ARRL Laboratory
Expanded Test-Result Report
Ten Tec Centaur

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$7.50 for ARRL Members, $12.50 for non-Members, postpaid.

Model Information:
Manufacturer: Ten Tec
Model: Centaur Serial #: 01A10087
QST "Product Review": June, 1997

Manufacturer:
Ten-Tec, Inc
1185 Dolly Parton Parkway
Sevierville, TN 37862
Phone: 423-453-7172
423-428-0364 (Repairs)
Fax: 423-428-4483
Web Site: http://www.tentec.com/

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Manufacturer	Model	Issue
ICOM	IC-706	Mar 96
	IC-756	May 97
	IC-775DSP	Jan 96
	IC-821H	Mar 97
JRC	NRD-535	May 97
Kenwood	TS-570D	Jan 97
	TS-870S	Feb 96
Ten Tec	Centaur	Jun 97
Yaesu	FT-1000MP	Apr 96

The ARRL Technical Information Service has prepared an information package, "What Rig Should I Buy?," (http://www.arrl.org/tis/info/bestrig.html) that discusses Product Review testing and the features of various types of equipment. Paper copies are available from the ARRL Technical Department Secretary. The cost for paper copies is $2.00 for ARRL Members, $4.00 for non-Members, postpaid.

Reprints of any *QST* article or Product Review are available from the ARRL Technical Department Secretary for $3.00 for ARRL Members, $5.00 for non-Members, postpaid (The QST CD ROMs usually represent a better value, however!).

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Introduction:

This document is a summary of an extensive battery of tests performed by the ARRL Laboratory for each unit that is featured in *QST* "Product Review." We have expanded the series of tests we perform on each unit and we are offering the test results to those who are interested in learning more technical details about equipment than can be fit into the pages of *QST*. The proceeds from the sale of these reports are used to fund the additional staff time that goes into testing the equipment and preparing these reports, allowing us to do more testing than we have room to document in *QST*. Please help promote this valuable new service so we can continue to offer it and expand our testing program.

Each test section contains up to three components. For all tests, there is a discussion of the test and test method used in ARRL Laboratory testing. For most tests, critical test conditions are listed to enable other engineers to duplicate our test methods. For some of the tests, a block diagram of the test setup is included. The ARRL Laboratory has an internal document, the *ARRL Laboratory Test Procedures Manual*. This manual explains our specific test methods in detail, with a test description similar to the one in this report, a block diagram, showing the specific equipment currently in use for each test, along with all equipment settings and a specific step by step procedure used in the ARRL Laboratory. While this is not available as an ARRL publication, the ARRL Technical Department Secretary can supply a photocopy. The charge is $20.00 for ARRL Members, $25.00 for non-Members, postpaid.

Tests performed during ARRL product testing are derived from recognized standards and test methods. The test methods have sometimes been adapted to specific amateur needs. Other tests have been developed by the ARRL Lab. The ARRL Laboratory Test equipment is calibrated as required, with traceability to National Institute of Standards and Technology (NIST http://www.nist.gov/)). Most of the equipment is calibrated by a contracted calibration laboratory. Other equipment, especially the custom test fixtures, is calibrated by the ARRL Laboratory Engineers, using calibrated equipment and standard techniques.

The units being tested are operated as specified by the equipment manufacturer. The ARRL screen room has an ac supply that is regulated to 117 or 234 volts. If possible, the equipment under test is operated from the ac supply. Mobile and portable equipment is operated at the voltage specified by the manufacturer, at 13.8 volts if not specified, or from a fully charged internal battery. Equipment that can be operated from 13.8 volts (nominal) is also tested for function, output power and frequency accuracy at the minimum specified voltage, or 11.5 volts if not specified. Units are tested at room temperature and humidity, both as determined by the ARRL HVAC system. In addition, units that are capable of mobile or portable operation are tested at their rated temperature range, or if not specified, at -10 to +60 degrees Celsius in a commercial temperature chamber.

ARRL "Product Review" testing represents a sample of only one unit. This is not necessarily representative of all units of the same model number. It is not uncommon that some parameters will vary significantly from unit to unit. The ARRL Laboratory and Product Review editor work with manufacturers to resolve any deviation from specifications or other problems encountered in the review process. These problems are documented in the Product Review.

Units used in "Product Review" testing are purchased off the shelf from major distributors. We take all necessary steps to ensure that we do not use units that have been specially selected by the manufacturer. When the review is complete, the unit is offered for sale in an open mail bid, announced regularly in *QST* .

73 from ARRL Headquarters, Mike Tracy, KC1SX, ARRL Laboratory Engineer

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Amplifier Output Power:

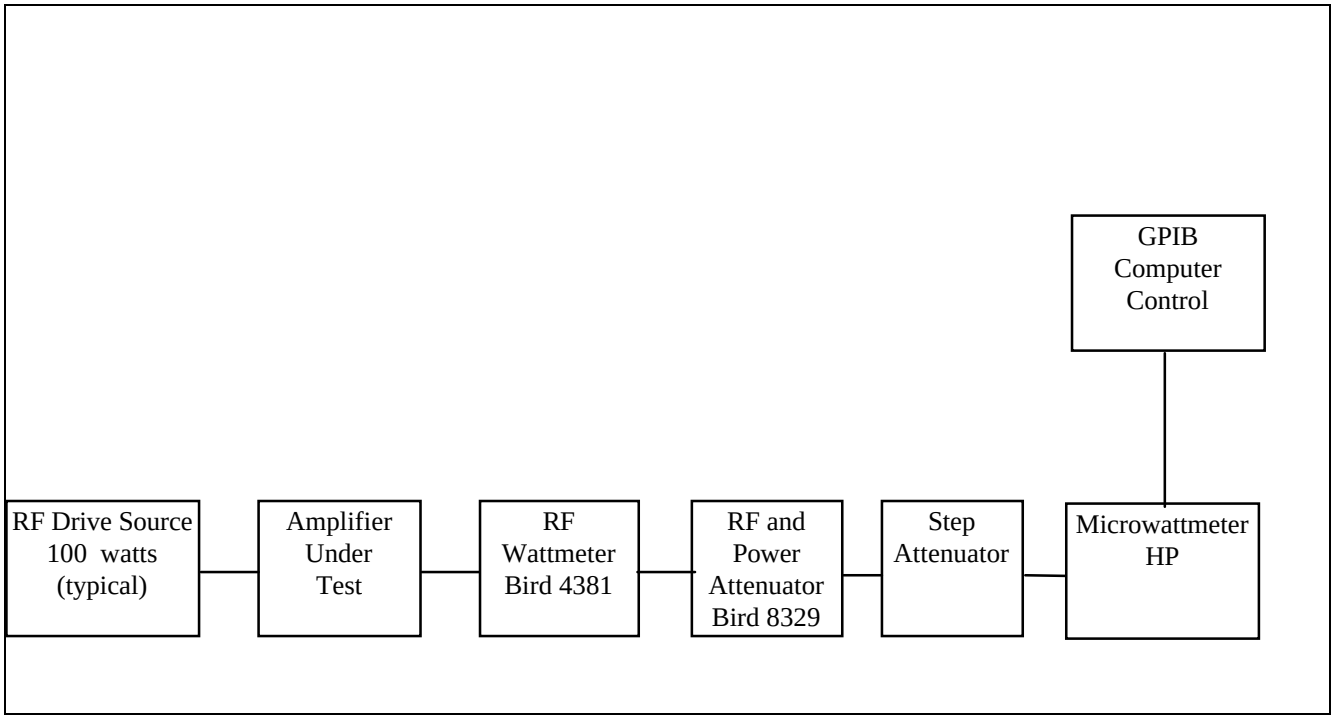
Test description: One of the first things an amateur wants to know about an amplifier is its RF output power. The ARRL Lab measures the CW output power for every band on which an amplifier can operate. The unit is tested across the entire amateur band and the worst-case number for each band is reported. Typically, the most popular band of operation for each mode is selected. Thus, on an HF amplifier, the SSB tests are done on 75 meters for lower sideband, 20 meters for upper sideband, and AM tests are done on 75 meters, FM tests are done on 10 meters, etc. This test also compares the accuracy of the unit's internal output-power metering against the ARRL Laboratory's calibrated test equipment. A two-tone audio input, at a level within the manufacturer's microphone-input specifications, is used for the SSB mode. No modulation is used in the AM and FM modes.

Some amplifiers are derated from maximum output power on full-carrier AM and FM modes, even though they can often deliver more than this derated power for short periods of time. In these cases, the published test-result table will list the AM or FM power as being "as specified."

In almost all cases, the linearity of an amplifier decreases as output power increases. An amplifier rated at 1000 watts PEP on single sideband may actually be able to deliver more power, but as the power is increased beyond the rated RF output power, adjacent channel splatter (IMD) usually increases dramatically. If the ARRL Lab determines that an amplifier is capable of delivering its rated PEP SSB output, the test-result table lists the power as being "as specified."

Key Test Conditions: Termination: 50 ohms resistive, or as specified by the manufacturer.

Block Diagram:



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Output Power Test Results:

Frequency (MHz)	Mode	Input Power FWD W	Input Power REF W	Ep V	Ip mA	Ig mA	Measured Power PEP W	Amp Power Meter PEP W	Spurs dBc	Notes
1.8 MHz	CW	86.9	1.9	1700	560	90	500	440	-46	
1.9 MHz	CW	84.9	1.9	1700	560	90	504	440	-46	
2.0 MHz	CW	81.2	1.7	1700	560	90	503	449	-46	
3.5 MHz	CW	116	2.4	1700	700	125	608	590	-50	
3.75 MHz	CW	103	0	1700	700	120	604	590	-49	
4.0 MHz	CW	90.5	0	1700	650	120	599	600	-52	
7.0 MHz	CW	101	1.7	1700	650	120	600	600	-52	
7.15 MHz	CW	102	1.7	1700	650	110	601	600	-51	
7.3 MHz	CW	98	1.5	1700	620	110	603	600	-51	
10.15 MHz	CW	119.3	1.91	1700	680	115	600	600	-55	
14.0 MHz	CW	85	0.2	1700	720	120	603	590	-55	
14.175 MHz	CW	87.1	1.4	1700	700	120	603	590	-55	
14.35 MHz	CW	87.5	1.1	1700	700	115	599	580	-55	
14.175 MHz	USB	--	--	1700	--	--	--	--	--	10
18.068 MHz	CW	93	4.7	1700	700	115	491	500	-58	
18.168 MHz	CW	90	4.4	1700	700	115	475	480	-58	
21.0 MHz	CW	82.3	0	1700	740	120	600	550	<-60	
21.225 MHz	CW	85.4	0	1700	750	130	600	560	<-60	
21.45 MHz	CW	83.3	0	1700	750	125	566	540	<-60	
24.89 MHz	CW	68.6	0	1700	700	140	514	490	-48	
24.00 MHz	CW	61.4	0	1700	680	115	501	470	-50	
28.0 MHz	CW	54.5	0	1700	680	125	505	470	-49	
28.5 MHz	CW	50.5	0	1700	700	100	497	460	-50	
29.0 MHz	CW	52.2	0	1700	700	145	501	470	-48	
29.7 MHz	CW	55.1	0	1700.	730	145	504	470	-50	

Notes:

10. Transmit IMD generally increases significantly above rated power. Unit met rated power on SSB.

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Spectral Purity Test:

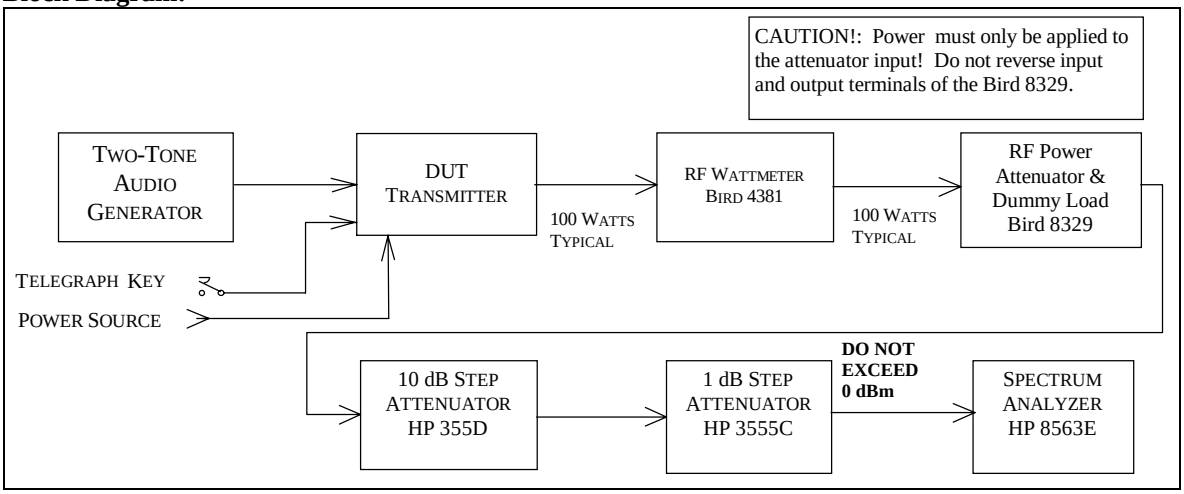
Test Description: All transmitters emit some signals outside their assigned frequency or frequency range. These signals are generally known as spurious emissions or "spurs." Part 97 of the FCC rules and regulations specify the amount of spurious emissions that can be emitted by a transmitter operating in the Amateur Radio Service. The ARRL Laboratory uses a spectrum analyzer to measure the spurious emission on each band on which an amplifier can operate. The amplifier is tested across the band and the worst-case spectral purity on each band is captured from the spectrum analyzer and stored on disk. Spectral purity is reported in dBc, meaning dB relative to the transmitted carrier.

The graphs and tables indicate the relative level of any spurious emissions from the amplifier. The lower that level, expressed in dB relative to the output carrier, the cleaner the amplifier is. So an amplifier whose spurious emissions are -60 dBc is spectrally cleaner than is one whose spurious emissions are -30 dBc. FCC Part 97 regulations governing spectral purity are contained in 97.307 of the FCC rules. Information about all amateur rules and regulations is found in the *ARRL FCC Rule Book.* Additional information about the decibel is found in the *ARRL Handbook.*

Key Test Conditions:

Unit is operated at nominal supply voltage and temperature.
Output power is adjusted to full power on each amateur band.
The level to the spectrum analyzer is - 10 dBm maximum.
The resolution bandwidth of the spectrum analyzer is 10 kHz on HF, 100 kHz on VHF, 1 MHz on UHF.

Block Diagram:



Notes:

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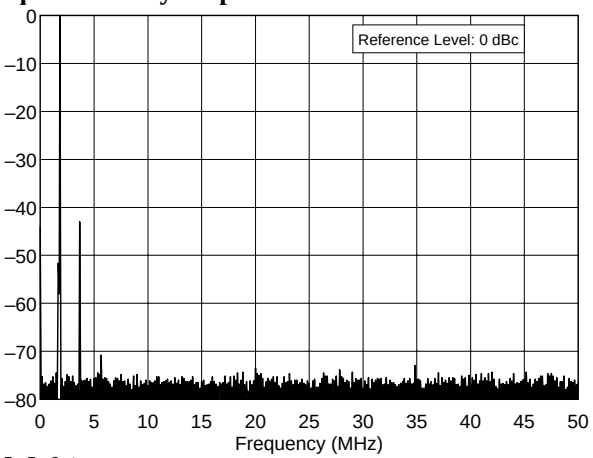
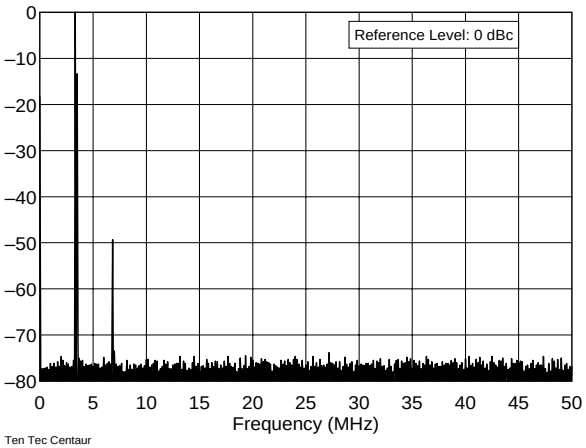
SpectralPurityGraph



Ten Tec Centaur
1.8 MHz Band, Spectral Purity, 600 W
P:\TESTS\CENTAUR\CENTSLO.TXT



Ten Tec Centaur
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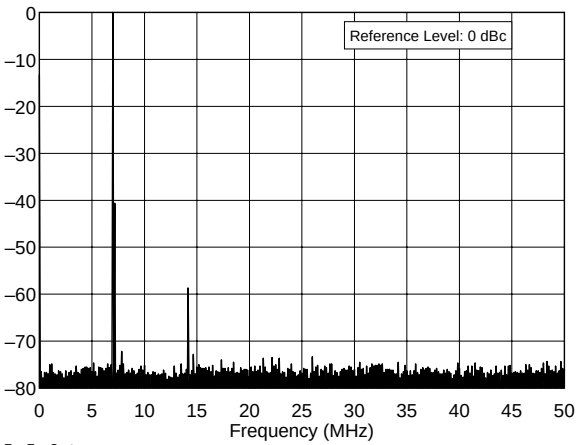

Ten Tec Centaur
7.0 MHz Band, Spectral Purity, 600 W
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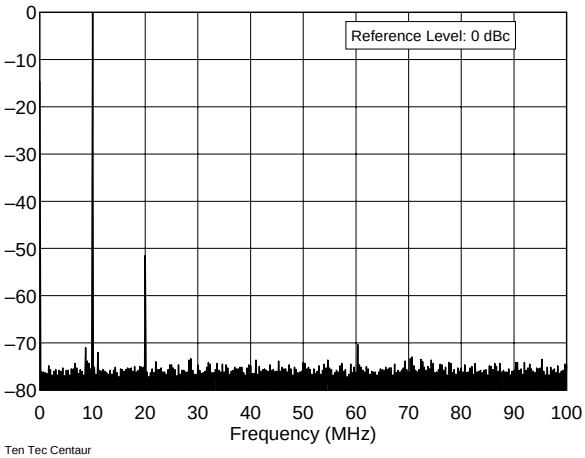

Ten Tec Centaur
10.1 MHz Band, Spectral Purity, 600 W
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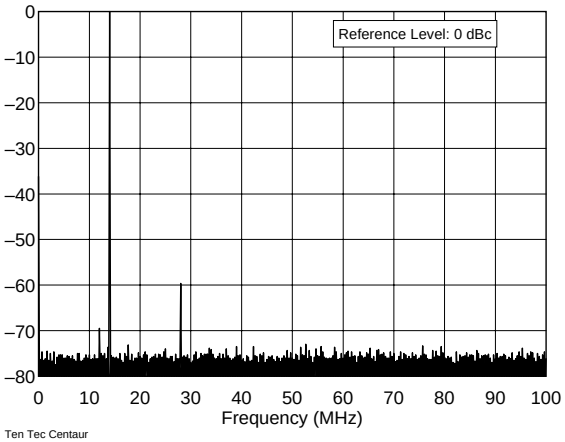

Ten Tec Centaur
14.0 MHz Band, Spectral Purity, 600 W
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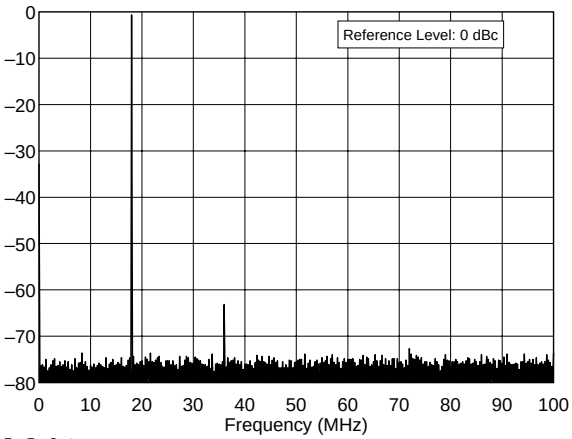

Ten Tec Centaur
18.1 MHz Band, Spectral Purity, 600 W
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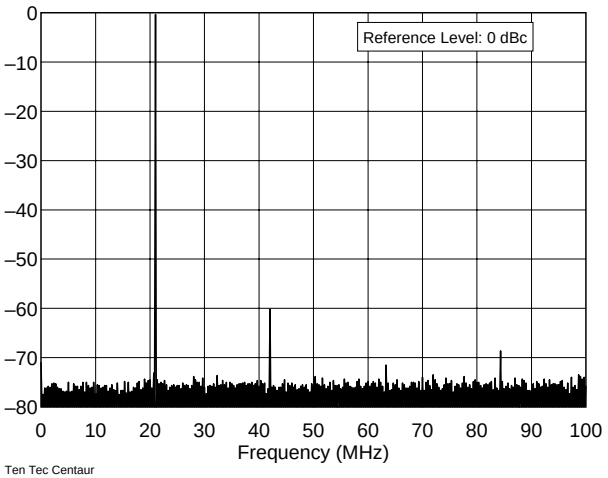

Ten Tec Centaur
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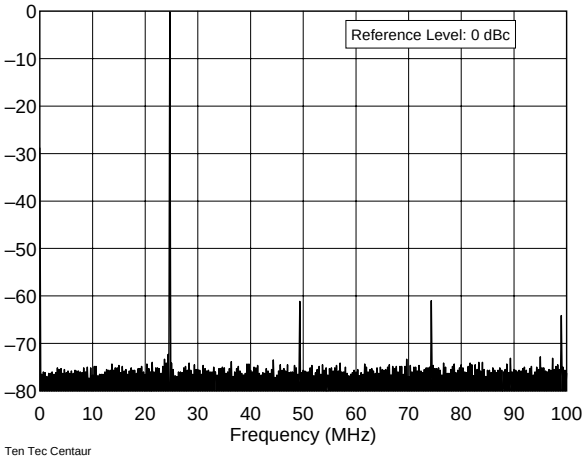

Ten Tec Centaur
24.9 MHz Band, Spectral Purity, 600 W
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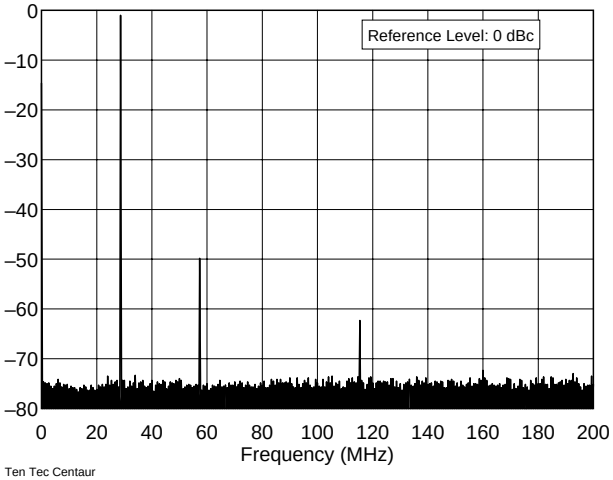

Ten Tec Centaur
28.0 MHz Band, Spectral Purity, 600 W
P:\TESTS\CENTAUR\CENTS10.TXT

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Transmit Two-Tone IMD Test:

Test Description: Investigating the sidebands from a modulated transmitter requires a narrow-band spectrum analysis. In this test, a two-tone test signal is fed into the amplifier. The display shows the two test tones plus some of the IMD products produced by the SSB transmitter. In the ARRL Lab, we use a high-power, hybrid combiner made from coaxial cable. This hybrid combiner combines two 100-watt 14.2 MHz signals, with 3 dB of loss, to produce a two-tone test signal of 200 W PEP.

These frequencies were selected to give a meaningful display of amplifier IMD. The intermodulation products appear on the spectral plot above and below the two tones. The lower the intermodulation products, the better the transmitter. In general, it is the products that are farthest removed from the two tones (typically > 3 kHz away) that cause the most problems. These can cause splatter up and down the band from strong signals.

Key Test Conditions:
Transmitter operated at rated output power. Audio tones and drive level adjusted for best performance. Audio tones 700 and 1900 Hz. Both audio tones adjusted for equal RF output. Level to spectrum analyzer, - 10 dBm nominal, -10 dBm maximum. Resolution bandwidth, 10 Hz

Block Diagram:

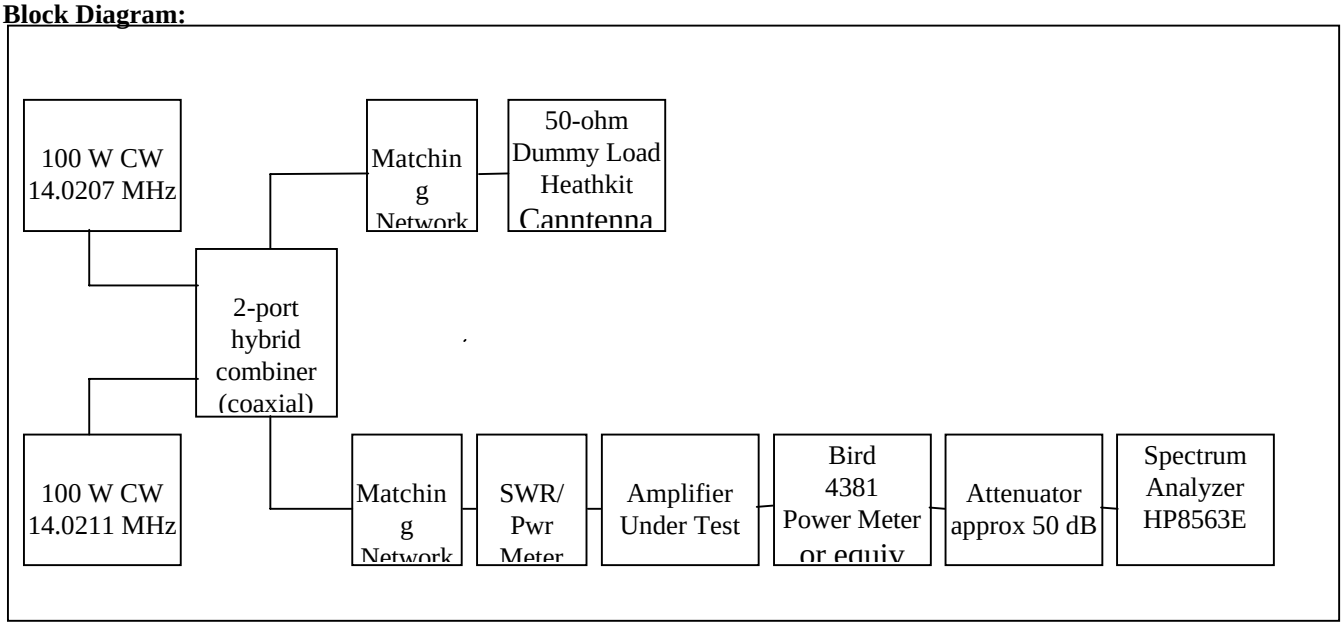

Figure 1 - Transmit Two-Tone Test Block Diagram

Notes:
1. The ARRL Lab's high-power IMD tests are done only on 20 meters. The two-port combiner is capable of operation only on 20 meters. The port-to-port isolation of the two-port coupler is critical to the accuracy of the test results. The baseline test-fixture IMD is about 55 dB below PEP for the third-order products, 65 dB for the fifth-order products and about 70 dB for higher-order products. A detailed setup and calibration procedure is used to ensure this level of isolation for each amplifier tested. This involves adjusting the "dummy load" matching network for maximum isolation when the coupler is terminated into 50 ohms, then adjusting the amplifier matching section for a 50-ohm load when the coupler is terminated into the amplifier under test, which is nominally 50 ohms, but can be significantly different enough that the coupler may not perform as desired unless it is matched.

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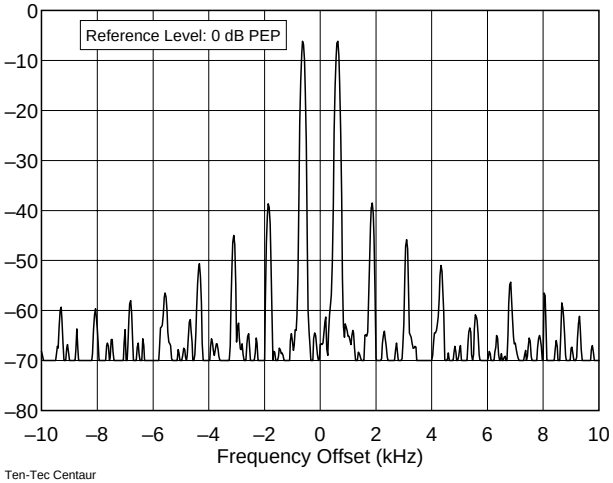
Transmit IMD Graphs



Ten-Tec Centaur
14.020 MHz, Transmit IMD, 605 W / Drive 115 W PEP
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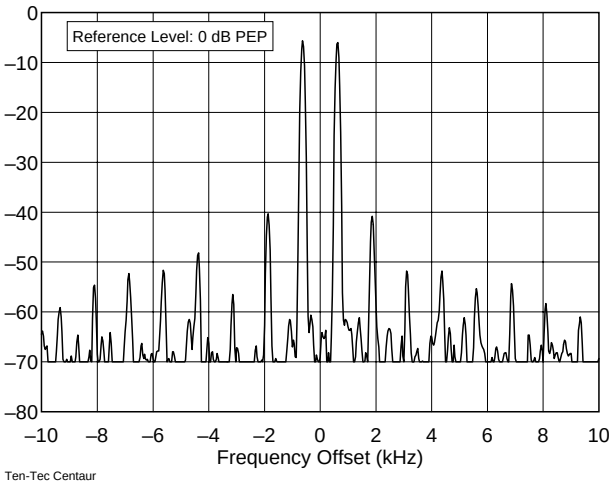

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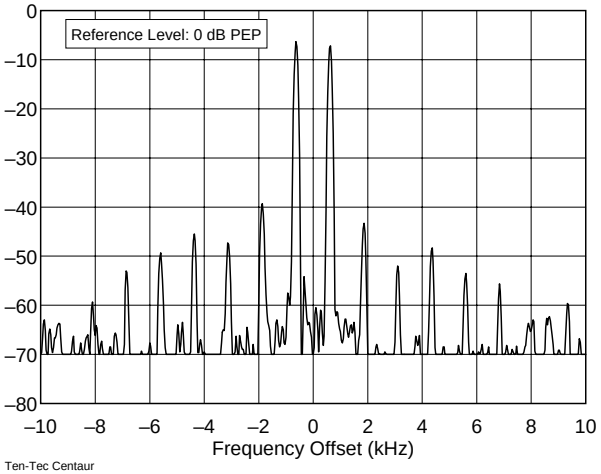

Ten-Tec Centaur
14.020 MHz, Transmit IMD, 300 W / Drive 37 W PEP
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