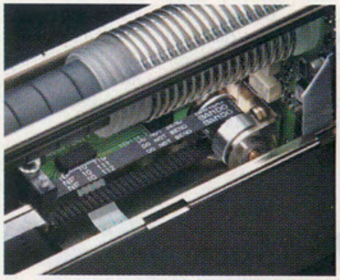
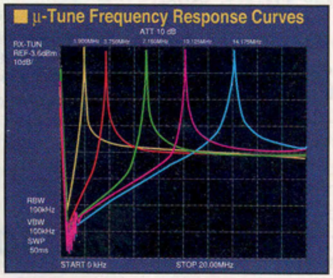
FT DX 9000 Series Technical Highlight-1

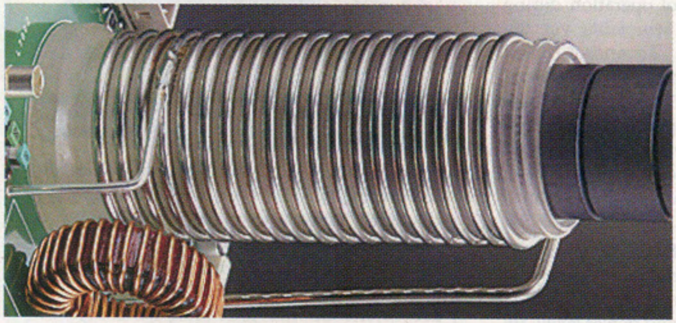
●Three μ-Tune Modules Installed in FT DX 9000 Mainframe

New Mu (μ) Narrow-bandwidth High-Q RF Filters Using Large-Diameter (1.1") Coils: Helping Weak Signals Rise Out of the Interference and Noise!


● Long-life Synchronizing Drive Belt



10 dB/Div · 2 MHz/Div

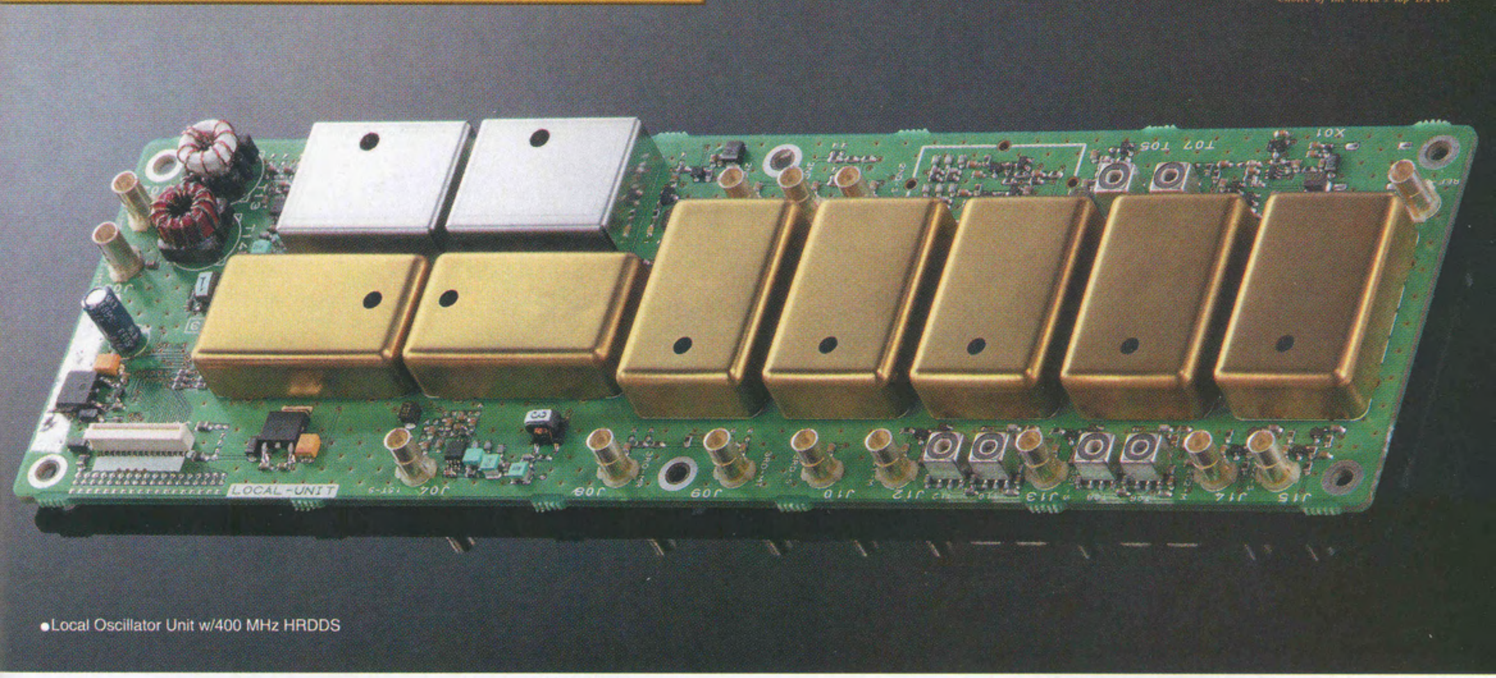

● Large-Area (1.1") Coil (Actual Size)

Operation on the low bands, especially 1.8 MHz, frequently involves very strong signals from close-by broadcast stations, with signal voltages much greater than on the high bands due to NVIS propagation and large antenna size. Heretofore no RF filtering system in an Amateur Transceiver was fully equipped to cope with this challenge, but Yaesu's new "μ -Tuning" filter breaks new ground, providing ultra-high-Q RF preselection selectivity on the 14 MHz and lower Amateur bands. A total of three μ -Tuning filter modules are required for this band coverage (1.8 MHz, 3.5/7 MHz, and 10/14 MHz), and all three modules are installed on the FT DX 9000D version; on the other versions, they are available options.

When the front panel's "μ -T" switch is turned on, the VRF circuit is switched out of the receiver input line, and is replaced by the μ -Tune circuit, which provides much tighter RF selectivity thanks to the high Q (300 or more) afforded by the large 1.1" diameter Ni-Zn ferrite magnet toroidal coil stack used in filter construction. As the toroid stack is passed through the coil structure, the center frequency is adjusted, and the resulting 3 dB bandwidth is approximately ±12 kHz on 1.8 MHz (-30 dB bandwidth ±450 kHz). Insertion of the μ -Tuning filter alone typically increases the IP3 by 4 dB.

The core stack is driven by a high-resolution hybrid stepping motor (4-phase, unipolar motor with 2-phase magnetization and 1.8° step resolution) which is connected to a long-life synchronized belt drive with an operational lifetime of over 10,000 hours. In order to cover the 1.8 MHz bands, the moving core stack is a whopping 2.2" long, and the resonance is controlled automatically by the microprocessor as you tune around the band. Manual override (±5 kHz during auto mode, or full manual tuning) is provided, allowing you to make very fine peaking adjustments in the peaking and/or interference suppression of the μ -Tune filter.

If you have turned the μ -Tune filter off, just switching it back on will automatically cause it to re-center itself on your operating frequency. On those bands on which you have μ -Tune filter modules installed, we recommend you always use this filter for its superior RF selectivity characteristics. If you have a special application involving wide TX/RX splits or want to adjust the μ -Tune filter yourself, the Menu system allows you to disable the μ -Tune filter, or engage fully manual control.



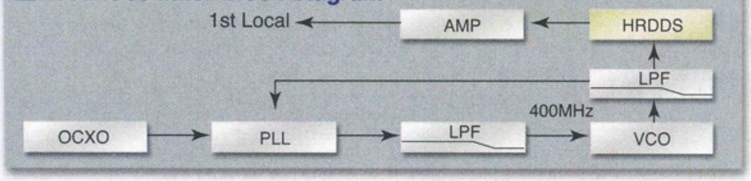
●Local Oscillator Unit w/400 MHz HRDDS

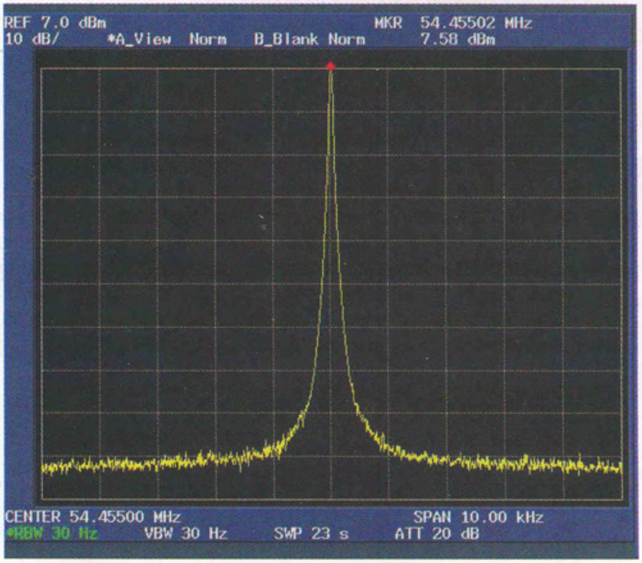
Ultra-Low-Noise Local Oscillator System Creates "The Sound of Silence ."

World's First 400 MHz High-Resolution Direct Digital Synthesizer (HRDDS): Unmatched Capability to Ensure Weak Signal Reception in a High-Level, Multi-Signal Environment

In order to make a dramatic improvement in multi-signal, close-in strong signal handling performance, new thinking was required in the crafting of the first local oscillator (LO), critical to the process because it feeds the important first mixer of the receiver. A noisy first LO can cause irreparable degradation to the received signal, as the noise cannot be removed in succeeding stages of the receiver. Traditional PLL systems, in seeking to achieve a rapid lock time, suffer a rapid rise in LO noise around the carrier signal. The HRDDS (High Resolution Direct Digital Synthesizer) system being introduced in the FT DX 9000 Series utilizes a direct locking technique using a 400 MHz reference signal, resulting in a lock time that approaches zero; because the lock time is zero, the inversely-related C/N ratio has no degradation close-in, resulting in unprecedented maintenance of the signal-to-noise ratio close to your operating frequency, and the BDR performance follows suit.

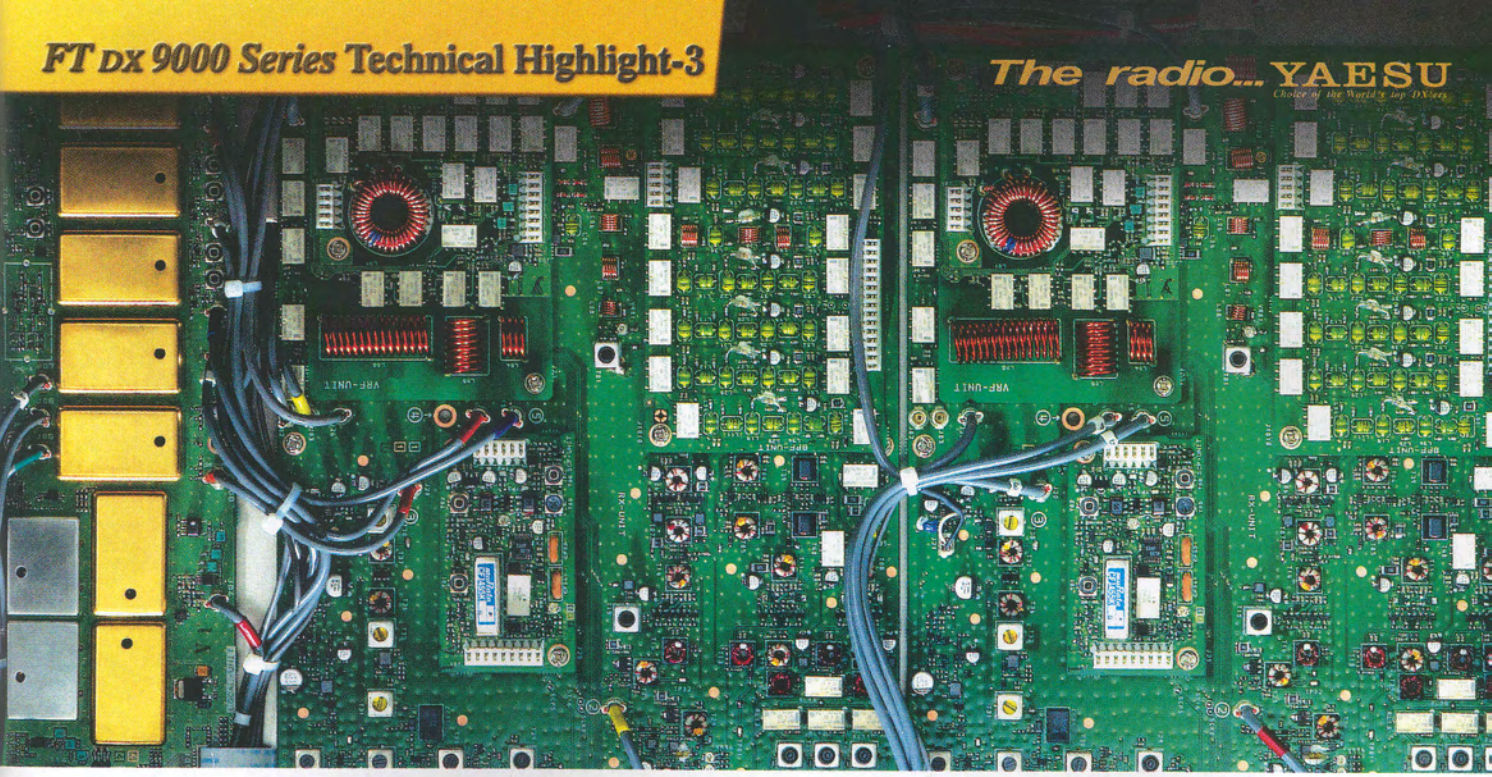
■Local Oscillator Block Diagram





■C/N Ratio Performance

FT DX 9000 Series Technical Highlight-3

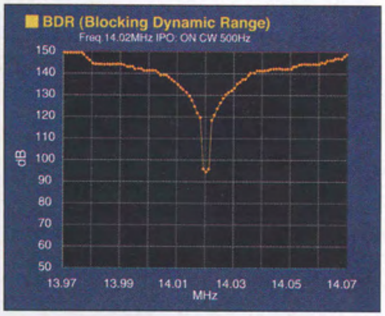


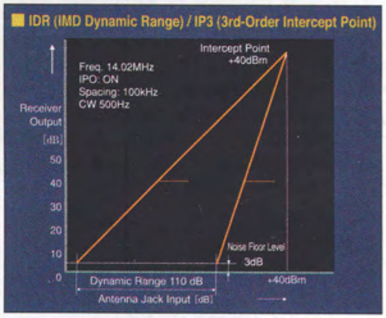
Creating serenity out of HF band chaos. . . it's the everlasting mission of an HF transceiver

Nature provides the propagation. . . and the noise, and your stress level rises as you anticipate the QRM. But from the first moment you experience truly quiet reception, you begin to realize the real wonder and glory of HF DX.

The Ultimate Overall Receiver Performance, Achieved through Balanced, High-Level Design

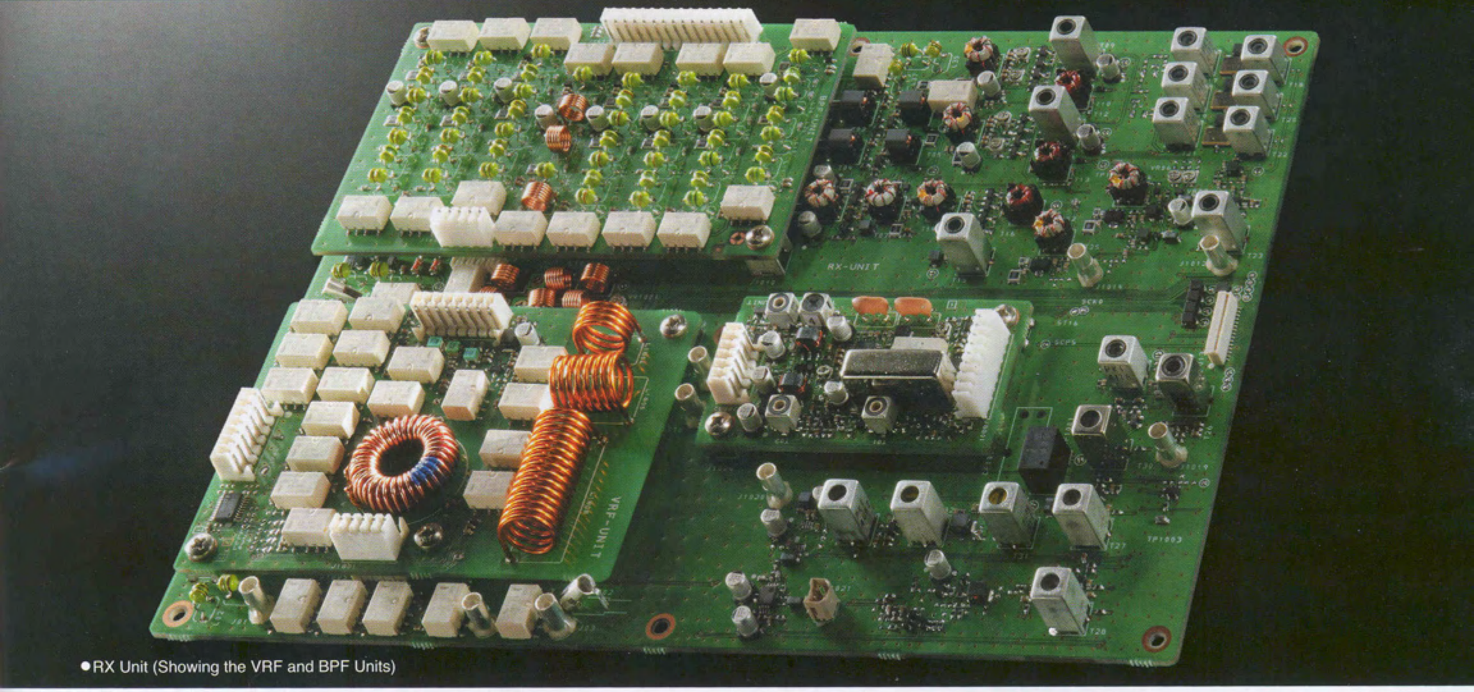
In elite-class Contest and DX-pedition environments, a large number of high-power stations are calling simultaneously inside a window of only a few kHz. Frequently, the RF front end's capabilities are exceeded by the presence of these high powered stations, obstructing reception due to a number of serious performance problems such as receiver gain compression, as well as an increase in internally-generated noise from the receiver's own local signals. The front end of an HF radio, of course, faces the diverse challenge of dealing with multiple signals, ranging in strength from micro-Volts to dozens of Volts, in additional to constantly-changing noise levels. The stress from this hostile RF environment is very harsh on a receiver's RF front end. Our engineering team has concentrated on improving the performance of a receiver operating in this kind of harsh environment. Most importantly, they have recognized the need to improve the overall receiver performance, balanced at the highest levels, and considering all measurement data (including BDR, IDR, IP3) to form a unified, optimized receiver figure of merit. This important optimization and balance have resulted in a superior receiver with the highest order of performance.





Moreover, care must be exercised when evaluating the claimed specifications of high-end receivers, as the precise measurement techniques associated with those specifications may be misleading. For example, a receiver with an outstanding Blocking Dynamic Range, measured with a test signal 100 kHz away, may, nonetheless, have inferior front-end characteristics when signals much closer than 10 kHz are encountered (as they typically are in a Contest or DX-pedition environment). Noise may be generated inside the receiver, to the extent that the desired signal is obscured by the noise or AGC action suppressing the sensitivity. Ultimately, the desired signal is lost.

Throughout the four-year FT DX 9000 design process, our mission has been to tackle the life-long challenges of multiple-signal interference, external noise, and internally-generated noise, and we have stayed true to the mission through completion of the FT DX 9000 Project. We are confident that you will enjoy the result.



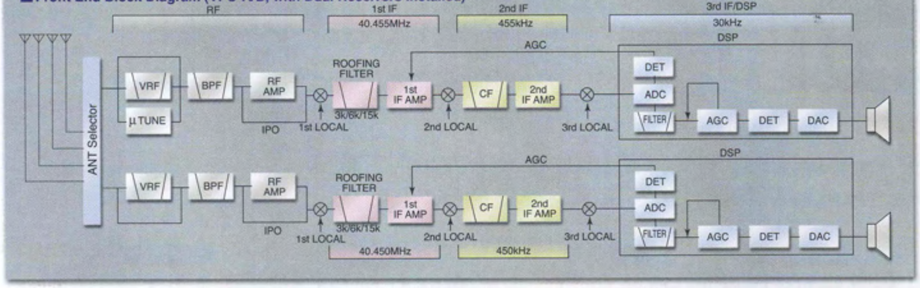
● RX Unit (Showing the VRF and BPF Units)

The close-in, multi-signal environment. . .
This is where a truly high-quality radio makes the difference.

Not only did YAESU's engineers devote attention to measurement data such as BDR, IDR, and IP3, which all are in the limelight in the modern HF industry, but they also directed special attention on high performance in the difficult close-in multiple-strong-signal environment by determining the optimum gain allocation for each stage, the purity of all local signals, adequate gain in the mixers, and then followed the research up with exhaustive field tests.

Triple Conversion Receiver using Gain Distribution Optimization

In the FT DX 9000, a gain-optimized triple-conversion super-heterodyne receiver architecture is employed, utilizing IFs of 40 MHz, 455 kHz, and 30 kHz (FM 3rd IF: 24 kHz). Each stage is carefully filtered, and its gain balanced against the other IF stages' gains, to optimize net system performance. The system architecture does not require extraneous circuits for image rejection, resulting in an efficient design without unnecessary stages that can provide opportunities for performance degradation.



■ Front End Block Diagram (VFO-A/B, with Dual Receivers Installed)

Ultra-Strong RF Front End

YAESU's outstanding RF-stage filtering system cuts off strong signals outside the RF filters' passbands. Then it is the important task of the RF amplifier and first mixer stages to have outstanding characteristics, so as to excel in performance as they confront the many close-in signals within the RF front-end filters.

The RF Amplifier stage consists of a pair of SST310 Junction FETs in a parallel push-pull configuration to provide low noise figure and excellent immunity to blocking and Intermodulation. For the 21 MHz and higher bands, push-pull configured 3SK131 FETs are used for optimal noise figure performance on these higher frequencies. Following the RF Amplifier is the 1st Mixer, crafted using four SST310s in a doubly-balanced configuration ideal for optimizing IMD rejection in a multi-signal environment. Gain distribution in the front end is carefully balanced, as are stage gains throughout the receiver. The power supply in the front end runs at 22 Volts, further enhancing strong-signal performance. And the 1st Mixer, being an active type, does not contribute loss to the signal path, so frequently there is no need to use the RF amplifier stage at all (IPO–Intercept Point Optimization mode), but rather provide direct feed to the 1st mixer, which improves intermodulation performance further.

For operation on the 50 MHz band, Yaesu's engineers have designed a special low-noise GaAs FET RF Amplifier using push-pull SGM2016 devices, while the first mixer utilizes four 2SK520 Junction FETs to push the Noise Figure well below what is required during HF operation.