mv.

MAIN BOARD

1. Set range to X10KHz at top of frequency dial. Monitor the fixed triangle output and adjust R4 for minimum ringing on triangle. set range to X100KHz and readjust R4 for linearity of the triangle at 1MHz. It may be necessary to repeat adjustments of R4 several times to insure optimum triangle linearity at 1MHz and minimum ringing at 100KHz.

2. Set range to X100 at extreme bottom of frequency dial. Use jumper to short pin 7, VCG board to circuit ground. Install 100K resistor between pin 1 and pin 3 of the main board. Observe integrator output with appropriate indicating device at junction of R17 and R18. Adjust R8 for zero volts. Remove jumper wire and 100K resistor.

3. Using Tektronix scope and type W plug-in, observe triangle at front panel connector, open circuit. Adjust R78 in switch set for the triangle break ⋁ at exactly -2.50 volts (use comparison voltage on type W plug-in). Adjust R77 for the triangle break ⋀ at exactly +2. 50 volts. To compensate for effects of interaction, repeat adjustments.

4. Observe 15nsec. square wave for leading edge spikes with 50Ω cable terminated into 50Ω. Adjust R104 for t and -2.50 volts ±1mv. Adjust R99 for symmetry about ground. Tolerance on spikes is 5% of total peak to peak amplitude.

5. Observe that 10nsec. square wave output on oscilloscope is free of excessive leading edge spikes, (X100K, top of frequency dial, using 50Ω cable terminated into 50Ω).

POWER AMPLIFIER

Set output amplifier function selector (front panel) switch on square wave (fully clockwise position). Set attenuator fully clockwise. Observe front panel output GR connector on oscilloscope open circuited and adjust R31 for a 32.5 volt peak to peak square wave.

Adjust square wave with output attenuator fully counter-clockwise for symmetry about ground with R41. Adjust 1MHz square wave into open circuit with C11 for optimum square wave with no overshoot. Check for less than 100nsec. risetime. Check for 30 volts into 600Ω, and 10 volts into 50Ω.

SINE WAVEFORM ADJUSTMENTS

1. Using Tektronix scope and type W plug-in, set frequency dial at 10, range x100. Place main board on extender cable. Observe sine at BNC connector.

Adjust R64 for sine wave out of ±2.5 volts ● lmv. Adjust R60 for sine

symmetry about ground. Using distortion analyzer, adjust R20, R24, R30, R33, R46 and R49 for minimum harmonic distortion. Readjust R64 and R60 for amplitude and symmetry about ground. Typical harmonic distortion 0. 12%.

2. Set dial at 1. Measure distortion. Typical distortion is 0. 2%.

VCG BOARD
(For instruments having first amplifier summing node zero adjustment.)

Measure ±6 volt power supplies (refer to Power Supply Board Calibration Procedure, page 4- 1).

1. Dial Setting Adjustment:

With Frequency Hertz switch at X100, Frequency Vernier fully clockwise, set Frequency Dial to 10, measure voltage at potentiometer wiper arm (pin 9 on the VCG Board) to be t5. 750 volts ±2mv. If this condition is not met, re-install the dial.

2. Dial Tracking Adjustment:

With Frequency Hertz switch X100, Vernier fully clockwise, set dial to 10 and adjust R13 for 1000Hz and R14 for time symmetry. Set the dial to 1. By alternately shorting and opening the VCG input terminals, adjust R9 for a minimum frequency shift.

NOTE

Frequency shift is caused by non-zero summing node at the first VCG amplifier. R9 is used to adjust this for zero volts and no frequency shift.

Adjust R51 (source current potentiometer) and R46 for 100Hz and time symmetry. Repeat steps for adjustment of R13 and R14 and adjustment of R9 until frequency, symmetry and source current are all calibrated at the top (1000Hz) and bottom (100Hz) of the dial.

3. VCG Input Calibration:

With Frequency Hertz switch X100, Frequency Vernier Potentiometer fully clockwise, adjust dial for 100Hz on frequency measuring device. Apply t4. 500 volts to the VCG input on the front panel and adjust R8 for 1000Hz.

4. Ramp Adjustment:

Observe ramp output at BNC connector with 50n cable unterminated. Adjust

R34 so that signal is neither  nor  , but is 

Adjust R33 for -2.5 volts peak ramp output.

CHECK RANGES

On Front Panel Board check all fixed ranges for frequency tracking. Trim resistors have been installed on individual ranges for tracking. Adjust C3 for proper tracking on X10K range. A trim resistor has been installed between position 3 and position 5 on wafer 1 of range switch for proper tracking on X1K range. Adjust C7 for proper tracking on X100K range.

TRIGGER BOARD

Minus 1 Amplifier. Set "Freq Hz" X100, dial 10, mode switch continuous. Observe selected differential output with 50Ω cable unterminated with an oscilloscope with type W plug-in. Place function selector on front panel in  position. Adjust R63, -1 amplifier gain control for 5. 00 volts peak to peak. Adjust R48 for symmetry about ground. Rotate function selector through all positions and check for appropriate output waveforms.

Offset Sine. Observe offset sine output connector, open circuited with oscilloscope and type W plug-in. Adjust R54 for 2.5 volts peak to peak sine wave with the most negative excursion at 0.00 volts dc.

Trigger Clamp Amplifier. Set "Freq Hz" switch X100, dial at 10, mode switch triggered, Start-Stop Point centered, trigger slope +, trigger level centered. Apply 1 volt sine wave to trigger input. Adjust trigger level control for one cycle triggered operation. Adjust R29 so that Start-Stop Point Potentiometer will cause the observed waveform to shift beyond $\pm 90^{\circ}$.

Set mode switch to gated. Adjust trigger level to give several cycles. Switch slope switch between + and - and insure that gated operation is maintained.

Set mode switch to triggered. With triggering signal applied, adjust trigger level for 1 cycle triggering. Remove trigger signal source and depress manual trigger button. Observe 1 cycle when button is depressed.

FRONT PANEL OUTPUT

Observe power amplifier output with externally triggered scope. Rotate function selector through its positions and insure that all outputs are available and in proper phase.

MODEL 1151116 CALIBRATION PROCEDURE

EQUIPMENT REQUIRED:

1. Voltmeter, 1% accuracy, 1mv resolution (WAVETEK Model 201 or equivalent).

*2. Oscilloscope, Tektronix 530 Series or equivalent.

*3. Plug-in, Tektronix type W or equivalent.

4. Plug-in, Tektronix type CA or equivalent.

5. Frequency counter, 5 digit resolution.

6. Distortion analyzer Hewlett/Packard Model 330C or equivalent.

7. Two 50Ω cables with BNC connectors, 50n termination.

8. WAVETEK Model 110 or equivalent.

9. CMC-27D Frequency Counter, or equivalent (dual trace oscilloscope with delayed sweep and external input capabilities can be used in lieu of the CMC Counter).

*If Tektronix scope and type W plug-in are not available, any peak reading device with an accuracy of 1% or better can be used.

Remove cover from instrument.

Set mode switch on continuous.

POWER SUPPLY BOARD

Bypass capacitors, Cl and C2, located in the bottom of the instrument, are filter capacitors for the +6 volt and -6 volt power supplies. C2, the capacitor toward the rear of the instrument, is in the +6 volt supply, and the other is in the -6 volt supply. The capacitor leads are convenient voltage test points. Connect an appropriate measuring device between the end marked t of C2 and circuit ground. Adjust R24 for +6.00* volts ±1mv. Move the measuring device to Cl between the end marked - and circuit ground. Adjust R9 for -6.00* volts ±1mv. To compensate for the effects of interaction, repeat these adjustments.

*Adjust to 6.01 volts in Model 116B only.

There is no adjustment in the t and - 24 volt supplies.

Typical 120 cycle ripple, ±6 volt supplies is less than 25mv.

Typical 120 cycle ripple, ±24 volt supplies is less than 500mv.

MAIN BOARD

1. Set range to X10KHz at top of frequency dial. Monitor the fixed triangle output and adjust R4 for minimum ringing on triangle. Set range to X100KHz and readjust R4 for linearity of the triangle at 1MHz. It may be necessary to repeat adjustments of R4 several times to insure optimum triangle linearity at 1MHz and minimum ringing at 100KHz.

2. Set range to X100 at extreme bottom of frequency dial. Use jumper to short pin 7, VCG board to circuit ground. Install 100K resistor between pin 1 and pin 3 of the main board. Observe integrator output with appropriate indicating device at junction of R17 and R18. Adjust R8 for zero volts. Remove jumper wire and 100K resistor.

3. Using Tektronix scope and type W plug-in, observe triangle at front panel connector, open circuit. Adjust R78 in switch set for the triangle break  at exactly -2.50 volts (use comparison voltage on type W plug-in). Adjust R77 for the triangle break  at exactly +2. 50 volts. To compensate for effects of interaction, repeat adjustments.

4. Observe 15nsec. square wave for leading edge spikes with 50Ω cable terminated into 50Ω. Adjust R104 for t and -2.5 volts ±1mv. Adjust R99 for symmetry about ground. Tolerance on spikes is 5% of total peak to peak amplitude.

5. Observe that 10nsec. square wave output on oscilloscope is free of excessive leading edge spikes, (X100K top of frequency dial, using 50Ω cable terminated into 50Ω).

POWER AMPLIFIER

Set output amplifier function selector (front panel) switch on square wave (fully clockwise position). Set attenuator fully clockwise. Observe front panel output GR connector on oscilloscope open circuited and adjust R31 for a 32.5 volt peak to peak square wave.

Adjust square wave with output attenuator fully counter-clockwise for symmetry about ground with R41. Adjust 1MHz square wave into open circuit with C11 for optimum square wave with no overshoot. Check for less than 100nsec. risetime. Check for 30 volts into 600Ω, and 10 volts into 50Ω.

SINE WAVEFORM ADJUSTMENTS

1. Using Tektronix scope and type W plug-in, set frequency dial at 10, range x100. Place main board on extender cable. Observe sine at BNC connector.

Adjust R64 for sine wave out of ±2.5 volts ±1mv. Adjust R60 for sine symmetry about ground. Using distortion analyzer, adjust R20, R24, R30, R33, R46 and R49 for minimum harmonic distortion. Readjust R64 and R60 for amplitude and symmetry about ground.

2. Set dial at 1. Measure distortion.

VCG BOARD
(For instruments having first amplifier summing node zero adjustment.)

Measure ±6 volt power supplies (refer to Power Supply Board Calibration Procedure, page 4- 1).

1. Dial Setting Adjustment:

With Frequency Hertz switch at X100, Frequency Vernier fully clockwise, set Frequency Dial to 10, measure voltage at potentiometer wiper arm (pin 9 on the VCG Board) to be +5.750 volts ±2mv. If this condition is not met, reinstall the dial.

2. Dial Tracking Adjustment:

With Frequency Hertz switch X100, Vernier fully clockwise, set dial to 10 and adjust R13 for 1000Hz and R14 for time symmetry. Set the dial to 1. By alternately shorting and opening the VCG input terminals, adjust R9 for a minimum frequency shift.

NOTE

Frequency shift is caused by non-zero summing node at the first VCG amplifier. R9 is used to adjust this for zero volts and no frequency shift.

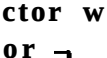
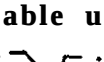
Adjust R51 (source current potentiometer) and R46 for 100Hz and time symmetry. Repeat steps for adjustment of R13 and R14 and adjustment of R9 until frequency, symmetry and source current are all calibrated at the top (1000Hz) and bottom (100Hz) of the dial.

3. VCG Input Calibration:

With Frequency Hertz switch X100, Frequency Vernier Potentiometer fully

clockwise, adjust dial for 100Hz on frequency measuring device. Apply $4.500 volts to the VCG input on the front panel and adjust R8 for 1000Hz.

4. Ramp Adjustment:

Observe ramp output at BNC connector with 50n cable unterminated. Adjust R34 so that signal is neither  nor  , but is  .

Adjust R33 for -2. 5 volts peak ramp output.

CHECK RANGES

Check all fixed ranges for frequency tracking. Trim resistors have been installed on individual ranges for tracking. Adjust C5 for proper tracking on X10K range. A trim resistor has been installed between position 3 and position 5 on wafer 1 of range switch for proper tracking on X1K range. Adjust Cl for proper tracking on X100K.

TRIGGER BOARD

Minus 1 Amplifier. Set "Freq Hz" X100, dial 10, mode switch continuous. Observe selected differential output unterminated with an oscilloscope with Type W plug-in. Place function selector on front panel in position. Adjust R63, -1 amplifier gain control for 5. 00 volts peak to peak. Adjust R48 for symmetry about ground. Rotate function selector through all positions and check for appropriate output waveforms.

Offset Sine. Observe offset sine output connector, open circuited with oscilloscope and type W plug-in. Adjust R54 for 2.5 volts peak to peak sine wave with the most negative excursion at 0. 00 volts dc.

Trigger Clamp Amplifier. Set "Freq Hz" switch X100, dial at 10, mode switch triggered, start-stop point centered, trigger slope t, trigger level centered. Model 115 trigger gated switch to "trig" (Model 116, "trig cycle" switch to one cycle). Apply 1 volt sine wave to trigger input. Adjust trigger level control for one cycle triggered operation. Adjust R29 so that start-stop point potentiometer will cause the observed waveform to shift beyond $\pm 90^{o}$.

Set Model 115 trigger/gated switch (Model 116, triggered cycle switch to external) to gated. Adjust trigger level to give several cycles. Switch slope switch between t and - and insure that gated operation is maintained.

Set Model 115 trigger/gated switch to triggered. With triggering signal applied, adjust trigger level for one cycle triggering. Remove trigger signal

source and depress manual trigger button. Observe one cycle when button is depressed.

Model 116 only: With a triggering signal applied, rotate the triggered cycles switch through all its positions and insure that the correct number of cycles are generated in each position.

FRONT PANEL OUTPUT

Observe power amplifier output with externally triggered scope. Rotate function selector through its positions and insure that all outputs are available and in proper phase.

PHASE LOCK CALIBRATION

NOTE

Insure that Model 115 trigger/gated switch is in the "trig" position or the Model 116 triggered cycles switch is in the one cycle position.

Set the Model 115 or Model 116 "Freq Hz" switch at X1K, mode switch phase lock, trigger slope minus, trigger level 90°, dial 5. Set the Model 110 function generator frequency hertz switch to X1K, dial at 5. Connect the 5 volt peak to peak sine wave from the Model 110 function generator to the in connector on the front panel of the Model 115/116. Connect the sine output of the Model 110 to one trace of a dual trace oscilloscope. Connect the sine output of the Model 115/116 to the other trace of the dual trace oscilloscope. Place the oscilloscope in the external trigger position and connect the Model 110 sync pulse to the trigger in connector on the oscilloscope. The two observed sygnals should be the same frequency with an adjustable phase difference that may be varied with the phase control on the Model 115/116 (trigger level control). The phase lock "un-cal" lamp on the Model 115/116 should be extinguished. Rotate the start-stop point potentiometer fully counter-clockwise until it is in its detent position. This is the 90° "cal" position for phase lock. A switch on the back of the start-stop point potentiometer places the instrument in the 90° "cal" position.

Connect the 10nsec. square wave output from the Model 110 to the "A" input connector of the CMC counter. Connect the Model 115/116 10nsec. square wave output to the "B" input of the CMC counter. Set the CMC counter to read time A to B. Set both the A slope and B slope on the CMC counter plus slope. Measure the time difference between the two 10nsec. square waves. This time difference should be 50 micro-seconds. Switch A slope and B slope on the CMC counter to minus slope. This reading should also be 50 micro-seconds. Adjust R73 for equal times when the CMC is on A and B

slopes positive and A and B slopes negative.

NOTE

This measurement and adjustment is dependent upon the calibrated symmetry of the Model 110 and the Model 115/116 waveforms. It should be insured that the Model 110 is in calibration before attempting to use it to set the 90° "cal" position.

Rotate the phase lock 90° "cal" switch out of its detent position (start-stop point potentiometer). Adjust the trigger level/phase control potentiometer to the maximum counter-clockwise (zero degrees) position. Set the A slope and B slope switches on the CMC counter both to plus, CMC counter read time A to B. Adjust R81 for zero time between A and B. This means that the two signals have a zero degree phase difference.

Slowly rotate the frequency dial on the Model 115/116 in a counter-clockwise direction until the phase "un-cal" lamp is illuminated. The dial should read approximately 3.5. Slowly turn the Model 115/116 dial clockwise until the lamp extinguishes and just begins to light again. The dial should read now approximately 6. 5 (insure that phase lock is maintained throughout this check). Slowly rotate the Model 110 dial through its entire range (if the Model 115/116 goes out of phase lock, the phase adjust/trigger level adjust/ control can be used to bring it back into phase lock). The instrument should phase lock to all frequencies throughout the Model 110 dial. Check the phase "un-cal" lamp and phase lock through the entire range on X10, X100, X10K and X100K ranges setting both the Model 110 and Model 115/116 frequency switches.

Connect the Model 115/116 sine output connector to a distortion analyzer. With the Model 115/116 phase locked to the Model 110 on frequency hertz X1K, dial 1, measure the sine distortion. The sine distortion should be less than 1. 5% insuring that introduced -distortion is less than 1%.