Accuphase

T-103

DIGITAL DISPLAY FM STEREO TUNER

Broadcasting stations are allotted frequencies digitally at regular intervals over the FM band. Therefore, the digital display system is well suited to show the frequency of a tuned-in FM station. However, there are probably many listeners who are so used to the conventional slide rule dial, and station selection by means of pointer position, that they would prefer to keep tuning in this manner. Because of the growing tendency to welcome the digital display method, however, and since digital display techniques are being increasingly adapted recently in various other fields, Accuphase is making available to FM fans a choice between both type tuning aids for its T-103 tuner.

There are two methods of tuning for digital display. The first is the conventional variable capacitor way, and the second is the electronic synthesizer method. Each has its merits and demerits.

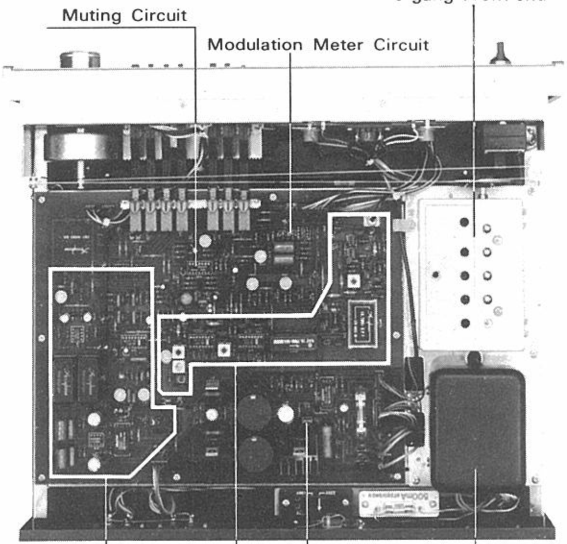
The variable capacitor way varies the tuning frequency mechanically as in the past. It is a highly perfected, reliable system which has a long history. With careful design, it assures a superior performance.

The synthesizer system, which is controlled by a quartz oscillator, tunes electronically, and assures accurate, instantaneous tuning of FM stations that are programmed beforehand into a memory system. However, a very high level, front-end design technique is necessary for the synthesizer tuner to achieve the same RF performance characteristics of a high grade variable capacitor tuner.

Therefore, it is a mistake to think that ALL synthesizer tuners are high grade tuners. Rather, it should be understood that the main difference between the two types of tuners is that only the variable capacitor system mechanism has been electronized in the synthesizer tuner. It is, therefore, a fact that as far as tuner performance capabilities are concerned, there are low grade synthesizer tuners, just as there are various class variable capacitor type tuners.

The T-103 is a hybrid FM Tuner which combines the merits of both the highly perfected Variable Capacitor Tuning system and the accurate Digital Frequency Display system. One of its unique features is that its digital display functions as a clock when the power switch is OFF, and displays the tuned-in FM frequency when the power switch is ON.

The combined aggregation of Accuphase Hi-Fi technology was harnessed to develop the T-103 into an ideal FM tuner that possesses the most outstanding performance capabilities. The success of our efforts, based on advanced FM tuner design, is attested by the outstanding specifications that confirm the T-103's Hi-Fi performance and super selectivity characteristics.



1 DIGITAL DISPLAY OF TUNED FREQUENCY AND CORRECT TIME

The Quartz Oscillator and Digital Counter circuits enable digital display of the tuned frequency in 100 kHz steps and takes the place of the conventional dial pointer system. Although the tuned frequency is displayed in 100 kHz steps, frequency is continuously variable to permit perfect tuning of odd sum radio station frequencies such as 25 kHz or 50 kHz. A unit of 10 kHz is rounded to the nearest whole number of 100 kHz. For example, when the tuner is receiving a station with a frequency of 92.25 MHz, the digital display shows the rounded figure of 92.3 MHz. Also a tuned frequency of 93.22 MHz is displayed as 93.2 MHz. Meanwhile, the Center Tuning Meter indicates accurate tuning points, and also shows on the meter scale, in frequency, how far the incoming signal may be out of tune.

The Digital Display works as a clock to show the correct time when the Power Switch is OFF. It can show the time even when the Power Switch is ON during radio reception by slightly pressing a button.

2 FRONT-END 5-GANG TUNING CAPACITOR COMPLETELY REJECTS INTERFERENCE

The front-end is virtually the "heart" of any tuner. It selects the input signal, amplifies it, and generates and delivers the intermediate frequency of 10.7 MHz to the IF section. Thus, the front-end design technique practically determines the performance of that tuner and its all-important sensitivity and interference rejection capabilities. The T-103 employs a 5-gang variable capacitor and achieves very excellent spurious noise rejection characteristics such as image rejection of 120 dB, and RF intermodulation rejection of 75 dB. It also assures a very high sensitivity of 10.3 dBf.

3 LINEAR PHASE IF CIRCUIT FEATURES LC AND SAW (Surface Acoustic Wave) FILTER NETWORK

The 10.7 MHz IF signal that is generated in the front-end is fed to the IF circuit where it is amplified, its amplitude limited and adjacent station signals eliminated before it is introduced to the discriminator circuit. In order to reconcile the high selectivity and low distortion requirements of the IF section, a SAW filter, which is superior in selectivity and group delay time characteristics, is combined with LC Filters.

SAW is short for Surface Acoustic Wave and is a filter device that employs two sets of electrodes with comb-like teeth that face each other. One side is excited by a piezo electric element and the energy is transduced to the other electrode by surface vibration to achieve electric conversion. It is a new filter device whose frequency and bandwidth can be determined by the shape, resiliency and substance of the element. It offers stable, long life performance.

Fig. 1 shows the group delay time and amplitude characteristics of the IF circuitry. The group delay time curve relates to distortion. The flatter it is the better, and means lower distortion. The chart shows that group delay time is within 0.06 microseconds within the operating bandwidth of ±100 kHz, which, when converted, means a distortion ratio of 0.01%. In other words, the distortion ratio caused by the IF amplifier section of this tuner is less than 0.01% which compares favorably with the distortion ratio of higher grade audio amplifiers.

This tuner permits a choice of NORMAL IF bandwidth for low distortion, and NARROW bandwidth for sharp selectivity that effectively eliminates interference of closely adjacent FM stations.

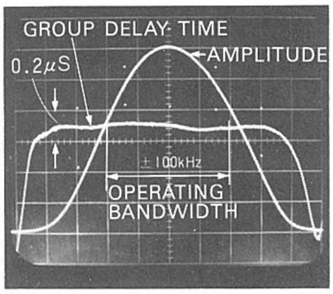


Fig.1 Group Delay Time and Amplitude Characteristics of the IF circuitry.

4 LOW DISTORTION, LINEAR PHASE FM DISCRIMINATOR

The FM discriminator derives audio amplitude signals from frequency modulated input signals. Its output amplitude variations must be linear with the frequency variations of the input for low distortion performance.

Linearity is checked as follows. A weakly modulated signal is swept and fed to the discriminator input. The output differential gain derived from the frequency variations is recorded and plotted to measure the flatness of the differential gain characteristics which reveals its distortion ratio.

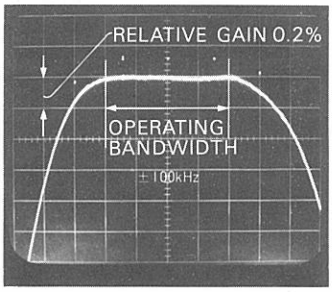


Fig.2 Differential Gain Characteristics of the Discriminator.

The circuit employed in the T-103 is a phase conversion type discriminator that derives the audio signal by multiplying the input "original" signal by the phase-shifted signal which comes through the quadrature network. Because of this newly designed wideband, linear phase shifter, practically no distortion occurs in the T-103 discriminator circuit.

Figure 2 shows the differential gain characteristics of this discriminator circuit and reveals its amazingly low distortion ratio of less than 0.005% within the operational bandwidth of ±100 kHz.

Moreover, each unit is perfectly adjusted on the factory production line with differential gain visual measuring equipment before shipment.

Figure 3, below, shows a block diagram of the T-103's Linear Phase Conversion type discriminator.

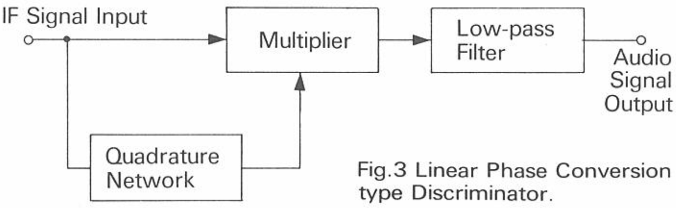


Fig.3 Linear Phase Conversion type Discriminator.

5 PLL (Phase-Locked Loop) DEMODULATOR WITH PILOT CARRIER CANCELLING CIRCUIT

A most advanced design PLL demodulator circuit which functions to separate the left-right composite signals for stereophonic reproduction is employed in the T-103. It features a new pilot carrier canceller circuit, which, together with the Linear Phase IF Filter and wideband discriminator, account for the very excellent specifications of 50 dB channel separation at 1 kHz, 45 dB at 10 kHz and distortion ratio of less than 0.02% at 1 kHz stereo, which place this tuner in the highest grade class.

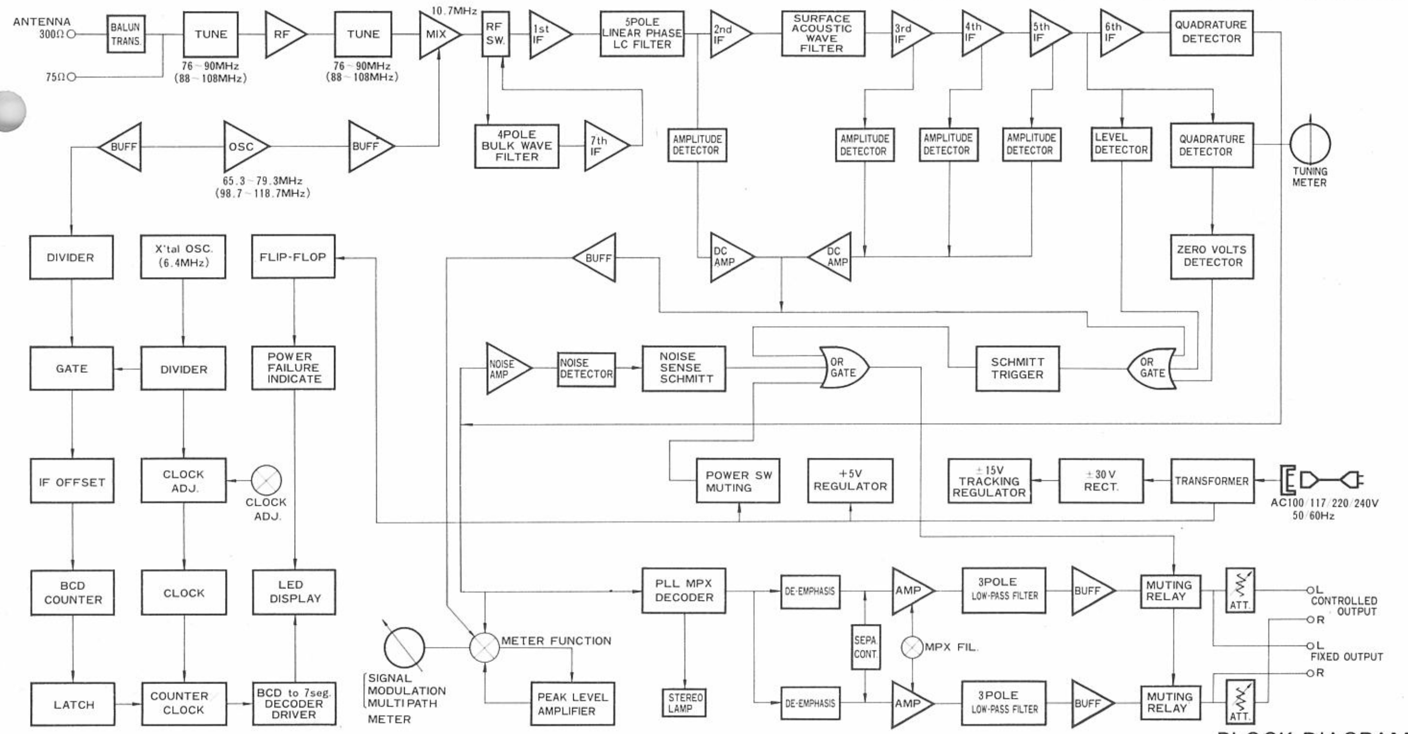
6 MULTI-FUNCTION METERS

Two meters are available which provide four functions that can be selected by push-button control. Meter functions include Center Tuning with frequency scale for precise tuning, Signal Strength and Modulation indications and Multipath detection.

Input signal strength can be observed on a dBf direct reading scale, modulation on a full scale of 200% (deviation ±150 kHz), and "clear mark" indication of multipath condition that reveals the optimum FM antenna installation direction.

7 OTHER FUNCTIONS

Other functions include a Noise Filter that helps to eliminate noise during stereo reception of weak signals, a Mode Switch to convert stereo reception to monaural, a Muting Switch to silence interstation noise and Dimmer Switch to dim the illumination of the digital display. Also available are three button switches, HOUR, MINUTE and CHECK, which function to set the digital clock.



BLOCK DIAGRAM

Accuphase T-103

DIGITAL DISPLAY FM STEREO TUNER

GUARANTY SPECIFICATIONS

PERFORMANCE GUARANTY:
All Accuphase product specifications are guaranteed as stated.
All specifications are measured in accordance with the new IHF measurement method.
(*old IHF methods at 300 ohms)

[MONOPHONIC PERFORMANCE]

SENSITIVITY: Usable Sensitivity: 10.3 dBf (1.8μV*)
50 dB Quieting Sensitivity: 17.3 dBf (4.0μV*)

VOLTAGE STANDING WAVE RATIO: 1.5

SIGNAL TO NOISE RATIO AT 65 dBf(1mV*): 77 dB

DISTORTION: with SELECTIVITY switch set to "NORMAL"

	100Hz	1,000Hz	6,000Hz	10,000Hz
65 dBf (1mV*) Input:	0.03%	0.03%	0.03%	0.04%

INTERMODULATION DISTORTION: will not exceed 0.01%
(Antenna input 65 dBf (1mV*), 100% mod., 14 kHz and 15 kHz = 1 : 1)

FREQUENCY RESPONSE: +0, −0.5 dB 20 Hz to 15,000 Hz

SELECTIVITY: with SELECTIVITY switch set to "NORMAL" "NARROW"

	"NORMAL"	"NARROW"
Alternate Channel:	50 dB	100 dB
Adjacent Channel:	6 dB	20 dB

CAPTURE RATIO: 1.5 dB
RF INTERMODULATION: 75 dB
IMAGE RESPONSE RATIO: 120 dB
IF/2 SPURIOUS RESPONSE RATIO: 100 dB
AM SUPPRESSION RATIO: 80 dB, at input 65 dBf (1mV*)
SUBCARRIER PRODUCT RATIO: 80 dB
SCA REJECTION RATIO: 80 dB
OUTPUT: 1.5 Volts, at 100% modulation

[STEREO PERFORMANCE]

SENSITIVITY: 40 dB Quieting Sensitivity: 28.8 dBf (15μV*)
50 dB Quieting Sensitivity: 37.3 dBf (40μV*)

SIGNAL TO NOISE RATIO AT 65 dBf (1mV*): 75 dB

DISTORTION: with SELECTIVITY switch set to "NORMAL"

	100Hz	1,000Hz	6,000Hz	10,000Hz
65 dBf (1mV*) Input:	0.03%	0.03%	0.05%	0.1%

INTERMODULATION DISTORTION: will not exceed 0.03%
(Antenna input 65 dBf (1mV*), Standard Stereo mod., 9 kHz and 10 kHz = 1 : 1)

FREQUENCY RESPONSE: +0, −0.5 dB 20 Hz to 15,000 Hz

STEREO SEPARATION:

100 Hz	1,000 Hz	10,000 Hz
50 dB	50 dB	45 dB

STEREO AND MUTING THRESHOLD: 19.2 dBf (5μV*)

[GENERAL]

FREQUENCY RANGE: 87.5 – 108 MHz
Continuously Variable

FREQUENCY DISPLAY: 100 kHz Interval
10 kHz Column is rounded to the nearest 100 kHz Column

TUNING CAPACITOR: Frequency Linear 5-gang

FREQUENCY DRIFT: ±30 kHz

OUTPUT IMPEDANCE: Audio Output Fixed: 200 ohms
Audio Output Controlled: 2.5k ohms

FM ANTENNA INPUTS: 300-ohm balanced; 75-ohm unbalanced

METERS: Center Tuning Meter
Signal Strength/Multipath/Modulation (Combination Meter)

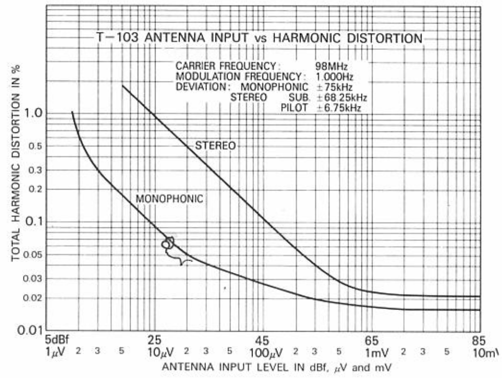
DIGITAL CLOCK: Quarts Oscillation System
Time Accuracy: ±15 seconds/month at 20°C

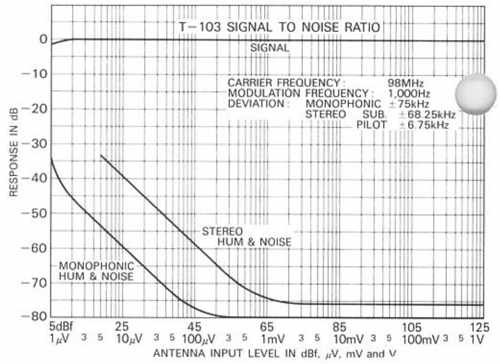
POWER REQUIREMENT: Voltage selector for 100V, 117V, 220V, 240V
50/60 Hz operation, Consumption: 25W

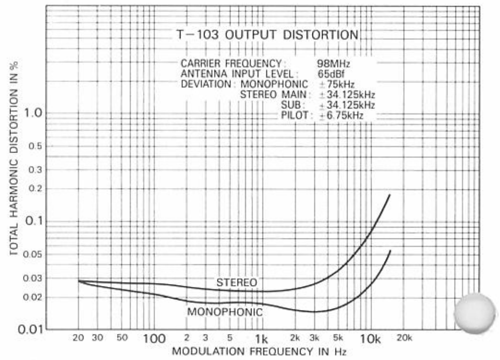
SEMICONDUCTOR COMPLEMENT: 24 Trs., 5 FETs, 13 ICs, 25 Diodes

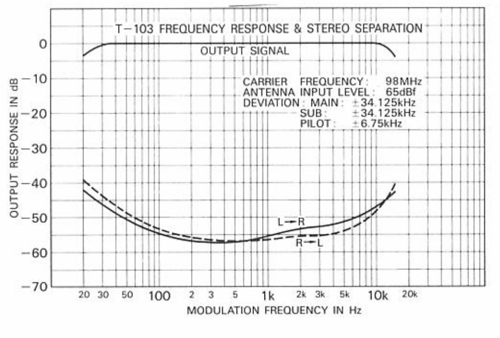
DIMENSIONS: 445mm (17 1/2 inches) wide,
128mm (5 1/16 inches) max. high,
370mm (14 9/16 inches) deep

WEIGHT: 10.0 kgr. (22.0 lbs.) net,
14.4 kgr. (31.7 lbs.) in shipping carton









Accuphase
KENSONIC LABORATORY INC.

0380-4Y(BL)

851-0017-00 PRINTED IN JAPAN