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Icom America - Downloads

Download Index:

Are you having problems downloading the files listed here? Here's a list of most common reasons:

1) Adobe® Acrobat® Reader is required to open PDF files. You can download the Acrobat® Reader for free from the Adobe® Web site.

2) A PDF file may appear blank at first, if you are opening a PDF file inside your Web browser. Give it some time to download completely.

3) If a PDF file, or an image file, opens inside your Web browser, and you wish to download the file and save it to your disk instead, you can do one of the following:

Apple® Macintosh®/Microsoft® Internet Explorer®: Click and hold on the desired link until a dialog box opens (it takes about 3 seconds). While still holding the mouse button down, drag to and select "Download image to disk". A "save" window will then appear; save the image to wherever you want on your hard drive.

Microsoft® Windows®/Microsoft® Internet Explorer®: Click with a right mouse button on the desired link and select "Save target as" from the pop-up menu. A "save" dialog box will then appear; save the file to your hard drive.

Netscape® Navigator®: Click with a right mouse button on the desired link and select "Save link as" from the pop-up menu. A "save" dialog box will then appear; save the file to your hard drive.

4) A file compression/decompression utility is required to open ZIP files. One of many popular compression utilities is WinZip.

Misc. PDF Documents

Amateur Radio Band Chart, and Grid Square Map

- Band Chart (70 KB PDF)
- Grid Square Map (459 KB PDF)

Adobe® Acrobat® Reader™ is required to open PDF documents

SnapFlash Trunking

- What is SnapFlash (86 KB PDF)

Marine SSB Single Sideband Simplified PDF

- Chapter 1: Introduction from Gordon West
- Chapter 2: Start with a Good VHF Set
- Chapter 3: The Marine SSB Single Sideband Service
- Chapter 4: High Frequency Bouncing Radio Waves
- Chapter 5: Single Sideband Range
- Chapter 6: Band and Channel Selection
- Chapter 7: Equipment Selection and Location
- Chapter 8: Grounding (Counterpoise)
- Chapter 9: Antennas
- Chapter 10: Adding 12 Volts
- Chapter 11: Eliminating Noise Interference
- Chapter 12: Your FCC License
- Chapter 13: Going on the Air
- Chapter 14: Operating Procedures-Distress, Urgency & Safety
- Chapter 15: Using Your SSB for Low-Cost E-mail
- Chapter 16: Review: SSB Channel Designators Explained
- Maritime Radiotelephone Public Correspondence Stations
- International Voice Channel Designators (4-16 MHz)
- SSB Marine Channels
- Weather Fax

Adobe® Acrobat® Reader™ is required to open PDF documents

Multimedia

IC-746PRO

- PowerPoint Presentation (3.06 MB PPT)

IC-756PRO

- PowerPoint Presentation (3207 KB PPT)
- IC-756PRO Flash presentation featured at Dayton 2001 Hamvention (1.28 MB SWF Macromedia Flash)
- IC-756PRO Flash presentation readme

IC-756PROII

- PowerPoint Presentation (2.5 MB PPT)

Miscellaneous

Miscellaneous

- IC-756PRO Advanced Operating Guide (39 KB DOC - MS Word)
- IC-756PROII Technical Report (3MB PDF)
- Ham Radio Terms (85kb PDF)

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Amateur Radios
This is how it all started. Back in the 50's, Icom was a leader in early amateur radio transistor technology. Now watch how Icom leads the way in ham technology with the latest in DSP.

▶SAVE! **Back to the Shack Savings!**

Avionics Radios
Whether you're in the air or on the ground, Icom keeps you in communications. Icom makes the world's best selling handheld navcom radio - the IC-A22. Come see what else we make.

Consumer Radios
Family Radio Service (FRS) radios are taking the country by storm. Icom FRS radios are doing that, and also taking the U.S. Marine Corps by storm, too.

Land Mobile Radios
These rugged, MIL SPEC radios offer a distinct advantage in price and performance. Come see which radio the U.S. Army selected for their soldier intercom.

▶NEW! **Check out our new F43G portable...**

Marine Radios
This has been another impressive year for Icom marine, winning prestigious awards from Powerboat Reports and Practical Sailor, and from NMEA. See our latest award for the industry-dominating IC-M502 fixed mount VHF!

Receivers
Looking for a serious scanning receiver? This is the place. Icom receivers come in all shapes and sizes, but they all have one thing in common... they are simply the best.

News

Jul 6, 2004	Icom America, Inc. Files Rule Changing Petition with FCC
Mar 22, 2004	Icom puts B.I.I.S power in the palm of your hand
Mar 22, 2004	Icom America Systems combines power and price
Mar 22, 2004	Icom's M88 now available in Intrinsically Safe (I.S.) version.
Mar 22, 2004	Icom America, Inc. handheld radios offers a new direction

More news...

Your opinion matters!

What features do you want in a handheld radio? Now's your chance to influence Icom's next generation of Amateur portable radios. Fill out our questionnaire and tell us what you're looking for.

GP360 Chart Plotter

Icom America is currently aware of a problem with the GP360 chart plotter causing the units to remain in sky search mode.

Update: Icom America now has a fix for the GP360. The fix is a firmware update that requires the units to be sent in to Icom America. More..

Warranty Registration

You can now register your new Icom radio online! Just follow this link and fill out the warranty form.

Icom America Systems

There are currently only a handful of communications providers – Kenwood, Motorola and E.F Johnson - capable of providing these systems, making Icom America part of an elite group of Land Mobile solution providers.

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Icom Product Line

Looking for the info about a specific radio? Choose the radio model number from the alphabetical list of all current Icom radios:

Make a selection

Radio Archive

The menu above features the Icom products currently in production. We have a Radio Archive on our Web site where you can look up features and specifications on many of our discontinued radios.

Icom America Technical Support

Welcome to the Icom America technical support area of the Web site. Here you will find frequently asked questions pertaining to the Icom products, tech info from our technical support department, information about discontinued Icom radios, service troubleshooting guides, list of authorized service centers, and more. This page contains general information below, and a list of links to more resources on the left side of this page.

Technical Support by E-Mail

Do you have additional questions not covered in our FAQs? Or need assistance in setting up or operating your Icom radio? You can send e-mail to our Technical Support Department.

Warranty Registration

You can now register your new Icom radio online! All you need is the UPC bar code, the serial number, and 5 minutes to fill out the form! Try it now!

Technical Support by Phone

To reach Icom America's Technical Support-by-Phone please call (425) 454-7619, Monday - Friday, 8:00 AM - 4:30 PM Pacific Time. (Please note: this free support-by-phone service is extremely popular. You may have to wait on hold during peak business hours.)

It is our intention to expedite technical support calls as much as possible. Until the technology improves, we request you do not utilize any of the Internet telephony programs to make technical calls to Icom America Inc. The audio distortion, echoes and slow digital processing of voice does not allow for a productive exchange of information. Please make these calls to Icom America Inc. on a standard telephone set.

Parts and Manuals

To order Icom parts, service manuals, or replacement owners manuals, please contact your local authorized Icom America dealer or call Icom America's Parts Department at (425) 454-7619 Monday - Friday, 8:00 AM-5:00 PM Pacific Time. We accept Visa, MasterCard, American Express, money order, or UPS C.O.D.

Instruction manuals for Icom radios (PDF files) are available for download here.

Repair Service

To check on the status of an Icom radio in for authorized Icom America servicing, please call (425) 454-7619 Monday - Friday, 8:00 AM - 5:00 PM Pacific Time.

To send in an Icom radio for authorized Icom America servicing, make sure to read our shipping instructions and Icom America service center addresses page.

Here's a list of information needed by Icom America Service Centers. You can print this form, fill it out, and ship it with your radio to an authorized Icom America service provider.

Quick Jump

Looking for the info about a specific radio? Choose the radio model number from the alphabetical list of all current Icom radios on our Products page.

Discontinued Icom radios can be found in the Archive.

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I Agree | I Decline

Where to Buy

Locate an authorized Icom America dealer near you

Please select a state and the product division to search:

State All

Products All

Search

Icom FRS Radios, receivers or scanners

Any Icom America dealer is authorized to sell any Icom Family Radio Service (FRS) radio, receiver or scanner. However, not all dealers may stock the item you want. Please call or fax in advance before visiting your dealer of choice.

Icom America Authorized Dealers

If you are one of Icom America authorized dealers and would like your business, home page or e-mail address added to this list, please contact your Icom District Sales Manager. Thank you.

Government Sales

Icom America Inc. sells directly to federal, state and local government agencies. Please click here for more information about Icom government sales.

Wholesale Distributors

Looking for a wholesale distributor?

•Icom America Wholesale Distributors

Canadian Purchasers

Please visit Icom Canada's web site for information about Icom dealers in Canada.

www.icomcanada.com

Dealer Opportunities

Dealer opportunities with Icom America Inc. are available. Find out how to become an authorized dealer for one of the fastest growing radio companies.

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NEW RADIOS

Select a radio from the list below.

AMATEUR: IC-7800 - The Transceiver - HF+6M

The ultimate ham transceiver is now a reality in the Japanese market. Soon coming to the American market. Read more about this amazing new HF + 6M transceiver.

AMATEUR: IC-703 - HF/6 Meter QRP Rig

IC-703 is Icom's product for the QRP enthusiasts. Focusing on QRP performance rather than an all-in-one solution, the IC-703 covers the Amateur Bands 160m to 6m*. Depending on the power supply the rig is capable of 5W @ 9.6VDC and 10W @ 13.8VDC, plus it has an internal antenna tuner. Icom engineers have addressed a lot of the concerns about current consumption and other comments gathered over the past two years regarding QRP performance. While it looks and feels like the IC-706MKIIG, this rig is a QRP version, not a replacement.

Read more about the new IC-703.

*6m is not available depending on version

AMATEUR: IC-2720H - 2m / 70cm Dual Bander

The IC-2720H is a new, advanced 2 M/70 cm mobile dual bander. It features a separate control head with a wide viewing angle display for mobile flexibility, user adjustable brightness controls and selectable amber or green colored display. Two microphone jacks - one on the control head, one on the main unit. Independent tuning, AF and squelch knobs for each band. V/V, U/U, V/U, U/V operation. And much more.

Go to the IC-2720H page.

AVIONICS: IC-A5 & IC-A23 VHF Handhelds

CQ Interview

Here's a PDF document of CQ Magazine's recent interview with Icom Inc. president **Tokuzo Inoue, JA3FA**.

Warranty Registration

You can now register your new Icom radio online! All you need is the UPC bar code, the serial number, and 5 minutes to fill out the form! Try it now!

Upcoming Shows

Here's a calendar of the upcoming trade shows. Catch Icom at the following air shows, boat shows, hamfests, and more.

Special Savings

Don't miss these special savings. Available only for a limited time!

Icom's IC-A23 has been awarded "Best VHF Handheld" by The Aviation Consumer magazine in its Gear of the Year issue, August 2002. The IC-A23 offers VOR navigation and is compact and water resistant to JIS-4 grade. Its sister radio, the IC-A5, is a com only version of the IC-A23. Both radios are easy to operate and feature large, clear LCD displays. Received conversations can be recorded and played back with the built-in voice recorder. With a large capacity rechargeable Ni-MH battery as a standard equipment, you can talk longer than ever before! Icom is the name pilots have come to know and trust. Simply the Best!

Go to the IC-A5 page.

Go to the IC-A23 page.

CONSUMER: IC-F21BR & IC-F21GM

Icom's latest UHF portable radios.

The IC-F21BR offers 3 services in 1 radio: **FRS** (Family Radio Service), **GMRS** (General Mobile Radio Service) and **BRS** (Business Radio Service)!

The IC-F21GM is a perfect choice for family or associates. It offers the **FRS** (Family Radio Service) and **GMRS** (General Mobile Radio Service) in one radio.

LAND MOBILE: IC-FR4000 Repeater

This ultimate repeater is feature rich, offering value without compromise.

50 watts of power and 100% duty cycle; internal space for a duplexer and isolator; DTMF remote capable; 32 channels, Switchable wide/narrow 12.5/25 kHz; and much more.

Go to the IC-FR4000 page.

LAND MOBILE: Icom America Systems

Employment

A chance to work for one of the fastest growing radio companies awaits you. Click here to go to the employment opportunities page.

Press Releases

This section contains the official press releases by Icom America Inc.

Icom America Inc. announces the creation of Icom America Systems, an enterprise of their Land Mobile Division. This enterprise will create high quality "turn key systems" that can be sold and installed by land mobile dealers as innovative solutions for their customers. There are currently only a handful of communications providers – Kenwood, Motorola and E.F Johnson - capable of providing these systems, making Icom America part of an elite group of Land Mobile solution providers.

Read the complete press release here.

Visit the Icom America Systems Web page for more details.

LAND MOBILE: IC-F121/F221 Series Mobiles

Icom IC-F121 series mobiles.

Powerful, rugged and simple to use with advanced capabilities. Available in VHF or UHF versions, and as either simple 8 channel or more advanced 128 channel versions. These mobiles offer power, flexibility, and dependability that can perform in any environment.

Go to the IC-F121 (VHF) page.
Go to the IC-F121S (VHF) page.

Go to the IC-F221 (UHF) page.
Go to the IC-F221S (UHF) page.

LAND MOBILE: IC-F30GT/GS (VHF) and IC-F40GT/GS (UHF)

PC programmable portables.

FM APPROVED

Intrinsically safe version now available

Attention petrochemical industry: Icom's IC-F30G series professional series radios now come in an intrinsically safe version. Contact your authorized Icom dealer today!

Go to the IC-F30GT and the IC-F30GS (VHF) page.

Go to the IC-F40GT and the IC-F40GS (UHF) page.

MARINE: IC-M88 - VHF Marine Transceiver

Icom's new, compact marine VHF is easier to operate and fits more comfortably in the hand.

Nix the bricks! This little marine VHF workhorse is incredibly compact, yet it feels comfortable in the hand. Go up to 24 hours without a recharge*. Built military rugged (MIL SPEC), Icom's IC-M88 is completely submersible and offers a 1700 mAh Li-Ion battery. It's the most powerful, longest lasting Li-ion battery in the industry. The IC-M88 offers a whole slew of options and accessories, from waterproof microphones to full headsets -- great for the commercial mariner! Yet, this radio is as easy to use as any other Icom handheld - which is to say it offers superior one-handed operation - so any recreational boater will appreciate its friendly interface. 5 Watts of power really gets your message out! For ease of use, powerful and long lasting Li-ion battery, and sheer performance, Icom's IC-M88 can't be beat. Compare and you'll see why Icom is best. Simply the best.

* 5% TX, 5% RX, 90% standby

Go to the IC-M88 page.

MARINE: IC-M602 - VHF Marine Transceiver

Icom's new, ULTIMATE marine VHF

For those who insist on the best, Icom proudly announces its new IC-M602. JIS-7 waterproof (submersible); built-in ITU class D DSC, with independent channel 70 watch; standard 4" tall front panel, to easily blend in to your cabin console or dashboard; full key pad, for fast access to all radio functions; built-in, 22 Watt hailer (most powerful in the industry); built-in foghorn, with 4 selectable patterns; large LCD with 7 levels of backlighting; built-in NMEA input/output jack; superior receiver performance; detachable smart-style hand microphone, for easier installation; and much more. Add up to 2 optional COMMANDMIC® remote control microphones and you'll have 3 radio station / intercom points onboard!

Combine the IC-M602 with the new, same sized IC-M802 marine SSB cousin and you'll have the ultimate communications station. They look as good as they perform!

Go to the IC-M602 page.

MARINE: IC-M802 Digital Marine SSB Radio

All new digital SSB with remoteable control head offers the clearest reception ever! The ultimate SSB is very user friendly and easy to install.

Big dials, a large dot-matrix LCD and well spaced buttons make Icom's newest SSB a snap to operate, even in rough seas. A full key pad, over 1300 channels, wide band RX, Ham band TX (license required) and RX included, one-touch e-mail access (a SSB first!) with no optional filters required, front panel headset jack (to keep from waking up the crew), and many more thoughtful features make this remoteable control head SSB Icom's most advanced ever.

Combine the IC-M802 with the new, same sized IC-M602 marine VHF cousin and you'll have the ultimate communications station. They look as good as they perform!

New! 2002's Best of Show award, AND 2002's Best SSB Radio Telephone award given to the IC-M802 by the National Marine Electronics Association (NMEA). The prestigious NMEA award once again goes to Icom (11/02)!

Go to the IC-M802 page.

RECEIVERS: IC-R5 - Compact, Wideband Handheld Receiver

Compact, Wideband Handheld Receiver. Coming soon. Winning Performance.

Get winning performance with Icom's new IC-R5. Crisp, clear audio. Super wide tuning range. A large, easy-to-read LCD display with the visual information you need - like operating status, signal strength, battery indicator, and alphanumeric naming for the 1250 memory channels (including 200 auto-write scan memories, and 25 scan edge pairs). Weather Alert keeps you informed of any weather emergencies. All in a compact, weather resistant package.

Go to the IC-R5 page.

RECEIVERS: IC-R3 Handheld Receiver

Handheld audio/video receiver.

The all new video capable IC-R3! Never before has a handheld receiver given you as much information as the IC-R3. Not only can you see receiver's operating status and spectrum scope, you can display broadcast visual information: TV program, picture from wireless cameras and more. The IC-R3 is great for sporting events, security, Amateur TV, and you can watch your favorite TV program at anytime, anywhere. But, with a frequency coverage of 0.495-2450 MHz**, and AM, FM, WFM modes built-in, the IC-R3 is not your average TV receiver! You've never seen anything like it!

Go to the IC-R3 page.

** U.S. cellular telephone frequencies blocked.

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Icom America Inc.
2380 116th Ave NE
Bellevue, WA 98004

Phone: (425) 454-8155
Fax: (425) 454-1509
Customer Service: (425) 454-7619

Online Technical Support

Are you looking for Icom America's online Technical Support? Just follow the "Support" link at the top navigation bar, or click here.

Technical Support by Phone

To reach Icom America's Technical Support-by-Phone please call (425) 454-7619, Monday - Friday, 8:00 AM - 4:30 PM Pacific Time. (Please note: this free support-by-phone service is extremely popular. You may have to wait on hold during peak business hours.)

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Technical questions, or questions regarding Icom products can be submitted via e-mail to our tech support staff here.

Parts and Manuals

Icom International

Icom, Inc. (Japan)
1-1-32, Kamiminami, Hirano-ku,
Osaka, 547-0003, Japan
Phone: 06 6793 5302
Fax: 06 6793 0013

Icom Canada
150-6165 Highway 17
Delta, B.C., V4K 5B8, Canada
Phone: (604) 952-4266

Icom (Australia) Pty. Ltd.
A.C.N. 006 092 575
290-294 Albert Street
Brunswick, Victoria, 3056, Australia
Phone: 03 9387 0666
Fax: 03 9387 0022

Asia Icom Inc.
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Taipei, Taiwan R.O.C.
Phone: (02) 2559 1899
Fax: (02) 2559 1874

Icom (Europe) GmbH
Himmelgeister Str. 100
D-40225 Düsseldorf, Germany.
Phone: 0211 346047
Fax: 0211 333639

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Crta. de Gracia a Manresa km. 14,750
08190 Sant Cugat Del Valles Barcelona, Spain
Phone: (93) 590 26 70
Fax: (93) 589 04 46
E-mail: icom@lleida.com

Icom (UK) Ltd.
Unit 9, Sea St.
Herne Bay, Kent, CT6 8LD, U.K.
Phone: 01227 741741
Fax: 01227 741742

Icom France S.a
Zac de la Plaine, Rue Brindejonc des Moulinais
BP 5804, 31505 Toulouse Cedex, France
Phone: 561 36 03 03
Fax: 561 36 03 00

To order Icom parts, service manuals, or replacement owners manuals, please contact your local authorized Icom America dealer or call Icom America's Parts Department at (425) 454-7619 Monday - Friday, 8:00 AM-5:00 PM Pacific Time. We accept Visa, MasterCard, American Express, money order, or UPS C.O.D.

Instruction manuals for Icom radios (PDF files) are available for download here.

Repair Service

To check on the status of an Icom radio in for authorized Icom America servicing, please call (425) 454-7619 Monday - Friday, 8:00 AM - 5:00 PM Pacific Time.

To send in an Icom radio for authorized Icom America servicing, make sure to read our shipping instructions, and Icom America Service Center addresses page.

Prices

Icom America Inc. sells mainframes only to authorized Icom America dealers. For the latest in Icom radio and parts prices, please contact an authorized Icom America dealer:

Authorized Icom America dealers

Other

To order free brochures about any current Icom radio, please call (425) 450-6088 at any time.

To contact Icom America's main switchboard, please call (425) 454-8155 Monday through Friday, 8:00 AM to 5:00 PM Pacific Time.

Technical questions, or questions regarding Icom products can be submitted via e-mail to our tech support staff here.

Thank you for using Icom radios!

Financial Information

Icom America, Inc. is listed with Dun & Bradstreet. Dun & Bradstreet maintains the world's largest business database containing information about more than 64 million businesses worldwide including 13 million in the United States.

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Icom America Account Login

E-mail

Password

Login

Forgot your password?

Registering your Icom product requires a few simple steps.

To get started, login to your Icom America account using your e-mail address and password. If you do not have an Icom America account, please create one to continue.

> Create New Account

Icom America, Inc. does not share the information collected with any third parties.

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Government Sales

Icom America Inc. sells directly to federal, state and local government agencies.

Federal Government Sales

To place an order, or to gather more information about specific Icom products, please call our Government Sales Support Desk at (425) 450-6090. You may also send a fax to 425-454-1509 or email gsa@icomamerica.com.

If you are a GSA purchaser and have a question on one of the following: price and availability, status of an order, Icom product information, or if you wish to get a tracking number; please contact our Customer Service Department at (425) 454-8155.

We accept Visa, Master Card or American Express credit cards for purchases.

GSA Ordering Information

GSA Schedule

Address:	Icom America Inc. 2380 116th AVE NE Bellevue, WA 98004
GSA Contract:	GS-35F-0109L expires 12/14/05
Tax ID:	91-1083924
DUNS:	037999331
Cage Code:	62526
CCR Registered:	Yes (Central Contractor Registration)
Business Size:	Large
Freight:	FOB Destination (UPS ground no charge, HI and AK ups blue no charge)
Terms:	3% 15, Net 30 (purchase order) (no terms on credit card orders)
Minimum Order:	Purchase Order = $100.00 new accts (credit card orders = no minimum)
Delivery Schedule:	132-8 Radios and Accessories = 90 days
Larger quantities:	120 days

State and Local Government Sales

If you are a state or a local government purchaser, and have a question on one of the following: price and availability, status of an order, Icom product information, if you wish to place an order, or get a tracking number; please contact our Customer Service Department at (425) 454-8155.

We accept Visa, Master Card or American Express credit cards for purchases.

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Icom Trade Show Calendar

Catch Icom at the following air shows, boat shows, hamfests, and more. Updated through end of February 2005. **PLEASE NOTE**: Events on this page are subject to change without notice. Icom is not responsible for any expenses of any type incurred due to changes, cancellations, or additions to the schedule.

Amateur:

Sept 4-5, 2004
Shelby Hamfest
Shelby, NC

Oct 15-17, 2004
Pacificon
San Ramon, CA

Nov 6-7, 2004
Stone Mountain Hamfest 2003
Lawrenceville, GA

Nov 13-14, 2004
Ft. Wayne Hamfest
Fort Wayne, IN

Dec 4-5, 2004
Tampa Bay Hamfest
Tampa Bay, FL

Feb 5-6, 2005
Miami Tropical Hamboree
Miami, FL

Feb 11-13, 2005
Orlando Hamcation
Orlando, FL

Avionics:

Oct 21-23, 2004
AOPA Expo
Long Beach, CA

Feb 26-27, 2005
N.W. Av. Conference
Puyallup, WA

Land Mobile:

Sept 13-16, 2004
National Guard Assoc of the US
Las Vegas, NV

Oct 6-9, 2004
ITA Wireless
Washington, DC

Oct 21, 2004
Fall Technology Show
Fort Hood, TX

Oct 31-Nov 4, 2004
NAPT Annual Conference & Trade Show
Cincinnati, OH

Nov 13-15, 2004
IACP (Chiefs of Police)
Los Angeles, CA

Nov 30-Dec 2, 2004
Ft. Gordon Annual
Ft. Gordon, GA

Marine:

Sept 15-16, 2004
Henry's Show
Orlando, FL

Sept 16-19, 2004
Newport Boat Show
Newport, RI

Oct 7-11, 2004
U.S. Sailboat Show
Annapolis, MD

Oct 14-17, 2004
U.S. Powerboat Show
Annapolis, MD

Oct 20-23, 2004
NMEA Convention
Sanibel, FL

Oct 25-27, 2004
IBEX
Miami Beach, FL

Oct 28-Nov 1, 2004
Ft. Lauderdale Boat Show
Ft Lauderdale, FL

Nov 7-11, 2004
Marine One
Las Vegas, NV

Nov 11-13, 2004
Pacific Marine Expo
Seattle, WA

Nov 18-20, 2004
Kellog Marine Dealer Trade Show
Ledyard, CT

Dec 1-3, 2004
WorkBoat Show

New Orleans, LA

Jan 1-9, 2005
New York Int'l Boat Show
New York, NY

Jan 14-23, 2005
Seattle Int'l Boat Show
Seattle, WA

Jan 20-23, 2005
Sail America
Philadelphia
Philadelphia, PA

Feb 2-6, 2005
Atlantic City Power Boat Show
Atlantic City, NJ

Feb 3-6, 2005
Strictly Sail Chicago
Chicago, IL

Feb 17-25, 2005
Miami Int'l Boat Show
Miami, FL

Feb 23-27, 2005
West Marine U.
Orlando, FL

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Attn: HR Dept.
Icom America Inc.
2380 116th Ave. NE
Bellevue, WA, 98004
Fax: (425) 454-1509

E-mail:
HR@IcomAmerica.com

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Icom America Inc.

Icom America Inc., con base en Bellevue, Washington, USA, anuncia la apertura de su nueva oficina de apoyo al cliente y ventas en México, ubicada en México D.F. Esta es una demostración de nuestro interes en el mercado Mexicano.

ICOM, uno de los lideres en fabricación de radios de dos vías a nivel mundial, anuncia su nueva linea de portátiles F50/F60 para uso terrestre, sumergible, trabaja en cualquier condición ambiental, cumplen con las especificaciones militares aprobadas en USA, de operación sencillia y con precios muy competitivos.

La nueva serie F de ICOM incluye los modelos: Portátiles IC-F43TR (UHF) y Móviles IC-F621TR(UHF) para uso convencional y troncalizado, asicomo los modelos IC-F121S (VHF) y IC-F221S (UHF) los cuales tienen capacidad para 8 y 128 canales, con pantalla, funciones programables por el usuario, escaneo normal y prioritario, estándares CTCSS / DTCSS y capacidad opcional para sistemas troncalizados.

Con ICOM usted satisface todas sus necesidades de radio comunicación, el portafolio de productos ICOM incluyen los siguientes radios: Terrestre, Aviacion, Marinos, Aficionados, Receptores, Repetidoras y Sistemas Troncalizados.

Para mayor información sobre los productos ICOM, favor de contactar a nuestro representante en México, Ing. Mario Bravo a las oficinas de ICOM en México:

Tel. (555) 547-6814
Fax (555) 547-6818
MarioBravo@icomamerica.com

Gracias por su interés en radios Icom.

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Company Overview

Icom America's parent company, Icom, Inc., was founded in 1954 by Tokuzo Inoue in Osaka, Japan. Icom Incorporated is a publicly held Japanese corporation; its stock is traded on the Tokyo and Osaka Stock Exchange. Icom, Inc. began as an engineering and manufacturing company in the business of designing, engineering, and manufacturing highly advanced, compact solid-state radio equipment for use in the Amateur industry. The company's product line has since expanded to include communications equipment and products based in the Marine, Avionics and Land Mobile industries.

Icom Inc. has sales offices and branch offices all over the world including Australia, Germany, France, United Kingdom, Spain, Canada and of course the U.S. Icom America is Icom Inc.'s largest subsidiary company and is the U.S. distributor. Icom America was incorporated in October of 1979 and has continued to gain market share in each of its five major divisions: Amateur, Aviation, Land Mobile, Marine and Receivers.

Amateur:
Icom is one of three companies who dominate the worldwide amateur radio market. Currently, Icom enjoys a significant market share position in the amateur business, both worldwide and in the U.S. Currently Icom makes amateur radio products for use in long and short-range communications. Icom also makes advanced technology products allowing worldwide communication relayed through space satellites owned by amateur organizations and manufactures a series of short-wave receivers used for hobby, industrial and government applications.

Aviation:
Icom has introduced aircraft handheld, mobile and base radios for use onboard and in field aviation use. These radios are used as primary ground communication as well as ground to air and backup aircraft communication equipment. Icom introduced the first navigation handheld, which also provides navigation information and direction location information. Icom has a current market share in the 50% range.

Land Mobile:
Icom joined the land mobile industry approximately nine years ago. This equipment is used in such areas as fire, public safety activities, as well as security, construction and farming communication. Icom currently supplies the radio system used by the U.S. Army for inter-squad communication known as the Soldier Intercom System.

Marine:
Icom has successfully introduced a series of communications equipment for use in the marine industry. Icom's equipment includes long range, ship-to-shore, side band transceivers for worldwide communications from shipboard operations as well as short range VHF communications equipment. In addition, Icom has produced a series of highly advanced, very compact, handheld transceivers for use in communication on marine vessels as well as between marine vessels and shore-to marine applications. While Icom enjoys significant market share in the industry (top three position) Icom has also won numerous awards for its marine VHF handheld radios as decided and voted by the marine dealers

Independent Dealer Association - NMEA. This is a highly prestigious award and reflects the industry's confidence in Icom handheld technology and quality.

Receivers:
Icom's communication receivers range from a small, pocketsize handheld to top-of-the-line super wide range receivers like the IC-R9000L. Icom also developed the unique receiver in a box (PCR1000) which turns your PC into a receiver. Icom continues to develop and manufacture receivers using new and innovative technology.

Icom America Inc.
2380 116th Ave NE
Bellevue, WA 98004

Phone: (425) 454-8155
Fax: (425) 454-1509
Customer Service: (425) 454-7619

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Date	Title
Jul 6, 2004	Icom America, Inc. Files Rule Changing Petition with FCC
Mar 22, 2004	Icom puts B.I.I.S power in the palm of your hand
Mar 22, 2004	Icom America Systems combines power and price
Mar 22, 2004	Icom's M88 now available in Intrinsically Safe (I.S.) version.
Mar 22, 2004	Icom America, Inc. handheld radios offers a new direction
Mar 22, 2004	Icom brings back the walkie talkie
Mar 22, 2004	Icom puts advanced high-frequency communication where you need it most
Mar 22, 2004	Icom America, Inc. Announces new GSA Customer Service Specialist
Mar 10, 2004	Icom America, Inc. promotes internal staffers to Regional Sales Managers
Mar 10, 2004	Icom America, Inc. announces new district sales manager for Upper Midwest.
Feb 1, 2004	Icom Amateur Radios to Keep Subaru Challenge Team in Contact During 2004 Alcan Winter Rally
Jan 21, 2004	EchoLink® over D-STAR allows VoIP Amateur Radio. Another Amateur Radio first by Icom!

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Icom America - Downloads - Instruction Manuals

Please note that this page contains a complete list of all available Icom instruction manuals in PDF format. Instruction manuals for radios other than those listed above are not available as PDF files.

Amateur Radios Instruction Manuals

- AG-2400
- IC-207H
- IC-208H
- IC-2100H
  - IC-2100H Manual Addendum
- IC-2200H
- IC-2720H
  - IC-2720H Manual Addendum
- IC-2800H
- IC-2GXAT
- IC-2SA / IC-3SA
- IC-703
  - IC-703 60m Addendum
- IC-706MKIIG
- IC-718
- IC-746
  - IC-746 Manual Addendum
  - IC-746 Manual Erratum
- IC-746PRO
- IC-751
- IC-756
- IC-756PRO
- IC-756PROII (Updated 10/30/2003)
- IC-775DSP
- IC-775DSP maintenance manual
- IC-78
- IC-7800
- IC-910H
- IC-PW1
- IC-Q7A
- IC-T2H
- IC-T7H
- IC-T22A
- IC-T81A
- IC-T90A
- IC-V8
- IC-V8000
- IC-W2A
- IC-W32A
- ID-1
- PS-125

Marine Radios Instruction Manuals

- FP-561
- IC-GM1500
- IC-M1
- IC-M1V
- IC-M2A
- IC-M3A
- IC-M32
- IC-M15
- IC-M127
- IC-M302
- IC-M402 / IC-M402S
- IC-M402A / IC-M402SA
- IC-M45A
- IC-M502
- IC-M502A
- IC-M56
- IC-M57
- IC-M59
- IC-M602
- IC-M80
- IC-M88
- IC-M700PRO
- IC-M710
- IC-M710RT
- IC-M802
- MR-570R

Receivers Instruction Manuals

- IC-PCR100
- IC-PCR1000
- IC-R2
- IC-R3
- IC-R5
- IC-R5 Hot 100 SWL List
- IC-R10
- IC-R20
- IC-R75
- IC-R8500
- IC-R9000L

Avionics Radios Instruction Manuals

- IC-A3
- IC-A4 Ver01
- IC-A4 Ver02
- IC-A5
- IC-A22
- IC-A23
- IC-A110
- IC-A200

Family Radio Service / General Mobile Radio Service (FRS / GMRS) Instruction Manuals

- IC-4088A.pdf

Land Mobile Radios Instruction Manuals

- IC-F3GT and IC-F3GS
- IC-F3/S and IC-F4/S
- IC-F4GT and IC-F4GS
- IC-F4TR
- IC-F11BR and IC-F21BR
- IC-F21
- IC-F21GM
- IC-F21S
- IC-F30GT and IC-F30GS
- IC-F40GT and IC-F40GS
- IC-F30LT and IC-F40LT
- IC-F121 and IC-F221
- IC-F121S and IC-F221S
- IC-F310 / IC-F320 / IC-F410 / IC-F420
- IC-F310S / IC-F320S / IC-F410S / IC-F420S
- IC-F50 / IC-F60
- IC-F510 / IC-F520 / IC-F610 / IC-F620
- IC-F621
- IC-F1020
- IC-F2020
- IC-F1500 and IC-F2500
- IC-V220 and IC-U220

Options and Accessories Instruction Manuals

- AH-4
- AT-130
- AT-140
- AT-180
- BC-137
- BC-143
- BC-143 & BC-144
- BC-146
- HM-127
- RS-R75
- UT-111
- UX-120
- UX-R9000

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Amateur Radios Brochures

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- IC-2200H
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- IC-703
- IC-706MKIIG
- IC-718
- IC-746
- IC-746PRO
- IC-756PRO
- IC-756PROII
- IC-775DSP
- IC-78
- IC-781
- IC-7800
- IC-821H
- IC-910H
- IC-Q7A
- IC-T2H
- IC-T2H Sport
- IC-T7H
- IC-T22A
- IC-T81A
- IC-T90A
- IC-V8
- IC-V8000
- IC-W32A
- ID-1

Avionics Radios Brochures

- IC-A3
- IC-A4
- IC-A4 Sport
- IC-A5
- IC-A22
- IC-A22 Sport
- IC-A23
- IC-A110

Marine Radios Brochures

- IC-F1020M
- IC-GM1500
- IC-M1V
- IC-M2A
- IC-M3A
- IC-M32
- IC-M15
- IC-M127
- IC-M302
- IC-M402
- IC-M402S
- IC-M45
- IC-M502
- IC-M602
- IC-M700PRO
- IC-M710
- IC-M88
- IC-M88 IS
- IC-M802
- MR-570R

Receivers Brochures

- IC-PCR100
- IC-PCR1000
- IC-R2
- IC-R3
- IC-R5
- IC-R10
- IC-R20
- IC-R20 (Spanish)
- IC-R75
- IC-R8500
- IC-R9000L

FRS/GMRS/BRS

- IC-4088A
- IC-4008M
- IC-F21BR
- IC-F21GM

- IC-A200
- IC-A200B and IC-A200M

Land Mobile Radios Brochures

- IC-F3GT and IC-F3GS
- IC-F3
- IC-F3S
- IC-F4
- IC-F4S
- IC-F4GT and IC-F4GS
- IC-F4TR
- IC-F43TR
- IC-F11 and IC-F21
- IC-F11 and IC-F21 (Spanish)
- IC-F11S and IC-F21S
- IC-F30GT and IC-F30GS
- IC-F40GT and IC-F40GS
- IC-F43GT and IC-F43GS
- IC-F43GT and IC-F43GS (Spanish)
- IC-F121 and IC-F221
- IC-F121 and IC-F221 (Spanish)
- IC-F121S and IC-F221S
- IC-F121S and IC-F221S (Spanish)
- IC-F320 and IC-F420
- IC-F320S and IC-F420S
- IC-F50 and IC-F60
- IC-F50 and IC-F60 (Spanish)
- IC-F520 and IC-F620
- IC-F521 and IC-F621
- IC-F620TR and IC-F621TR
- IC-F1020
- IC-F2020
- IC-FR3000 and IC-FR4000
- IC-FR3000 and IC-FR4000 (Spanish)
- IC-F7000
- IC-F7000 (Spanish)
- Soldier Intercom

Options and Accessories Brochures

- AH-4
- AT-130
- IC-PW1

Catalogs

- Amateur Catalog
- Avionics Catalog
- LandMobile Catalog
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- The most popular compression utility for Windows, with more than 125 million downloads
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- Easy-to-use AES encryption to protect your sensitive data
- Flexible user interface: the intuitive WinZip Wizard for first-time users and the award-winning WinZip Classic interface for power users

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Note: On August 26, 2004 WinZip Computing released **WinZip 9.0 SR-1**, a maintenance release of WinZip 9.0 containing important security-related fixes and improvements. More...

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Other WinZip Products

WinZip Self-Extractor
Easily create native Windows self-extracting Zip files. More...

WinZip Command Line Support Add-On
Use WinZip directly from the command prompt and scripts. More...

WinZip E-Mail Attachment Add-On for Outlook Beta
Automatically zip your attachments to Microsoft® Outlook e-mail messages. More...

Ø = Zero; "I." = Island; "Is." = Islands

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1AØ	Sov. Mil. Order of Malta	C8-C9	Mozambique	H4	Solomon Is.	OJØ	Market Reef	VK9L	Lord Howe I.
1S, 9MØ	Spratly Is.	CA-CE	Chile	H4Ø	Temotu Province	OK-OL	Czech Republic	VK9M	Mellish Reef
3A	Monaco	CEØX	San Felix & San Ambrosio Is.	HA	Hungary	OM	Slovak Republic	VK9N	Norfolk I.
3B6, 3B7	Agalega & St. Brandon Is.	CEØY	Easter I.	HB	Switzerland	ON-OT	Belgium	VK9W	Willis I.
3B8	Mauritius	CEØZ	Juan Fernandez Is.	HBØ	Liechtenstein	OX	Greenland	VK9X	Christmas I.
3B9	Rodriguez I.	CE9	Antarctica	HC-HD	Ecuador	OY	Faroe Is.	VO	Canada
3C	Equatorial Guinea	CM	Cuba	HC8-HD8	Galapagos Is.	OZ	Denmark	VP2E	Anguilla
3CØ	Annobon I.	CN	Morocco	HFØ	South Shetland Is.	P2	Papua New Guinea	VP2M	Montserrat
3D2	Fiji Is.	CO	Cuba	HG	Hungary	P4	Aruba	VP2V	British Virgin Is.
3D2	Rotuma I.	CP	Bolivia	HH	Haiti	P5	North Korea	VP5	Turks & Caicos Is.
3D2	Conway Reef	CT	Portugal	HI	Dominican Republic	PA-PI	Netherlands	VP6	Pitcairn I.
3DA	Swaziland	CT3	Madeira Is.	HJ-HK	Colombia	PJ2, PJ4	Bonaire, Curacao	VP8	Antarctica
3V	Tunisia	CU	Azores	HKØ	San Andres & Providencia	PJ5-PJ8	St. Maarten, Saba, St. Eustatius	VP8	Falkland Is.
3W	Vietnam	CV-CX	Uruguay	HKØ	Malpelo I.	PJ9	Netherlands Antilles	VP8	South Georgia I.
3X	Guinea	CYØ	Sable I.	HL	South Korea	PP-PY	Brazil	VP8	South Shetland Is.
3Y	Bouvet I.	CY9	St. Paul I.	HO-HP	Panama	PPØ-PYØF	Fernando de Noronha	VP8	South Orkney Is.
3Y	Peter I I.	D2, D3	Angola	HQ-HR	Honduras	PPØ, PYØS	St. Peter & St. Paul Rocks	VP8	South Sandwich Is.
4J-4K	Azerbaijan	D4	Cape Verde	HS, E2	Thailand	PPØ, PYØT	Trindade I. & Martim Vaz Is.	VP9	Bermuda
4L	Georgia	D6	Comoros	HV	Vatican	PZ	Surinam	VQ9	Chagos Is.
4P-4S	Sri Lanka	DA-DL	Germany	HZ	Saudi Arabia	RA-RZ	European Russia	VS6	Hong Kong
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4U_ITU	ITU Headquarters	E2	Thailand	ISØ, IMØ	Sardinia	R1FJ	Franz Josef Land	VU	Laccadive Is.
4W	Timor-Leste	E3	Eritrea	J2	Djibouti	R1MV	Malyj Vysotskij I.	VU	India
4X, 4Z	Israel	E4	Palestine	J3	Grenada	SØ	Western Sahara	VY	Canada
5A	Libya	EA-EH	Spain	J5	Guinea-Bissau	S2	Bangladesh	W	USA
5B	Cyprus	EA6-EH6	Balearic Is.	J6	St. Lucia	S5	Slovenia	XA-XI	Mexico
5H-5I	Tanzania	EA8-EH8	Canary Is.	J7	Dominica	S7	Seychelles	XA4-XI4	Revilla Gigedo
5N-5O	Nigeria	EA9-EH9	Ceuta & Melilla	J8	St. Vincent	S9	Sao Tome & Principe	XT	Burkina Faso
5R-5S	Madagascar	EI-EJ	Ireland	JA-JS	Japan	SA-SM	Sweden	XU	Cambodia
5T	Mauritania	EK	Armenia	JD1	Minami-Torishima	SN-SR	Poland	XV	Vietnam
5U	Niger	EL	Liberia	JD1	Ogasawara	ST	Sudan	XW	Laos
5V	Togo	EM-EO	Ukraine	JT-JV	Mongolia	SU	Egypt	XX9	Macao
5W	Western Samoa	EP-EQ	Iran	JW	Svalbard	SV/A	Mount Athos	XY-XZ	Myanmar
5X	Uganda	ER	Moldova	JX	Jan Mayen	SV-SZ	Greece	YA	Afghanistan
5Y-5Z	Kenya	ES	Estonia	JY	Jordan	SV5	Dodecanese	YB-YH	Indonesia
6V-6W	Senegal	ET	Ethiopia	K	U.S.A.	SV9	Crete	YI	Iraq
6Y	Jamaica	EU-EW	Belarus	KC4	Antarctica	T2	Tuvalu	YJ	Vanuatu
7O	Yemen	EX	Kyrgzstan	KC6	Palau	T3Ø	West Kiribati Is.	YK	Syria
7P	Lesotho	EY	Tajikistan	KG4	Guantanamo Bay	T31	Central Kiribati Is.	YL	Latvia
7Q	Malawi	EZ	Turkmenistan	KHØ	Marianas Is.	T32	East Kiribati Is.	YN	Nicaragua
7T-7Y	Algeria	F	France	KH1	Baker & Howland Is.	T33	Banaba I.	YO-YR	Romania
8P	Barbados	FG	Guadeloupe	KH2	Guam	T5	Somalia	YS	El Salvador
8Q	Maldive Is.	FH	Mayotte	KH3	Johnston I.	T7	San Marino	YT-YU	Serbia & Montenegro
8R	Guyana	FJ	Saint Martin	KH4	Midway I.	T8	Palau	YU3	Slovenia
9A	Croatia	FK	New Caledonia	KH5	Palymra & Jarvis Is.	T9	Bosnia-Herzegovina	YV-YY	Venezuela
9G	Ghana	FK/C	Chesterfield Is.	KH5K	Kingman Reef	TA-TC	Turkey	YVØ	Aves I.
9H	Malta	FM	Martinique	KH6-KH7	Hawaii	TD	Guatemala	YZ	Serbia & Montenegro
9I, 9J	Zambia	FO	Austral I.	KH7K	Kure I.	TE	Costa Rica	Z2	Zimbabwe
9K	Kuwait	FO	Clipperton I.	KH8	American Samoa	TF	Iceland	Z3	Macedonia
9L	Sierra Leone	FO	French Polynesia	KH9	Wake I.	TG	Guatemala	ZA	Albania
9MØ	Spratly Is.	FO	Marquesas I.	KL7	Alaska	TI	Costa Rica	ZB2	Gibraltar
9M2, 9M4	West Malaysia	FP	St. Pierre & Miquelon	KP1	Navassa I.	TI9	Cocos I.	ZC4	UK Sov. Base on Cyprus
9M6, 9M8	East Malaysia	FR	Reunion I.	KP2	Virgin Is.	TJ	Cameroon	ZD7	St. Helena I.
9N	Nepal	FR/E	Europa Is.	KP3-KP4	Puerto Rico	TK	Corsica	ZD8	Ascension I.
9Q-9T	Democratic Rep. of Congo	FR/G	Glorioso Is.	KP5	Desecheo I.	TL	Central African Republic	ZD9	Tristan da Cunha & Gough Is.
9U	Burundi	FR/J	Juan de Nova Is.	LA-LN	Norway	TN	Congo	ZF	Cayman Is.
9V	Singapore	FR/T	Tromelin I.	LO-LW	Argentina	TR	Gabon	ZK1	South Cook Is.
9X	Rwanda	FS	Saint Martin	LU	South Georgia I.	TT	Chad	ZK1	North Cook Is.
9Y-9Z	Trinidad & Tobago	FT5W	Crozet Is.	LU	South Shetland Is.	TU	Ivory Coast	ZK2	Niue
A2	Botswana	FT5X	Kerguelen Is.	LU	South Orkney Is.	TY	Benin	ZK3	Tokelau Is.
A3	Tonga	FT5Z	Amsterdam & St. Paul Is.	LU	South Sandwich Is.	TZ	Mali	ZL-ZM	New Zealand
A4	Oman	FW	Wallis & Futuna Is.	LX	Luxembourg	UA2	Kaliningrad	ZL7	Chatham Is.
A5	Bhutan	FY	French Guiana	LY	Lithuania	UJ-UM	Uzbekistan	ZL8	Kermadec Is.
A6	United Arab Emirates	G	England	LZ	Bulgaria	UN-UQ	Kazakhstan	ZL9	Auckland & Campbell Is.
A7	Qatar	GC	Wales	M	England	UR-UZ	Ukraine	ZP	Paraguay
A9	Bahrain	GD	Isle of Man	MD	Isle of Man	V2	Antigua & Barbuda	ZR-ZU	South Africa
AA-AK	USA	GH	Jersey	MI	Northern Ireland	V3	Belize	ZS8	Prince Edward & Marion Is.
AP-AS	Pakistan	GI	Northern Ireland	MJ	Jersey	V4	St. Kitts & Nevis		
BS7	Scarborough Reef	GJ	Jersey	MM	Scotland	V5	Namibia		
BT	China	GM	Scotland	MU	Guernsey	V6	Micronesia		
BV	Taiwan	GN	Northern Ireland	MW	Wales	V7	Marshall Is.		
BV9P	Pratas I.	GP	Guernsey	N	USA	V8	Brunei, Darussalam		
BY	China	GS	Scotland	OA-OC	Peru	VE	Canada		
C2	Nauru	GT	Isle of Man	OD	Lebanon	VK	Australia		
C3	Andorra	GU	Guernsey	OE	Austria	VKØ	Heard I.		
C5	The Gambia	GW	Wales	OF-OI	Finland	VKØ	Macquarie I.		
C6	Bahamas	GX	England	OHØ	Aland Is.	VK9C	Cocos (Keeling) Is.		

BAND PLAN FREQUENCY ASSIGNMENTS

23-cm, 1240-1300 MHz ARRL Band Plan

MHz	Use
1240-1246	ATV #1
1246-1248	Narrow-bandwidth FM point-to-point links and digital, duplex with 1258-1260 MHz
1248-1252	Digital communications
1252-1258	ATV #2
1258-1260	Narrow-bandwidth FM point-to-point links and digital, duplexed with 1246-1252 MHz
1260-1270	Satellite uplinks
1260-1270	Wide-bandwidth experimental, simplex ATV
1270-1276	Repeater inputs, FM and linear, paired with 1282-1288 MHz, 239 pairs every 25 kHz, e.g., 1270.025, 1270.050, 1270.075, etc., 1271.0-1238.0 MHz uncoordinated test pair
1276-1282	ATV #3
1282-1288	Repeater outputs, paired with 1270-1276 MHz
1288-1294	Wide-bandwidth experimental, simplex ATV
1294-1295	Narrow-bandwidth FM simplex services, 25 kHz channels
1294.5	National FM simplex calling frequency
1295-1297	Narrow bandwidth weak-signal communications (no FM)
1295.0-1295.8	SSTV, FAX, ACSB, experimental
1295.8-1296.0	Reserved for EME, CW expansion
1296.0-1296.05	EME exclusive
1296.07-1296.08	CW beacons
1296.1	CW, SSB calling frequency
1296.4-1296.6	Crossband linear translator input
1296.6-1296.8	Crossband linear translator output
1296.8-1297.0	Experimental beacons (exclusive)
1297-1300	Digital communications

ARRL 70-cm Wavelength Band Plan, 420-450 MHz

MHz	Use
420.00-426.00	ATV repeater or simplex with 421.25 MHz video carrier control links and experimental
426.00-432.00	ATV simplex with 427.250 MHz video carrier frequency
432.00-432.08	EME (Earth-Moon-Earth)
432.08-432.10	Weak-signal CW
432.100	70 cm CW/SSB calling frequency
432.10-433.00	Mixed-mode and weak-signal work
432.30-432.40	New beacon band
433.00-435.00	Auxiliary/repeater links
435.00-438.00	Satellite only uplink/downlink
438.00-444.00	ATV repeater input with 439.250 MHz video carrier frequency and repeater links
442.00-445.00	Repeater inputs and outputs (local option)
445.00-447.00	Shared by auxiliary and control links, repeaters and simplex (local option); 446.00 MHz national simplex frequency
447.00-450.00	Repeater inputs and outputs

ARRL 33-cm Wavelength Band Plan, 902-928 MHz

MHz	Use
902-904	Narrow-bandwidth, weak-signal communications
902.0-902.8	SSTV, FAX, ACSB, experimental
902.8-903.0	Reserved for EME, CW expansion
903.0-903.05	EME exclusive
903.07-903.08	CW beacons
903.1	CW, SSB calling frequency
903.4-903.6	Crossband linear translator inputs
903.6-903.8	Crossband linear translator outputs
903.8-904.0	Experimental beacons exclusive

ARRL 33-cm Wavelength Band Plan, 902-928 MHz (cont.)

MHz	Use
904-906	Digital communications
906-907	Narrow bandwidth FM-simplex services, 25 kHz channels
906.50	National simplex frequency
907-910	FM repeater inputs paired with 919-922 MHz; 119 pairs every 25 kHz; e.g., 907.025, 907.050, 907.075, etc., 908-920 MHz uncoordinated pair
910-916	ATV
916-918	Digital communications
918-919	Narrow-bandwidth, FM control links and remote bases
919-922	FM repeater outputs, paired with 907-910 MHz
922-928	Wide-bandwidth experimental, simplex ATV, Spread Spectrum

ARRL 2 Meter Wavelength Band Plan, 144-148 MHz

MHz	Use
144.00-144.05	EME (CW)
144.275-144.300	Propagation beacons
144.06-144.10	General CW and weak signals
144.10-144.20	EME and weak-signal SSB
144.200	National SSB calling frequency
144.200-144.275	General SSB operation, upper sideband
144.275-144.300	Beacon band
144.30-144.50	OSCAR subband plus simplex
144.50-144.60	Linear translator outputs
144.60-144.90	FM repeater inputs
144.90-145.10	Weak signal and FM simplex
145.10-145.20	Linear translator outputs plus packet
145.20-145.50	FM repeater outputs
145.50-145.80	Miscellaneous and experimental modes
145.80-146.00	OSCAR subband – satellite use only!
146.01-146.37	Repeater inputs
146.40-146.58	Simplex
146.61-146.97	Repeater outputs

ARRL 2 Meter Wavelength Band Plan, 144-148 MHz (cont.)

MHz	Use
147.00-147.39	Repeater outputs
147.42-147.57	Simplex
147.60-147.99	Repeater inputs

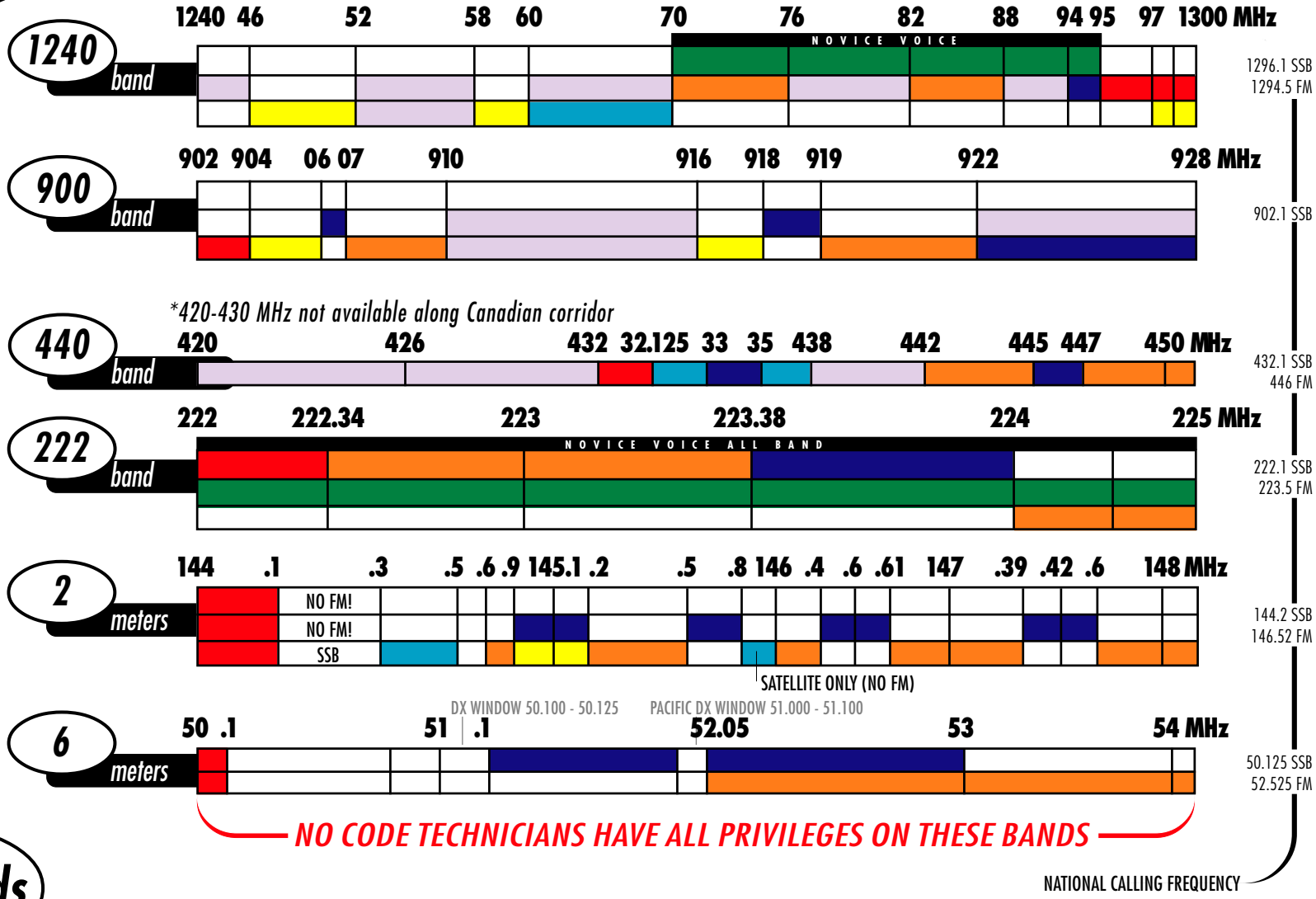
ARRL 6 Meter Wavelength Band Plan, 50.0-54.0 MHz

MHz	Use
50.000-50.100	CW and beacons
50.060-50.080	U.S. beacons
50.100-50.600	SSB
50.125	SSB DX calling frequency
50.200	SSB domestic calling frequency (Note: Suggest QSY up for local & down for long-distance QSOs)
50.400	AM calling frequency
50.600-51.000	Experimental and special modes
50.700	RTTY calling frequency
50.800-50.980	Radio Control (R/C) channels, 10 channels spaced 20 kHz apart (new)
51.000-51.100	Pacific DX window
51.000-52.000	Newly authorized FM repeater allocation
51.100-52.000	FM simplex
52.000-52.050	Pacific DX window
52.000-53.000	FM repeater and simplex
53.000-54.000	Present radio control (R/C) channels, 10 channels spaced 100 kHz apart

SOUTHERN CALIFORNIA REGIONAL NOTE: Southern California, plus other major metropolitan cities throughout the country, may adopt local 2 Meter band plans slightly different than what appears here. See your local Icom dealer for more local details.

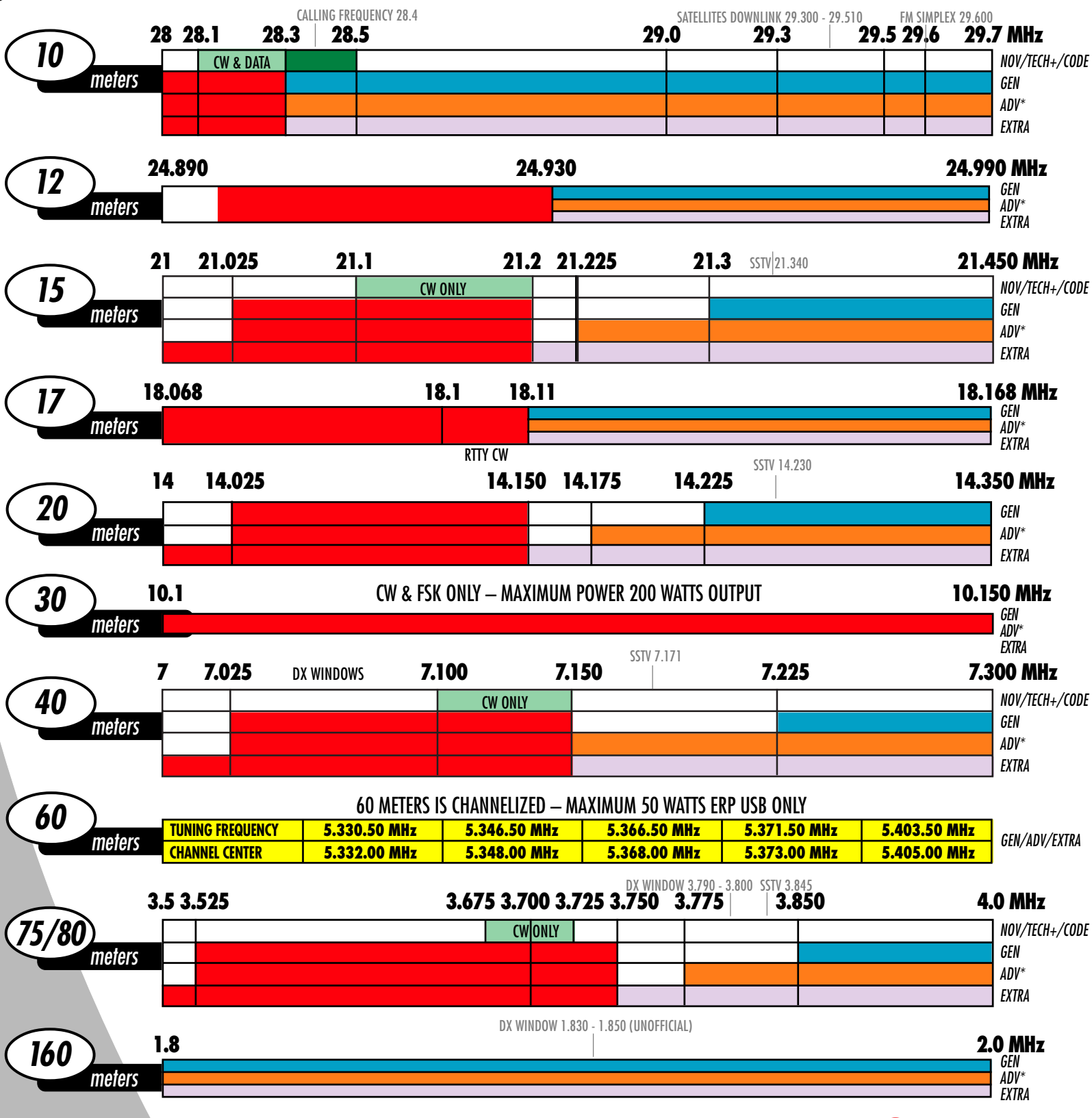
AMATEUR RADIO BAND PLAN

UHF/VHF



NOVICE VOICE AND DATA*
AMATEUR TELEVISION FAST SCAN
SATELLITE (NO FM)
CW AND WEAK SIGNAL (NO FM)
DIGITAL
FM SIMPLEX
SSB
FM REPEATER

HF Bands



NOVICE/TECHNICIAN W/CODE, CW*
NOVICE/TECHNICIAN PLUS, VOICE*
GENERAL VOICE, CW, SSTV, FAX
ADVANCED VOICE, CW, SSTV, FAX*
EXTRA VOICE, CW, SSTV, FAX
CW, FSK
NO PRIVILEGES

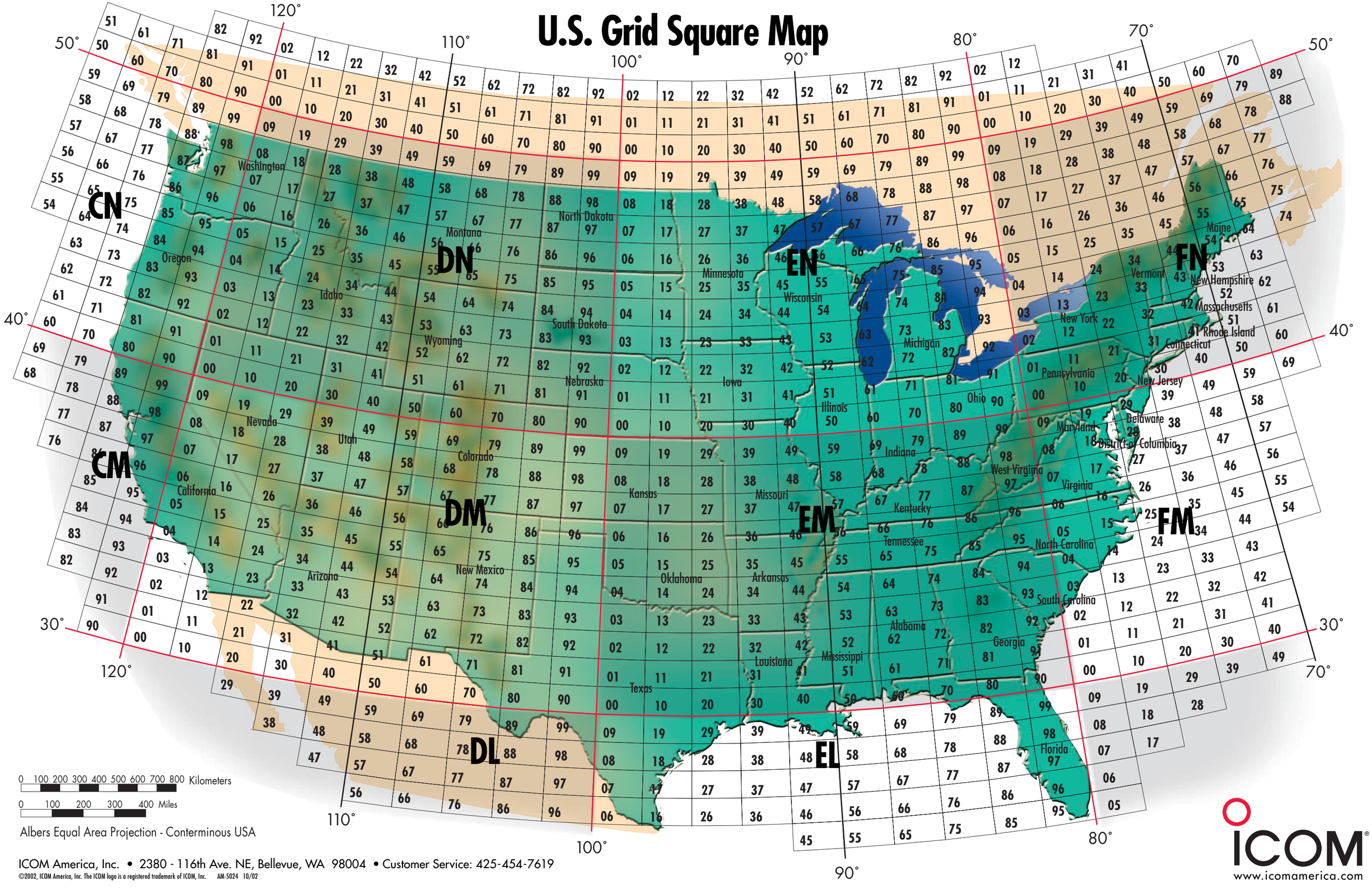
*Grandfathered

All old & new license classes retain their operating privileges after April 15, 2000.

Developed by Gordon West, WB6NOA, RADIO SCHOOL, INC., for exclusive use by Icom America Inc.

ICOM®

U.S. Grid Square Map



Albers Equal Area Projection - Conterminous USA

ICOM America, Inc. • 2380 - 116th Ave. NE, Bellevue, WA 98004 • Customer Service: 425-454-7619

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www.icomamerica.com

U.S. Grid Square Map

Major VHF/UHF Contests

Mid January, Full Weekend
ARRL VHF Sweepstakes

Early March, Full Weekend
ARRL International DX Contest Phone

Early April, Spring Sprint–144 MHz

Early April, Spring Sprint–222 MHz

Early April, Spring Sprint–432 MHz

Early May, Spring Sprint–50 MHz

Mid May, Full Weekend
CQ National Fox Hunting Weekend

Early June, Full Weekend
ARRL VHF QSO Party

Mid June, Full Weekend,
SMIRK 6 meter QSO Party

Mid/Late June, Full Weekend
ARRL Field Day

Mid July,
CQ World Wide VHF Contest

Mid July, Full Weekend
IARU HF World Championships

Early August, Full Weekend
ARRL UHF Contest

Mid September, Full Weekend
ARRL September VHF QSO Party

Courtesy: ***CQ Magazine & ARRL***

ICOM Grid Square Tips:

1. Say your grid square location when operating on VHF & UHF bands.

2. Many portable GPS receivers can read out Maidenhead* grid squares automatically.

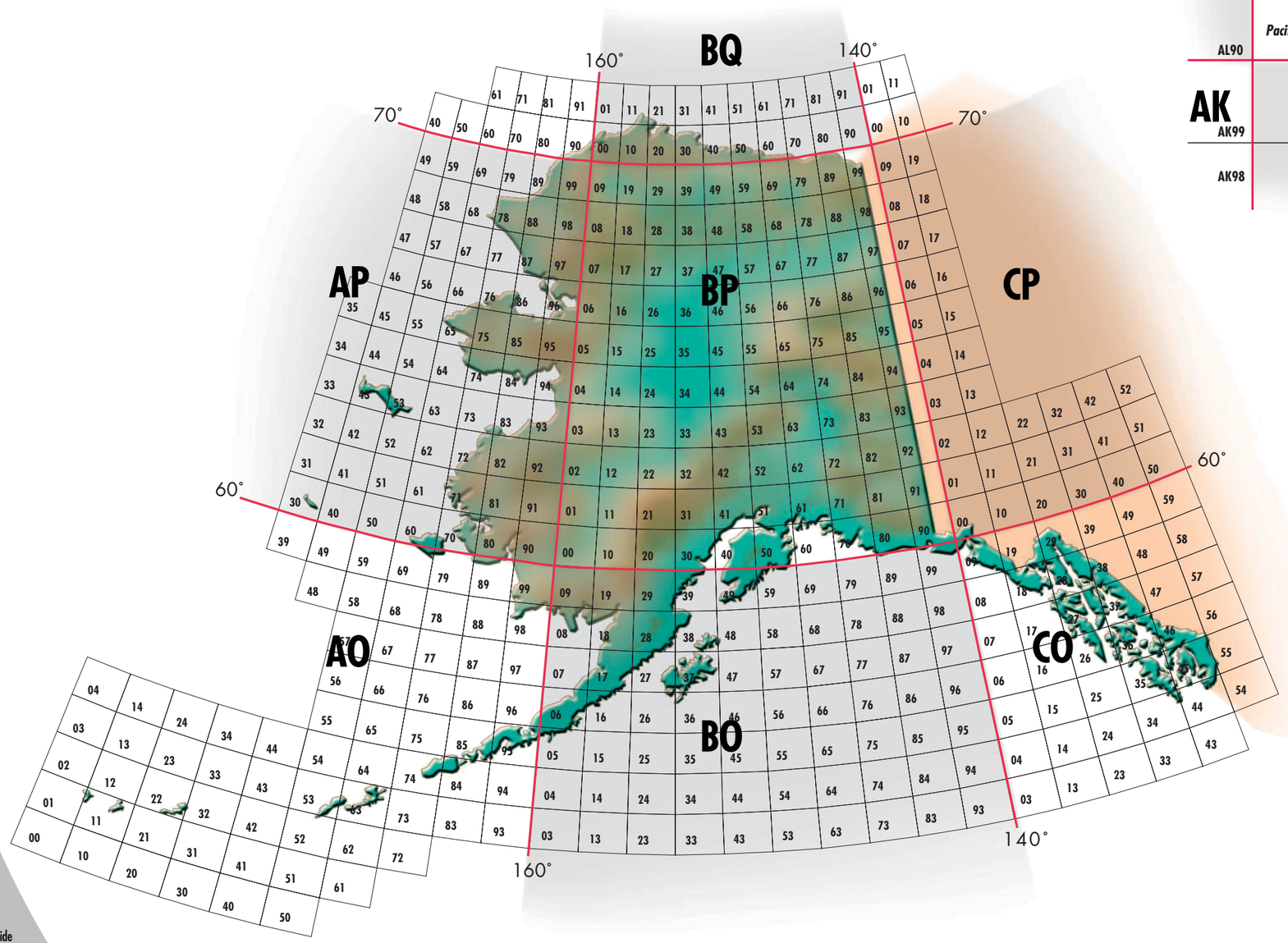
3. Say your grid square letters phonetically. Example: for grid 13 in region DM say "delta, mike, one, three" on air.

4. Give your general location along with your grid square.

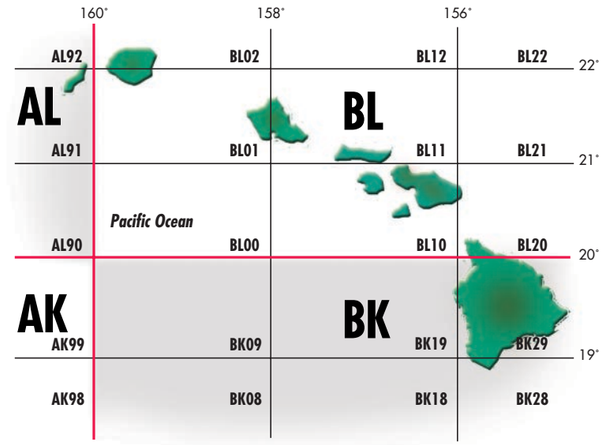
5. Have fun on VHF & UHF!

*An instrument of the Maidenhead Locator System (named after the town outside London where it was first conceived by a meeting of European VHF managers in 1980), a grid square measures 1° latitude by 2° longitude and measures approximately 70 x 100 miles in the continental US. A grid square is indicated by two letters (the field) and two numbers (the square).. "
From ARRL source: http://www.arrl.org/locate/gridinfo.html

Alaska



Hawaii**



0 10 20 30 40 50 60 70 800 Kilometers
0 100 200 300 400 Miles

Albers Equal Area Projection - Alaska

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**All maps except Hawaii use an Albers Equal Area Projection. The map of Hawaii is based on the grid square map information from ARRL.

ICOM®
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WHAT IS **SNAP**?

CONVENTIONAL TO TRUNKING, IN A SNAP. REALLY.

ICOM's subscriber units are built to meet strict military (MIL SPEC) standards[1]*. All units feature a die-cast aluminum chassis. A smart choice!*

Basic LTR® trunking is only a SNAP away! Our unique UT-111 snap in module lets you upgrade an ICOM subscriber unit[*2] to LTR trunking in seconds. Need conventional again? It's still available, even with the UT-111 module snapped in. Carriers and dealers alike will find their business two-way has never been more flexible...or profitable!

SNAP FLASH™

TRUNKING

Need more than basic LTR, either now or in the future? ICOM's new IC-F4TR[*3] portable and upcoming mobiles[*4] feature both basic LTR and PassPort® software programmed into FLASH memory. Operate basic LTR now, then upgrade to PassPort when you're ready…or just go straight to PassPort now! Both models are backwards compatible, so you can operate a mixed system of PassPort and LTR. Future enhancements are possible with the FLASH memory.

FLASH MEANS FLEXIBLE UPGRADES AND CUSTOMIZATIONS.

WHAT IS **FLASH**?

ICOM®
www.icomamerica.com

Call 425-450-6088 for free brochures
or 425-454-8155 to speak with
an ICOM representative

*1 Meets MIL SPEC 810 C/D/E for shock/vibration
*2 Select models only. Contact your ICOM dealer or, contact ICOM directly for more information: 425-454-8155.

*3 This device has not been approved by the FCC. This device may not be sold or leased, or offered for sale or lease, until approval of the FCC has been obtained.
*4 Estimated availability: December 2000. Availability subject to change without notice.

FOR PEOPLE WHO MAKE SMART CHOICES

Introduction from Gordon West

Welcome to the world of long distance communications with marine single sideband (SSB) radio. Hundreds of voice and data e-mail channels in the MF and HF frequency spectrum have been allocated to mariners for long-range, ship-to-ship, and ship-to-shore communications. Marine single sideband, voice, "party line" communications can never be replaced by ship satellite "private" communications! The advantage of marine SSB is the ability to have a multiparty conversation for the exchange of information. Satellite communications is like a telephone call - you can only talk to a specific person at a specific time. You cannot talk to a group of individuals. An SSB gives mariners the ability to share information with one another about weather, ports of call, cruising conditions etc. Marine SSB is more like an internet chat group than a phone call.

The marine single sideband service and frequencies have been around for years. However, only recently have we seen the introduction of low-cost, no-crystal, marine SSB equipment that can offer marine radio, ham radio, and marine e-mail capabilities in one neat, 12-volt DC package. ICOM, a leader in marine, commercial, and amateur radio equipment, presents the overview of the marine single sideband service, an easy-to-understand review of equipment, and suggested installation of the radio and antenna and ground systems.

If you are like most mariners, you are probably not all that interested in what makes SSB radio work on the inside. However, one thing is for sure, when you pick up the mic or prepare to send a computer e-mail message, you want the very best signal on the band, and you want to connect with the station you are calling, on the first try!

In this book we'll show you how, in a non-technical, easy-to-understand language. We will also give you some proven installation techniques that will help you to install the equipment on your boat if you are handy with tools. But, keep in mind that your marine electronics

dealer is an expert in this field. They have the experience to complete a proper installation of your equipment. If you don't feel you have the necessary skills, your dealer is the best person you can find to insure proper installation and top performance from your marine SSB radio.

This handbook is also a ready reference for the hundreds of voice and data (e-mail) channels available in the maritime service, as well as channels and frequencies for ship-to-ship and ship-to-shore in both the marine service and the amateur radio service. We'll even show you how to tune in weather facsimile and NAVTEX.

TIP!
All frequencies listed have been updated in early 1997, with no anticipated changes for the next few years.

Ready to communicate throughout the world on your marine SSB transceiver? Do you want to pick up that microphone and immediately make a quick phone call home? Want to send a FAX or e-mail? Ready to receive weather information over your lap-top computer? If so, then read on—ICOM presents the very best in marine single sideband and we will give you a fun and easy-to-understand look at long-range radio.

Start with a Good VHF Set

Before you begin thinking about marine SSB long distance communications, let's first review the hard working marine VHF radio system.

ICOM's lC-M59 VHF set is shown with optional flush mount kit.

Radio rules require that you must have a marine VHF radio in your vessel before you can install a marine SSB transceiver.

The international marine VHF service is designed for coastal cruising. We use marine VHF when we are within 20 miles of a shore station or another VHF equipped vessel. This is the effective range of the VHF receiver.

The VHF system is worldwide. Whether you cruise to Hawaii, Bermuda, or the Mediterranean, the VHF/FM channels are the same as they are here. Just use the international (INT) button on your radio. The frequencies assigned to channels may be different in the US, Canada or the rest of the world.

Your typical ship-to-shore VHF range to the Coast Guard should be about 20 miles. You can normally hear weather broadcast stations WX-1, WX-2, and others, up to 80 miles away. The marine WX channels are available only in the US and Canada. The range to a marine telephone operator should be at least 20 miles. Ship-to-ship range is better than 10 miles.

If you are not achieving this minimum range, check out your VHF antenna system and all connections. For sailboats, the best type of antenna is one that is mounted on the mast with good quality cable down to your set. Keep a portable antenna as a spare in case of dismasting. Sailboat masthead antennas will generally pull in stations and transmit further than any other type of antenna system. These antenna are only 3' tall and have "3dB" gain. They use the height of the mast head to achieve maximum range.

For powerboats, you should use a minimum of an 8-foot "6dB" antenna. If you have a large more stable vessel, you might want to select a 21-foot, 9dB gain antenna that performs well in all but heavy seas. A good powerboat antenna installation will normally let you reach out to the distances described above.

A good quality, high-tech, VHF transceiver is also important to obtain maximum range. ICOM produces both handheld and permanently installed marine VHF transceivers. These installed radios (with options) meet minimum digital selective calling (DSC) requirements. DSC is a new system for making distress calls. This system will be implemented worldwide over the next several years. Deep Draft (over 300 tons) vessels put into service since 1992 comply with this system now. All such vessels must comply by early 1999. Ultimately recreational vessels will need DSC VHF radios to communicate with DSC equipped ships. It is expected that all new marine VHF radios approved for sale in the US will be DSC equipped by 2001-2002. An ICOM DSC VHF set connected to your onboard GPS gives you added automatic safety communications in case of an emergency. The DSC radio will transmit an emergency call that includes your vessel's position taken from the GPS. See the wide variety of ICOM VHF sets at your favorite marine electronics dealer.

You must have a VHF set on board and a current FCC ship station license before a single sideband radio may be installed. If you have a licensed VHF system aboard, and you need more than 20+ miles of range when out at sea, then single sideband communications is your next step.

CHAPTER 3

The Marine Single Sideband (SSB) Service

Don't let the words "single sideband" scare you. It's simply a type of radio transmission. The military has been using single sideband for years to transmit messages throughout the world. Ham radio operators, who are permitted to select almost any type of worldwide transmission mode, have been using single sideband for years on worldwide frequencies, to talk to their buddies anywhere and everywhere.

In 1971, the Federal Communications Commission (FCC) phased in SSB transmissions for the long distance marine radio service. At the same time, it introduced the expanded marine VHF service for local communications. It also phased out the older double sideband sets.

A single sideband signal concentrates your voice onto a tightly compacted radio wave capable of traveling from hundreds to thousands of miles. This very efficient, compacted radio signal is a faithful reproduction of your actual voice. Unlike a commercial AM broadcast station, that sends out duplicate double voice wave forms plus an energy robbing "carrier," marine single sideband eliminates the unneeded mirrorlike lower sideband, the power robbing "carrier" that does nothing more than hush background noise when nothing is on the air. Marine SSB puts all of the radio energy from your voice into a compacted upper sideband wave form that gives you worldwide talk power.

If you don't speak into the mic, your transmitter doesn't put out any energy. Only when you speak will radio energy jump out into the air

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If you don't speak into the mic, your transmitter doesn't put out any energy. Only when you speak will radio energy jump out into the air

waves. In between each word, your transmitter and battery system relax! This means that you can talk further with less current demands from your battery system.

Your compressed, upper sideband signal, is captured by a distant receiver, and that receiver converts your radio signal into crystal clear reception.

When the FCC phased out double sideband equipment and introduced SSB, it doubled the number of available channels for marine communications. More new SSB channels were also added in 1991!

By compressing the transmitted signal into a very narrow band width, distant receivers are able to reject almost half the normal noise and interference level from the air waves. FCC-required frequency tolerances keep SSB sets precisely on frequency to minimize that sound distortion on receive. By simply adjusting a single "clarifier" knob on your SSB receiver, you can produce the normal sounding voice that was transmitted by a distant ship or shore station.

Coast Guard

Since safety at sea communications deserve the highest priority, let's first examine the United States Coast Guard and its role in the high frequency marine single sideband service. Our Coast Guard and other distress agencies throughout the world, guard 2182 kHz as the International Distress frequency. This allows you to contact shore-side and marine rescue agencies immediately when outside of VHF Channel 16 range. Since 2182 kHz is an international distress frequency, you will find that there are literally thousands of stations guarding this channel for a distress call, 24 hours a day.

In 1999, 2182 was replaced by 2187.5 as the International Distress frequency. This new frequency asisignment is part of the new GMDSS service required on vessels over 310 tons. Use of 2182 will be phased out and replaced by digital (DSC) watch on 2187.5.

The United States Coast Guard also offers additional working channels on its Automated Mutual-Assistance Vessel Reserve frequencies in each of the popular single sideband bands. Imagine using your marine SSB set to place a call for help when you're thousands of miles away from any shore station. Through the Coast Guard AMVER system, they can readily pinpoint the position of commercial and military vessels passing through your area and signal them to immediately alter course and steam to your location to render assistance. Believe it or not, you just thought you were all alone out on the ocean. There are actually many commercial and military vessels that could reach you within a matter of hours accounted for and pinpointed via SSB AMVER system radio communications. The AMVER system uses a full range of SSB frequencies to provide world-wide safety to ocean-going vessels. See appendix for frequencies.

Phone Home?

Want to place a telephone call? Shore-side commercial telephone stations are standing by on hundreds of frequencies to place your phone call. These shore-based phone companies operate extensive transmitting and receiving antenna systems to bring in your signals loud and clear. Remember, their revenue depends on your satisfaction. You can be assured that they have the most going for them when it comes to powerful transmitters, sensitive receivers, and huge antenna arrays that beam in on your single sideband signal. These same telephone stations also transmit "traffic lists" for ships at sea who have telephone calls waiting from shore-side parties. They also broadcast weather reports, storm warnings, and other notices to mariners where safety at sea is important. If an emergency should arise the phone companies with their massive antenna systems can also patch you into rescue coordination centers, hospitals, and emergency-at sea medical systems without charge. See appendix for frequencies.

E-Mail

Your new marine SSB can also send and receive electronic mail over public common carrier, narrow band direct printing channels. It is just like sending e-mail from your home or office through a specific using your secret password over phone lines. SSB e-mail relies on the

airwaves and ionosphere in place of phone lines. Your e-mail provider can be reached from anywhere in the world with up to 12 network stations standing by for your computer traffic. An e-mail connection will provide a significant $$$ savings over conventional, high-frequency, SSB voice or satellite-phone communications from your vessel to your business or home; or to anyone who has an e-mail or FAX capability on shore. Shore stations can automatically reach your computer, by dialing a single phone number to get to your e-mail network provider. If you have a lap-top computer onboard, your present or new ICOM SSB may need only a small modem and software to complete the e-mail connection.

More about SSB e-mail in Chapter 3, with a complete listing of narrow-band direct printing frequencies listed in the appendix, plus a map showing a radio e-mail electronic worldwide network of stations also found in the appendix.

It is a plug-in affair to hook your marine SSB into e-mail via the airwaves.

Ship-To-Ship

There are many ship-to-ship frequencies allocated for communicating over long distances to other vessels with marine SSB gear. Without incurring any "land line" charges, you can communicate from one ship to another ship in opposite parts of the world, free of charge, with crystal clear reception. Thanks to Mother Nature, which we'll talk about

in a few moments, your signals can travel thousands of miles to other vessels with SSB equipment with almost no loss of voice quality. See appendix for frequencies.

Ship-To-Shore For Free

Private shore stations share ship-to-ship channels. This allows you to communicate directly with a marine supply company that can help you replace the part that fell off your anchor windless 3,000 miles away. There is no land line charge in this communication service because you are transmitting directly to a distant marine parts or marine electronics store. These "private coast stations" can also include private marine business, yacht club and marine salvage companies, private air ambulance companies, and any other type of marine business that need to regularly communicate over hundreds or even thousands of miles to distant ship stations. You may even be able to set up a marine SSB base station at your office to stay in touch regarding marine matters when you're far out at sea. Your sideband may also be operated in the SITOR mode, allowing for digital-transmission and reception of documents, such as yacht race standings, business transactions, and detailed manifests. See appendix for voice and SITOR frequencies.

Shortwave

Your marine SSB radio from ICOM can also be used to receive (and in certain cases, transmit) other services that share frequencies adjacent to the marine band.

You can tune into worldwide international broadcast stations and find out the latest news, here and abroad. You can eavesdrop on military and State Department communications that fill the high frequency spectrum. See appendix for frequencies.

Weather Facsimile Charts Free

You can tie your weather facsimile receiver into your marine sideband set and receive crystal clear weather charts in your particular area of cruising. See appendix for frequencies.

Ham Radio

You can also tune into amateur radio frequencies, and listen for local weather reports on the maritime mobile amateur radio nets. Licensed amateur operators may use ICOM SSB transceivers that are capable of transmitting on amateur frequencies. The "No Code Technician" license allows you worldwide ham privileges when cruising within Mexico with a valid Mexican reciprocal operating permit. And even if you don't obtain the ham license to talk, all ICOM marine SSB transceivers easily tune into ham calls so you can listen to the valuable maritime mobile weather nets, both upper and lower sideband.

Military

Use your marine SSB set as an ultra-sensitive shortwave receiver You can tune into foreign embassies, the Air Force and the Navy, "secret" shortwave stations, and any other type of communications that can be found on the worldwide high frequency spectrum.

Time Signals

Oh yes, one last thing—if you forgot to set your watch, you can tune into the international time signals wherever you cruise. Tick, tick tick, at the sound of the tone, it is exactly. . . See appendix for frequencies.

Worldwide Reception for Free

If time ticks don't interest you, consider the following that can be received on your new marine single sideband, all-band transceiver:

U.S. Air Force in-flight communications
Strategic Air Command
Air Force 1 (the President's plane)
Civil Air Patrol
United States Intelligence Agencies
Antarctic Stations
Interpol
U.S. Weather ships
Hurricane Research Center
Volmet-Aviation Weather Broadcasts

Morse Code News and Weather for Free

It's also possible to tune in radio facsimile broadcasts and CW Morse code broadcasts from national news agencies, i.e. United Press International and Associated Press. These broadcasts take place on international frequencies that can be picked up just about anywhere in the world. There are Morse code readers and teleprinter displays that are easily hooked up to your ICOM transceiver and will instantly read out what is being sent! It's almost as good as your morning newspaper.

While your ICOM marine SSB may be capable of transmitting on any or all of these frequencies, you should not! Transmitting outside of your authorized maritime and ham limits is illegal. If you hold a valid amateur radio license, you will be permitted to transmit on ham bands—but transmitting outside of the marine and ham bands would be illegal except in an emergency to signal for help.

So get that modem and lap-top computer hooked up your ICOM marine SSB by the plug-in jacks on the back.

- Send and receive e-mail.
- Tune into weather facsimile broadcasts, and watch the weather charts unfold on your computer screen. Decode the dots and dashes of Morse code computer programs.
- Tune into Navtex broadcasts from the Coast Guard, and check out the latest weather report or navigational warning.
- Your computer and your SSB make a perfect marriage to add information and safety to your cruising.

CHAPTER 4

High Frequency Bouncing Radio Waves

Marine single sideband transceivers broadcast in the "high frequency" range of the radio spectrum. Unlike VHF (very high frequency) communications that always travel line-of-sight, transmissions in the "high frequency" region take advantage of Mother Nature for some extra long distance communications.

As of July 1, 1991, the following frequency bands have been allocated for marine single sideband service:

2 MHz	6 MHz	12 MHz	18 MHz	25 MHz
4 MHz	8 MHz	16 MHz	22 MHz	27 MHz

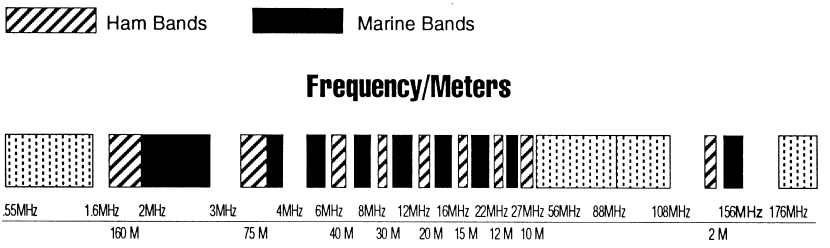

FIGURE A

When transmitting on any band, one component of your radio signal hugs the surface of the ocean. This is called the ground wave. Ground waves that hug the surface of the earth and ocean travel approximately 50 to 200 miles from your transmitter. If you are communicating on single sideband with a nearby shore station or another boat less than 100 miles away, chances are it's the ground wave component of your signal that's doing all the work. Your ground wave signal is always there, day or night, and does not depend on anything other than a good, strong transmitted signal.

Good ground wave coverage out to 150 miles depends on a good antenna and a good radio frequency ground system aboard your boat. The better your antenna and grounding, the further you can communicate via ground waves. More on this later!

It's the "sky wave" component of your transmitted radio signal that gives you long distance, single side band range. Sky waves are the components of your transmitted radio signal that travel up into the air and bounce off of the ionosphere and are reflected back to earth hundreds and even thousands of miles away.

The ionosphere surrounds our globe and is present 24 hours a day. Its density and reflecting capabilities change with day and night, the season of the year, and the 11-year solar cycle. Hanging like an invisible radio mirror between two stations, the ionosphere is responsible for reflecting back to earth marine SSB waves that strike it at the right angle.

“The right angle" to establish communications with a station, let's say 3,000 miles away, depends on the time of day you are broadcasting and the particular band of frequencies you are using. Lower frequencies tend to bounce back to earth close in. Frequencies around 12 MHz tend to bounce back to earth over fairly long distances, typically 3,000 miles. 22 MHz may give us the longest bounce, enabling you to communicate from the West Coast of the United States into the Mediterranean. If the ionosphere is very strong, you may get a second bounce off your sky wave signal, which enables you to talk twice the distance that you normally would. On 22 MHz, this means that you can easily talk all the way around the world on a double-hop or triple-hop transmission.

The ionosphere is constantly changing, and a frequency that you communicated on yesterday might not be suitable for communications today. Often the time of day and season of the year will make a difference. When band conditions change in the ionosphere, you simply change frequencies on your ICOM to maintain a good, clear signal. With multiple frequencies and multiple bands available, you can stay in touch as the ionosphere goes through its regular ups and downs.

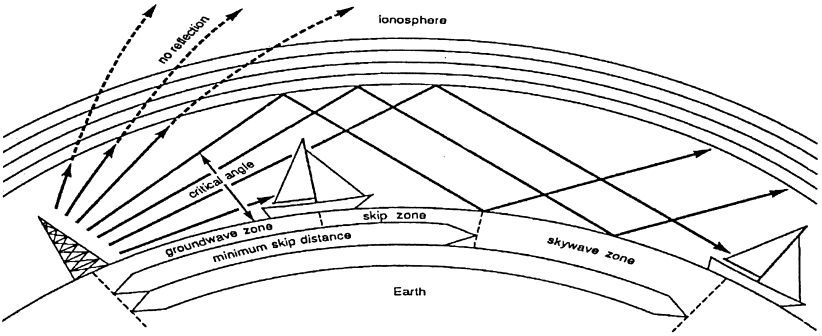

FIGURE B

At night, the ionosphere gradually lowers. Your signals won't be able to bounce as far, however, you will still enjoy several thousand miles of communications range.

During daylight hours, the ionosphere rises, giving you longer range on higher frequencies. Since it's the sun's rays that charge up the ionospheric layers, solar and other disturbances will sometimes enhance— and sometimes occlude—single sideband marine communications.

Sky waves are unaffected by local weather conditions. Whether it's sunny or cloudy, snow or rain, windy or still, your sky wave range will not be influenced by local weather conditions.

Did You Know?

The only time you will hear "weather noise" on your transceiver is in the proximity of lightning and thunderstorms. Lightning may be picked up as far away as 200 miles on lower frequencies. It sounds like a static crash at the exact same time that you see the bolt illuminate. Some mariners leave their SSB radio turned on while cruising at night in inclement weather to get prepared for storm cells. When they hear it on the radio they should be prepared to see it soon!

After a few weeks of playing around with your new single sideband radio telephone, you will begin to get a feel for the expected range on any one particular band of frequencies. In our next chapter, we'll give you some secrets!

CHAPTER 5

Single Sideband Range

Your transmitted ground waves are seldom influenced by atmospheric or ionospheric conditions. Here is what to expect in ground wave range, 24 hours a day:

SSB Ground Wave Range			
2 MHz	-	150 miles	
4 MHz	-	100 miles	
6 MHz	-	75 miles	Anytime,
8 MHz	-	70 miles	day or night
12 MHz	-	50 miles	
16 MHz	-	50 miles	
VHF Band (156 MHz)	-	8 miles vessel-to-vessel	
25 miles to Coast Guard			

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16 MHz	-	50 miles	
VHF Band (156 MHz)	-	8 miles vessel-to-vessel	
25 miles to Coast Guard			

Sky waves give you the very longest range, thanks to the ionosphere. Here's what to expect in solid communication range to distant ship and shore stations:

SSB SKY WAVE RANGE		
FREQUENCY BAND	**DAYTIME RANGE**	**NIGHT TIME RANGE**
2 MHz	Sky waves absorbed	1,000 miles
4 MHz	Sky waves absorbed	1,500 miles
6 MHz	500 miles	2,000 miles
8 MHz	700 miles	3,000 miles
12 MHz	1,500 miles	Worldwide in the direction of the sun.
16 MHz	3,000 miles	Worldwide in the direction of the sun until 8 p.m. local time.
22 MHz	Worldwide	Little sky wave reflection after sunset.
25 MHz	Worldwide	Little sky wave reflection after sunset.

As you can see, to talk further, go to a higher frequency. However, watch out—you can sometimes select a frequency that is too high. This may cause your sky wave signal to actually bounce over the station that you wish to communicate with, or go off into space.

If your signal is literally skipping over the desired station, switch to a lower frequency.

After a few weeks of tuning your receiver to different stations, you will be able to anticipate which band will be the best for a particular time of day to talk to a specific station hundreds or thousands of miles away. Try tuning your set during the day, and then at night, and listen to the

difference in range. Switch between bands and begin to get a feel for how the ionosphere causes signals to skip long distances, and sometimes short distances.

Marine telephone shore stations make it easy to predict the best band to establish rock-solid communications. Every four hours they read a traffic list (calls being held for vessels at sea) as well as ocean weather conditions. They simultaneously transmit this information on each one of the authorized bands. Simply switch bands while they are transmitting and determine which band offers the best reception. Where you hear them loudest is where they will hear you best. After they finish with their traffic list, give them a short call and you have now established communications, thanks to sky waves and Mother Nature's reflective ionospheric mirror.

CHAPTER 6

Band and Channel Selection

It's easy to program additional frequencies and channels with today's modern, high-frequency, marine single-sideband transceivers. You don't need to purchase expensive plug-in crystal elements. Everything is synthesized, and your modern ICOM marine SSB receives from .5 MHz through 29.999 MHz, and transmits from 1.6 MHz to 27.500 MHz.

The marine single-sideband service uses specific channels to identify specific frequencies between 4 MHz and 27.5 MHz This book has a listing of channels and frequency assignments in the appendix. On the 2 MHz band, we use actual frequencies not International Telecommunications Union (ITU) channel designators. We use ITU channel designators on frequencies between 4 MHz and 27.5 MHz.

Most mariners will use about 10 frequencies in each marine band. New ICOM marine SSB transceivers offer over 300 channels that are synthesized, for voice, and an additional 600 channels for electronic

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Most mariners will use about 10 frequencies in each marine band. New ICOM marine SSB transceivers offer over 300 channels that are synthesized, for voice, and an additional 600 channels for electronic

e-mail. ICOM marine transceivers also offer over 100 channels that are user-programmable, perfect for ham frequencies, shortwave broadcasting stations, weather facsimile frequencies, and just about any other frequency that you might want to tune in and listen.

You can add, change, or delete frequencies yourself by entering the proper numbers on the keypad. Most ICOM marine electronic dealers can custom program local frequencies to save you the time of entering them into memory using the key pad.

Did You Know?

Your ICOM marine SSB can also work in any mode, including lower sideband or ham channels on 40 meters and 80 meters, without the need to buy an expensive lower sideband filter.

Plan your communications range by selecting the appropriate bands. If you're not going to be communicating halfway around the world, then don't program many channels above 16 MHz. If you are only going to Mexico, or to the Caribbean, load up on 4 MHz, 8 MHz, and 12 MHz frequencies and channels. More than likely, these frequencies and channels are already loaded into your equipment.

Equipment Selection and Location

Locate your marine SSB in a place that is convenient for operation. The radios are large and heavy. They should be positioned for easy access to all controls. Most of the time your SSB set can nestle right along with your other nav gear.

You can build the equipment into your instrument panel, however, you should provide some ventilation. Many new SSB's are fan coded and there needs to be a source of fresh air to facilitate this process. Everything on the inside of the radio is transistorized, and slight amounts of heat are actually good for the equipment—it dries things out.

TIP!

We recommend keeping the equipment down low for easy channel selection. Make it comfortable to operate. Some night in a cozy harbor you may wish to simple flip through the worldwide frequencies to pick up some action. You want the set as accessible to your hand as possible without any undue effort.

ICOM SSBs have a built-in speaker that faces forward. This eliminates having to purchase an external speaker which is required when the built-in speaker is located elsewhere. A good carpenter can build a teak frame that will make the equipment look nice. An anodized aluminum trim kit is also available from your ICOM dealer. A heavy-duty mounting bracket is shipped with each rig to facilitate mounting it from below or hanging from above.

Once you have selected an ideal location for mounting the equipment, read on, because we'll take a look at power requirements, antennas, and grounding.

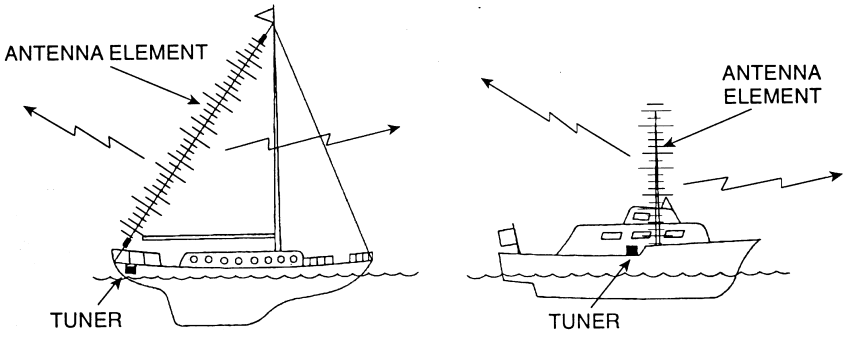
◆ *Installation Recommendations*

Automatic Antenna Tuner Mounting Locations

(1) Aboard sailboats, the automatic antenna tuner normally feeds an insulated section of rigging, such as a backstay or, on a ketch, a mizzen sidestay. The automatic tuner hides away, below, near the chain plate that holds this particular insulated stay. The automatic tuner should go as far away from the radio as possible in order to minimize RF feedback.

TIP!

FCC rules require the active antenna tuner to be located as far away from people as possible. In other words, don't mount the tuner in an area where someone could actually touch the high voltage output single wire terminal!



■ ANTENNA TUNER

(2) The automatic tuner requires no specific orientation. You can hang it vertically or horizontally. You should insure that it will stay relatively dry and the water drain screws (if any) are at the low point of the unit if it is going to get wet.

(3) Remove the downward-facing drain screw to provide an escape path for trapped moisture.

(4) Aboard powerboats, the automatic antenna tuner normally feeds a fiberglass whip. If possible, mount the tuner up in the flying bridge area, well protected from the weather. Mount it as far away from the helm as possible. If there is no flying bridge on the powerboat, the tuner may be mounted near the base of the white fiberglass whip.

(5) The wire feeding your antenna system is high-voltage "GTO-15." It is available at most marine electronic stores. Although it looks like coaxial cable, it is not. The jacket contains no internal braid. This means the high-voltage single wire is part of your active antenna system, and should be routed far away from other wires aboard. Keep it away from sleeping quarters or areas where crew members might sit. It's always a good idea to keep everyone at least 5 feet away from the GTO-15, antenna lead wire.

Did You Know?

It is normal to hear your automatic tuner make a clicking sound during tune-up. What you are hearing are the internal relays self-adjusting inductance and capacitance for the best possible match. The clicking will normally stop after about 5 seconds of initial tune-up. The tuner will remain silent during normal communications on marine SSB. The clicking sounds during normal tune-up are a positive indication that your system is performing as it should. However, if the clicking continues for more than 10 seconds, chances are the tuner is missing its ground connection or the antenna connection up on deck.

CHAPTER 8

Grounding (Counterpoise)

Good grounding or counterpoise techniques are absolutely necessary for maximum single sideband range. Half your antenna is your radio frequency ground, so don't skimp here! The radiating portion of your antenna needs to see a mirror image of itself before it will send out your SSB signal. This mirror image, called a counterpoise, is created by using metal surface and seawater as your radio frequency ground plane.

Your marine single sideband system will not perform satisfactorily if you don't have a good counterpoise system. Poor counterpoise (ground) equals poor range. This is especially true on lower frequencies where large RF grounds (counterpoise) are required for good range.

If you make direct contact with the seawater, you may be able to reduce the amount of ground foil that must be run from your radio and the automatic tuner. If your through-hulls are metal and are all bonded with a green wire per ABYC (American Boat & Yacht Council) standards, find a couple of in-water bronze through-hulls, and run the foil directly to them for an effective seawater ground. But make sure that bronze through-hull is already part of your bonding system with a telltale green wire attached to it and going off to other underwater metals. Never ground to a bronze through-hull that has been specifically left isolated and ungrounded.

Use a wire brush to clean up the neck of the through-hull, and then use a hose clamp to affix the copper foil to that through-hull. Bunch the foil up a few times to provide a good solid connection where it won't easily rip.

TIP!

If there are several bonded underwater through-hulls near your automatic antenna tuner, your grounding will be easier. You might only need 50 feet of ground foil to complete the entire process! Direct contact with seawater improves any RF ground system.

Same thing for a powerboat—but you'll need more ground foil because your automatic antenna tuner is probably mounted up top on the flying bridge. In this case, you will need to follow a wire run channel from the top of the flying bridge down below decks, and down to the bilge area where you can make connection to underwater through-hulls. You could even use a metal tube that may already be in place as part of your ground foil run.

Use 3-inch wide, 3-mil copper foil to ensure a good sea water ground.

Why foil? Round wires create inductive reactance at radio frequencies, and are not effective as a good grounding conveyance. Use 2 or 3 inch wide, 3 mil copper foil (available at most marine electronic stores) to achieve a good seawater ground.

Your counterpoise system needs to begin directly below your antenna feed-point if at all possible. When you use an antenna coupler, we will consider this as the "feedpoint."

An ideal counterpoise for all frequency single side band work should consist of up to 100 square feet of metal surface area directly below the feedpoint. While this may sound like an impossible number of square feet to achieve, consider the following large surface RF ground planes (counterpoise) already available to you:

Tanks	Stainless steel tuna towers/stanchions
Propeller and shaft	Chain plates
Encapsulated lead keel	Engine block
Bonded through-hulls	

You can develop your own large surface area RF ground plane (counterpoise) system by fiberglassing into your hull copper screen or 2-3 inch wide copper foil strips. It's too bad they didn't build in the ground plane when they laid up the hull, isn't it?

It will probably take you about a day and a half and a hundred feet of copper foil to create a good capacity ground plane below the water line. You will be running copper foil inside your hull for a capacitive ground to the seawater. No, the foil does not go on the outside of the hull! The fact that the ground foil is close to the seawater makes all the difference on transmit and receive range. While it might be an effort to get all this foil below the water line, it will really make the difference when you press down on your microphone key.

Did You Know?

Your bonding of underwater metals that are already tied in with a common ground wire will not affect your corrosion control system. If your present underwater metals are not all bonded together, you may wish to lay out a RF ground system (counterpoise) independent of an actual connection to the seawater but that's not really necessary.

These other copper foil leads go directly to the antenna tuner. The tuner will have a ground terminal to which the foil is attached. Do not reduce

the size of the foil as you approach the tuner or the radio. Also, do not convert the foil to wire as you approach the tuner or the radio. Fold the foil back on itself and drill a hole for the mounting stud.

Your RF ground system (counterpoise) does not actually need to contact the seawater to be effective. Even though an encapsulate lead keel doesn't actually touch the seawater, it makes a capacitive ground by being next to the seawater, if you run wide copper foil to it.

You may either double bolt the foil to an exposed keel bolt, or actually tap directly into the lead keel with a bolt going through the copper foil and into the lead.

In attaching to through-hulls, remember, it will improve performance if you run foil between each through-hull. Stainless steel hose clamps are the best way to "pick up" these underwater metals. Water tanks, copper hydraulic lines, etc.; can also be connected with foil using hose clamps.

I know, I know, trying to get a good RF ground (counterpoise) system is a bit difficult—especially if you can't get at your keel bolt. If this is the case, then drill into the keel and pull up some lead. Any sailboat system that doesn't use a poured keel is losing a tremendous amount of potential in obtaining a super signal. Only if your keel is made of lead shot poured in fiberglass would you not elect to use it. In any other case, where there is a large amount of surface area below the water line, such as a lead keel, by all means use it in your RF ground plane counterpoise. It will save you many hours of trying to run more copper foil and screen below decks.

Good RF grounding (counterpoise) techniques will also enhance your overall protection from a lightning strike. Lightning protection and good RF grounding all have a common denominator—a large amount of surface area below the water line.

Again, I would like to mention that running wire—even battery cable—is not effective as an RF ground (counterpoise) at radio frequencies. Although, wire looks like a good DC ground, it looks invisible at most

radio frequencies. Use foil, and only foil. Even aluminum foil will work in a pinch. You can even use aluminum air conditioning foil with sticky on the back as counterpoise. Wires won't work so forget about using them.

The more counterpoise, the better your signal. Ever wonder why supertankers always have the loudest signals on the band? They are only using 100-watt equipment, and a standard 23-foot antenna, but their signal literally bounces off of their gigantic counterpoise.

TIP!

Again, RF grounding IS the key to single sideband super range. It's one of the few components of the installation you can control.

Once the copper is in place, you can just about forget it. It will do the work for you. We recommend applying a thin coat of paint or resin over the copper to keep the salt water from tarnishing it. While green copper works just as well as bright, shiny copper, it's a much more sanitary installation to keep it isolated from the elements. It also prevents tearing or other damage to the system.

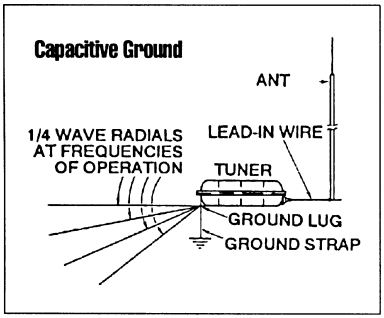
If you have soldered all copper joints, you won't need to check for continuity. However, you may wish to clean up copper connections at through-hull fittings every couple of years. Since these connections are made with hose clamps, there is the possibility that the contacts may get corroded after a few years in the bilge. A steel brush should bring both the copper and the through-hull fitting up to a nice shiny surface, and you can make your connection again.

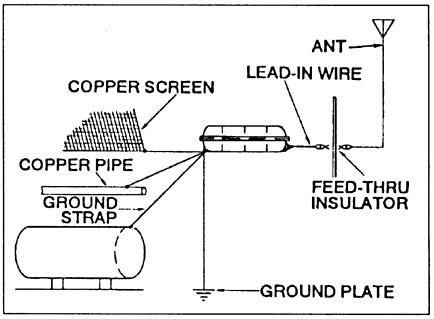
The periodic inspection of your copper ground system, you can be assured that your signal will stay loud and clear.

◆ ***Ground System Review***

(1) The automatic tuner must be connected to a good electrical ground. A good ground prevents shocks, interference and numerous other problems. One example of a good ground is the nearest metal member on a metal vessel. For best results, use metal strap or foil. Make the length as short as possible.

(2) Good ground systems on wood or fiberglass boats are more difficult to install. For best results, use strap or foil connected to the keel, tanks, or other large metal objects.





If you have no way of contacting the seawater, you could install a counterpoise for each band of frequencies used above 4 MHz, as shown in the figure. This would be a last resort!

Ground plates? We save the underwater ground plate as an absolute last resort for a single-sideband antenna system that is working off of an automatic antenna tuner. Ground plates provide terrific contact to the seawater, and also have good connection points to attach the foil. The porous ground plates don't achieve any better ground than if you were to come up with your own copper plate, but they do provide a superior means for mounting them through the hull. Using a ground plate as a RF ground may cause interference with other on board electronics using the same ground plate as a DC ground.

The automatic antenna tuner performs best with a direct seawater ground connection. Whether it be through your bonded underwater through-hulls, or to a dedicated ground plate, the direct connection is one great way to minimize hours spent in the bilge developing a good-ground system.

TIP!

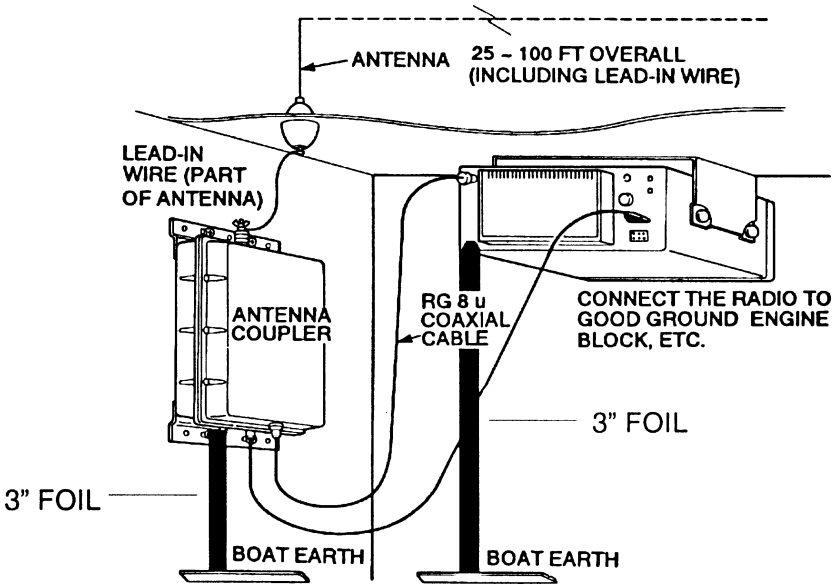
A capacitive ground system, made up of copper strips run around the hull below the water line, or individual copper strips at one-quarter wavelength sections, is one way to achieve a good ground, but may take several days to lay into the hull and keep dry. Why not go for the direct seawater contact, and establish your single-sideband ground connection in hours instead of days!

◆ *Typical Installation*

The following figure shows a typical installation. Any radio communications system operating with a whip antenna or long wire antenna (insulated back stay) must have an adequate ground connection, otherwise the overall efficiency of the radio installation is degraded especially at low frequencies.

The 50 ohm output impedance of the transceiver makes it necessary to employ antennas of the trapped or externally matched type. The use of an antenna coupler in conjunction with a whip antenna or long wire antenna (insulated back stay) allows an efficient installation which will cover all HF marine bands.

Of course, those of you with aluminum hull vessels, your RF groundplane (counterpoise) is your hull, and you'll probably have the loudest signal anywhere in the world. No further RF grounding is necessary.



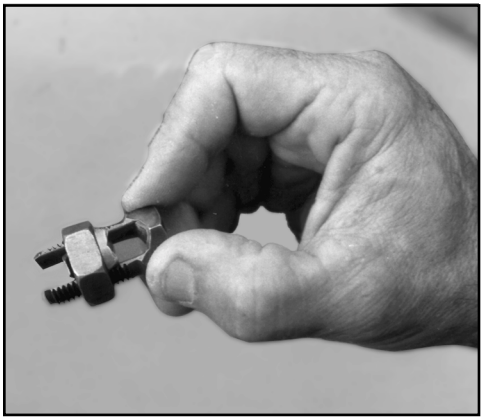
CHAPTER 9

Antennas

To achieve the ultimate in long skywave range, you need an antenna system that is a minimum of 23 feet long tied into your automatic antenna tuner. The longer the antenna, the better!

For powerboats, your antenna will be a 2 or 3-piece, fiberglass whip. The fiberglass whip, on a powerboat, is mounted on the port or starboard side with an upper support bracket. It is fed with single wire GTO-15 that connects the whip to the nearby automatic antenna tuner. This whip is sufficient for most powerboats.

For sailboats, insulating one of the stays "in the clear" is the best way to achieve an antenna system that is between 30 feet and 70 feet long. An insulated backstay is the most popular choice. The insulators are put on by professional riggers. The rigger should place the top insulator at a point where it is about 3 feet from the mast. The bottom



Use a stainless steel hose clamp or brass kearny nut to make your connection.

insulator, on a single backstay, is placed at eye level. Any lower and someone might actually touch the hot part of the antenna. Any higher and it's tough to service the connection point. Keep it at eye level.

On a split backstay, where the split is below the masthead, use three (3) insulators. The top and bottom insulators are installed on the side of the backstay to be used as the antenna. The other insulator should be placed near the top of the split leg as close to the Y as possible. This effectively takes the split out of the antenna system. Run the GTO-15 up the stay to a point above the lower insulator.

Use a stainless steel hose clamp to make your connection. You can also make the connection with a brass kearny nut available at electrical houses. Make sure that there is a good contact between the GTO-15 single wire and the insulated stay. NEVER USE COAX! Use rigger's tape to completely seal the connection, and at least once a year check your connection to insure it is making a good electrical contact with the stay.

On a ketch, you can insulate either the port or the starboard main stays, or you could insulate a mizzen stay and achieve good results. I like the mizzen stay better than the port or starboard stay, because it is more likely to be outside of and away from other riggins. Anytime you provide an antenna that is part of your rigging that is surrounded by other rigging, you lose valuable transmission and reception range. On sailboats, with all sorts of grounded rigging, your antenna must be outside of this rigging, and in the clear, to transmit and receive over long range.

If your insulated stay may come in contact with other metals, or could be touched by someone on deck, use rigger's tape or plastic stay covers to keep it isolated. Always keep in mind that everyone on deck needs to stay away from your transmitting antenna when you are actually on the air with the microphone keyed. On receive, the antennas are harmless. But on transmit, new FCC rules require everyone stay clear of the radiating antenna.

Remember, where ever you install GTO-15 (a "hot" part of your antenna system) along a metal component of the vessel, you should cut any green bonding wire that connects that component to ground. If the backstay chain plate is bonded, cut the bonding wire to that chain plate. If you have installed GTO-15 next to a stanchion, that stanchion should be removed from the bonding system. This prevents that powerful SSB signal from going right back to ground rather than radiating from your antenna

Whip antenna mounted over a stailess steel rail

Pre-Tuned 6-Foot Whip

A pre-tuned 6-foot whip containing both ham and marine radio frequencies will work nicely on both powerboats and sailboats. The whip does not require an automatic antenna tuner, so what you pay for the whip will actually be less than what you would have paid for an automatic antenna tuner. Your range with the whip is about 30% less than you would get with an automatic tuner connected to a long antenna wire.

The Whip Must Be Mounted Over A Horizontal Stainless Steel Rail!

The whip cannot be mounted on wood, nor can it be mounted on fiber-glass. These pre-tuned whips MUST be over a horizontal rail with at least 3 feet of surface area on each side of the whip.

For sailboats, the whip goes where you normally put the hibachi or outboard motor. Keep it away from the self-steering metal wind vane or wind generator.

On powerboats, the pre-tuned whip is placed over any horizontal rail, with the rail around the flying bridge most preferred. This gets the energy up and away from everyone down below. Remember, everyone must be at least 5 feet away from any transmitting high frequency antenna system.

The whip features plug-in "taps" to cause the antenna to self-resonate on specific marine radio or ham radio frequencies. Each tap point is marked in MHz for marine band, and meters for the ham band. You simply plug in the banana plug to the appropriate jack, and you are on the air with your self-tuned antenna system.

The self-resonant whip antenna gives good results up to a 3,000 miles range. But each time you switch from one marine MHz band to an other one, you must send someone out to the whip to tap into the appropriate band that you plan to operate on.

Adding 12 Volts

Your transceiver will be shipped with a red and black power cord. This is your 12-volt connection, and it is fused.

A 150-watt marine single sideband transceiver can draw over 30 amps on voice peaks. It's only when you talk that current is consumed in these proportions so don't worry, it's not 30 amps continuous out of your battery when the mic button is pressed down!

It's recommended to hook up your 12-volt connections directly to your ship's battery system. This allows you to stay on the air in case of a malfunction of your electrical panel. This is when you may need your set the most.

If you have some hefty 12-volt wires leading from your battery compartment to your fuse panel, a second choice would be to go ahead and make your connection at the instrument panel. Clip off large amounts of extra power cable, but always leave enough coiled up behind the radio so you can pull it from its mount with enough cable to work on the set turned on.

Route your power cable along the same track as your RF ground foil. Watch out for those sharp edges so that they don't nick the cable. Don't even think about using the RF ground foil as the black side of the power cable—these are two separate "ground" systems. One is for 12 volts DC and the other is for radio frequencies!

Use wire lugs to attach the cable to the terminal strip. The radio power lead is already fused, you do not necessarily need to go through an external circuit breaker; you can if you want, but that adds one more "weak link" in your power cable assembly.

TIP!

If you run the power cable to your battery system, choose a battery that is less apt to fail in an emergency. It you have a separate battery that is located above the water line, choose it in case of flooding. Just as soon as seawater covers your batteries, you are off the air—just when you wish you were on.

If you need to extend the wires supplied by the factory, see the wire table below. Make certain that any splices are well soldered and are protected from the salt environment. Soldering with radio solder is the preferred method. Measure the distance from the battery to the radio and back to the battery.

CONDUCTOR SIZED (AWG) FOR 3% VOLTAGE DROP AT 12 VOLTS

	Current (AMPS)												
LENGTH	**5**	**10**	**15**	**20**	**25**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
10'	18	14	12	12	10	10	8	8	6	6	6	4	4
15'	16	12	10	10	8	8	6	6	4	4	4	2	2
20'	14	12	10	8	8	6	6	4	4	4	2	2	2
25'	14	10	8	8	6	6	4	4	2	2	2	1	1
30'	12	10	8	6	6	4	4	2	2	2	1	1/0	1/0
40'	12	8	6	6	4	4	2	2	1	1/0	1/0	1/0	1/0
50'	10	8	6	4	4	2	2	1	1/0	1/0	2/0	3/0	3/0
60'	10	6	6	4	2	2	1	1/0	2/0	2/0	3/0	3/0	4/0
70'	10	6	4	2	2	2	1/0	2/0	2/0	3/0	3/0	4/0	4/0
80'	8	6	4	2	2	1	1/0	2/0	3/0	3/0	4/0		
90'	8	4	4	2	1	1/0	2/0	3/0	3/0	4/0			

Use 3% voltage drop for any "critical application" affecting the safety of the vessel or its passengers: bilge pumps, navigation lights, electronics, etc.

Eliminating Noise Interference

Now that you have your SSB station completely installed, it's time to turn it on and start listening to the bands. Your antenna tuner system is automatically set close enough on receive that you should hear plenty of signals. Notice that there is more atmospheric noise on the lower frequencies than the higher frequencies. With your engines and other motors turned off, the noise is the usual type of background racket prevalent on every band until a signal appears.

TIP!

Strong signals will usually completely mask out noise. Weak signals on 2 and 4 MHz will only quiet the noise by about 50 percent. The more sensitive your receiver, the more atmospheric noise you are going to pick up—this is normal. **Poor receivers don't pick up backgr ound noise!**

Atmospheric noise is always there—on any frequency, but louder on lower frequencies. It can not be filtered out—to do so would also cause your distant radio signals to fade away.

The noise that can be filtered is electrical noise generated by the ignition system of your engine, plus noise from other motors onboard. Fluorescent lights also create noise that is usually heard on the lower frequencies. Other noise sources: fans, refrigeration, battery voltage monitors, inverters, computers and battery chargers.

Onboard noise sources should be filtered at the spot they are generated. There are filters for alternators, and filters for fluorescent lights. You can put resistor spark plugs on your gas engine, and electronic tachometer filters on your electronic tachs. Fuel pumps can be quieted down, and bait tanks silenced, with specific filters designed for each individual interference source.

TIP!

Tune in a relatively weak signal on your SSB set, and then start the engine. If the signal is still there, your interference noise problems are few. However, if the signal completely disappears—you will need to get some filters for each noise interference source.

For noises and interference external to your boat, such as a passing skiff with an outboard that can be heard clearly on your SSB set, simply turn on your noise-blanker switch on the front of your radio. This will cancel out the repetitious popping sound almost completely. It may also help on your fluorescent lights. Although the noise-blanker built into your set is one way of dampening repetition-type noise, noise filters at the source of the noise are the best way to go. Like plugging leaks, you must methodically get every single one.

Your FCC License

Did You Know?

Marine SSB operation still requires a Federal Communications Commission marine station license, as well as a restricted operators permit. Even though the Federal Communications Commission has stopped licensing certain VHF radio systems, your longer range marine single side band still needs the proper call letters.

FCC Form 506 must be completed, following all instructions carefully. If you already have a valid VHF license, you will still use Form 506, but indicate that you are requesting a modification.

Form 506 is rather complex, but give it your best try by indicating "fee type code" as "PASR", and a licensing fee for 10 years at $75. Be sure to answer "Yes" on requesting a new or modified maritime mobile service identity number. This will give you capabilities for digital selective calling.

Check the category of transmitters for VHF, all EPIRB types, SSB for both bands, radar at 9300-9500 MHz, RTTY, and satellite. If you already have a selective call number be sure to list it. Same for your INMARSAT number—if you have one, list it!

Read the fine print on the form, and then send it on to the Federal Communications Commission. It may take several tries to get the license to go through; but when it does, you will be all set for your new marine SSB system.

Complete FCC Form 753 for your personal operators permit. This is called the restricted operators permit, and it's necessary for all SSB installations. If you will be carrying passengers for hire, you also need

a marine radio operators permit. This requires a simple multiple-choice test to make sure you know how to run and operate a marine radio telephone. For information about the marine radio operators permit, and a simple book that prepares you for the test, call 1-(800) 669-9594 and ask for the Gordon West Commercial General Radiotelephone book.

The Federal Communications Commission may also have these forms on the lnternet (http://www.fcc.gov), and you may be able to go on-line and apply for all of this right at the computer.

Going on the Air

Your new marine SSB transceiver has been pre-programmed by the manufacturer, a dealer, or distributor that sold the equipment. It is easy to reprogram different frequencies into your new equipment. Refer to your owner's manual for programming instructions. It's just as easy as pushing buttons on your telephone. Go on, give it a try!

The Federal Communications Commission requires that your marine station license is valid and covers the frequencies 2,000 kHz to 27,000 kHz or 2 MHz to 27 MHz before transmitting. Make sure you have this license posted before going on the air.

If you followed the installation instructions precisely for both your radio equipment and the automatic antenna tuner, your radio should perform up to specifications. If you have any questions, you might want a technician to check it out. The instruction manual with your new ICOM SSB lists several ways to verify full power output.

TIP!

Before transmitting on any frequency, listen! In fact, spend a complete week listening to different frequencies and different bands to get a feel for how marine SSB communications take place.

When listening to ship-to-ship and ship-to-private shore station calls, you will generally hear both sides of the conversation. This will give you an idea of how ship-to-ship communications take place. Always remember to give your official FCC call sign at the beginning of your transmission, at least once every 10 minutes, and when you sign off.

When tuning into the ship-to-shore marine telephone station, you will only hear the shore station side of the conversation. The marine telephone frequencies are duplex. Ship stations transmit on different

frequencies than the shore stations. Your ICOM SSB automatically knows where to transmit when tuned to the shore station telephone companies. The very professional marine telephone operators and their service technicians will expertly ask you the questions about where you are, who you are, and what number you want. Simply follow their instructions and you will have no problems communicating through the telephone service.

The same thing holds true with the United States Coast Guard AMVER stations. You will only hear the shore side of the conversation. The United States Coast Guard personnel expertly extract all of the information they need for any emergency. Once again, do a lot of listening before making any calls.

Probably your first call will be for a radio check. Don't use the United States Coast Guard or 2182 kHz for radio checks as they have far more important matters than giving out signal reports all day long.

When you are ready for a radio check, try the distant high seas marine operator. Wait until they are finished with their local weather reports before giving them a call. Always choose the band that sounds the strongest to you.

Follow the procedures for initiating a call in the upcoming chapters of this handbook. The marine telephone companies, it they're not real busy, are more than happy to accommodate a radio check.

You can also receive radio checks from other pleasure boats that you might hear on ship-to-ship frequencies. Most commercial vessels will probably ignore any calls for radio check, so try to select one that sounds like a fellow pleasure boat mariner, and exchange signal reports. You should generally receive reciprocal reports. If a station sounds very weak to you, they will probably say that you are weak to them. Same thing with the telephone service; if they're not coming in strong, you won't either.

Weak signals are not necessarily a result of something wrong with your installation. Sometimes ionospheric band conditions simply won't

favor any particular single sideband band. Try the next band up to improve signal reports. Try a different time of day, and expect that some days you'll have better signal levels than others.

Did You Know?

Since your radio waves are solely dependent on ionospheric conditions, it's quite normal for signal levels to change. You may also notice that signals will fade in and out on the higher frequencies, such as 12, to 27 MHz. Again, this is completely normal and should result in almost no loss of intelligibility during a call.

Another fun way to check the operation of your equipment is to receive as many foreign broadcast stations as possible. Refer to the back of this book for a listing of international shortwave transmitting stations. These stations should normally come in loud and clear, but are still subject to 20 second fades. If you are hearing plenty of activity on these frequencies, plus strong signals from other boats and shore stations, chances are your installation is working fine, and you will enjoy worldwide communications with single sideband equipment.

If you decide to have a licensed technician check out your equipment, most marine electronic dealerships will be more than happy to send a tech with the proper field strength equipment to "sign off" your station. Since you completely installed the equipment yourself, there will be little that the technician will need to do other than to check out your antenna tuner setup, double check all connections to insure that they are weatherproof, and to make some field strength measurements and exchange signal reports with distant stations. Since electronic technicians are quite familiar with the characteristics of single sideband frequencies, they can quite accurately assure you that your set is on the air and operating perfectly. If there is any way that they can squeeze a few more watts out of your system, they will also do that. Have them sign your log book with their license number to further verify that your system is 100 percent "go."

CHAPTER 14

Operating Procedures - Distress, Urgency and Safety

If you have an emergency, plan to use your VHF set as well as your marine single sideband to call out for help. If you are within 100 miles of the shore, first try your VHF on the international distress channel, Channel 16. If you are far out to sea and do not receive immediate response on VHF Channel 16, your next step is to switch to long-range single sideband.

First try 2187.5 kHz, the international distress call for marine single sideband. If after three attempts you do not receive an immediate reply to your distress call, then switch to any frequency where you hear strong signals. The marine operator is always a good one. Use any frequency on your marine sideband that will get a response from another station.

Here are the procedures for placing or acknowledging a distress call on your marine single side band, as well as for your VHF marine transceiver. These are the approved procedures as outlined by the Radio Technical Commission for Maritime Services in cooperation with the Federal Communications Commission.

◆ ***Spoken Emergency Signals***

There are three spoken emergency signals:

(1) Distress Signal: MAYDAY

Distress signal MAYDAY is used to indicate that a mobile station is threatened by grave and immediate danger and requests immediate assistance. MAYDAY has priority over all other communications.

(2) Urgency Signal: PAN-PAN (Properly pronounced PAHN-PAHN)

Used when the safety of the vessel or person is in jeopardy.

"Man overboard" messages are sent with the Urgency signal. PAN-PAN has priority over all other communications with the exception of distress traffic.

(3) Safety Signal: SECURITY (Pronounced SAY-CURITAY)

Used for messages concerning the safety of navigation or giving important meteorological warnings.

Any message headed by one of the emergency signals (MAYDAY, PAN-PAN, or SECURITY), must be given precedence over routine communications. This means listen. Don't transmit. Be prepared to help if you can. The decision of which of these emergency signals to use is the responsibility of the person in charge of the vessel.

◆ ***Radiotelephone Alarm Signal*** [notes indicate this rule changes in 1999 -- 2187.5]

This signal consists of two audio frequency tones transmitted alternately. This signal is similar in sound to a two-tone siren used by some ambulances. When generated by automatic means, it shall be sent as continuously as practicable over a period of not less than 30 seconds nor more than one minute. The purpose of the signal is to attract the attention of the person on watch or to actuate automatic alarm devices. The radiotelephone alarm signal shall be used only with the distress signal except in the situation discussed in the section dealing with the Urgency Call and Message Procedures.

◆ ***Distress Call and Message***

SENDING: Distress Call and Message

First send the Radiotelephone Alarm Signal, if available.

(1) Distress signal MAYDAY (spoken three times)
(2) The words THIS IS (spoken once)
(3) Name of vessel in distress (spoken three times) and call sign (spoken once)

The Distress Message immediately follows the Distress Call and consists of:

(4) Distress signal MAYDAY (spoken once)
(5) Name of vessel (spoken once)
(6) Position of vessel in distress by latitude and longitude or bearing (true or magnetic, state which) and distance to a well-known landmark such as a navigational aid or small island, or in any terms which will assist a responding station in locating the vessel in distress. Include any information on vessel movement such as course, speed, and destination.
(7) Nature of distress (sinking, fire, etc.)
(8) Kind of assistance desired
(9) Any other information which might facilitate rescue, such as: length or tonnage of vessel, number of persons on board, and number needing medical attention, color of hull, decks, cabin, masts, etc. (10) The word OVER

EXAMPLE: Distress Call and Message

(Send Radiotelephone Alarm Signal, if available, for at least 30 seconds but not more than one minute)

"MAYDAY-MAYDAY-MAYDAY
THIS IS-BLUE DUCK-BLUE DUCK-BLUE DUCK-WA 1234
MAYDAY-BLUE DUCK
DUNGENESS LIGHT BEARS 185 DEGREES
MAGNETIC-DISTANCE 2 MILES
STRUCK SUBMERGED OBJECT
NEED PUMPS-MEDICAL ASSISTANCE AND TOW
THREE ADULTS-TWO CHILDREN ABOARD
ONE PERSON COMPOUND FRACTURE OF ARM
ESTIMATE CAN REMAIN AFLOAT TWO HOURS
BLUE DUCK IS THIRTY-TWO FOOT CABIN CRUISER
BLUE HULL-WHITE DECK HOUSE
OVER"

NOTE: Repeat at intervals until answer is received. If no answer is received on the Distress frequency, repeat using any other available channel on which attention might be attracted.

◆ ***Acknowledgment of Distress Message***

If you hear a Distress Message from a vessel and it is not answered, then YOU must answer. If you are reasonably sure that the distressed vessel is not in your vicinity, you should wait a short time for others to acknowledge. In any event, you must log all pertinent details of the Distress Call and Message.

SENDING: Acknowledgment of Receipt of Distress Message

Acknowledgment of receipt of a Distress Message usually includes the following:

(1) Name of vessel sending the Distress Message (spoken three times)
(2) The words THIS IS (spoken once)
(3) Name of your vessel (spoken three times)
(4) The words RECEIVED MAYDAY (spoken once)
(5) The word OVER (spoken once)

EXAMPLE: Acknowledgment Message

"BLUE DUCK-BLUE DUCK-BLUE DUCK-WA 1234
THIS IS-WHITE WHALE-WHITE WHALE-WHITE WHALE-WZ4321
RECEIVED MAYDAY
OVER"

◆ ***Offer of Assistance***

After you acknowledge receipt of the distress message, allow a short interval of time for other stations to acknowledge receipt, if any are in a position to assist. When you are sure of not interfering with other

distress-related communications, contact the vessel in distress and advise them what assistance you can render. Make every effort to notify the Coast Guard. The offer-of-assistance message shall be sent only with the permission of the person in charge of your vessel.

SENDING: Offer-of-Assistance Message

The Offer-of-Assistance Message usually includes the following:

(1) Name of the distressed vessel (spoken once)
(2) The words THIS IS (spoken once)
(3) Name of the calling vessel (spoken once)
(4) The word OVER (spoken once)
(5) (On hearing an acknowledgment, ending with the word OVER from the distressed vessel, continue with your offer of assistance message.)
(6) Name of calling vessel and radio call sign (spoken once)
(7) The word OVER (spoken once)

EXAMPLE: Offer-of-Assistance

To be sent after a short interval of time, but long enough to be sure that further transmissions will not cause harmful interference and long enough to work out relative position and time to reach the distressed vessel:

"BLUE DUCK-THIS IS-WHITE WHALE-OVER
(on hearing the word OVER from BLUE DUCK, continue)
I AM PROCEEDING TOWARD YOU PROM TEN MILES WESTWARD EXPECT TO ARRIVE IN ONE HOUR
COAST GUARD HAS BEEN NOTIFIED INCLUDING YOUR NEED FOR DOCTOR
I HAVE ONE INCH PORTABLE PUMP
PLEASE ADVISE IF MY ASSISTANCE IS NOT NEEDED
WHITE WHALE-WZ4321-OVER"

◆ ***Urgency Call and Message Procedures***

The Urgency Call begins with the emergency signal, consisting of three repetitions of the group of words PAN-PAN (pronounced PAHN-PAHN). The Urgency Call and Message is transmitted on VHF Channel 16 (or 2182 kHz, in the same way as the Distress Call and Distress Message. The Urgency signal PAN-PAN indicates that the calling person has a message concerning the safety of the vessel, or a person in jeopardy. The Urgency signal is authorized for situations like the following:

- Transmission of an urgent storm warning by an authorized shore station.
- Loss of person overboard but only when the assistance of other vessels is required.
- No steering or power in shipping lane.

SENDING: Urgency Call and Message

The Urgency Call and Message usually include the following:

(1) The Urgency signal PAN-PAN PAN-PAN PAN-PAN
(2) Addressee-ALL STATIONS (or a particular station)
(3) The words THIS IS (spoken once)
(4) Name of calling vessel (spoken three times) and call sign (spoken once)
(5) The Urgency Message (state the urgent problem)
(6) Position of vessel and any other information that will assist responding vessels. Include description of your vessel, etc.
(7) The words THIS IS (spoken once)
(8) Name of calling vessel and radio call sign (spoken once)
(9) The word OVER

EXAMPLE: Urgency Call and Message

(Not involving possible use of radiotelephone alarm)

"PAN-PAN PAN-PAN PAN-PAN-ALL-STATIONS
(or a particular station)
THIS IS-BLUE DUCK-BLUE DUCK-BLUE DUCK
HAVE LOST MY RUDDER
AM DRIFTING TOWARD SHORE AND REQUIRE TOW
SEVEN PERSONS ON BOARD
BLUE DUCK IS THIRTY-TWO FOOT CABIN
CRUISER - BLUE HULL
WHITE DECK HOUSE
THIS IS-BLUE DUCK-WA 1234
OVER"

◆ ***Safety Call and Message Procedures***

The Safety Call, headed with the word SECURITY (SAY-CURITAY, spoken three times), is transmitted on the Distress and Calling frequency (VHF Channel 16 or 2182 kHz), together with a request to shift to a working frequency where the Safety Message will be given. The Safety Message may be given on any available working frequency.

United States Coast Guard stations routinely use the Safety Call SECURITY to alert boating operators that they are preparing to broadcast a message concerning safety of navigation. The call also precedes an important meteorological warning. The Safety Message itself is usually broadcast on Coast Guard Channel 22A (157.1 MHz) and 2670 kHz. Although recreational boating operators may use the Safety Signal and Message, in many cases they would get better results and perhaps suffer less criticism by giving the information to the Coast Guard without making a formal Safety Call. The Coast Guard usually has better broadcast coverage from its shore stations and will rebroadcast the information if it is appropriate.

SENDING: The Safety Call and Message

The Safety Call usually includes the following: (On VHF Channel 16 or 2182 kHz.)

(1) The Safety Signal SECURITY (spoken three times)
(2) Addressee-ALL STATIONS (or a particular station)
(3) The words THIS IS (spoken once)
(4) Name of vessel calling and radio call sign
(5) Announcement of the working channel (frequency) where the Safety Message will be given
(6) Radio Call Sign
(7) The word OUT

The Safety Message usually includes the following: (Select working channel (frequency) announced in step 5 above)

(1) The Safety Signal SECURITY (spoken three times)
(2) The words ALL STATIONS (spoken once)
(3) The words THIS IS (spoken once)
(4) Give the Safety Message
(5) Repeat the Radio Call Sign
(6) The word OUT

EXAMPLES: Safety Call and Message

(On VHF Channel 16)
"SECURITY-SECURITY-SECURITY-ALL STATIONS
THIS IS-BLUE DUCK-WA 1234
LISTEN CHANNEL 68
WA 1234-OUT"

(On VHF Channel 68)
"SECURITY-SECURITY-Security-ALL STATIONS
THIS IS-BLUE DUCK-WA 1234
A LOG APPROXIMATELY TWENTY FEET LONG TWO FEET IN DIAMETER ADRIFT OFF HAINS POINT
POTOMAC RIVER
WA 1234-OUT"

◆ ***Coast Guard Channels***

The government frequency 2182 kHz and 2670 kHz are widely used by recreational boating operators for communicating with U.S. Coast Guard shore stations and ship stations, and with USCG Auxiliary vessels when these vessels are operating under orders. When using these channels, you must first establish communications on the appropriate calling frequency, 2182 kHz on the following long range Coast Guard channels:

COAST GUARD CHANNELS			
Your Transmit	**Your Receive**	**I.T.U. Channels**	**Remarks**
2182 kHz	2182 kHz	None	International distress & calling frequency to all Coast Guard & Rescue agencies worldwide.
2670 kHz	2670 kHz	None	U.S. Coast Guard working channel.
4134 kHz	4426 kHz	424	500-mile Coast Guard working channel.
6200 kHz	6501 kHz	601	Gulf Coast Guard working channel.
8240 kHz	8764 kHz	816	Medium-range Coast Gaurd working channel.
12242 kHz	13089 kHz	1205	Long-range 24-hour Coast Guard working channel.
16432 kHz	17314 kHz	1625	Day/evening long-range Coast Gaurd working channel.

TIP!
Consult your ICOM SSB frequency chart to see where these channels are in your set's memory.

◆ ***Operating Procedures - Regular Communications***

It's very important that you monitor a frequency at least one minute prior to transmitting over it. This insures that you won't "cover up" any communications that may be going on that you might not hear clearly at first. Always wait until a frequency is clear before transmitting.

The following procedures for operating your marine SSB are approved by the Radio Technical Commission for Maritime Services in cooperation with the Federal Communications Commission:

Safety Frequencies

The following table describes the distress and safety frequencies between 4000-27,500 kHz for ship and coast stations, public and private, operating voice radiotelephony (HF-SSB).

SAFETY FREQUENCIES	
FREQUENCY	**CHANNEL DESIGNATOR**
4125.0	"4 Safety"
6125.0	"6 Safety"
8291.0	"8 Safety"
12290.0	"12 Safety"
16420.0	"16 Safety"

Operating Procedures (other than Distress, Urgency and Safety)

◆ ***Maintain a Watch***

Whenever your marine VHF or SSB radio is turned on, keep the receiver tuned to the appropriate distress and calling frequency, 156.8 (VHF Channel 16) or 2182 kHz. This listening watch must be maintained at all times the station is in operation and you are not actually communicating. The Coast Guard maintains a silent period on 2182 kHz for three minutes immediately after the hour and for three minutes immediately after the half hour. During these silent periods only messages or transmissions concerning distress or urgency are made.

Since this watch is required for safety and to facilitate communications by providing a common calling channel, it is not permissible for one vessel in a fleet of vessels traveling together to maintain this watch while the other vessels guard another channel, such as a common intership channel. You may maintain a watch on a working channel, however, and may establish communications directly on that channel provided you simultaneously maintain your watch on the distress and calling channel.

Record the times you maintain this watch in your Radio Log.

◆ ***Choose the Correct Channel or Frequency***

Ship-to-Ship Channels

Each of the marine frequencies and channels is authorized for a specific type of communication. It is required that you choose the correct channel for the type of communication you are making. For example, certain channels are set aside exclusively for intership use. See the following chart.

SHIP FREQUENCIES (SIMPLEX) (USB)			
MINIMUM RANGE	**INFORMAL CHNL CODE**	**FREQUENCY kKz**	**BEST TIME**
50 miles	Ship 2-A	2065.0	Night
50 miles	Ship 2-B	2079.0	Night
50 miles	Ship 2-C	2096.5	Night
50 miles	Ship 3-A	3023	Night
150 miles	Ship 4-A	4146	Night
150 miles	Ship 4-B	4149	Night
150 miles	Ship 4-C	4417	Night
170 miles	Ship 5-S	5680	Day/Night
200 miles	Ship 6-A	6224	Day/Night
200 miles	Ship 6-B	6227	Day/Night
200 miles	Ship 6-C	6230	Day/Night
200 miles	Ship 6-D	6516	Day/Night
400 miles	Ship 8-A	8294	Day
400 miles	Ship 8-B	8297	Day
1000 miles	Ship 12-A	12353	Day
1000 miles	Ship 12-B	12356	Day
1000 miles	Ship 12-C	12359	Day
5000 miles	Ship 16-A	16528	Day
5000 miles	Ship 16-B	16531	Day
5000 miles	Ship 16-C	16534	Day
5000 miles	Ship 18-A	18840	Day
5000 miles	Ship 18-B	18843	Day
10,000 miles	Ship 22-A	22159	Day
10,000 miles	Ship 22-B	22162	Day
10,000 miles	Ship 22-C	22165	Day
10,000 miles	Ship 22-D	22168	Day
10,000 miles	Ship 22-E	22171	Day
10,000 miles	Ship 25-A	25115	Day
10,000 miles	Ship 25-B	25118	Day

◆ ***Calling Another Ship***

Turn your radiotelephone on and listen on the appropriate distress and calling frequency, 2182 kHz, to make sure it is not being used. If it is clear, put your transmitter on the air. This is usually done by depressing the "push to talk" button on the microphone. (To hear a reply, you must release this button.)

Speak directly into the microphone in a normal tone of voice. Speak clearly and distinctly. Call the vessel with which you wish to communicate by using its name; then identify your vessel with its name and FCC assigned call sign. Do not add unnecessary words and phrases as "COME IN BOB" or "DO YOU READ ME." Limit the use of phonetics to poor transmission conditions.

This preliminary call must not exceed 30 seconds. If contact is not made, wait at least two minutes before repeating the call. After this time interval, make the call in the same manner. This procedure may be repeated no more than three times. If contact is not made during this period, you must wait at least 15 minutes before making your next attempt.

Once contact is established on 2182 kHz, you must switch to an appropriate working frequency for further communication. You may only use VHF Channel 16 and 2182 kHz for calling, and in emergency situations.

Since switching to a working frequency is required to carry out the actual communications, it is often helpful to monitor the working frequency you wish to use, briefly, before initiating the call on 2182 kHz. This will help prevent you from interrupting other users of the channel.

All communications should be kept as brief as possible and at the end of the communication, each vessel is required to give its call sign, after which, both vessels switch back to the distress and calling channel in order to reestablish the watch.

Two examples of acceptable forms for establishing communication with another vessel follow:

EXAMPLE 1	
VESSEL	**VOICE TRANSMISSION**
BLUE DUCK (on 2182 kHz)	"MARYJANE-THIS IS-BLUE DUCK-WA 1234"
MARY JANE (on 2182 kHz)	"BLUE DUCK-THIS IS-MARY JANE-WA 5678-REPLY 8A" (or some toher proper working channel.)
BLUE DUCK (on 2182 kHz)	"8A" ie "ROGER" (If unable to replay on the channel selected, an appropriate alternate should be selected.)
BLUE DUCK (on working channel 8A)	"BLUE DUCK"
MARY JANE (on working channel 8A)	"MARY JANE"
BLUE DUCK (on working channel 8A)	(Continue with message and terminate communications within three minutes. At the end of the communications, each vessel gives its call sign.)

EXAMPLE 2	
VESSEL	**VOICE TRANSMISSION**
BLUE DUCK (on 2182 kHz)	"MARYJANE-BLUE DUCK-WA 1234-REPLY"
MARY JANE (on 4A)	"MARY JANE-WA 5678"
BLUE DUCK (on 4A)	"BLUE DUCK" (Continues message and terminate communicaitons as indicated in example 1)

A short form most useful when both parties are familiar with it

CHAPTER 15

Using Your SSB for Low-Cost E-Mail

Marine SSB will accept the radio modem and computer on rear accessory plugs.

Your new SSB transceiver may have many channels designated for narrow-band direct printing (NBDP). These are frequencies for simplex telex over radio (SITOR) which has been the established mode of maritime communications for the merchant shipping industry for more than 50 years. SITOR is electronic e-mail over marine frequencies. All you need is a computer and a radio modem to complete the marriage to your marine SSB. With this equipment, you will be able to send and receive e-mail over worldwide frequencies.

Using your lap-top computer and a special modem and your new ICOM SSB, you can send and receive written text messages far more efficiently than voice messages. Written messages allow you to think through what you want to say ahead of time, format your message off-line in your computer, and then send it off with a few keystrokes, right from your vessel at anytime, day or night, anywhere in the world. Your SITOR one-third page of text can go in less than 2 or 3 minutes or often less than the minimum air time voice telephone charge. If you have several pages of text, it could take up to 10-30 minutes, but you are assured of "solid copy" at the other end of the

circuit. You can also receive e-mail as well. Inbound traffic for your vessel is saved in your vessel's own mailbox in the host computer until you are ready to receive it. People on shore can access the system by the Internet, or any one of the several commercial e-mail system such as CompuServe, AOL, Telex, FAX, or voice transcription, using the public telephone system via any of the common carriers. You can also use your computer and your SSB to receive, free of charge, weather facsimile imagery directly from the Coast Guard. You can also receive high-quality weather forecast charts in your mailbox for downloading at your convenience through private yacht weather forecasting companies.

Electronic e-mail over marine SSB circuits are carried on by more than 200 radio telex shore stations in the world as described in the admiralty list of radio signals. All of these worldwide data stations have been coordinated in respect to international billing arrangements for ships of all nations which wish to connect to any foreign coast station along the route of their voyage. Two companies, Globe Wireless, and PinOak Digital offer worldwide networks of pickup and relay stations with only one administration to deal with as you make your international voyage. These networks, of high-frequency coast radio stations are designed to provide both spacial and frequency-diverse channel capacity to all mariners around the globe. Multiple propagation paths together with automated control of the ship's existing high-frequency SSB radio system provide transmission quality and link availability not previously obtainable on similar voice circuits. Traffic lists, message traffic, and other data services are sent throughout all of the world wide network e-mail stations, and downloaded easily with your shipboard lap-top computer.

The typical cost for a SITOR message is about $2.00 a minute, where approximately 300 characters can be sent per minute. This works out to be about three cents per word. If you plan to send high volumes of data on your computer on an almost daily basis, PinOak Digital and Globe Wireless offer other types of high speed data transfer systems that allow you to send and receive messages in about one-tenth the time as normal SITOR.

Did You Know?

For more information about the Globe Wireless e-mail connection to your ICOM SSB, contact Globe Wireless at (800) 876-7234.

For more information about PinOak Digital High Frequency Digital Communications, call (800) 746-625l.

For more information about SAILMAN visit their website at www.sailmail.com

CHAPTER 16

Review: SSB Channel Designators Explained

Your friends with marine SSB may tell you. . .

To talk local, you want to go on 4A. They sometimes call that 4-alpha. It's good in the mornings, and 4-alpha on your set is 4-2. Some sets have it as 4-1, but that's really 4-S. You can look up this channel as 451, which is really 4146. Got it?"

The mysteries of SSB channelization get worse. Did you know that international distress frequency 2182 kHz may NOT be the best place to cry Mayday when you are halfway across the sea?

Single Sideband

And if you call Mayday on Coast Guard working channel 816 or 1205, they could be "duplexing" a weather report and not listening to their input frequency. So WHO do you call in an emergency, anyway, on marine SSB?

And what about making phone calls? Are you really charged $25 just for getting an answering machine? I am happy to report, NO.

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So let's demystify that new marine SSB installation, and compare the channels and frequencies listed in this chapter with what is stored in your SSB's memory.

ALL THOSE CHANNELS. Marine SSB frequencies are assigned specific channels within the following megahertz regions:

MEGAHERTZ REGIONS		
CHANNEL	**MHZ**	**APPROXIMATE RANGE**
2 XX	2 MHz	100 miles day; 1000 miles night
4 XX	4 MHz	100 miles day; 1500 miles night
6 XX	6 MHz	500 miles; 1500 miles night
8 XX	8 MHz	700 miles day; 2000 miles night
12 XX	12 & 13 MHz	100 miles evenings; 3000 miles days
16 XX	17 & 17 MHz	Unreliable evenings; 4000 miles days
22 XX	22 MHz	Daytime only band, worldwide

Each band of marine frequencies skips off the ionosphere and refracts signals back down to earth at different angles. 2 and 4 MHz come back down relatively close to your vessel. 8 and 12 MHz are excellent for medium-range, day and night, skywave "skip" contacts. On 16 and 22 MHz, skywaves fade out at night, but offer the longest range during daylight hours. **The best range usually follows the direction of the sun.**

Choose the megahertz range that will skip your signal to the approximate distance you want to reach. 8 and 12 MHz are the favorites during the day, and 4 and 6 MHz are the favorite bands during the night. 2 MHz is clobbered with noise, and you won't get zip. 22 MHz is too high for reliable daily contacts. Choose 8 and 12 MHz as your "bread and butter" bands.

Marine radio channels are assigned ITU designators. ITU stands for International Telecommunications Union, and assigns commonality to every country's marine SSB set.

But there are differences between each manufacturer of SSB equipment on how they read out the channels, so stay tuned. More to follow.

Most 2 MHz frequencies have little use even 2182 MHz, the international distress and calling frequency. The range is so limited, you would do better to squawk Mayday on VHF channel 16. Most 2 MHz frequencies go by their actual numerical frequency kilohertz, not by three-digit channel designators. Lucky for us, a kilohertz readout on the radio dial is common among all marine SSB radios in every country.

4 MHz to 22 MHz marine channels are all listed by a three-digit or four-digit channel designator. An example would be marine Channel 401, or marine Channel 809, or marine Channel 1206. These channel numbers, common worldwide, are assigned to pairs of radio frequencies that make up a radio channel. Both the marine telephone companies of the world and the United States Coast Guard and rescue agencies throughout the world operate on frequency PAIRS where they transmit on one frequency, and listen on another. This is called DUPLEX. But you don't need to worry about the individual frequencies for ship transmit and ship receive because your marine SSB has all of these channels pre stored in ITU memory. If you dial up marine Channel 808, your set automatically receives on 2740 kHz, and transmits automatically on 8216 kHz. It is prestored duplex, so all you need to know is the channel number and what service goes with which channel numbers.

Currently, AT&T runs the high seas maritime radiotelephone services from three stations that serve this half of the world. However in the future, access will be through station WLO out of Mobile Alabama. AT&T will be limiting the service provided by KMI, WOM, and WOO. From Australia to Africa and everything in between, the AT&T marine operator offers you radiotelephone service on the following channels:

AT&T MARINE OPERATOR		
AT&T SAN FRANCISCO KMI	**AT&T FLORIDA WOM**	**AT&T NEW JERSEY WOO**
401, 416, 417	403, 412, 417	410, 411, 416
804, 809, 822	423, 802, 810	808, 811, 815
1201, 1202, 1203	814, 825, 831	1203, 1210, 1211
1229, 1602, 1603	1206, 1208, 1209	1605, 1620, 1626
1624, 2214, 2223	1215, 1223, 1601	2201, 2205, 2210
2228, 2236	1609, 1610, 1611	2236
	1616, 2215, 2216	
	2222	

TIP!

Choose the channel on a likely frequency that will skip your waves into the particular AT&T maritime services station closest to you. If you're in the South Seas, you might try Channel 1602 to AT&T coast station in California. If you're in the Caribbean, try AT&T coast station in Florida on Channel 403. And if you're sailing to Spain, you might to try AT&T coast station New Jersey on 1203. Otherwise use the WLO Frequencies listed below.

WLO ITU CHANNELS

Channel Number	RX Frequency	TX Frequency
405	4369.0	4077.0
414	4396.0	4104.0
419	4411.0	4119.0
607	6519.0	6218.0
824	8788.0	8264.0

WLO ITU Channels continued on page 62

WLO ITU CHANNELS

Channel Number	RX Frequency	TX Frequency
829	8803.0	8279.0
830	8806.0	8282.0
1212	13110.0	12263.0
1225	13149.0	12302.0
1226	13152.0	12305.0
1607	17260.0	16378.0
1641	17362.0	1648.0
1647	17380.0	16498.0
2237	22804.0	22108.0

Contact Rene Stiegler of WLO radio for information and frequency information packs. PH:(334)665-5110, FX:(334)666-8339, or wloemail@aol.com or rene@shipcom.com

Try tuning these channels in now and listen to the ship-to-shore traffic. You will hear only the shore side of the conversation because the ships are transmitting duplex. Phone calls cost under $5 a minute, with no land-line charges. There is a 3-minute minimum, so once you start gabbing, go for 3 minutes and make it a $15 bill. If you get an answering machine, tell the operator to cancel the call, and you pay nothing. Radio checks with AT&T are free. Calling the Coast Guard through AT&T is also free. What? **Calling the Coast Guard through the high seas marine telephone service? Why?**

COAST GUARD CHANNELS

2182 kHz - Distress	424	Working, Weather, AMVER
Channel	601	Working, Weather, AMVER
Channel	816	Working, Weather, AMVER
Channel	1205	Working, Weather, AMVER
Channel	625	Working, Weather, AMVER

These are United States Coast Guard weather, AMVER, and working channels and are not necessarily monitored 24 hours a day for a distress call. These are the channels where you will hear automated Coast Guard weather. It is digital speech synthesized, and will sound like someone sitting on a fish hook.

If you need the Coast Guard anywhere in the world, call on the high seas marine operator duplex channels. I guarantee they are listening because they're looking to make money on an incoming phone call. They won't make money on a Coast Guard call because they'll patch you through free. But once your situation is stabilized, the Coast Guard will ask you to switch over to one of their working channels. Suggest a channel near the MHz band you are presently going through the marine operator on. Just look at your radio dial—if it's reading 1201, then you are on the 12 MHz band. You would suggest to the Coast Guard you can work them on ITU Channel 1205. Switch over, and you will hear their friendly voice.

Did You Know?

The Coast Guard tracks commercial shipping all over the world on a computer in New York—and if you need help or evacuation anywhere out on the sea they can probably find someone within 300 miles of you and request them to divert and lend assistance. This is part of the Coast Guard's AMVER program.

Ship-to-Ship

Here is where SSB radio manufacturers have split from the normal channeling scheme. Here are the channel designators that SHOULD come up on your marine SSB for ship to-ship safety and routine calls:

CHANNEL DESIGNATORS		
CHANNEL	**FREQUENCY**	**USE AND DESIGNATOR**
4-0	4125 kHz	Safety, "4S"
4-1	4146 kHz	Ship-to-Ship, "4A"
4-2	4149 kHz	Ship-to-Ship, "4B"
4-3	4417 kHz	Ship-to-Ship, "4C"
6-0	6125 kHz	Safety, "6S"
6-1	6224 kHz	Ship-to-Ship, "6A"
6-2	6227 kHz	Ship-to-Ship, "6B"
6-3	6230 kHz	Ship-to-Ship, "6C"
6-4	6516 kHz	Ship-to-Ship, "6C"
8-0	8291 kHz	Safety, "8S"
8-1	8294 kHz	Ship-to-Ship, "8A"
8-2	8297 kHz	Ship-to-Ship, "8B"
12-0	12.290 kHz	Safety, "12S"
12-1	12.353 kHz	Ship-to-Ship, "12A"
12-2	12.356 kHz	Ship-to-Ship, "12B"
12-3	12.359 kHz	Ship-to-Ship, "12C"
12-4	12.362 kHz	Ship-to-Ship, "12C"
12-5	12.356 kHz	Ship-to-Ship, "12E"
16-0	16.420 kHz	Safety, "16S"
16-1	16.528 kHz	Ship-to-Ship, "16A"
16-2	16.528 kHz	Ship-to-Ship, "16B"
16-3	16.534 kHz	Ship-to-Ship, "16C"
22-8	22.159 kHz	Ship-to-Ship, "22A"
22-9	22.162 kHz	Ship-to-Ship, "22B"
22-0	22.165 kHz	Ship-to-Ship, "22C"
22-4	22.168 kHz	Ship-to-Ship, "22C"
22-5	22.171 kHz	Ship-to-Ship, "22E"

TIP!

Not all marine SSB transceivers list these ship-to-ship channels by the ITU duplex number. Most ICOM marine SSB transceivers list ship-to-ship simplex frequencies by the megahertz band, a hyphen, and numbers 1 through 9. Sometimes the number l and 2 correspond with ship-to-ship A and B channels, yet other times they number up from the safety channel so A now becomes "-2." But not to worry, just double check the frequency with the ship-to-ship channels and frequencies I have just listed, and go with the frequency.

The safety channels are restricted to navigation. Safety, and weather information, similar to what takes place on marine VHF channel 6. No gabbing on the marine SSB safety channels. The marine ship-to ship channels may also be used by private coast stations so you can talk from ship to shore and bypass the marine operator. Towing and salvage companies, plus marine stores regularly conduct business on ship-to-ship channels 4A, 8A, and 12A. Now go back to the list and double check the frequencies:

4A = 4146 kHz
8A = 8294 kHz
12A = 12,353 kHz

Find these channels on your own SSB radio, and verify the channel number agreeing with the actual ship-to-ship/ship-private coast shore frequency.

If you're cruising, the Federal Communications Commission offers additional 4 MHz and 8 MHz channels for ship-to-ship communications. This will relieve all of the congestion now found on popular channels 4A, 4B, 8A and 8B. At last—"secret" ship-to-ship SSB frequencies that are perfectly legal under FCC Rule 80.374 (b) (c).

"SECRET" SHIP-TO-SHIP FREQUENCIES	
4 MHz SHIP-TO-SHIP FREQUENCIES	**8 MHz SHIP-TO-SHIP FREQUENCIES**
4000	8101
4003	8104
4006	8107
4009	8110
4012	8116
4015	8119
4018	8122
4021	8125
4024	8131
4027	8134
4030	8137
4033	8140
4036	8143
4039	8146
4042	8149
4045	8152
4048	8155
4051	8158
4054	8161
4057	8164
	8157
	8170
	8173
	8176
	8179
	8182
	8185
	8188
	8191

The FCC Rules state, "These frequencies are shared with fixed services, and marine ship-to-ship operation must not cause harmful interference to those other services." In other words, if you and a cruising buddy land on a frequency and overhear shore traffic complaining about your ship-to-ship communications, switch off that channel in the table above.

Shore stations will continue to monitor their regular frequencies on 4 and 8 Alpha and Bravo frequencies, no charge. But mariners wishing to intercommunicate ship-to-ship on 4 MHz and 8 MHz may now switch to these new, very quiet SSB channels in full compliance with FCC rules. In fact, 4030 MHz is fast becoming the Baja "intercom" channel for mariners with SSB transceivers.

In the Caribbean to Panama canal, try 4054. Hams in the canal, listen 7083 to 7085 lower sideband.

WEATHER FACSIMILE CHANNELS	
ALL UPPER SIDEBAND:	
Pacific Coast	8680.1 kHz
Pacific Coast/Long-Range	12,728.1 kHz
Hawaii	11,088.1 kHz
Pacific/Hawaii	16,133.1 kHz
Hawaii	9980.6 kHz
New Gulf Frequencies	4316, 8502, 12,788 kHz
Boston	6340.5 kHz
Atlantic	10,863.2, 12,748.1, 8078.1, 15,957 kHz

TIP!

You might also memorize aeronautical East Coast and West Coast tower channels 13,282 and 13,270 kHz. I would also fill up one of those user-programmable memory channels with 13,300 and 5547 kHz, both upper sideband, aeronautical in-route frequencies. **If you can't raise the Coast Guard in an emergency, squawk Mayday to an airliner! It's been done before.**

FCC rules prohibit a marine radio being shared with another radio service. But if you are a voluntary equipped boat, you are not required by law to have a marine radio onboard—so one day you consider it a marine radio, and the next day you consider that marine radio a ham radio. Trust me. It works, but only if the marine radio has capabilities already unleashed as an amateur radio.

You could store the ham FREQUENCIES into any one of the 100 or more user-programmable marine channels on a modem ICOM marine SSB radio. A sample:

3968 kHz, lower sideband, West Coast marine nets
7268 kHz, lower sideband, East Coast waterway net
7238 & 7294 kHz, lower sideband, morning West Coast nets
14.300 kHz, upper sideband, 24-hour ham maritime mobile nets
14.340 kHz, upper sideband, West Coast 11 :00 a.m. mañana net
14,313 kHz, upper sideband, Pacific evening maritime net
21,402 kHz, upper sideband, Pacific and South Pacific

You need an amateur license to talk on these frequencies, but you don't need a license to listen and glean great weather information. In an emergency, you can holler for help on these frequencies without any questions asked. But it better be a real life-and-death emergency. You know how hams are. I'm one of them, too!

Finally, your SSB transceiver can be put into the AM double sideband mode, and the time signals and shortwave broadcast frequencies memorized to get up-to-date weather information the correct time, and the latest news from BBC and Voice of America.

5, 10, 15 and 20 MHz time signals
5975 kHz AM shortwave
7435 kHz AM shortwave
9575 kHz AM shortwave
11, 835 kHz AM shortwave
13,760 kHz AM shortwave
15,120 kHz AM shortwave

Tune anywhere around these AM shortwave frequencies for plenty of foreign and USA broadcasts.

Your best radio check is with the high seas marine operator. You must call them for a minimum of 45 seconds in order for them to beam you in with their massive antenna systems. A quick call will lead to no contact. Make it a long call, giving your vessel name, official FCC call sign or ship registration number, your position, the ITU channel you are communicating over, and repeat the process over and over and over and over again for 45 total seconds. Close talk the mic—push the plastic right up against your lips. If you talk 6 inches away from the mic, your power output will be zilch. SSB mic are all noise canceling, and you must absolutely touch the mic to your lips to get a signal out on the airwaves.

As you talk, you may notice your panel lights blinking, your anemometer exceeding 100 knots, your electric head going into the masticate mode, and various other pieces of marine electronics including autopilots going nuts on transmit. This is perfectly normal. It means you're putting out one walloping signal. You must live with it. There is no simple cure.

TIP!

Your radio check to the marine operator should finally achieve success on one of their working channels. If one megahertz band doesn't work, dial in another marine operator in another part of the country, and give THEM a try. Or tail in at the end of another ship contact when the marine operator is ready to sign off. If you can hear the marine operator well, they should pick you up as well.

One of the best radio checks is from the technician that installed the marine SSB. Don't let them off the ship until they reach a marine operator at least 1,000 miles away and get a good radio check on the air. Accept no excuses. I have seen marine SSB installations that LOOK good on a wattmeter, but over the air SOUND bad. An improperly installed automatic antenna tuner cable rectifies the RF wave and brings it back into the radio, scrambling your audio to sound like you are talking underwater. You can't see it on a meter, but you'll sure know you have this problem if absolutely nobody comes back to your request for radio checks.

With more and more radiotelephone calls going satellite aboard ships, be assured that the high seas marine SSB radiotelephone service is looking for more activity out there on the airwaves, and the technicians are eager to get you into their computers and will regularly run radio checks with you to give you the confidence of knowing they can reach out almost anywhere to take your incoming or outgoing phone call. Radio checks are free.

Did You Know?

The marine SSB radio manufacturers are delivering equipment designed more for the radio guru than the active sailor with things on the mind other than is 451 really 4-1 or is it really 4-alpha? ICOM's M710 marine SSB has the capability of programming the screen to read out the channel function in addition to just the channel number and frequency. Great idea.

A marine SSB is a powerful communications device for worldwide cruising and sailing. Know its capabilities, and know what the channels can do for you. There is absolutely nowhere in the world that you could cruise that you couldn't get back to a shore-side station on marine SSB on one of the megahertz bands. EVERYWHERE there are domestic and foreign shore-side stations ready to take your duplex channel activity. The modern marine SSB has all of these channels in memory. Now you know where to go to make that ship-to-ship, ship-to-shore, or emergency distress call.

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
ALBANIA	Durres P.T. Radio	ZAD	402, 805, 1206, 1639, 2226
ALGERIA	Alder Radio	7TA	410, 413, 424, 426, 601, 603, 605, 802, 809, 813, 825, 1207, 1215, 1217, 1232, 1629, 1631, 1636, 1641, 2205, 2225, 2227, 2238
ARGENTINA	Bahia Blanca Radio	LPW	406, 421, 601, 818, 821
	Corrientes Radio	LPB	424, 810
	General Pacheco Radio	LPL	413, 421, 426, 603, 606, 802, 814, 821, 1220, 1221, 1601, 1621, 2204, 2221
	Ushuaia Radio	LPC	410, 812, 1230
AUSTRALIA	Adelaide Radio	VIA	419, 424, 603, 817, 1227
	Brisbande Radio	VIB	404, 415, 424, 603, 811, 1229
	Broome Radio	VIO	424, 603
	Carnarvon Radio	VIC	424, 603
	Darwin Radio	VID	415, 424, 603, 811, 815, 1227, 1229
	Esperance Radio	VIE	424, 603
	Hobart Radio	VIH	424, 603
	Melbourne Radio	VIM	404, 424, 603, 811, 1226
	Perth Radio	VIP	404, 424, 603, 811, 1226
	Rockhampton Radio	VIR	424, 603
	Sydney Radio	VIS	405, 417, 424, 603, 802, 829, 1206, 1231, 1602, 1610, 2203, 2223,
	Thursday Island Radio	VII	424, 603
	Townsville Radio	VIT	419, 424, 603, 817
AZORES	Miguel Radio	CUG	426, 813, 1207, 1615, 1632, 2207, 2222
BAHRAIN	Bahrain Radio	A9M	413, 806, 1209, 1618

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
BANGLADESH	Chittagong Radio	S3D	402, 416, 421, 602, 806, 821, 1202, 1221, 1603, 2202
	Khulna Radio	S3E	418, 416, 421
BARBADOS	Barbados Radio	8PO	407, 816, 825, 1213, 1640
BELGIUM	Oostende Radio	OSU	408, 411, 417, 421, 422, 425, 602, 606, 803, 805, 806, 812, 813, 815, 821, 829, 1207, 1213, 1215, 1218, 1219, 1221, 1609, 1613, 1621, 1625, 1627, 1630, 2209, 2214, 2219, 2221, 2225, 2239
BERMUDA	Bermuda Radio	VRT	410, 603, 817, 1220, 1618
BRAZIL	Belem Radio	PPL	404, 405, 419, 819, 821, 822, 830, 1228, 1633
	Fortaleza Radio	PPF	819, 821, 828
	Ilheus Radio	PPI	404, 405, 819, 821, 824
	Itajai Radio	PPC	404, 405, 819, 821, 822
	Juncao Radio	PPJ	404, 409, 419, 819, 821, 824, 828, 1228, 1617
	Manaus Radio	PPM	404, 405, 416, 819, 821, 830
	Natal Radio	PPN	404, 409, 819, 821, 830
	Olinda Radio	PPO	404, 405, 419, 821, 824, 828, 1211, 1606
	Rio Radio	PPR	404, 405, 409, 416, 419, 819, 821, 822, 828, 830, 1214, 1221, 1611, 1613, 1621, 2221, 2238
	Salvador Radio	PPA	404, 409, 416, 819, 821, 822
	Santarem Radio	PPT	404, 409, 819, 821, 824, 1209

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
BRAZIL (CONT'D)	Santos Radio	PPS	404, 409, 416, 819, 821, 824, 1219
	S. Luis Radio	PPB	404, 409, 819, 821, 824
	Vitoria Radio	PPV	404, 409, 416, 819, 821, 828
CANADA	Cambridge Bay Coast Guard Radio	VFC	403
	Coppermine Coast Gaurd Radio	VFU	403
	Coral Harbor Coast Guard Radio	VFU	407
	Frobisher Bay Coast Guard Radio	VFF	407, 603, 812, 1201, 1634
	Goose Bay Coast Guard Radio	VFZ	408
	Halifax Coast Guard Radio	VCS	413, 418, 605, 823, 1213, 1604
	Inuvik Coast Guard Radio	VFA	403
	Killinek Coast Gaurd Radio	VAW	407
	Resolute Coast Guard Radio	VFR	407, 825
	Vancouver Coast Guard Radio	VAI	410, 605, 807, 1207, 1608, 2220
	Vancouver Radio (B.C. Tel.)	CFW	418
CAPE VERDE	Praia de Dabo Verde Radio	D4D	418, 820, 1218, 1623
	S. Vicente de Cabo Verde Radio	D4A	418, 820, 1218, 1623
CHILE	Valparaiso Playa Ancha Radiomaritima	CBV	419, 421, 425, 601, 606, 807, 809, 815, 821, 1210, 1218, 1221, 1224, 1621, 1631, 1640, 2221, 2225, 2240

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
COLOMBIA	Barranquilla Radio Buenaventura Radio	HKB HKC	406, 826, 1203, 1615 406, 826, 1203, 1615
COOK ISLAND	Rarotonga Radio	ZKR	821, 825
CUBA	Havana Radio Sntiago de Cuba Radio	CLA CLM	401, 418 418, 809, 1217, 1626
CYPRUS	Cyprus Radio	5BA	406, 141, 421, 426, 603, 606, 807, 818, 820, 821, 829, 1201, 1208, 1221, 1230, 1603, 1621, 1632, 2212, 2218, 2221
DENMARK	Lyngby Radio	OXZ	401, 403, 409, 415, 418, 420, 421, 424, 425, 426, 603, 605, 606, 801, 808, 811, 813, 818, 821, 823, 825, 827, 829, 1203, 1210, 1211, 1214, 1215, 1217, 1219, 1221, 1223, 1226, 1601, 1603, 1605, 1608, 1614, 1617, 1618, 1621, 1622, 1635, 1641, 2203, 2208, 2211, 2213, 2216, 2218, 2228, 2234, 2236
DJIBOUTI	Djibouti Radio	J2A	418, 827, 1210
EGYPT	Alexandria Radio	SUH	418, 605, 817, 1216, 1610, 2226
ETHIOPIA	Assab Radio	ETC	403, 605, 805
FIJI	Suva Radio	3DP	406, 810

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
COLOMBIA	Barranquilla Radio Buenaventura Radio	HKB HKC	406, 826, 1203, 1615 406, 826, 1203, 1615
COOK ISLAND	Rarotonga Radio	ZKR	821, 825
CUBA	Havana Radio Sntiago de Cuba Radio	CLA CLM	401, 418 418, 809, 1217, 1626
CYPRUS	Cyprus Radio	5BA	406, 141, 421, 426, 603, 606, 807, 818, 820, 821, 829, 1201, 1208, 1221, 1230, 1603, 1621, 1632, 2212, 2218, 2221
DENMARK	Lyngby Radio	OXZ	401, 403, 409, 415, 418, 420, 421, 424, 425, 426, 603, 605, 606, 801, 808, 811, 813, 818, 821, 823, 825, 827, 829, 1203, 1210, 1211, 1214, 1215, 1217, 1219, 1221, 1223, 1226, 1601, 1603, 1605, 1608, 1614, 1617, 1618, 1621, 1622, 1635, 1641, 2203, 2208, 2211, 2213, 2216, 2218, 2228, 2234, 2236
DJIBOUTI	Djibouti Radio	J2A	418, 827, 1210
EGYPT	Alexandria Radio	SUH	418, 605, 817, 1216, 1610, 2226
ETHIOPIA	Assab Radio	ETC	403, 605, 805
FIJI	Suva Radio	3DP	406, 810

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
FRANCE	S. Lys Radio	FFL	404, 405, 416, 419, 817, 825, 828, 830, 1222, 1226, 1229, 1231, 1604, 1619, 1628, 1633, 2204, 2226, 2231, 2235
FRENCH SOUTHERN & ANTARCTIC LANDS	S. Paul et Amsterdam Radio	FJY	411, 825
FINLAND	Hanko Radio Helsinki Radio	OFI OHG	406, 413, 141, 417, 422 406, 413, 414, 417, 422, 802, 804, 805, 809, 829, 1206, 1209, 1213, 1216, 1224, 1227, 1230, 1606, 1611, 1614, 1615, 1623, 1636, 1638, 2204, 2210, 2214, 2222, 2231
GAMBIA	Banjul Radio	C5G	405, 829
GERMANY	Norddeich Radio Ruegen Radio	DAP Y5P	401, 824, 1205, 1610, 2217 405, 407, 410, 419, 802, 809, 826, 831, 1202, 1204, 1206, 1232, 1619, 1629, 1633, 1640, 2220, 2224, 2226, 2230
GHANA	Takoradi Radio Tema Radio	9GA 9GX	402, 601, 823, 1202, 1616, 2213 409, 602, 825, 1224, 1622, 2215
GIBRALTAR	Gilbraltar Naval Radio	GYU	401, 404, 602, 807, 1212, 1611, 2212

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
GREECE	Athinai Radio	SVN	413, 415, 424, 425, 603, 802, 806, 808, 809, 814, 819, 820, 823, 1204, 1207, 1212, 1220, 1232, 1607, 1609, 1625, 1626, 1627, 1629, 1640, 2217, 2219, 2224, 2231, 2235
GUINEA-BISSAU	Bissau Radio	J5M	413, 426, 802, 813, 1203, 1615, 1635
HONG KONG	Cap D'Aguilar Radio (Hong Kong Radio)		411, 417, 606
ICELAND	Hornafjoerdur Radio	TFT	406, 414, 416, 419
	Reykjavik Radio	TFA	406, 414, 416, 419, 601, 603, 805, 807, 809, 831, 1206, 1208, 1215, 1220, 1606, 1615, 1625, 1630, 2225, 2226
	Siglufjoerdur Radio	TFX	406, 414, 416, 419
INDONESIA	Amboina Radio	PKE	408, 826, 1210
	Banjarmasin Radio	PKG	411, 602, 816
	Belawan Radio	PKB	810, 1205
	Bitung Radio	PKM	418, 830, 1209
	Dumia Radio	PKP	401, 816, 1209
	Jakarta Radio	PKI	812, 1210, 1610, 2234
	Kupang Radio	PKK	604
	Makassar Radio	PKF	414, 828, 1201
	Palembang Radio	PKC	414, 830
	Sabang Radio	PKA	411, 826
	Semarang Radio	PKR	422, 604, 828
	Sorong Radio	PKY	422, 601, 828
	Surabaya Radio	PKD	408, 826, 1212
	Telukbayur Radio	PKP	605
IRAN	Abadan Radio	EQA	407, 604, 1605
	Abbas Radio	EQI	416, 604, 805, 1616, 2235

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
IRAN (Cont'd)	Bushire Radio	EQM	405, 604, 810, 1629, 2203
	Khark Radio	EQQ	410, 604, 1220
	Khoramshahr Radio	EQK	408, 604, 824, 1625, 2205
	Lavan Radio	EQR	420, 604
	Nowshahr Radio	EQO	411, 604, 817
	Shahpoor Radio	EQN	402, 604, 829, 1231, 2233
ISRAEL	Haifa Radio	4XO	404, 410, 418, 423, 603, 604, 801, 805, 812, 821, 827, 1204, 1207, 1213, 1215, 1221, 1609, 1613, 1617, 1628, 2204, 2207, 2217
ITALY	Genova P.T. Radio	ICB	408, 409, 806, 823, 1205, 1211, 1608, 1614, 2216
	Roma P.T. Radio	IAR	402, 412, 420, 423, 602, 604, 814, 819, 820, 826, 831, 1206, 1209, 1213, 1218, 1230, 1603, 1606, 1616, 1624, 2202, 2211, 2223, 2237
IVORY COAST	Abidjan Reche Radio		404, 602, 806, 1212
	Abidjan Radio	TUA	419, 603, 822, 1205, 1634, 2225
JAMAICA	Kingston Jamaica Radio	6YI	405, 416, 605, 812, 1224
JAPAN	Tokyo Radio	JBO	407, 425, 426, 810, 812, 820, 1207, 1212, 1218, 1604, 1609, 1632, 2227, 2236, 2240
KENYA	Mombasa Radio	5ZF	414, 822

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
KIRIBATI (Republic of)	Tarawa Radio	T3T	411, 814
KOREA	Seoul Radio	HLS	401, 419, 602, 605, 803, 827, 1213, 1229, 1634, 1637, 2209, 2222
LEBANON	Beyrouth Radio	ODR	426, 828, 1216
MADAGASCAR	Antalaha Radio		402
	Diego-Suarez Radio	5RL	415
	Fort-Dauphin Radio	5RD	406
	Maintirano Radio		415
	Majunga Radio	5RO	415
	Manakara-Sud Radio		402
	Manajary Radio		415
	Morondava Radio		406
	Nossi-Be Radio	5RN	406
	Tamatave Radio	5RS	406, 604, 605, 807, 831, 1206, 1225, 1637, 2240
MADEIRA	Madeira Radio	CUB	413, 426, 802, 813, 1203, 1207, 1615, 1632, 2207, 2222
MARTINIQUE (French Dept. of)	Fort de France Radio	FFP	404, 424, 825, 828
MEXICO	Acapulco, Guerrero Radio	XFA	403, 408, 421, 603, 604, 606, 809, 821, 826, 1209, 1221, 1222, 1604, 1614, 1621, 2221, 2225, 2234
	Chetumai, Quintana Roo Radio	XFP	404, 401, 421, 601, 604, 606, 817, 821, 829, 1209, 1221, 1222, 1604, 1614, 1621, 2221, 2225, 2238
	Ciudad del Carmen Campeche Radio	XFD	404, 413, 421, 606, 809, 821, 826, 1209, 1221, 1222, 1604, 1614, 1621, 2221, 2225, 2234

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
MEXICO (Cont'd)	Coatzacoalcos, Veracruz Radio	XFF	404, 413, 421, 603, 604, 606, 817, 821, 829, 1221, 1222, 1225, 1604, 1614, 1621, 2221, 2234, 2238
	Cozumel, Quintana Roo Radio	XFC	403, 408, 421, 603, 604, 606, 809, 821, 826, 1209, 1221, 1225, 1604, 1614, 1621, 2221, 2225, 2234
	Ensendada, Baja California Radio	XFE	403, 413, 421, 603, 604, 606, 809, 821, 826, 1209, 1221, 1222, 1604, 1614, 1621, 2221, 2225, 2234
	Guaymas, Sonora Radio	XFY	404, 413, 421, 606, 817, 821, 829, 1209, 1221, 1225, 1604, 1614, 1621, 2221, 2225, 2238
	La Pax, Baja California Radio	XFK	404, 413, 421, 603, 604, 606, 817, 821, 829, 1221, 1222, 1225, 1604, 1621, 2221, 2234, 2238
	Manzanillo, Comima Radio	XFM	404, 413, 421, 601, 603, 606, 817, 821, 829, 1209, 1221, 1222, 1604, 1614, 1621, 2221, 2225, 2234
	Mazatlan, Sinaloa Radio	XFL	403, 408, 601, 604, 606, 809, 821, 826, 1209, 1221, 1225, 1604, 1621, 2221, 2225, 2238
	Progreso, Yucatan Radio	XFN	404, 413, 421, 601, 603, 606, 817, 821, 829, 1221, 1222, 1225, 1614, 1617, 1621, 2221, 2234, 2238
	Salina Cruz, Oaxaca Radio	XFQ	404, 413, 421, 601, 604, 606, 817, 821, 829, 1221, 1222, 1225, 1604, 1621, 2221, 2234, 2238

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
MEXICO (Cont'd)	Tampico, Tamaulipas Radio	XFS	404, 413, 421, 601, 604, 606, 817, 821, 829, 1221, 1222, 1225, 1604, 1614, 1621, 2221, 2225, 2238
	Veracruz, Veracruz Radio	XFU	404, 413, 421, 601, 604, 606, 817, 821, 829, 1209, 1221, 1222, 1604, 1621, 2221, 2234, 2238
MONACO	Monaco Radio	3AC	403, 413, 421, 602, 804, 809, 821, 1221, 1224, 1607, 1621, 2219, 2221
MOROCCO	Casablanca Radio	CNP	828, 1223, 1638
NAURU	Nauru Radio	C2N	817
NETHERLANDS ANTILES	Curacao Radio	PJC	408, 803, 1207, 1607
NETHERLANDS	Scheveningen Radio	PCG	405, 407, 410, 419, 421, 602, 606, 805, 806, 821, 826, 1207, 1213, 1219, 1221, 1621, 1621, 1623, 1636, 1639, 2205, 2221, 2232
NEW CALEDONIA & Dependencies	Noumea Radio	RJP	404, 805, 1205
NEW ZEALAND	Awarua Radio	ZLB	421
	Wellington Radio	ZLW	408, 421, 601, 807, 1209, 1606, 2213
NORWAY	Rogaland Radio	LGN	401, 403, 407, 409, 415, 418, 420, 421, 424, 425, 426, 603, 605, 606

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
NORWAY (Cont'd)		LFL	801, 803, 808, 809, 810, 811, 813, 818, 821, 823, 825, 827, 828, 829, 1203, 1204, 1205, 1210, 1211, 1213, 1214, 1217, 1218, 1219, 1221, 1222, 1223, 1225, 1226, 1228, 1231
		LFN	1601, 1603, 1604, 1605, 1607, 1608, 1610, 1613, 1614, 1617, 1618, 1619, 1620, 1621, 1622, 1627, 1629, 1635, 1641, 2202, 2203, 2208, 2211, 2213, 2215, 2216, 2218, 2221, 2228, 2230, 2233, 2234, 2236, 2237, 2239, 2240
PAPUA NEW GUINEA	Port Moresby Radio	P2M	409, 417, 604, 805
	Rabaul Radio	P2R	409, 417, 604, 805, 1225
PHILIPPINES	Bacoor Radio	DZI	409, 605, 817, 1220, 1605
	Bulacan Radio	DZJ	418, 603, 814, 1201, 1605
	Bulacan Radio	DZO	409, 605, 820, 1220, 1605, 825
	Cebu Radio	DYP	825
	Iloilo Radio	DYV	412, 820
	Manila Radio	DZZ	418, 603, 808, 1201, 1605
POLAND	Gdynia Radio	SPF	402, 804, 1209, 1633, 2206
		SPD	406, 824, 1229, 1631, 2232
		SPC	423, 602, 812, 1216, 1607, 2215
		SPG	806, 1231, 2209
	Szczecin Radio	SPR	404, 830, 1227, 1638
		SPO	408, 604, 810, 1220, 1625, 2219

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
FRENCH POLYNESIA	Mahina Radio	FJA	416, 829, 1605
PORTUGAL	Lisboa Radio	CUL	413, 602, 802, 1203, 1615, 1632, 2207, 2222
POLAND	Gdynia Radio	SPF	402, 804, 1209, 1633, 2206
		SPD	406, 824, 1229, 1631, 2232
		SPC	423, 602, 812, 1216, 1607, 2215
		SPG	806, 1231, 2209
	Szczecin Radio	SPR	404, 830, 1227, 1638
		SPO	408, 604, 810, 1220, 1625, 2219
PUERTO RICO	Q.P.P.A. Radio	A7S	423, 804, 1229, 1626, 2235
REUNION (French Dept. of)	S. Denis Reunion	FFD	404, 418, 819, 824
SAMOA (American)	Pago Pago Radio	KUQ	408, 806, 1232, 1638
SAMOA (Western)	Apia Radio	5WA	603, 820, 1213, 1624, 2219
SAUDI ARABIA	Dammam Radio	HZG	406, 409, 421, 601, 603, 606, 808, 811, 821, 1202, 1221, 1223, 1602, 1609, 1621, 2221, 2222, 2231
SENEGAL	Dakar Radio	6VA	404, 803, 1212, 1629, 2220
SEYCHELLES (Republic of)	Seychelles Radio	S7Q	410, 818, 1215, 1601
S. HELENA	S. Helena Radio	ZHH	414, 807, 1217

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
SINGAPORE	Singapore Radio	9VG	405, 407, 602, 606, 804, 815, 821, 824, 1216, 1219, 1221, 1613, 1621, 1641, 2212, 2221
SOLOMON ISLANDS	Honiara Radio	VQJ	830
SOUTH AFRICA	Cape Town Radio	ZSC	405, 421, 821, 1209, 1608, 2204
	Durban Radio	ZSD	407, 421, 602, 808, 821, 1221, 1224, 1633, 2206
SPAIN	Pozuelo del Rey Radio	EHY	406, 407, 409, 411, 416, 601, 604, 803, 804, 810, 816, 818, 1201, 1208, 1210, 1225, 1227, 1620, 1630, 1634, 1637, 1639, 2201, 2224, 2226, 2229, 2234
SWEDEN	Goteborg Radio	SAG, SAB	401, 403, 409, 418, 420, 424, 603, 605, 801, 803, 808, 811, 818, 825, 827, 829, 1203, 1210, 1211, 1214, 1215, 1217, 1219, 1223, 1226, 1601, 1603, 1605, 1608, 1614, 1617, 1618, 1622, 1635, 1641, 2203, 2208, 2211, 2213, 2218, 2228, 2230, 2234
	Harnosand Radio	SAH	401, 420, 424
SWITZERLAND	Bern Radio	HEB	408, 424, 822, 824, 831, 1202, 1227, 1230, 1611, 1615, 1631, 2214, 2220, 2232
TOGO	Lome Radio	5VA	403

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
TURKEY	Antalya Radio	TAM	409, 1620
	Canakkale Radio	TAM	407, 810, 1226
	Iskenderun Radio	TAM	420
	Istanbul Radio	TAN	417, 811, 831, 1218, 1608, 2230
	Izmir Radio	TAN	401, 602, 1618
	Mersin Radio	TAM	803, 1206, 1216, 1611, 2213, 2214
	Samsun Radio	TAN	420, 1606
	Trabzon Radio	TAO	401, 602
	Zonguldak Radio	TAN	411, 1222
TUVALU	Funafuti Island Radio		814, 1207, 1608
UNITED KINGDOM	Portishead Radio	GKT	402, 406, 410, 802, 1201, 1202, 1206, 1602, 1606, 2206
		GKV	426, 822, 826, 1224, 1228, 1230, 1623, 2227, 2229
		GKU	816, 819, 1611, 1615, 1618, 2212, 2220
		GKW	831, 1232, 1632, 1637, 1640
RUSSIA	Arkhangelsk Radio		401, 823, 1209, 1626
	Astrakhan Radio		405, 804
	Baku Radio		405, 807
	Jdanov, Donetskoi Radio		413, 1641
	Kholmsk Radio		1626, 2213
	Klaipeda Radio		405, 1205, 1601
	Leningrad Radio		414, 807, 1204, 1605, 2213
	Moskva Radio		1201, 1606, 2207
	Murmansk Radio		402, 824
	Nakhodka, Primorskogo Radio		1613
	Novorossiisk, Krasnodarskogo Radio		405, 815, 1209, 1601, 2231

MARITIME RADIOTELEPHONE PUBLIC CORRESPONDENCE STATIONS

Country	Station Name	Call	I.T.U. Channel #
RUSSIA (Cont'd)	Odessa Radio		1205, 1623, 2202, 2218
	Riga Radio		401, 1205, 1630
	Vladivostok Radio		401, 603, 805, 1201, 1607, 2202
UNITED STATES	Mobile, Alambama Radio	WLO	405, 414, 419, 607, 824, 829, 830, 1212, 1225, 1226, 1607, 1632,
	Point Reyes, California Radio	KMI*	1641, 2227, 2231, 2237 401, 416, 417, 804, 809, 822, 1201, 1202, 1203, 1229, 1602, 1603, 1624,
	Ft. Lauderdale, Florida Radio	WOM*	2214, 2223, 2228, 2236 403, 412, 417, 423, 802, 805, 810, 814, 825, 831, 1206, 1208, 1209, 1215, 1223, 1230, 1601, 1609, 1610, 1611, 1616, 2215,
	Manahawkin, New Jersey Radio	WOO*	2216, 2222 410, 411, 416, 422, 808, 811, 815, 826, 1203, 1210, 1211, 1228, 1605, 1620, 1626, 1631, 2201, 2205, 2210, 2236
	Rijeka Radio	YUR	408, 419, 602, 605, 810, 830, 1224, 1229, 1611, 1627, 2204, 2206, 2239

* Limited services after 2/28/2000

INTERNATIONAL VOICE CHANNEL DESIGNATORS (4-16 MHZ)

Channel No.	Coast Tranmit (kHz)	Ship Transmit (kHz)	Channel No.	Coast Tranmit (kHz)	Ship Transmit (kHz)	Channel No.	Coast Tranmit (kHz)	Ship Transmit (kHz)
401	4065	4357	812	8228	8752	1230	12317	13164
402	4068	4360	813	8231	8755	1231	12320	13167
403	4071	4363	814	8234	8758	1232	12323	13170
404	4074	4366	815	8237	8761	1250	12290	Safety
405	4077	4369	816	8240	8765	1251	12353	Simplex
406	4080	4372	817	8243	8767	1252	12356	Simplex
407	4083	4375	818	8246	8770	1253	12359	Simplex
408	4086	4378	819	8249	8773	1601	16360	17242
409	4089	4381	820	8252	8776	1602	16363	17245
410	4092	4384	821	8255	8779	1603	16366	17248
411	4095	4387	822	8258	8782	1604	16369	17251
412	4098	4390	823	8261	8785	1605	16372	17254
413	4101	4393	824	8264	8788	1606	16375	17257
414	4104	4396	825	8267	8791	1607	16378	17260
415	4107	4399	826	8270	8794	1608	16381	17263
416	4110	4402	827	8273	8797	1609	16384	17266
417	4113	4405	828	8276	8800	1610	16387	17269
418	4116	4408	829	8279	8803	1611	16390	17272
419	4119	4411	830	8282	8806	1612	16393	17275
420	4122	4414	831	8285	8809	1613	16396	17278
421	4125	4417	832	8288	8812	1614	16399	17281
422	4128	4420	850	8291	Safety	1615	16402	17284
423	4131	4423	851	8294	Simplex	1616	16405	17287
424	4134	4426	852	8297	Simplex	1617	16408	17290
425	4137	4429	1201	12230	13077	1618	16411	17293
426	4140	4432	1202	12233	13080	1619	16414	17296
427	4143	4435	1203	12236	13083	1620	16417	17299
450	4125	Safety	1204	12239	13086	1621	16420	17302
451	4146	Simplex	1205	12242	13089	1622	16423	17305
452	4149	Simplex	1206	12245	13092	1623	16426	17308
453	4417	Simplex	1207	12248	13095	1624	16429	17311
601	6200	6501	1208	12251	13098	1625	16432	17314
602	6203	6504	1209	12254	13101	1626	16435	17317
603	6206	6507	1210	12257	13104	1627	16436	17320
604	6209	6510	1211	12260	13107	1628	16441	17323
605	3212	6513	1212	12263	13110	1629	16444	17326
606	6215	6516	1213	12266	13113	1630	16447	17329
650	6215	Safety	1214	12269	13116	1631	16450	17332
651	6224	Simplex	1215	12272	13119	1632	16453	17335
652	6227	Simplex	1216	12275	13122	1633	16456	17338
653	6230	Simplex	1217	12278	13125	1634	16459	17341
654	6516	Simplex	1218	12281	13128	1635	16462	17344
801	8195	8719	1219	12284	13131	1636	16465	17347
802	8198	8722	1220	12287	13134	1637	16468	17350
803	8201	8725	1221	12290	13137	1638	16471	17353
804	8204	8728	1222	12293	13140	1639	16474	17356
805	8207	8731	1223	12296	13143	1640	16477	17359
806	8210	8734	1224	12299	13146	1641	16480	17362

INTERNATIONAL VOICE CHANNEL DESIGNATORS (4-16 MHZ)

Channel No.	Coast Tranmit (kHz)	Ship Transmit (kHz)	Channel No.	Coast Tranmit (kHz)	Ship Transmit (kHz)	Channel No.	Coast Tranmit (kHz)	Ship Transmit (kHz)
807	8213	9737	1225	12302	13149	1650	16520	Safety
808	8216	8740	1226	12305	13152	1651	16528	Simplex
809	8219	8743	1227	12308	13155	1652	16531	Simplex
810	8222	8746	1228	12311	13158			
811	8225	8749	1229	12314	13161			
1801	19755	18780	2209	22024	22720	2232	22093	22789
1802	19758	18783	2210	22027	22723	2233	22096	22792
1803	19761	18786	2211	22030	22726	2234	22099	22795
1804	19764	18789	2212	22033	22729	2235	22102	22798
1805	19767	18792	2213	22036	22732	2236	22105	22801
1806	19770	18795	2214	22039	22735	2237	22108	22804
1807	19773	18798	2215	22042	22738	2238	22111	22807
1808	19776	18801	2216	22045	22741	2239	22114	22810
1809	19779	18804	2217	22048	22744	2240	22117	22813
1810	19782	18807	2218	22051	22747	2251	22159	Simplex
1811	19785	18810	2219	22054	22750	2252	22162	Simplex
1812	19788	18813	2220	22057	22753	2253	22165	Simplex
1813	19791	18816	2221	22060	22756	2254	22168	Simplex
1814	19794	18319	2222	22063	22759	2255	22171	Simplex
1815	19797	18822	2223	22066	22762	2501	26145	25070
2201	22000	22696	2224	22069	22765	2502	26148	25073
2202	22003	22699	2225	22072	22768	2503	26151	25076
2203	22006	22702	2226	22075	22771	2504	26154	25079
2204	22009	22705	2227	22078	22774	2505	26157	25082
2205	22012	22708	2228	22081	22777	2506	26160	25085
2206	22015	22711	2229	22084	22780	2507	26163	25088
2207	22018	22714	2230	22087	22793	2508	26166	25091
2208	22021	22717	2231	22090	22786			

SSB MARINE CHANNELS

Ship-to-ship and ship-to-coast shore station SSB marine channels, along with their channel designators. Safety channels are identified with a designator "S". Regualr ship-to-ship channels are designated "A" through "E".

Frequency	Chnl Designator	Application
SAFETY ONLY		
2182		Marine, international distress & calling
		Coast Gaurd short-range
4125	4S	short-range safety
6215	6S	short-range safety
8291	8S	medium-range safety
12,290	12S	long-range safety
16,420	16S	very long-range safety
SHORT-RANGE SHIP-TO-SHIP CHANNELS		
2065		nights, short-range
2079		nights, short-range
2096.5		nights, short-range
3023		search and rescue
4146	4A	short-range
4149	4B	short-range
4417	4C	daytime short-range
6224	6A	medium-range
6227	6B	medium-range
6230	6C	medium-range
8294	8A	long-range
8297	8B	long-range
12,353	12A	long-range
12,356	12B	long-range
12,359	12C	long-range
VERY LONG-RANGE SHIP-TO-SHIP CHANNELS		
16,528	16A	very long-range days
16,531	16B	long-range
16,534	16C	very long-range
18,840	18A	quiet channel, long-range
18,843	18B	quiet channel, very long-range
22,159	22A	extremely long-range
22,162	22B	extremely long-range
22,165	22C	extremely long-range
22,168	22D	extremely long-range

WEATHER FAX

Country	Call Signs	Frequencies	Times
CAIRO, EGYPT	SUU29 SUU33 SUU45	11015 kHz 15664 kHz 17635 kHz	1900-0700 # 0700-1900
NAIROBI, KENYA	5YE1 5YE2 5YE8 5YE6 5YE3 5YE7	9043 kHz 12315 kHz 15525 kHz 16315 kHz 17365 kHz 15525 kHz	Continuous Continuous Continuous Continuous Continuous Continuous
SAINT DENIS/ CHAUDRON,REUNION	FZR81 FZS63	8176 kHz 16335 kHz	24 hrs. 24 hrs.
DAKAR, SENEGAL	6VU73 6VU79	13667.5 kHz 19750 kHz	Continuous Continuous
PRETORIA, SOUTH AFRICA	ZRO5 ZRO2 ZRO3 ZRO4	4014 kHz 7508 kHz 13538 kHz 18238 kHz	1530-0400 Continuous Continuous Continuous
ASIA			
BEIGING (PEKING), CHINA	BAF6 BAF36 BAF4 BAF8 BAF9 BAF33	5525 kHz 8120 kHz 10115 kHz 14365 kHz 16025 kHz 18235 kHz	
SHANGHAI, CHINA	BDF	3241 kHz 5100 kHz 7420 kHz 11420 kHz 18940 kHz	
NEW DELHI, INDIA	ATA55 ATP57 ATV65 ATU38	4993.5 kHz 7403 kHz 14842 kHz 18227 kHz	1430-0230 Continuous Continuous 0230-1430

WEATHER FAX

Country	Call Signs	Frequencies	Times
TOKYO 1, JAPAN	JMH JMH2 JMH3 JMH4 JMH5 JMH6	3622.5 kHz 7305 kHz 9970 kHz 13597 kHz 18220 kHz 23522.9 kHz	Continuous Continuous Continuous Continuous Continuous Continuous
TOKYO 2, JAPAN	JMJ JMJ2 JMJ3 JMJ4 JMJ5	3365 kHz 5405 kHz 9438 kHz 14692.5 kHz 18441.2 kHz	Continuous Continuous Continuous Continuous Continuous
TAIPEI, REPUBLIC OF CHINA	BMF	4616 kHz 5250 kHz 8140 kHz 13900 kHz	
SEOUL, REPUBLIC OF KOREA	HLL8	5857.5 kHz	Continuous
BANGKOK, THAILAND	HSW64 HSW61	7395 kHz 17520 kHz	
KHABAROVSK, RUSSIA	RXB72 RXB75 RXO70 RXO72 RXO74	4516.7 kHz 7475 kHz 9230 kHz 14737 kHz 19275 kHz	Continuous Continuous Continuous Continuous Continuous
NOVOSIBIRSK 1, RUSSIA	ROF73 RYO79 RTB26 RYO76	4445 kHz 5765 kHz 9220 kHz 12320 kHz	Continuous Continuous Continuous Continuous
NOVOSIBIRSK 2, RUSSIA	 RCU73 RCU79	3675 kHz 4475 kHz 9060 kHz 12230 kHz	Continuous 1425-0245 Continuous 0350-1325
TIKSI BUKHTA, RUSSIA		227 kHz	

WEATHER FAX

Country	Call Signs	Frequencies	Times
TOKYO 1, JAPAN	JMH JMH2 JMH3 JMH4 JMH5 JMH6	3622.5 kHz 7305 kHz 9970 kHz 13597 kHz 18220 kHz 23522.9 kHz	Continuous Continuous Continuous Continuous Continuous Continuous
TASHKENT 1, UZBEKISTAN	RBV70 RPJ78 RBV78 RBX72 RCH72 RBV76	3690 kHz 4365 kHz 5890 kHz 7570 kHz 9340 kHz 14982.5 kHz	1300-0130 Continuous Continuous 0130-1300 Continuous Continuous
TASHKENT 2, UZBEKISTAN	RBX70 RBX71 RCH73	3280 kHz 5090 kHz 5285 kHz 9150 kHz	Continuous Continuous Continuous Continuous
SOUTH AMERICA			
BEUNOS AIRES, ARGENTINA	LRO69 LRB72 LRO84	5185 kHz 10720 kHz 18053 kHz	Continuous Continuous Continuous
OLINDA/ RIO DE JANEIRO, BRAZIL	PPO PWZ-33 PWZ-33	8294 kHz 12660 kHz 17140 kHz	0745/1745 0745/1745 0745/1745
SANTIAGO, CHILE	CCS	4766 kHz 6418 kHz 8594 kHz 13525 kHz 22071 kHz	Continuous Night Continuous Day Continuous
NORTH AMERICA			
ESQUIMALT, BRITISH COLUMBIA, CANADA	CKN	2752.1 kHz 4266.1 kHz 6454.1 kHz 12751.1 kHz	Continuous Continuous Continuous Continuous

WEATHER FAX

Country	Call Signs	Frequencies	Times
HALIFAX, NOVA SCOTIA, CANADA	CFN	122.5 kHz 4271 kHz 6496.4 kHz 10536 kHz 13510 kHz	Continuous Continuous Continuous Continuous Continuous
IQALUIT, N.W.T., CANADA	VFF VFF	3251.1 kHz 7708.1 kHz	1 July - 15 Oct. 1 July - 15 Oct.
RESOLUTE, N.W.T., CANADA	VFR VFR	3251.1 kHz 7708.1 kHz	1 July - 15 Oct. 1 July - 15 Oct.
NEW ORLEANS, LOUISIANA	NMG	8503.9 kHz 4317.9 kHz	Various Various
ELENDORF AFB, ALASKA, U.S.A.		2280 kHz 3394 kHz 5095 kHz 7398 kHz 10665 kHz 15805 kHz 19332 kHz	 1200-2400 0000-1200 1200-2400 0000-1200
KODIAK, ALASKA, U.S.A.	NOJ	4298 kHz 8459 kHz	
POINT REYES, CALIFORNIA, U.S.A.	NMC	4346 kHz 8682 kHz 12730 kHz 17151.2 kHz 22528 kHz	
BOSTON, MASSACHUSETTS, USA	NIK	6340.5 kHz 12750 kHz	1600 & 1840 1600 & 1840
MARSHFIELD, MASSACHUSETTS, USA	NMF	6340.5 kHz 12750 kHz	1600 & 1840 1600 & 1840
ROGERS CITY, MICHIGAN, U.S.A.	WLC	2195.5 kHz 5898.6 kHz	0130-0430(2) 1030-2230(2)

WEATHER FAX

Country	Call Signs	Frequencies	Times
OFFUTT AFB/ELKHORN, NEBRASKA, U.S.A.		3231 kHz 5096 kHz 6904 kHz 10576 kHz 11120 kHz 15681 kHz 19325 kHz	 0000-1200 0000-1200 1200-2400 1200-2400
NORFOLK, VIRGINIA, U.S.A.	NAM NAM NAM NAM NAM	3357 kHz 3820.5 kHz 8080 kHz 9318 kHz 9108.1 kHz 12748.1 kHz 10865 kHz 15959 kHz 18486 kHz 20015 kHz	0000-1200 On Call On Call Continuous 1200-0000 On Call On Call On Call
PACIFIC OCEAN BASIN			
DARWIN, AUSTRALIA	AXI32 AXI33 AXI34 AXI35 AXI37	5755 kHz 7535 kHz 10555 kHz 15615 kHz 18060 kHz	1110-2300 1110-2300 0000-2359 2300-1110 2300-1110
MELBOURNE, AUSTRALIA	AXM31 AXM32 AXM34 AXM35 AXM37	2628 kHz 5100 kHz 11030 kHz 13920 kHz 20469 kHz	Continuous Continuous Continuous Continuous Continuous
WELLINGTON, NEW ZEALAND	ZKLF	5807 kHz 9459 kHz 13550 kHz 16340.1 kHz	Continuous Continuous Continuous Continuous

WEATHER FAX

Country	Call Signs	Frequencies	Times
QUAM 1, M.I.	NPN	49657 kHz	0000-2359@ LSB
		10255 kHz	0000-2359* LSB/USB
		12777 kHz	0000-2359@ USB
		16029.6 kHz	0000-2359* LSB
		19860 kHz	0000-2359* LSB/USB
		22324.5 kHz	0000-2359@ LSB
			@ Japan freq. * Guam freq.
QUAM 2, M.I.	NPN	5260 kHz	0000-2359* USB
	NKM	7580 kHz	1400-0159$ USB
	NKM	12804 kHz	0000-2359$ USB
	NKM	20300 kHz	0200-1359$ USB
	NPN	23010 kHz	0000-2359* LSB
			$ Diego Garcia freq. * Guam freq.
QUAM 3/ ANDERSON AFB, M.I.		4943 kHz 6919 kHz 7708.5 kHz 13385 kHz 14397 kHz 17526 kHz 20380 kHz	
HONOLULU, HAWAII, U.S.A.	KVM70	9982.5 kHz 11090 kHz 16135 kHz 23331.5 kHz	Continuous Continuous Continuous Continuous

WEATHER FAX

Country	Call Signs	Frequencies	Times
PEARL HARBOR, HAWAII, U.S.A.	NPM	4855 kHz 6453 kHz 8494 kHz 9090 kHz 21735 kHz	0600-1600* LSB/ISB Continuous& USB/ISB Continuous# LSB Continuous& USB/ISB 1600-0600* LSB/ISB * Pearl Harbor freq. # ADAK, AK freq. & Stockton, CA freq.
EUROPE			
PRAGUE, CZECH REPUBLIC	OLT21	111.8 kHz	Continuous
SKAMLEBAEK, DENMARK	OXT(1)	5850 kHz 9360 kHz 13855 kHz 17510 kHz	0030-1005 0005-0025 1010-1215 1245-1305 1830-1850 1220-1240 1310-1330 1805-1825 1335-1355
HELSINKI, FINLAND	OGH OGH OFB28	2803 kHz 2811.7 kHz 8018 kHz	0840 0840 0840
MARIEHAMM, FINLAND	OFH	1877.7 kHz	0840, 0990, 1300
HAMBURG/ PINNEBERG, GERMANY	DDH3 DDK3 DDK6	3855 kHz 7880 kHz 13882.5 kHz	0600-2300 Continuous Continuous

WEATHER FAX

Country	Call Signs	Frequencies	Times
OFFENBACH/ MAIN-MAINFLINGEN 1, GERMANY	DCF54	134.2 kHz	Continuous
OFFENBACH/ MAIN-MAINFLINGEN 2, GERMANY	DCF37	117.4 kHz	Continuous
ATHENS, GREECE	SVJ4	8530 kHz	
ROME, ITALY	IMB51 IMB55 IMB56	4777.5 kHz 8146.6 kHz 13597.4 kHz	Continuous Continuous Continuous
MADRID, SPAIN	ECA7	3650 kHz 6918.5 kHz 10250 kHz	
ROTO, SPAIN	AOK	4623 kHz 5856.4 kHz 9382.5 kHz 11485 kHz	1800-0600 Continuous Continuous 0600-1800
ANKARA, TURKEY	YMA20 YMA20	3377 kHz 6790 kHz	1610-0500 0500-1610
MOSCOW, RUSSIA	RVO76 RCI72 RND77 RAW78 RKA73 RDD79 RBI77 RIZ59	2815 kHz 3875 kHz 5355 kHz 7750 kHz 10710 kHz 10980 kHz 15950 kHz 18710 kHz	1530-0510 1710-0510 Continuous Continuous Continuous Continuous 1510-1710 Unknown
MOSCOW 2, RUSSIA	RTO RVO73 RAN77 RCC76 RKA78 RWZ77 RKU71	53.6 kHz 5150 kHz 6880 kHz 7670 kHz 10230 kHz 11525 kHz 13470 kHz	Continuous Continuous Continuous Continuous Continuous 0230-1805 Continuous

WEATHER FAX

Country	Call Signs	Frequencies	Times
MOSCOW 3, RUSSIA	RGC RKB78	144.5 kHz 12165 kHz	
MOSCOW 4, RUSSIA	RWW79	4550 kHz	
MURMANSK, RUSSIA	RBW48	10130 kHz	0600-1900
ST. PETERSBURG, RUSSIA		7480 kHz 13780 kHz	1900-2200 1900-2200
BRACKNELL, UNITED KINGDOM	GFA GFA GFA GFA GFA	2618.5 kHz 4610 kHz 8040 kHz 14436 kHz 18261 kHz	1800-0600 Continuous Continuous Continuous 0600-1800
CROUGHTON, UNITED KINGDOM		4755 kHz 5235 kHz 5932 kHz 6827 kHz 6937 kHz 7596 kHz 7623 kHz 7930 kHz 9100 kHz 10385 kHz 10873 kHz 13537 kHz 13585 kHz 14397 kHz 14677 kHz 17526 kHz 20051 kHz 20095 kHz 23155 kHz 23195 kHz 25245 kHz 25480 kHz	

WEATHER FAX

Country	Call Signs	Frequencies	Times
NORTHWOOD, UNITED KINGDOM	GYA	2374 kHz	Continuous
	GYA	3652 kHz	Continuous
	GYA	4307 kHz	Continuous
	GYA	6446 kHz	Continuous
	GYA	8331.5 kHz	Continuous
	GYA	12844.56 kHz	Continuous
	GYA	16912 kHz	Continuous
ANTARCTICA			
CASEY, ANTARCTICA	VLM	7468.1 kHz	1200-0300
	VLM	11453.1 kHz	0300-1200

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All information contained in this presentation is current as of 1/1/01. Thank you for using ICOM radios!

ICOM

TECHNICAL REPORT

IC-7596PRO II

TECHNICAL REPORT

Icom Inc.

CONTENTS

The IC-756PROII is the high performance HF transceiver of choice for today's discriminating amateur radio operator. Icom's engineers took cutting-edge digital technology and paired it with Icom's extensive experience with analog technology. The result is a major advancement of Icom's original digital IF filter which, in the earlier IC-756PRO model, enjoyed a great reputation around the world.

The IC-756PROII uses the same 32-bit floating point DSP and a 24-bit A/D-D/A converter as the IC-756PRO. It is now possible to execute the digital IF filter, noise reduction and the digital IF filter in the AGC loop processing, and to select the soft/sharp filter shapes. The IC-756PROII employs exclusive DSP/analog circuit matching to further improve receiver performance.

Icom's engineers analyzed the influence of the AGC loop upon the received audio, matching it to an analog circuit suitable for the dynamic range of the A/D converter and the other parts used, and also re-examined the core stage of the receiver (ranging from RF top to mixer circuit), to distribute the mixer levels properly. As a result, the matching of digital and analog technology has attained a level never before achieved.

This technical report does not explain in depth all the digital engineering with its many calculations and formulas. Instead, it focuses on the DSP engineering in an easy-to-understand manner. This report also explains why the 32-bit floating point DSP and 24-bit A/D-D/A converter are included. The dynamic range of the 32-bit floating point DSP and the 24-bit A/D-D/A converter may seem to be an over specification for amateur radio. But this is not the case. This technical report helps clarify these points.

It is Icom's hope that in providing you with this report you will discover the IC-756PROII's many digital advantages. Enjoy!

2. Features

32-bit floating point DSP and 24-bit A/D-D/A converter

The adoption of a 32-bit floating point DSP and 24-bit A/D-D/A converter in the IF stage (36kHz) was originally developed by Icom. It enables various digital functions which amateur radio operator's desire.

■ 51 types of digital IF filtering

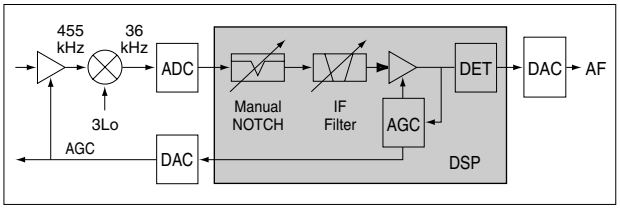
The digital IF filter has superior filtering performance and a distinguished shaping factor that demonstrates the power of 32-bit floating point DSP. The digital filter is completely free from deterioration due to deviations in band characteristics, temperature change, or mechanical vibration, all of which have been observed in analog filters. It also provides excellent ripple characteristics that have never been available with analog filters. The passband (50Hz–3.6kHz) of the digital IF filters used for IC-756PROII come in 51 types. This function allows 3 of these 51 types to be pre-set for each mode and to be changed instantaneously by using the filter button, depending on the situation.

■ 2 types of filter shape (Sharp/Soft)

Changing the IF filter shape is a feature that is not available with analog radios. Select the filter shape from two types, Sharp and Soft, depending on the purpose, operating band, band conditions, etc. It is possible to set CW and SSB filter characteristics independently and also select the filter shape while actually receiving a signal.

■ Digital IF filter in AGC loop

The digital IF filter, manual notch filter, etc. are located in the AGC loop, using DSP, which completely eliminates interference from adjacent strong signals. This allows the AGC to be operated only on the selected frequency. It is also possible to pre-set the operation of AGC in each mode in accordance with 13 types of time constants.



■ Digital twin PBT

The IC-756PROII is equipped with DSP based twin PBT filtering. It provides excellent performance on a completely different level than analog filters. Set the frequency, and then adjust the passband width of the received signal in steps of 50Hz using the dedicated two-position knob. The passband width and direction of shift may be graphically displayed on the LCD, if the operator chooses.

■ High-accuracy digital modulation and demodulation in all modes

The DSP unit allows you to increase transmit/receive audio levels, modulation, and demodulation — even while decoding RTTY. This makes it possible to set the passband width of the IF filter for SSB transmit to 3 different stages. The DSP unit also provides a demodulation level suitable for high-grade HF performance and high-fidelity sound.

■ Manual notch with superior attenuation level

The IC-756PROII's manual notch filter has extremely sharp characteristics for processing in the DSP and provides tremendous performance for attenuation levels >70dB. Analog notch circuits are susceptible to fluctuations in attenuation or changes in temperature. The DSP-based manual notch provides stable performance and is not susceptible to such changes. Also, the DSP signal processing executed within the AGC loop completely shuts off undesirable signals, even with the AGC set to high speed. An automatic notch is included to further enhance receiver performance.

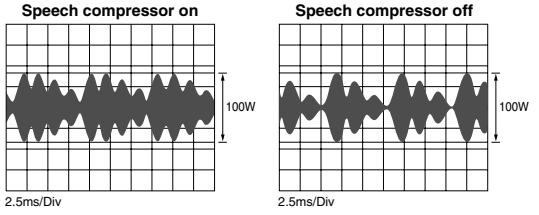
■ Demodulator/decoder for RTTY

This transceiver is equipped with a demodulator and a decoder for BAUDOT RTTY as a standard feature. On-air station calls may be recognized instantaneously by reading the received RTTY message directly on the IC-756PROII's LCD – no personal computer or external components are required. The transceiver is fitted with an on-screen tuning indicator that allows the RTTY to be fine tuned with ease. A DSP based twin-peak audio filter further improves the S/N ratio. This filter will reduce interference that appears between each tone (mark and space), which cannot be removed by conventional analog filters. This twin-peak audio filter works to capture noise-level signals accurately and to significantly reduce the generation of noise distortion.

RTTY reception screen

■ New-generation speech compressor

The DSP based speech compressor enhances the readability of your transmitted signal at a receiving station without any distortion, even when the compression is set to a high level. The gradation of voice processing is extremely close to the original sound. This assures superior sound quality at all compression levels.



■ Microphone equalizer (enables 121 different settings)

The IC-756PROII is equipped with a microphone equalizer that makes it possible to set the frequency characteristics of the transmitted signal in 11 different stages for both the high-tone range and the low-tone range. Considering all permutations, this provides for a total of 121 different settings. With this flexibility of DSP based waveform shaping, it is possible to adjust transmit audio quality depending on the application. For example, it is possible to set the dynamic sound quality for "Pileup" or to set pleasant sound for "Ragchewing".

■ Variable level type noise reduction

The 32-bit floating point DSP has excellent calculation performance, which processes complex and sophisticated algorithms. This allows the DSP to attenuate noise without delay and extracts noise-level signals. It is possible to vary the suppression level in 16 stages.

■ CW keying waveform shaping function

DSP controls the rise and fall of the CW transmit waveform. The result is a proper CW waveform. The rise/fall timing is selectable to 4 stages of 2ms, 4ms, 6ms and 8ms. This makes it possible to set a "Soft" or "Hard" CW signal, depending on your preference.

Enhanced functions

■ Advanced receive functions

The RF stage's front-end receive mixer is designed in a 4-element configuration. In the IC-756PROII, this configuration is used in the BPF stage at the RF top. Each element is examined to tune the circuit after RF stage to mixer, which makes it possible to enhance the receive performance. This significantly reduces 3rd and other order distortion and provides a wide dynamic range. This means the IC-756PROII will accurately capture weak signals that analog type radios cannot hear, even in low bands with high noise levels.

■ Real-time spectrum scope

A real-time spectrum scope is recognized as indispensable for DX hunting. The IC-756PROII's spectrum scope uses two colors to display all RF signal activity within a user-selectable bandwidth. One color indicates real-time RF signal activity, while the other color provides peak hold indication. The spectrum scope may be used for sophisticated applications such as identifying the band conditions, quick discovery of stations, and confirmation of interval or call-back frequency. Additionally, you may monitor normal band conditions, while you display sub readout or transmit markers. In case of high-band noise, the IC-756PROII is equipped with an attenuator (10/20/30dB) dedicated to the spectrum scope, which allows a reduction of total signal level at the band scope without affecting the received signal.

Real-time spectrum scope screen

■ Exceptionally clear SSB transmit signal

Using Icom's advanced digital PSN modulation, the IC-756PROII emits high-quality signals, which makes its transmitter suitable for use as the exciter of a linear amplifier. Unwanted sidebands and carrier leaks are almost completely eliminated. Further, the transmitter employs a wide band power amplifier that incorporates highly reliable bipolar transistors (2SC5125 × 2). The linearity and IMD characteristics achieve superior signal quality never before seen in any amateur redio transceiver. This makes it possible to transmit RF signals with significantly reduced distortion.

■ Built-in high-stability reference crystall oscillator

The IC-756PROII's transceiver exhibits excellent frequency stability of < 0.5ppm. This assures stable communication even for RTTY and SSTV modes for which particularly high frequency stability is required.


High-stability reference crystal oscillation unit

The best in operating convenience and features

■ Dual-watch

Dual-watch enables simultaneous two-frequency receive in the same band, providing identical band and filter configurations in both receive systems. This makes it possible to receive two signals simultaneously as if two separate receivers are being used. This greatly enhances split frequency operation; enjoy enhanced DX-operation by searching for pickup frequencies while watching the transmit frequency of a DX station experiencing pile-up. Or have a QSO while simultaneously monitoring a DX net.

■ Triple band stacking register

With the push of a band button, get quick memory recall of three preferred operating settings (including antenna port) per band. Band or mode hopping has never been easier. It's the ultimate in multi-mode flexibility.

■ Digital Voice Recorder (DVR)

The DVR feature is an indispensable function for DX hunting and contests. The IC-756PROII is equipped with a DVR with 4 channels for transmit and 4 channels for receive, for a total of 8 channels. High quality digital mapping of the transmitted or received analog signal provides high quality audio reproduction, resulting in a natural sounding voice without any noticeable degradation. It is also possible to use these 4 communication channels by allotting them freely with a total recording time of 90 seconds. Each of the 4 channels for receive has a recording time of 15 seconds, or 60 seconds total. Press the key once in any TFT display mode and it becomes possible to not only record or reproduce voice but also to record for up to 30 minutes continuously. The receive audio may be reproduced for the most recent 15 seconds back to an interruption in recording. By constructing the simplified control unit (page 26) and connecting it to the microphone connector, digital voice recorder function may also be operated.

DVR key

■ Full-scale electronic keyer

Plug a CW, iambic paddle into the electronic keyer jack on the front panel. Especially handy during long hours of operation, it is possible to set the CW speed between 7 and 56WPM. The discriminating operator may also set the dot/dash keying ratio (2.8:1 to 4.5:1) and polarity, depending on preference. The keyer may also be set for either right or left hand use. For the CW operator who prefers not to use the IC-756PROII's built-in electronic keyer, an ordinary key jack is available on the rear panel, for bug or straight key and is fully compatible with external keyers or PC keying.

■ Multi-function memory keyer

Enhance your contest operations. The IC-756PROII is fully equipped with a convenient memory keyer, offering features such as memory content editing function, auto-repeat function, serial contest number automatic count-up function, contest number abbreviating function, and more. These features will reduce effort when repeating a formatted contents for calling CQ, continuous transmission of call sign, or contests. Since it is possible to confirm the contents of memory on the display, transmission mistakes are eliminated. Construct the simplified control unit (page 26) and connect it to the microphone connector to enhance operation of these memory keyer functions.

■ **Quick split function**
When the split button is pressed and held, the frequency of the sub-VFO is adjusted to the frequency in the main VFO. Using the split function, it is also possible to control the following:
1. Vary the transmit frequency via the main dial.
2. Direct entry of the designated frequency.
3. Direct entry of the shift frequency.
You are now ready to “bag the DX” while other operators are still tuning up.

■ **Preamplifier and attenuator**
The IC-756PROII incorporates two types of receive preamplifiers: Preamplifier 1 (10dB) emphasizes modulation across all bands, and preamplifier 2 (16dB) emphasizes sensitivity especially for high bands. The attenuator is selectable in three stages, 6, 12 and 18dB. When there is a strong signal from a local commercial station it becomes possible to control the generation of distortion at the RF stage of the receiver. It is also possible to retain the preamplifier and attenuator settings for each band.

■ **Variable noise blanker**
The transceiver uses a new noise blanker design that provides significant reduction of pulse-type noise. The noise blanker also greatly enhances weak signal copy, allowing the operator to change the sensitivity in 100 stages in accordance with the noise level without distorting the target signal.

■ **Frequency shift function for change from/to SSB to/from CW**
A frequency shift function automatically adjusts the CW carrier point when selecting from SSB mode, or vice versa. You may select “Shift function off” whereby the frequency remains the same (by moving the carrier point), or “Shift function on” in which the frequency is shifted without moving the carrier point. Using CW-R mode it is possible to set the carrier point to USB.

Enhanced TFT color display

■ **High visibility**
A high visibility 5-inch TFT color display has been integrated into the IC-756PROII to provide ease of use and clear indication of the radio’s many features. Various function settings such as frequency, memory frequency, comment, filter setting status, RTTY tuning indicator, and more are displayed in the upper portion of the display, The lower portion of the display gives voice memory, characters of received RTTY, and the real-time spectrum scope information. The display color may be selected from 8 types, from vivid color to muted grays. 7 different font types may also be selected. These settings may be made in any combination – customize your display to best suit your personality or favored operating set-up.

■ **Memory channel/memory list**
The transceiver is equipped with 99 regular memory channels and 2 scan edges, totaling 101 channels. It is possible to enter text of up to 10 characters in each memory channel. It is also possible to display a list of up to 13 memories at a time.

■ **Simplified set mode**
The IC-756PROII has a list display that allows the status of each set mode item to be seen at a glance. Each function is divided into 4 setting groups and multiple items are listed or displayed to allow quick access to the desired item. This allows the many functions of the radio to be used with ease.

■ **Digital meter simultaneously displays 4 transmit level indicators**
With the digital meter (including peak-hold), it is possible to confirm the output power, ALC, SWR, and COMP, all at the same time while transmitting. The signal strength is also displayed while receiving.

Enhanced functions

■ **Antenna system**
· High-speed built-in auto antenna tuner covering up to the 50MHz band
· 2-piece antenna terminal (incorporated with auto antenna selector)
· Dedicated receive antenna connector

■ **Receive system**
· General coverage receive (30kHz to 60MHz)
· Control of RF gain and squelch with one knob

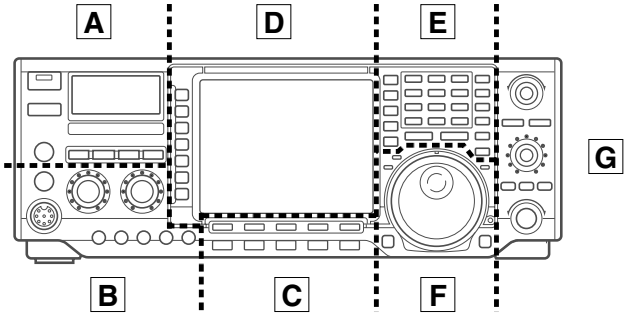
■ **Transmit system**
· IF Monitor function allows the transmissions of your station to be listened to locally
· Built-in 50 frequencies of tone encoder/decoder
· VOX function allows the automatic selection of transmit and receive for “hands free” operation
· All-mode power control function

■ **CW system**
· CW pitch control function allows the CW receive tone to be set to a desired frequency (300 to 900Hz continuously)
· Double key jack allows 2 types of keys to be connected simultaneously
· Full break-in function allows receive during a break while keying

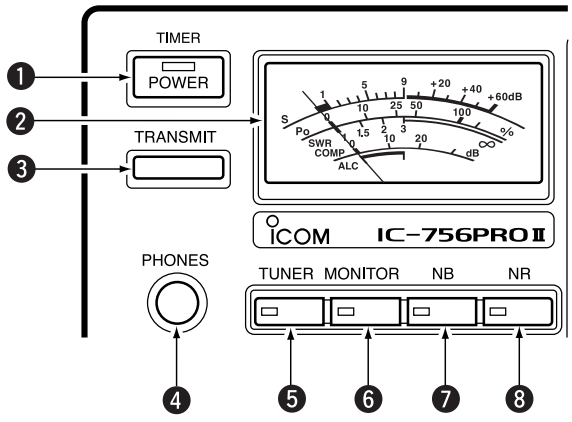
■ **Operation system**
· 5-channel memo pad saves frequency and mode
(It is also possible to change the 5-channel memo pad to a 10-channel type.)
· RIT and TX variable up to ± 9.999kHz
· 1Hz pitch tuning
· Optional frequency speech allows the S-meter level to be announced
· High visibility needle type white-tone analog meter
· Various scanning functions (program, memory, select memory, ⊿F)
· Auto Tuning Step
· Dial-lock
· Split frequency lock
· Torque adjustment mechanism for main dial
· Band edge beep function
· CI-V terminal allows control from a personal computer
· Clock/timer function
· AH-4 control circuit

3. Front and rear panel

3-1 Front panel

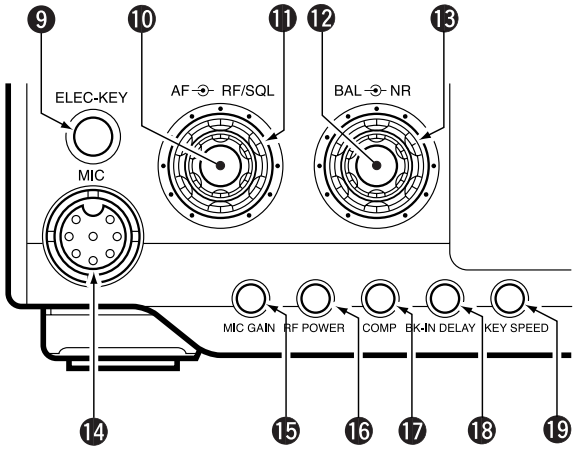


A



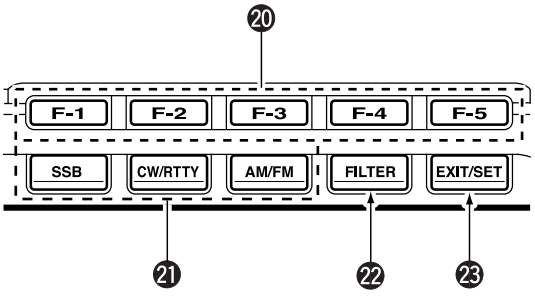
❶ POWER SWITCH [POWER TIMER]
❷ S/RF METER
❸ TRANSMIT SWITCH [TRANSMIT]
❹ HEADPHONE JACK [PHONES]
❺ ANTENNA TUNER SWITCH [TUNER]
❻ MONITOR SWITCH [MONITOR]
❼ NOISE BLANKER SWITCH [NB]
❽ NOISE REDUCTION SWITCH [NR]

B



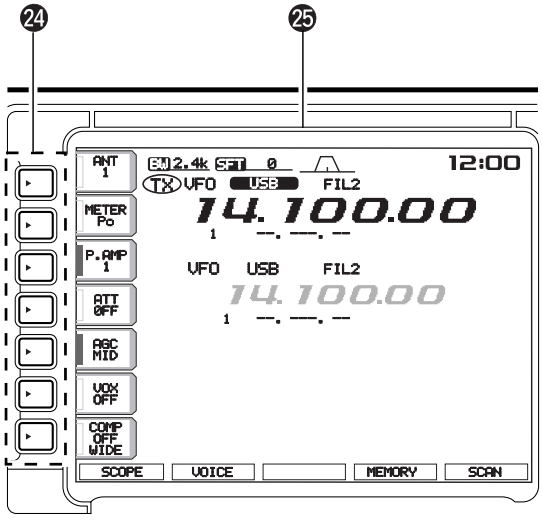
❾ ELECTRONIC KEYER JACK [ELEC-KEY]
❿ AF CONTROL [AF]
⓫ RF GAIN CONTROL/SQUELCH CONTROL [RF/SQL]
⓬ BALANCE CONTROL [BAL]
⓭ NOISE REDUCTION LEVEL CONTROL [NR]
⓮ MICROPHONE CONNECTOR [MIC]
⓯ MIC GAIN CONTROL [MIC GAIN]
⓰ RF POWER CONTROL [RF POWER]
⓱ COMPRESSION LEVEL CONTROL [COMP]
⓲ SEMI BREAK-IN DELAY CONTROL [BK-IN DELAY]
⓳ ELECTRONIC CW KEYER SPEED CONTROL [KEY SPEED]

C



⓴ LCD FUNCTION SWITCHES [F1]-[F5]
㉑ MODE SWITCHES
㉒ FILTER SWITCH [FILTER]
㉓ EXIT/SET SWITCH [EXIT/SET]

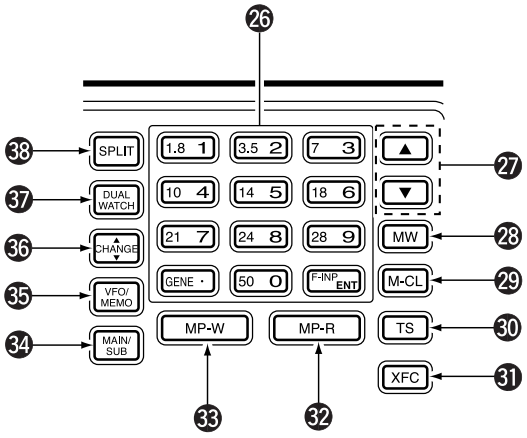
D



㉔ MULTI-FUNCTION SWITCH GUIDE

㉕ LCD FUNCTION DISPLAY

E



㉖ KEYPAD

㉗ MEMORY UP/DOWN SWITCHES [▲][▼]

㉘ MEMORY WRITE SWITCH [MW]

㉙ MEMORY CLEAR SWITCH [M-CL]

㉚ QUICK TUNING SWITCH [TS]

㉛ TRANSMIT FREQUENCY CHECK SWITCH [XFC]

㉜ MEMO PAD-READ SWITCH [MP-R]

㉝ MEMO PAD-WRITE SWITCH [MP-W]

㉞ MAIN/SUB CHANGE SWITCH [CHANGE]

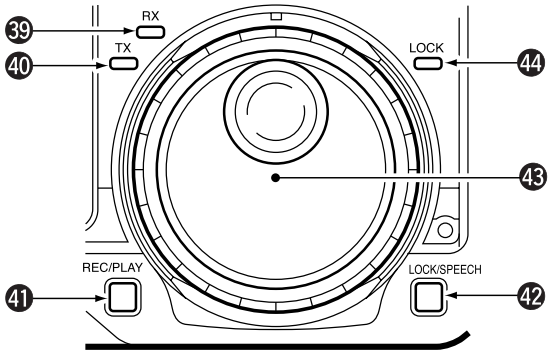
㉟ VFO/MEMORY SWITCH [VFO/MEMO]

㊱ MAIN/SUB CHANGE SWITCH [CHANGE]

㊲ DUALWATCH SWITCH [DUALWATCH]

㊳ SPLIT SWITCH [SPLIT]

F



㊴ RECEIVE INDICATOR [RX]

㊵ TRANSMIT INDICATOR [TX]

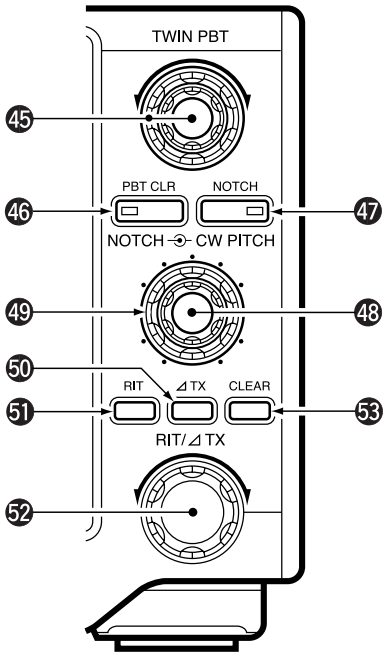
㊶ REC/PLAY SWITCH [REC/PLAY]

㊷ LOCK/SPEECH SWITCH [LOCK/SPEECH]

㊸ TUNING DIAL

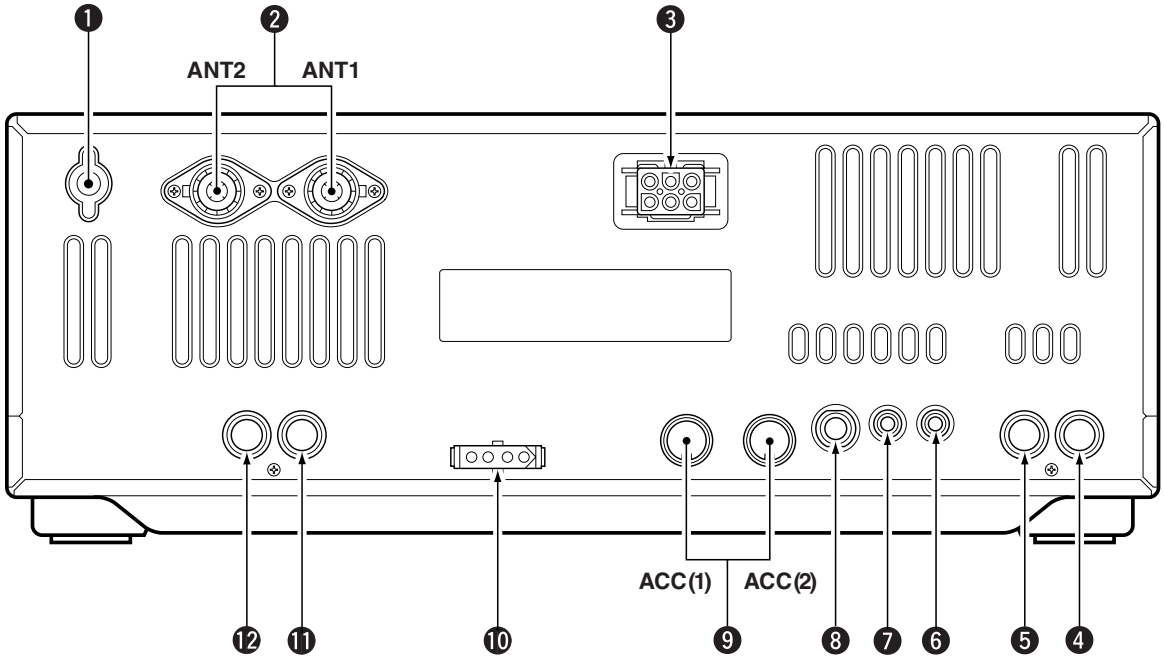
㊹ LOCK INDICATOR [LOCK]

G



- ㊺ PASSBAND TUNING CONTROLS [TWIN PBT]
- ㊻ PBT CLEAR SWITCH [PBT CLR]
- ㊼ NOTCH SWITCH [NOTCH]
- ㊽ MANUAL NOTCH FILTER CONTROL [NOTCH]
- ㊾ CW PITCH CONTROL [CW PITCH]
- ㊿ ⊿TX SWITCH [⊿TX]
- (51) RIT SWITCH [RIT]
- (52) RIT/⊿TX CONTROL [RIT/⊿TX]
- (53) CLEAR SWITCH [CLEAR]

3-2 Rear panel



- ❶ GROUND TERMINAL
- ❷ ANTENNA CONNECTOR 1 [ANT 1]/ ANTENNA CONNECTOR 2 [ANT 2]
- ❸ DC POWER SOCKET [DC 13.8V]
- ❹ SEND CONTROL JACK [SEND]
- ❺ ALC INPUT JACK [ALC]
- ❻ EXTERNAL SPEAKER JACK [EXT SP]
- ❼ CI-V REMOTE CONTROL JACK [REMOTE]
- ❽ STRAIGHT KEY JACK [KEY]
- ❾ ACCESSORY SOCKET 1 [ACC (1)]/ ACCESSORY SOCKET 2 [ACC (2)]
- ❿ TUNER CONTROL SOCKET [TUNER]
- ⓫ RECEIVE ANTENNA CONNECTOR [RX ANT]
- ⓬ TRANSVERTER JACK [XVERT]

4. What is DSP in radio communication?

The term DSP stands for “digital signal processor”. When DSP is used in a communication unit, the electrical signal processes (amplification, filtering mixer, modulation, demodulation, etc.) are handled by the DSP. Such signal processing, using numerical calculations, is called “digital signal processing”.
Digital signal processing assures the same results every time providing for the characteristics defined in the design phase. When digital signal processing is utilized, it is not necessary to take the adjustment deviations of the conventional analog circuit into consideration. These deviations are caused by variations in component characteristics, temperature change, or deterioration over time. It is also possible to perform complicated processing tasks such as Fourier transformation, adaptive control, special function processing (*1), and more. Such complicated processing tasks are very difficult and costly for a conventional analog circuit.

*1 Special function processing: Trigonometric function, inverse function of trigonometric function, square root, logarithmic function, exponential function, etc.

Digital signal processing is also widely used in fields other than radio communication units, such as:

- Modems for telephone circuits
- Surround-sound effects (stereo sets, stereo components)
- Echo canceller (telephone)
- Voice compression/coding (cellular phones)

It is possible for a computer CPU to execute digital signal processing. However, a DSP differs from a CPU in that it has the dedicated hardware construction required for the effective execution of digital signal processing. Basically the unit has a multiplication/addition circuit widely used for DSP to execute the combination of multiplications and additions in one clock, and with an internal data bus of more than two circuits, to fetch two data items required for calculation at the same time. It also has a loop processing function to execute repeated calculations with high efficiency and a data address creation function to transmit signal data effectively, which are assigned to consecutive addresses. These functions are incorporated as dedicated hardware.

Because their performance has developed quickly, the CPUs currently used for computers can execute digital signal processing. A CPU with a high clock frequency may be superior in calculation performance to a low-end DSP chip. When it is compared with a CPU of equivalent performance, a DSP with hardware specialized to digital signal processing has the following advantages:

- Low clock frequency
- Low integrity (reduced logic scale)
- Low power consumption (Low heat energy generated)
- Low cost

When various judgment functions are required, or when different calculations are repeated each time, a DSP is not suitable. The CPU is then more suitable for such processing.

DSP chip

Background to development of the first-generation IC-756PRO

From the early stages of research into DSP transceivers Icom has been on the forefront of shifting IF filter design from analog to digital type filters. To put the digital IF filter to practical use it was necessary to incorporate the digital IF filter into the AGC loop. It was also necessary to provide AGC processing using the DSP. To achieve this there remained a lot of technical problems to be resolved.

In the initial stage of research, it was not possible to complete the DSP, A/D, and D/A devices in a radio unit at a practical cost, as shortage in device capacity was a significant factor. Icom conducted research into digital PSN modulation, noise reduction, automatic notch, and audio peak filter, while also proceeding with research into digital IF filter processing and digital AGC processing. This research includes the ultra-narrow filter for CW that allows the advantages of DSP to be fully utilized for commercialization of a DSP transceiver. As the first devices were developed with improved capacity, Icom started full-scale research into integrating the digital IF filter processing (*2) and digital AGC processing in practical applications.

*2 Advantages of digital IF filter processing:
Since a digital IF filter is free from deterioration due to passband width deviations, temperature changes, change in mechanical strength, etc., the changes seen in an analog filter will not occur. It will not deteriorate through years of use and will provide excellent ripple characteristics that are not possible with analog filters.

When the DSP filter is processed at the AF stage, the demodulated AF signal is filtered after this. This filter type will function effectively when the level of the interfering signal is equal to or less than that of the desired signal. However, when the level of the interfering signal increases, the AGC activates reducing the level of the desired signal causing it not to be heard (AGC blocking phenomenon). This phenomenon is caused by filtering taking place outside the AGC loop. Even if filtering is executed at the IF stage before demodulation, it is not possible to avoid this blocking phenomenon when the digital filter is not incorporated in the AGC loop. Therefore, it is necessary to execute both IF filter processing and AGC processing using the DSP to prevent the AGC blocking phenomenon.
To realize a digital AGC, it is necessary to obtain the adjustment range for AGC gain internally in the DSP (*3), and to input both the desired signal and the interference signal into the A/D converter without them distorting (*4). For these reasons, Icom decided on a dynamic range for the A/D converter of at least 110dB, and approximately 120dB when the margin is taken into consideration.

*3 To control the AGC attack response properly, it is necessary to adjust the gain even after the completion of IF filter processing. If the adjustment range of gain within the DSP is set to 60dB, it is necessary to obtain a wider dynamic range, as the noise floor is raised 60dB under full-gain conditions where AGC is not applied.

*4 If the signal is distorted before entering the A/D converter, a distortion component may be mixed in the band. If it is mixed in the band, it is extremely difficult to remove it by post processing.

The DSP in the IC-756PRO/756PROII employs a 24-bit A/D converter. The logical value of the dynamic range of a 24-bit A/D converter is 144dB, however the actual value of the analog performance is smaller than this and performance may differ considerably, depending on the type of A/D converter used.

The A/D converter used for the IC-756PROII is a super-high performance A/D converter that is also used in digital mixers for recording studios and provides an actual analog performance value of 120dB. To bring this performance to an optimum level it is necessary to execute calibration for 10 seconds after powering on.
The wait time when IC-756PROII is started is allotted to the calibration operation.

To execute the processing of data sampled by the 24-bit A/D converter it is necessary to obtain 24-bit calculation accuracy. Since the dynamic range is decreased substantially due to the scaling operation (*5) for the accumulation of calculation errors or digital filter processing, Icom felt the 24-bit fixed decimal point DSP would provide insufficient calculation accuracy.

*5 Scaling
For digital filter processing, a frequency which causes the gain to increase may exist at the intermediate stage of processing even if the filter used provides a passband gain of 0dB. For a fixed decimal point, DSP the calculation is executed with the gain decreased in advance so as not to allow an overflow to occur due to a signal of that frequency.
This gain adjustment operation is called "scaling".

Since the level of scaling required is also increased to provide an IF filter with a sharp shape factor the calculation accuracy is liable to be decreased, even if double-precision (32-bit fixed decimal point) calculation is executed when using a high-speed 16-bit DSP. To provide both the digital IF filter processing and digital AGC processing using DSP, Icom determined it was necessary to use a 32-bit floating point DSP.

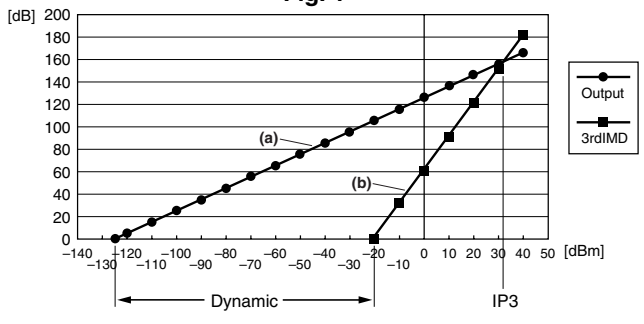
For a 32-bit floating point DSP, the numerical data within the DSP is adjusted automatically according to the size of the numerical value. Consequently, errors generated due to calculation are extremely limited and the influence of calculation errors is almost negligible. Because it is not necessary to consider the overflow during calculation, the dynamic range will not be decreased due to the scaling operation.

The 32-bit floating point DSP and 24-bit A/D-D/A converter use a signal processing algorithm (newly developed to demonstrate its performance) in combination for the reasons above, which make it possible to provide highly accurate digital IF filter processing and digital AGC processing. These new functions (FM demodulation, AM modulation/demodulation, RTTY modulator, etc.) were incorporated in the IC-756PRO to make it an IF DSP radio.

Two Dynamic ranges

Dynamic range as RF performance

Fig. 1



"Dynamic range" from the viewpoint of RF performance indicates to what extent the distortion component (generated due to the frequency of a signal) can be heard at the receive frequency when a frequency component different from two receive frequencies is input.
"Dynamic range" generally means the value by 3rd order distortion component.

If the receive frequency is substituted for "f_{RX}", the input frequency for "f_1" and the input frequency for "f_2" respectively, the following relationship is established for 3rd order distortion component.

$f_1 \times 2 \pm f_2 = f_{RX}$, or
$f_1 \pm f_2 \times 2 = f_{RX}$

If there are inputs of 14.2MHz and 14.3MHz while 14.1MHz is being received, the distortion component is heard at 14.1MHz. The relative value of the input level when the signal can be heard at 14.1MHz and the level of the signal received at the essential receive frequency is called the "dynamic range".

Figure 1 shows an example in which the following are plotted on the same axis.
- Input/output characteristics at receive frequency, or the characteristic data (a) for a case when the receive frequency component input from the ANT is detected and output as a low frequency signal
- Input level of frequency component (generating 3rd order distortion from the receive frequency) and level (b) at which the distortion can be heard at the receive frequency.
  The difference in level at which (a) and (b) above can be heard is the dynamic range.
  The level at intersecting point between (a) and (b) above is called IP3 (3rd order intercept point).

If these numerical values are large, it can be said that signal processing is executed without distortion. When the numerical values are small, a frequency component that does not exist in the essential receive frequency is heard and distortion will be generated.

Dynamic range for A/D converter

Consider the dynamic range (used as an index for the performance of an A/D converter) as the ratio between maximum value and minimum value to be treated by the A/D converter. If the maximum resolution for one bit is "Vmax" in the case of a 16-bit A/D converter, the following is given:

$Vmax \div 2^{16} = Vmax \div 65536$

In other words, the change in level for one bit is 1/65536 of Vmax.
This value seems to be an extremely small value, in decibels it will be as follows:

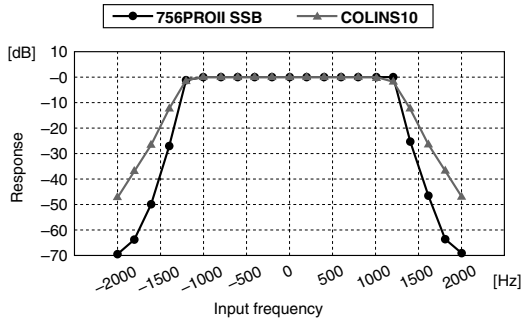
$20\log (1/65536) = -96.33dB$

This means that an S/N ratio of over 96dB is never allowed for transmit. The minimum resolution of signal the A/D converter can treat is affected by its specifications, which are 24 bits and 144dB logical value. Some may say that a transceiver is not a high-grade audio system and therefore does not require a specification of 144dB, or that a specification of 96dB is sufficient; however this value is not an over specification. If there is no AGC in the DSP and the input level of the A/D converter is properly controlled by the analog circuit AGC, the specification of 96dB will be sufficient (the IC-775DSP uses this system). When the A/D converter is in the AGC loop, the input level of the A/D converter may fluctuate significantly. For this reason, the gain control by AGC within DSP requires at least the dynamic range of the A/D converter.

5. Circuit description

5-1 Digital IF filter

For IC-756PROII the transmit/receive passband width in all modes is determined by the digital IF filter using DSP. A filter of this type provides an ideal shape factor that cannot be achieved by an analog filter. If an attempt is made to increase the shape factor and band ripple characteristics of an analog filter, it is necessary to increase the number of crystal components (or ceramic elements), which may result in physical restrictions. A digital IF filter using DSP assures the desired characteristics by overlaying multiple filters. This is governed only by the processing volume of the software and it is possible to overlay such filters with any number of stages.



The diagram shows a graph of receive selectivity when the IC-756PROII is set to the SSB BW mode of 2.4kHz as well as the selectivity characteristic of each Collins 10-pole mechanical filter. The digital IF filter of the IC-756PROII is of a design equivalent to a 14-pole filter. The filter serves to cut the undesired adjacent signals sharply under any circumstances using the superior shape factor (sharp/soft) and 51 types of variable passband width provided by IF stage processing using the DSP. When viewing a received CW signal the difference between the cut-off performance of this filter and that of an analog IF filter is evident.

In a transceiver equipped with a conventional analog IF filter the beat frequency of an adjacent signal is present when the CW signal is received resulting in interference. The beat frequency is contained in the skirt of the filter even if it is out of the set band range. (Fig. 1.1)

Fig. 1.1

Conventional analog filter

The signal out of setting band is also heard as CW reception sound.

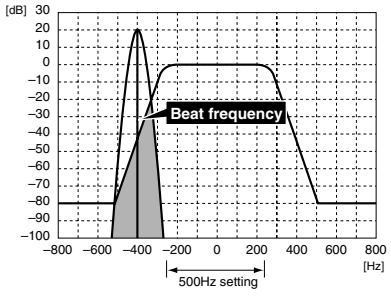
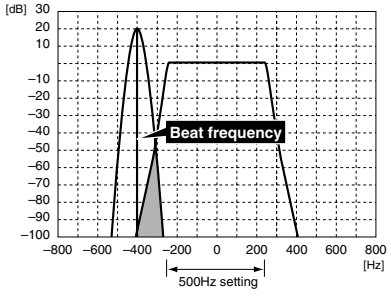


Fig. 1.2

Digital filter of IC-756PROII

The signal out of setting band is not heard as CW reception sound.

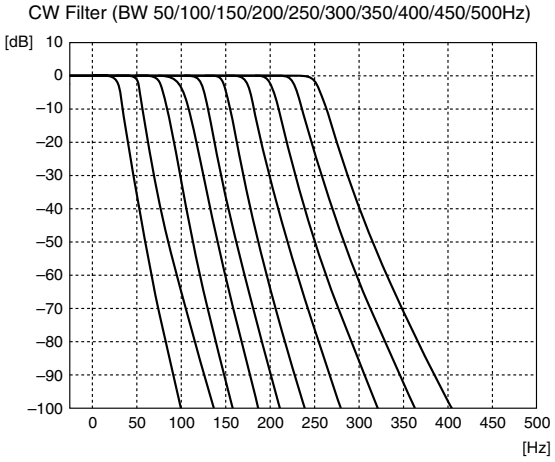


When using a digital IF filter the beat frequency of an unwanted adjacent signal moves out of the filter passband width, which will not cause interference. (Fig. 1.2) This is the greatest difference between an analog IF filter and a digital IF filter. During “pile-ups”, such as those that occur in DX’peditions, contests, etc., it is possible to make a proper selection suitable to the application by selecting the broad filter shape (SOFT).

5-1-1 CW sharp filter

The digital IF filter offers an ideal shape factor which has never been available with conventional analog filters. It enables a greater ability to receive weak stations that may lie behind radio interference. This is the filter shape that Icom would suggest to the DX hunter due to its superior cut-off performance. The cut-off performance is of a level to actually extend the CW band as explained above.

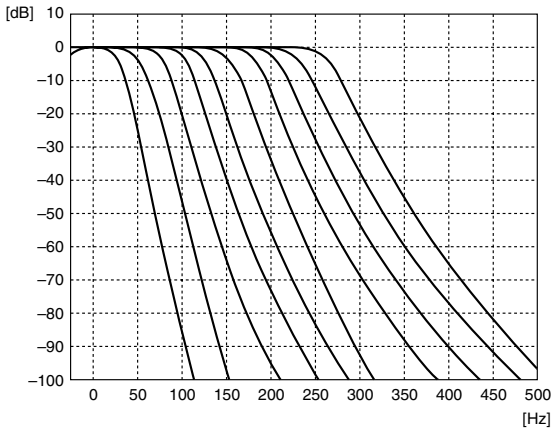
CW sharp filter characteristic



5-1-2 CW soft filter

The skirt characteristics of the soft filter are broadened so that the listening level of the filtered signal is the same level as that of a conventional analog filter. When using the radio for DX’pedition the filter is recommended for “pile-up” operation and is most suitable for the CW DX’peditioner and CW contestant.

CW soft filter characteristics

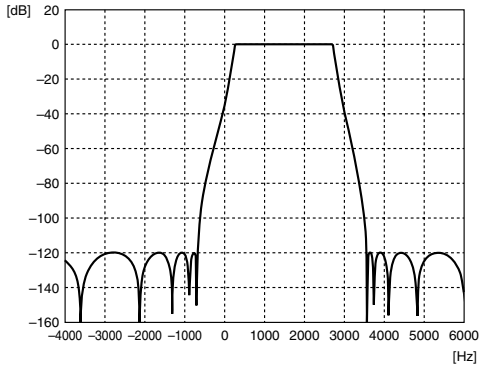


5-1-3 SSB sharp filter

This filter creates an ideal shape factor and in-band flatness, and makes it possible to cut out-of-band signals while reproducing the in-band signal, without deteriorating sound quality. This filter shape is most suited for situations which emphasize ragchewing and receive sound quality.

SSB Sharp Filter

SSB Filter (BW 2.4kHz)

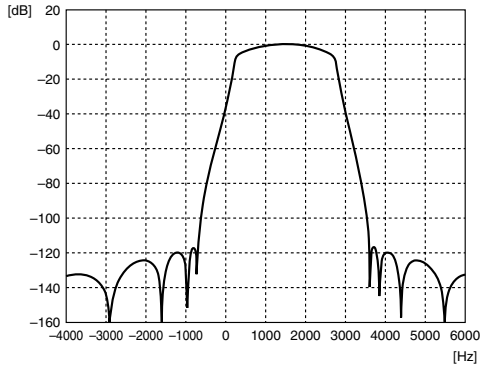


5-1-4 SSB soft filter

The soft filter shoulder is rounded to provide a receive sound approximating an analog filter. The noise is reduced for high-pass and low-pass to improve the S/N ratio for the desired signal. This function will demonstrate its effect when the signal closest to the noise level is picked up in the 50MHz band. Since the desired skirt characteristics are maintained it assures superior filtering performance.

SSB Soft Filter

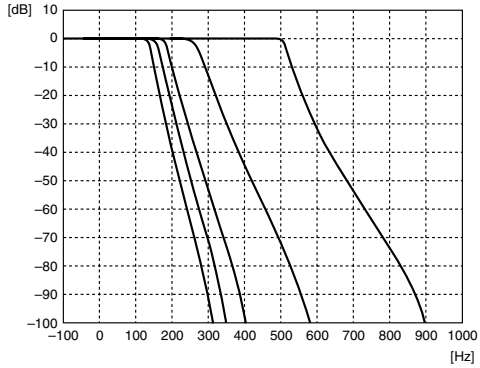
SSB Filter (BW 2.4kHz)



5-1-5 Other digital filters

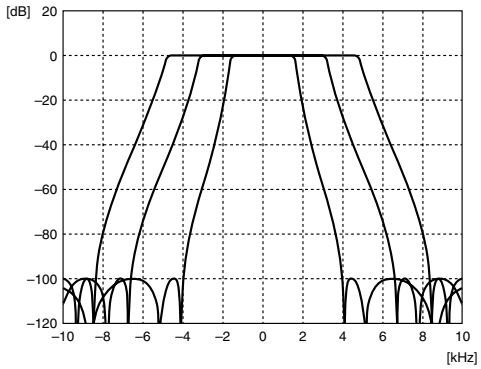
RTTY filter characteristics

RTTY Filter (BW 250/300/350/500/1000Hz)



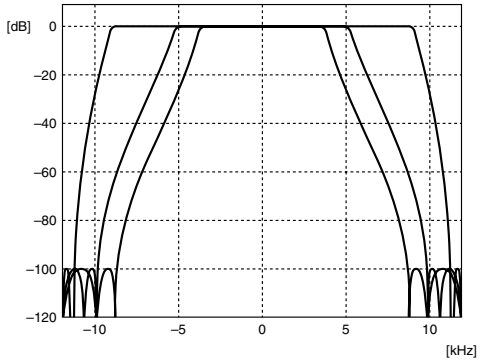
AM Filter Characteristic

AM Filter (BW 3/6/9kHz)



FM Filter Characteristic

FM Filter (BW 7/10/15kHz)



Digital IF filter transmission band (51 types)

Application mode	FILTER	Standard values	Setting range (step width)
SSB	FIL1	3.0kHz	50–500Hz (50Hz) / 600–3.6kHz (100Hz)
	FIL2	2.4kHz	
	FIL3	1.8kHz	
SSB•D CW	FIL1	1.2kHz	50–500Hz (50Hz) / 600–3.6kHz (100Hz)
	FIL2	500Hz	
	FIL3	250Hz	
RTTY	FIL1	2.4kHz	50–500Hz (50Hz) / 600–2.7kHz (100Hz)
	FIL2	500Hz	
	FIL3	250Hz	
AM	FIL1	9.0kHz	—
	FIL2	6.0kHz	
	FIL3	3.0kHz	
FM	FIL1	15kHz	—
	FIL2	10kHz	
	FIL3	7.0kHz	

5-2 Digital functions

5-2-1 Noise reduction, automatic notch

An adaptive filter made up of an FIR filter and LMS algorithm as shown in Fig. 2 is used to provide the basic configurations of noise reduction and automatic notch. This adaptive filter (*5) separates the target signal and noise, the correlation of separation parameters, and controls the coefficient of the FIR filter with the LMS adaptive algorithm to minimize the error between the output of the FIR filter and the reference signal.

*5 Adaptive filter

This type of filter is called an "adaptive filter" since the filter characteristics are changed by adapting to the characteristics of the input signal.

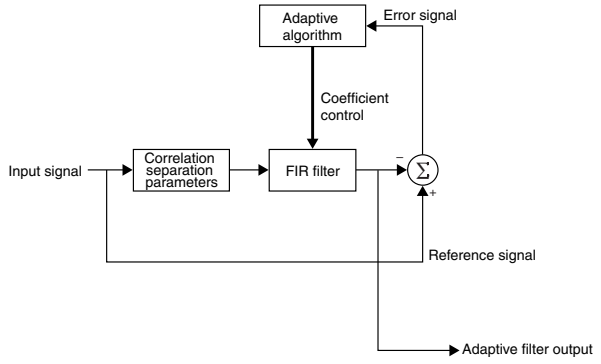


Fig. 2

5-2-2 Noise reduction

The adaptive filter allows the target signal to pass while the noise component (random signal) is attenuated. The voice signal has a high short-time correlation and a low long-time correlation. (For discrimination the signal correlation is called "short-time" or "long-time" for convenience, however it is a difference of only several hundreds microseconds.) If the correlation separation parameters are set to allow short-time correlation to be detectable, the voice signal is detected as a low correlation component, and the noise as a high correlation component. In this case the voice component must pass as it is, and only the noise component is attenuated. The noise reduction effect is random at the head of a word (the moment when speech begins) and at points where intonation changes significantly. If the noise reduction effect is increased too much, the voice component may be attenuated together with the noise as described above. In this case it may decrease clarity, even if the S/N ratio is improved.

The transceiver is designed with the flexibility to set the noise reduction level accurately (16 stages) in order to meet all circumstances. This makes it possible to adjust the balance between the S/N ratio and clarity quickly.

5-2-3 Automatic notch

If the correlation separation parameters are so set to allow long-time correlation to be detectable, the voice signal is detected as a low correlation component, and only the tone signal is detected as a high correlation component. If the correlation separation parameters are set to allow long-time correlation to be detectable the voice signal is detected as a low correlation component, and only the tone signal is detected as a high correlation component. Since this setting makes it possible to separate the tone signal component from the voice component the output from the adaptive filter will be only the tone signal. Since the phase and amplitude of the tone signal from this adaptive filter become the same as those of the input signal, the output of the error signal shown in Fig. 2 makes it possible to obtain a voice signal from which the tone signal is removed. In other words, this adaptive filter setting will operate as an automatic notch to remove beat interference such as CW and RTTY signals, which may interfere with SSB. Automatic notch makes it possible to detect and remove interference correctly even when more than two tones occur. As the tone frequency changes the interference is followed and removed automatically. Since the characteristics are adjusted to minimize the influence upon a voice, it can be used in SSB mode without any sense of incongruity even if automatic notch is turned on all the time.

5-3 PSN modulation

The IC-756PROII adopts a digital PSN modulation system for SSB modulation processing to provide superior band characteristics and a high transmission S/N ratio. This means that unwanted sidebands and carrier leaks are almost completely eliminated. This section explains the principle of operation while comparing the PSN type SSB modulator with the analog filter type SSB modulator used in conventional analog transceivers.

5-3-1 Analog filter type SSB demodulator

The configuration of analog filter type SSB modulator is shown in Fig. 3.

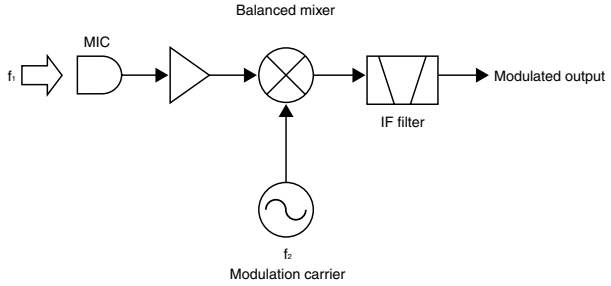


Fig. 3

If the tone signal of frequency (f_1) is presented to a microphone, two spectra (f_2–f_1 and f_2+f_1) are generated against the mixer output as shown in Fig. 4.

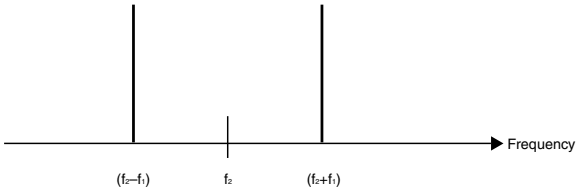


Fig. 4 Mixer output spectrum

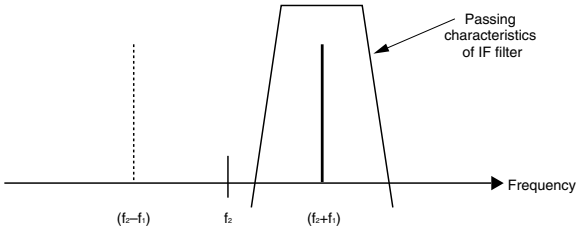


Fig. 5 SSB demodulated wave

This mixer output passes through the IF filter, passing only the necessary band. Its unwanted sideband is attenuated, which assures a modulated SSB signal. (Fig. 5)

Since the performance limits of the IF filter become the performance limits of the modulator in an analog filter type SSB modulator (Fig. 3 shown on page 14) the problems below will exist:

1. The ripple characteristics within the passband of the IF filter is reflected directly upon the entire frequency characteristic of the modulator.
2. There is a limitation in the shape factor of an IF filter.
   If an attempt is made to execute the modulation output to be excessively low-bandwidth it becomes unable to fully restrict the unwanted sideband signal.
3. A crystal IF filter with a good shape factor may not provide the satisfactory group delay characteristics in many cases and may be inferior from the viewpoint of sound quality.

5-3-2 PSN type SSB modulator (basic type)

The PSN type SSB modulator uses phase shift operation to negate the unwanted sideband signal and to attain a modulated SSB signal. If it is possible to reduce the phase difference at low-band of a 90° phase shifter it will assure superior characteristics to the filter type SSB modulator as it is possible to attain a higher unwanted sideband signal suppression ratio compared with that at low-band.

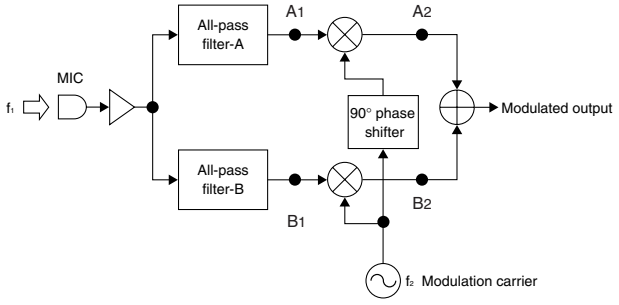


Fig. 6 Configuration of PSN type SSB modulator

The two filters (filter A and filter B) shown in Fig. 6 are combined to make a 90° phase shifter. This is an all-pass filter (*6) designed using two filters in pairs so that the signal output from each filter appears to have a phase difference of exactly 90° when the same signal is input.

*6 All-pass filter:
An all-pass filter is used to change only the phase without changing the amplitude of the signal sent from the all-pass filter.

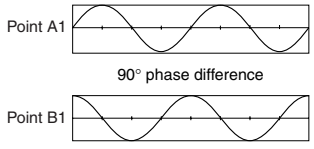


Fig. 7 Output signal of all-pass filter

When a signal (frequency: f_2) having a phase difference of 90° against the signal output from the all-pass filter of two lines (A, B) transmitted from a station is modulated with the tone signal of frequency (f_1) presented to the microphone, two spectra (f_2–f_1 and f_2+f_1) are generated at two points, point A2 and point B2 respectively, each of whose phase relationship is as shown in Fig. 8. The signal at point A2 is added to that at point B2 as indicated. The sideband signals having a phase difference of 180° are negated while the sideband signals of the same phase add with each other, causing an output whose amplitude is doubled. The example shown in Fig. 8 shows a USB signal that is obtained.
When an LSB signal is required for modulated output, it is best to add it after inverting the polarity. Since the component with a 180° phase difference is replaced with that having the same phase the modulated output appears to be an LSB signal.

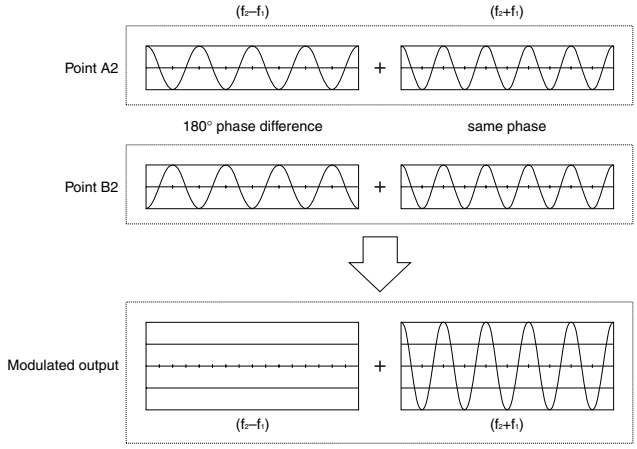


Fig. 8 Phase relationship of modulated signal

The PSN type SSB modulator provides an SSB modulated signal by eliminating the unwanted side band component. To achieve this it is necessary to keep the phase difference accurately and to set the amplitudes to precisely the same level.
With a PSN type SSB modulator using analog circuit, such problems as changes in characteristics due to deviation in parts or temperature may occur. Accordingly, it is very difficult to achieve the same unwanted sideband signal restriction ratio with a filter type SSB modulator.
For these reasons few transceivers adopt the analog type PSN.
Using the DSP it is possible to provide stabilized performance even if the PSN method is used, as it has few of the fluctuations seen in the analog circuit.

5-3-3 Icom's PSN type SSB modulator

Figure 6 is a basic configuration drawing of a PSN type SSB modulator. The IC-756PROII adopts the PSN type SSB modulator using Icom's unique architecture shown in Fig. 9.
This method makes it possible to obtain an effect equivalent to multi-rate processing (*7) even if the sampling rate is not decreased during all-pass filter processing. This makes it possible to improve the DSP calculation by more than two times which is required for accurate SSB modulation processing. The part of modulated carrier multiplication in the conventional method is changed to the multiplication of a constant leading to an improvement in efficiency.

*7 Multi-rate processing
A method of processing that uses the multiple sampling rates selectively, depending on the frequency of signal to be processed.
Even if the processing contents are the same, the processing of a lower sampling rate will decrease the volume of calculations.

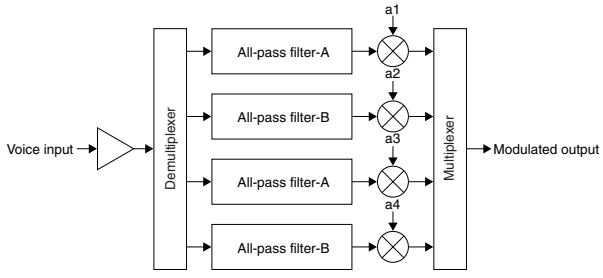


Fig. 9 Configuration of Icom's PSN type SSB modulator

For the SSB modulator shown in Fig. 9, the signal is input to each filter sequentially for each sampling cycle by using a multiplexer with 4 all-pass filters (filter A, filter B, each designed for a phase difference of 90°) arranged alternately to multiply each filter output by the constants (a1 to a4).
Using the multiplexer the result of multiplication is output sequentially, making it possible to gain the desired SSB-modulated output signal.

· For USB: Constant {a1, a2, a3, a4} = {1, 1, –1, –1}
· For LSB: Constant {a1, a2, a3, a4} = {1, –1, –1, 1}

For PSN modulation processing using the 16-bit fixed decimal point DSP of conventional transceivers, the characteristics are adjusted to decrease the influence of the rounding error (when the filter coefficient is quantized) as it occurs. For the 32-bit floating point DSP nearly ideal characteristics are assured as the influence of errors due to quantizing is extremely limited. The IC-756PROII was re-designed with this point taken into consideration to further improve the low-band characteristics as compared with conventional transceivers. Figure 10 shows the restriction characteristics of an unwanted sideband signal and the pass characteristics of the desired sideband signal.

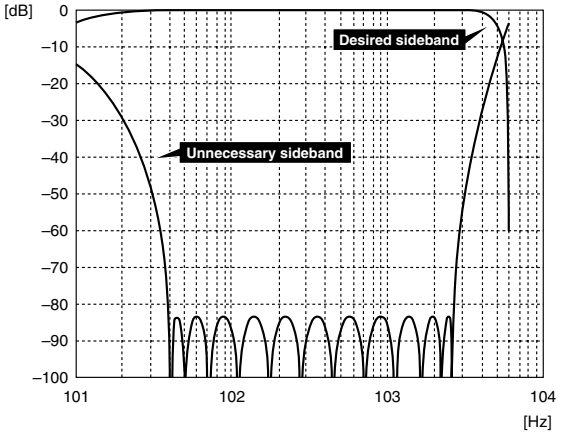
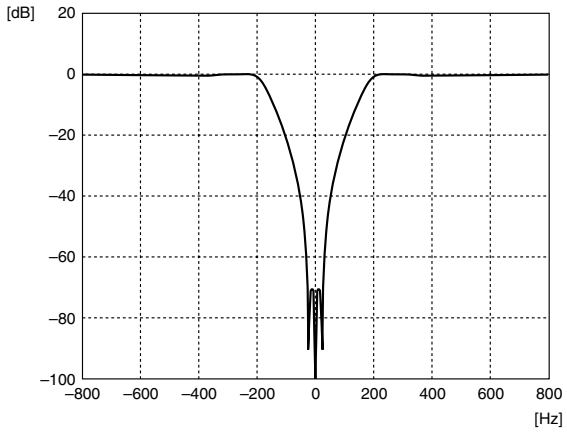


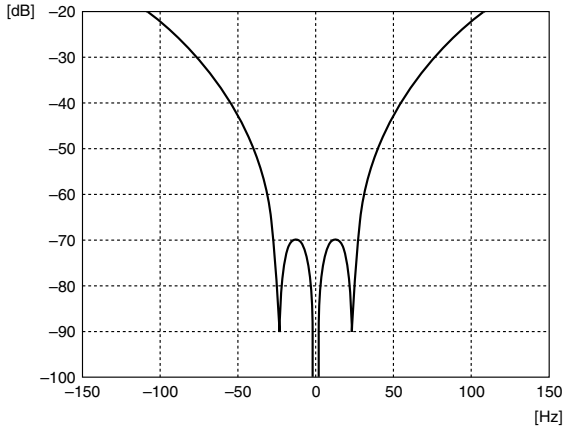
Fig. 10 SSB modulation characteristics

5-4 Manual notch

The IC-756PROII manual notch filter has extremely sharp characteristics which can be provided only by DSP processing.
Since this manual notch is processed within the AGC loop even powerful beats are cut-off sharply without any influence upon the AGC. The filter characteristics are sharp and the passband width is held to approximately 50Hz with an attenuation level of over 70dB. This makes it possible to adjust the notch point accurately. Only the DSP provides the characteristics as shown above.
With an analog type notch filter (crystal or LC notch filter) it is not possible to adjust the notch point characteristics accurately as shown above, as the frequency characteristics are liable to deviate. The manual notch assures stable filter characteristics by DSP processing because of its extremely sharp characteristics and the high-stability reference oscillator provides superior frequency stability.
Accordingly it provides stable operation such that it is not necessary to re-adjust the notch point, provided the beat signal is not moved once it is set.



Characteristics of manual notch



Characteristics of manual notch (enlarged view)

5-5 Speech compressor

The IC-756PROII is equipped with a newly developed RF type speech compressor. The configuration of the speech compressor is shown in Fig. 11.

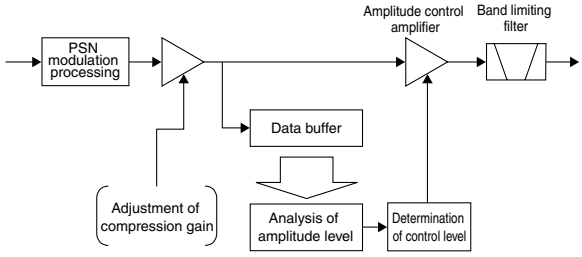


Fig. 11 Configuration of speech compressor

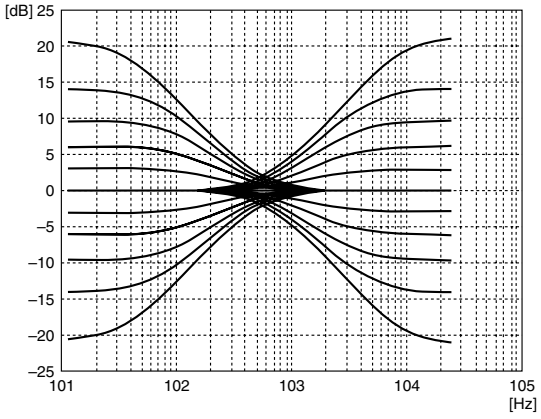
The operating principle of this compressor is that the SSB-modulated IF signal is saved in the data buffer for a fixed time at first, and then the IF signal saved in the buffer is analyzed for amplitude level. The control level of the amplitude control amplifier is determined in accordance with the analysis, providing compression control such that the signal peak does not exceed a certain level. In other words, the amplitude of the current signal is controlled in accordance with the change in amplitude over a certain previous period.

Unlike the RF compressor used widely in conventional analog processing type transceivers little distortion will occur as the signal is not clipped. The speech compressor resembles an AGC type compressor in that the signal level is controlled, however the normal AGC method has a lot of problems. It is usually considered that the AGC type has an improved compression effect along with shortened gain recovery time constant, compared to the grip type. Setting the time constant to a low level may bring about an inferior compression effect as the adjustment range of the time constant is limited due to spoiled AGC loop stability.
The Icom type compressor assures a high compression effect as there are no problems due to the non-execution of feedback processing with a proper follow-up performance against changes in amplitude of the IF signal. Even when the compression level is high only a slight distortion outside audible range may occur. To prevent the transmit passband width from extending a wide-band limiting filter is used. Since this filter was designed to prevent group delay degradation, it does not have an influence upon the modulated sound quality.

Distortion generated by compressor processing
For distortion generated by compressor processing, only the high order distortion may be addressed in many cases. Also, mutual modulation distortion may occur when the input signal is of 2 tones or more. The RF stage grip-processing compressor is better than the AF stage grip-processing compressor from the viewpoint of high-order distortion. The reason why it is not so highly rated from the sound quality viewpoint is because there is a problem with mutual modulation distortion. The AGC type compressor provides a lower mutual modulation distortion level as compared to the grip-processing compressor assuring better sound quality. The Icom type restricts mutual modulation distortion similarly.

5-6 Microphone equalizer

The microphone equalizer characteristics used for the IC-756PROII are based on the frequency characteristics of the audio tone control circuit which has been re-designed to be dedicated to voice frequency range. The transmit function of an analog filter is simulated and converted into that of a digital filter to provide the microphone equalizer function. In some microphone equalizers for transceivers the characteristics may change suddenly with a specific frequency as a limit. Unnatural sounds may be generated by such equalizers depending on their tone quality. Not in Icom's.



Characteristics of microphone equalizer

The microphone equalizer of IC-756PROII allows smooth selection of characteristics and may be adjusted accurately over 11 stages for high band and low band. This makes the frequency characteristics adjustable without any sense of incongruity.

5-7 RTTY demodulator

The IC-756PROII is equipped with a built-in demodulator/decoder function (for BAUDOT RTTY) for the first time in an HF amateur transceiver. It is possible to decode RTTY signals using the transceiver independently even if external units such as multi-function TNC, and a RTTY terminal unit (compatible to RTTY) are not used. When the RTTY signal is decoded the DSP unit executes the demodulator processing and the binary signal (BAUDOT) obtained is decoded by the main CPU, and its characters are displayed in the lower portion of the display. Figure 12 shows the configuration of demodulator processing using DSP.

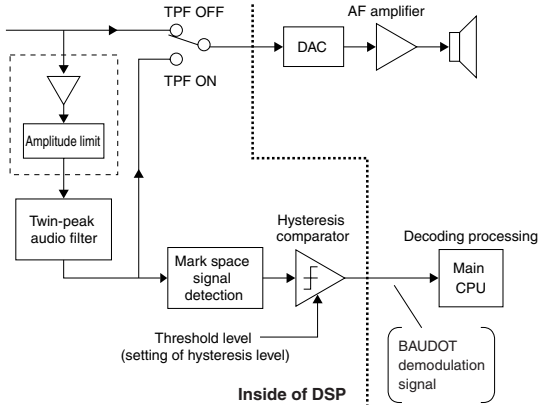


Fig. 12 Configuration of RTTY demodulator

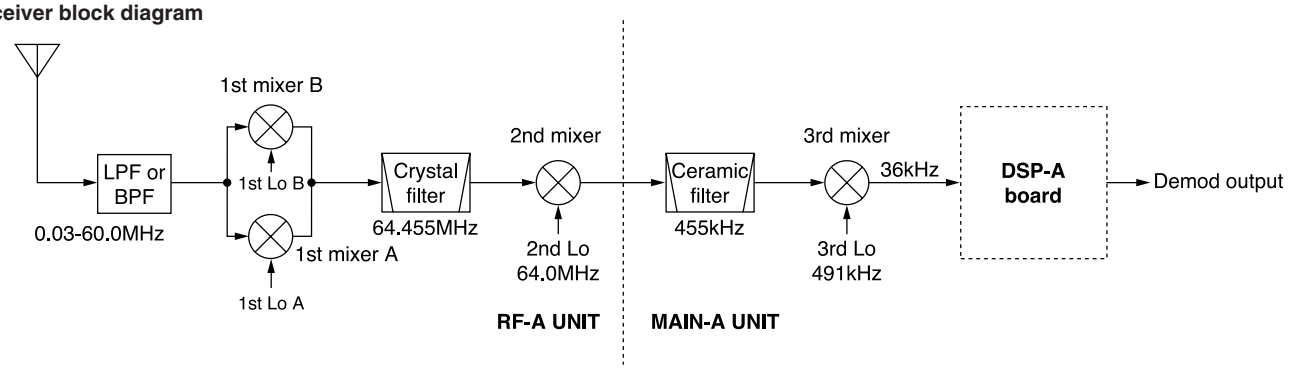
Most conventional RTTY terminal units or TNCs use either the PLL type or filter type demodulator to detect the mark/space signal. When the communication conditions are undesirable due to interference, fading, etc., the filter type is generally superior. The demodulator processing of IC-756PROII uses the basic configuration of a filter type demodulator.

For demodulator processing in DSP the amplification and amplitude limitations are first executed against the audio signal demodulated through product detection. This processing provides sufficient demodulation performance against even low level signals that do not move the S-meter, so there is no influence due to deviations in amplitude. The twin-peak audio filter then removes the radio interference and improves the S/N ratio before detecting mark/space signals. Two narrow-band pass filters are used in detection processing to extract the components near the mark frequency and space frequency. The output of each filter is detected and balanced, polarity reversed, and then passed to comparator processing. The comparator processing has a hysteresis characteristic such that it is hardly affected by fluctuations in the noise component. The hysteresis width is adjustable by changing the threshold level value on the RTTY decoding screen. The comparator determines the signal for polarity. The result is converted into a logic signal and then transmitted to the main CPU. The main CPU decodes the RTTY signal and displays the characters on the display screen.

In filter type demodulators, the difference in filter characteristics appears to be a difference in decoding performance. The filter will enhance the decoding ratio provided a high performance filter is used. It is also influenced by the phase and time response characteristics. Twin-peak audio filters and mark/space signal detection filters are carefully tested to adjust their characteristics. Final development of the Icom filter was conducted in part in cooperation with veteran stations with a long RTTY history. A decoding ratio equivalent to a dedicated RTTY unit such as TNC or RTTY terminal units designed for existing RTTY is achieved. For the IC-756PROII RTTY demodulator the effect of twin-peak audio filtering has made a significant contribution to improving the decoding ratio. When the RTTY mode setting is selected, it becomes possible to change the speaker output and the audio output through the accessory terminal to a signal filtered by the twin-peak audio filter. Using this function it is possible to improve the decoding ratio of a TNC, terminal unit, etc. connected to the radio. Since the twin-peak audio filter is connected at all times to the built-in demodulator, it is not necessary to set the twin-peak audio filter output when using only the built-in demodulator.

5-8 Receiver

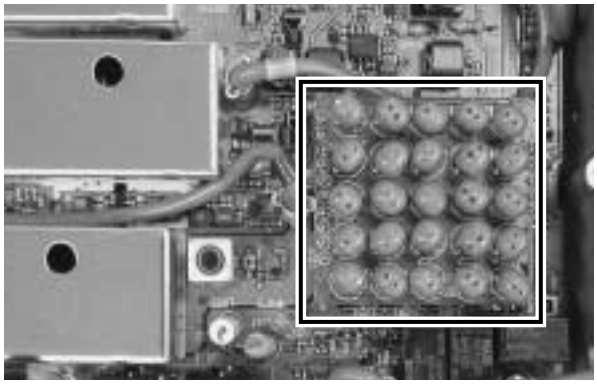
Receiver block diagram



The signal received at the antenna terminal (ANT1/ANT2) passes through the antenna selector and enters the RF-A unit through the LPF built into the CTRL unit. When the antenna tuner is turned on the IC-756PROII removes interference and cross modulation from unwanted radio signals to some degree in the first stage during receive, using the coil/capacitor of antenna tuner, and by allowing the signal to pass through the matching circuit. The signal input to the RF-A unit passes through the relay selectable ATT circuit (6/12/18dB) and is lead to the BPF stage which is divided into 13 sections. Various frequency components are included in the input side of the BPF stage. When distortion occurs in the BPF stage input side the distortion component may enter the band resulting in an interfering signal. However high-performance BPF may be used. The PIN diode with wide-range frequency characteristics and limited secondary distortion (Motorala, MMBV3700) is used to restrict such distortion. In addition, a large-sized coil (L) is used in the BPF stage element. The capacitor (C) provides low conductivity and low distortion. This prevents the IMD characteristic from being deteriorated by the filter and significantly improves the performance against the influence of adjacent intensive electric fields and weak signals.

13-division BPF stage

Band	Control signal	Band	Control signal
0.03–1.6MHz	B0	11–15MHz	B7
1.6–2MHz	B1	15–22MHz	B8
2–3MHz	B2	22–30MHz	B9
3–4MHz	B3	30–50MHz	B10W
4–6MHz	B4	50–54MHz	B10
6–8MHz	B5	54–60MHz	B10W
8–11MHz	B6		



BPF stage

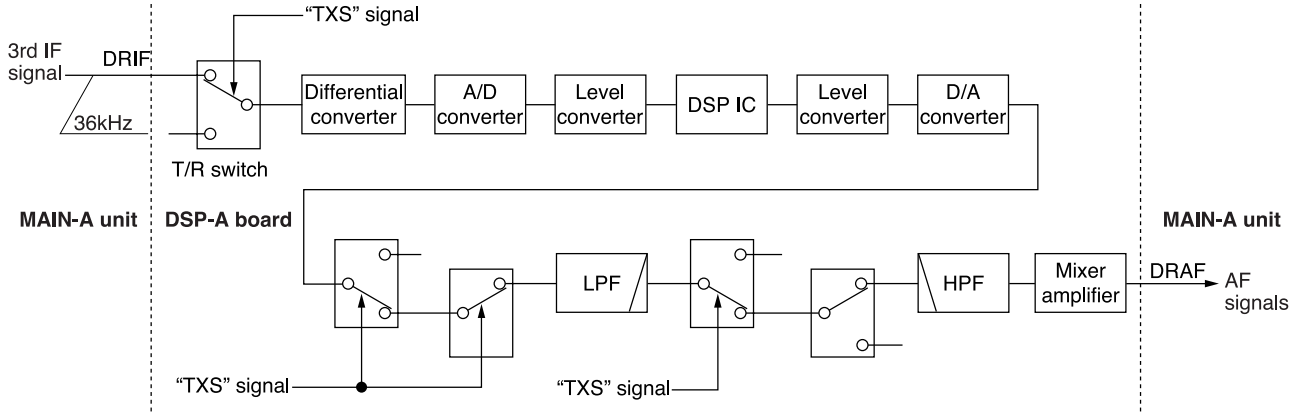
Having passed through the BPF stage the signal enters the preamplifiers (2 types). Preamplifier 1 is a GG (granted gate) amplifier of push-pull configuration instead of the conventional FET gate-earth type parallel amplifier. Preamplifier 2 is designed with gain for high-bands emphasized and is suitable for antennas with increased loss, small-loop type antennas having a limited band, and compact type YAGI antennas. The gain is set to approximately 10dB for preamplifier 1 and to approximately 16dB for preamplifier 2.

After passing through a preamplifier, the signal enters the parallel GG (granted gate) amplifier arranged at the front of the 1st mixer. This amplifier compensates for the loss of the splitter circuit for dual watch and isolates the main mixer from the sub-mixer. This signal enters the 1st mixer through the GG amplifier.

The mixer circuit incorporates a double balanced mixer in which four FETs are used to provide high IP and high dynamic range. This provides a significant improvement of the S/N ratio with limited distortion against large input signals, and provides superior 2-signal characteristics with no influence from the strong signals of an adjacent frequency.
The 1st mixer and LO circuits are arranged in two sets to provide the dual-watch function. The signal is converted to 64.455MHz by the 1st mixer and then passes through a variable type attenuator (using the PIN diode) to adjust the dual-watch balance where an attenuation of approximately 70dB (maximum) is assured. The receive level is adjustable for main band and sub band by changing the balance.
The GG amplifier (located in the succeeding stage) as well as the GG amplifier (located at the input side of the mixer) isolates the main mixer from the sub-mixer, improving the 2-signal characteristics, while maintaining the impedance (as viewed from the mixer) at a constant level. A combiner transformer determines the output for main mixer and sub mixer. The IF stage following the combiner transformer uses the circuit used for the main mixer and sub-mixer in common. The received signal passes through the 1st filter to eliminate unwanted signal components in the mixer stage. The 1st IF filter is a crystal filter selected taking 3rd order distortion into consideration. After passing through the 1st IF filter the signal is controlled by the AGC. It then enters the 2nd mixer through the 1st IF amplifier. This mixer is a diode double-balanced type with high IP which is highly effective against in-band IMD and adjacent signal interference. The element of the signal converted to 455kHz by the 2nd mixer enters the noise blanker circuit. The IF amplifier is connected to the noise blanker circuit by 4 stages in series to assure high gain. When the threshold level of the circuit used to control the noise blanker gate is varied, it is possible to change the noise blanker level in 100 stages.

The signal is further amplified by the 2nd IF amplifier and enters the 2nd IF filter. This is a ceramic filter with a high shape factor and a center frequency of 455kHz to restrict the maximum passband width of the signal passed to the DSP. The 455kHz signal is then passed to the 3rd mixer. The IC-756PROII uses a high-speed analog switch instead of the conventional mixing IC to improve the adjacent dynamic range characteristics and to restrict distortion.
An active LPF (consisting mainly of an operating amplifier) is included to collect the necessary frequency component (36kHz) from the 3rd mixer output. The capacitor of this active LPF circuit is a film type capacitor with limited distortion and superior temperature characteristics. The signal is then amplified and passed to the DSP port.
The 36kHz IF signal is differentially converted by the operating amplifier and is passed to the A/D converter. The signal is passed to the DSP IC through the level converter. The DSP IC is operated as a digital IF filter of 36kHz or as a demodulator under each mode. The demodulated signal is then passed to the D/A converter through a level converter and converted into an analog signal to pass through the low-pass filter via a differential input type active filter, buffer amplifier and analog switch to remove unwanted signals. The filtered signal passes through the analog switch to absorb the demodulation level difference between each mode with a demodulation level equalizing circuit.

DSP-A board block diagram

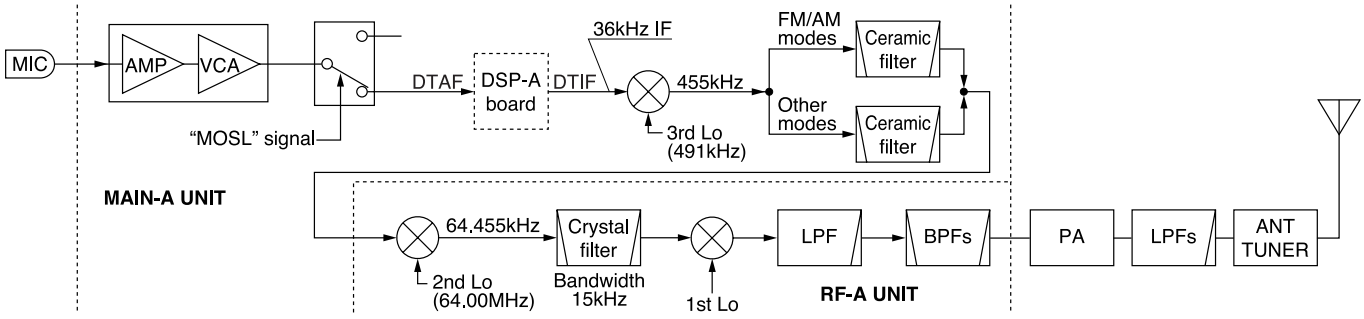


5-9 Transmitter

The voice signal enters through the microphone and is amplified by the VCA (voltage control amplifier). The voice signal is controlled in gain and passed to the DSP as the DTAF signal through the analog switch. The VCA controls the gain of the microphone in accordance with a signal output from the main CPU. When SSB mode is selected, the signal enters the amplifier through the analog switch and passes through the low-pass filter entering the differential amplifier, to restrict the band of the A/D converter input signal. When FM/AM mode is selected, the signal passes through the limiter amplifier, low-pass filter and pre-emphasis circuit, and enters the differential amplifier in the same manner as SSB mode. The amplified signal enters the A/D converter and enters the DSP IC through the level converter. After the signal has been demodulated by the DSP IC, it is output as a 36kHz transmit IF signal. The demodulated signal passes through the level converter and is converted to an analog signal by the D/A converter. The analog signal passes through the differential input type active filter and enters the analog switch through the buffer amplifier.

The signal then leaves the analog switch and enters the Main-A unit through the LPF as the DTIF signal to attenuate the out-of-band, spurious, or image noise. The signal is converted to the 2nd IF of 455kHz by the 3rd mixer circuit built into the Main-A unit and passes through the ceramic filter and IF filter via IF amplifier, to enter the RF-A unit. The 2nd IF signal is mixed with a 64MHz signal sent from the PLL circuit by the 2nd mixer, converted to an IF signal of 64.455MHz, stripped of unwanted components by the XTAL BPF, and enters the IF amplifier. The ALC is applied to the IF amplifier.
The IF signal is converted to the desired frequency by the HSB88WS diode mixer, stripped of unwanted frequency components by the 60MHz cut-off LPF, amplified by the RF YGR amplifier, and is then output to the PA unit. The transmit signal passes through a class A type amplifier, is amplified by the class AB push-pull amplifier, and is then amplified to 100W by the final amplifier (2SC5125 × 2). In the output of the final amplifier the higher harmonic is attenuated by the transmit PF compatible with each band.

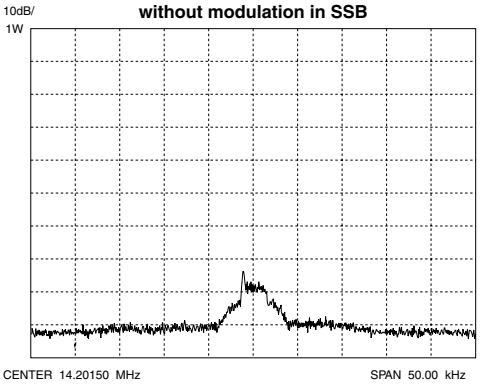
Transmitter block diagram



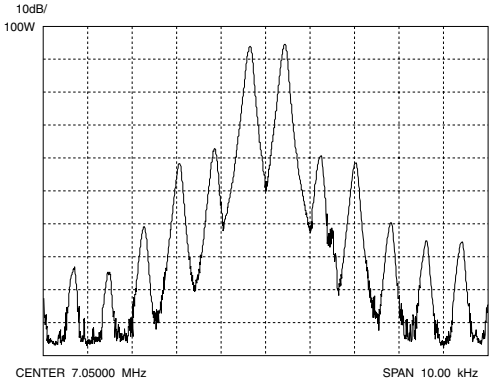
The IC-756PROII uses a well-balanced push-pull amplifier and LPF to provide an enhanced harmonic level for all bands of approximately 60dB (practical value).

The demodulation input/output to/from DSP uses the 24-bit A/D-D/A. The demodulation input/output to and from the DSP uses a 24-bit A/D-D/A converter. The use of the high-bit A/D-D/A converter significantly reduces modulation distortion due to bit error. Note that the limited number of bits causes the level deviation/bit to be increased and consequently causes the non-linear movement and demodulation distortion to be increased. The limited number of bits may also cause the maximum output level/noise output level ratio to be decreased resulting in an increased noise level when demodulation is not executed. This relationship will theoretically be "number of bits × 5dB". For a 16-bit D/A converter this is a S/N of 96dB. Comparing the rated output of 100W with the noise when demodulation is not executed the S/N will be the value obtained by subtracting the gain controlled by ALC from 96dB. When the 20dB gain control is executed at 100W, using the ALC for instance, the value of 76dB (=96 – 20) will be the ratio between noise when demodulation is not executed and level at time of 100W transmit.
For 24 bits this is 124dB (=24 × 6 – 20). As a result the noise of the A/D converter is reduced to a level where it is not a problem.

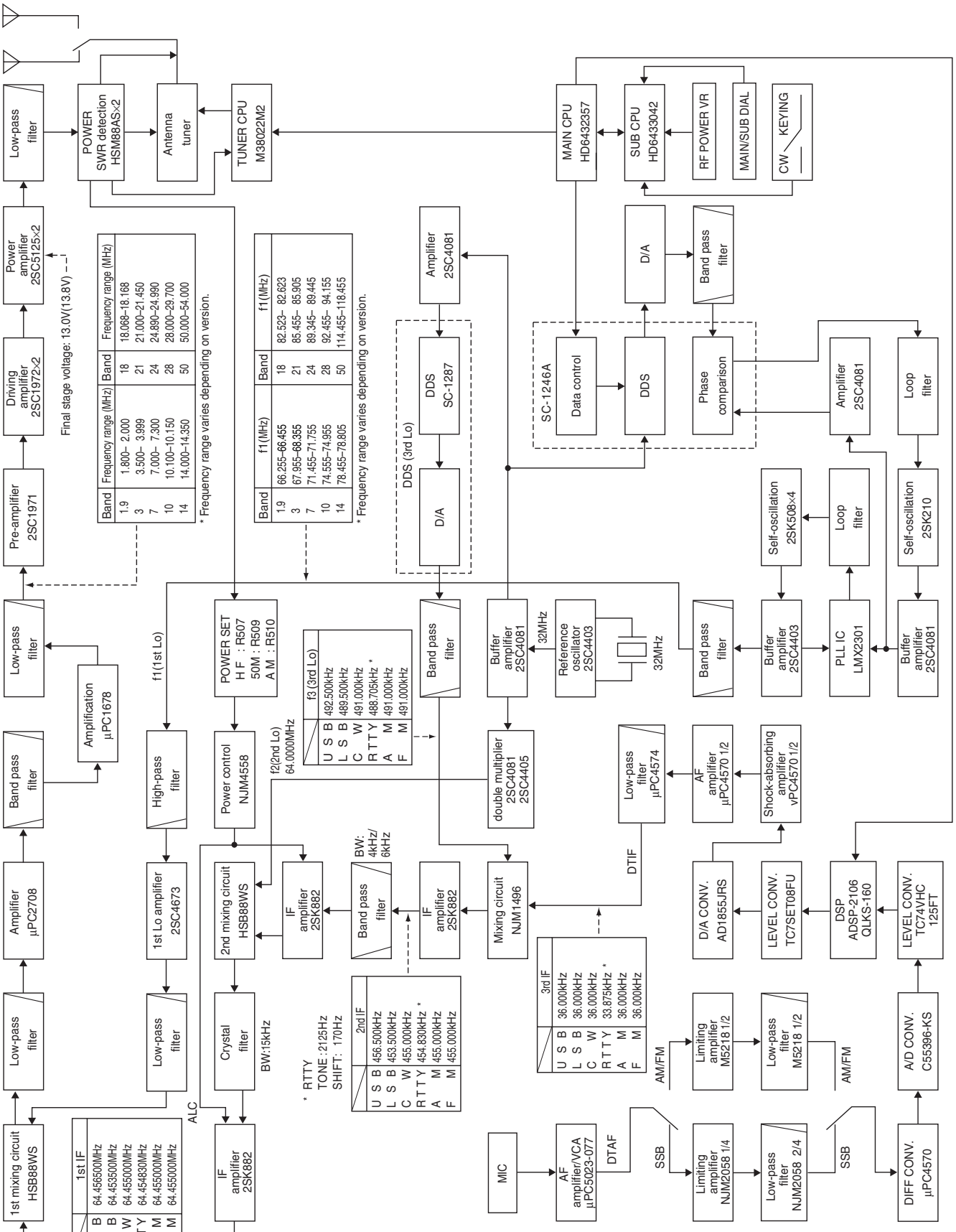
Noise within transmission band without modulation in SSB



SSB 2-tone IMD (transmission)



Transmitter Block Diagram



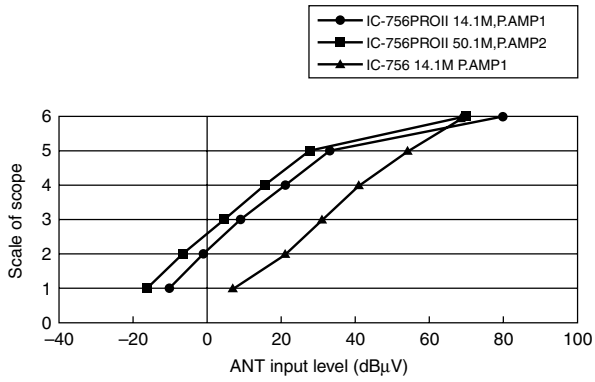
5-10 Dual-watch function

The dual-watch function allows the designated receive frequency and another frequency or the transmit/receive frequency of a DX station (used for split operation) to be watched at the same time. Fitting the transceiver with two receive circuits is one way of obtaining this dual-watch function. If a sub-receive circuit is used the performance is liable to decrease compared with the receive performance of the main receive circuit. The IC-756PROII has a dual-watch system which exceeds those in conventional equipment. Here two sets of a PLL circuit and 1st mixer are used for the dual-watch function. Both sets are used when the first intermediate frequency is attained to provide for dual watch. The ATT circuit has a PIN diode (used to adjust the balance so that the weak signal is not masked) when the difference in the levels of the signals received is increased right after the output from the 1st mixer. The transceiver is designed to receive these two signals properly by operating the balance adjustment knob located on the front panel. The transceiver uses a gate earth buffer amplifier before and after the mixer, with the FET having significant reverse isolation, so that the oscillation signal of the 1st stations (2 sets) will not be mixed with each other. The receive characteristics of this system when the main receive circuit receives a signal is the same as when the sub-receive circuit receives a signal. This makes it possible to validate the noise reduction, noise blanker, etc. even when a signal is received by the sub-receive circuit.

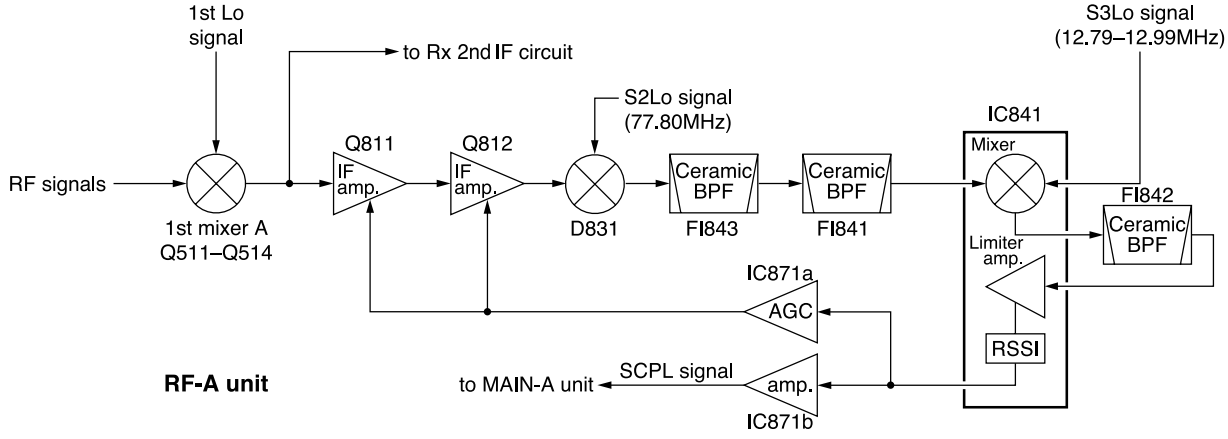
5-11 Real-time spectrum scope

The receive system circuit is separate from the real-time spectrum scope in the IC-756PROII. The circuit dedicated to the spectrum scope is used to enhance its accuracy. This makes it possible to use an attenuator dedicated to the spectrum scope, and to reflect the desired signal clearly without the band scope being saturated when the attenuator is turned on, even while receiving a low-level signal with a high noise floor.

Comparison of characteristics of spectrum scope



Spectrum scope block diagram



Description of circuit

The signal from the 1st mixer (while receiving) or the mixer in the RF-A unit (while transmitting) is passed through the PIN attenuator (D801) and amplified at Q811 and Q812, and applied to the D831 mixer. The D831 converts this signal to the 13MHz band using the 2nd mixer. The converted signal passes through the BPF, which is composed of two ceramic filters to suppress unwanted signals. The signal then enters IC841. This IC is designed for FM IF and has an algorithmic output RSSI terminal and MIX, and is operated by sweeping the LO input to this point. The FI842 filter determines the resolution of the spectrum scope, using a ceramic filter in CW mode, to assure stable performance without need for adjustment. The RSSI voltage output from IC841 is amplified by IC871 to provide both a scope voltage and to apply the AGC to Q811 and Q812, to extend the dynamic range of the spectrum scope.

5-12 Voice record/playback function

This radio uses a dedicated IC (ISD4003-04) for voice recording/playback, and stores the analog signal as an analog value. Usually an analog signal is digitized temporarily and stored as a numerical value, to be converted back into an analog signal when it is reproduced. With this method it is necessary to use expensive A/D and D/A converters and storage media (RAM).

The IC-756PROII does not require these devices as it uses an IC dedicated to voice recording/playback which provides full quality audio reproduction. The previous IC-756PRO also used this method. The storage chip in the IC-756PROII was changed to one with a greater memory capacity to allow continuous recording capability.

5-13 PLL circuit

Since the IC-756PROII is equipped with a Dual-watch function, two sets of PLL circuits with the same configuration are included. Unlike the PLL circuits of other HF transceivers, no mixer is used. The mixer is intended to create a sum or difference for the two signals to pick out the desired frequency component. In fact the input signal as well as the sum and difference are output for mixer output. For this reason, it is necessary to arrange a filter for the mixer output. The unwanted components required by the mixer are also spurious for transmit/receive. For a system configuration in which reference oscillation is controlled by the DDS (Direct Digital Synthesizer) to output 10MHz, 10MHz is oscillated by the VCO of PLL on the basis of the 10MHz generated by this DDS. The PLL oscillating the desired frequency at 10MHz created by the VCO is controlled to oscillate the VCO. In this case, it becomes unnecessary to arrange the mixer in the transmit system.
This successful design concept, using high-speed DDS, was adopted for the first time by the IC-775DSP.

Reference oscillator circuit
The reference oscillator circuit generates the frequency used as the reference by all oscillation circuits concerned with transmit/receive frequency. Thus the frequency accuracy depends on the accuracy of this oscillation circuit. The oscillator used for the reference oscillation circuit of the IC-756PROII provides the high accuracy of < –0.5ppm (0.5×10^{-6}) when at temperatures between –30°C to +60°C. This oscillator is a crystal oscillator called POC, in which the oscillator is thermally balanced due to the heat generated in the posistor in the oscillator, which does not allow the temperature change to occur in the oscillator even if an external temperature change occurs. It is also possible to adjust the deviation generated due to deterioration over time.

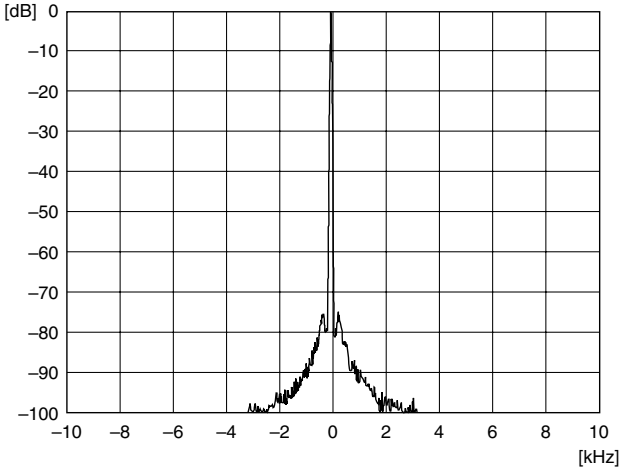
Configuration of LO for split operation
The 1st transmit LO for split operation is generated by changing the oscillation frequency of the PLL that generates the 1st receive LO.
With this configuration no transmit or receive signals will leak at the receive frequency during split transmission.

VCO of PLL for 1st LO
Four VCOs cover the receive frequency range from 0.03MHz to 60MHz:

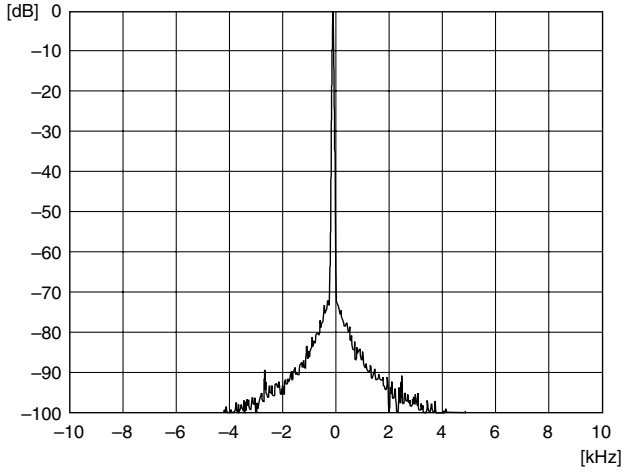
0.03–7.999MHz	VCO1
8–19.999MHz	VCO2
20–44.999MHz	VCO3
45–60MHz	VCO4

This VCO uses a HI-Q coil to minimize the noise generation, thus assuring high C/N characteristics.
(C/N characteristics diagram)

1st Lo C/N characteristics of IC-756PROII



1st Lo C/N characteristic of high-grade HF radio of a competitor

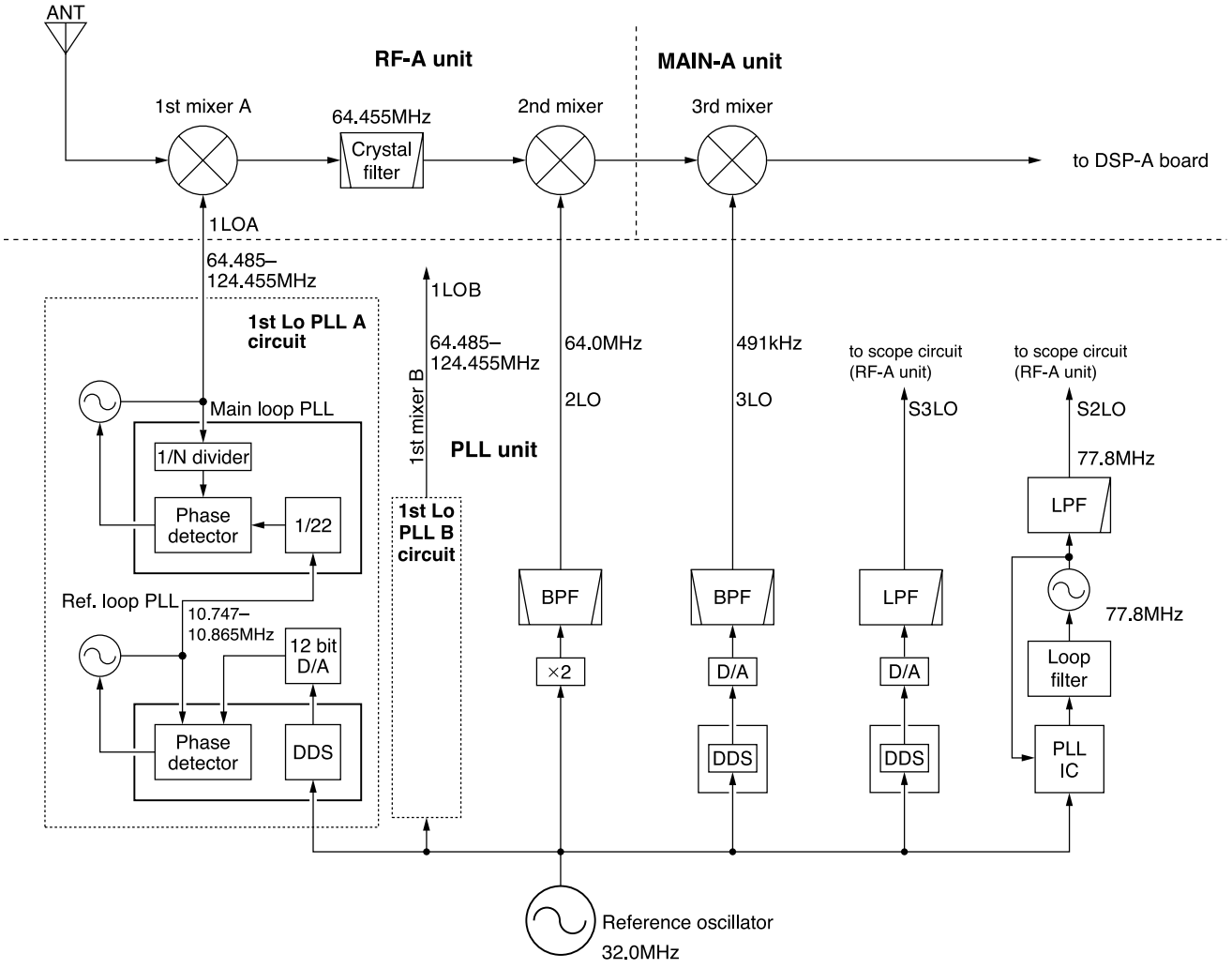


The above graphs show the 1st LO C/N characteristics for IC-756PROII and the PLL of a high grade HF unit from another manufacturer. The graph to the left indicates the LO C/N characteristic for the IC-756PROII. While the difference seems to be slight, the output of the 1st LO significantly affects the transmit/receive performance. When the low-band signal in the HF band is received, the difference will be apparent.

Other LOs

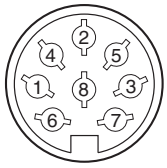
The 2nd LO works to double the output of the reference oscillator circuit previously described, and the 3rd LO is obtained directly from the DDS operating in accordance with the output of the 2nd LO reference oscillator circuit. Since the PLL is not used for such frequency components, high purity and stable operation is obtained.

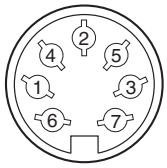
Block diagram of PLL



6. Connection to option/peripheral units

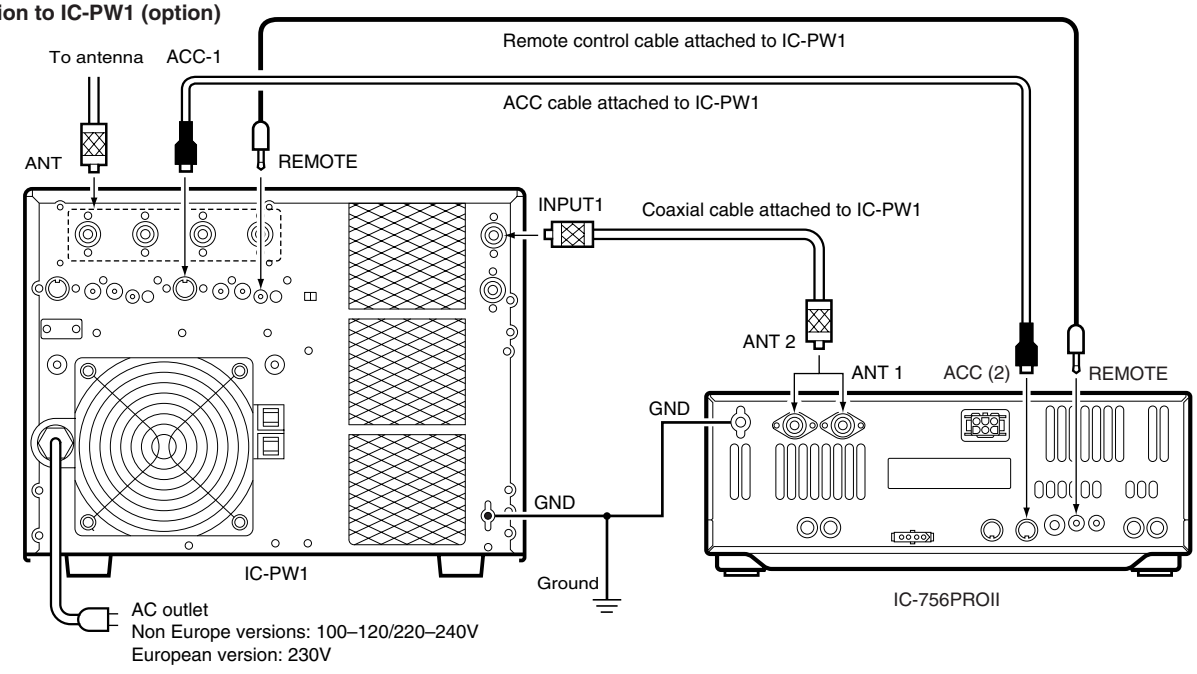
6-1 ACC Sockets

ACC (1)	PIN No.	NAME	DESCRIPTION	SPECIFICATIONS
8 pin  Rear panel view	1	RTTY	Controls RTTY keying	"High" level : More than 2.4V "Low" level : Less than 0.6V Output current : Less than 2mA
	2	GND	Connects to ground.	Connected in parallel with ACC (2) pin 2.
	3	SEND	Inout/output pin. Goes to ground when transmitting. When grounded, transmits.	Ground level : –0.5V to 0.80V Output current : Less than 200mA Input current (Tx) : Less than 200mA Connected in parallel with ACC (2) pin 3.
	4	MOD	Modulator input. Connects to a modulator.	Input impedance : 10kΩ Input level : Approx. 100mV rms
	5	AF	AF detector output. Fixed, regardless of [AF] position in default settings.	Output impedance : 4.7kΩ Output level : 100–300mV rms
	6	SQLS	Squelch output. Goes to ground when squelch opens.	SQL open : Less than 0.3V/5mA SQL closed : More than 6.0V/100µA
	7	13.8V	13.8V output when power is ON.	Output current : Max. 1 A Connected in parallel with ACC (2) pin 7.
	8	ALC	ALC voltage input.	Control voltage : –4V to 0V Input impedance : More than 10kΩ Connected in parallel with ACC (2) pin 5.

ACC (2)	PIN No.	NAME	DESCRIPTION	SPECIFICATIONS
7 pin  Rear panel view	1	8V	Regulated 8V output.	Output voltage : 8V ± 0.3V Output current : Less than 10mA
	2	GND	Same as ACC (1) pin 2.	
	3	SEND	Same as ACC (1) pin 3.	
	4	BAND	Band voltage output. (Varies with amateur band)	Output voltage : 0 to 8.0V
	5	ALC	Same as ACC (1) pin 8.	
	6	TRV	Activates [XVERT] input/output when "HIGH" voltage is applied.	Input impedance : More than 10kΩ Input voltage : 2 to 13.8V
	7	13.8V	Same as ACC (1) pin 7.	

6-2 HF/50MHz, 1kW linear amplifier

Connection to IC-PW1 (option)

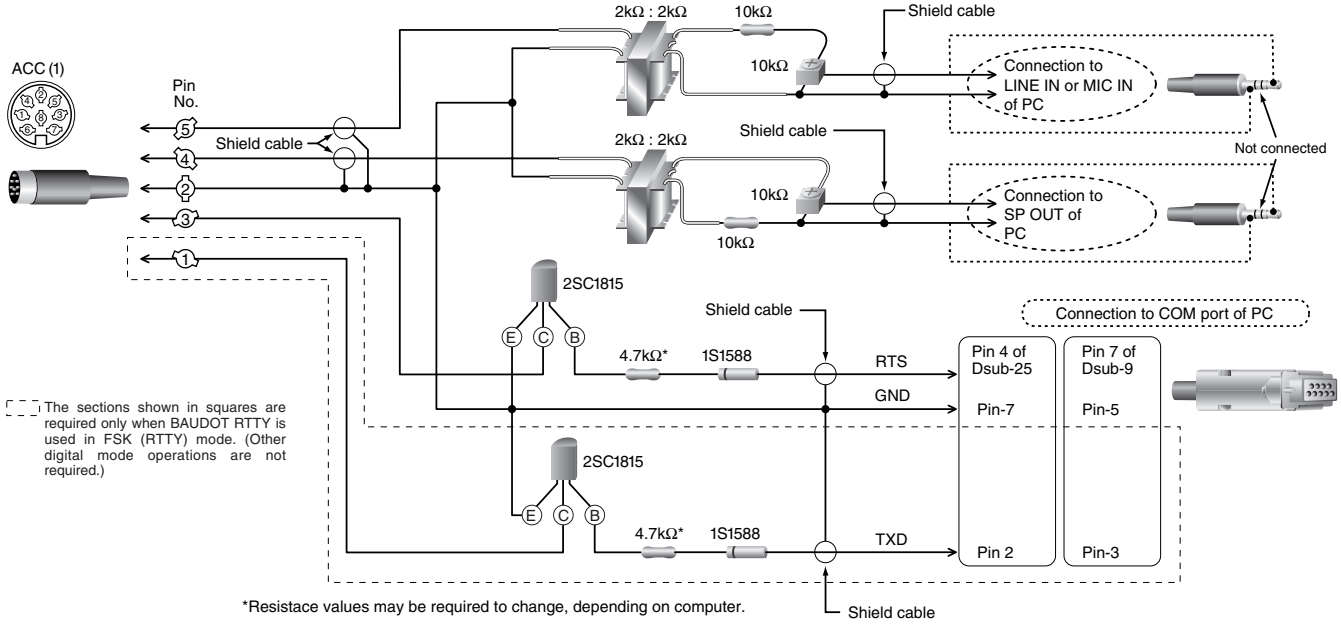


6-3 Interface for digital mode

To use a personal computer to operate the digital modes (SSTV, PSK31, BAUDOT RTTY, etc.), it is necessary to install the following interface.
The IC-756PROII is equipped with a digital IF filter that may narrow the receive passband range to 50Hz making it possible to select and receive only one station, even when it is used in PSK31 mode.

If a filter width of 500Hz or less is selected the receive passband filter is activated to avoid interference while the transceiver receives SSB-D (SSB data mode).
Refer to the instruction manual or help file contained in the 3rd party software prior to use.

Example of interface for digital mode
(Not provided by Icom)

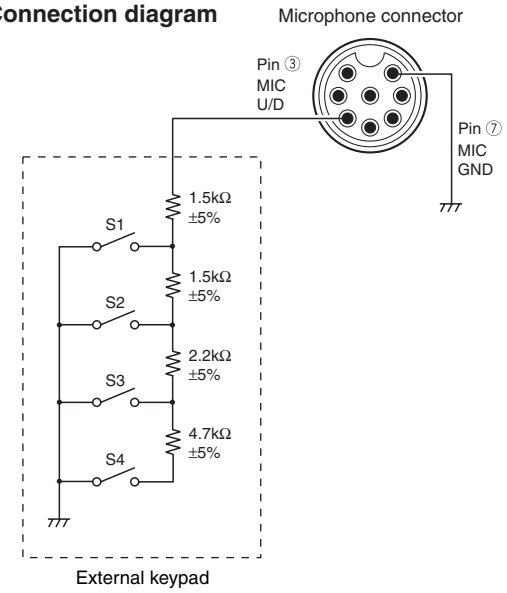


This circuit connects the input and output through transformers to prevent RF feedback and to isolate the transceiver from the computer.

6-4 External control unit for voice memory keyer

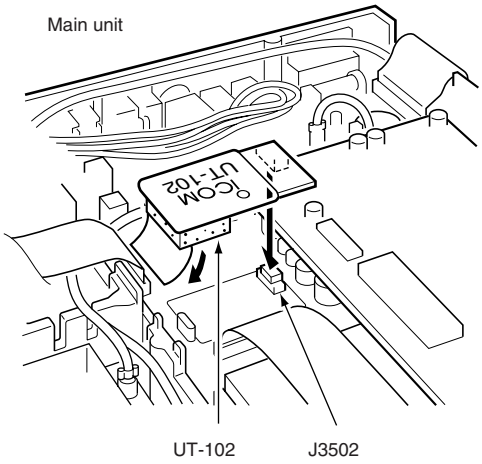
Example of external control circuit
(Not provided by Icom.)

Connection diagram



When a properly constructed control circuit is connected to the microphone connector, it is possible to control the transmission of the CW memory keyer (M1 to M4) and DVR (T1 to T4).
This also makes it possible to transmit the memory keyer and voice memory while displaying the scope.

6-5 Installation of UT-102 optional Voice Synthesizer Unit

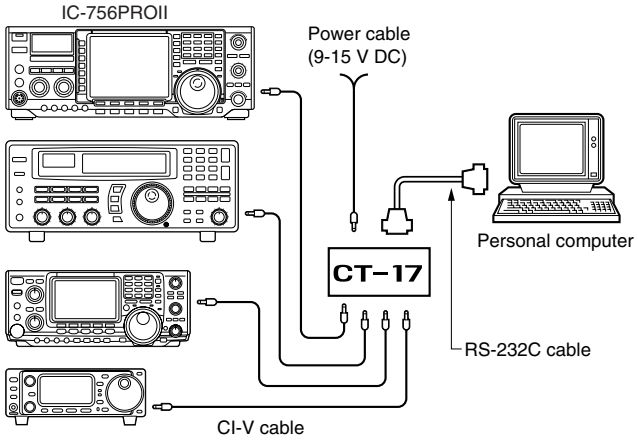


The UT-102 is capable of announcing S-meter level, frequency, and operating mode in English (on Japanese). It is possible to select voice speed (fast/slow).

7. CI-V control

7-1 Remote jack

Connection of computer



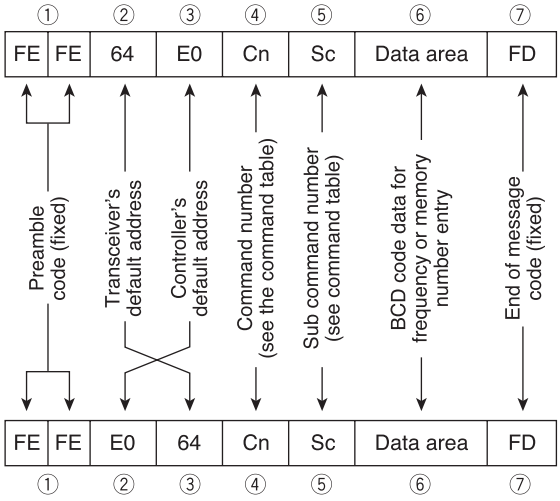
It is possible to connect up to 4 computers.

A personal computer may be used to control the frequency, operating mode, VFO/memory status, etc. via its serial port, using the Icom Communication Interface V (CI-V).

When the optional CT-17 (CI-V level converter) is connected, it is possible to control up to 4 Icom Transceivers Receivers with a personal computer. A wide variety of 3rd party software applications may be used to provide automated logging and control of your radio.

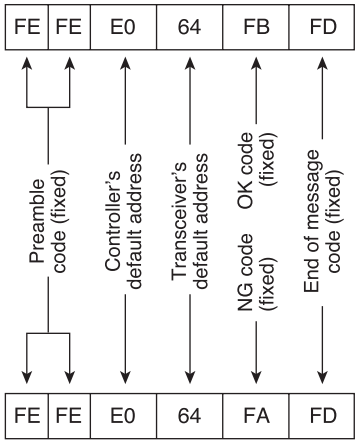
7-2 Data format of CI-V

Controller to IC-756PROII



IC-756PROII to controller

OK message to controller



NG message to controller

① Pre-amble synchronous code to insert the data at first.
The hexadecimal "FE" is transmitted twice.
② Reception address
③ Transmission address
} : The address of IC-756PROII is "64" (hexadecimal), and shows when the controller is set to "E0".
④ Command : The controllable function is given by a 2-digit hexadecimal command.
⑤ Sub-command : A 2-digit hexadecimal command is used for supplementary command instructions
⑥ Data area : The area is used to set the frequency data, etc., and the length is variable, depending on the data.
⑦ Post-amble : This is a code indicating the end of a message, and is a hexadecimal "FD".

7-3 List of commands

• Command table

Command	Sub command	Description
00	–	Send frequency data
01	Same as command 06	Send mode data
02	–	Read band edge frequencies
03	–	Read operating frequency
04	–	Read operating mode
05	–	Set frequency data
06	00	Select LSB
	01	Select USB
	02	Select AM
	03	Select CW
	04	Select RTTY
	05	Select FM
	07	Select CW-R
	08	Select RTTY-R
07	–	Select VFO mode
	B0	Exchange main and sub readouts
	B1	Equalize main and sub readouts
	C0	Turn the dualwatch OFF
	C1	Turn the dualwatch ON
	D0	Select main readout
	D1	Select sub readout
08	–	Select memory mode
	0001–0101*1	Select memory channel *1P1=0100, P2=0101
09	–	Memory write
0A	–	Memory to VFO
0B	–	Memory clear
0E	00	Scan stop
	01	Programmed/memory scan start
	02	Programmed scan start
	03	⊿F scan start
	12	Fine programmed scan start
	13	Fine ⊿F scan start
	22	Memory scan start
	23	Select memory scan start
	A1–A7	Set ⊿F scan span (A1=±5kHz, A2=±10kHz, A3=±20kHz, A4=±50kHz, A5=±100kHz, A6=±500kHz, A7=±1MHz)
	B0	Set as non-select channel
	B1	Set as select channel
	D0	Set scan resume OFF
	D3	Set scan resume ON
0F	00	Turn the split function OFF
	01	Turn the split function ON
10	00	Select 10Hz (1Hz) tuning step
	01	Select 100Hz tuning step
	02	Select 1kHz tuning step
	03	Select 5kHz tuning step
	04	Select 9kHz tuning step
	05	Select 10kHz tuning step
	06	Select 12.5kHz tuning step
	07	Select 20kHz tuning step
	08	Select 25kHz tuning step
11	00	Attenuator OFF
	06	Attenuator ON (6dB)
	12	Attenuator ON (12dB)
	18	Attenuator ON (18dB)

Command	Sub command	Description
12	00 01	Select/read antenna selection (00=ANT1, 01=ANT2 : Add 0 or 1 to turn [RX ANT] OFF or ON, respectively.)
13	00 01 02	Announce with voice synthesizer (00=all data; 01=frequency and S-meter level; 02=receive mode)
14	01 + Level data	[AF] level setting (0=max. CCW to 255=max. CW
	02 + Level data	[RF] level setting (0=max. CCW to 255=11 o'clock)
	03 + Level data	[SQL] level setting (0=11 o'clock to 255=max. CW
	06 + Level data	[NR] level setting (0=min. to 255=max.)
	07 + Level data	Inside [TWIN PBT] setting or IF shift setting (0=max. CCW, 128=center, 255=max. CW)
	08 + Level data	Outside [TWIN PBT] setting (0=max. CCW, 128=center, 255=max.CW)
	09 + Level data	[CW PITCH] setting (0=low pitch to 255=high pitch)
	0A + Level data	[RF POWER] setting (0=mini. to 255=max.)
	0B + Level data	[MIC GAIN] setting (0=mini. to 255=max.)
	0C + Level data	[KEY SPEED] setting (0=slow to 255=fast)
	0D + Level data	[NOTCH] setting (0=low freq. to 255=high freq.)
	0E + Level data	[COMP] setting (0=mini. to 255=max.)
	0F + Level data	[BK-IN DELAY] setting (0=short delay to 255=long delay)
	10 + Level data	[BAL] level setting (0=max. CCW, 128=center, 255=max. CW)
15	01	Read squelch condition
	02	Read S-meter level
16	02	Preamp (0=OFF; 1=preamp 1; 2=preamp 2)
	12	AGC selection (1=Fast; 2=Mid; 3=Slow)
	22	Noise blanker (0=OFF; 1=ON)
	40	Noise reduction (0=OFF; 1=ON)
	41	Auto notch (0=OFF; 1=ON)
	42	Repeater tone (0=OFF; 1=ON)
	43	Tone squelch (0=OFF; 1=ON)
	44	Speech compressor (0=OFF; 1=ON)
	45	Monitor(0=OFF; 1=ON)
	46	VOX function (0=OFF; 1=ON)
	47	Break-in (0=OFF; 1=semi break-in; 2=full break-in)
	48	Manual notch (0=OFF; 1=ON)
	49	RTTY filter (0=OFF; 1=ON)
19	00	Read the transceiver ID
1A	00	Send/read memory contents (see p. 31 for details)
	01	Send/read band stacking register contents (see p. 31 for details)
	02	Send/read memory keyer contents (see p. 31 for details)
	03	Send/read the selected filter width (0=50Hz to 40/31=3600/2700Hz)

• Command table (continued)

Command	Sub command	Description
1A	04	Send/read the selected AGC time constant (0=OFF, 1=0.1/0.3 sec. to 13=6.0/8.0 sec.)
	0501	Send/read SSB TX Tone (Bass) level (0=min. to 10=max.)
	0502	Send/read SSB TX Tone (Treble) level (0=min. to 10=max.)
	0503	Send/read MONITOR gain (0=min. to 255=max.)
	0504	Send/read CW side tone gain (0=min. to 255=max.)
	0505	Send/read CW side tone gain limit (0=OFF, 1=ON)
	0506	Send/read beep gain (0=min. to 255=max.)
	0507	Send/read beep gain limit (0=OFF, 1=ON)
	0508	Send/read LCD contrast (0=0% to 255=100%)
	0509	Send/read LCD Backlight (0=0% to 255=100%)
	0510	Send/read LCD horizontal position (0=1 to 7=8)
	0511	Send/read switch backlight (0=1 to 7=8)
	0512	Send/read display type (0=A, 1=B, 2=C, 3=D, 4=E, 5=F, 6=G, 7=H)
	0513	Send/read display font (0=Basic1, 1=Basic2, 2=Pop, 3=7seg, 4=Italic1, 5=Italic2, 6=Classic)
	0514	Send/read memory name (0=OFF, 1=ON)
	0515	Send/read my call setting (10-character: see p. 31)
	0516	Send/read current time (0000 to 2359)
	0517	Send/read power-ON timer set (0000 to 2359)
	0518	Send/read power-OFF period (5=5 min. to 120=120 min. in 5 min. step)
	0519	Send/read calibration marker (0=OFF, 1=ON)
	0520	Send/read confirmation beep (0=OFF, 1=ON)
	0521	Send/read band edge beep (0=OFF, 1=ON)
	0522	Send/read RF/SQL control set (0=Auto, 1=SQL, 2=RF+SQL)
	0523	Send/read quick dualwatch set (0=OFF, 1=ON)
	0524	Send/read quick split set (0=OFF, 1=ON)
	0525	Send/read FM split offset (HF) –4,000 to + 4,000MHz (see p. 31 for details)
	0526	Send/read FM split offset (50MHz) –4,000 to + 4,000MHz (see p. 31 for details)
	0527	Send/read split lock set (0=OFF, 1=ON)
	0528	Send/read tuner auto start set (0=OFF, 1=ON)
	0529	Send/read PTT tune set (0=OFF, 1=ON)
	0530	Send/read antenna selection (0=OFF, 1=Manual, 2=Auto)

Command	Sub command	Description
1A	0531	Send/read RTTY mark frequency (0=1275Hz, 1=1615Hz, 2=2125Hz)
	0532	Send/read RTTY shift width (0=170Hz, 1=200Hz, 2=425Hz)
	0533	Send/read RTTY keying polarity (0=Normal, 1=Reverse)
	0534	Send/read RTTY decode USOS (0=OFF, 1=ON)
	0535	Send/read RTTY decode new line code (0=CR, LF, CR+LF, 1=CR+LF)
	0536	Send/read speech language (0=English, 1=Japanese)
	0537	Send/read speech speed (0=slow, 1=fast)
	0538	Send/read S-level speech (0=OFF, 1=ON)
	0539	Send/read memo pad numbers (0=5 ch, 1=10 ch)
	0540	Send/read main dial auto TS (0=OFF, 1=Low, 2=High)
	0541	Send/read mic. up/down speed (0=Low, 1=High)
	0542	Send/read CI-V transceive set (0=OFF, 1=ON)
	0543	Send/read CI-V 731 mode set (0=OFF, 1=ON)
	0544	Send/read TX spectrum scope set (0=OFF, 1=ON)
	0545	Send/read spectrum scope max. hold set (0=OFF, 1=ON)
	0546	Send/read voice auto monitor set (0=OFF, 1=ON)
	0547	Send/read cut number style (0=Normal, 1=190→ANO, 2=190→ANT, 3=90→NO, 4=90→NT)
	0548	Send/read count up trigger channel (1=M1, 2=M2, 3=M3, 4=M4)
	0549	Send/read present number (1–9999)
	0550	Send/read CW keyer repeat time (1=1 sec. to 60=60 sec.)
	0551	Send/read CW keyer dot/dash ratio (28=1:1:2.8 to 45=1:1:4.5)
	0552	Send/read rise time (0=2 msec., 1=4 msec., 2=6 msec., 3=8 msec.)
	0553	Send/read paddle polarity (0=Normal, 1=Reverse)
	0554	Send/read keyer type (0=Straight, 1=Bug-key, 2=ELEC-Key)
	0555	Send/read mic. up/down keyer set (0=OFF, 1=ON)
	0556	Send/read scan speed (0=low, 1=high)
	0557	Send/read scan resume (0=OFF, 1=ON)
	0558	Send/read VOX gain (0=0% to 255=100%)
	0559	Send/read anti VOX gain (0=0% to 255=100%)
	0560	Send/read VOX delay (0=0.0 sec. to 20=2.0 sec.)
	0561	Send/read RTTY filter bandwidth (0=250Hz, 1=300Hz, 2=350Hz, 3=500Hz, 4=1kHz)

• Command table (continued)

Command	Sub command	Description
1A	0562	Send/read twin peak filter (0=OFF, 1=ON)
	0563	Send/read timer functions (0=OFF, 1=ON)
	0564	Send/read DSP filter type (0=SSB: sharp; CW: sharp, 1=SSB: sharp; CW: soft, 2=SSB: soft CW: sharp, 3=SSB: soft CW: soft)
	0565	Send/read quick RIT/ΔTX clear function (0=OFF, 1=ON)
	0566	Send/read SSB/CW synchronous tuning function (0=OFF, 1=ON)
	0567	Send/read CW normal side set (0=LSB, 1=USB)
	0568	Send/read external keypad type (0=OFF, 1=Keyer send, 2=Voice play (Tx), 3=Auto)
	0569	Send/read NB level (0=0% to 255=100%)
	06	Send/read DATA mode (0=OFF, 1=ON)
	07	Send/read SSB transmit bandwidth (0=Wide, 1=Middle, 2=Narrow)
1B	00	Set repeater tone frequency
	01	Set tone squelch tone frequency
1C	00	Set the transceiver to receive or transmit condition (0=Rx; 1=Tx)

• To send/read memory contents

When sending or reading memory contents, additional code as follows must be added to appoint the memory channel.
➥Additional code: 0000–0101 (0100=P1, 0101=P2)

• Band stacking register

To send or read desired band stacking register's contents, combined code of the frequency band and register codes as follows are used.
For example, when sending/reading the oldest contents in the 21 MHz band, the code "0703" is used.

• Frequency band code

Code	Frequency band	Frequency range (unit: MHz)
01	1.8	1.800000– 1.999999
02	3.5	3.400000– 4.099999
03	7	6.900000– 7.499999
04	10	9.900000–10.499999
05	14	13.900000–14.499999
06	18	17.900000–18.499999
07	21	20.900000–21.499999
08	24	24.400000–25.099999
09	28	28.000000–29.999999
10	50	50.000000–54.000000
11	GENE	Other than above

• Register code

Code	Registered number
01	1 (latest)
02	2
03	3 (oldest)

• Channel code for memory keyer

To send or read the desired memory keyer contents, the channel and character codes as follows are used.

• Channel code

Code	Channel number
01	M1
02	M2
03	M3
04	M4

• Character's code

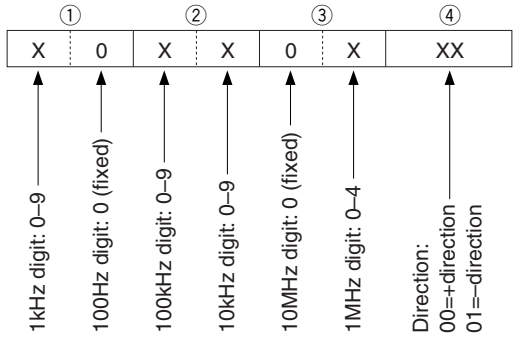
Character	ASCII code	Description
0–9	30–39	Numerals
A–Z	41–5A	Alphabetical characters
a–z	61–7A	Alphabetical characters
space	20	Word space
/	2F	Symbol
?	3F	Symbol
,	2C	Symbol
.	2E	Symbol
^	5E	e.g., to send $\overline{BT}$, enter ^4254
*	2A	Inserts contact number (can be used for 1 channel only)

• Character's code for my call

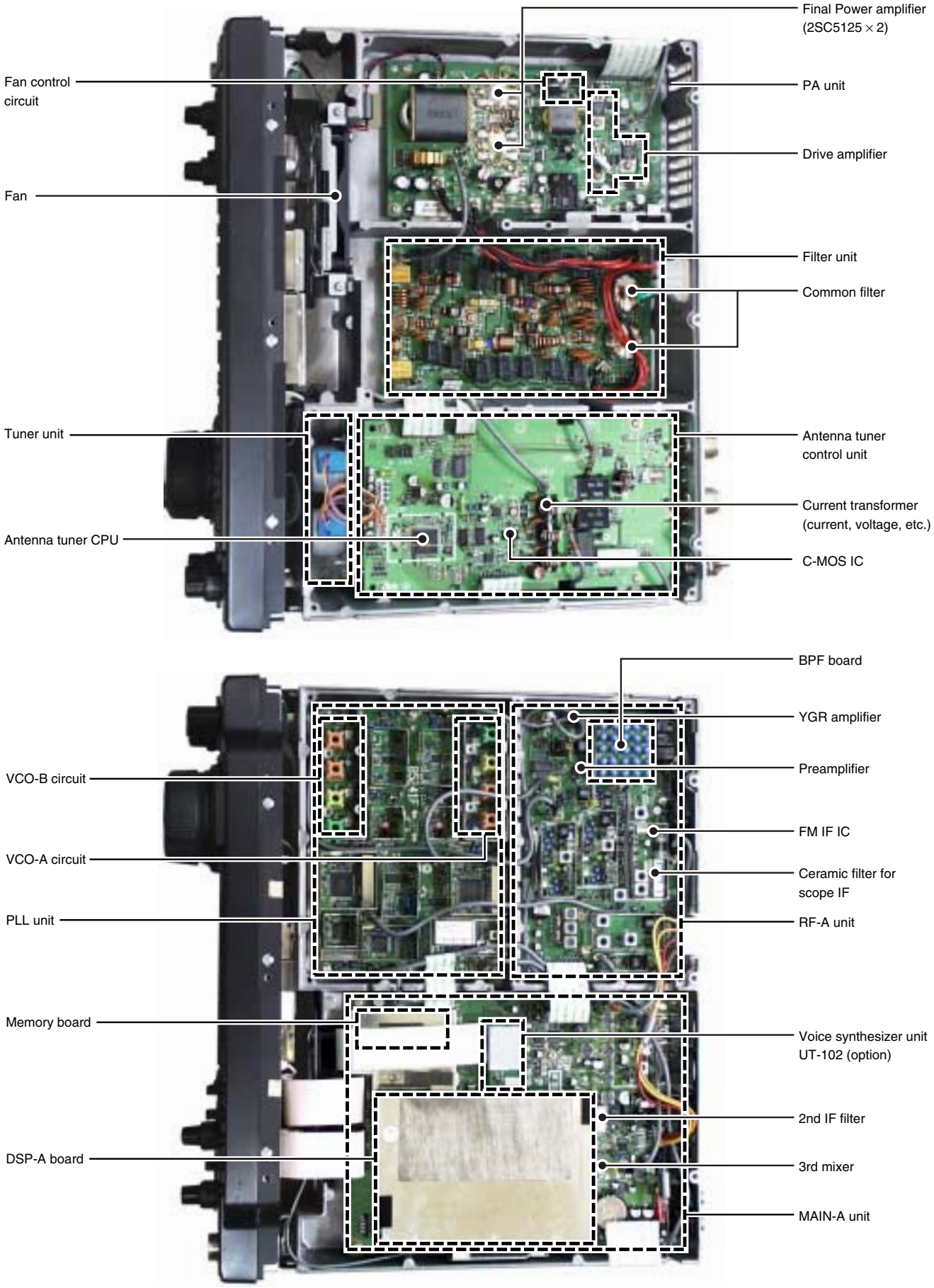
Character	ASCII code	Description
0–9	30–39	Numerals
A–Z	41–5A	Alphabetical characters
a–z	61–7A	Alphabetical characters
space	20	Word space
–	2D	Symbol
.	2E	Symbol
/	2F	Symbol

• FM split frequency (HF/50MHz) setting

The following data sequence is used when sending/reading the FM split frequency setting.



8. Inside Views



9. Options

IC-PW1 HF/50MHz ALL BAND 1kW LINEAR AMPLIFIER

Full-duty 1kW linear amplifier including an automatic antenna tuner. Has automatic tuning and band selection capability. Full break-in (QSK) operation is possible. The amplifier/power supply unit and the remote control unit are separated.

PS-125 DC POWER SUPPLY

Light weight power supply.
- Output voltage: 13.8V DC
- Max. current drain: 25A

AH-4 HF/50 MHz AUTOMATIC ANTENNA TUNER

Specially designed to tune a long wire antenna for portable or mobile 3.5–54MHz operation.
- Input power rating: 120W

AH-2b ANTENNA ELEMENT

A 2.5 m long antenna element for mobile operation with the AH-4.
- Frequency coverage: 7–54MHz bands with the AH-4

HM-36 HAND MICROPHONE

Hand microphone equipped with [UP]/[DOWN] switches. Same as supplied.

SM-20 DESKTOP MICROPHONE

Unidirectional, electret microphone for base station operation. Includes [UP]/[DOWN] switches and a low cut function.

SP-20 EXTERNAL SPEAKER

4 audio filters; headphone jack; can connect to 2 transceivers.
- Input impedance: 8Ω
- Max. input power: 5W

SP-21 EXTERNAL SPEAKER

Designed for base station operation.
- Input impedance: 8Ω
- Max. input power: 5W

CT-17 CI-V LEVEL CONVERTER

For remote transceiver control using a PC. You can change frequencies, operating mode, memory channels, etc.

UT-102 VOICE SYNTHESIZER UNIT

Announces the receive frequency, mode and S-meter level in a clear, electronically-generated voice, in English (or Japanese).

10. Specifications

GENERAL

- Frequency coverage :

U.S.A.	Rx	0.030–60.000*1	
	Tx	1.800– 2.000*1	3.500– 3.999
		7.000– 7.300	10.100–10.150
		14.000–14.350	18.068–18.168
		21.000–21.450	24.890–24.990
		28.000–29.700	50.000–54.000
Europe	Rx	0.030–60.000*1	
	Tx	1.800– 1.999	3.400– 4.099*1
		6.900– 7.499*1	9.900–10.499*1
		13.900–14.499*1	17.900–18.499*1
		20.900–21.499*1	24.400–25.099*1
		28.000–29.999*1	50.000–52.000
France	Tx/Rx	1.810– 1.850 (France)	
Italy		1.830– 1.850 (Italy, Spain)	
Spain		3.500– 3.800	7.000– 7.100
		10.100–10.150	14.000–14.350
		18.068–18.168	21.000–21.450
		24.890–24.990	28.000–29.700
		50.200–51.200 (France)	
		50.000–51.000 (Italy)	
		50.000–50.200 (Spain)	

*1 Some freq. bands are not guaranteed.

- Mode : USB, LSB, CW, RTTY, AM, FM
- Number of memory Ch. : 101 (99 regular, 2 scan edges)
- Antenna connector : SO-239×2 and phono [RCA; (50Ω)]
- Temperature range : –10˚C to +50˚C; +14˚F to +122˚F
- Frequency stability : Less than ±0.5ppm (From 1 minute after power ON at 0˚C to 50˚C; +32˚F to +122˚F)
- Frequency resolution : 1Hz
- Power supply requirement : 13.8V DC ±15% (negative ground)
- Power consumption : Tx Max. power 23A
  Rx Standby 3.0A (typ.)
  Max. audio 3.3A (typ.)
- Dimensions : 340(W)×111(H)×285(D) mm;
  (projections not included) 13 3/8(W)×4 3/8(H)×11 7/32(D) in
- Weight (approx.) : 9.6kg; 21.2lb
- ACC 1 connector : 8-pin DIN connector
- ACC 2 connector : 7-pin DIN connector
- CI-V connector : 2-conductor 3.5 (d) mm (1/8″)
- Display : 5-inch (diagonal) TFT color LCD

TRANSCEIVER

- Output power : SSB, CW, RTTY, FM 5–100W
  (continuously adjustable) AM 5–40W
- Modulation system : SSB DPSN modulation
  AM Digital low power modulation
  FM Digital phase modulation
- Spurious emission : 50dB (HF bands)
  60dB (50MHz band)
- Carrier suppression : More than 40dB
- Unwanted sideband suppression:
  More than 55dB
- ⊿TX variable range : ±9.999kHz
- Microphone connector : 8-pin connector (600Ω)
- ELE-KEY connector : 3-conductor 6.35 (d) mm (1/4″)
- KEY connector : 3-conductor 6.35 (d) mm (1/4″)
- SEND connector : Phono (RCA)
- ALC connector : Phono (RCA)

RECEIVER

- Receive system : Triple conversion superheterodyne system
- Intermediate frequencies : 1st 64.455MHz (for all modes)
  2nd 455kHz (for all modes)
  3rd 36kHz (for all modes)
- Sensitivity (typical) :

SSB, CW, RTTY	0.16μV*1 (1.80–29.99MHz)
(10dB S/N)	0.13μV*2 (50.0–54.0MHz)
AM (10dB S/N)	13μV (0.5–1.799MHz)
	2μV*1 (1.80–29.99MHz)
	1μV (50.0–54.0MHz)
FM (12dB SINAD)	0.5μV*1 (28.0–29.9MHz)
	0.32μV*2 (50.0MHz–54.0MHz)

*1Pre-amp 1 is ON, *2Pre-amp 2 is ON

- Squelch sensitivity (Pre-amp: OFF):

SSB, CW, RTTY	Less than 5.6μV
FM	Less than 1μV

- Selectivity (representative value):

SSB, RTTY	More than 2.4kHz/–6dB
(BW: 2.4kHz)	Less than 3.2kHz/–40dB
	Less than 3.6kHz/–60dB
	Less than 4.3kHz/–80dB
CW (BW: 500Hz)	More than 500Hz/–6dB
	Less than 700Hz/–60dB
AM (BW: 6kHz)	More than 6.0kHz/–6dB
	Less than 15.0kHz/–60dB
FM (BW: 15kHz)	More than 12.0kHz/–6dB
	Less than 20.0kHz/–60dB

- Spurious and image rejection ratio : More than 70dB (except IF through on 50MHz band)
- AF output power (at 13.8V DC) : More than 2.0W at 10% distortion with an 8Ω load
- RIT variable range : ±9.999kHz
- PHONES connector : 2-pin connector 6.35 (d) mm (1/4″)
- EXT SP connector : 2-pin connector 3.5 (d) mm (1/4″)/8Ω

ANTENNA TUNER

- Matching impedance range:
  16.7–150Ω unbalanced*1 (HF bands)
  20–125Ω unbalanced*2 (50MHz band)
  *1Less than VSWR 3:1; *2Less than VSWR 2.5:1
- Min. operating input power: 8 W
- Tuning accuracy : VSWR 1.5:1 or less
- Insertion loss : Less than 1.0dB (after tuning)

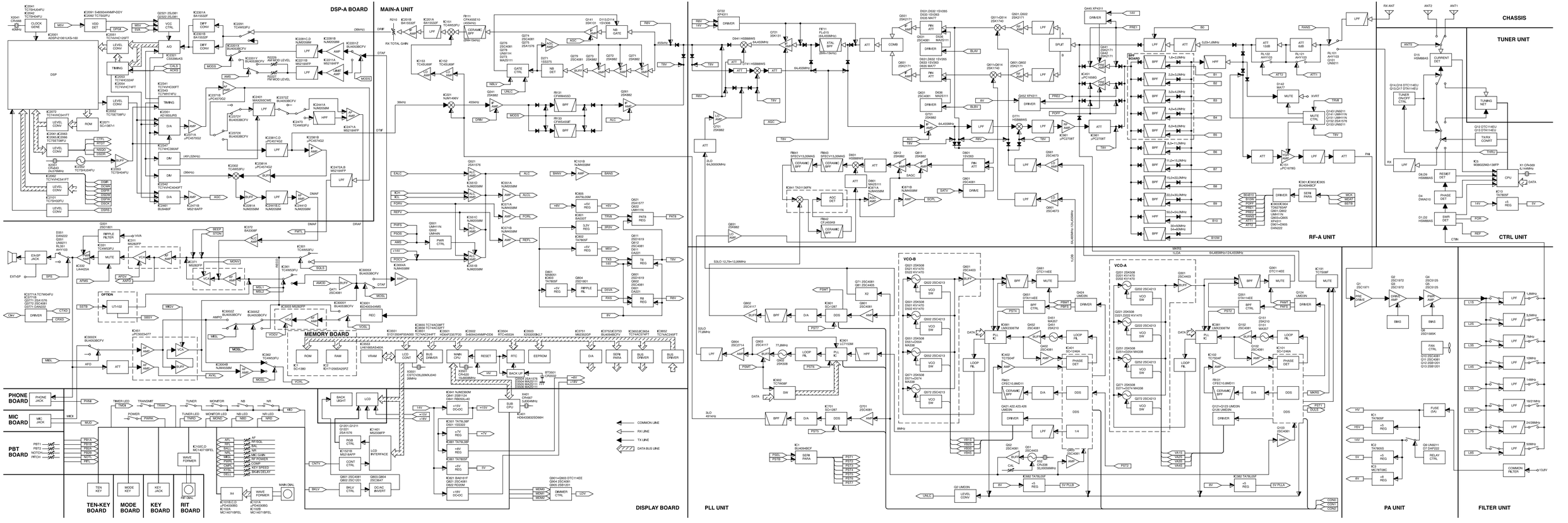
Supplied accessories:

- Hand microphone, HM-36
- DC power cable
- Spare fuses
- CW key plug

The LCD display may have cosmetic imperfections that appear as small or dark spots. This is not a malfunction or defect, but a normal characteristic of LCD displays. All trademarks are the properties of their respective holders.

All stated specifications are subject to change without notice or obligation.

11. Block diagram



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GLOSSARY

HAM RADIO TERMS

This is glossary contains general definitions of typical amateur radio terms. Not all of the definition listed may apply to your specific model of radio. Consult the manufacture for further clarification of model-specific terms.

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A

ACC (ACCessory)

Adjacent-channel interference
When a receiver is tuned to a specific frequency and interference is received on a nearby frequency.

AF (Audio Frequency)

AFC (Automatic Frequency Control)
Automatically compensate frequency drift.

AFSK (Audio Frequency Shift Keying)

AGC (Automatic Gain Control)
Automatically optimize receiver amplifier gain.

ALC (Automatic Limiting Control)
Limits RF drive level to power amplifier during transmit to prevent distortion.

AM (Amplitude Modulation)

AMSAT (AMateur SATellite)

AMTOR (AMateur Teleprinting Over Radio)
A form of RTTY, radio teletype.

ANF (Automatic Notch Filter)

ANL (Automatic Noise Limiter)
Eliminates impulse and static noise peaks.

ANT (ANTenna)

Antenna ground system
Term used for a RF reference potential for some types of antennas. Most unbalanced or asymmetrical antennas need a good RF ground.

Antenna impedance
The impedance of an antenna at its resonance. Although an antenna's impedance fluctuates with the frequency of operation, an antenna should be 50 Ω for most transceivers.

Antenna matching
When the antenna's impedance at resonance is at optimum performance for your transmitter output circuit.

Antenna tuner
Device used to match an antenna to the output impedance of a transmitter.

APC (Automatic Power Control)
Current limiting of power amplifier to prevent damage to finals in high SWR conditions.

APRS (Automatic Position Reporting System)
In conjunction with a GPS and TNC provide position reporting.

ARES (Amateur Radio Emergency Service)
ARES is a public-service organization of the ARRL.

ARRL (The American Radio Relay League
The National Association for Amateur Radio in the US.

ASCII (American National Standard Code for Information Interchange)
A seven-unit digital code for the transmission of teleprinter data.

ATT (ATTenuator)
A network designed to reduce the amplitude of a signal.

ATV (Amateur Television)
FSTV, SSTV

Auto patch
Used in repeater operation for telephone interconnect.

Average power
Power measured on standard power meter.

B

Backscatter
Form of ionosphere propagation via the E and F layers allowing stations to hear other stations within the skip zones.

Balun
A simple transformer used to change an unbalanced input to a balanced output.

Band
A range of frequencies.

Bandwidth
Frequency needed for particular type of emission.

Bank
Memory bank

BCI (BroadCast Interference)

BFO (Beat Frequency Oscillator)

BNC (Bayonet Neill-Concelman)
A type of antenna connector

BPF (BandPass Filter)

Busy lockout
Inhibits transmit on a frequency in use

C

Call sign
Sequence of letter and numbers used to identify amateur radio operators and issued by the FCC.

CAP (Civil Air Patrol)
Volunteer affiliate of the United States Air Force.

Carrier
An unmodulated transmitted signal.

Carrier frequency offset (=Carrier Shift)
Distance between mark and space of the carrier for RTTY or similar communications.

CBR (Cross Band Repeater)
A repeater which receive incoming signal and re-transmit it in different bands— e.g. receives 144 MHz bands and re-transmits 430(440) MHz bands.

CCW (Counter ClockWise)

CH (CHannel)
Sequence of memory positions where frequency and related information is stored.

CI-V
Icom computer Control Interface allows multiple radio control simultaneously.

Conversion
Number of IF circuits in the receiver.

CPU (Central Processing Unit)

CQ
Radio communications term used to call others.

CTCSS (Continuous Tone Coded Squelch System)
Adds a continuous sub-audible low frequency tone to the transmitted carrier. Receivers set for the same low frequency tone can decode signal.

CW
1) Carrier Wave
2) ClockWise

CW filter
Used to narrow IF passband to improve reception in crowded band conditions.

D

Data communications
Transfer of data between two or more locations.

dBd
Unit of RF power as compared to a dipole antenna.

dBi
Unit of RF power as compared to an isotropic antenna.

dBm
Decibels measure, 1 mW with a load impedance of 600 Ω (0 dBm=1 mW).

DC (Direct Current)

DC ground
A connection point directly to chassis or battery ground to prevent build-up of hazardous DC voltages.

Deviation
A measurement for a FM signals for the maximum carrier frequency changes either side of the carrier frequency.

Distress call
Signals a life-threatening situation. Most commonly referred to as an SOS or MAYDAY call.

Distress frequency
A frequency or channel specific for use in distress calling. Radiotelephone distress frequencies are 2.182 MHz and 156.8 MHz. Survival craft use 243 MHz. Maritime distress frequencies are the same, while general aviation frequencies are 121.5 MHz.

Downlink (↔Uplink)
Frequency that repeater or satellite transmits on to a user.

DSP (Digital Signal Processor)
Used to improve the signal to noise ratio for clearer and more legible communications. Relatively new to the ham radio.

DTCS (Digital Tone Coded Squelch)
A Selective call system

DTMF (Dual Tone Multi-Frequency (=touch-tone))
Used for transmit/receive numeric information such as phone number, PIN, remote radio control commands etc.

Dualwatch
Receiving two signals simultaneously.

Dummy load
A non radiating 50 Ω load connected to the transmitter to replace the antenna for testing purposes.

Duplex
An operation mode in which the transmit and receive frequencies are different.

Duplexer
A device which divides transmit and receive signals.

Duty cycle
The ratios of transmit to receive time.

Dx'pedition
Trip to foreign land to "be DX."

E

EBS (Emergency Broadcast System)
A system where at first an attention tone is transmitted over all station ad the second tone followed with specific instruction regarding the receivable frequency in the national emergency.

EEPROM (Electrically Erasable and Programmable Read Only Memory)

EME (Earth-Moon-Earth)
Moon bounce communication.

EMI (Electro-Magnetic Interference)
Often called RFI (Radio-Frequency Interference).

Emission
Transmission of a signal

Encryption
Transmitting cryptic form so that only certain people understand what has been sent.

F

Fading
Signal reduction due to atmospherics.

Filter
A circuit designed to pass only the desired frequency(s).

FM
1) Frequency Modulation
2) FM broadcast

FSK (Frequency Shift Keying)

FSTV (Fast Scan TV)
Graphics (and audio) communication using TV broadcast signals, requires a wide bandwidth.

Full duplex
An operation mode, which transmits and receives on different frequencies at the same time, as a telephone communication.

G

Ground Plane
A type of Omni-directional antenna

Ground Wave
Electrical wave directly travelling from transmitter.

Grounding
Electrical connection to the earth.

H

Harmonic
Multiple of a fundamental frequency.

HF (High Frequency)
3–30 MHz range signals. (Normally, 1.9 MHz band also included.)

HPF (High Pass Filter)

Hz (Hertz)

I

IC (Integrated Circuit)

IF (Intermediate Frequency)
Internally converted frequency for amplification and other signal processing.

IF shift
A function that electronically shifts IF frequency from a center frequency.

IMD (Inter-Modulation Distortion)
Distortion within RF circuits made with upper and lower adjacent channel signals.

L

LF (Low Frequency)
30–300 kHz range signals.

Li-Ion (Lithium Ion)
Rechargeable battery which has better capacity than Ni-Cd, Ni-MH, etc., no memory effect after repeated non-full charge/discharge cycles.

LPF (Low Pass Filter)

LSB (Lower Side Band)

M

MARS (Military Affiliate Radio Service)

Memory bank
A set of memory channels organized into a group.

Memory effect
Rechargeable batteries such as Ni-Cd and Ni-MH types may be temporality getting less capacity as a result of repeated non-full charge/discharge cycles. It is called so since rechargeable batteries lose capacity as if “memorize” wrong full capacity level at less than full charge. Li-Ion batteries are free from this effect.

MF (Medium Frequency)
300 kHz–3 MHz range signals

MIC (MICrophone)

Modulation
Method of adding information to a radio frequency carrier

N

NB (Noise Blanker)
A function reducing pulse-type noises.

NBFM (Narrow Band FM)

Ni-Cd (Nickel-Cadmium)

Ni-MH (Nickel-Metal Hydride)

Notch filter
Sharp and narrow rejection filter for elimination of interfering signals

NR (Noise Reduction)
DSP feature reduces unwanted signal noise

O

Offset frequency
Frequency difference between transmits and receives.

OSC (OSCillator)

P

PA (Power Amplifier)

Parawatch (=Dualwatch)

PBT (PassBand Tuning)
A function electronically reduce interference by narrowing IF bandwidth

PEP (Peak Envelope Power)
RF power at maximum amplitude.

PLL (Phase Locked Loop)
Circuit to synthesize the different frequencies a radio will operate on.

Pocket beep
Beeping function when specific signal is received.

Priority watch
Reception mode, which by a selected frequency is always periodically, checked when VFO is set to different frequency

PTT (Push To Talk)

PWR (PoWeR)

R

Reflected power
Non-radiated power dissipated as heat when the transmitter is mismatched to the antenna or load.

Repeater
Radio systems, which receive incoming signal and re-transmit it for extended communication area. Normally put on geographically high locations for VHF/UHF hand portables.

RF (Radio Frequency)

RF ground
Connection of amateur equipment to earth ground to eliminate hazards from RF exposure and reduce RFI.

RFI (Radio Frequency Interference)

RIT (Receiver Incremental Tuning)
Fine-tuning receive frequency without changing displayed or memory frequency.

RTTY (Radio TeleTYpe)

RX (Receive)

S

S/N (Signal to Noise ratio)

SAR (Search And Rescue)

Scan
Continually sweeping frequencies looking for signals.

Scan Edge
End and start frequencies for a scanning range.

Scratch Pad Memory
Temporary frequency memories for quick access.

Semi Duplex
An operation mode in which transmits and receives is accomplished on different frequencies alternatively.

Sensitivity
Indicates how weak a signal the receiver will pick up.

Set mode
An operation mode used for radio. To set less frequently used control features.

Simplex
An operation mode where transmit and receive frequency is same.

Skywarn
Trained volunteer storm spotters for the National Weather Service.

SMA (Sub-Miniature a connector)
Type of antenna connector, used in VHF/UHF portable.

SP (SPeaker)

Split
A mode in which the transmit and receive frequency is different.

SQL (SQueLch)
A function muting audio output for set conditions.

SSB (Single Side Band)

SSTV (Slow Scan TV)
Graphics communication using narrow bandwidth.

SWL (Short Wave Listener)

SWR (Standing Wave Ratio)
Measurement of forward vs. reflected power output during transmit.

T

TCXO (Temperature Compensated Crystal Oscillator)
Heated crystal oscillator for better frequency stability.

TNC
1) Terminal Node Controller
Modem for data communication.
2) A type of antenna connector

TOT (Time Out Timer)
Time limiting function for continued repeater or other operations.

TS (Tuning Step)
Incremental steps

TSQL (Tone SQueLch)
Squelch function using subaudible tones, selective call.

TVI (TeleVision Interference)

TX (Transmit)

U

UHF (Ultra High Frequency)
300 MHz–3 GHz range signals.

Uplink (↔Downlink)
Frequency that user transmits to the repeater or satellite.

USB (Upper Side Band)

UTC (Universal Time Coordinated)
An astronomical time based on the Greenwich meridian (zero degrees longitude).

V

VFO (Variable Frequency Oscillator)
An operation mode in which operator can change frequency freely.

VHF (Very High Frequency)
30–300 MHz range signals.

VOX (Voice Operated transmission)
A function automatically put the transmitter in transmit when talk into a microphone.

VSC
1) Voice Scan Control
2) Voice Squelch Control

W

Weather Alert

NOAA broadcast station transmitting alert signals.

WFM (Wideband FM)

Number/Others

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