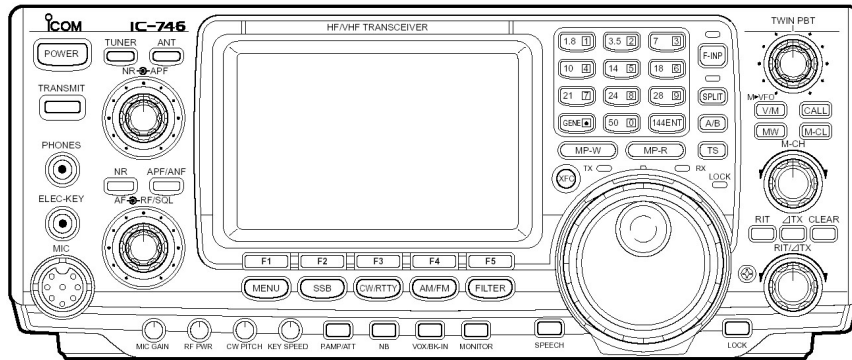


Icom IC-746 FAQ



Frequently Asked Questions About the Icom IC-746 HF/VHF Transceiver

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Recent Changes

2003.02.06	Added another QST article to the article list
2003.02.06	Added current vs voltage chart to power supply section.
2003.02.06	Added Q/A on zero-beating CW signals
2003.02.05	Added info on annotated copy of IC-746 Instruction Manual
2003.02.05	Added info on an Italian copy of the IC-746 Instruction Manual
2003.02.04	Added another SEND amp interface
2003.02.04	Added another microphone pre-amp circuit
2003.02.04	Added a Q/A about circuit schematics
2003.02.03	Added a Canadian repair center
2003.02.03	More info on LCD scratch removal
2003.02.02	Added ACC-2 pin-out diagram
2003.02.02	Added ACC-1 pin-out diagram
2003.02.02	Added MIC pin-out diagram
2003.02.01	Added errata about receiver selectivity
2003.02.01	Added extensive info on low RF output power
2003.02.01	More non-746 information links
2003.02.01	Add Q/A on intermittent audio
2002.12.04	Minor/trivial corrections/additions, too numerous/small to list separately
2002.12.03	Added another article
2002.12.03	First rough draft in document format
2002.11.29	Started converting ASCII format to document format

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1 ADMINISTRIVIA

1.1 *What is an FAQ?*

1.2 *Where can I get a copy?*

1.3 *Where do I send feedback?*

Welcome to the IC-746 FAQ.

Short Answer

FAQ stands for "Frequently Asked Questions". It tries to cover common questions, problems, and issues associated with Icom's IC-746 HF/VHF amateur radio transceiver.

The master copy is kept at:

<http://groups.yahoo.com/group/IC746/files/IC746-faq.pdf>

Mirrored copies (after a short delay) appear at:

<http://www.qsl.net/kb9sss/IC-746/IC746-faq.pdf>

<http://www.skysdaughter.com/icom746-faq.pdf>

You do not need a Yahoo email account to access the master copy, however, you will need a logon account. Yes, that is a subtle but hopefully minor distinction. Not everyone is willing to have a login account at Yahoo (even if it is free), which is one of several reasons for maintaining the mirror sites.

Also, we post the FAQ monthly to:

news:rec.radio.amateur.equipment

usually sometime between the 1st and the 10th.

You can post questions/comments about the FAQ to the above newsgroup.

Long Answer

The format of this FAQ should become apparent right from the start. Questions are grouped into related sections and subsections, roughly in the form of an outline.

When possible/practical, there will be both a short and long answer. The short answers will try to be brief and to the point, typically about one paragraph. While correct, quick, and immediate, it will often gloss over subtleties and details. The long answers will cover theory, alternatives, dissenting opinions, and other supplemental material. We try not to unnecessarily duplicate information between the answers (this one is an example of that). Long answers may go on for several pages.

The questions that are addressed here (as well as the answers) come from several sources.

This FAQ was originally created and hosted by folks on a Yahoo e-mail discussion group at:

<http://groups.yahoo.com/group/IC746/>

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They have extensive information on the IC-746, including bookmarks and a file download area.

<http://www.qth.net/> hosts a more generalized Icom e-mail list that covers all models, not just the IC-746. You can lookup more information or subscribe to that list at:

<http://mailman.qth.net/mailman/listinfo/icom/>

There's a search engine for the above list, but it's accessed from a Hallicrafters site at:

<http://www.w9wze.org/>

Some of the info here originally appeared upon a bbs style on-line discussion group that used to be at:

<http://vartel.com/icom746/icom746index.html>

(The site not been responding since Jan-2002)

There are also the following newsgroups:

news:rec.radio.amateur.equipment

news:rec.radio.swap

Specific comments or clarifications can be sent directly to the FAQ coordinator. "Content submissions" would be greatly appreciated. However, general discussion/debate over the answers is best done in a more public forum, like one of those mentioned above.

1.4 What are the future plans for the FAQ?

Starting in February, 2003, this FAQ went from a text ASCII format to Adobe Acrobat (PDF) format. This is facilitating the inclusion of charts and diagrams, along with bookmarks and hyperlinks. That process will continue. To view or print the document, you will need a copy of the Acrobat Reader, available for free from:

<http://www.adobe.com/products/acrobat/readstep2.html>

Most of the power supply information should be separated out into a separate FAQ that is applicable to all rigs. This fits in better with the new ICOM Resource pages at:

<http://www.qsl.net/icom/>

1.5 *What questions still need to be answered?*

There are plenty of topics that still need or deserve to be covered. Here are some topics and details we'd like information on (in no particular order):

- Levels and impedances of all audio connections (mic, phones, acc, etc...)
- We still do not have enough reliable reports to confirm which "birdies" (if any) actually exist.
- How does one go about hooking the 746 up for PSK, TNC, and CI-V operations at the same time?
- CW Zero-Beat confusion (as well as BFO and "reverse" operation)
- More information is needed on the front panel power switch and its interaction with the extra pins on the T-connector in the back.
- More service and repair information
- Better explanation of band stacking registers
- Operating tips
- Instructions on how to use internal ATU
- Better explanation of COMP (gain, FM, etc...)
- Compare/contrast the 746 vs 746PRO
- Does the 746 exhibit a full power spike at beginning of TX?

We welcome and encourage submissions.

1.6 *What does this abbreviation or TLA mean?*

Hams use a lot of abbreviations and TLAs (Three Letter Acronyms), Toward the end of this document, is a small glossary to some of the abbreviations we use in the FAQ.

2 GENERAL INFO

2.1 *Should I buy an IC-746?*

Yes. Try it, you'll like it.

This FAQ is maintained by happy, loyal, and devoted IC-746 owners. What do you really think we're going to say?

One thing nearly everyone (both loyalists and detractors) agrees upon is that you should make every effort to try out a rig before purchasing it.

2.2 *What are the IC-746's features?*

For features, check out the IC-746 specifications from brochures available at your local amateur radio equipment store, on-line documents at various vendor sites, or directly from Icom's WWW site at:

<http://www.icomamerica.com/>

On-line copies of the IC-746 sales brochure are available at:

<http://www.qsl.net/kb9sss/IC-746/IC-746-Brochure.pdf>

<http://groups.yahoo.com/group/IC746/files/IC-746-Brochure.pdf>

Of particular interest might be the on-line copy of the instruction manual.

Most of the 746's problems or faults show up either in this FAQ (eventually) or in one of the archives at:

<http://groups.yahoo.com/group/IC746/files/IC-746-Brochure.pdf>

<http://mailman.qth.net/mailman/listinfo/icom/>

2.3 *How does the IC-746 stand up to the _____ ?*

Probably the most objective, quantitative comparisons you will find are the QST product reviews (freely available to ARRL members):

<http://www.arrl.org/members-only/prodrev/>

An Excel spreadsheet that allows side by side comparison of the technical specifications for many HF transceivers can be found at:

<http://groups.yahoo.com/group/IC746/files/HF-RIGS.xls>

Simpler, more limited, comparison charts are available on the Amateur Electronic Supply WWW site at:

http://www.aesham.com/compare/comp_hf.html

User written reviews can be both more personal and more detailed. They can also be more biased. You can find plenty of them at:

<http://www.eham.net/reviews>

This topic has come up several times on Yahoo's IC746 discussion group. One of the more interesting threads along these lines starts with message 1012 and ends with message 1028. I'm told that message 1023 is particularly good. Another good thread starts with 1049 and ends with 1077.

<http://groups.yahoo.com/group/IC746/message/1012>

<http://groups.yahoo.com/group/IC746/message/1023>

2.4 Where can I buy/sell a used IC-746?

Usually when someone asks this on the internet, they are looking for an on-line swap page. There are, of course, plenty of other options. Most dealers have used/demo equipment. Hamfests are a traditional favorite, as are "swap nets" on HF.

That said; the two largest forums on the internet for amateur radio gear are the USENET newsgroup

news:rec.radio.swap

and the infamous eBay auction site.

<http://www.ebay.com/>

"Amateur Radio Trader" is both a magazine and a WWW site devoted to amateur radio classifieds:

<http://www.amradiotrader.com/>

(site not responding Jan-2002)

Yahoo has a small auction site as well:

<http://list.auctions.shopping.yahoo.com/23761-category.html?alocale=0us>

After those, you have your choice of dozens of dedicated swap sites on the net. A few of them are:

<http://www.arrl.org/RadiosOnline/>

<http://www.qrz.com/forum/>

<http://www.eham.net/classifieds/>

<http://www.k1dww.net/hamtrader/>

AC6V maintains an entire list of swap pages as part of his excellent ham links/resource site.

<http://www.ac6v.com/swap.htm>

2.5 How much is a used IC-746 worth?

Unlike used cars, there is no official "blue book" for ham equipment. Only YOU can decide this.

Your best bet is to peruse the archives for

news:rec.radio.swap

over the past 6 months or so.

You might also check out one of the following sites

Electronic Boneyard Prices:

<http://www.geocities.com/CapeCanaveral/Hall/8701/ham/boneyard.htm>

E-Bay prices:

<http://aade.com/hampedia/prices.htm>

Virtual Hamfest - Recent Prices:

<http://www.vhamfest.com/prices.html>

(site not responding Jan-2002)

Ham Shopper:

<http://www.hamshopper.com/>

Good luck.

2.6 Is there a dedicated HF net for the IC-746?

Yes, one was started in October 2001.

It convenes 20M SSB near 14.2525 Mhz +/- QRM, on Sunday evenings at 9:00pm Eastern time (6:00pm Pacific).

The folks that run the net shift it along with Daylight Savings Time in the U.S.A. Therefore, during "standard" time (last Sunday in October to the first Sunday in April) the net starts at 0200 UTC Monday. During "savings" time (first Sunday of April through last Sunday of October) the net starts at 0100 UTC Monday.

For the curious, not all of the U.S.A. participates in "daylight savings time". Likewise, portions of Europe participate, but on a different timetable. A wealth of information on DST can be found via Yahoo at:

http://dir.yahoo.com/Science/Measurements_and_Units/Time/Daylight_Saving_Time

or within the AC6V link indices at:

<http://www.ac6v.com/opaid.htm> - CLOCKTIME

or directly from NIST (the National Institute of Standards and Technology) at:

<http://www.time.gov/>

The folks in the Yahoo IC746 e-mail group try to maintain a net calendar at:

<http://groups.yahoo.com/group/IC746/calendar>

Yes, you have to be a member of the e-mail group to access their pages, but as a fringe benefit, you'll even get an automatic e-mail reminder on the day of the event.

Doug, N7BNT, located in Vancouver, WA is usually Net Control, and "K.C." KG9JP in Phoenix, AZ is usually helping out and hosting the chat room.

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There is usually a IC746 chat room set up on Yahoo Internet Messenger. Click on the "Chat" button, go to "Hobbies and Crafts", click on the "User Rooms" tab and join in! If you need a relay to check-in to the net, this is the place to go... The chat room should be up about 10 minutes before net.

We've heard of a few other HF nets devoted to Icom equipment in general. They meet at:

Sunday, 1700 UTC, 14.315 Mhz ssb

Sunday, 2100 UTC, 14.317 Mhz ssb

2.7 Are there electronic copies of 746 instruction manuals?

YES! A PDF (Adobe Acrobat format) version of the IC-746 Instruction Manual is available on the IC746 Yahoo Group WWW site at:

<http://groups.yahoo.com/group/IC746/files/IC-746-Instruction-Manual-Extra.pdf>

This version of the manual has a full set of TOC bookmarks, hyperlinks for all intra-document page references, and comment bubbles for all known errata.

During the first week of November, 2001, Icom made an electronic copy of the original IC-746 Instruction Manual (along with many others) available on their WWW site at:

<http://icomamerica.com/support/documents/index.html>

A backup copy of the above manual is available from several locations:

<http://groups.yahoo.com/group/IC746/files/IC-746-Instruction-Manual.pdf>

<http://www.qsl.net/kb9sss/IC-746/IC-746-Instruction-Manual.pdf>

Additionally, the FCC posted the IC-746pro instruction manual (and various other documents) at:

http://gullfoss2.fcc.gov/cgi-bin/ws.exe/prod/oet/forms/reports/Search_Form.hts?mode=Edit&form=Exhibits&application_id=740578&fcc_id=AFJIC-746PRO

Backup copies of both parts of this manual are also available:

<http://groups.yahoo.com/group/IC746/files/IC-746pro-Instruction-Manual-1.pdf>

<http://groups.yahoo.com/group/IC746/files/IC-746pro-Instruction-Manual-2.pdf>

Another good place to look for on-line manuals is:

<http://www.mods.dk/>

Hey, we even found a copy of the IC-746 Instruction Manual in Italian.

<http://www.marcucci.it/download/>

While Icom has relaxed a little in providing these documents, they are still protected by copyright. Please, treat them accordingly. Remember, Icom is doing us a favor.

2.8 Are there electronic copies of the circuit schematics?

We know of some for the IC-746-PRO, but not for the IC-746. Check out:

http://hamradio.online.ru/sch_eng.html

for a wide variety of schematics.

2.9 *Are there electronic copies of 746 service manuals?*

No such copies are known to exist, although they would quickly become popular if they did. As of May 2001, Icom had no plans for releasing one. Additionally, Icom considers any such external productions to be a violation of their copyright. Ray (the product manager at the 2001 Hamvention) was very firm on this.

Hard copies are available through any Icom retailer as well as through the W7FG Vintage Manual WWW site at:

<http://www.w7fg.com/>

2.10 *How do I fix the font substitution error in the PDF manual?*

When trying to read the PDF version of a 746 Instruction Manual with the Adobe Acrobat Reader, some people encounter the following three dialogs on page 10 of the document (PDF page 12).

A font required for font substitution is missing.

An error has occurred that may be fixed by installing the latest version of the Japanese Language Support package.

Unable to find or create font "Ryumin-Light-Identity-H". Some characters may not display or print correctly.

The error is not fatal. There are about dozen places in the manual where text in diagrams will show up as a series of dots.

You can get rid of the error by downloading the appropriate Asian font package directly from Adobe's support pages. As of November 2001, the appropriate link was:

<http://www.adobe.com/support/techdocs/2a156.htm>

2.11 *How does an IC-746s differ from an IC-746?*

Japan has a 3rd Class license that is power limited (sort of like the defunct US Novice class). The IC-746s is identical to the IC-746, except that it caters to this limited operating class. It's output power is limited to 10w on HF and 20w on VHF.

Nobody has yet reported a "mod" for this rig to bring its power up.

2.12 What is the IC-7400?

2.13 What is the IC-746-PRO?

These are both successors to the IC-746. The IC-7400 is the Japanese version while the IC-746-PRO is the English version. We don't know yet what else (if anything) differentiates them besides their name.

There are two ways to look at the IC-746-PRO. Some view it as a beefed up IC-746 while others view it as a watered down IC-756-PRO. On the outside, it looks and operates very much like the IC-746. The controls are similar enough that you confuse the two. However, the inside (RF chain and DSP) is more like the IC-756-PRO than anything else.

Here are some features that the IC-746-PRO has over the IC-746:

- 32bit DSP with 24bit ADC
- Selectable digital filters (50+)
- Sharp or Soft filtering (via DSP)
- Digital TPBT
- Manual digital notch filter (in addition to ANF)
- Twinned Digital APF (great for RTTY?)
- DSP based RTTY decoder
- Adjustable digital noise blanker
- Digital TX/RX equalization (instead of analog)
- Digital speech compressor (instead of analog)
- Digital voice recorder

You'll notice how prominently the DSP plays in this rig.

One thing the original 746 has over the 746-PRO is an additional IF stage, thus its TPBT is actually going through two offset IF filters. The 746-PRO achieves its TPBT via the DSP. It is argued that the DSP filtering more than makes up for the lack of the extra filter and is more programmable/flexible. It is counter argued that DSP filtering is not as effective as traditional IF filtering (the 746-PRO instruction manual even eludes to this) and that insufficient filtering early on overtaxes the DSP.

Both are excellent rigs and only time will tell just how effective DSP really is. Perhaps someday Icom will make a rig with both.

Here are some of the features the IC-756-PRO has that the IC-746 does not.

- Dual watch receiver design
- Real-time spectrum scope

Additionally, the IC-746-PRO retains the basic form factor, LCD, control layout, and bonus 2m capabilities of the IC-746.

IC-746 FAQ

Plenty of sales and technical information is available (including downloadable pictures and brochures) from Icom's WWW site at:

<http://www.icomamerica.com/>

There is a Yahoo discussion group devoted to the IC-7400, as well as a group devoted to the 746 series in general.

<http://groups.yahoo.com/group/IC7400>

<http://groups.yahoo.com/group/IC746/files/IC-746pro-Instruction-Manual-2.pdf>

Icom has not yet made a copy of the IC-746-PRO instruction manual available in electronic form, however, the FCC has. You can access it and other information at:

http://gullfoss2.fcc.gov/cgi-bin/ws.exe/prod/oet/forms/reports/Search_Form.hts?mode=Edit&form=Exhibits&application_id=740578&fcc_id=AFJIC-746PRO

And a nice ham-written synopsis appears at:

<http://www.qsl.net/ab4oj/ja7ude/ic7400.html>

<http://www.qsl.net/ab4oj/icom/ic7400/ic7400.html>

2.14 Where can I find info on other Icom rigs?

2.15 Where is info on the 706, 718, 756, 765, 735, ...

This FAQ is devoted to the IC-746. As of November 2001, we do not know of any FAQ's devoted to other Icom models. However, as of Jan-2002, a project was underway to start accumulating and centralizing Icom information at:

<http://www.qsl.net/icom/>

While the coordinators of this list already have their hands full, they would be glad to advise, help, and collaborate with people interested in maintaining other FAQs.

Much of the generic information in this FAQ is applicable to other Icom rigs, but please, use common sense when trying to apply it.

For general information on other Icom rigs try:

Icom's WWW site at:

<http://www.icomamerica.com/>

Icom e-mail discussion group at:

<http://www.qth.net/>

Usenet newsgroup:

<news:rec.radio.amateur.equipment>

The Icom Amateur Radio Information Pages at:

<http://www.qsl.net/icom/>

The definitive collection of "mods" for all makes and models of amateur radio equipment is at:

<http://www.mods.dk/>

Yahoo Groups hosts more than 40 e-mail/WWW discussion groups related or devoted to Icom equipment. Here are some of the more than 50 Icom related groups there.

<http://groups.yahoo.com/group/icomr2>
<http://groups.yahoo.com/group/ICOMR3>
<http://groups.yahoo.com/group/ic706>
<http://groups.yahoo.com/group/ICOM706>
<http://groups.yahoo.com/group/IC-706Mk2G>
<http://groups.yahoo.com/group/IC-756PRO>
<http://groups.yahoo.com/group/ic756pro2>
<http://groups.yahoo.com/group/IC-Q7>
<http://groups.yahoo.com/group/IcomRadio>

IC-751 information pages

<http://www.sweb.cz/ok1fig/ic751a.htm>
http://www.qsl.net/ab4oj/icom/751a_pbt.html
<http://www.qsl.net/ab4oj/icom/icom.html#IC751A>
http://www.piexx.com/cgi-bin/piexx.cgi?p=ICOMProm&cart_id=1452031.27134
http://www.piexx.com/cgi-bin/piexx.cgi?p=ux14&cart_id=4031494.24744

IC-765 information pages

<http://www.execulink.com/~dstalk/>

Last, but certainly not least, AC6V has a wealth of links and resources on amateur radios.

<http://www.ac6v.com/swap.htm>

2.16 What articles have been written about the IC-746?

Add Remote Control to your ICOM Transceiver

Hansen, John, W2FS
February, 2003, QST, p.41

Adapt a mundane infrared TV remote to control your rig.

ICOM IC-746PRO HF/VHF Transceiver (product review)

Lindquist, Rick, N1RL
May, 2002, QST, p.72

A product review article

<http://www.arrl.org/members-only/prodrev/pdf/pr0205.pdf>

A Microphone Adapter for the IC-706

Davidson, Taylor, N4TD
May, 2002, QST, p.38

Describes a microphone preamp/control project that could be easily adapted to the IC-746.

A Quality Sound Card Interface for ICOM Rigs

Lewis, Bob, AA4PB
March, 2002, QST, p.31

A great way to capitalize upon the ACC ports.

Feedback in
May, 2002, QST, p.78

Solving Sound Card Microphone Problems

Covington, Michael A., N4TMI
June, 2000, QST, p.61

Shows a tiny, phantom powered, microphone preamp

Automatic Amplifier Selection for the ICOM IC-746, IC-736 and IC-706MKII Transceivers

Hewitt, Paul, WD7S
May, 2000, QST, p.33

Operating via the ACC connector (thus bypassing the SEND relay), this project provides automatic amplifier keying (with ALC selection) based on the Icom band signal.

An External-Amplifier Control Circuit for the IC-706 MK2

Hauff, Fritz, W3NZ
September, 1999, QST, p.80 (Hints+Kinks)

The IC-706 and IC-746 have nearly identical external amplifier interfaces/issues, so most of the information is relevant.

A Direct Frequency Entry Keypad for ICOM Transceivers

Hansen, John, W2FS
December, 1999, QST, p.38

Adds an external keypad via a PIC and CI-V.

ICOM IC-746 MF/HF/VHF Transceiver (Product Review)

Wolfgang, Larry, WR1B
September, 1998, QST, p.70

A product review article

<http://www.arrl.org/members-only/prodrev/pdf/pr9809.pdf>

Der Neue von Icom: IC-746 - mit 100w und DSP auf 11 Bandern

Petermann, Bernd, DJ1TO
April, 1998, Funkamateuer, p.392

A product review article (German)

A Remotely Controlled Antenna Switch

Thompson, Nigel, KG7SG
April, 1993, QST, p.32

Uses the band signal on the Icom ACC connector to remotely switch between antennas with a single feedline. (This article predates the 746, but is still appliccable)

Everything You Always Wanted to Know About Hardware For Computer-Controlling Modern Radios

Blackburn, Wallace, AA8DX
February, 1993, QST, p.37

Computer control interfaces for several makes and models of transceivers, including Icom.

<http://www.arrl.org/members-only/tis/info/pdf/9302037.pdf>

A Low-Cost PC Interface for ICOM Radios

Thompson, Nigel, KG7SG
July, 1992, QST, p.37

One of the early/original designs for a homebrew CI-V interface.

How To Build A Super-Simple Computer Interface For The Kenwood TS-440S And ICOM IC-735

Brown, Paul, NF2B
March, 1992, CQ, p.42

One of the early/original designs for a homebrew CI-V interface.

2.17 *Can I transmit 100w at 100% duty cycle on CW, SSB, RTTY, PSK, etc...?*

Yes. All of the 746/756 series were designed to handle continuous 100w output in all modes. The rig will get quite warm and the fan will run continuously. Be sure you allow adequate ventilation.

2.18 *I thought the LCD was blue, but photos show it as green?*

The screen is blue. The green color that shows up in many photos is caused by the camera flash, sort of an optical illusion. Non-flash photos always show the screen as blue.

For an example, see N4WMX's 746 non-pro at:

<http://www.backroadadventure.net/gallery/Radio/aaj>

2.19 *Can the IC-746 work on the 60m band?*

2.20 *Can the IC-746 work on the Alaska Emergency Frequency?*

Yes, no, no, and yes. To both questions.

For the purposes of our discussion, the Alaska Emergency Frequency of 5.1675 MHz USB can be treated as part of the 60m band.

Yes, the IC-746 can receive the 60m band, and does so quite nicely.

No, as shipped, the IC-746 will not transmit on the 60m band.

No, there is no 60m specific mod to the rig.

Yes, there is an all-band mod that will allow the IC-746 to transmit on the 60m band. See:

<http://www.mods.dk/>

Of course, once you've opened up ALL of the bands this way, appropriate caution is dictated.

The IC-756 (original, not the pro) has a very similar design to the IC-746. Some IC-756 users report an output power dropoff near 5 MHz, presumably due to the output band pass filters. Anonymous reports indicate that the 746 does not suffer the same problem. I do not have any data on the 746-PRO.

3 Accessories

3.1 Power Supplies

3.1.1 *What power supply should I use with the IC-746?*

Short Answer

Any good quality, communications grade, power supply rated at least 20 amps or more (continuous duty) should do just fine. However, most of us use larger supplies (for a variety of reasons).

Popular supplies that are known to work (via testimonial):

Alinco	DM-330MVT	30/32A switching
Astron	RS-35M	25/35A linear
Astron	SS-30	25/30A switching
Astron	SS-25	20/25A switching
MFJ	4125	22/25A switching (MightyLite)
MFJ	4225	22/25A switching
MFJ	4035-MV	30/35A linear
Samlex	SEC-1223	23/25A switching
Kenwood	PS-52	20/22A linear

Power supplies to avoid (via testimonial):

Astron	RS-20	- overloads too easily
Kenwood	PS-30	- overloads too easily
Diamnond	GZV-4000	- RF hash on 40/20m
Icom	PS-85	- RF hash

Long Answer

This question typically arises for one of two reasons. Either someone wants to buy a new power supply, or they have an existing power supply that they want to use. In both cases, the issues are: load capacity, size, weight, electrical noise, mechanical noise, cost, features, and appearance. Buying a new supply gives you a lot of options; there are plenty of great supplies out there. With an existing supply, you have no control over these factors; you're simply looking for a "fit".

You'll want to consider the following factors.

Reviews

QST tested and reviewed many supplies in January and September, 2000. You'll find the results informative. ARRL members can access those and other reviews on-line at:

<http://www.arrl.org/members-only/prodrev/pdf/pr0001.pdf>

<http://www.arrl.org/members-only/prodrev/pdf/pr0009.pdf>

Transportability

The larger the capacity, the larger and heavier the supply. If size and weight are critical for you, consider a "switching" supply as they are usually less than half the size of a "linear" supply.

Electrical Noise

All supplies generate some electrical noise. Typically the noise from linear supplies will be in the form of AC hum while from switching supplies the noise will be RF hash. Communications grade power supplies of either type are designed to minimize the noise, and generally cause no problem. (i.e. this is not a good place to cut corners)

"Computer" power supplies that are pressed into radio service are particularly bad when it comes to electrical noise.

Usually, the harder you push a supply (the heavier the load), the worse the noise will become.

Mechanical Noise

Many supplies have cooling fans. Sometimes, the fans are loud enough to be a noise problem themselves. Fan noise is variable from supply to supply (even within the same manufacturer and model). Likewise, hearing tolerance varies from operator to operator. Thus, it's hard to tell in advance if a specific supply will have a problem. Time may yet tell.

We do know that fans are driven by load. The closer you operate to a supply's capacity, the more the fan runs.

Also, some of the transformers used in linear supplies will generate an audible hum. The transformer itself vibrates with the AC supply. Mass seems to help here. Usually (but not always) the heavier the transformer is, the less the hum.

Its pretty easy to put a noisy power supply under a table, behind a cabinet, or elsewhere to cut down on the noise level. Just be careful to allow proper airflow for cooling.

Features

Most of us consider current limiting, over voltage protection, and high temperature shutdown to be mandatory in a new supply.

Fuses or breakers are required for UL certification. Buy spare fuses right away; they never blow at a convenient time.

Meters are non-essential; they are luxury items. They make the supply bigger and more expensive. However, they can be very handy and even fun. Lets face it; most hams enjoy gadgets.

Adjustable output voltage is a useful feature, more useful than you might realize. Most new supplies have it (usually internally).

Load Capacity

The size, weight, and cost of a power supply all tend to increase with its load capacity. Those factors encourage us to get the smallest supply we can. There are also factors that encourage larger supplies; such as noise, heat, accessories, etc...

The IC-746 specifications list a current drain at maximum transmit power of 20A at 13.8Vdc. Thus, the recommendation that your supply should handle 20 amps (or more) continuously.

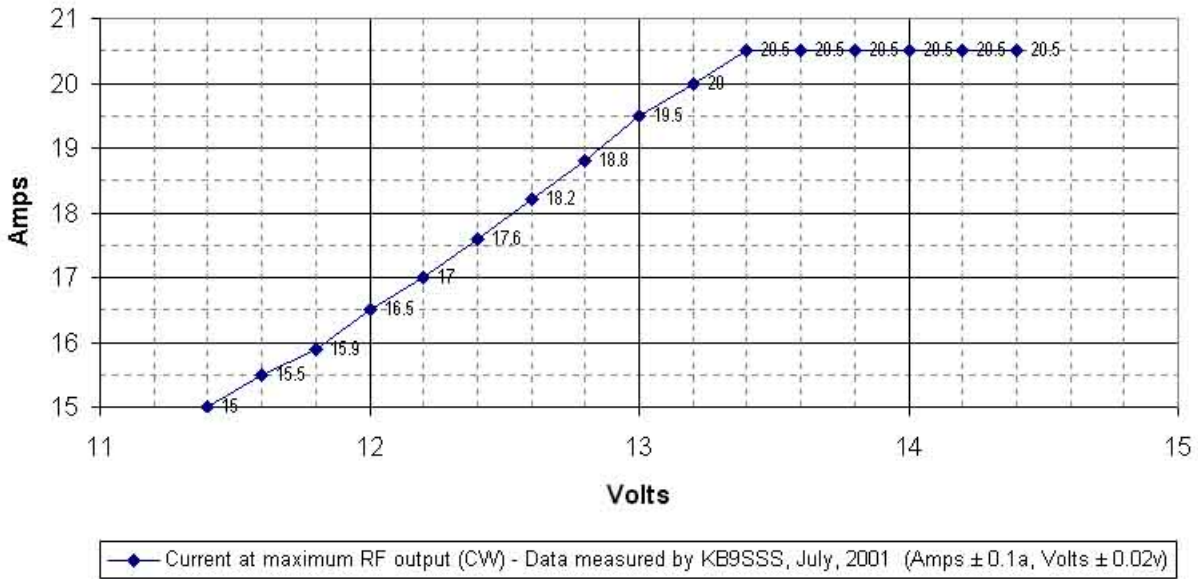
It is possible to run the IC-746 with a smaller supply, but extreme caution and discipline are required. Very few, if any, of us recommend it for normal operation.

For example, the 20 amp maximum in the IC-746 specifications is full key-down at full power. You could just lower your RF power to help match your load to the supply. You could even run the IC-746 QRP, drawing as little as 3-4 amps on transmit.

Another factor is operating mode. Some of us have measured full-key loads as high as 21-22 amps. Normal SSB transmit at full power draws 6-15 amps. But FM, digital, and CW will generally pull 18-20 amps at full power.

Consider the following measurements on 20m into a dummy load.

IC-746 Transmit Current vs Input Voltage



Continuous vs. Intermittent Load

There are issues concerning a supply's "intermittent", "peak", or "surge" capacity. A supply might be rated for 16 amps continuous and 20 amps peak. Normally, the IC-746 runs at about 2-3 amps for receive and only hits the 20 amp maximum during transmission. Thinking of transmitting as "peak" or "intermittent" activity can lead one to think that such a supply is acceptable. It might even be. However, a problem develops when we try to define what peak or intermittent activity is.

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Everyone would agree that transmitting for 3 minutes at 20 amps till the repeater time-out cuts you off is not a peak. How short a time constitutes a peak and at what duty cycle? Without some sort of specification or standard, "peak" and "intermittent" could mean just about anything. Most of us feel more comfortable with a "better safe than sorry" approach.

This dual rating system for power supplies is a great source of confusion. Specifically, you could buy a power supply rated for 20A and have it fail under full load. The Astron RS-20 and Pyramid PS-21 are examples of such supplies. While both are excellent supplies, they just can't keep up with an IC-746 under full power.

The exact definition of intermittent, peak, or surge as used by the power supply manufacturers has not been established.

(Some of us are trying to talk to the supply manufacturers about this to get more details)

To quote a tech from Samlex:

Maximum rating is surge current requirement for starting reactive loads or short term dynamic loading and is limited to a few seconds.

This supply is not designed for pulsing loads.

Currents beyond the maximum rating will force the unit into current limit and the output voltage will drop and it will no longer be regulated.

Meanwhile, MFJ said (of the MFJ-4322):

Our units will shut down at surge. At 25 amps surge, the power supply will shut down at about ten seconds.

So while it is theoretically possible, most people do not use supplies rated less than 20 amps continuous. In fact, most use substantially bigger supplies.

Bigger Supplies

Why use a bigger supply? There are several reasons.

As noted earlier, the closer you operate a supply to its rated capacity, the greater the electrical noise, mechanical noise, heat, etc, ...

Strain leads to wear-and-tear. So it can be argued that a bigger supply should last longer.

The IC-746 is rated at 20 amps max, but loads as high as 21-22 amps have been measured. "Your mileage may vary" definitely applies.

The continuous rating is generally based upon an ambient air temperature of 20 C. The rating degrades as the temperature rises, but by how much, we're not sure. Field Day conditions will be stressful to your supply.

13.8 V times 20 A yields 276 watts. There's a tendency for some supplies to drop voltage a little when they get hot or overloaded. There's also a tendency for some radios to increase their current pull when the voltage drops. At 12 Vdc, that same 276 watts would imply 23 amps. You push the supply capacity, which drops voltage a little, which drives the rig current up, which pushes the supply further ... then BANG. You blow a fuse. (AK6R has actually seen this effect with his 756pro)

There are plenty of other devices that need DC power. You need to account for them as well.

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Other and future rigs may have greater power demands (like the 756pro). Extra capacity now may avoid the need to upgrade your supply in the future.

You might well spend most of your time in a low power situation (SSB QRP) and get by with less than 5A. But, in an emergency, you and your gear may be called upon to operate in different modes, at higher power, and with heavier duty cycles. Planning ahead for the worst case usage helps prevent an untimely failure at just the wrong time.

Conclusion

So, you'll find most of us with power supplies ranging from 20 to 30 amps continuous; and some with even bigger supplies.

3.2 Antennas

3.2.1 *What antenna should I use with the IC-746?*

Short Answer

Any antenna you want.

Long Answer

Seriously. ANY antenna will work with the IC-746, with the proper interfacing. People have even made contacts using dummy loads.

Antennas are probably the most uniquely individualistic aspect of any ham station. Antenna selection is a BIG topic; much too big to deal with in an FAQ (at least for this one).

The IC-746 has 50 ohm, unbalanced, coaxial RF outputs. With the automatic ATU capable of handling SWR mismatches of up to 3:1 on HF (and 2.5:1 on 6 meters), you have a wide variety of choices available to you.

There are many excellent books on the topic; the ARRL has a couple dozen of them. A good one to start with is:

The ARRL Antenna Book

At over 800 pages (and over 1,000 antennas), you're sure to find SOMETHING that fits your style and budget.

For more information, try hanging out on one of over 50 e-mail groups on the topic at

<http://groups.yahoo.com/group/IcomRadio>

or visit one of the hundreds of antenna oriented WWW sites indexed by AC6V:

<http://www.ac6v.com/antprojects.htm>

<http://www.ac6v.com/antprojects.htm>

or follow along with the discussions on the newsgroup:

news:rec.radio.amateur.antenna

or visit the on-line antenna magazine:

<http://www.antennex.com/>

or, you could just put up a trusty old dipole.

Just be sure you do use an antenna. The IC-746 does not like to transmit into an open load (no connected antenna). It will put an undue (and possibly fatal) strain on your output transistors.

3.2.2 What range can the automatic antenna tuning unit (ATU) handle?

Officially, the automatic ATU in the IC-746 can handle SWR mismatches of up to 3:1 on HF and up to 2.5:1 on 6 meters. In practice, many people get even wider ranges, a few as high as 7:1, but be wary of pushing the ATU that hard.

The ATU does not function on 2 meters.

Some have pointed out that, even though the internal tuner may tune a particular antenna configuration, if there is a high SWR, you could end up burning out the tuner.

We have at least one case (reported by KG6GLN) where the detector diodes in an IC-746 were fried. According to the ICOM tech, "... it could happen if you tried to use an external antenna tuner in conjunction with the internal tuner. "

3.2.3 Will the internal ATU handle "random" wire antennas?

3.2.4 Will the internal ATU handle "long wire" antennas?

No. You'll need an external ATU.

The internal ATU can only handle an SWR mismatch of about 3:1 on HF and 2.5:1 on 6 meters. Such antennas will exceed those limits somewhere, over stressing the ATU and possibly blowing it out. Matching will be hit or miss (mostly miss).

Of course, there's always an exception. N4EUK reports successfully tuning his 100 foot wire antenna using the internal ATU. Even he was surprised.

3.2.5 Are there any "tips" to using the ATU?

You mean, besides the tips already provided on page 58 of the Instruction Manual? Yes.

The ATU appears to pay attention to the reflected power, not the SWR. [Note: we'd love someone to analyze the schematics to confirm or deny this.] This is evidenced by two effects.

When starting from a close match at QRP power levels, the auto ATU doesn't always home in on the best match. Increasing the power level and tuning again often improves the match, which the ATU then retains when returning to QRP power. In fact, the manual mentions at least 8w on HF and 15w on 6m.

The converse situation can also cause trouble. When starting from a poor match at full power, the auto ATU sometimes can't find a match at all. In this case, tuning at lower power allows the ATU to get a match, which the ATU then retains when returning to high power.

If one end of a band consistently gives you trouble while the other end tunes easily, then you may still be able to coax the ATU into matching the antenna. Start in the portion of the band where the ATU works and tune there. Then, move your way across the band in increments (maybe 25Khz at a time), tuning as you go until you reach the desired portion.

3.2.6 Can I use the internal ATU along with an external ATU?

Maybe. Theory says yes, but Icom says no. The results are mixed. Use at your own risk.

Many people use an external ATU along with their IC-746. Usually, they leave the external ATU switched to "bypass" and let the internal ATU do its thing. For troublesome bands/antennas, they turn off the internal ATU and engage the external one.

Others use an external ATU to match their antenna to the middle of the desired band and let the internal ATU handle the rest. In theory, the ATU doesn't know or care what's hooked up to it; it simply tries to match up to the impedance it sees.

In most cases, either of the above approaches work fine. Many hams have been applying both for years with no problems.

However, some IC-746's have had their ATUs go out from fried detector diodes and driver transistors. On many repairs, Icom has blamed the failure upon external tuners. One ham was told that external tuners can cause problems even when they are switched to "bypass".

Nobody has been able to adequately explain why an external tuner would cause such damage, particularly when bypassed. Some speculate that tuning with low power is safer than tuning with high power (if nothing else, its at least more polite).

We need more information on this, but at least you've been warned.

The best procedure we can suggest at this point is:

- Turn off the internal ATU.
- Reduce power to about 1/4 (25w).
- Adjust the external ATU using the rig's SWR meter. (The two meters usually disagree. It is what the rig sees that is important.)
- Restore full power.
- Turn on the internal ATU.

Do not adjust the external ATU at full power.

Do not adjust the external ATU while the ATU is on.

Do not change frequency while the ATU is searching for a match.

3.2.7 Does the internal ATU work on receive?

Yes. The internal ATU is enabled while receiving. Of course, it can only "match" while transmitting.

It's unclear if the internal ATU acts as an additional preselector when enabled.

3.2.8 Any other "gotchas" with the internal ATU?

We've already mentioned above the possible hazard of using the internal ATU and an external ATU at the same time.

We've also mentioned above that operating the internal ATU at the limits of its abilities might overtax it over time.

A possible problem we haven't already mentioned may stem from the possible similarity between the IC-746 and the IC-756. The IC-756 users have been warned not to use either their "Auto Tune" or "PTT Tune" features while on 6m. (even the manuals mention this, although in passing). Several have damaged their internal ATUs this way, causing them to get stuck in 6m operation after damaging the relays.

It has been speculated that some of the reported mishaps with the IC-746 internal ATU with 6m may be related. It's not hard to imagine that the 746/756 share a common ATU design. We'd appreciate someone (with access to both service manuals) doing a detailed circuit comparison to confirm/refute this.

Finally, the internal ATU is only matching at the internal PA. You'll still have high SWR out on your coax, as expected.

3.2.9 How do I use a "beverage" antenna?

3.2.10 How do I use different antennas for receive vs. transmit?

As previously stated, nearly ANY antenna can be used with the IC-746, provided it can be matched to the 746's 50 ohm, unbalanced antenna terminals. However, there is more to using a "beverage" antenna than just impedance matching.

Beverage antennas tend to sacrifice gain in order to improve their signal to noise ratio. So, while they are good for receiving, they are poor for transmitting. Therefore, you would typically use a separate antenna for transmitting.

Split VFO Method

While not convenient, the IC-746 can be configured to use one of its antenna ports for transmitting and the other for receiving. Run the rig in split mode with both VFOs on the same frequency, but have VFO A use antenna 1 and VFO B use antenna 2.

External Antenna Switcher Method

A more traditional approach (albeit, more work) is to take the HF transmit signal from one of the accessory ports activate a coaxial relay (via a driver transistor) to switch between antennas. This is the same basic setup you would use to control an external amplifier.

(refer to articles and external amplifier questions for more information)

External RF Sense Antenna Preamp Method

Some manufacturers make antenna preamps that sense the RF on the line to switch between antennas as well as switch in/out the preamp. The Ameco PT3 preamp is one example.

3.2.11 How do I measure SWR while in SSB?

Usually, you don't. Measuring SWR requires a signal. The only way to get a signal on SSB is to modulate; i.e. you talk.

The simple thing to do is to switch modes to either AM or RTTY briefly. After making your measurement, switch back to SSB.

3.2.12 How do I tune up in CW without a key?

Usually you don't. You probably don't even want to be in CW mode without a key.

Odds are, you're trying to tune up for a different mode, for example, PSK on SSB. The simplest thing to do is switch briefly to AM or RTTY and tune there.

If you insist upon tuning up in CW without a key, then you really only have one option; simulate a key. You could turn on the mic-keyer, which uses the scan buttons (UP/DN) operate the keyer. Or you could wire up a dummy key jack and key the rig by plugging the dummy jack in and out. There's even one ham who uses his headphones as a dummy key, but very few of us are willing to take that risk!

3.2.13 What about using an external, automatic, ATU?

There are many automatic ATUs you could use. Your choice boils down to two basic questions:

Do you want to tune at the antenna or in the shack?

Do you want an Icom tuner or a third party tuner?

Tuning at the antenna is far more efficient than tuning in the shack (feedline SWR, etc...), however tuning in the shack is more convenient (no power or control cables).

Icom tuners will be "plug-n-play" with the IC-746, while third party tuners may require cabling or a change in procedure.

Remember, the transceiver's internal ATU must always be disengaged when driving an external tuner. Cascading tuners can reflect high reactance values back into the internal ATU and/or LPF. As a result, dangerously high RF voltages can appear across capacitors in these networks, leading to component failure.

Icom's cabling to their own antenna tuners takes care of the above automatically.

There are too many possible automatic ATUs to cover in this document, but here are a few that merit special comment.

AT-500

The AT-500 is intended for use in the shack with near-resonant antennas. It is documented as handling mismatches of up to 3:1 SWR, but in practice can do better than that, particularly at lower power levels. It's rated for 500w, 160-10m.

The hard part to using this tuner is finding an OPC-118 interface cable (they're not made anymore). W2ENY has a clone available at:

http://members.fortunecity.com/w2eny/icom_opc118a/

AT-180

The AT-180 is intended for use in the shack with near-resonant antennas; it will tune a maximum excursion of 3:1. The AT-180 was designed for the ham bands only but should have sufficient band overlap to accommodate the MARS frequencies.

Here are the AT-180 specifications:

<http://www.icomamerica.com/amateur/hf/at-180.html>

No real point to using this ATU over the built-in one

AH-4

The AH-4 is an automatic antenna coupler, intended to tune random-length wire and whip antennas. The AH-4 is mounted at the antenna, and the RF lead from the coupler to the radiator should be as short as possible. The AH-4 covers 3.5 to 54 MHz (continuous) with a 7m (23 ft) wire antenna.

Here is the AH-4 brochure:

<http://www.icomamerica.com/support/documents/brochures/ah-4.pdf>

And a very informative site on the AH-4 (including an AH-4 FAQ):

<http://www.hamoperator.com/ah4/ah4.htm>

AH-3

The AH-3 is an older (out of production) alternative to the AH-4; it covers 1.8 to 30 MHz (continuous) with a 7m wire antenna. There is info on it at the following WWW site:

<http://www.qsl.net/n4pl/ah3/>

AH-2

Older still, the AH-2 could cover 1.8 to 30 MHz with a 12m antenna or 3.8 to 30 MHz with a 3m antenna.

3.2.14 Can the TUNER button activate an external automatic ATU?

Yes. The IC-746 has a connector designed to directly connect to the Icom AH-4 automatic antenna tuning unit. Page 80 in the instruction manual describes hookup and operation. Once installed, pressing the TUNER button for 2 seconds will cause the rig to transmit 10w in CW mode until the AH-4 finishes.

The IC-746 assumes that the AH-4 is connected to ANT-1 and automatic tuning will only work there. ANT-2 is still available, but with no ATU.

In fact, there's a whole WWW site devoted to the AH-4. Check it out at:

<http://www.hamoperator.com/ah4/ah4.htm>

Most Icom tuners use the same interface (AH-2, AH-3, AT-180, etc...).

Connecting and operating an LDG tuner is exactly the same; they even make a cable specifically for the task.

Connecting and operating an SGC tuner is almost the same; you'll have to make your own interface cable. Instructions for that are at:

<http://www.sgcworld.com/products/Couplers/icom706.html>

Sure, the page says its for the IC-706, but the external ATU interface is identical to that of the IC-746. Once wired up, operation will be just like for the AH-4.

Finally, you could just fake the IC-746 into thinking that there is an ATU out there with a dummy plug like that available from W2ENY at:

<http://members.fortunecity.com/w2eny/tenatuner/>

Operation is similar to that for the other tuners, but transmission stops after an 8 second timeout instead of by tuner acknowledgement. You can even build this yourself based on the information at:

<http://www.mods.dk/mods.php3?radio=icom&model=ic-706&selectid=1864>

or

<http://www.qsl.net/wb8rcr/706Tune.html>

<http://www.qsl.net/g4fzn/706cct.gif>

Don't mind that the info says its for the IC-706, all Icom rigs from this era use the same circuitry/connector.

3.2.15 Why doesn't the rig SWR meter match my external SWR meter?

Its normal for different points along the RF "feed" to register different SWR readings. The SWR meter in the 746 reads the SWR between the final amplifier stage and the tuner. Your external SWR meter reads the SWR between the tuner and the antenna. The external meter should always read greater than or equal to the meter in the 746.

It's actually possible to "match" your rig to your antenna by simply changing the length of your feed line. For an extreme (but very workable) example, check out:

<http://www.qsl.net/w5dyp/notuner.htm>

This is not to say that the internal SWR meter is accurate. Posts that suggest that the internal SWR meter reads lower at lower output power than at full output power. The effect is noticeable, but not pronounced.

3.2.16 Which SWR meter should I trust: internal or external?

Both can be trusted, but tune by the internal meter.

You probably care because you are using an external ATU. Tune to bring the internal meter to a minimum reading. Its the meter that tells you how happy your RF power transistors are and whether or not you're suffering SWR power foldback.

3.2.17 How do I repair the detector diodes in the internal ATU?

???? (Mike) describes his experience at fixing blown detector diodes in the internal ATU.

The problem was that the Auto-Tuner would no longer tune up the antennas that it used to for me, and the SWR didn't change on the antennas (as measured by my MFJ-259 antenna analyzer). It would either try for 6-10 seconds and then drop out, or try for only one or two seconds and drop out. When it "dropped out", the Tuner indication would go away on the display.

Rather than sending it in for repair, I managed to figure out the bad parts were the D8 and D9 Diodes on the Control Unit. They are HSM88AS diodes. They are a 3 lead device, and look like a surface mount transistor. They have "C1" indication on the top. These diodes are located NEXT to the orange "L9" inductor close to the speaker, just below the 820pf caps near the open core inductors.. If you have trouble locating it from the description above, you'll either need the manual from Icom to locate the two diodes, or I have a picture that I took is available showing the location.

Looking at the specs for these diodes

<http://www.hitachisemiconductor.com/sic/jsp/japan/eng/products/standardics/diod/lineup/diode/eHSM88AS.pdf>

They have a minimum 10 V (sub) R voltage rating (not too high) which may explain why they blow so easily (but then I don't know the signals that they receive under normal circumstances).

Notice also from the specifications that each part really has 2 internal diodes. By looking at the schematic for the radio (that comes with your Owners Manual, D8 and D9 both have open leads where one diode is NOT used. They are on OPPOSITE sides!! What you can do (one time only) is to swap D8 and D9 and the radio should work again. I found that the D8 diode was leaky. I never did find the D9 diode to be able to measure it (notice the warning below!)

HOWEVER, this repair procedure is not for the faint hearted.

These are surface mount parts and are about the size of 2 grains of sand. To replace the parts requires a very small tip soldering iron, a fine tipped pair of tweezers and a very steady hand.

What I did was to use some solder wick to remove much of the solder. I was then able to remove the parts with reasonable ease. Just as a warning, when I changed mine out, once the solder joint released, my D9 when flying. I never did find it. Lucky I had already ordered spares.

If you're brave enough to try it, I'll wish you the best of luck, and add that I give no guarantees that this will fix your rig, but it did fix mine.

3.2.18 How do I switch between more than two antenna ports?

With a switch, of course.

Actually, you're probably looking for an "automatic" way to switch between different antennas based upon your current operating band. For that, check out "Automatic Antenna/Amplifier Selection by Band" mods elsewhere in this FAQ.

3.3 Microphones

3.3.1 *What is the best microphone to use with the IC-746?*

In theory, your favorite microphone is the best choice, provided you hook it up and adjust it properly. Its basically just a matter of personal preference.

The confusion lies in the definition of "best". Most users generally agree that the stock hand mic is generally adequate for general use, but is not "best" or "optimal" for any specific use. You know the tale; jack of all trades, master of none.

If you want better transmit fidelity (or even broadcast quality sound), then you'll want a full range microphone, possibly with a dynamic element. Icom's own SM-20 gets good reviews for this application, as does Heil Goldline microphones. Other microphones will also work; these just happen to be the most popular.

Many operators have found that the inexpensive studio microphones from Radio Shack work astonishingly well. Yielding 90% of the performance at 10% of the price makes this a viable, budget conscious, choice. It also shows just how poor the stock mic is.

If you're after more "punch" for DXing or contesting, then you'll want to look into one of the Heil DX style microphones. They're frequency responses have been tailored to accentuate the portions of the voice spectrum that most contribute to understandability. Their great performance have made them very popular.

For those of you who "want it all", Heil even makes a microphone that switches both ways, literally. It has two pick-up elements in the same mic, so you can change between ragchewing and DXing punch at the flick of a switch.

Who says you can't have your cake and eat it too?

3.3.2 *Can I hook up a different microphone directly to the IC-746?*

Yes, but only if properly wired.

There is more to wiring up an external microphone than just the differing pin-outs. You will also have to deal with: DC bias, signal level, and impedance.

Icom uses electret elements and incorporate preamps right into their hand mics. The DC power is fed directly from the rig through the mic cable. If you are using a different electret microphone, by sure it will operate with the 8 Vdc bias. When using a dynamic microphone, be sure you have a capacitor (value not critical, around 1.0-4.7 uf) in the circuit to block the DC supply voltage

Depending upon the microphone, you may have to use a hefty amount of mic gain (and possibly compression as well) to make up for the lack of the handset pre-amp. You may even need to use an out-board microphone preamp to get the signal high enough.

Finally, the Icom microphone input is at a relatively high impedance (1-2K ?). A matching transformer (or preamp) will yield the best results. Most microphones operate at only 600

ohms impedance, and the impedance mismatch will exacerbate the signal level deficiencies. Some microphones operate at much higher impedances (as high as 100K) and, unmatched, will suffer from distortion in addition to signal level problems.

Since you're already wiring up a new mic cable, you might want to short pins 6 and 7 with the chassis ground to assure that they are at the same ground potential. This often helps reduce RFI from coming in through the mic cable.

3.3.3 *Can I use a Heil microphone with the IC-746?*

Yes, most Heil microphones work well with the IC-746. Bob does this himself.

As with any dynamic microphone, be sure you have a DC blocking capacitor in the circuit to isolate the mic element from the DC supply voltage. Heil's pre-wired mic harnesses are perfect for this.

A notable exception is the HS-706 which (as the sales literature clearly states) ONLY works on the IC-706 series.

3.3.4 *How do I adjust the IC-746 for a Heil headset?*

In theory, the IC-746 has enough microphone gain to use an unaided Heil microphone. Heil's May, 2000, newsletter discusses this topic, see:

<http://www.heilsound.com/newslettermay00.htm>

In short, you use moderate mic gain (50-75%, 12-3 o'clock position) along with moderate compression (8-10db, 12-1 o'clock position) for the best results.

3.3.5 *Do I need a pre-amp to use a Heil microphone?*

While the above procedure works for most rigs, it does not seem to work for everyone. For the few that still have gain problems, adding the Heil HMP microphone pre-amp should work.

Some speculate that the differing mic gain requirements are due to different versions of the IC-746, or simply due to widely varying component tolerances. Nobody has collected enough information yet to nail this issue down.

DO NOT use the HMP pre-amp unless you're sure you need it. Too much gain will distort your transmitted audio; with all the usual detriments (hard to copy, splatter, etc...)

If you decide you need a pre-amp but want to build it instead of buying it, then check out:

"Build a low cost Boost Microphone"
QST, Aug, 1989

along with the Icom specific mods available (DC blocking capacitor, etc...) from KK5DR (Matt Erickson) at:

kk5dr@ev1.net

Another good QST article on microphone preamps is:

"Adapting the Astatic D-104 Microphone for use with Modern Transceivers"
QST, Aug, 1999, p.34

a copy of which can be found at:

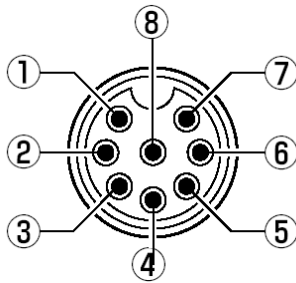
<http://members.aol.com/ampmicro/>

Another interesting design can be found at:

<http://www.muzique.com/ssm2166.gif>

3.3.6 **What are the pin-outs on the microphone connector?**

As listed on page 67 of the Instruction Manual:



- 1 - mic input
- 2 - +8V DC Output at up to 10ma
- 3 - freq up/down
- 4 - Main readout squelch switch
- 5 - PTT
- 6 - GND (PTT)
- 7 - GND (MIC)
- 8 - AF Out (varies with [AF]) (center pin)

3.4 Keyers

3.4.1 Can I hook my straight key to the front "Elec Key" Jack?

3.4.2 Can I connect my own Electronic Keyer to the IC-746?

3.4.3 How do I wire up my paddles for use with the internal keyer?

Short Answer

Yes, virtually any type of key/keyer can be connected to the IC-746 via either the front "Elec Key" jack or the back key jack. However, the two jacks require different wiring, and only the front jack will give access to the internal electronic keyer.

The front "Elec Key" jack on the radio accepts a 3-conductor 1/4-inch stereo phone plug and can be wired for use with anything. The back "key" jack accepts a 2-conductor 1/4-inch mono phone plug and can be wired for use with either a straight key or an external keyer, but not for the internal keyer.

See page 68 in the operator's manual for wiring details and pages 23 and 27 for the programming details.

Long Answer

FOR A STRAIGHT KEY OR EXTERNAL KEYS:

For a diagram on how to wire the stereo plug see page 68 of the Instruction Manual. For a straight Key or keyer, wire only the tip and the Sleeve, and leave the ring as No-Connect.

```
tip   ring   sleeve
oooo  ====  ]]]]]]]} ----->  2 cond wire to key/keyer
(+ )  (nc)   (-)
```

The back "key" jack is a mono 1/4 inch phone plug and is easy to wire.

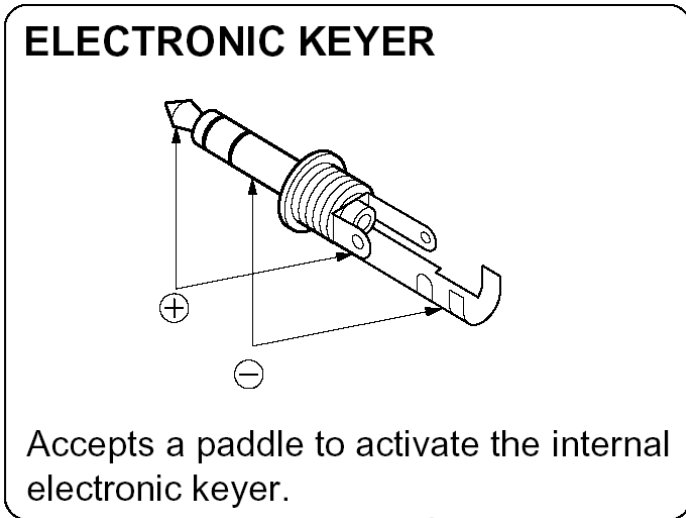
When using the front Jack, You also have to set the radio to recognize that the ring is not used. To set the radio, You do have to go to the "key", "set" menu and tell it you will be using a straight key. See Page 23 and page 27 in the operation manual. While in CW mode press KEY(F4), then press SET(F5), Press the down arrow(F2) until you reach the sixth menu (KEYER TYPE), Use the Main tuning knob to set the type of keyer to "Straight Key".

TO USE THE BUILT IN ELECTRONIC KEYS WITH PADDLES:

Wire the 3cond Stereo plug (use the front jack) so that the "Dit" is the tip, the "Dash" is the ring and the sleeve is common (-). (You can also wire up a "bug" this way (without electronic keyer))

tip ring sleeve
 oooo ====]]]]]} -----> 3 cond wire to paddles
 (dit) (dash) (-)

To set the radio to use the internal electronic keyer, You do have to go to the "key", "set" menu and tell it you will be using paddles. See Page 23 and page 27 in the operation manual. While in CW mode press KEY(F4), then press SET(F5), Press the down arrow(F2) until you reach the sixth menu (KEYER TYPE), Use the Main tuning knob to set the type of keyer to "Elec Key". (or "bug Key" to use the bug without electronic keyer)



3.4.4 Can I use the internal and external keyers at the same time?

Sure ... you can have an iambic keyer plugged into the front, and a straight or external electronic keyer plugged into the back. You can then use either interchangeably.

We don't yet know of anyone brave enough (let alone capable) to actually use both keys SIMULTANEOUSLY. Would such a person be a "two fisted" operator? 8)

3.5 Amplifiers

3.5.1 *How do I hook up an Icom IC-PW1 RF power amplifier?*

The electrical connections are easy; just follow the diagram at the top of page 79 in your instruction manual. Then carefully read the instructions that came with the IC-PW1 because they can be confusing.

Icom has instructions for this on their WWW site at:

<http://www.icomamerica.com/support/documents/pw1-746.html>

They state:

1. Make sure the CT-17 is powered up. Connect the CT-17 output 1 to IC-746, and output 2 to IC-PW1.
2. Power up the IC-746 and set up the CI-V communication per the IC-PW1 manual. The CI-V set up will vary between the early and the latest IC-PW1 units.
3. Power on the IC-746 and the IC-PW1. The IC-PW1 should now automatically select the band the IC-746 is set to.
4. Now start the software, and set the software com port setting to the port you have the CT-17 connected to. The software should recognize the IC-746 and show the exact frequency on the computer screen the IC-746 is tuned to.
5. As you change bands on either the IC-746 or the software, the IC-PW1 will follow that band change. If you change bands on the software, both the IC-746 and the IC-PW1 will follow that band change.

Paraphrased (thanks to WA0SXV), the procedure is:

- Turn everything on, set the 746 to full power, and key up in RTTY.
- Adjust the ALC pot on the back of the PW1 to set the IC-PW1 ALC meter to the mid-scale point.

Power out on the amp should now read around 500w if you are using 110 or 1000w if you are using 220vac.

No adjustments are needed on the 746 --- the PW-1 ALC should take care of that. When properly adjusted the power output scale on the 746 will read something around 35-50w.

3.5.2 *What if I hook up more than just an IC-PW1?*

The PW-1 manual claims that you will not have to mess with the CI-V addressing. That's not always true. If the IC-PW1 is directly connected to the IC-746 (on default CI-V address 54h and 56H respectively) with no other devices, then the PW-1 auto-config routine senses the IC-746 and everything works just fine.

If you introduce additional devices or alternative interfaces (such as the DX4WIN logging software using the "\$10 Radio Shack" interface, talking to the IC-746 in CI-V address 56H) then the PW-1 can become confused and stop talking to the IC-746.

One solution to the problem is to set both the IC-746 and DX4WIN for CI-V address 54H - the same as the PW-1.

(But, shouldn't each device have a distinct address??)

3.5.3 *How do I hook up a non-Icom RF power amplifier?*

Start by examining the diagram at the bottom of page 79 in your instruction manual, but be careful, it can mislead you into some expensive mistakes.

The ground and antenna connections are just as straightforward as they appear, no problems there.

Do not hook the SEND output directly to your amplifier as shown. You will need an external switching relay or circuit to avoid overloading the internal SEND relay. Burning out the internal SEND relay is a common failure.

Not all amplifiers will have compatible ALC control signals. The IC-746 ALC input runs from 0 to -4 Vdc. W7DS designed a circuit to aid in automatic amplifier band switching that may be useful to you. Check out the "mods" section of this FAQ for more details.

3.5.4 *Do I really need an external amplifier switching relay?*

Most likely, yes. If you hook up a non-Icom amplifier that does not have a solid-state keying interface, then you'll probably want an external switching interface.

This is often a hotly debated topic that has left quite a few blown out rigs in its wake. It is possible to run an amplifier without a switching interface. The article at:

<http://www.qsl.net/icom/keynotes.html>

tries to describe the necessary conditions.

3.5.5 *Why do I need an external amplifier switching relay?*

Short Answer

It's far too easy to overload and damage the internal switching relay, resulting in expensive and/or annoying repairs. The external isolation relays are cheap insurance for our rigs. Even Icom technical support recommends them.

Long Answer

Given that the relay is prone to overload, the natural question that arises is; just how much can it handle? Things get both lengthy and muddy from this point on, but since you're still reading, we'll press on. Remember, you were warned.

This continues to be a process of discovery, so I'll present what we know in that form.

Instruction Manual

Page 79 of the instruction manual says that the SEND jack is rated for 16 Vdc at 2A. Some rigs have failed while well within those specs. Others seem to survive conditions far in excess of that rating. Obviously, the ratings in the manual don't tell the full story.

Homebrew explanations (and solutions for) the problems abound. Some talk about bypass capacitors while others talk about suppression diodes. Folks debate inductive vs resistive loads and ratings. Surge currents and hot switching usually get brought up, as well as AC vs DC loading. For years, the topic keeps coming up, but with no consensus or dependable solution; except that using an isolation relay/circuit seems to prevent any overloads.

Tech Support

So, many of us contacted Icom technical support. Unfortunately, we received different answers at different times. For example, in the icom@qth.net archives for January 2000, we see that tech support told AB2BK that there was a misprint in the manual. The true rating was 12 Vdc at 20mA and Icom recommended an external isolation relay. While that would explain the failures, it makes some of the successes almost unbelievable. On the other hand, the archives for February 2002 show that tech support told N1JM that "The real scoop is UP TO 16V -OR- UP TO 2 amps." Again, Icom recommended an isolation relay.

While the techs did not agree upon the ratings, they did agree upon using the external relay. Unfortunately, none of the answers from tech support have adequately explained the odd successes and failures.

Service Manual

All of this boils down to how much abuse relay RL1271 on the Main board can take. The parts list on page 6-12 shows the relay as an OMR-109F. The obvious solution is to look up the parts and see what they are rated for. As of January 2002, nobody had revealed any spec sheets for the relay.

Internet Search

Searching for "OMR-109" on the Internet did turn up a curious tidbit. Icom has used the OMR-109 before, as the SEND relay (RL2) in the IC-761. It had problems too. There is a Service Bulletin (#24287-001A) entitled "Larger relay for keying non-ICOM amplifiers" which recommends:

Replace RL 2 (currently labeled OMR 109) on the PA Connector Board with a SY-12 relay (ICOM P/N 921-04696). This relay is larger but can be squeezed into place. Glue this relay to the board with RTV.

For the full bulletins, check out:

<http://www.qsl.net/kd4sai/mods/icom/ic-761.txt>
<http://www89405.temp.w1.com/Modifications/B2502>

More searching did turn up information for the SY-12-K relay, which lists a contact rating of 1 A @ 24 Vdc or 0.5 A @ 120 Vac (resistive). We can infer that the OMR-109 specs are most likely less than these.

<http://www.fceu.fujitsu.com/pdf/sy.pdf>

Unfortunately, we still do not have many answers.

Contact Parts Supplers

Finally, in February 2002, we found a listing for the OMR-109F (thanks to the kind folks at Omron Electronics for helping out). It doesn't say much, but does show a contact current rating of 1 A.

<http://catalog.tycoelectronics.com/TE/bin/TE.Connect?C=14894&P=87296,91080,86600,76287,76437&M=PROP&N=1&LG=1&I=81&G=G>

However, the above link did show who the manufacturer is. OMR relays are made by OEG. That finally led to some actual data sheets.

http://www.oeg.com.cn/pdf/14_OMR.pdf

http://www.qsl.net/kb9sss/IC-746/Parts/14_omr.pdf

Here are a few interesting pieces of info from the datasheet:

Max. Switched Voltage	AC: 120V DC: 60V
Max. Switched Current	1A (OMR-F) 0.5A (OMR-H).
Max. Switched Power	OMR-F: 50VA, 50W. OMR-H: 10VA, 10W
Max. Switching Rate	300 ops./min. (no load). 30 ops./min. (rated load).
Operate Time	1.0 msec
Release Time	0.5 msec
Expected Mech. Life	100 million operations (no load).
Expected Elec. Life	1 million operations (rated load)

First we see that the listed current/voltage ratings do not match anything we've seen or have been told before. Curious that. Why has Icom technical support given out at least TWO different sets of specs? One theory is that the relay specs we have are still not detailed enough.

It turns out that there are two ways to report maximum contact current. "Maximum Switched Current" is the maximum current at switching time; when the contacts are opening or closing. Once the relay is switched on, the contact current may rise to as high as the "Maximum Carrying Current", but must reduce again prior to switching off. Thus, if the maximum carrying current is 2A, then the answer from Feb-2002 could make sense.

Switching Rates Explored

Closer examination of the maximum switching rates reveals a possible problem. Suppose, for example, I transmit at only 1 word per minute. We average 5 characters per word, 3 dit-dahs per character, and 2 switches per dit-dah. So, CW at 1 wpm will generate 30 relay operations per minute. That's the limit of what the relay can handle at full load. 10 wpm will generate 300 op/min, which is the no-load limit for the relay. 30-40 wpm (what my local CW contesters do) pushes us to about 1,000 op/min; which is well beyond the relay's rating. The max internal keyer speed of 67 wpm (as per ARRL review) would yield a brutal 2,010 op/sec.

This could account for the varying results encountered in the field. We'd all assumed till now that the problem was simply one of current or voltage overload. Now we can see that those operating QSK CW are overstressing the part, no matter what the load. Pushing the part that far beyond its operational limits would certainly make it more failure prone, which could explain some of the failures that have happened within the supposed current limitations.

Expected Lifetime?

Consider this: CW at 20 wpm would generate about 600 op/min, which would reach the expected mechanical life of the part after less than 3,000 hours of transmitting. But wait; if we apply that same rate to the expected electrical life, we get less than 30 hours of transmitting time.

In contrast, AM/FM/SSB/RTTY operation would likely require 200,000 to 2,000 hours (respectively) of operating time to hit either expected lifetime.

The Schematics

The schematic on page 11-4 of the Service Manual shows the SEND relay as an AHY103, not the OMR-109F listed in the Parts List on page 6-12.

(this is listed in the "Manual Discrepancy" section of the FAQ)

Currently, we believe that the parts list is correct and that the schematic is wrong. However, this might help explain why Icom Tech Support has quoted different specs at different times.

Mysterious Successes

OK. To be totally fair, there are some amps out there that seem to work OK without an isolation switcher. Alpha Power, for example, uses an IC-746 daily to test their Alpha 99 series of amplifiers. They report no problems. Off course, their 25 Vdc exceeds Icom's specifications but are within the relay specifications. Go figure.

Connection Confusion

So far, we've concentrated upon the SEND jack on the back of the rig. There are also HSEND and VSEND signals available via the ACC connectors. What makes matters worse is when some folks mistake these signals for the relay driven SEND line, when in fact they

are driven by transistor Q1302. The transistor is not as hardy as the relay, with obvious consequences.

Summary

We have now identified MANY possible failure conditions for the SEND relay.

- * Too much voltage
- * Too much current (switching or carrying)
- * V/C spiking from inductive loading
- * Accidental AC operation
- * Exceeding operational rate
- * Exceeding expected lifetime
- * Connection confusion

Those are the reasons for using an external SEND relay.

3.5.6 *My SEND relay seems to be stuck, what do I do?*

Ultimately, you'll have to replace it, either yourself or via Icom service.

It is possible (battle field repair) to free the contacts by tapping the relay till it frees; but YMMV! Actually, it takes a fair amount of disassembly to access the relay, and this solution is temporary at best.

3.5.7 *Where can I get an external switching relay?*

You have several to choose from:

Ameritron ARS 702
Ameritron ARB 704
MFJ ARB-702-I
MFJ ARB-704
W2ENY Amplifier Interface
Yaesu FRB-757

Users of older amplifiers (like the Heathkit SB-200) will want to check out the "soft key" modules from:

<http://www.harbagelectronics.com/>

or a similar product, the AmpKeyer, at:

<http://www.theheathkitshop.com/ampkeyer.html>

Heil Sound makes a foot switch that can control both PTT and amplifier switching, in the correct sequence.

<http://www.heilsound.com/FS-2-Dual-Footswitch.htm>

KD9SV has a "Front-End-Saver" switchers that can handle extra antennas along with the amplifier.

<http://www.qsl.net/icom/download/fes.pdf>
<http://johnjeanantiqueradio.com/gary.htm>

You could build a very simple solid-state switcher like:

<http://www.qsl.net/icom/ampcontrol.html>
<http://www.qsl.net/dxlab/Amp%20Control%20Circuit.jpg>

3.5.8 Can't I just use the ACC port to key my amp?

An Icom IC-PW1? Yes. Any other amp? Not directly.

First off, the signal from the ACC ports is from an internal transistor and will only handle a miniscule load. An external switching circuit will be required.

The SEND jack (RCA phono connector) on the back of the rig is relay operated and is output only. However, the HSEND and VSEND signals that are available from ACC1-pin-3, ACC2-pin-3, ACC2-pin6, and MIC-pin-5 are all bi-directional. These leads go to ground through a transistor when the rig transmits. Actively grounding these leads will put the radio in the transmit mode.

You'll almost certainly need a solid-state isolation circuit of some sort for this to work correctly.

3.5.9 How do I build my own SEND relay isolation circuit/relay?

Your design will be dominated by several basic considerations: the voltage/load/polarity requirements of your amplifier, your choice of SEND jack keying or ACC port keying, and your choice of relay or solid state switching.

The send relay in the IC-746 (and others) closes 10 to 11 milliseconds before the start of the RF and opens about 7 milliseconds after the end of the RF. If you use a relay between the rig and the amp it had BETTER BE FAST. The relay in the amp needs to be closed before the start of the RF. This means the amp relay AND your intermediate relay together must be faster than 10 msec.

In general, solid-state systems tend to switch faster than mechanical systems. However, the relay based systems tend to be easier to design/build and are more versatile.

The line used in the ACC port for this is a bi-directional signal; it does both SEND and PTT functions. You'll need to account for that in your design.

One example of a relay based design, complete with suppressor diode, bypass capacitor, and limiting resistor can be found at:

<http://www.qsl.net/kk5dr/IcomKeyInterface.html>

Rumor has it that Matt will even build it for you; for a fee, of course. But then, you wouldn't have built your own, would you?

One example of a solid-state design (originally intended for a Kenwood, but easily adapted to an Icom) can be found at:

<http://www.qsl.net/k0bx/amp.html>

Another example is here:

<http://www.k6xx.com/radio/ic706amp.pdf>

And yet another example:

<http://www.yccc.org/Articles/AL1200relay.html>

3.5.10 Why do I get IC-746 birdies when I turn on my IC-2KL?

The IC-2KL is at fault, not the IC-746. A noisy, 12 volt switching supply within the IC-2KL causes the problem.

The supply is in a small, shielded box on the top of the chassis, behind the meter. Cleaning and tightening the metal box and covers will help. Additionally, Icom recommends changing out leaky bypass and filter capacitors.

3.5.11 How do I hook up a Yaesu Quadra (VL-1000) amp to an IC-746?

The RF, ALC, and SEND connections are pretty straightforward. The only truly tricky part is getting the band select data from the IC-746 to the VL-1000. Fortunately, AB4OJ (Adam) has already forged the way. The details are at:

<http://www.qsl.net/ab4oj/quadra/interface.html>

He did all of this for the IC-756-PRO-II, but all of Icom's modern transceivers use the exact same ACC port interfacing, so you should be all set now.

3.6 TNC

3.6.1 *How do I hook up a TNC to the IC-746?*

Check out the wiring diagrams available at:

<http://www.packetradio.com/tnc-to-radio.htm>

4 IF Filters

4.1 How many optional IF filters can I install into the IC-746?

There are two (2) slots for optional filters in the 9Mhz IF, and one (1) slot for an optional filter in the 455Khz IF.

4.2 What optional IF filters are available for the IC-746?

Available filters for the 9Mhz IF include:

Filter	IF	Bandwidth	SF	Typical Use
Inrad 121	9 Mhz	250 hz	2.2	CW narrow
Icom FL-101	9 Mhz	250 hz	3.0	CW narrow
Icom FL-232	9 Mhz	350 hz	2.8	CW / RTTY narrow
Inrad 111	9 Mhz	400 hz	2.3	CW / RTTY narrow
Icom FL-100	9 Mhz	500 hz	2.5	CW / RTTY narrow
Inrad 320	9 Mhz	1,800 hz	1.5	SSB
Icom FL-223	9 Mhz	1,900 hz	1.9	SSB narrow
Inrad 110	9 Mhz	2,100 hz	1.5	SSB
Inrad 123	9 Mhz	2,800 hz	1.5	SSB wide
Icom FL-103	9 Mhz	2,800 hz	1.8	SSB wide
Inrad 306	455 Khz	125 hz	2.1	CW narrow (might not fit)
Inrad 122	455 Khz	250 hz	1.8	CW narrow
Icom FL-53A	455 Khz	250 hz	1.9	CW narrow
Inrad 116	455 Khz	400 hz	1.7	CW
Icom FL-52A	455 Khz	500 hz	2.0	CW / RTTY narrow
Inrad 322	455 Khz	1,800 hz	1.5	SSB narrow
Icom FL-222	455 Khz	1,800 hz	1.7	SSB narrow
Inrad 314	455 Khz	2,100 hz	1.5	SSB
Inrad 109	455 Khz	2,400 hz	1.6	SSB
Icom FL-44A	455 Khz	2,400 hz	1.75	SSB
Icom FL-96	455 Khz	2,800 hz	2.0	SSB wide
Inrad 124	455 Khz	2,800 hz	?	SSB wide
Icom FL-257	455 Khz	3,300 hz	?	SSB wide

Notes:

The above specifications come from several sources, so they might not be directly comparable. Also, there are always variations from one manufacturing lot to another. Use these figures only as a guide.

The Inrad 306 is listed on their WWW site, and is electrically compatible, but might not fit in the available socket.

The Icom crystal filters with an "A" suffix (FL-44A, FL-52A, FL-53A) all have 6mm lower case heights than the equivalent filters without the "A". Icom calls them "low profile". They are electrically identical to the taller filters. Nobody knows if there is enough clearance to install one of the larger filters into an IC-746.

There are apparently TWO slightly different FL-44A filters. The earlier model has a slightly wider bandwidth and steeper skirts than the later model. No word yet on how to tell them apart.

While not an optional filter, W2ENY has a kit to modify the IC-746 by replacing either the stock 9Khz or 15Khz wide internal filters with a 6Khz wide filter. See the "mod" question of the FAQ for more details.

4.3 Which optional IF filters should I buy?

Better to ask, "Why would I even need filters?"

Quite possibly, you'll won't need any optional filters. Use the Twin PassBand Tuning (TPBT) to dynamically adjust your IF bandwidth first. Properly used, TPBT can give you nearly any bandwidth you want. You may decide that you don't need any anything else.

There are over a thousand possible combinations of optional filters (1,539 at the last count). Most of them will make sense (i.e. be useful) to someone, somewhere. As it is a matter of style and situation, ultimately, the choice will be up to you.

We've broken up this issue into several questions, each targeting a more specific issue or problem. Short of writing a book, it is the only hope of providing any useful answers.

At the end of this section, we've listed some popular combinations. Don't use a filter combination just because it's popular. Optional filters could total \$500 or more. Understand what and WHY you're buying to make sure you get your money's worth.

4.4 What is an IF filter's "bandwidth"?

4.5 What is an IF filter's "shape factor"?

Also called "passband", a filter's bandwidth is a measure of how wide a signal will pass thru the filter. For IF filters, this is typically measured as the span between the filter's -6db points. (Some folks measure bandwidth at the -3db points. Pay careful attention to the specifications when comparing filters)

"Shape factor" tries to represent steepness of the filter's attenuation curve. Typically defined as the ratio of the -60db passband to the -6db passband (bandwidth). The perfect shape factor of 1.0 is unobtainable. Shape factors of 2.0 or less are considered excellent.

This is one of those situations where a picture is worth a thousand words. A good look at the spectral response curve of a typical filter will make these terms clearer.

Inrad publishes basic performance curves of most of their filters on-line. An example of a typical curve is:

<http://www.qth.com/INRAD/graphs/116.gif>

AB4OJ has a complete set of passband curves for Icom's filters on his WWW site at:

<http://www.qsl.net/ab4oj/icom/filters/filters.html>

Several companies have good on-line treatments describing basic filter characteristics, complete with diagrams.

Corning Frequency Control has a very concise page styled in a glossary format at:

<http://www.ofc.com/filters/definitions.html>

(site not responding Jan-2002)

Vectron International also has a nice on-line treatment of filter characteristics at:

<http://www.vectron.com/products/xtal/filter.htm - definition>

The folks at Piezo Technology Inc. describe filter characteristics with attenuation curves.

http://www.piezotech.com/Technical_Information/techindex.htm

4.6 Why do filter "bandwidth" or "shape factor" matter?

Narrower bandwidths reject more noise and improve sensitivity. Wider bandwidths provide better fidelity.

Narrower bandwidths also reduce the number of simultaneous signals the rig can "hear". This reduces the AGC pumping action caused by nearby signals, particularly important for CW and digital modes.

Smaller (tighter) shape factors reject more noise and improve selectivity. Larger (wider) shape factors generate fewer problems/complaints with fidelity or ringing.

4.7 What is considered to be a narrow filter?

In the context of (and for the purposes of) this FAQ, a narrow filter is any filter that has a smaller bandwidth than the stock 2.4Khz wide filters. However, most texts will describe a filter as being narrow if its bandwidth is smaller than that of the desired signal.

4.8 What are narrow IF filters used for?

Usually, narrow filters are used to reject unwanted signals or noise. The narrower the bandwidth, the less noise there will be and the better the sensitivity. You can lose part of the desired signal in the process, but that may be preferable to the interference you're trying to reject.

4.9 Can an IF filter be too narrow?

Yes, an IF filter can be too narrow, but sometimes, that can actually work to your advantage. We'll describe only a few specific situations as examples.

When the IF filter's bandwidth is less than the bandwidth of the desired signal, then part of the signal will be rejected. This degrades the fidelity (quality) of the received signal. In phone modes, the fidelity loss is often mistakenly perceived or described by operators as "distortion".

Fortunately, the inherent information redundancy of human speech allows it to be readable even when an overly narrow filter has rejected part of the desired signal. That's where our advantage comes from.

One form of interference is when a nearby signal overlaps your desired signal; as in an overcrowded band. Rejecting the interfering signal necessarily rejects part of the desired signal as well. Thus, the filter is too narrow to allow all of the desired signal to come through, but it is narrow enough to reject the interference. While the result is "distorted" in comparison to a clean signal, it is still more readable than if you left the interference there.

Another example would involve CW or PSK31. The more narrow the filter is, the less the interference and noise. In these modes, it's almost impossible for a filter to be narrow enough to actually reject part of the desired signal, as in the previous phone example. Instead, when a CW/PSK31 filter gets too narrow, you start to experience the auditory equivalent of tunnel vision. This can make it difficult to scan around for signals.

One of the handy things about TPBT is that you can narrow your effective IF filtering bandwidth at any time.

4.10 What's the difference between IF filters from Inrad vs. Icom?

Inrad filters tend to have a superior shape factor to Icom's (smaller numbers are better) as well as deeper stopbands. They also tend to be cheaper.

When dealing with adjacent channel interference, the filter shape (depth and slope of the attenuation curve) is generally the prime factor. Inrad filters tend to outperform the Icom filters for this application.

For example, the stock Icom filter in the 455Khz IF has a -6db bandwidth of 2.4Khz and a -60db bandwidth of about 5Khz. That gives it a shape factor of approximately 2.1. The comparable filter from Inrad has a shape factor of 1.6, a -6db bandwidth of 2.4Khz and a -60db bandwidth of 3.8Khz.

This all means that the Inrad filter has a steeper attenuation curve, resulting in better extraneous signal rejection and improved selectivity.

The Inrad filters tend to have greater ultimate attenuation than the Icom counterparts. Thus, Inrad filters tend to do a better job of adjacent signal rejection than Icom's filters.

However, while the 455Khz Inrad filters are drop-in replacements for the Icom counterparts, the 9Mhz filters are not. They need a short piece of coax and a connector to wired up to the filter first. The adapting connector plugs into the filter slot, thus alleviating any mods to the

radio itself. Reported assembly times range from 1-4 hours per filter, depending upon the skill and care of the installer.

Finally, some claim that there is an insertion loss to the Inrad filters vs. the Icom filters. However, it's been demonstrated that dropping the noise level also drops the S-meter reading, possibly accounting for the reports. Bench tests do not show any insertion loss. Your ears may vary.

eHam.net has several user reviews on Inrad crystal filters at:

<http://www.eham.net/reviews/detail/1499>

4.11 Which IF should I put an optional filter into?

Realistically, the performance differences between using filters in the 9Mhz IF vs. the 455Khz IF are fairly small and will probably go unnoticed in normal operation.

Most people make this decision based upon slot availability and filter cost.

4.12 What's different between IF filters for 9Mhz vs. 455Khz?

455Khz IF filters tend to have superior performance characteristics while 9Mhz IF filters tend to be less expensive.

There are other differences (filter blow-by, ultimate rejection, earlier roofing, etc...), but usually it all comes down to cost. When money is no object, you'll want to use one of each. On a tight budget, you'll do fine with whatever you can afford.

4.13 What are the 9Mhz IF filters best for?

When dealing with interference from nearby signals, the sooner you reject the unwanted signals from your RF chain, the better. So a single narrow IF filter in a 9Mhz slot will sometimes outperform a single filter in a 455Khz slot.

4.14 What are the 455Khz IF filters best for?

455KHz filters tend to have superior shape factors, which seem to do a better job of eliminating background noise and allow tighter adjacent channel rejection. So a single narrow IF filter in the 455KHz slot will sometimes outperform a single filter in a 9MHz slot.

4.15 How do I get the best results from TPBT?

TPBT works best when the 9Mhz and 455Khz IF filters have closely matching bandwidths. Non-matching bandwidths will still work, but are less intuitive, which can cause confusion.

There are several techniques to using TPBT. The one described below has the virtue of simplicity.

Starting with both filters in their center, detented, position (widest effective bandwidth), and tune in your desired signal as accurately as possible.

Grasping both IF shift knobs simultaneously, simply turn and adjust for the best sound. If you have a nearby, interfering signal, then you'll probably have the best results shifting your bandpass away from it.

Now, adjust just the 455Khz IF shift (the inner knob) in the opposite direction for the best sound.

There's a whole document describing the theory and mechanics behind TPBT at:

http://groups.yahoo.com/group/IC746/files/ic746_tpbt.txt

4.16 How do I configure the IC-746 to use an optional filter?

After you've installed a filter, you need to tell the radio about it. Using the SET menu, tell the radio which filter you've installed (by Icom part number) and which slot it is in. Then, hold in the FILTER button for two seconds to bring up the filter selector. Cycle through your available filters by mode and by wide/narrow until everything is set up the way you want.

See the operator's manual for details.

4.17 How do I configure the IC-746 to use a non-Icom filter?

You have to lie to the rig.

All of the IC-746 filter settings are on the basis of Icom part numbers. (This is supposed to make things easier for new operators.) Just tell the rig you've installed the Icom crystal that most closely matches the one you're actually using.

Lying to the rig does have a side effect.

The 746 cannot actually shift the IF filters' passbands. Instead, the 746 shifts the local oscillator frequencies of the 2nd and 3rd IF stages to shift the signal back or forth, aligning the edge of the desired signal with the computed edge of the filter's passband.

Small lies generate small effects, like when you tell the rig that a 2.1Khz wide filter is actually 1.9Khz wide, yielding a 100hz offset in the control. Larger lies generate larger effects, like when you tell the rig that a 400hz filter is actually 2.4 Khz wide, yielding a 1,000hz offset in the TPBT control.

4.18 How do I use a CW filter in SSB mode to receive PSK31?

Icom took their ease of use one step further, and programmed the rig to prevent the use of a CW filter while in SSB mode; probably to prevent what they considered to be a foolish user error. They didn't know about PSK31 at that time. So again, you lie to the rig during setup, telling it that the crystal is wider so that the rig will allow you to select it for SSB use.

4.19 Why is there only one optional 455Khz IF filter slot?

Nobody knows for sure, but the most popular speculation is that it made the radio cheaper.

4.20 Any tips on installing 9Mhz Inrad filters?

Neatness counts. Good soldering skills are a must. Most of the hams who have installed one report that it was more time consuming than they expected, but nothing they couldn't handle.

KE5DC says,

"Inrad also ships two socket pins that look like they are to be used for the filter. This doesn't work, as with the pins on the filter, the filter won't fit in between the case and the fan. Solder the leads etc. directly on the filter pins and then trim the pins to prevent grounding. My first attempt the pins had poked through the electrical tape and grounded to the case. It initially seemed like the filter was more effective than it should have been. Some playing around with the filter settings while listening to a decent signal narrowed down the problem to the 9MHz filter, and I just redid it and it worked."

4.21 Where do I install a 2nd Inrad 9Mhz IF filter?

According to K7ZL, the place Inrad tells you to put the first filter is way over on one side in a little opening next to a fan, and that works fine. But he has found a second location. When you have the rig opened, if you go on a line from the 9 Mhz filters, then to the 455 Khz filters, and keep on going towards the front panel, you will see a square metal plate on the circuit board. He mounted his second filter on top of the metal plate, on its side, and it seems to work fine.

However, KE5DC reports that is very difficult to prevent the cover from coming into contact with the filter. One could mistakenly force the cover closed; putting stress on the circuit board causing failure at some point in the future.

G0HDB has installed an InRad filter this way and can confirm KE5DC's comment about the cover pressing on the filter and thus stressing the circuit board. He overcame this by slightly deforming the cover to make it clear the filter; the deformation was done (very carefully!) using the rubber-coated handle of a hammer! It only needs a small amount of extra clearance so the deformation (a very slight bulge in the cover) is barely visible - if you didn't know it's there you'd probably never notice it

4.22 Where can I find more information on filter characteristics?

Here are a few places on the WWW where you can find more information on filter characteristics:

<http://www.qsl.net/icom/filters.html>

<http://www.qth.com/INRAD/IC-756.HTM>

<http://www.qsl.net/ab4oj/icom/filters/filters.html>

<http://www.qsl.net/ab4oj/icom/passband/passband.html>

http://www.icomclassic.com/tech_data/icom_filter_rev_a.xls

4.23 What are some popular filter combinations?

"Popular" does not necessarily equal "best". Don't do something just because it's popular. Read the above material so that you can make an informed choice.

For example, one of the "best" optional filters for an IC-746 is a 2.4Khz wide crystal filter for the 455Khz IF (either the Icom FL-44A or the Inrad 109). The superior characteristics of these filters over the stock ceramic filter probably improve every one of the important receiver specs. However, the filter is unpopular. Most hams simply have trouble justifying \$100-200 for a filter "they already have" (the stock filter has the same bandwidth).

Given that caveat, here are some popular filter combinations you might want to ponder.

- None
- Single 500hz wide CW filter in either IF
- Dual 500hz wide CW filters, one in each IF
- Single narrow SSB filter in either IF
- Dual narrow SSB filters, one in either IF
- One wide CW and one narrow SSB filter at 9Mhz IF

Icom vs. Inrad? 455Khz vs. 9Mhz? Mostly a matter of preference (read above) and probably not as important as you think, otherwise, you need to read the more detailed material above.

5 Computer Control

5.1 *How do I wire the IC-746 up for computer control?*

5.2 *What cables do I need?*

5.3 *What are CT-17, OPC-478, OPC-662 all about?*

The IC-746 is computer controllable through a serial interface, but it is not RS-232. This is both good and bad. Bad, because you can't just plug it straight into your computer (wrong voltages, etc...). Good, because you can control four separate rigs with the same serial line. Therefore, to connect the IC-746 to a computer requires some interfacing. Icom made three: the CT-17, OPC-478, and OPC-662.

The CT-17 is the full boat. Versatile, it will allow 4 rigs to be controlled by a single RS-232 serial line. It's also the most expensive option and requires external power.

If all you want to do is connect up a single rig, then Icom's WWW site lists the OPC-662 remote PC control cable as the official part. If you can find it, then great. Most people can't. Instead, many hams have successfully used the OPC-478 PC cloning cable. It's less than half the cost of the CT-17. However, it is very short (1 ft ?) and will require a 1/8 inch stereo to mono plug adapter for use with the IC-746.

When you buy the RS-746 remote control software from ICOM, it comes with a single rig cable (OPC-662 or OPC-478?).

W2ENY sells a complete CT-17 clone and a single rig cable. They're both more complete package than Icom's, coming with cables and software resources on a CD-ROM. They're also cheaper. You can find out more at:

<http://www.geocities.com/w2eny/civ/>
http://www.geocities.com/w2eny/icom_cable/

You could purchase the nearly universal rig interface, the RigBlaster, from the folks at West Mountain Radio. It does a lot more than simply computer control, and is adaptable to other manufacturers (for a price).

<http://www.westmountainradio.com/>

The Raymond Sarrio Company also make transceiver to computer interfaces:

<http://www.sarrio.com/sarrio/w1gee.html>

There's really not that much circuitry in "simple" interface cables, and many have homebrewed them for as little as \$10. Supposedly, the November 2000 issue of QST has a suitable design (with feedback in the January 2001 issue). On-line circuit diagrams based on the QST article appear at:

http://www.ambersoft.com/Amateur_Radio/Icom_Interface.jpg

and

http://www.qsl.net/civ_commander/interface.jpg

KD6UU posted detailed schematics and instructions on eham.net:

<http://www.eham.net/articles/1588>

and then wrote an excellent updated follow-up article at:

<http://www.qsl.net/kd6uu/icomci.html>

Designs have been published in both QST and CQ magazines.

"Everything You Always Wanted to Know About Hardware For Computer-Controlling Modern Radios"

Blackburn, Wallace, AA8DX
February, 1993, QST, p.37

"A Low-Cost PC Interface for ICOM Radios"

Thompson, Nigel, KG7SG
July, 1992, QST, p.37

Far Circuits has some of the required PC boards at:

<http://www.farcircuits.net/>

The actual design of the interface circuit is subject to debate (as the above link will make clear). Several alternative designs (along with a wealth of related information) are available from DF4OR's WWW site at:

<http://www.plicht.de/ekki/civ/>

A few other sources for CT-17 circuit information are:

[http://www.seed-solutions.com/gregordy/Amateur Radio/Experimentation/CIVInterface.htm](http://www.seed-solutions.com/gregordy/Amateur%20Radio/Experimentation/CIVInterface.htm)

<http://www.oz1eqc.dk/Downloads.htm>

<http://www.g3vgr.co.uk/civ.htm>

The OZ1EQC version of the circuit allows the use of the same COM port for both CT-17 control and RTS style keyer control. The software configuration implications are left as a puzzle for the reader.

When building the G3VGR version, AD6ZU makes the following observations:

I found that the G3VGR interface to be quite easy to build inside the DB-9 shell. The parts are cheap and it's quite tolerant to using components not listed on the schematics. I used 2N3904's instead of 2N2222's because they were what I had. I also used 5.1K resistors instead of 4.7K and had no problems with the interface. I've built about a half dozen so far and the suggestions I have for this interface are:

Start with the shortest connections (the shorting of the pins).

Imagine working from the connector toward the back of the shell. This makes for a much neater layout than randomly building the circuit "ugly style". You can practice by building your first interface that way since the parts are so cheap it's easy to build another one.

Physically stack the two transistors atop each other with the two emitters twisted together. This helps to keep the volume down.

A little heat shrink tubing may help here and there, but use it very sparingly; it adds volume and a smart layout really doesn't require any.

Use a highlighter to trace out the connections you've made. It's easy to get mixed up as to which connection you've made and which ones you haven't.

Be sure to strain relief the cable in the shell. An inadvertent tug on the cable can pull a connection loose or cause a short circuit (nothing will "burn out", you'll just lose the communications and start pulling your hair out).

When you complete the interface, if it doesn't work, recheck your connections and follow the schematic again. The design REALLY DOES WORK. Most likely, there was a mistake in the soldering.

You can also purchase many renditions of these hardware interfaces from a variety of sources:

Universal RS232 Serial Interface for Icom/Yaesu

<http://www.butel.nl/icomr2/icom11.html>

K1NU ICOM Computer Control Interface

<http://home.att.net/~k1nu/k1nu/Products/>

RTS-01 Computer Interface cable for Icom HF Radios

http://rtsars.com/othercables_template.cfm
<http://www.sarrio.com/sarrio/wlgee.html>

5.4 Do I need a special cable to connect a CT-17 to an IC-746?

No - the cable is a simple 2 wire cable with a 1/8" miniature phone jack on each end. When homebrewing, some folks don't even bother to shield the cable and just use a twisted pair.

5.5 What is the control protocol for the IC-746?

5.6 What is CI-V?

CI-V is the control protocol used by ICOM for remote PC control of their equipment.

This feature was originally used to enable a separate transmitter and receiver to act as a transceiver when interconnected via the CI-V bus (the receiver acts as a "slave" to the transmitter's QSY and mode-change reports) and for external amplifier control. It was only natural to adapt it to computer control.

The basics of the protocol are documented in the IC-746 Instruction Manual on pages 74-75. However, most people will prefer the documentation available from DF4OR's WWW site at:

<http://www.plicht.de/ekki/civ/>

or the documentation that comes shipped with W2ENY's control cables:

<http://www.geocities.com/w2eny/civ/>
http://www.geocities.com/w2eny/icom_cable/

W7FG Vintage Manuals has listings in their catalog for both the CT-17 Level Converter and for the CI-V Communications Interface on their WWW site at:

<http://www.w7fg.com/>

5.7 What is the CI-V address of the IC-746?

The CI-V address of the 746 is \$56 (hexadecimal).

5.8 What computer software is available?

5.9 Where can I get computer software and upgrades?

There are several choices (compromises?) available. On one end of the spectrum, we have programs that replicate nearly all of the IC-746 controls on the computer. On the other end, there are programs that do computer assisted contact and contest logging.

There is a fairly comprehensive listing of CI-V compatible software on DF4OR's WWW site at:

<http://www.plicht.de/ekki/civ/>

We'll mention some of the available software options below. User reviews for some of the below software can be found at:

<http://www.eham.net/reviews/detail/1499>
<http://www.qrz.com/search.pl?topic=reviews>

Icom RS-746 software

Icom SELLS a program called RS-746; buying it is certainly the path of least resistance. It is available through the usual retail channels. It comes complete with both software and the necessary cabling (OPC-662?). Many people describe it as a thing of beauty. (Of course, beauty only runs skin deep.)

A description of the software can be found at:

<http://www.icomamerica.com/amateur/hf/746soft.html>

To quote Icom's own support FAQ (circa May 2001):

Q: Where can I download the ICOM PC programming (or cloning) software?

A: The ICOM programming software is not freeware, and is not available for download on our Web site, or anywhere else on the Internet. It must be purchased either from an authorized Icom America dealer, or direct from ICOM. RT Systems also develops programming software for ICOM radios.

Ray (the product manager at the 2001 Hamvention) was very firm on this issue. They take a dim view of the pirated copies available on the internet.

IC-746 FAQ

Last word we know of (January 2001), Icom had no plans to update/fix/enhance the RS-746 software.

RT Systems software

OK, so Icom refers us to RT Systems at:

<http://www.rtsars.com/>

However, as of May 2001, RT Systems does not have a 746 control program. They told N8AVX (in February 2001) that they had no plans to do so either.

Kingsmith Software

Kingsmith Software is developing control software for the IC-746 (RATS IC-746), but as of May 2001, it wasn't available yet. More information is available at their WWW site at:

<http://www.kingsmith-software.com/>

W2ENY

W2ENY ships a CD-ROM with lots of software and documentation along with the PC to rig interface cables he sells. Many of the packages listed here are also on his disk.

<http://www.geocities.com/w2eny/civ/>
http://www.geocities.com/w2eny/icom_cable/

RadioComm

Arachnophilia has several programs: RadioComm, IcomControl, and EasyTuner (among others). Check out the download section on their WWW site is at:

<http://www.arachnoid.com/>

YP Log

Tony Field (VE6YP) makes a radio control and logging program called YPLOG that can control up to 4 rigs at a time and supports logging and contesting. His WWW site is at:

<http://members.shaw.ca/ve6yp/>

TRX Manager

Some say that TRX Manager by F6DEX has more features than the original radios. More info can be found at:

<http://www.trx-manager.com/>
<http://www.hosenose.com/trx-manager/>

XMLOG

The freeware logging software produced by W1ECT also talks directly to the IC-746. You can learn more at either the WWW site:

<http://www.xmlog.com/>

or at the yahoo e-mail group site at:

<http://groups.yahoo.com/group/xmlog>

TR Log

One of TR-Log's claims to fame is that it will run on just about any PC. More details at:

<http://www.qth.com/tr/>

CI-V Commander

A package that integrates well with the DxLab software suite. More details at:

http://www.qsl.net/civ_commander/interface.jpg

IRC

One of IRC's claim to fame is selectable skins. You get to choose what you want your radio to look like, be it IC-746, IC-706, or even a 007 spy watch. More details at:

<http://n9zle.tripod.com/>

ScanCat

Very extensive scanning support, including automatic digital recording to your hard disk,

<http://www.scancat.com/>

Radio Manager

An example of the virtue of simplicity, this shareware from KC5IRJ does a lot with minimal resources.

<http://www.interplaza.com/bensware/rmm32.htm>

<http://www.leader.it/shareware/info/00088.html>

Zakanaka

This (and a logger) was written by K4CY:

<http://www.qsl.net/kc4elo/>

Icom Pro Memory Edit.

Small program that allows editing and organizing all of the memories in any of the 746/756 series, including the CW keyer memories.

<http://www.plicht.de/ekki/software/pme.html>

MixW

<http://tav.kiev.ua/~nick/mixw/mixw.htm>

5.10 Why doesn't computer software update freq when tuning the 746?

CIV Transceiver, when enabled, forces the radio to report its frequency whenever you QSY, and to report its mode whenever you change mode via a front panel button. Make sure you've set this option in the IC-746 if your software supports it.

With CIV Transceiver not enabled, rig control software must periodically "poll" the radio to determine its current frequency and mode. When using this mode, make sure you have set your software's polling rate accordingly.

5.11 How do I wire up the IC-746 for use with PSK31?

The simplest way is to buy an interface. There are several available, some examples are:

BUX CommCo <http://www.buxcommco.com/>

Donner's Digital <http://home.att.net/~n8st/>

West Mountain Radio <http://www.westmountainradio.com/>

Or, you could build an interface. You'll need audio-in, audio-out, and PTT signals. Several DIY plans are available:

<http://www.qsl.net/wm2u/interface.html>

<http://www.qsl.net/wm2u/psk31.html>

<http://www.arrl.org/tis/info/HTML/psk31/index.html>

<http://www.w5bbr.com/soundbd.html>

<http://home.teleport.com/~nb6z/psk31.htm>

http://www.psk31.com/Hook_it_Up/hook_it_up.htm

5.12 Why isn't my computer control working?

There are MANY things that could be wrong. Here are a few of the things you can check:

- Computer's serial port baud rate
- Computer's serial port address
- Interconnect wiring
- Make sure the 746 CI-V address (#28 in the 746 menu) is set for "56h".
- Make sure the 746 CI-V baud rate (#27 in the 746 menu) is set to "AUTO".
- Make sure the 746 CI-V Transceive (#29 in the 746 menu) is set to "ON".
- Make sure the 746 CI-V 731 Mode (#30 in the 746 menu) is set to "OFF".

6 Problems and Clarifications

6.1 *What's that funny rattling noise I hear when I first power on?*

Often, it's the internal antenna tuning unit. The relays make audible clicking/rattling sounds.

6.2 *What's that "click" I hear as I tune across certain frequencies?*

The clicking noise you hear is very likely from the relays for the rig's preselector (the service manual calls them RF filters). At each boundary point, the rig switches in a different RF filter. There are several:

0 - 1.6 Mhz	low pass
1.6 - 2 Mhz	band pass
2 - 4 Mhz	band pass
4 - 8 Mhz	band pass
8 - 11 Mhz	band pass
11 - 15 Mhz	band pass
15 - 22 Mhz	band pass
22 - 30 Mhz	band pass
30 - 50 Mhz	band pass
50 - 54 Mhz	band pass
54 - 60 Mhz	band pass
108-174 Mhz	band pass

Some mistakenly call this the antenna tuner (there is even some component overlap), however, the preselector and tuner serve different purposes and are each switched in and out accordingly.

6.3 *Why doesn't the ALC meter work while adjusting the "mic gain"?*

Despite what the manual says, the ALC meter only works for SSB. It does not work for FM, CW, or RTTY. Nobody knows what (if anything) the ALC meter means on these other modes.

6.4 *Why can't I set numbers into memory names, CW keyer, etc...?*

Use the keypad to enter numbers. The dial only does letters and punctuation.

6.5 ***Why isn't my output power up at 100 watts?***

There are quite a few possibilities. Here are a few that have been discovered over the years.

Low DC supply voltage.

As shipped, the IC-746 really wants a full 13.8 V dc to yield full output power. While the rig can operate at voltages as low as 11 V dc, power starts dropping off as soon as you drop below 13.5 V dc. Check the actual voltage your rig is receiving. You may need to adjust the voltage setting on your power supply.

If your rig isn't getting the voltage you think it should, then check for voltage drops along the power cord as well as across joints, fuses, and connectors. It's possible to lose as much as a half-volt per connection. Solder joints and use high quality connectors where possible.

12 AWG wiring is the minimum, but 10 AWG is better.

Some in-line fuses have had their solder end caps oxidize, thus interfering with current flow and dropping the voltage.

If you absolutely can't get your voltage up (for example, total battery power), then you might consider adjusting the power settings for the RF PAs (there are 4 of them). However, trying to run a full 100w output at the reduced voltage will most likely degrade the quality of your transmitted signal (clipping, IMD, etc...). Most hams decide that 1-2db gains don't justify the crummy signal.

There is one more possible remedy for the low voltage problem. You could get a DC-DC voltage converter. These are also called voltage boosters. Such a device accepts 12Vdc in and yields 13.8Vdc output. There's a price. First, they tend to only be 80-90% efficient, so a 20A draw by the IC-746 can translate to a 25-29 amp draw by the converter. Secondly, commercial units like the Newmar 12-12-35I DC-DC Converter can retail for more than \$900.

There is a more affordable, ham designed and built, voltage booster system from W4RRY that should do the job. Check out:

<http://www.fastq.com/~w4rry/>

You have an IC-746s instead of an IC-746

The 's' variation on the IC-746 is limited to only 10 watts output power to match up with the restrictions of one of the Japanese amateur radio license classes.

Blown Internal Fuse

Check the 5A fuse within the RF power amplifier of the IC746 - reference page 81 of the instruction manual. If this fuse is blown - there will be little to no output (< 10w).

There has even been a case of an intermittent fuse. Outside the rig with a multi-meter, the fuse would test OK. However, replacing the fuse still fixed the problem.

The RF driver transistors may have failed.

The driver stage is common for 2 meters and HF. The two driver transistors (2SC1972) are right under the top cover. You can easily measure the voltage on the basis, or feel the temperature of the 100-ohm basis resistors.

2SC1971 transistors are much cheaper than 2SC1972 transistors (and are used in the common pre-driver), but can only provide half the power (50 watts). If your rig is used then it's possible, though not likely, that a previous owner did a repair using the wrong part.

Replacing these parts are not for the faint of heart. Have the service manual on hand and be prepared to readjust/realign everything afterwards. Don't try to replace the transistors without a safety resistor in the +13 volts; otherwise they will be gone before you notice. After you properly adjust of the bias current, you can remove the safety resistor.

The RF power amplifier transistors may have failed.

In the IC-746, there are separate PA's for HF/6m and 2m. Each PA uses a matched pair of 2SC2694's. If you've lost power from one but not the other, then this is a strong possibility.

As with the driver transistors, have the service manual on hand and be prepared to readjust/realign everything afterwards.

Blown Output Detector Diodes.

Blown diodes in the SWR detector can fool the power-fold-back circuitry into cutting back power unnecessarily. The blown diodes will be shorted. This can easily happen by playing around with an external antenna tuner in conjunction with the internal ATU.

Your ALC circuit may have failed.

A failure within the ALC circuitry can cause a drop off in power.

SWR Foldback

The IC-746 is very sensitive to any sort of SWR mismatch. Even a mild mismatch of 1.3:1 can have a significant impact. In fact, a few hams have even encountered this when feeding amplifiers. Turning on the internal ATU is a simple fix.

Confused Meter Readings

When checking RF power output, you should always use CW. It is normal for the output meter to read considerably lower during voice transmissions than during CW transmissions. The average male voice has a peak to average power ratio of about 14 dB, which means that an indicated average output of 10-20 watts is about right for 100 watts PEP.

Processed speech will have a high average value and the meter will read higher, of course. A loud tone or whistle will read higher yet. A lot depends upon the characteristics of the meter. Some meters will follow voice peaks better than others.

IC-746 FAQ

Try setting option 10 "Meter Peak Hold" to give you a better idea of your peak power output. Or better yet, monitor your output on a scope with a standard two-tone test. There are excellent instructions on using an oscilloscope to make PEP measurements at:

<http://www.qsl.net/ab4oj/peptest.html>

If you conclude that you have an audio feed level problem, then try increasing the microphone gain or turning on some compression.

CW Break-In Turned off

When the rig is receiving, and Break-In operation is turned off; the rig will generate a sidetone even though it is not transmitting. While this is good for tuning and CW practice, it can fool you into thinking that there is no RF output. Check your settings and make sure you really are transmitting (perhaps switch to RTTY mode and see if you get any output).

Internal adjustments set a little low

Apparently, many IC-746 rigs were factory adjusted with lower RF outputs of about 80-90 watts. If the fractional db of power is important, check out the power adjustment instructions in the "mod" section of this document.

The service manual specifies setting R989 for 100W on 14100khz, R991 for 100W on 51000khz and R993 for 100w on 145000khz, mode set to RTTY, rf power pot set fully c/wise.(pots on "main unit" board - the board with the filters on.) That's three specific adjustments to cover all 11 bands. Check the power output on 20m first. Contrary to what the instruction manual implies, the alignment does not specify 100w on all bands.

Expect higher power on lower HF bands and lower power on higher HF bands.

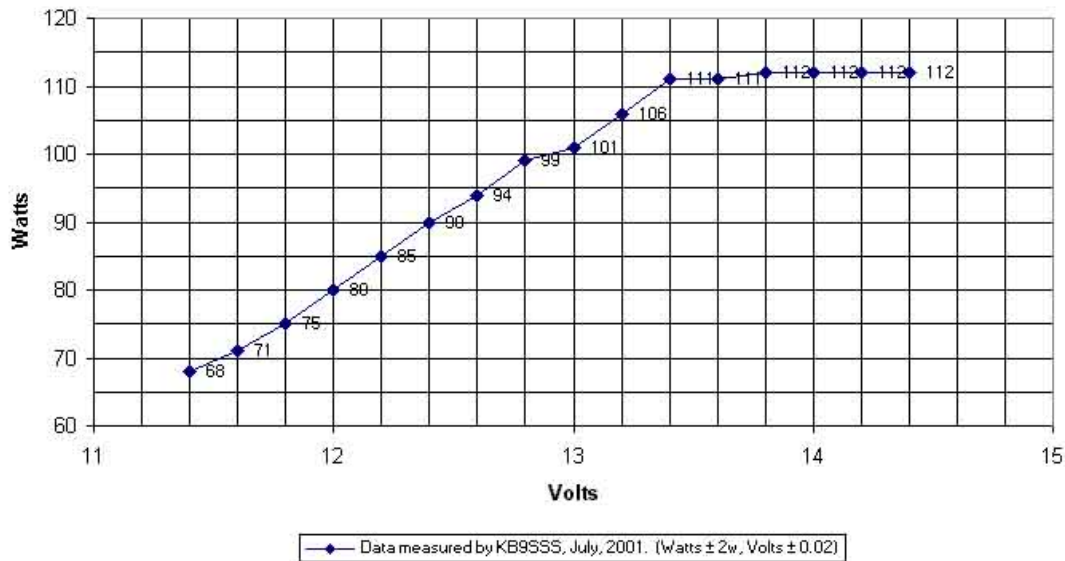
6.6 How low can the IC-746 supply voltage be?

Well, page 69 of the Instruction manual says the supply voltage can range from 12 - 15 Vdc. Whereas, page 84 says 13.8 Vdc +/- 15%, which is about 11.7 - 15.8 Vdc.

Despite what the manual says, some IC-746's run at voltages as low as 11.0 V dc. The highest "drop-out" voltage reported so far has been 11.4 V dc.

Be aware, that while the IC-746 will operate at lower voltages, it does so at reduced power. The power roll off starts at about 13.4 V dc, as evidenced from the measurements shown at:

IC-746 Power Output vs Input Voltage



The above chart is available on the WWW at:

<http://groups.yahoo.com/group/IC746/files/IC746-Power.jpg>

6.7 *The backlight in my LCD has stopped working. What's wrong?*

Short Answer

Your problem is probably one of the display driver transistors on the S-Logic board behind the display. It will have to be replaced.

There is reason to believe (but no proof) that setting the LCD brightness to HIGH may reduce the failure rate.

Long Answer

Unfortunately, this has become a problem for many 746 rigs, as evidenced by the data collected at:

<http://groups.yahoo.com/group/IC746/database?method=reportRows&tbl=2>

It's not the actual 'lamp' itself, but one of the driver transistors. The lamp is fluorescent, and will probably never wear out. Even if it did, the lamp isn't available as a separate part; it's part of an assembly you need to get from Icom.

Background into problem

There is a DC/AC converter driving the "lamp". Check the S-Logic board for transistors Q301, Q302, Q303, and Q304. Q302 is usually the culprit as it is the voltage/current regulator for the dimmer function. If you have a DC voltage on the collector, which is

variable by the dimmer function on the radio, then this transistor is probably OK. Q303 and Q304 are the next most likely candidates. These 2 transistors are in push-pull configuration to drive the X-former (base is 180deg phase shift by the X-former)

Refer to pages 6-1, 9-1, 10-1, and 11-2 in the "Service Manual" for more details.

Several folks at:

<http://groups.yahoo.com/group/IC746/database?method=reportRows&tbl=2>

have successfully performed these repairs themselves.

OZ5ACI feels that the way the Q302 transistor is mounted is a design flaw. Icom used the cooling fin of the transistor as a soldering point, thus if it gets too hot, the solder might melt. That slowly deteriorates the soldering material resulting in a lost connection and a cooked transistor. He has a feeling that future cooked transistors can be prevented by simply unsoldering the transistor cooling fin to lift it and lengthening the center leg to establish connection at the cooling fins soldering point.

AH6LE counters that if the transistor gets hot enough to melt solder (300 degrees or so), then there are other more serious problems. Most solid-state devices won't survive such temperatures, thus we're seeing the result, not the cause.

The repair

One of the techs at MTS (a company that repairs Icom gear) told K8UT that the repair is not difficult, but he does not recommend it to those without soldering/desoldering experience. The repair involves disemboweling the rig to get the S-logic board out; removing a metal shield that covers the transistors (about six solder connections); and then replacing the surface mount transistor. And, of course, reversing the whole process to put the rig back together again. The part itself is cheap - around \$3.00 (Feb-2002).

If you're tempted to unsolder the control pots from the S-Logic board, stop and think; you're probably doing things the hard way. The affected transistors are on the side of the board facing the front of the radio. More extensive "mechanical" disassembly will eventually gain you access. Start by removing the front panel and work your way back. Page 7-2 of the Service Manual should help.

Icom UK told GW3WSU:

"The transistor (Q302) is available from stock but is a 2SB1201, it is only 47p + carr and vat, but unfortunately is below out <A3>10 minimum order charge. You do not have to unsolder the pots, remove the plastic front panel, then undo the pot fixing nuts from the metal sub-chassis, and it should all just come away. When you come to replace the transistor, its best to remove the screening can, this gives better access to the device. After replacement I would advise you to put a generous drop of heatsink compound across the transistor and spread it over to the metal of the screening can, this will keep the transistor from getting too hot again in the future."

OZ5ACI used an "overkill" transistor from his junk box and had to cut a bit of the cooling fin to make it fit under the shield. The original transistor is not very tall and can be left at an angle so no cutting is needed (or wanted!). He says it's all fairly simple. The only trouble is that the front section of the 746 has to be taken totally apart and getting it back together with

no dust behind the plastic screen is a pain. Get yourself a small can of workshop compressed air or CO2 if you can.

VK4TZL (Glenn) reports:

"The actual repair is relatively easy...assuming that Q302 is the problem. The whole repair took me one hour. Removing the front panel from the radio, by removing 4 screws and the one ribbon connector lets you work on the front panel by itself as an assembly. You can remove the S Logic Board by removing all the large knobs, the tuning knob, the tuning knob friction break and then two ribbon cables from the display board.

On removal of the tin lid on the shielding box housing Q302, it was obvious that this thing was getting HOT. It had unsoldered itself from the pad under the collector, and I think this was the cause of the "flashing" as the collector was left floating. I decided to mount the new transistor vertically, and add a small L shaped brass strip from the collector to the pad on the board, in an attempt to keep it cooler. I removed the tin plate shield to enable this to be done and have some room to solder."

The part

So far, all reports from heftier transistor replacements have been positive.

From page 6-1 of the service manual, we can see that Q302 is a 2SB1201. At one point, the folks at MTS suggested a 2SB1202 as a replacement. Examining the specifications:

<http://www.nedis.com/datasheets/datasemi/2SB/2SB1201.pdf>

<http://www.qsl.net/kb9sss/IC-746/Parts/2SB1201.pdf>

<http://www.nedis.com/datasheets/datasemi/2SB/2SB1202.pdf>

<http://www.qsl.net/kb9sss/IC-746/Parts/2SB1202.pdf>

We can see that the suggested replacement is physically identical to the original part, but with 50% higher current capacity and 25% higher power dissipation. Its switching time is about 10-20% longer (slower), but that should be unimportant for this application.

K8UT has successfully installed a 2SB1202 replacement.

The Transformer

In some cases, the transformer is also fried. Watch out for that when you make your repair, otherwise you'll just blow the transistors again.

Further Analysis & Possible Prevention

WA0KWK observes that we appear to have a DC-AC converter circuit with Q302 operating as a current carrying switch being turned off and on by Q301. (a light dimmer).

When the backlight is dim, the switch gets hotter because it is dissipating the current rather than the backlight. When the backlight gets brighter, more power is required by the display and the transistor has to sink less current by itself.

This leads to the counterintuitive deduction that brighter displays put less strain on the transistor than dimmer displays. Thus, the natural reaction (turning down the display brightness) actually makes the problem worse.

While we can't yet prove the above assertion, data compiled by WA0KWK from voluntary usage reports (brightness level, operation time, problems and repair, etc...) would seem to support the theory. The raw data is at:

<http://groups.yahoo.com/group/IC746/database?method=reportRows&tbl=2>

Of course if your 746 is still under warranty, you may want to consider going that route. Either way, you can contact Icom for the parts you need.

Alternate Prevention and Possible Field Repair

AD6ZU (Roy) reports that his 746 exhibited this problem when he shut the power supply off while the 746 was left "on", then turned the power supply back on a while later. Once on, changing the brightness setting would restore the LCD. Furthermore, when he powers down the 746 before shutting off the main power supply, he has no problem.

6.8 *Is there some way to get the Icom-746 to generate DTMF tones?*

No. The IC-746 will not generate DTMF tones.

However, you have some options for generating DTMF tones yourself.

The good news is that Icom's compatibility table shows that the HM-14 DTMF hand microphone will work with the IC-746. It even comes with a handy switch to enable/disable the UP/DN buttons (if only the buttons would work). Remember, you have to press the PTT switch to use the DTMF pad.

The bad news is that the HM-14 is a discontinued item, so availability is limited. Also, as K9HFX discovered, there are apparently two versions of the HM-14. The version without the scan button enable/disable switch did not work for him. More information is needed.

While not listed on Icom's compatibility charts as such, VE2MHF reports that the HM-56A also works, even the scan buttons and 14 DTMF memories. However, beware, as VE4HAY reports that the DTMF pad on the HM-56 will also work with the IC-746, but its scan buttons will not. We have to be careful of the 'exact' model numbers.

Icom confirms that the HM-118T will work with a suitable wired adapter. There is also speculation (but no confirmation) that an HM-95 microphone might also work with a suitably wired adapter. If you succeed with such an experiment, please let us know.

KC2CJW has successfully adapted an Alinco EMS-11 microphone for use on the IC-746. You'll need two cable-mount 8-pin microphone connectors (one female, one male), a couple of inches (maybe a foot) of decent multi-conductor cable, a 470 ohm resistor, and some soldering skills. Paul can provide pin-outs upon request.

Another option is a portable tone dialer, such as one that you could get at any Radio Shack. Just send the tone sequence right through the microphone. Not all such devices give access to the 'A' - 'D' tones, but those tones don't get used much anyway.

Some have suggested wiring a DTMF pad into a microphone cable, much like what you would do for a TNC. However, as yet, nobody has shared any success stories. Far Circuits at:

<http://www.farcircuits.net/dtmf1.htm>

have some circuits that might be adaptable. Perhaps someone could base a design upon the NS TP-5089?

<http://alds.stts.edu/datasheet/DTMF/NS-TP5089.pdf>

<http://www.boondog.com/%5Ctutorials%5Cdtmf%5Cdtmf.htm>

Another approach is to let your nearby PC generate the tones. Those with PSK31 (or equivalent) audio interfaces will find this relatively easy to do. Here are a few of the many DTMF programs for the PC:

<http://www.silverstones.com/DTMFdial.html>

<http://groups.yahoo.com/group/IC746/files/Dial.zip>

6.9 Why don't my "band edge beeps" match the US amateur bands?

Nobody knows what (if anything) the band edge beeps correspond to.

6.10 Can I transmit all the way out to the "band edge beeps"?

Yes, you can transmit all the way out to the beeps. The IC-746, as shipped from the factory, can transmit outside of the amateur radio bands. This has been tested and confirmed on several rigs via dummy loads.

6.11 Can I reprogram the "band edge beeps"?

No, there is no known way to reprogram the band edge beeps. There are no fixes or planned updates from Icom dealing with them.

You can, however, turn them off entirely.

6.12 Do we know anything about the "band edge beeps"?

The band edge beeps generate a lot of discussion and speculation. As of October, 2002, the band edge beeps on all tested rigs (both 746 and 746-PRO) correspond to:

1.8 - 2.0 MHz

3.4 - 4.1 MHz

6.9 - 7.5 MHz

9.9 - 10.5 MHz

13.9 - 14.5 MHz

17.9 - 18.5 MHz

20.9 - 21.5 MHz

24.4 - 25.1 MHz

28.0 - 30.0 MHz

If you know of an ANY rig that differs from this, then please let us know.

Rumor has it that the IC-756-PRO and IC-756-PRO-II have the exact same behavior.

While nobody has figured out what the band edge beeps correspond to, we have been able to rule out several possibilities.

They do not correspond to the amateur radio frequencies in Japan. For that matter, they do not correspond to the ham allocations in any of the IARU regions.

They are not a combination of all available amateur radio from around the world (i.e. a minimal superset). They are much wider than that.

As wide as the band edge beeps are, they do not encompass all of the MARS (Military Affiliated Radio Service) or CAP (Civil Air Patrol) frequencies. To do that still requires a "mod".

The known "TX mods" do not affect the band edge beeps.

Anybody have any other ideas or info?

6.13 How I reset back to factory default settings?

The procedure is listed on page 81 of the Instruction Manual as well as on Icom's WWW site at:

<http://www.icomamerica.com/support/cpureset.html#amateur>

While pushing in [F-INP] and [M-CL], push [POWER] to turn power ON.

6.14 What "birdies" does the IC-746 have?

"Birdies" are spurious signals internal/inherent to the rig itself. They are normally generated by harmonics and/or mixing products of the internal oscillators (IF, VFO, display driver, CPU clock, etc...) that are picked up by one of the RF/IF stages of the rig.

Birdies are usually perceived as silent carriers on AM and FM and as steady tones on SSB and CW; sort of like someone tuning up on that frequency. Thus the perceived frequency of occurrence is affected by your preferred sidetone.

Often, local noise sources can be mistaken for birdies.

True birdies tend to be consistent from rig to rig.

The following frequencies have been submitted as possible birdies. There have not been enough correlated reports yet to confirm these as birdies. More information and reports are needed.

1.955.5 #	10.503	30.002.0 #
1.957	13.991.0 #	50.001
1.981.0 #	13.999.0 #	50.006
3.608	18.078	50.533.0 #
7.008	18.433	144.400
9.468	21.150	
10.106	28.001	

6.15 *How do I adjust the LCD display?*

Page 66 of the Instruction Manual describes how to change both the LCD contrast and the LCD backlight.

- Push MENU to select M2.
- Push button to select LCD.
- Push buttons to select lighting or contrast.
- Turn the tuning knob to adjust value.

6.16 *The Noise Blanker doesn't seem to do any good. What's wrong?*

Probably nothing. Possibly your expectations.

Noise blankers are placed in the IF signal path, and designed to gate/mute/attenuate out impulse noise. Impulse noise is characterized by very sharp pulses (steep rise time and short duration). Such noise is typically a result of ignition spikes and certain types of power-line noise.

A good clue comes from the 746 service manual. The NB adjustment procedure uses square wave pulses 30 mv high and 1 msec long.

Therefore, a NB is not a panacea. Unlike an ANL or DSP, a NB will have little or no effect upon static crashes and/or white noise. Noise generated by power supplies, fluorescent lights, and power inverters are generally unaffected.

The NB works best when impulse noise is strong and the signal is weak; like mobile in a vehicle.

Most hams report that the 746's NB is effective against ignition noise, but not as effective as other rigs they've owned.

Noise blankers are not all that sophisticated, and will try to blank out anything that resembles an impulse; even sharp voice peaks in an audio signal. Sometimes, the NB will generate more noise than it removes.

The IC-746 NB is operating within the first IF, where the passband is about 15 Khz wide. Any impulse like component of a nearby strong signal may activate the NB, again possibly doing more harm than good. Also, strong nearby signals can fool the NB into fluttering the receive audio.

The single best way to deal with impulse noise is to eliminate it at the source. A NB (any NB) is a compromise solution at best.

6.17 How do I get rid of ignition noise?

Someone should write a book on this topic. (Oh wait, someone did, see below) Here are some of the suggestions that have been made in the past.

- Clean the battery contacts
- Run the power leads inside a grounded shield (possibly an old coax braid)
- Add bypass capacitors to chassis at both ends of each power lead (positive and negative).
- Ground the tailpipe to chassis
- Ground the hood to chassis
- Use higher quality plug wires (Magnecor?)
- Use better spark plugs (Platinum is better than resistor) (Iridium is even better)
- Better quality (copper inserts) cap and rotor button
- New radio suppression condenser at coil
- Use PI network noise filter at radio power feed
- Ground the fuel pump and add RF suppression
- Check the tachometer as a noise source
- Add RF chokes to remote head cable (not applicable to the IC-746)
- Put snap-on ferrite beads on the electronic ignition-wiring bundle.
- Ground engine block to chassis

This problem is not specific to the 746; all radios can be afflicted. Covering this topic thoroughly is beyond the scope of this FAQ. For more help/information, try the following:

<http://www.arrl.org/tis/info/rfiignit.html>
<http://www.arrl.org/tis/info/pdf/001qex32.pdf>
<http://www.k2bj.com/Pages/Noise/Intro.htm>
<http://www.qsl.net/ka6wke/>
http://www.realhamradio.com/Ford_F350.htm

or join the "mobile-portable" e-mail list at <http://www.qth.net/>

It turns out that someone DID write a book on this topic: the "ARRL RFI Book". Chapter 16 is devoted to "Automobiles". Check out the description at:

<http://www.arrl.org/catalog/6834/>

6.18 How do I adjust or make the NB work better?

The NB is susceptible to both overload and cross modulation from strong nearby signals. Often, turning off the RF preamp or even turning on the attenuator will improve the performance. Remember, the IC-746 has plenty of gain to spare.

The IC-746 Service Manual does have an adjustment procedure for the NB on page 5-10. Icom Tech Support provided W7GJ with a PDF copy of that page around Jun-25-2001. That PDF file is now available from several places.

<http://www.bigskyspaces.com/w7gj/IC-746.pdf>

<http://groups.yahoo.com/group/IC746/files/IC-746-NB-Adjustment.pdf>

<http://www.qsl.net/kb9sss/IC-746/IC-746-NB-Adjustment.pdf>

6.19 *How do I fix a loose rubber grip from the tuning knob?*

Very few people have had this problem. These are the suggestions people have made to remedy the problem.

- Use a large rubber band
- Use a glue stick
- Use electrical tape
- Use rubber cement
 - beware that RC might deteriorate rubber
 - leave set hole uncovered to allow front panel removal
 - maybe tack just a few places to allow ring removal?

6.20 *Where should I go for repairs?*

There are lots of places you could go. A few of the authorized Icom service/repair centers come highly recommended by other hams:

AVVid

<http://www.avvid.com/>

Email: Clif@avvid.com

AA5SH, Michael
2101 E. Shady Grove Rd.
Irving, Tx. 75060

Phone: (800) 214-5779 9AM-6PM CST Mon.-Fri

Local: (972) 554-6801

KK7TV Communications

<http://www.kk7tv.com/>

Email: info@kk7tv.com

Custom Sound and Video
2350 W. Mission Lane Ste. #7
Phoenix, AZ. 85021

Phone: (888) 767-9997

Local: (602) 371-0555
FAX: (602) 371-0522

Paul Hanson & Associates

Paul Hansen & Associates
2411 Robert Nash Ct.
Tucker, GA. 30084
Phone: (770) 939-1320

Houston Amateur Radio Supply

George
Phone: (281) 355-7373

While not "authorized" by Icom, the following repair shops have excellent reputations, particularly for out-of-warranty repairs or for older equipment.

MTS

<http://www.angelfire.com/biz2/mts/>
Email: mts@plix.com
Malcom Technical Support (MTS)
3617 Deep Lake Boundary Rd.
Colville, WA 99114-9142
Voice: (509) 732-8883
Fax: (509) 732-8884

Burghardt's

<http://www.burghardt-amateur.com/>
Email: hamsales@burghardt-amateur.com
service@burghardt-amateur.com
Burghardt Amateur Center
710 10th Street SW
PO Box 73
Watertown, SD 57201
Voice: (605) 886-7314 9-6 CST
Fax: (605) 886-3444

W6XA

Paul W Hansen (W6XA)
2411 Robert Nash Ct
Tucker GA 30084-3325

Phone: (770) 939-1320

Tim Moes

Email: tcmmoes@yahoo.com

Watertown, SD

RadioWorld

<http://www.radioworld.ca/>

Email: service@radioworld.ca

4335 Steeles Ave W.

Toronto, Ontario

Canada, M3N 1V7

Phone: 416-667-1000

Fax: 416-667-9995

And of course, you could always just run down through the list of authorized dealers at:

<http://www.icomamerica.com/dealers/index2.html>

6.21 How do I fix scratches on the LCD?

Short of replacing it, you might try one of the following suggestions.

- You could try '**Polywatch**' which you might get from a local watchmaker (note: watchmaker not battery-changer!!) It's for restoring plastic watch crystals; works great on them.
- If it is just an abrasion, toothpaste or tooth powder might work or try body polish (not wax) for a car.
- For fine or hairline scratches, you could try a product call '**Everclear**'. Apply with a cotton ball, then remove with a clean cotton ball. There's more info on this product at:

http://www.onecybersquare.com/shopping/everclear/how_to_repair_clear_surfaces.htm

These are only suggestions from people who have had to cope with this problem. **YMMV**.

6.22 What can I do about sticky switches?

KF4YIO(?) cleaned his switches by spraying a LITTLE contact cleaner in the spaces between the switches and the faceplate and that cleared up the problem.

Make sure the spray cleaner will not damage the plastic knobs or face.

6.23 *Why does the S-meter seem low on 2m FM?*

While this is apparently common on many modern multimode rigs, we do not know precisely why. The S-meter sensitivities published in the QST product review did not show a problem on 2m. (6m is a different story, but nobody seems to complain about 6m readings). Likewise, the measured receiver sensitivities do not reveal any problems.

Some dealers blame all this on the wide-band receiver technology, but again, that doesn't really answer the question.

Turning on the preamp will increase the reading.

6.24 *Why is my tuning shaft/knob loose and sloppy?*

If the factory did not tighten the nut that holds the main tuning unit, then, over time, movement may cause the friction screw to crack the faceplate.

This is a hard one to get at.

6.25 *Why is my audio cutting in and out?*

There are several possibilities:

- Check your RF-Gain/Squelch settings, the squelch could be kicking in.
- Check your headphone jack, it may have an intermittent contact causing problems.

7 Modifications

7.1 *What TX/RX "mods" are there for the IC-746?*

"mod" is slang for "modification".

Most people who ask about modifying their radio are looking for ways to make the IC-746 transmit or receive additional non-amateur RF bands. The 746 already has general receive coverage from 0.5 to 60.0Mhz, so no "mod" there.

Modifying the IC-746 to transmit outside of the amateur bands is generally considered to be illegal. There are a few exceptions; like perhaps MARS/CAP, transverter usage, changes/additions to ham bands, etc..., but they can become controversial.

Icom will give you the correct mod for your IC-746 based upon your serial number, providing you give them a copy of your MARS license to prove eligibility. If you let Icom make the mod for you (small fee plus shipping), then the mod will not void your warranty

That said, MARS/CAP/TX/RX modifications for the IC-746 (and many other radios) can be found at:

<http://www.mods.dk/>

Another source for the TX/RX mods is QRZ.COM

<http://www.qrz.com/download/mods-i-k/ic746.txt>

Pay close attention, as there are two distinct mod procedures, which correspond to the differing placement of the programming diodes on the PCB.

7.2 *What other "mods" are there for the IC-746?*

Not all mods are about TX/RX frequencies. Here are some of the others.

Note that none of the following modifications were either provided by or approved by Icom. These all come from fellow hams. Each "mod" exists for a reason, but that reason may not apply to your circumstances.

Use at your own risk.

6Khz wide IF filters

W2ENY has devised a way to replace the stock 15KHz or 9MHz IF filters for AM work with 6KHz filters.

<http://www.geocities.com/w2eny/icom/filter.htm>

N9IRD also talks about this type of mod at:

<http://www.qsl.net/icom/n9ird.html>

Safe 2m TX/RX Sequencing

AH6LE has modified his IC-746 to provide safe sequencing for EME work.

<http://www.ah6le.net/radiomods.html>

Simple CAT interface

OK2WY has a "Simple CAT / programming interface for ICOM RIGs". Rumor has it that he has also designed an in-board step attenuator.

<http://www.qsl.net/ok2wy/projects.htm>

Separate 2m TX/RX Antenna Lines

K7YVZ has proposed a mod to the VHF section to provide separate transmitting and receiving antenna ports. The details can be found at his WWW site:

<http://www.qsl.net/k7yvz/746mod/>

G4YTL describes the same thing at:

<http://www.mods.dk/mods.php3?radio=icom&model=ic-746&selectid=1919 - 1919>

WA2TTP (Steve) reports:

"I did that mod recently and it seems to be working OK. I found a coax jumper in an old Kenwood commercial radio that had the right connector on one end and I installed a BNC flange mount on the other end. I mounted the BNC connector to a bracket on the back of the radio; the bracket is attached with one 8-32 screw and nut through one of the slots on the rear of the radio. The cable passes through the same slot. I put some shrink tubing over the original plug and tucked it out of the way inside the 746. Seems to work fine with my tower top pre-amp and 432 tower top transverter. As with all my antennas I ran the 746 receive line through my patch panel, which makes it easy to disconnect it when not in use. I also measured a 1.5 db improvement in sensitivity by going directly into the receiver board."

Finally, W8FN (Randy) says:

To do this modification, you first need to obtain some of the Icom PC connectors used to make internal RF connections. The female (PC board mount) connector is P/N 93602690 and the male connector is P/N 93602689. About 18 months ago the Icom price was \$1.07 per connector. I ordered six of each, figuring I'd screw up at least one pair figuring out how to attach the coax to them. Icom parts (425-454-7619 option #3) took a phone order and shipped them to me via USPS in just a few days.

The internal connection that needs to be broken in the radio is the HRX line from CTRL unit J2 to RF unit J1. The source (i.e., the RX line from the T/R switch) is on the CTRL unit and the RX input is J1 on the RF unit. With the radio upside down with the cover off, remove the shield covering the left rear compartment on the RF unit. J1 is located near the rear panel right next to the Key jack and just behind a small relay on the board.

Using the Icom PC connector pair and two short lengths of miniature coax, construct two pigtail cable assemblies with a RCA female jack on one end and a male and female PC connector, respectively, on the other. If you are really careful, you can use RG-174 miniature coax, but if possible try to find some RG-188 or similar coax with Teflon

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dielectric. This will make it a lot easier to construct the input and output cables without melting insulation.

The male PC connector is designed for crimp termination, but it can be soldered as well. I just stripped the center conductor of the coax and (carefully) soldered it into the center pin. I made a small pigtail with the braid and tacked it to the top of the shell. Be careful! It's really easy to apply too much heat and displace the center pin. Once the assembly is complete, check it with an ohmmeter to be sure it's not shorted.

The female PC connector is really designed for PC mounting, so it's a bit tricky to install the coax. I took a small piece of #26 bus wire and wrapped it around the ground pins and tack-soldered the shield to this wire. I then encased the junction in heat shrink tubing to immobilize the connection.

Although it's a little close, the ends of the completed assemblies with the PC connectors can be fished through the slots in the rear panel heat sink near the Key jack. The assembly with the female PC connector is the T/R RX antenna output and the assembly with the male PC connector is the RX input. Be sure that you have somehow marked the pigtail assemblies so you know which is.

Once the pigtails are ready, it's time to install them. Pull the coax from J1 on the RF board; this is the T/R switch RX output line. Reconnect it to the female pigtail cable assembly. Plug the male pin from the other pigtail assembly into J1 on the RF unit. To minimize the chances of mechanical problems, I used plastic tie wraps to bundle the input and output pigtail cables together. Once the RF compartment shield is replaced, it will hold the cables in place.

To check your work, power up the radio with an antenna connected but no connection to the pigtail jacks. You should NOT hear signals in the receiver. Momentarily insert the stripped end of a short piece of hookup wire into the RX input pigtail connector; you should hear static and possibly signals. If all is well, connect a short RCA-RCA jumper cable between the two pigtail jacks. You should have normal receiver function.

To insert a bandpass filter, overload protector, etc. in the receiver line, connect it between the RX antenna out and RX in jacks. To use an external receive antenna, connect it to the RX in jack.

Hope this is clear. Except for the fiddly process of soldering on the PC connectors, the procedure is really pretty easy. Let me know if you need further assistance.

Increased MONITOR Volume

Unhappy with the volume level of the MONITOR, some have tried placing a 4.7K resistor in parallel with R1087 to raise the level. There are more details on the www.mods.dk site at:

<http://www.mods.dk/mods.php3?radio=icom&model=ic-746&selectid=2299>

LCD Driver Transistor Replacement

Some folks have replaced the transistors that drive the LCD backlight in an attempt to prevent overloading and burnout. See the question devoted to LCD lamps repairs for all the gory details.

Poor Man's TCXO

N0UK (Chris) came up with a "poor man's" TCXO that substantially reduces frequency drift, particularly for 2m. He discovered that the cooling fan, which runs during transmit, draws air right across the local oscillator. The resulting temperature drop causes the LO to drift. He stuffed the 60 Mhz LO compartment with a few "cotton wool balls" as insulation. It doesn't eliminate drift entirely, but the improvement is dramatic.

The original e-mail message on this is at:

<http://groups.yahoo.com/group/IC746/message/1959>

A WWW site describing the mod (complete with pictures) is at:

<http://www.chris.org/Modifications/IC-746-almost-free-tcxo.html>

Upgrading Stock Ceramic IF Filter to a Crystal Filter

The stock 455 KHz IF filter is a 2.4 KHz wide ceramic. The PC board is drilled and traced for a full-fledged crystal filter (either from Icom or Inrad). In theory, replacing the cheapo ceramic filter (Murata CFJ455K) with a superior crystal filter should improve the rig's performance. Three obvious choices have been suggested:

- Inrad 109 crystal filter
- Icom FL-44A crystal filter
- Kokusai MF-455-11GZ mechanical filter

One source of info claims that to do this mod with crystal filters requires changing 2 resistors (R701 and R704) from 10K to 3.9K to change the impedance seen by the filter from 2K to about 1.2-1.5K. Most do not bother.

N9IRD talks about this type of mod at:

<http://www.qsl.net/icom/n9ird.html>

7.3 ***Can I increase my RF power output beyond 100w?***

Yes, but you probably shouldn't.

Technically, this is more of an adjustment than a "mod". NI4L (and others) have outlined the alignment procedure for increasing the RF power output above 100 watts. The basis for these procedures can be found on page 5-4 of the Service Manual.

The procedure can be found on-line at:

<http://www.mods.dk/>

<http://www.qrz.com/download/mods-i-k/ic746pwr.txt>

After examining the circuitry in the schematics and the specifications for the transistors involved,

<http://www.qsl.net/kb9sss/Parts/2SC2694.pdf>

Most hams feel that raising the RF output power above 100w is a bad idea for a variety of reasons:

- You can exceed the power ratings on the output transistors. Even if they don't blow out right away, they can eventually due to the long-term electrical and thermal strain.

There's nothing to prevent you from frying the rig except luck. There have been reports of output levels as high as 180w; nearly 30% above the published ratings.

- Pushing the PA transistors closer to saturation moves them toward non-linear operation; thus increasing IMD and splatter. Much of the "extra" power can end up as interference instead of in your signal.

Some IC-756 owners have found this out first hand, that their rig uses the same transistors in its RF PA. Distortion started at less than 110 watts.

- Increased heat dissipation may be a problem. Nobody has any design/spec data to tell how severe a thermal gradient the heatsink and fan was designed for. Even if the PA transistors could handle the heat, other components might not.
- Increased power supply current could cause unexpected problems. What happens to your external power supply when you demand 30+ A on transmit? What about the 746's internal voltage regulators?
- Increasing the power by 50% more than doubles the RF voltages within the internal ATU. Thus, making it more prone to arcing and burnout.
- Differing part tolerances can surprise you. It's much easier to compensate for component variations when you stay well within their tolerances. Thus some rigs may be more prone to the above problems than others. Just because one ham's rig worked is no guarantee that your's will.

On the plus side, you might be able to increase your RF output by as much as 1-2 dB.

That's a lot of potential problems for a meager gain. Most hams don't feel that it is worth it. If you really need more than 100w out, then you should probably consider an amplifier.

7.4 *I'm brave; what untested "mods" are there?*

While several other "mods" have been discussed, to date, we don't know of anyone brave enough to try them.

Replacing PIN Diodes in the Demodulator

Likewise, it is speculated that the IC-746 has cheapo PIN diodes in the detector circuit. Again, in theory, replacing these with higher quality components (closely matched) would improve performance, in particular, the 3rd order intercept point. This mod even helps the famous IC-781, which is where the idea came from.

The IC-746-PRO is not eligible for this experiment. It uses it's DSP for modulation and demodulation.

Removing the BCB Attenuator

A few folks have noticed that the IC-746 is less sensitive below 1.6Mhz. This appears to be due to an additional attenuator being switched in to protect the first RF amplifier from overload by commercial broadcast transmitters.

Some theorize that removing the extra attenuator (by simply bypassing it with a jumper) would improve the sensitivity. This involves R11 - R14 on the RF board (see p 11-5 of the Service Manual for the schematics).

Others point out that the atmospheric noise level on that band is too high to put any additional sensitivity to use.

Again, we don't know of anyone willing to admit to performing any of these modifications. If you perform one of these (or some other esoteric "mod"), then we'd love for you to share your results with the rest of us.

7.5 *What "external" mods are there for the IC-746?*

These modifications are not made on the IC-746 internal circuitry, but are external interfaces of one sort or another.

Remote, Direct Frequency Entry Keypad

W2FS wrote an article for the Dec 99 QST entitled "A Direct Frequency Entry Keypad for ICOM Transceivers". The "Millennium QSYer" is based upon that design and available from:

<http://www.john.hansen.net/keypad.htm>

Cordless Headset Microphone

Some hams have come up with a clever way to add a cordless headset to their rig. Basically, you find a cordless phone with a soundcard interface on it; something designed to work with your PC as an Internet phone. (The IBM3330 900Mhz phone is a popular choice) You hook up the phone to the transceiver like you would a PC, and then use VOX to control TX/RX. Some have had great success. W8WWV provides all the details at:

<http://www.seed-solutions.com/gregordy/AmateurRadio/Experimentation/CLessPhone.htm>

Instead of a cordless phone, you could try using one of the cordless microphone headsets they sell for use with computers.

Automatic Antenna/Amplifier Selection by Band

These are also referred to as "automatic band decoders". It's the art of controlling external equipment (amplifiers, antenna switches, etc...) based upon what RF band the transceiver is currently switched to. There are two basic approaches for this. One approach attempts to interpret the data transmitted by the CI-V interface, Icom's amplifiers are a good example. Others attempt to decode the band voltage available from the ACC port. Most "projects" use that approach.

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WD7S wrote an article for the May 2000 QST entitled

"Automatic Amplifier Selection for the ICOM IC-746, IC-736 and IC-706MKII Transceivers".

Hewitt, Paul, WD7S May, 2000, QST, p.33

K6XX has similar circuitry described on his WWW site at:

<http://www.k6xx.com/radio/icbsciv.html>

Another copy is at:

<http://krasnodar.online.ru/hamradio/w7ds.htm>

EI7BA has some related projects on his site at:

<http://www.iol.ie/~bravo/remote.htm>

There are also commercial solutions at:

<http://www.rfapps.com/ibs-1.htm>

<http://www.qth.com/topten/bdecoder.htm>

<http://users.skynet.be/ON4AOI/banddecoder.shtml>

Here is a CI-V based approach:

<http://www.microham.com/product1.htm>

2m TX/RX Sequencer

G3SEK outlines a complete TX/RX sequencer for handling more complicated transceiver/transverter/amplifier hookups.

<http://www.ifwtech.com/g3sek/dx-book/sequencer/>

External Tuner Pulser

This is covered in the Antenna Section as well.

You can make the IC-746 think that there is an ATU out there with a dummy plug like that available from W2ENY at:

<http://members.fortunecity.com/w2eny/tenatuner/>

Operation is similar to that for the other tuners, but transmission stops after an 8 second timeout instead of by tuner acknowledgement. You can even build this yourself based on the information at:

<http://www.mods.dk/mods.php3?radio=icom&model=ic-706&selectid=1864>

Don't mind that the info says its for the IC-706, all Icom rigs from this era use the same circuitry/connector.

Unmuffling Icom Hand Mics

W0VD had problems with muffled audio; so he opened up all of his Icom hand mics and removed the heavy wad of felt that was in front of the mic elements. He's receiving much better audio reports now.

The felt was probably there to prevent "popping" from consonants like "B" or "P". So, beware.

8 Misc...

8.1 Are there different versions of the IC-746?

Yes, there are at least two distinct versions of the IC-746.

While most of the indications are circumstantial, one definitive piece of evidence are the two different procedures for modifying the transmit/receive range.

Another definitive indication are the 2m differences between the U.S., Japanese, and European versions. In Japan, the IC-746 has different auto-repeater offsets and is limited to only 50w RF output. In Europe, the IC-746 does not transmit above 146Mhz and has no auto-repeater offsets at all. There's also a version in Australia that is limited to 20/8 watts on 2m for FM/AM.

There are varying reports about the necessity of a microphone pre-amp when using Heil microphones, leading some to speculate upon differences in the microphone input circuitry. K9HFX was unable to generate DTMF with an HM-14 microphone; that might be related. There isn't enough information yet to be conclusive.

Some rigs seem to have problems with the transistors that drive the LCD backlight, while some do not. This might be due to a circuitry change, or a difference in assembly. The jury is still out.

The only way the issue will be resolved conclusively is for someone to organize a data collection effort to sort out these details by serial number. So far, no one has volunteered.

8.2 Can I operate 2m on reduced power?

Sure, just turn down the RF output power control (along the bottom front edge of the rig).

Too inconvenient? Then you could get inside and tweak the pots that control the RF PA settings. There are 4 of them for HF, 6M, 2M and AM (R989, R991, R993, and R990 respectively). Refer to your Service Manual for details.

8.3 Where can I find plugs for the ACC connectors?

They are 7-pin DIN connectors (the old style AT keyboards used 5-pin Din). A couple (of many) possible sources are:

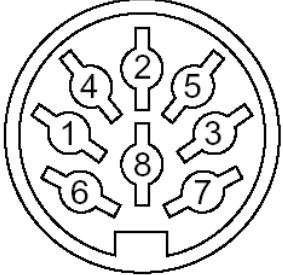
Digi-Key <http://www.digikey.com/>

BUX CommCo <http://www.buxcommco.com/>

Your local electronics store probably either has them or can get suitable substitutes. For example, most Radio Shacks have the 8-pin DINs in stock (#274-026). They are compatible after you remove the center pin.

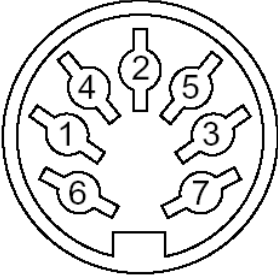
8.4 What are the pin-outs on the ACC-1 connector?

Page 72 of the Instruction Manual has the full scoop. Here is a brief description.

	1	RTTY	High > 2.4 V dc Low < 0.8 V dc Current < 2 ma
	2	GND	
	3	HSEND	Input/Output for HF-6m When grounded, transmits Goes to ground when transmitting Ground level: -0.5 to 0.8 V dc Output current: < 20 ma Input current: < 200 ma
	4	MOD	Audio input - direct to modulator Bypasses microphone preamp and VOX 100 mV rms at 10,000 ohms
	5	AF	Audio output - fixed level Also monitor output when transmitting 100-300 mV rms at 4,700 ohms
	6	SQLS	Goes to ground when squelch opens Current: 0.1 ma
	7	13.8 V	Unregulated connection to main supply voltage Max Current: 1 amp
	8	ALC	Automatic Level Control 0 to -4 V dc yields 0 to 100 w RF output

8.5 What are the pin-outs on the ACC-2 connector?

Page 72 of the Instruction Manual has the full scoop. Here is a brief description.

	1	8 V	< 10 ma at 8 V dc (+/- 0.3 V)																
	2	GND	Connected directly to pin 2 on ACC-1																
	3	HSEND	Connected directly to pin 3 on ACC-1																
	4	BAND	Band output voltage Varies from 0 to 8 V dc <table style="margin-left: 20px;"> <tr><td>7.5 V</td><td>160m</td></tr> <tr><td>6.1 V</td><td>80m</td></tr> <tr><td>5.1 V</td><td>40m</td></tr> <tr><td>0 V</td><td>30m</td></tr> <tr><td>4.1 V</td><td>20m</td></tr> <tr><td>3.2 V</td><td>17m/15m</td></tr> <tr><td>2.2 V</td><td>12m/10m</td></tr> <tr><td>1.9 V</td><td>6m/2m</td></tr> </table>	7.5 V	160m	6.1 V	80m	5.1 V	40m	0 V	30m	4.1 V	20m	3.2 V	17m/15m	2.2 V	12m/10m	1.9 V	6m/2m
	7.5 V	160m																	
	6.1 V	80m																	
	5.1 V	40m																	
0 V	30m																		
4.1 V	20m																		
3.2 V	17m/15m																		
2.2 V	12m/10m																		
1.9 V	6m/2m																		
5	ALC	Connected directly to pin 5 on ACC-1																	
6	VSEND	Input/Output for VHF When grounded, transmits Goes to ground when transmitting <table style="margin-left: 20px;"> <tr><td>Ground level:</td><td>-0.5 to 0.8 V dc</td></tr> <tr><td>Output current:</td><td>< 20 ma</td></tr> <tr><td>Input current:</td><td>< 200 ma</td></tr> </table>	Ground level:	-0.5 to 0.8 V dc	Output current:	< 20 ma	Input current:	< 200 ma											
Ground level:	-0.5 to 0.8 V dc																		
Output current:	< 20 ma																		
Input current:	< 200 ma																		
7	13.8 V	Connected directly to pin 7 on ACC-1																	

8.6 Does audio to pin 4 of ACC-1 trigger the VOX?

No. Pin 4 of ACC-1 does not trigger the VOX circuitry, nor is the level of that input affected by the front panel mic gain control.

8.7 Where can I get replacement power connectors?

Obvious Solution

The connector you need is often called an "OEM-T" connector. You can order Icom part number OPC-025A or OPC-025D from any of the major ham equipment retailers for a pre-wired cable.

Icom's cable compatibility chart lists the OPC-025A. Most retailers sell the OPC-025D. Both apparently work. The OPC-025A is rated for 20 amps, while the OPC-025D is rated for 30 amps. Most hams prefer the beefier cables.

BUX CommCo sells equivalent cables/connectors that are cheaper. You can find more info at:

<http://www.buxcommco.com/>

Better Solution

Rather than finding another Icom connector, many folks put inexpensive connectors on the cables of all their rigs and power sources. That way they can use any rig with any supply no matter what brand. This style of setup is particularly handy for switching between mobile rigs. Even Radio Shack has these, cheap.

One very popular connector is the Anderson PowerPole.

<http://www.andersonpower.com/>

which is readily available from either

<http://www.dcpwr.com/>

<http://www.powerwerx.com/>

In fact, the PowerWerx folks have pre-wired, PowerPole to OEM-T cables ranging from 1 to 10 feet long that are much cheaper than the Icom part (less than half the cost). You can always just snip off the PowerPole connector if you don't want it.

Many clubs and organizations have been standardizing on the PowerPole connectors for their high amperage 12VDC power. This makes all of their equipment inter-compatible and interchangeable; a real plus in an emergency. There's a good article on that subject at:

<http://www.dcpwr.com/standard.html>

8.8 *Where can I get replacement microphone connectors?*

You've got plenty of sources:

Radio Shack - P/N 274-025 for the plug.

BUX CommCo at: <http://www.buxcommco.com/>

The RF Connection at: <http://www.therfc.com/micconn.htm>

8.9 *What is "Lo-Fi" SSB operation?*

8.10 *What is "Hi-Fi" SSB operation?*

Trick questions, as they are both the same.

They both refer to attempts to transmit/receive higher bandwidth/quality SSB signals. Basically, hams are trying to improve audio fidelity; they are striving for "Hi-Fi" quality. Few (if any) SSB rigs will ever achieve the 20 Khz bandwidth normally associated with "Hi-Fi", thus the "Lo-Fi" pun.

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"Hi-Fi SSB" audio is a hot topic within ham radio. Everyone wants the best transmitted audio they can get, however, not everyone agrees upon what "best" is. The issues become even more heated once you add concerns over excessive bandwidth usage and splatter.

The characteristics/capabilities of the IC-746 allow this FAQ to take a neutral position in the debate.

Stock, the IC-746 has a SSB bandwidth of about 2.4 KHz. That bandwidth can be widened to as much as 3.4 KHz without deleterious effects (the FAQ describes how elsewhere). Pushing beyond that point requires more effort than most people are willing to invest.

A lot of "Hi-Fi" activity occurs on or about 14.178 Mhz. There is also an active group of hams at:

<http://groups.yahoo.com/group/hfssbaudio/>

8.11 *How does one improve the fidelity of a received signal?*

Here is a checklist of several possible actions (not in any particular order).

- Assure precise tuning
- Use a high quality external speaker or headphones
- Try to run without pre-amps or with attenuator
- Reduce the RF gain (increase AF gain to compensate)
- Set TPBT to widest bandwidth
- Use wider IF filters
- Lower level of NR (counterclockwise - to the left)
- Turn off NR
- Turn off ANF
- Turn off NB
- Set AGC to SLOW
- Be sure input power is greater than or equal to 13.5 Vdc
- Use an external AF amp via the ACC ports.
- Equalize the AF output.

8.12 *How does one improve transmission fidelity?*

Here is a checklist of several possible actions (not in any particular order).

- Using TCN, set the "SSB TX Tone" control to H. (SSB TX Tone affects all voice modes)
- Turn off COMP (compression).
- Use a higher quality microphone.
- Use microphone shock mountings and pop filters.
- Use external microphone equalization.
- Feed transmission audio directly via the ACC port, bypassing the microphone preamp. (may not help the PRO as much as the CLASSIC).
- Make sure supply voltage is 13.5 V or higher.
- Lower RF output
- Adjust by monitoring signal on a second receiver.

8.13 *Can the IC-746 transmit at less than 5 watts?*

Yes, with the help of some external circuitry.

The IC-746 isn't really designed for QRP operation (the 2+ amp draw on receive should prove that). The front panel control will only get you down to about 4-5 watts. However, you can apply a voltage to the external ALC input to get even lower. 0 to -4Vdc input yields 0 to 100 Watts output. One ham even uses a simple voltage divider/pot arrangement powered by 2 AA batteries.

K5UHF warns that there can be a minute moment of higher power output before the external ALC level kicks in. Not normally a problem unless you're driving input sensitive equipment; like transverters.

8.14 *How do I turn on both HF pre-amps at the same time?*

You can't. Nor would you really want to.

HF preamp 1 is transistor based and yields about 10db gain for the 1.8 - 54 Mhz range (160m to 6m bands). HF preamp 2 is IC based (presumably an op-amp) and yields about 16db gain for the 21 - 60 Mhz range (15m thru 6m bands).

In practice, each HF preamp will work on any HF band.

The sensitivity of the IC-746 is so high that neither of the HF preamps are rarely needed. You'll need the attenuator more often than the preamps.

8.15 *How do I adjust the 746 for best AM performance?*

The 746 performs well on AM for general communications. However, many operators choose (and fall in love with) AM for the sound. For this, the 746 can fall a little short of expectations.

Start by improving your audio fidelity as described elsewhere in the FAQ. Then, WU1T (Damon) suggests that the trick is to back off the carrier level. You don't want to run full carrier or full mic gain. He also suggests turning compression off when using AM.

For general guidelines on setting up modern transceivers for AM use, check out:

<http://www.thebizlink.com/am/tech/htm/plastic.htm>

8.16 *Is the IC-746 suitable for CAP and MARS operation?*

For CAP (Civil Air Patrol) use, the IC-746 is compliant only for HF, and then only if it has the CR-282 TXCO option installed. It's not compliant on VHF at all. See the following for more details:

http://www.ntc.cap.gov/comm/equipment/hf_equipment.cfm

<http://www.ntc.cap.gov/comm/equipment/Lists.cfm>

There's more information on this general topic at:

<http://www.ntia.doc.gov/osmhome/redbook/redbook.html>

While I don't have a link for it at the moment, I've been told that MARS (Military Affiliated Radio Service) must adhere to the same standards.

For both CAP and MARS, some grandfathering did occur, however, that should have expired by now.

8.17 *How do I adjust the Noise Reduction (NR)?*

The level of NR you want varies by mode and personal preference. CW can generally tolerate more NR than SSB. Most AM operators prefer little to none.

Fortunately, setting the correct level is very intuitive.

Start with the minimum, full counterclockwise setting (7-8 o'clock). Increase the level by turning clockwise; the signal should sound better as you go. After a while, the signal will start to sound worse; when that happens, simply back off a bit.

So, essentially, you adjust back and forth until you "home in" onto the best setting. Most people end up between 9-12 o'clock for SSB and a little higher for CW.

As you eliminate noise, you alter the signal. In phone modes, that's often interpreted as distortion. At some point, the perceived distortion becomes greater than the removed noise.

8.18 How do I program a non-standard repeater offset?

Repeater offsets are just a special (convenience) case of general "split" operation. If you need to set up such a repeater without changing your default/normal offset, then here's what you do (as outlined on page 35 of the instruction manual):

- Go to VFO mode.
- Depending upon the frequencies involved, you may have to turn off AUTO-REPEATER temporarily.
- Set VFO-A to RX frequency plus RX-PL tone (tone squelch) if needed or desired.
- Set VFO-B to TX frequency plus TX-PL tone.
- Switch back to VFO-A.
- Press the SPLIT button so indicator light comes on.
- Store into selected memory slot as usual.
- Turn AUTO-REPEATER back on, if desired.

8.19 How do I turn on repeater (PL) tones?

There are two different tones you might need. In the USA, PL tones are used while in Europe a 1750Hz tone is used. You access them both the same way.

Page 34 of the instruction manual covers the procedure, which we summarize here.

- With the frequency set to somewhere in the 2m band, with M1 displayed (press the menu button to get M1 displayed if M2 is displayed). You'll see TON above the F3 button.
- Press and hold F3 - you'll see Rptr Tone come on the display.
- Release F3.
- Spin the tuning dial to get the tone you want.
- Press the menu button to get back to seeing M1 displayed.
- Watching the display, press F3 ****briefly****.

Each time you press F3 that way, you will see the letter T come on the screen or off the screen about 3/4 of the way down from the top above the F4 button. When the letter T is on the screen, sub audible tone transmission will occur when you key the mike.

8.20 *How do “zero-beat” a CW signal?*

Zero beating ensures that your CW signal is being sent at exactly the same frequency as the received signal.

First, make sure that RIT is turned OFF. Then, use one of the following two techniques:

- Adjust the frequency of the radio to where the pitch of the received CW signal is the same as your sidetone pitch. Your accuracy may depend upon your ability to remember a perceived pitch. Most people can get to within 10 Hz this way.
- Adjust the frequency of the radio until the pitch of the received CW signal is the same in CW mode as CW-R mode. By A/B comparison, you can reliably get to within 5Hz.

Either of these techniques will work very well. There are other approaches, but these two are the simplest, most convenient, and the most popular.

Yes, it can be tough to "zero beat" a side tone against dits and dahs, but it takes very little effort to get close enough to put your signal within the person's passband so that he will hear you, even if he is using an extremely narrow filter.

Beware; if you turn off break-in operation so that you can hear your sidetone simultaneously with the other signal, then you must remember to turn it back on again. Otherwise, you won't actually be transmitting; you'll just be practicing your code.

Instruction Manual Errata

Know errors in the Instruction Manual, by page number.

Page:2 Incorrect Page References

(12) AF CONTROL references p.12, should be p.11

Page:6 External speaker and remote interface jacks are swapped.

Page 6 has the external speaker and computer remote connectors mislabeled (reversed). Looking at the rear of the rig, the REMOTE jack is on the left and the SPEAKER jack is on the right.

Page 68 shows the connections properly.

Page:9 Incorrect page references

Incorrect page references in MENU descriptions at the bottom of the page.

- (4) TCN p.20 should be p.19
- (7) KEY p.24 should be p.23
- (8) RTY p.30 should be p.29
- (9) TON p.35 should be p.34
- (10) TSQ p.33 should be p.32

Page:15 BAND EDGE BEEPS simply do not work as expected.

This is more a failing of the radio itself than it is an error in the manual. For more info, refer to the rest of the FAQ.

Page:19 SSB TX Tone affects more than SSB

The "SSB TX Tone" setting affects the tonal quality of AM and FM transmissions as well as SSB.

Page:22 TRANSMIT button does not transmit on CW

This is more of a clarification than an error. In every other mode (AM, SSB, FM, RTTY), the TRANSMIT button actually "keys" the 746 to transmit a signal. In CW mode, you have to activate the keyer as well.

Most operators use QSK when operating CW, which makes the TRANSMIT button superfluous.

Page:27 Only one bar for CW sidetone level, not two

In the CW -> KEY -> SET menu, there are 2 options that control the CW sidetone: options 1 and 2. Option 1 sets the sidetone level via the displayed bar. However, option 2 is only an ON/OFF setting; there is no level bar (contrary to what the manual shows).

Page:32 No ALC adjustment for FM

In "FM Operation", under TRANSMITTING, section 5 it states: Push TRANSMIT...and adjust the MIC GAIN so that the ALC level in the ALC meter stays in the ALC zone when speaking into the microphone.

The ALC meter is maxed out on any setting of the mike gain and has no meaning or effect under FM.

ALC adjustments made in SSB carry over modes. Once you get the audio drive level adjusted for proper SSB modulation, then the audio drive level ends up being right for all the other modes as well.

Page:33 Incorrect filter diagram

The diagram at the top of the page is incorrect. It shows only one stock filter (2.4 Khz wide) at the 9Mhz IF. There is a second, 15Khz wide, filter at that point instead of the direct "through" connection shown.

Page:42 Incorrect Page Reference

Reference for Noise reduction p.39, should be p.40

15Khz filter at 9Mhz IF?

Page:46 No ALC adjustment for either AM or FM

In the "Speech compressor" section, the ALC meter doesn't appear to work on AM.

ALC adjustments made in SSB seem to carry over to other modes. Once you get the audio drive level adjusted for proper SSB modulation, then the audio drive level ends up being right for all the other modes as well.

Page:46 Speech compressor

The "Speech compressor" instructions fail to make clear the fact that both the MIC GAIN and COMP GAIN controls will have to be adjusted for proper operation.

Page:53 Enter numbers via keypad, not tuning dial

While the diagram specifically highlights the numeric keypad on the radio; the "instructions" fail to mention that numbers and the decimal point are entered via the keypad instead of the tuning knob.

Page:56 Incorrect Page References

In the 1st paragraph, the reference "for programming scan edges" is p.56 but should be p.52.

Page:68 Unclear Voltage Specification

The box describing the ALC JACK lists an input voltage of "0-4 V". It should read "-4 to 0 Vdc".

Page:70 Overoptimistic SWR Specification

In the box labeled "ANTENNA SWR" the manual states (in part):

When the SWR is higher than approx. 2.0:1, the transceiver's power drops to protect the final transistors.

Actually, power starts cutting back much earlier than that; somewhere between 1.7:1 and 1.3:1

Page:77 Unclear UT-102 Installation Instructions

The UT-102 Voice Synthesizer is installed in the "bottom" of the transceiver, not the "top". Also, the "shield cover" is not involved.

Page:79 Incorrect SEND Relay Specifications

The "NOTE" for "CONNECTING A NON-ICOM AMPLIFIER", should read

NOTE: The specifications for the SEND relay are 12 V DC at 20 ma (milli-amps). If this level is exceeded, an external relay or switching transistor must be used.

The 746 SEND line is designed to interface to a solid-state amplifier trigger, like those used in Icom's power amps. Many people have damaged their rigs by trying to switch amplifiers with higher voltage/current requirements.

Page:84 Incorrect Bandwidth listing

Under Receiver Specifications, the USB/LSB/CW Selectivity is listed incorrectly as 2.1Khz. The actual selectivity (bandwidth) is determined by the IF filter selections. By default, as shipped, the selectivity (bandwidth) for those modes is 2.4 Khz.

Service Manual Discrepancies

The "Service Manual" is supposed to be the best, final word on the electronics within the IC-746. However, the data it contains isn't always consistent. Here are the known discrepancies.

Identity of Q302

Q302 on the S-Logic Board is a driver transistor for the LCD backlight. It's listing varies depending upon the reference within the Service Manual. We'd love to hear which part is actually in your rig.

p. 6-1	Parts List	2SB1201-S-TL
p. 8-1	Semiconductor Information	2SB1201 S
p.10-1	Block Diagram	2SB1202
p.11-2	Voltage Diagram (schematic)	2SB1201

We believe the part is supposed to be a 2SB1201.

Identity of R1271

R1271 on the Main Board is a dry reed relay for switching the SEND signal used to operate external RF power amplifiers. It's listing varies depending upon the reference within the Service Manual. We'd love to hear which part is actually in your rig.

p. 6-12	Parts List	OMR-109F
p.11-4	Voltage Diagram (schematic)	AHY103

The Board Layout on page 9-7 clearly shows that the R1271 has a completely different layout than either R1111 or R1291, which are identified as AHY103 relays in both the parts list and the schematics.

We believe the part is supposed to be an OMR-109F.

Glossary

Here are short expansions of some of the more common acronyms you'll encounter when reading about the IC-746. This document is not a dictionary; these are not definitions. A more comprehensive and detailed listing of terms can be found at:

<http://www.qrz.com/i/hamspeak.html>

ACC	ACCessory connector
AF	Audio Frequency
AFSK	Audio Frequency Shift Keying
AGC	Automatic Gain Control
ALC	Automatic Level Control
AM	Amplitude Modulation
ANF	Automatic Notch Filter
ANL	Automatic Noise Limiter
ANT	ANTenna
APF	Audio Peak Filter
ARRL	Amateur Radio Relay League
ATT	ATTenuator
ATU	Antenna Tuning Unit
BCB	BroadCast Band
BFO	Beat Frequency Oscillator
CAP	Civil Air Patrol
COMP	COMPression
DSP	Digital Signal Processing
DTMF	Dual Tone Multi-Frequency - (touch tone)
FAQ	Frequently Asked Questions
FM	Frequency Modulation
FSK	Frequency Shift Keying
IF	Intermediate Frequency
IMD	Inter-Modulation Distortion
LCD	Liquid Crystal Display
LSB	Lower Side Band
MARS	Military Affiliated Radio Service
MIC	MICrophone
NB	Noise Blanker
NR	Noise Reduction
PA	Power Amplifier
PBT	Pass Band Tuning
PCB	Printed Circuit Board
pig	Pig is to rig as lemon is to car
PLL	Phase Locked Loop
PTT	Push To Talk
QRP	low power operation

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RIT Receiver Incremental Tuning
RTTY Radio TeleTYpe
RX short for Receive or Receiver
SSB Single Side Band
SWR Standing Wave Ratio
TCN Tone CoNtrol - SSB transmit cutoff
TCXO Temperature Compensated crystal Oscillator
TPBT Twin Pass Band Tuning
TS Tuning Step
TX short for Transmit or Transmitter
USB Upper Side Band
VFO Variable Frequency Oscillator
VOX Voice Operated transmission
YMMV Your Milage May Vary (standard disclaimer)

Contributors + Acknowledgements

There are two kinds of contributors to this FAQ: direct and indirect.

Direct contributors have written entire passages that have been incorporated nearly verbatim. Sometimes, they are specifically authoring something with the FAQ in mind. Also, they are individuals who have been recruited to review specific sections prior to distribution.

Indirect contributors have had their comments and input collected and assimilated from public correspondence on discussion and news groups, often without their knowledge. They were simply answering questions, offering advice, or otherwise just helping people out.

The coordinator has not tried to keep a record of who has contributed what; the book-keeping would be horrendous. All sources of information have been **INVALUABLE** and are **APPRECIATED**. Listing contributors here is a small token of thanks for their neighborly spirit and generosity. The Coordinator apologizes if anyone has been missed.

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N8AVX	Jim	
N8GJ	Jerry	
N9IRD	George	
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VA7JWR	Jan Reimers	Canada
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VE3EXT	Jerry Beneteau	Canada
VE3GWX	Peter	Canada
VE3JKC	Keith Carter	Canada
VE4HAY	Derek Hay	Canada
VE6CGX	Tony Hwang	Canada
VE7MDL	Erik	Canada
VE9FX	Lin	Canada
VK4ZSS	Sam	Canada
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W0VD	Dan	
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W2MAW	Mark Wolf	
W2VJN	George	
W3UHF	Frank Ellis	
W4LT	George	
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W4UGM	Richard Cash	
W4UK	Jerry	
W5UN	David Blaschke	
W5YR	George	
W6CCD	Dick	
W6OLD	Dick Flanagan	
W6RCA	Cecil Moore	
W7DGX	Rolly	
W7SAC	David McCallum	
W8DBF	Duane Fischer	
W8FN	Randy Farmer	
W8JN	Paul	
W9FCC	Dan McKenzie	
W9FS	Jerry	
W9LVC	Frank	
W9NHQ	Bill	
W9SWL	John Ingersoll	
WA0KWK	Larry Boyler	
WA0SXV	Mike	
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If anything, then the sheer number of people involved (more than 100 contributors from more than a dozen countries) should illustrate the collaborative effort involved in producing this FAQ.

Thanks to everyone involved.

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Revision History

2002.11.26	Added Q/A on Quadra amp hookup
2002.11.25	Updated info on band decoders
2002.11.22	More info on researching rig prices
2002.11.20	More info on LCD repairs
2002.11.19	Added/updated article information
2002.11.19	More info on CT-17 interfaces
2002.11.19	Added more info on RX/TX receive line split
2002.11.18	Added another ham repair center
2002.11.18	More info on the "Poor Man's TCXO"
2002.10.22	Minor addition to band edge beeps
2002.10.20	More info on ignition noise
2002.10.11	Updated info on Icom HF net
2002.10.08	Added Q/A about loose tuning shaft
2002.10.07	Added Q/A about 2m S-meter readings
2002.09.30	Corrected page number error in errata
2002.09.29	Added Q/A on automatic external ATUs
2002.09.28	Added Q/A about sticky switches
2002.09.25	Added Q/A on finding repair shops
2002.09.23	Added Q/A on TNC hookup
2002.09.20	Added Q/A on CT-17 cable
2002.09.15	Several minor changes and link updates
2002.09.15	More info on power drop off
2002.09.09	Added Q/A about low voltage operation/shutdown
2002.09.08	More info on IC-PW1 operation
2002.09.06	Added Q/A about Alaska Emergency Frequency
2002.08.26	More info on ignition noise
2002.08.20	More info on SEND connection problems.
2002.07.17	Added Q/A about 60m operation
2002.07.15	Added Q/A about IC-2KL amplifier birdies
2002.07.12	Added Q/A about loose rubber tuning dial grip
2002.07.12	Added Q/A about LCD color
2002.07.11	Added more info on IF filter characteristics
2002.07.10	Added more info on building CI-V interfaces
2002.07.09	Added more info on LCD brightness problem
2002.07.08	Added Q/A on internal ATU diode repair
2002.07.08	Added more info on transmit fidelity
2002.07.07	Added Q/A about ignition noise
2002.07.06	Added Q/A about repeater (PL) tones
2002.07.05	Added Q/A about possible computer control problems
2002.07.03	Clarified info about 455KHz IF filters
2002.07.02	Added more info about 2nd 9MHz Inrad filters
2002.07.02	Added Q/A about PSK31 hookups
2002.07.01	Added more info about DTMF generation
2002.07.01	Added more info SEND relay options
2002.07.01	Added more info on IC-746 HF Net
2002.06.03	Added info on 2n TX/RX seperation mod

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2002.06.03	Added Q/A on non-standard repeater offsets
2002.06.03	Updated info on internal+external ATU usage
2002.06.03	Corrected amplifier question numbers
2002.06.03	Added Q/A about 100% duty cycle
2002.05.06	Added a few more WWW links
2002.04.20	Added another magazine article
2002.04.07	More info on >100w power output.
2002.04.06	Added Q/A about setting NR level
2002.03.27	General cleanup - links, TOC, etc...
2002.03.24	More info on SEND relay isolation circuits
2002.03.24	Added SM reference for BCB ATT mod
2002.03.19	Added another magazine article
2002.03.18	Expanded info about >100w output alignment
2002.03.17	Started moving "mods" into a seperate section
2002.03.16	More updated info on LCD (Q302) failures
2002.03.08	Added Q/A on "long wire" antennas
2002.03.06	More info on amp/ant switching
2002.03.04	Added Q/A about internal/external SWR meters
2002.03.04	Updated Q/As on split TX/RX antennas
2002.03.03	Added more info on switching amps with ACC-1/2
2002.03.02	Added Service Manual Discrepancies
2002.03.02	Added "microphone mod"
2002.03.01	Yet more info on SEND relays
2002.02.28	Even more info on Q302 and LCD problems
2002.02.27	Added more info on voltage boosters
2002.02.26	Minor editing/formatting of "mods"
2002.02.25	More info on LCD driver repair
2002.02.22	More info on SEND relay limitations
2002.02.21	Added more info on Q302 and LCD burnout
2002.02.21	Added alternative prevention to LCD blow-out
2002.02.21	Added mod to MONITOR level.
2002.02.21	Updated Q/A on external tuner activation
2002.02.20	Added Q/A about internal ATU "gotchas"
2002.02.19	Updated Q/As on non-Icom amp hook-up
2002.02.19	Updated info on installing Inrad filters
2002.02.18	Added more TLAs to glossary
2002.02.13	Added Q/A about external ATUs
2002.02.12	Added citation for latest QST article
2002.02.11	Minor addition to NB question
2002.02.10	Updated some of the WWW links
2002.02.08	Added Q/A about keyless tuning in CW mode
2002.02.07	Updated mod Q/A to add tx/rx sequencer
2002.02.06	Minor addition to transmit fidelity Q/A
2002.02.04	Added Q/A internal/external SWR readings
2002.02.04	Added Q/A on measuring SWR in SSB
2002.02.04	Added Q/A about "popular" filter combos
2002.02.03	Added another IF filter passband link
2002.02.03	Added info on "A" suffix IF filters
2002.02.02	Updated Q/A's on microphones
2002.02.02	Added several Q/A's on amplifiers
2002.02.01	Reformatting of some manual errata
2002.02.01	Added M/E P:27 - CW sidetone level

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2002.02.01	Added M/E P:19 - SSB TX Tone affects AM/FM
2002.01.31	Added Q/A about CAP/MARS compliance
2002.01.31	Added Q/A about future of FAQ
2002.01.21	Updated info on 746 NET
2002.01.12	Rearranging and updating "mods" info
2002.01.11	Added info on "cordless headset" mod
2002.01.10	Tested and updated all links
2002.01.09	Added Q/A on Noise Blankers
2002.01.08	Added Q/A on adjusting AM performance
2002.01.07	Added Q/A about tuning clicks
2002.01.06	Added M/E P:22 - TRANSMIT button on CW
2002.01.05	Added Q/A about using both preamps
2002.01.04	Updated Q/A on electronic manuals
2002.01.03	Added info on "cotton wool ball" mod
2001.12.31	Added Q/A on transmit fidelity
2001.12.31	Updated Q/A on receive fidelity
2001.12.31	Updated info on 746 NET
2001.12.28	Updated info on power supplies
2001.12.18	Updated info on 746 "mods"
2001.11.29	Updated Q/A about magazine articles
2001.11.26	Updated freq for HF net
2001.11.20	Updated info on wiring dynamic microphones
2001.11.19	Updated info on IC-746-PRO
2001.11.16	Added Q/A about PDF font error
2001.11.13	Added Q/A about magazine articles
2001.11.10	Checked and added more manual page references
2001.11.09	Added M/E P:42 - 15Khz filter at 9Mhz IF
2001.11.09	Added M/E P:56 - use keypad for numbers
2001.11.09	Added M/E P:46 - COMP GAIN control
2001.11.09	Added M/E P:15 - band edge beeps
2001.11.08	Added M/E P:68 - confusing ALC voltage
2001.11.08	Added M/E P:46 - ALC only on SSB
2001.11.08	Minor updates regarding SWR values
2001.11.08	Added M/E P:70 - SWR fold back
2001.11.07	Added M/E P:79 - SEND relay limits
2001.11.07	Updated Q/A about electronic manuals
2001.11.06	Added M/E P:32 - No ALC for FM
2001.11.06	Added M/E P:6 - speaker/remote jacks swapped
2001.11.06	Added M/E P:56 - incorrect page reference
2001.11.06	Added M/E P:33 - incorrect page references
2001.11.06	Added M/E P:9 - incorrect page references
2001.11.06	Added M/E P:2 - incorrect page reference
2001.11.05	Added M/E P:77 - UT-102 installation
2001.11.05	Added section for Manual Errata
2001.11.03	More info on IC-746 net and daylight savings time
2001.11.02	More info on MARS mod by Icom
2001.11.01	Added Q/A about microphone pin-outs
2001.11.01	Separated Q/A on "mods" into three Q/A
2001.11.01	More "mods" information
2001.11.01	Updated info on DTMF microphones
2001.10.30	Added Q/A about low power 2m operation
2001.10.30	Updated info on power output vs. input voltage

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2001.10.30	Added Q/A on IC-746s
2001.10.24	Added Q/A on multiple keyers
2001.10.24	Started a small glossary
2001.10.23	Clarified Q/A about Heil mic adjustments
2001.10.23	Added Q/A about dynamic microphones
2001.10.22	Updated info on different versions
2001.10.21	Added info on ACC pin-outs
2001.10.20	Added info on Sunday evening 20m IC-746 net
2001.10.19	Updated info on "mods"
2001.10.18	Added Q/A on transmitting less than 5 watts.
2001.10.18	Added Q/A on internal ATU while receiving
2001.10.17	Added Q/A on finding Mic connectors
2001.10.16	Added another mirror site at qth.net
2001.10.15	Changed all newsgroup references into links
2001.10.15	Added Q/A on where to buy/sell a used IC-746.
2001.10.14	Added Q/A on other Icom rigs (756, 765, 735, etc...)
2001.10.12	More info on internal/external ATU interactions
2001.10.09	Updated info on internal/external ATU interactions
2001.10.05	Added Q/A on computer interfacing
2001.10.01	Added Q/A on "birdies".
2001.09.21	Added info about QTH.NET's ICOM e-mail list
2001.09.21	Updated Q/A on IC-7400
2001.09.06	Added Q/A about "beverage" antennas
2001.09.05	Fixed numerous spelling errors
2001.09.01	Updated Q/A on ATU to reflect recently reported damage
2001.09.01	Added Q/A about IC-7400 (IC-746-MKII?)
2001.08.28	Updated info buying a 746
2001.08.14	Updated info on accessing the FAQ
2001.08.07	Updated Q/A on ATU range
2001.08.07	Updated Q/A on ATU tricks (band sweeping)
2001.08.07	Added Q/A about reset to factory defaults
2001.07.25	Added Q/A on VOX and ACC-1
2001.07.20	Reorganized into sections with contents
2001.07.19	Added Q/A on Receive fidelity
2001.07.18	Updated info on different versions of IC-746
2001.07.09	Updated info on computer control
2001.06.30	Updated many Q/A on IF filters
2001.06.28	Added Q/A on ACC DIN connectors
2001.06.27	Changed Q/A to ATU tips (high power)
2001.06.26	Added several Q/A on band edge beeps
2001.06.26	Added many Q/A on IF filters
2001.06.22	More info on computer control software
2001.06.12	Added disclaimer & copyright notice
2001.06.12	More information on power supplies
2001.06.12	Added Q/A on ATU at QRP power
2001.06.12	Added Q/A about low output power
2001.05.30	Added Q/A about Heil microphones
2001.05.30	Added Q/A on wiring up keys/keyers
2001.05.29	More information on power supplies
2001.05.28	Added multiple Q/A on computer control
2001.05.27	Added Q/A about different versions of IC-746

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2001.05.25	More information on power supplies
2001.05.24	Added Q/A about DTMF tones
2001.05.23	Added Q/A about numeric programming
2001.05.22	Added Q/A about antennas
2001.05.21	Added Q/A about electronic manuals
2001.05.20	Updated info on rig modifications
2001.05.20	More info on power connectors
2001.05.19	(Dayton Hamvention, WooHoo!)
2001.05.18	Updated info about an Icom HF net
2001.05.17	Added Q/A about non-SSB ALC readings
2001.05.16	Added new info about an Icom HF net
2001.05.15	Added Q/A about broken LCD backlight
2001.05.14	More information on power supplies
2001.05.01	First circulated copy.
2001.04.20	First rough draft
2001.04.02	Started collecting notes
2001.04.01	Decided to make FAQ