MODEL 1020A
FM ALIGNMENT GENERATOR
OPERATOR'S MANUAL

SOUND TECHNOLOGY
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Manual Part Number: 7900-0026
Manual Printed in U.S.A.

Price: $10.00

TABLE OF CONTENTS

SECTON I

GENERAL INFORMATION AND SPECIFICATIONS

1.1 General

This manual describes the ST1020A FM Alignment Generator and tells you how to use it for testing and aligning FM tuners and receivers. A separate ST1020A Maintenance Manual, part number 7900-0027, may be purchased by users who want theory of operation, schematics, and calibration and adjustment information.

1.2 Safety Information

Line voltages up to 250V ac are present in the 1020. Since there are no operator adjustments inside the 1020, do not remove the instrument covers and internal shields unless you are a qualified service person.

1.3 Customer Service

Information regarding parts and service can be obtained from the Customer Service Department of Sound Technology, Inc., Campbell, California. Call to obtain authorization for the return of equipment for repair whether in or out of warranty.

1.4 Receiving Inspection

Your 1020 was carefully tested, inspected and packaged before shipment. It should be completely undamaged upon receipt. To confirm this, carefully inspect the 1020 and its shipping carton for damage that may have occurred in transit. If the 1020 is received in a damaged condition, notify the carrier immediately and file a damage claim with him.

1.5 Input Power

The 1020 operates from a 100V, 120V, 220V, or 240V nominal, 48-66 Hz single phase power source. The power requirement is 35 watts. The power cord plugs into a module on the rear panel of the 1020. This module contains a line fuse and voltage selector card which are accessible only while the power cord is removed. Nominal operating line voltages are marked on the selector card so that only one marking is visible with the card installed. TO CHANGE THE OPERATING VOLTAGE of the 1020 slide the plastic cover over the power receptacle and use a small hook or wire to slowly pull out the selector card (you may have to deflect or pull the FUSE PULL handle to clear the card). Turn the selector card so that the correct operating voltage will be visible and then re-insert the card. TO CHANGE A BLOWN FUSE simply pull out on the FUSE PULL handle, remove and replace the fuse with a 1/2 A 250 V normal blow type. To assure maximum performance of the 1020, related test equipment, and devices being tested, plug all power cords into the same ac power line.

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*    WARNING   *
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The 1020 is equipped with a 3-wire power connector with neutral connected to the chassis. Safety regulations in many places require that the neutral conductor be connected to an adequate earth ground. Operation of the 1020 with a floating neutral conductor may result in a safety hazard to operating personnel.

1.6 Accessories

ST 100 and ST 105 Matching Transformers

These units provide an impedance match from the 50 ohm unbalanced 1020A output to 300 ohm balanced (ST 100) or 75 ohm unbalanced (ST 105) tuner inputs. The voltage transfer ratio is 1:1. The 1020 RF LEVEL dial has dBf 300 ohm and dBf 75 ohm scales to directly read the rf input when using one of these matching transformers.

ST 110 Frequency Converter

The ST 110 converts a 90 MHz RF signal from the 1020 to an equivalent IF signal at 10.7 MHz. This accessory is a substitute for the RF front end of a receiver

Rack Mounting Adapters - option 002

Transport Case - option 008

1.7 Specifications

SYSTEM SPECIFICATIONS (Audio inputs to FM RF output)

Total Harmonic Distortion: 20-30 C° (68 - 86°F)
Mono or Stereo (L, R, or L=R): 0.01% (0.02%, 10 - 40° C)
Stereo (L = -R) : 0.02% (0.03%, 10 - 40°C)

Stereo Separation
L - R : 60 dB, 20 Hz to 10 kHz (65 dB at 98 ± 3 MHz)
decreasing to 55 dB at 15 kHz.
M - S (L = R or L = -R, 1 kHz): >66 dB.

Residual Noise
dB below 100% Modulation at 1 kHz with 75 u sec de-emphasis

RF MODULATION	IEEE/IHF (200 Hz - 15 kHz)	FLAT (30 Hz - 15 kHz)
OFF or MONO	89	84
PILOT	85	
STEREO	83	

FM RF OUTPUT

Tuning Range: 88 MHz to 108 MHz.
Output Level: 0.3 uV to 30 mV into 50 ohm load.
Level Accuracy: ± 1 dB ± 0.1 uV @ 98 MHz; ± 1.3 dB ± 0.1 uV., 88 - 108 MHz.
Sufficiently low leakage to permit accurate measurements below 0.5 uV.
Output Impedance: 50 ohm, VSWR <1.2, 250 Vac, 50/60 Hz isolation.
Drift: <2 kHz / Hr after 1 Hr warm-up.
Temperature Coefficient: <5 kHz /°C.

COMPOSITE OUTPUT

L/R Separation: >65 dB 20 Hz - 10 kHz, decreasing to 55 dB at 15 kHz.
M-S Separation: Same as system spec.
Residual 38 kHz: >65 db below 100% modulation.
Spurious Signals Above 53 kHz: >70 dB below 100% modulation.
Pilot: 19 kHz ± 1 Hz, 0 - 25% modulation.

SCA MODULATION

IEEE/IHF Standard: 67 kHz frequency modulated at 2.5 kHz with ± 6 kHz deviation.

INTERNAL OSCILLATOR

Frequencies: 100 Hz, 1 kHz, 6 kHz, 10 kHz, ± 2%
Distortion: 1, 6, 10 kHz: <0.002%: 100 Hz: <0.003%

SWEEP CHARACTERISTICS

Power Line Frequency and 7 kHz (fixed at 10% modulation) superimposed in DUAL SWEEP alignment or SMPTE IM testing. Line frequency alone in STD sweep mode.
Sweep Width: Adjustable 0 - 600 kHz.
Linearity: ±5% of width.
Incremental Linearity (eq. to peak IM distortion): <0.04% at 150 kHz sweep width.
Horiz Phase: 60° range.

DISPLAY CHARACTERISTICS

Meter Accuracy: ±2% of full scale.
RF Frequency Counter: 5 digit display, 10 kHz resolution, ± 1 digit accuracy

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INPUT/OUTPUT SPECIFICATIONS

LEFT/RIGHT external inputs: Zin 50k// 30 pf. Sensitivity 0.25 V for 100% modulation.
Pilot Output: 1 Vrms, 10 K ohm max load.
Internal Oscillator: 2.5 Vrms at 100% modulation, 10 K ohm max load.
RCVR AUDIO: Input Z 100 K // 30 pf.
SCOPE VERT: Zs = 10 K, Gain from RCVR AUDIO = 20 at 7 kHz.
SCOPE HORIZ: Output 20 Vp-p, Zs = 10 K.
WIDE BAND AUX INPUT (rear panel) Input Z 5K ohm, 2.5 V for 100% modulation, 11 V p-p max.

PRE-EMPHASIS

Time Constants: 25, 50, and 75 us, 0.1 dB Accuracy

10.7 MHz MARKER

Accuracy: ±1 kHz.
Output: 200 mV into 50 ohm load.
Adjustment Range: >40 dB.

ENVIRONMENTAL CONDITIONS

Ambient Temperature: 10 - 40°C (50 - 104°F)
Relative Humidity: to 90%

POWER REQUIREMENTS

Four selectable line voltages: 100V nom (86 - 106 V), 120V nom (104 to 127 V), 220V nom (190 - 233 V), 240V nom (208 - 250 V), 48-66 Hz line frequency.
Power Consumption: 35 VA

GENERAL

Dimensions: 7" high x 17" wide x 16.4" deep.
Weight: 25 lb.
Shipping Weight: 34 lb.

SECTION 2

OPERATION

2.1 Introduction

The 1020 generates frequency modulated signals in the 88 to 108 MHz band used for FM broadcasting in the western hemisphere. It offers particularly high performance with respect to distortion and stereo separation. Modulation modes and characteristics are designed to facilitate measurement of receiver/tuner performance as specified by IHF/IEEE Standard 185-1975 "Standard Methods of Testing Frequency Modulation Broadcast Receivers".

User convenience features are:

- a built-in counter/frequency display
- accurate piston attenuator connected to a large RF Level dial with 3 calibrated scales; in microvolts, dBf 75 ohm and dBf 300 ohm.
- accurate pre-emphasis networks with 3 time constants
- SCA signal
- four internal audio frequencies with low distortion
- 10.7 MHz marker
- dual and standard sweeps

We suggest that before using the 1020, you read the following descriptions of each control and input or output so that you will become familiar with the 1020's capabilities.

2.2 Controls and Indicators

POWER - This push switch applies power to the 1020.

ON - This LED indicates when power is applied to the 1020.

FREQUENCY DISPLAY - 5 digit readout shows 1020 carrier frequency with a resolution of 10 kHz.

FREQUENCY - Adjusts 1020 carrier frequency. Frequency knob has a spinner attached to speed frequency changes.

RF LEVEL - Adjusts the output level of the 1020 from 0.3 uV to 30 mV. The dial incorporates two dBf scales for direct indication of signal power when the generator output is matched to 75 ohm or 300 ohm loads.

MODULATION METER - Displays the amount of FM modulation applied to the RF output. In all modes except DUAL, STD and PILOT, it is calibrated to read 0-150% modulation, with 100% equal to 75 kHz deviation. In PILOT, the meter reads 0-15% modulation to accurately set the pilot level. In DUAL and STD, the meter indicates 0-600 kHz sweep width (Sweep width = 2 X deviation). The red marks on the three meter scales show the most common settings. The mark on the SWEEP WIDTH scale is at 150 kHz to denote 100% modulation. The mark on the PILOT scale shows a range from 8% to 10% PILOT, with 9% being the most common setting.

OSC LEVEL - Adjusts the RF Modulation level in MONO and STEREO when the internal oscillator is selected as the MODULATION SOURCE. It does not affect the modulation level in EXT.

PILOT LEVEL - Adjusts the modulation level of the 19 kHz Pilot signal. Once set in the PILOT mode, pilot amplitude remains the same in STEREO mode.

10.7 MHz MARKER - This control sets the level of the 10.7 MHz Marker over a 40 dB range. When not in use, it should be turned off by rotating the knob fully CCW into the detent position so that no extraneous 10.7 MHz signal will influence your measurements.

MODULATION SOURCE - Selects one of four internal oscillator frequencies (100 Hz, 1 kHz, 6 kHz, 10 kHz) or EXT. In the EXT position, the internal oscillator is disabled and external audio sources can be used to modulate the 1020.

PRE-EMPHASIS - Selects none, 25, 50 or 75 us pre-emphasis depending on the position of the two switches. For no pre-emphasis both switches are out. Selecting the left switch alone gives 25 usec, and selecting the right switch alone gives 50 usec. If <u>both</u> switches are depressed then 75 usec pre-emphasis is inserted. The pre-emphasis curves are all normalized at dc, so at 100 Hz, modulation level stays essentially the same for all pre-emphasis selections. At higher frequencies, adding pre-emphasis will <u>increase</u> the modulation level.

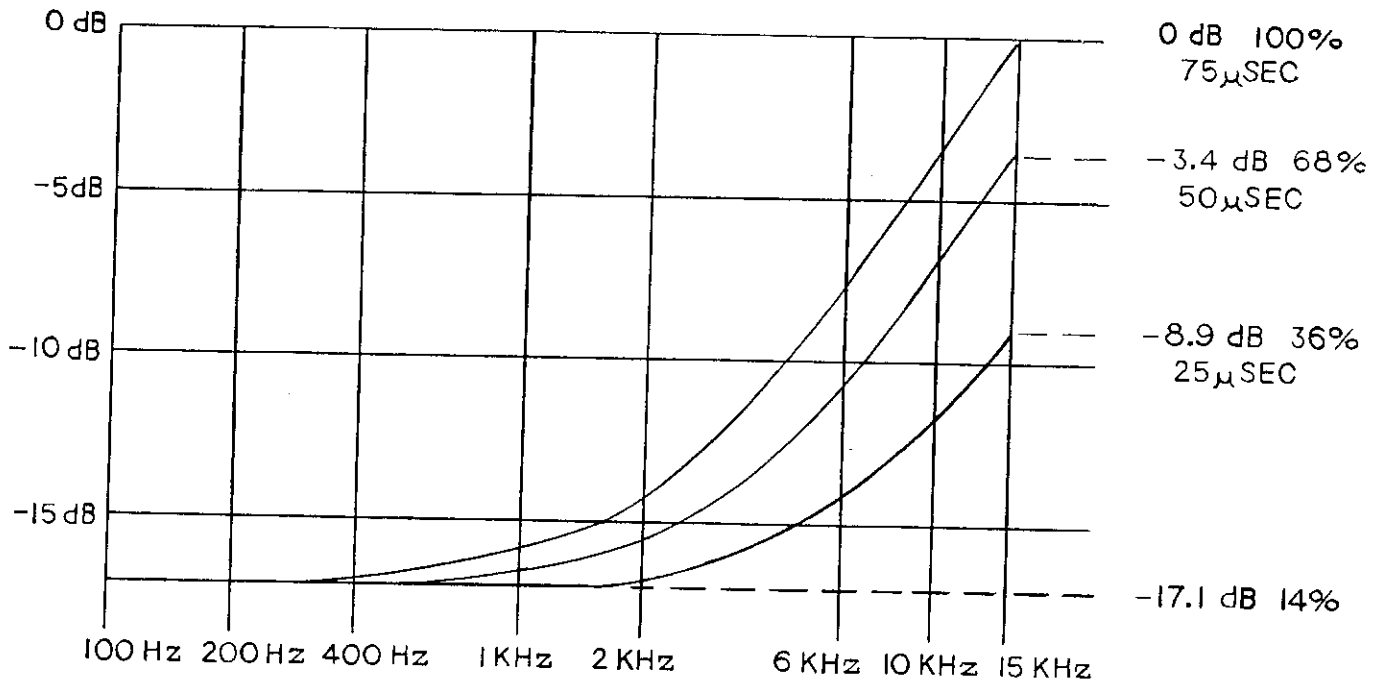

Figure 2.1

STEREO MODE

Selects the type of stereo modulation desired. All five switches are used for EXT (external) modulation, while only the right-most four are used with INT (internal) modulation. Because the internal oscillator is simultaneously connected to both the L and R channels, L&R is functionally equivalent to L=R when an internal source is used.

L&R - Allows independent L and R channel modulation (full stereo) from the EXT Left and Right inputs.

L - Allows only Left channel modulation, and the Right channel is set equal to zero. If a Right channel source is connected to the 1020, the input is ignored.

R - Allows only Right channel modulation, and the Left channel is set equal to zero. Any Left input source is ignored.

L=R - In this mode, the Right channel is set equal to the Left channel, which cancels the L-R component of the composite signal. If an external source is used, only the left input is active.

L=-R - In this mode, the Right channel is set equal to the inverse of the Left channel, which cancels the L+R component of the composite signal; a receiver should produce no output while in mono mode. If an external source is used, only the left input is active.

RF MODULATION - Selects the type of modulation to be applied to the RF output.

OFF - This position turns off all modulation to the RF unit. In addition, all audio signal sources in the 1020 are disabled. (i.e. internal oscillator, both sweep oscillators, pilot generator, and stereo composite generator.) This mode is used for monophonic signal/noise measurements.

MONO - This position provides monophonic modulation to the RF unit. The MODULATION SOURCE and PRE-EMPHASIS selectors function as described previously. Any external modulation must be connected to the MONO/LEFT input. The STEREO MODE switches are not used in MONO.

PILOT - This mode provides only PILOT modulation of the RF output. The modulation meter sensitivity is increased to 0-15% in this position so that the PILOT level can be accurately set. The internal oscillator, sweep oscillator and stereo composite generator are all disabled in this mode, which is used primarily to make stereo signal/noise measurements.

STEREO - This position provides stereo composite modulation of the RF output. The STEREO MODE switch determines the composition of the stereo signal and the OSC Level and PILOT Level controls set the depth of modulation. The 1020 is calibrated so that with 100% MONO deviation and 9% pilot level, the peak deviation will be the same in MONO and STEREO.

IHF SCA - This switch adds an SCA Rejection Test signal to the stereo composite. It consists of a 67 kHz carrier, frequency modulated by 2.5 kHz with a deviation of 6 kHz. The SCA signal is internally adjusted to modulate the RF carrier by 10%. The SCA signal is included in the composite signal only in STEREO mode.

SWEEP - Maximum modulation extended to 400% at power line frequency.

DUAL SWEEP - This mode is used primarily for tuner alignment and provides two-tone sweep modulation of the RF output. One tone is 7 kHz which modulates at a fixed sweep width of 15 kHz (10%); the other tone is at power line frequency which modulates 0 to 600 kHz depending on the adjustment of the SWEEP WIDTH control.

STD - This mode provides standard sweep modulation with 0 to 600 kHz width using power line frequency alone.

SWEEP WIDTH - Sets the total sweep width of the power line modulation from 0 to 600 kHz.

PHASE - Adjusts the phase of the HORIZ (horizontal) scope output relative to the sweep modulation to compensate for phase shifts in the receiver under test.

2.3 Inputs and Outputs

MARKER OUTPUT - Provides a 10.7 MHz Marker signal through an output impedance of 50 ohm.

PILOT OUTPUT - Provides high level PILOT signal through an output impedance of 600 ohm. Amplitude is not affected by the PILOT LEVEL control and the signal is present only in the PILOT and STEREO modes.

COMPOSITE OUTPUT - Provides the modulating signal through an output impedance of 50 ohm.

INT OSC OUTPUT - Provides the low distortion internal oscillator signal though an output impedance of 600 ohm. No signal is present when OFF, PILOT, or EXT is selected.

MONO/LEFT INPUT - Connects to a companion audio source to provide MONO (in mono) or external LEFT modulation in the STEREO mode. This input is active only when EXT switch is depressed.

RIGHT INPUT - Connects to a companion audio source to provide external RIGHT modulation in the STEREO mode. This input is active only when the EXT switch is depressed.

RF OUTPUT - Provides the RF output of the 1020 and usually connects to either the ST 105 (75 ohm) or ST 100 (300 ohm) matching transformer.

HORIZ - Provides a signal at power line frequency to drive the horizontal axis of an oscilloscope for sweep measurements.

RCVR AUDIO - This is an input connection used for DUAL SWEEP. It should be connected to the audio output of a receiver.

VERT - This output is the RCVR AUDIO after high pass filtering to eliminate the line frequency component. It is used to drive the vertical axis of an oscilloscope in the DUAL SWEEP mode.

EXTERNAL WIDEBAND MODULATION INPUT (Rear Panel) - This input can be used to add externally generated modulation signals. It is active in all RF MODULATION modes except OFF. The input sensitivity is 2.5 Vrms for 100% modulation (or 400 kHz sweep width in DUAL and STD). Care must be taken to assure that the input signal has a dc value of less than 2 mV or a degradation of the distortion specifications will occur.

SECTION 3

USING THE ST1020A

3.1 Introduction

Front panel functions and nomenclature are consistent with IEEE Std 185-1975/IHF-T-200,1975 "Standard Methods of Testing Frequency Modulation Broadcast Receivers"* referred to hereafter as the IEEE Standard. The IEEE Standard is now generally accepted and followed in our industry and we recommend that you obtain a copy. While the instructions which follow explain how to make specific measurements, the IEEE Standard provides more detail and describes a family of measurements that can be made to analyze a receiver's performance over its whole operating range. Examples are distortion versus tuning, distortion versus modulation frequency and distortion versus percentage modulation.

3.2 Test Set-Up

Whenever the 1020 RF output is connected to a 75 ohm or 300 ohm FM receiver input, a suitable matching network or "dummy antenna" should be connected between the 1020 and the receiver. Sound Technology matching transformers ST 100 (300 ohm) and ST 105 (75 ohm) provide 1:1 voltage ratio match between the 50 ohm 1020 output and the receiver input, so the dBf scales on the RF LEVEL dial indicate directly the RF power input to the receiver.

For most receiver measurements, the IEEE Standard specifies use of a 200 Hz high pass, 15 kHz low-pass, or 200 Hz to 15 kHz bandpass filter between the receiver audio output and measurement instruments, with allowance for the errors introduced by the filter. It is better to insert these filters in the analyzer circuits of the distortion analyzer being used, where it will introduce no measurement error. The Sound Technology ST 1200A Stereo Test Panel used in conjunction with a 1700 series Distortion Analyzer provides this capability. It is important to recognize that measurements made without the specified filter will not generally agree with measurements made using the filter.

Interconnections for a test set-up using the 1020, 1700, 1200 filters and an oscilloscope are shown in Figure 3.1.

Procedures and set-ups for using DUAL SWEEP or STD SWEEP for efficient alignment of FM receivers are written in the Sound Technology brochure "How to align stereo receivers" which is included as part of this manual. Any reference to the 1000 in the brochure applies equally well to the 1020, but of course accurate read-out of carrier frequency in the 1020 eliminates the need for separate crystal oscillators to aid in receiver dial calibration.

*Available for purchase from:
I.E.E.E., 345 E. 47 St., New York, NY 10017

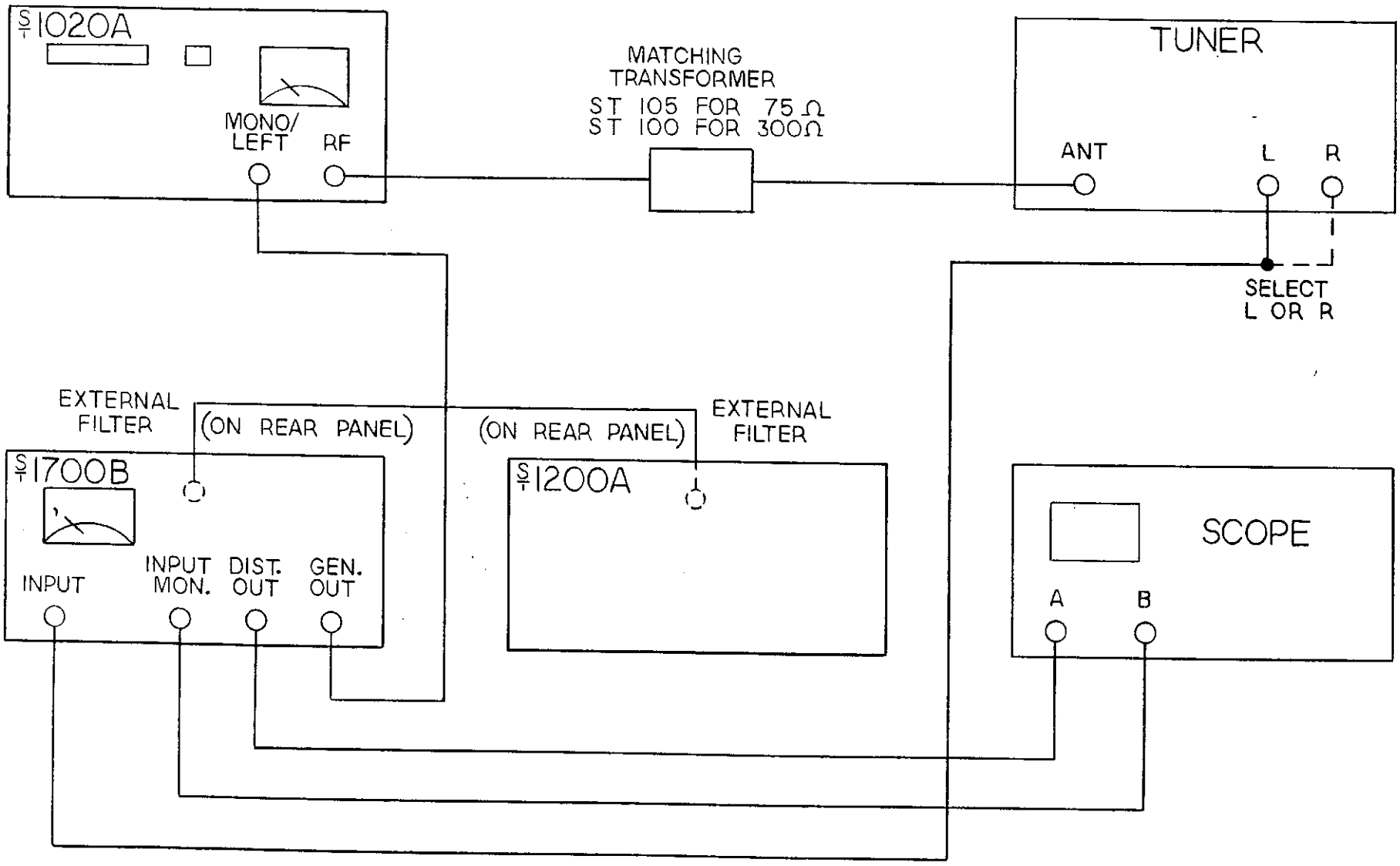
S-1020A
MONO/
LEFT
RF
MATCHING
TRANSFORMER
ST 105 FOR 75 Ω
ST 100 FOR 300Ω
TUNER
ANT
L
R
SELECT
L OR R
EXTERNAL
FILTER
(ON REAR PANEL)
(ON REAR PANEL)
EXTERNAL
FILTER
S-1700B
INPUT
INPUT
MON.
DIST.
OUT
GEN.
OUT
S-1200A
SCOPE
A
B

Figure 3.1

3.3 Front Panel Verification

Although recalibration or specification verification may be performed only with the aid of specialized test equipment, a number of confidence checks may be performed with the aid of an audio frequency voltmeter and FM receiver. Performing the following simple tests will also aid in familiarization with the 1020.

Connect an audio frequency voltmeter to the 1020 COMPOSITE OUTPUT jack. Select MONO modulation, 1 kHz source and no pre-emphasis. When the oscillator level control is set for a 1020 meter reading of 100%, the composite voltage should be between 2.4V and 2.6V. The 1020 meter and composite voltage should not change more then a needle width as each of the other three internal modulation frequencies (100 Hz, 6 kHz, 10 kHz) is selected. When switching from OFF to MONO, there will be a delay of a second or so before the internal oscillator reaches full amplitude, and when switching between frequencies there will normally be a transient change in amplitude which will last for a fraction of a second.

The effects of the PRE-EMPHASIS circuits can be seen by selecting various combinations of modulation frequency and pre-emphasis. The following table gives the expected 1020 meter reading and composite voltage for all possible combinations when OSC LEVEL is set for 100% modulation at 10 kHz and 75 usec pre-emphasis.

Set PRE-EMPHASIS switches for no pre-emphasis (both switches out). When PILOT is selected and PILOT LEVEL adjusted for a meter reading of 10%, the composite voltage should be 0.25V. Reduce PILOT LEVEL to a reading of 9%, composite voltage of .225V. Then switch to STEREO mode. The 1020 meter should read within a needle width of 100% for STEREO MODE selections L, R, L=-R and at about 103% when MODE is L=R.

When the voltmeter is connected to the PILOT output BNC, it should read about 1.6V, and will not vary as the PILOT LEVEL knob is adjusted.

A standard average-responding voltmeter is not particularly useful for measurement of the COMPOSITE output in STEREO mode where the waveforms are quite complex and average values are not easily related to peak values as read by the 1020 Modulation meter.

To make a check of the accuracy of the 1020 carrier frequency display, connect the RF output to a FM receiver with at least three feet of single shielded cable, such as RG58/U. Set the RF LEVEL dial for a low output, 1uV or less, and select MODULATION OFF. Listen to the audio output of the FM receiver and tune in a weak signal from a FM station whose frequency you know. Set the 1020 FREQUENCY to the station frequency and vary it and the RF LEVEL until the 1020 signal obliterates the signal from the station. With proper selection of station strength and RF LEVEL, a sharp null can be perceived, and the 1020 display should read within 10 kHz (1 count) of the FM station's assigned carrier frequency.

Frequency	25us		50us		75us	
	%	Volts	%	Volts	%	Volts
100Hz	21	.52	21	.52	21	.52
1 kHz	21	.52	22	.55	23	.58
6 kHz	28	.71	44	1.11	62	1.56
10 kHz	39	.97	68	1.71	100	2.50

The following procedures describe how to verify the performance of an FM receiver and would be used after alignment has been performed using the sweep techniques. The sequence followed is the same as that of the IEEE Standard. These procedures assume that an ST 1700 series Distortion Analyzer is being used for all audio signal measurements.

3.4 Monophonic Measurements

The standard test signal is frequency modulated at 1 kHz with 100% (75 kHz) deviation. Select MONO RF MODULATION, 1 kHz MODULATION SOURCE, no PRE-EMPHASIS and adjust OSC LEVEL for a meter reading of 100%. Standard test frequencies are 90.1, 98.1 and 106.1 MHz, but if these channels are assigned to broadcast stations in your area, try to find nearby clear channels with at least 200 kHz separation from medium power stations and at least 400 kHz separation from high power stations. Measurements are made using an external ST 1200A 200 Hz to 15 kHz bandpass filter in the 1700 analyzer section.

3.4.1 Usable Sensitivity

With the 1020 set for the standard test signal of paragraph 3.4, set the RF LEVEL dial at 65 dBf. Select the following 1700 settings:

FREQUENCY	1 kHz
FUNCTION	SET LEVEL
RATIO	-30 dB

Adjust the 1700 INPUT switch and SET LEVEL ADJ knob for 0 dB reading on the 1700 meter. Select the DISTORTION function on the 1700. The 1700 meter should read near zero scale, indicating low distortion and complete limiting in the receiver. Decrease RF LEVEL until the 1700 meter averages 0 dB (the reading will be noisy). The 1700 is reading the receiver noise and distortion (practically all noise with a decent receiver) and the 1020 RF LEVEL dial indicates the receiver's usable sensitivity, which is the level at which the receiver's signal-to-noise ratio is 30 dB.

When you switch the 1700 FUNCTION back to SET LEVEL, the meter should still read 0 dB, but if it has dropped (not full limiting in the receiver) tweak the RF LEVEL and readjust SET LEVEL so that you have the RF LEVEL for 30 dB signal-to-noise ratio.

3.4.2 50 dB Quieting Sensitivity

Set the RF LEVEL dial back to 65 dBf and change the 1700 RATIO switch to -50 dB. Readjust the SET LEVEL knob if necessary to read 0 dB. Switch the 1020 modulation OFF and 1700 FUNCTION to dB VOLTS. The 1700 meter should read near zero scale indicating complete quieting. Decrease the RF LEVEL until the 1700 meter reads 0 dB (equaling -50 dB because of the RATIO switch setting). The RF LEVEL dial indicates the receiver input signal level for 50 dB quieting. Some receivers with a high muting threshold may automatically mute before this level is reached.

3.4.3 Signal-to-Noise Ratio at 65 dBf

Increase the RF LEVEL to 65 dBf again and measure the noise by changing the 1700 RATIO switch until an on-scale meter reading is obtained. This reading is the noise-to-signal ratio, so the signal-to-noise ratio is just the same dB value without the minus sign. If you don't go directly from measuring the 50 dB quieting sensitivity to this measurement, remember to reset the 0 dB reference level with MONO modulation, then switch the modulation OFF to measure the noise level.

3.4.4 Distortion at 50 dB Quieting

Set the RF LEVEL at the level measured in section 3.4.2, the 50 dB quieting sensitivity. Switch the 1020 to MONO modulation, check that the 1700 reference level is 0 dB (SET LEVEL) or AUTO SET LEVEL and measure the distortion by selecting the 1700 DISTORTION FUNCTION. The test should be repeated with modulation frequencies of 100 Hz and 6 kHz (at least).

3.4.5 Distortion at 65 dBf

The procedure is the same as 3.4.4 with the RF LEVEL set and maintained at 65 dBf. It is usually necessary to tune a receiver very critically to obtain lowest distortion readings.

3.4.6 Frequency Response

The three pre-emphasis time constants in the 1020 have been included specifically to eliminate the laborious corrections that would be needed to compensate for the de-emphasis characteristic of the receiver under test. Select the pre-emphasis time constant desired (75 usec U.S., 50 usec European, 25 usec Dolby) and then set up 100% modulation at the highest audio frequency you will be using. If you have been using a filter in the analyzer section of the distortion analyzer, there is no need to switch it out, because you will be measuring the signal level with the analyzer's VOLTS or SET LEVEL function and the filter will not affect the readings. If you have inserted a filter between the receiver output and analyzer input, remove it.

3.5 Stereophonic Tests

The IEEE Standard Stereophonic test signal is frequency modulated at 1 kHz with 9% pilot and 100% (75 kHz) deviation. The set-up sequence to obtain the correct levels is as follows: select MONO modulation and adjust the OSC LEVEL control for 100% modulation. If an external oscillator is being used, connect it to the LEFT/MONO BNC and terminate the RIGHT input with the 50 ohm BNC load provided. Adjust the oscillator amplitude for 100% modulation. Then select PILOT modulation and adjust the PILOT LEVEL control for 9% modulation. Switching to STEREO modulation automatically sets the total modulation to 100% in modes L, R and L=-R. In mode L=R, the modulation increases to 102.6% which is technically in violation of the IEEE Standard but practical in that the amplitude of each channel is the same as in L=-R mode. In general the performance of the two audio receiver channels will not be identical, so you should perform each test on each channel. Separation and distortion are usually critically dependent on receiver tuning, so the IEEE Standard states that once tuning has been adjusted for the best performance in measuring one of these parameters, it should not be changed to measure the other.

3.5.1 Usable Sensitivity

This is basically the same measurement as described in 3.4.1 but with STEREO Modulation, using L=-R mode. The procedure steps are:

a) Establish a reference level with 1 kHz modulation at 65 dBf RF LEVEL using the 1700 SET LEVEL controls.

b) Switch the 1700 to the DISTORTION function with the RATIO switch set at -30 dB. This inserts a 1 kHz notch filter in the 1700 meter circuit.

c) Reduce the RF LEVEL until the 1700 reads -30 dB. This level is the Stereophonic Usable Sensitivity. Some receivers may automatically switch to MONO mode before this level is reached, in which case you will not be able to make this measurement.

3.5.2 Stereophonic 50 dB Quieting

Set the RF LEVEL back to 65 dBf, on the 1700 select SET LEVEL and change the Ratio switch to -50 dB. Readjust the 1700 SET LEVEL if necessary to read 0 dB. Switch 1020 MODULATION to PILOT, select dB VOLTS on the 1700 and decrease RF LEVEL until the 1700 reads -50 dB. As a precaution or in case you are using a distortion analyzer other than the 1700 with the IEEE filter, monitor the distortion product output of the analyzer for any residual 19 kHz (Pilot) components which could affect the reading. If there is any 19 kHz component, tune the distortion analyzer for a null at 19 kHz, select the 1700 DISTORTION function and reduce the RF LEVEL until the analyzer reading increases to -50 dB.

3.5.3 Distortion at 50 dB Quieting Sensitivity

Maintain the RF LEVEL at the 50 dB Quieting Sensitivity. Switch the 1020 MODULATION to STEREO and read the distortion on the 1700 using its DISTORTION function.

3.5.4 Stereophonic Signal-to-Noise Ratio at 65 dBf

Again, set the reference level to 0 dB using STEREO modulation at an RF LEVEL of 65 dBf. Then switch the 1020 to PILOT modulation and measure the noise with the 1700 using the dB VOLTS function. Observe the same precautions regarding pilot residual as in 3.5.2.

3.5.5 Distortion at 65 dBf

Maintain the RF LEVEL at 65 dBf and switch the 1020 MODULATION back to STEREO. Read the distortion of each output on the 1700 using its DISTORTION function.

3.5.6 Muting - Stereo Threshold

If the receiver is equipped with an automatic and/or manually adjustable switch for defeating sub-carrier detection, these tests may be performed. Select stereo mode on the receiver and set the 1020 for STEREO modulation with RF LEVEL of 65 dBf. If the receiver has an adjustable threshold control, set it at one extreme. Measure the receiver outp using the 1700 SET LEVEL or VOLTS POWER function. Decrease the RF LE slowly until the receiver output dr sharply and record this RF LEVEL. Slowly increase the RF LEVEL until output is restored and record this second level. These two levels are measure of the stereo switching threshold and hysteresis. Repeat t measurements at the other extreme o the threshold control.

To measure the sensitivity of the stereo threshold to pilot level, maintain the RF LEVEL at 65 dBf and slowly reduce the PILOT LEVEL until receiver output drops sharply. Swi the 1020 to PILOT MODULATION to rea this pilot level.

3.5.7 Stereo Separation

To measure the Left channel separation, connect the 1700 Input the receiver Left output. Set the LEVEL to 65 dBf. Set PILOT LEVEL t 9% and Modulation to 100% at 1 kHz L MODULATION mode. Set the 1700 SE LEVEL controls for a reading of 0 d Move the 1700 INPUT to the receiver Right Output and measure the separation using the 1700 dB VOLTS function. Repeat measurements at 1 Hz and 10 kHz at least. Similarly measure Right channel separation by selecting R MODULATION mode. For a more complete characterization of t receiver, measure separation as a function of PILOT LEVEL.

3.5.8 Stereo Frequency Response

The test procedure for measuring frequency response in the receiver' stereo mode is essentially the same that given in 3.4.6 (Monophonic Frequency Response). You have to choose an appropriate STEREO MODE, generally should use L- only and R- only to provide the most realistic results. If you use L=R mode, ther will be no sub-carrier modulation products and if you use L=-R mode there will be no main channel modulation products. When you use only or R only modes, half the sign information is carried in the main channel and half in the sub-channel

3.5.9 Sub-Carrier Product Rejection

During measurement of Signal-to-Noise Ratio at 65 dBf input (3.5.4), if the "noise" reading on the 1700 increases when the 15 kHz low-pass filter is removed, the new reading is an indication of the sub-carrier products present in the receiver output. To verify and measure the sub-carrier product rejection in a high performance receiver, it is necessary to examine the outputs of the receiver with a spectrum analyzer or wave analyzer, specifically looking for 19 kHz and 38 kHz components.

3.5.10 SCA Interference

The SCA signal characteristics have been chosen to provide the most difficult signal for a receiver to handle. The 67 kHz sub-carrier is frequency modulated at 2.5 kHz with 6 kHz deviation with modulation frequency and deviation internally adjusted so that essentially all the energy is in the sidebands and the sub-carrier is suppressed. The output level of the SCA signal modulates the RF carrier 10%.

To measure SCA Interference, set RF LEVEL to 65 dBf, set PILOT LEVEL TO 9%, then select STEREO, L=-R mode, and 1 kHz internal modulation source. Adjust OSC LEVEL for 90% MODULATION (SCA will add 10% for 100% total modulation). Measure the receiver's left or right channel output and set to 0 dB or note as the 0 dB reference. Select SCA and remove 1 kHz modulation by switching to EXT (with no external source connected). Read the new receiver output level - if you have used the SET LEVEL function of the 1700 to read the reference level, using the 1700 dB VOLTS function will give the value of the SCA interference in dB below the reference level. To verify that there really is SCA interference, turn off the SCA signal. If the meter reading drops at least a few dB, there is SCA interference and you have not just been reading the stereo signal-to-noise ratio at 90% modulation.