

# Accuphase

FM STEREO TUNER

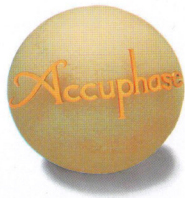
# T-109

●Ultra-precise electronic tuning●Front end with double-tuned antenna circuit easily handles high signal levels●Newly developed Advanced DGL Detector●Extremely stable high-performance stereo decoder●32-station memory also stores reception settings●Pulse tuning system



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**Ultimate FM tuner offers numerous technology highlights: Front end with double-tuned antenna circuit easily copes with high signal levels. Newly developed adjustment-free Advanced DGL Detector. Stereo decoder with ceramic resonator provides ultra high-performance. 32-station memory also stores reception settings.**

Among the great variety of program sources available today, such as CDs and LPs, digital satellite broadcasts, or prerecorded music tapes, FM broadcasts play a special role, since they cover the entire spectrum from live performances of time-honored classical works to the latest hits. The FM band provides a rich choice of music all day long, and when received with state-of-the-art equipment can rival the CD in sound quality. The FM tuner therefore is an important component in a stereo system designed to enlighten and entertain.

The FM Stereo Tuner T-109 from Accuphase was conceived for the music lover who accepts no compromises when it comes to sound quality. It represents the ultimate in FM reception technology. The PLL electronic tuning system pulls in any desired station with pin-point precision and total reliability. A convenient memory function lets you store as many as 32 stations including sensitivity and filter on/off settings, and the pulse tuning principle developed by Accuphase blends digital accuracy with the familiar feeling of operating an analog tuning knob. The front end employs a dual-stage design that can handle even extremely high input signals without cross modulation interference problems, and the newly developed Advanced DGL Detector assures high performance and rock-stable reception. The stereo decoder takes sophisticated circuit topology to new heights, with its reference frequency provided by a ceramic resonator for utmost stability. Since it would not do to dilute the outstanding sonic virtues of this tuner further down the signal path, a balanced output stage sends the audio signal to the next component without any sound quality deterioration. And to top it off, the supplied remote commander provides the convenience of operating this top-notch tuner from the comfort of your easy chair.

**Ultra-precise electronic tuning**  
The T-109 tunes to the station frequency by means of a quartz crystal oscillator that operates with extreme precision and is virtually free of time or temperature induced drift. It precisely locks the tuner to the reception point that yields minimum distortion

tion and maximum sensitivity. Electronic tuning also means that the T-109 is not susceptible to modulation and other noise caused by external vibrations.

**Front end with double-tuned antenna circuit prevents cross modulation interference**

Each FM tuner has a front end that serves to pick just the desired station out of the crowded FM band and convert the radio frequency into an intermediate frequency. The design of this stage is highly crucial, since it must discern and select minute signals, while at the same time being able to withstand the very high levels that can occur when a strong station is broadcasting nearby. Freedom from interference and distortion is what makes the difference between a run-of-the-mill product and a sophisticated high-class FM tuner.

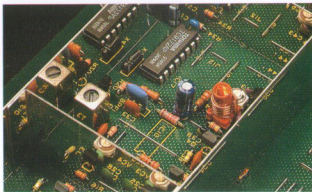
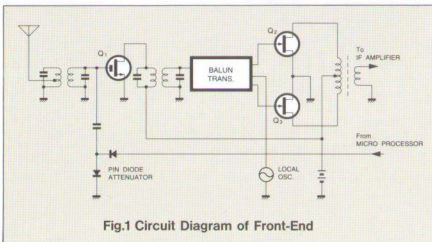


Figure 1 shows the circuit diagram of the front end employed in the T-109. Accuphase has long been advocating the "double-tuned antenna circuit principle", whereby a high selectivity circuit precedes the antenna signal amplifier stage. This prevents intermodulation distortion and other undesirable side effects which can occur if a strong signal were amplified directly. The RF amplifier stage uses FET devices configured as a low-feedback cascode amplifier. This means that two amplifying elements are connected in a cascaded arrangement with drastically improved frequency response.

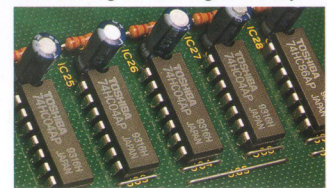
The input stage gate features a PIN-diode attenuator that is switched on or off by a micro-processor, depending on the antenna input level. This assures high-quality reception, free from interference and distortion, even in areas which are close to strong broadcast stations that could otherwise overload the front end. The balanced mixer stage uses a push-pull FET arrangement to minimize harmonic distortion and reliably reject interference signals.



**Newly developed Advanced DGL Detector**  
Ever since the invention of the frequency-modulation principle, the most commonly used detector types were Foster-Seeley or ratio detectors. However, the evolution of system quality and performance called for other, more sophisticated detector techniques. Accuphase answered this need with the DGL (Differential Gain Linear) detector adopted since the model T-106, featuring low distortion, high S/N ratio, low capture ratio, and reliable, adjustment-free performance. For the T-109, Accuphase has now further developed and refined the DGL principle, resulting in the Advanced DGL Detector.

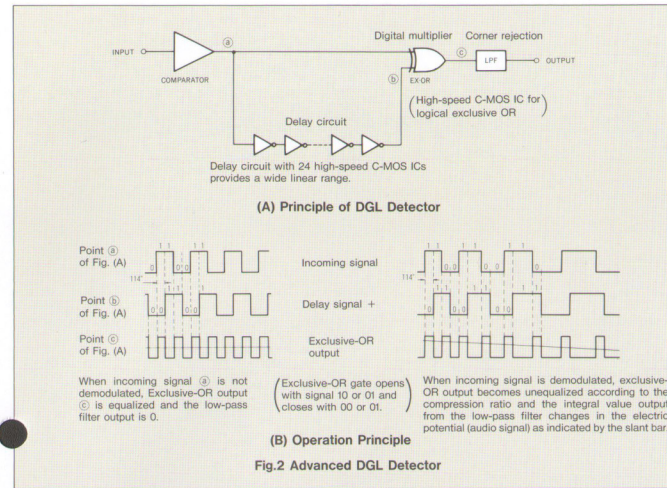
Figure 2 (A) shows the circuit principle of the Advanced DGL Detector. The input stage uses a high-speed comparator as a broadband 2.4 MHz amplifier to prevent beat interference. The delay circuit consists of 24 high-speed C-MOS ICs.

Figure 2 (B) illustrates the DGL operation principle. The delay circuit takes the slight output delay of high-speed logic ICs into consideration. An arrangement of 24 ICs delays the phase angle by 114 degrees to assure minimum distortion and maximum S/N ratio. The delayed signal (b) is then compared to the input signal (a) by an EXCLUSIVE OR circuit which switches the circuit on and off according to the electric potential between the two signals. As a result, the degree of condensation and rarefaction of frequency-modulated signal is detected digitally (c) and extracted as the audio signal. Thanks to this approximate linearity of the delay circuit is maintained over a very wide range ( $\pm 2.4$  MHz), and adjustment is not required, assuring excellent long-term reliability. Another advantage is outstanding differential gain linearity.



**Switchable IF bandwidth (NORMAL, NARROW)**

FM broadcasts have an audio frequency range up to 15 kHz and S/N ratio of about 80 dB. To make the most of this impressive quality potential, the T-109 normally uses an IF stage with wide bandwidth (NORMAL) to receive broadcasts. However, if there are strong neighboring stations which might impair reception, the IF bandwidth can be switched to NARROW. In this position, distortion and stereo separation are slightly worse, but selectivity is maximized to ensure sharp reception.



**Stereo decoder controlled by a solid resonator for ultra-low distortion and excellent long-term stability**

The right and left channel information of the FM stereo signal is encoded by means of a 38-kHz subcarrier. To decode this information, the tuner must produce a signal that is perfectly synchronized with the subcarrier, allowing a switching circuit to extract the right and left signal components at exactly the right time. Otherwise, stereo separation and imaging will be notably impaired. To accomplish this task, the pilot signal in the input is used to lock the oscillator of a PLL circuit in the tuner to the required frequency, as shown in Figure 3 (A).

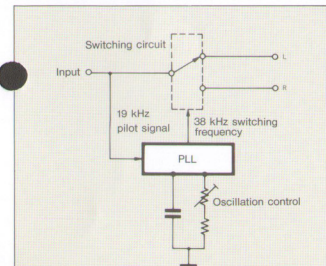


Fig.3(A) Trimmer Potentiometer Type Stereo Demodulator

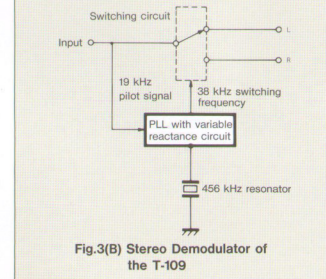


Fig.3(B) Stereo Demodulator of the T-109

- In the T-109, the internal PLL oscillator employs a ceramic resonator, as shown in Figure 3 (B), in conjunction with a reactance circuit that can be switched between positive and negative reactance by a control voltage. This allows accurate switching in a more narrow locking frequency range than is possible with conventional circuits. The main advantages of the Accuphase design are:
- (a) Superior long-term stability without the need for adjustment.
  - (b) Virtually no change in stereo separation due to temperature or line voltage fluctuations.
  - (c) Narrow locking frequency range reduces the danger of beat interference at high frequencies.

**32-station memory also stores reception settings**

The T-109 provides ample memory capacity, allowing the user to quickly store and recall up to 32 stations. There are 16 station buttons which control two memory slots each. Selecting the first or second station number of a button is as simple as it could be: just keep the button depressed for more than one second to select the second station number (the station number flashes once on the display). When you store a station, the T-109 memorizes not only the broadcast frequency but also all other function settings (including SELECTIVITY, METER, FILTER, MUTING, and MONO). Therefore, even if you store for example a weak station for which you prefer to have the filter on, just touch the memory button and the station will be received in optimum condition.

**Innovative pulse tuning system developed by Accuphase allows manual tuning with that traditional "analog feeling"**

The T-109 not only offers the capability to instantly memorize and tune in a station at the touch of a button, it also possesses a tuning knob that makes it possible to hunt for broadcast stations with the familiar feeling of an analog tuner. However, behind the

front panel the operation of this knob is truly state-of-the-art. A disc with radial slits is mounted to a shaft that is turned by the knob. An optical (non-contact) phase detector translates the rotation of the disc into a series of pulses which are input to a microprocessor that in turn controls the PLL tuning frequency. A series of low-level beep tones can be heard when the knob is turned, to indicate the frequency change.

**Balanced audio output**

The balanced signal transmission principle is used extensively in professional installations such as recording and broadcast studios, because it prevents sound quality deterioration caused by externally induced noise. Accuphase has adopted this principle for its entire line of audio amplifiers. The T-109 now offers the same advantages in a tuner, to keep the signal and ground lines free from any kind of noise interference.



**Multi-function meter also indicates multipath**

The meter of the T-109 can be switched to show either the antenna input level (field strength) or multipath condition. Multipath distortion occurs when the broadcast signal is reflected by buildings, mountains etc. and arrives at the antenna in multiple instances (similar to ghost images on a TV screen). To minimize multipath, it is essential to select the best transmitter station and optimize the antenna orientation, a task that is made easy by the multipath indication mode of the meter on the T-109. In the antenna input mode, the meter indicates the field strength of the currently received station. The higher the meter indication, the better is the available S/N ratio.



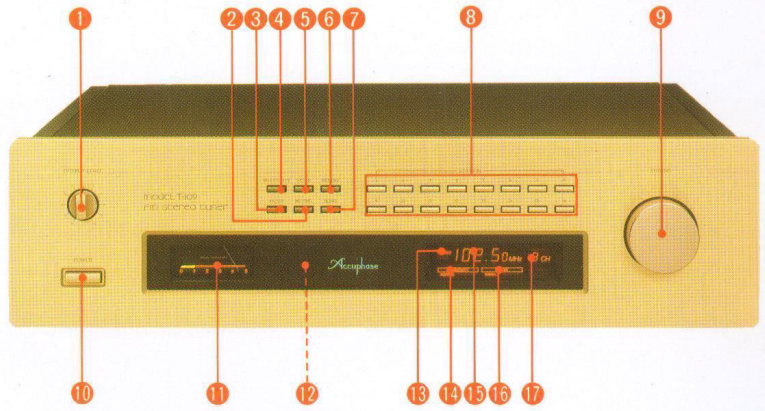
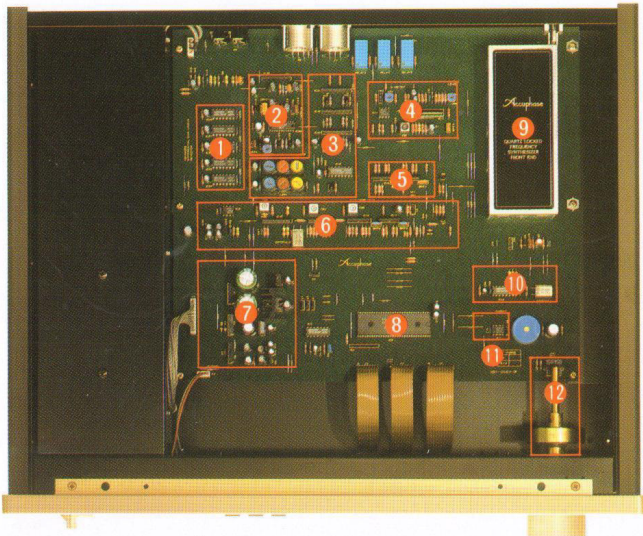
**Other features**

The T-109 offers many other desirable features, including a switchable Noise Filter that is useful to reduce noise on stereo broadcasts from weak stations, a Muting Switch to eliminate noise during manual tuning, a Mono Switch, and an Output Level Control that allows matching the tuner's output level to that of other components in the system.

**Remote commander allows convenient operation from anywhere**

With the supplied remote commander RC-12, you can change stations and control all other features of the T-109 from any location.





**Internal layout**

- 1 Advanced DGL Detector
- 2 Stereo decoder
- 3 Audio output amplifier
- 4 Meter circuit IF amplifier
- 5 Narrow-bandwidth IF amplifier
- 6 IF amplifier
- 7 Power supply
- 8 8-bit microprocessor
- 9 Double-tuned front end
- 10 Basic oscillation circuit
- 11 Nonvolatile memory
- 12 Pulse tuning rotary encoder

**FRONT PANEL**

- 1 Output level control
- 2 Interstation noise silencing switch
- 3 Multiplex noise filter switch
- 4 Selectivity control switch
- 5 Meter function switch
- 6 Station memory switch
- 7 Monophonic switch
- 8 Preset station selector switches
- 9 Pulse-tuning knob
- 10 Power switch
- 11 Multipath/signal meter
- 12 Remote sensor
- 13 Stereo/mono indicator
- 14 Selectivity indicator
- 15 Frequency indicator
- 16 Meter indicator
- 17 Station number indicator

**GUARANTEED SPECIFICATIONS**

*enrich life through technology*

**Performance Guaranty:**

All Accuphase product specifications are guaranteed as stated.

**MONOPHONIC PERFORMANCE**

- **Frequency Range:**  
Europe 87.50MHz-108.00MHz  
(in 50-kHz channel steps)  
USA 87.5MHz-108.0MHz  
(in 100-kHz channel steps)  
Asia 87.5MHz-107.9MHz  
(in 200-kHz channel steps)
- **Sensitivity:**  
Usable Sensitivity: 11dBf (IHF)  
50dB Quieting Sensitivity: 17dBf (IHF)
- **Voltage Standing Wave Ratio:**  
1.5
- **Signal-to-Noise Ratio at 80dBf:**  
90 dB (A-Weighted)
- **Total Harmonic Distortion:**  
With SELECTIVITY switch set to NORMAL  
80dBf input at  $\pm 75$ kHz deviation  
20Hz 1000Hz 10,000Hz  
0.02% 0.02% 0.02%
- **Intermodulation Distortion:**  
Will not exceed 0.01% (Antenna input 80dBf,  $\pm 75$ kHz deviation)
- **Frequency Response:**  
 $\pm 0, -1.0$ dB, 10Hz to 16,000Hz
- **Selectivity:(IHF)**  
With SELECTIVITY switch set to NORMAL or NARROW

Interference Wave	NORMAL	NARROW
400kHz	70dB	100dB min
300kHz	30dB	100dB
200kHz	10dB	40dB

- **Capture Ratio:** 1.5dB
- **RF intermodulation:** 80dB
- **Spurious Response Ratio:** 120dB
- **Image Response Ratio:** 80dB
- **AM Suppression Ratio:** 80dB at 65dBf input
- **Subcarrier Product Ratio:** 70dB
- **SCA Rejection Ratio:** 80dB
- **Output:** 1.0 Volt at  $\pm 75$ kHz deviation

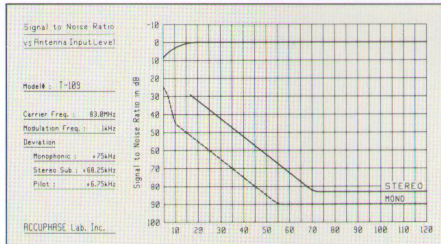
**STEREOPHONIC PERFORMANCE**

- **Sensitivity:**  
40dB Quieting Sensitivity: 29dBf (IHF)  
50dB Quieting Sensitivity: 37dBf (IHF)
- **Signal-to-Noise Ratio at 80dBf:**  
85dB (A-Weighted)

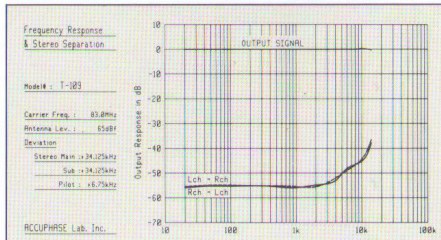
- **Total Harmonic Distortion:**  
With SELECTIVITY switch set to NORMAL 80dBf input  
at  $\pm 75$ kHz deviation  
20Hz 1000Hz 10,000Hz  
0.04% 0.04% 0.04%
- **Intermodulation Distortion:**  
Will not exceed 0.03% (Antenna input  
80dBf,  $\pm 75$ kHz deviation)
- **Frequency Response:**  
 $\pm 0, -1.0$ dB, 10Hz to 16,000Hz
- **Stereo Separation:**  
100Hz 1,000Hz 10,000Hz  
50dB 50dB 40dB
- **Stereo and Muting Threshold:** 20dBf

**GENERAL**

- **Antenna Input:**  
75-ohm unbalanced
- **Tuning System:**  
Quartz-lock frequency synthesized tuning system Preset  
tuning random memory for 32 stations
- **FM Detector:**  
DGL (Differential Gain Linear) Detector



Signal-to-noise ratio vs. antenna input level

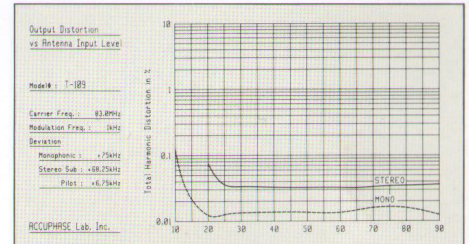


Frequency characteristics and stereo separation

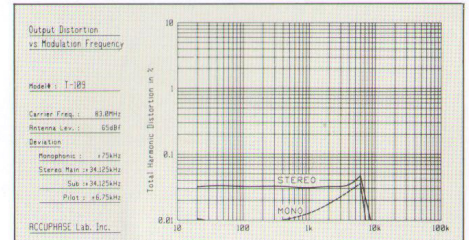
- **Output Impedance:**  
BALANCED, XLR type:  
200 ohms (100 ohms/100 ohms)  
UNBALANCED  
Audio output FIXED: 200 ohms  
Audio output CONTROLLED: 1.25 kohms max
- **Meter:** Multipath/Signal strength (selectable)
- **Power Supply and Power Consumption:**  
Compatible to 100/177 V and 220/240V 50/60Hz operation  
Consumption: 15 Watts
- **Maximum Dimensions:** 475mm (18-11/16") width,  
140mm (5-1/2") height (max)  
402mm (15-15/16") depth
- **Weight:** 9.5kg (20.9 lbs.) net  
14.5kg (32 lbs.) in shipping carton

**Supplied Remote Commander RC-12**

Remote Control System: Infra-red Pulse  
Power Supply: 3V DC (Two IEC R6 batteries)  
Dimensions: 64mm (3-1/2") width, 149mm (5-7/8")  
height, 18mm (11/16") depth  
Weight: 145g (0.3 lbs) including batteries



Output distortion vs. antenna input level



Output distortion vs. modulation frequency

