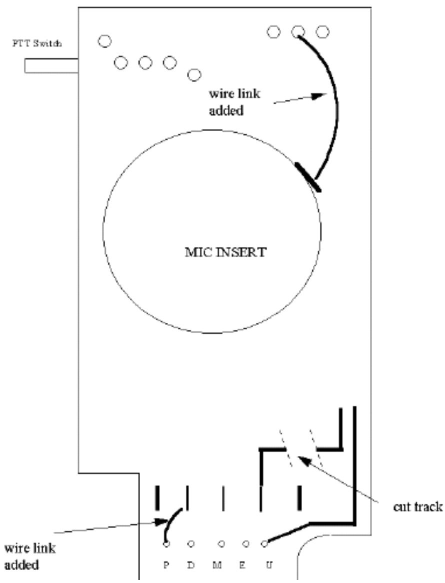
Chapter 8

IF Rigs

Yaesu FT290 Microphone Mod

Chris Towns, G8BKE

Many of us use the FT290 as a prime mover on the microwave bands. Quite often, during initial line up testing, one is asked to transmit a continuous carrier for perhaps some minutes while the far end searches for your signal. This usually entails holding the PTT or key down for this period. A good strong elastic band is useful for this purpose but that can either get forgotten, or worse...snap!
The Yaesu YM-47 microphone has a slide switch on its rear which allows one to "lock" the up/down buttons. I, like many others no doubt, never use this function and thus decided to use the slide switch for a PTT function.
Unplug the microphone from the rig and take out the two screws which hold the microphone casing together. Carefully separate the two parts of the microphone casing and remove the pcb with the microphone insert attached from the casing. Don't loose the up/ down buttons or the PTT lever in the process but note that the up/ down switches themselves come away with the pcb. With the microphone insert facing you, locate the pcb track shown in the drawing. (Not all the pcb tracks are shown for clarity.) Carefully cut the pcb track and add the 2 wire links shown, using insulated wire. Re-assemble the microphone and there you have it. The up/down function is retained but the slide switch will now work in parallel with the PTT switch. Slide the switch to the "on" position and you can send continuous carrier for as long as the other station needs it while you can get on with your ham sandwich!
The usual disclaimers regarding modification of equipment apply.



Using the FT817 in a Microwave System

More gleanings from the internet reflectors

Tom Williams' (WA1MBA) internet microwave reflector is a most useful source of information.

There was much discussion when it was launched, of the value of the FT817 QRP portable Transceiver to the microwave operator. With our thanks to the various operators mentioned below, we publish a summary of this discussion in the hope that it might help those who are looking for a substitute for their IC202 microwave IF "prime mover" or even very portable talkback equipment.

From: Ed Cole, AL7EB, [al7eb@ptialaska.net]

I have used the FT-817 with my DEM 10GHz transverter and 1w Qualcomm amp. I mounted everything in a U-shaped aluminium chassis which fits into a sturdy carrying case (Pelican-1520) making it handy for taking on-board an airplane when I travel. The case has room for my key, microphone, a 12v gel-cell battery, 1.5 amp wall charger, a 17dBi horn and assorted cables.

Since most of the equipment is pre-mounted on the chassis, set up takes only about 3 minutes using the horn. I use a DEM sequencer to control the transverter and amp T/R as well as controlling microphone PTT. I run the microphone PTT line through one of the sequencer relays to prevent transmitting before the T/R sequence is complete. The microphone keys the control line of the sequencer. To break out the microphone PTT line, I use a couple of RJ-45 wall jack modules and a RJ-45 jumper to the radio microphone jack. For CW I chose manually switched T/R rather than break-in operation to keep it fool-proof and simple. The Qualcomm PSU and sequencer are housed in a plastic box. I use the sma-relay supplied by DEM and have the 3w transceiver option for connecting the FT-817 antenna to the transverter. I adjusted my transverter drive level to use the FT-817 1w power level as this permits me to operate the FT-817 using the battery at lower current draw.

Lower power is easy by switching the FT-817 to the 1/2w power level. I can take along a mobile mag-mount whip or use my Arrow (2m 3 elem/70cm 7-ele) Yagi for liaison. The Arrow breaks down and fits into a 2-inch diameter by 25-inch long plastic drain tube, using plastic end-caps. It looks just like those carry-on fishing-pole tubes.

The equipment sits on the car seat very nicely for mobile operation (I use a cigarette-lighter power cord).

The FT817 will make a very nice IF unit for portable microwave operation, as long as you have adequate battery capacity. The only negative I see is the <relatively> high current draw in receive (~300 mA)

From: Peter Freeman, VK3KAI [peter.freeman@sci.monash.edu.au]

I have been using an FT817 as an IF box since October and it's an excellent box for the job! The biggest problem is remembering what the IF frequency should be - I have some transverters set up for 144MHz IF, some on 145MHz IF and 2403 set up for 147MHz IF ! During a Field Day, it is easy to NOT change to the appropriate IF.

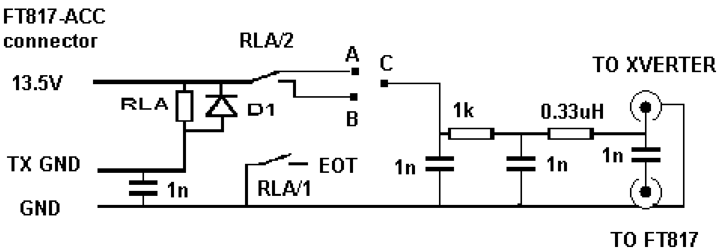
I have built a Bias Tee box that plugs into the RF connector on the rear of the unit and brings in the Tx GND connection from the ACC connector. The RF coax cable then goes to

the IF interface board and controls the sequencing in the transverter.
Another useful item is the keyer … hook up a switch to the keyer plug on the rear of the radio, switch to CW mode, set to Break-In operation and you have a beacon keyer running at 50% duty cycle!

From:WW2R (G4FRE) David Robinson [robinda@nortelnetworks.com]
I have been using one as a microwave IF on 10/24/47GHz since they dropped $100 off the price last year (August). I have been very pleased with it as an IF, especially with the extended frequency coverage, its quite fun as an hf rig as well! I built a bias box for the rear SO239 connector that plugs into the accessory socket and makes the 817 look like an FT290/IC202. I learnt the hard way that you do not have a second chance if you short out the 13.8v output on the acc socket ...it is fed through a 10 ohm 1/16w 0604 chip resistor that blows.
From experience it is a devil to replace.
I got over the small frequency etc display by installing FT 817 commander by HB9DRV that remotes everything onto a laptop.

Interface circuits for the FT817

Dave Robinson WW2R



Interfacing to a transverter:

Refer to the diagram above ...
For IC202: connect points A and C
For IC402/FT290: connect points B and C

This unit simulates either an IC202 (9V on RX) or IC402/FT290 (9V on TX). For RLA I used a very miniature DPDT relay (the antenna changeover relay from a Pye PF2UH!), mounting the components in a small die cast box with a miniature 6 pin DIN socket for the FT817 connections. I then have a lead from the accessory socket of the FT817 to the interface box. The advantage of this is that I can use the same box with a miniature 6 pin din to 13 pin din lead and use it to interface with an IC706mkIIG. The input and output connectors are UHF. The box also produces a ground on transmit signal on a 3.5mm socket to control other circuits.

When the unit is completed make doubly sure there are no shorts on the 13.8V pin, as measured at the miniature 8 pin din aux plug that goes into the FT817, unless you have 40/40 vision and would like to learn how to remove the main FT817 PCB to replace an 0604 chip resistor! If you are worried about this possibility, provide the 13.5V from a supply external to the 817.

Computer Interfacing:

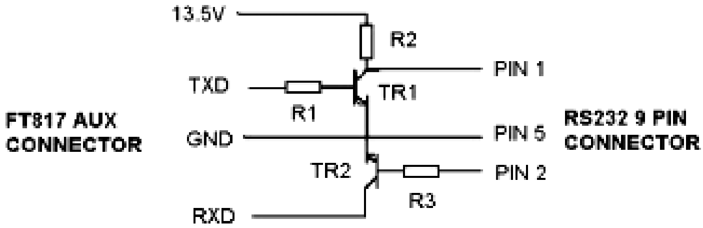
Refer to the diagram on the next page
Loading the memories of the FT817 before a contest was a pain, until I discovered the FT817 commander software by Simon Brown HB9DRV (ex GD4ELI!) at:
http://www.kns.ch/sysgem/hb9drv/
All I needed was a cheaper RS232 interface than the Yaesu CT62. I came across a circuit of Russian origin that only required 2 NPN transistors and 3 resistors arranged as on the next page.

The transistor types aren't critical, I just had some 2N3904 around. R1=R3 =39k, R2=3k9. I easily built mine into the 9-pin RS232 connector using 1/8W resistors with a lead connecting to the FT817 auxiliary connector.

Other Notes:

Be aware that, even with the FT817 turned off, there is still 13.5V on the aux connector 13.5V pin.

Don't leave accessories plugged into the aux socket when running off batteries or they will flatten.



For those worried about conserving every last mA of battery drain, see the KA7OEI web site,
http://www.ussc.com/~turner ft817pg.shtml
where the matter is thoroughly investigated, along with lots of other related topics.

My radio bought in the USA was supplied with a ferrite choke but nothing to say why (my addendum sheet was missing). I soon discovered why whilst using it for talkback with W5LUA on 432.1MHz SSB. RF gets into it and it is so distorted as to be unreadable. It doesn't matter if you are using the helical antenna on the front panel or back panel, same effect. I couldn't repeat the effect on any other band/ mode, even the HF bands with the ATX whip. Putting the choke on the external power lead close to the power connector cured it on the Yaesu supplied DC power cord.

Interestingly when powering the radio off an external G3TUX power adaptor (http://www.g3tux.co. uk/) the same ferrite choke doesn't cure it. Having got tired of having to remove the radio from its leather case every time I wanted to plug in his adaptor (because it has a right angled plug which wont fit easily through the hole) I chopped it off and fitted a straight plug with a 100pF chip capacitor soldered across it and that fixed the problem.

Versatile Transverter Interface for the FT817

Peter Day, G3PHO

The FT817 is a deservedly popular transceiver, used by thousands of QRP enthusiasts around the world and immediately recognised by the amateur Microwaver as a modern replacement for the ageing IC202 or FT290 "prime movers" of yesteryear.

I've used a couple of IC202 transceivers (one an S model) for over fifteen years and have been very pleased with their performance as a microwave IF, except for one feature … the poor frequency display of ten kHz per dial division. In the past few years, my microwave transverters have been improved so much, with features such as hi-stability OCXOs, that their frequency stability and resetting accuracy now exceeds that of much of my old VHF gear. Hence I thought it was about time I treated all the transverters to a more modern IF transceiver.

In late March 2004 I purchased a new FT817 and was immediately impressed at how Yaesu could pack so much into so little!

My 3.4, 5.7, 10 and 24GHz transverters are designed around DB6NT transverters, constructed from Michael's excellent kits and driven by 120 milliwatts of 144MHz from an IC202S. My 23cm old DEM transverter is driven at 10 watts input by an aged TS700A, while my recently acquired 47GHz gear, bought from a "retired millimetre man", requires an FT290 at 3 watts. Apart from the 23cm transverter which uses a separate PTT line, all the others require a switching voltage on the coax connecting the IF transceiver to the microwave transverter. The 47GHz transverter send/receive is controlled by a positive voltage on TX while the others are switched by a positive voltage on RX. A look through my (almost complete) collection of Microwave Update Proceedings found a couple of relevant articles in the 2002 edition one by Paul Wade, W1GHZ and the other by UK expatriate Dave Robinson, WW2R. Dave's article provided me with the solution to the problem of switching the transverters no matter what the configuration (IC202S or FT290).

The final outcome was the unit shown in the photographs. A versatile and switchable interface between the FT817 and the microwave transverters. This little unit allows the FT817 to directly replace either IC202 or FT290 type transceivers with no modifications at all required to the microwave transceivers. A facility to adjust the RF input to the transverters is also included, as well as a near foolproof protection circuit for those who have been known to get the 12V DC input leads the wrong way round … a potentially disastrous event when out / portable!

Apart from a little mechanical ingenuity, most of this article relies entirely on other people's work. My thanks go to Dave, WW2R, for the basic circuitry.

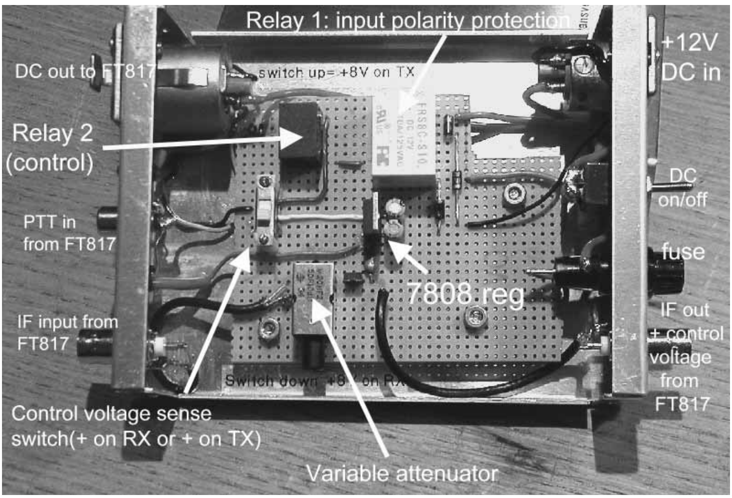
The Design:
The interface module is connected to the +12 volt DC input supply (e.g. a battery if operating portable).

If the supply is connected reversed polarity then Relay 1 does not go over and you will have to reverse the supply leads for correct operation. The correct state is shown by the red LED. Over the years I have found this relay protection just about "idiot proof" and I now have no fear of damaging my precious microwave gear through lack of care when hooking up supplies. The few extra milliamps drawn by the relay is a small price to pay for piece of mind …. and please don't tell me that you have **never** connected a supply the wrong way round!

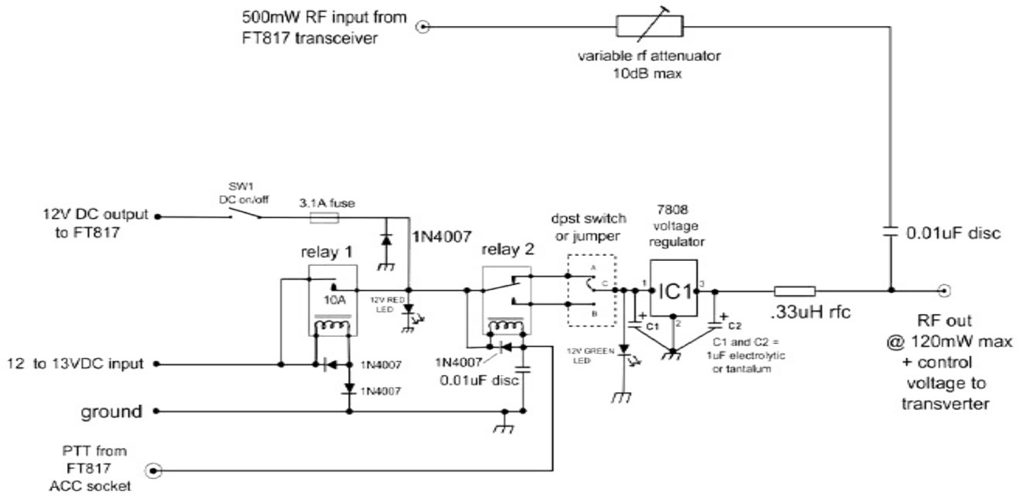
The FT817 power lead is connected to the fused 12V output socket on the interface, while the FT817's BNC VHF antenna connector is connected via a short length of coax to the socket marked '500mW RF input'. The FT817 power output is reduced to 0.5W by means of the transceiver's menu. A coax cable of any convenient length then connects the interface to the microwave transverter. My own system uses a 15 foot length of 50 ohm double screened lead here, the variable attenuator in the interface being adjusted to give 120mW at the far end of this cable.

To obtain full send/receive control of the transverter by the FT817 PTT line, an 8 pin mini DIN plug is wired up to take a short, thin coaxial lead from the transceiver's ACC socket (pin 2) to the PTT phono socket on the interface. When the microphone PTT button is pressed or the Morse key activated, pin 2 ('TX ground') of the ACC socket of the FT817 is grounded to pin 3 and in turn completes the ground connection of the coil of Relay 2 in the interface. This applies 12V to the 7808 regulator IC. Depending on the configuration of the slider switch in the interface, a +8VDC control voltage will be applied to the IF output line on either RX or TX.

Construction:
There's nothing special about this module. One off units like this don't need a purpose made PCB unless you like your gear to look fancy! The enclosure is a small aluminium box I had in the



FT817 /Microwave Transverter Interface



Peter Day,G3PHO, April 2004

“come handy drawer” and I used some perforated board that has strips of copper foil on one side (called “Veroboard” in the UK) for the circuitry. The board should be populated with the various components and tested before it is put into the small aluminium enclosure, as shown in the photographs.

The box is drilled at both front and rear aprons to take the various connectors and switches, making sure that all I/O leads to the FT817 go to one apron and the outputs to the microwave transceiver to the other.

The finished product:
The complete interface is a little smaller than the FT817. If a larger enclosure were used, extra DC and IF output sockets could be fitted, enabling use with several transverters at the same time.

After completing this project I realised it would have been more useful to have the control voltage sense switch on the front apron of the enclosure rather than inside the box!

Components:
The component values are marked on the schematic but a few extra points are added below ....

The variable attenuator:
I already had a few of these nice little pc mounting variables in my junk box. Although they do not provide a constant input and output impedance (and therefore not a good VSWR for the FT817), they are very convenient. A fixed resistive attenuator (T or Pi type) can easily be substituted and calculated from the values of input and output required. I decided not to switch out the attenuator when receiving as my transverters have more than adequate RX gain in reserve to overcome the 6dB or so of attenuation in the IF line. This is probably the case for most systems.

Relay 1:
This is for polarity reversal protection. Any 12V DC type will do here so long as the contacts can handle a few amps. I used one rated at 10A. To reduce overall load on portable batteries choose one with low coil current.

Relay 2:
This is the main control relay. I used a miniature 12VDC type with 1 amp contacts.

With both relays, don’t forget to put 1N4001, or similar diodes, across the coils to prevent “back EMF” effects.

RF choke:
A small axial lead 0.33uH type

8 Pin mini-DIN connector (male):
This is needed for connecting the interface to the ACC socket on the rear of the FT817.

Make sure that the inner of the thin coax lead goes to pin 2 and the shield to pin 3 of the male connector. Use the pin numbers on the connector itself to absolutely sure you have the correct pins. Wrap some insulation over nearby pins, one of which, pin 1, carries +13.8V from the T817. Short this to ground at your peril! Refer to the FT817 manual diagram. On the ACC socket pin 2 is named “TX ground” and pin 3   ground”.

Do not use the PTT pin on the DATA socket.

Control Voltage Sense Switch:
A small slider switched was mounted

on three pins that are soldered through the perforated board.
Pin 1 of the 7808 regulator is connected to the slider. In the schematic, pins A and C are connected by the switch to simulate IC202 control switching while pins C and B provide FT290 type switching. This switch could be mounted on the front panel for ease of use.

Internal IF coax lead:
I used a short length of RG174 here, taking care to minimise the exposed sections of inner conductor at the attenuator and the BNC connectors.

Summary:
The interface worked first time and has been used with excellent results in the May and June 5.7/10GHz cumulatives and millimetre band contests. One added advantage of using the FT817 is that if 'KYR' is selected by pressing key F on the front panel, the C function switch below the main dial puts the FT817 into beacon mode, sending a steady stream of dots or dashes according to your tastes (provided a Morse key is plugged in).
After over a decade of using IC202s to make hundreds of microwave contacts you get quite used to using antiquated gear. Only now do I feel I'm in real control of frequency setting. I got quite a "buzz" from a report by G3LRP that I was only 100Hz out on 24GHz when I called him on 24048.100MHz. I can live with that considering I do not yet have GPS locked oscillators!

References:
1. Bias Tee for Remote Transverter Control - Paul Wade, W1GHZ: Microwave Update Proceedings 2002

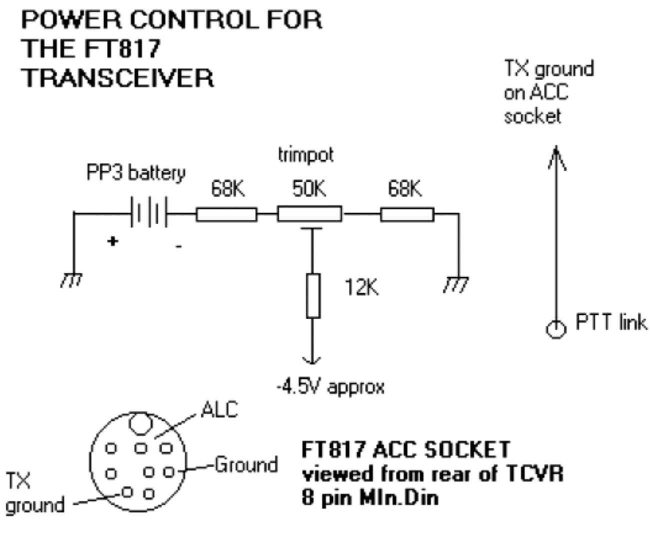
2. Interface circuits for the FT817 - Dave Robinson, WW2R (G4FRE): Microwave Update Proceedings2002 and also RSGB Microwave Newsletter April 2002

Power Reduction for the FT817

Martyn Vincent, G3UKV

Editor's note:
A number of modern transceivers while allowing you to turn the power down to 5 Watts or less, often have an initial "spike" of almost full power for a few milliseconds on pressing the PTT. This can cause damage to sensitive transverters

This is the circuit that G3UKV uses with his FT817 as a driver for his microwave transverters.
The transceiver seems to be an ideal microwave IF and he uses it both on 144MHz and 432MHz in this manner.



Transverter Interfacing and other Useful Tips

Bill, W3IY

W3IY's "Rover" station

Transverter interfacing

Lot's of guys run into trouble when they try to get ready for the higher bands. Many modern-day rigs do not have built-in transverter ports, so the interfacing job can be challenging. I certainly don't know enough about most popular transceivers to be of great help but here's what I did with my IC-706MKII.

I use it as an IF on 144MHz to interface with transverters for 903 - 10368MHz. My transverters all want 2-3W of RF drive on transmit and I haven't blown any up yet! The major task of interfacing a transverter with the IC706 is that of making sure you have a method of reducing the RF output on 2 metres to a level compatible with your transverter. Most popular transverters can live with 2-3 watts of drive (e.g. the DB6NT series … editor) and the nice units from Down East Microwave can be ordered for nearly any level you would want to use. For the 2W level, I built a simple negative power supply board using the 7660 voltage inverter IC. The 706 has an external ALC input, which will limit the transmit power level when it receives a negative voltage between -5VDC and 0 VDC. I just used some perforated PC board material from Radio Slack, and took a 7805 regulator to drop the vehicle voltage down to +5VDC. Then this voltage is fed to the 7660, which turns the +5V into -5VDC, at low current. The ALC input doesn't load down this supply very much, so even though the 7660 only puts out 20mA, max, things will be OK.

Take the output from the 7660 to a 10-turn pot and run the wiper into the ALC input. Of course, you should also add some .01uF bypass capacitors, and some RF chokes, or ferrite beads, to keep things cool from RFI. I set my IC706 for a low level using the built-in power reduction feature, and then keyed up the rig on CW and set the pot for 2.5W output on 144.100MHz. If you are thinking about this carefully, you may ask "Why not just use the IC706 built-in power control?". Well, the answer is that it produces spikes in the RF output amplitude, which can blow up your favourite transverter. I think the reason is that, internally, the 706 filters this line with a capacitor which slows down the response time. It only takes a few uSec to zap your expensive transverter however.

I recently experimented with my FT-100 to see what was required to interface it to my DEM 222 transverter, using a 28 MHz IF. I found that, even with the RF power on HF turned all the way down, there was a 20W RF power spike which occurred whenever I pressed the microphone PTT switch. It only lasted 5 milliseconds or thereabouts, but it's enough to toast a receiver mixer stage (I didn't do this, fortunately). Many guys have blown transverters by failing to realize the existence of this RF power spike. After the initial spike, the RF level was a well-behaved 3W, which was about what my transverter requires. I believe the addition of negative voltage to the FT-100 ALC input will fix this problem, enabling me to use the FT-100 with the DEM transverter. There's a good chance that the transverter would survive this spike, if I could be sure that it was switched into the transmit mode, before the spike arrived. This requires some sequencing, using a foot-switch or a delay-generator to prevent the 28 MHz transceiver from being keyed until after the transverter is keyed into transmit.

We're working on a way to do this, and still use the FT-100 microphone PTT switch. More information will be made available after some testing.

Another successful approach that can prevent RF power spikes from damaging your transverters is to disconnect the DC power from your IF exciter power amplifier. This is a proven approach for the IC706 transceiver, and it's probably applicable to the FT-100 and other radios as well. This idea is from K6LEW who spends lots of effort helping some of the K8GP rovers configure things for the contests. Owen says that it's necessary to go inside of the IC706 to do this, but that it isn't difficult to find the right place to disconnect DC power. About 100mW is still available from the RF output connector, as the RF leaks past the disabled PA stage. The beauty of this approach is that it's easy to restore normal operation when driving transverters is no longer desired (preserving resale value of the IC706). The drawback is that is disables the transceiver from being used for full power operation on the IF frequency (unless switching is added).

Another area which is dangerously ignored by many VHF and above operators is that of sequencing. Lot's of guys have gotten away without doing it but most have already, or will soon be, paying a price for this shortcut. All vhf systems that I am aware of should use sequencers!

Think about it … if you try to key up your transverter, T/R switch, power amplifier, etc, from the exciter, the RF will already be coming out of the radio before the external gear has had time to switch. Yeah, I know about the QST product reviews that show a variable delay in the CW RF output but I don't think any of these rigs provide a delay in the RF output for SSB. (The IC551D that I had many moons ago actually did have a bucket-brigade delay line inside which did perform this job … but it was mind boggling to monitor yourself in headphones with this delay happening).

RF Relays can take up to 100mSec or more to fully close, and hot switching most RF relays will damage them (now you know where many of those "bargain" RF switches at hamfests come from!). Anyway, what I am trying to say is, that to be safe, you really need an external foot-switch or toggle switch of some sort to trigger your VHF-microwave station into the transmit mode … you can't reliably use the microphone PTT contacts, unless you run them through another box of some sort.

If you really want to be crafty, you can build a microphone interface unit which will accept the microphone PTT contacts, and then drive the sequencer, which then drives your exciter to place it into the transmit mode. I like have a separate toggle switch for CW but many operators stick with the microphone PTT switch to trigger the station. Most high-performance stations still use a footswitch, to my knowledge. Anyway, you need to take your PTT source and trigger a sequencer from it. The sequencer should then

1) first close the antenna T/R switch (and the IF relays, if your transverter uses them at the RF in/IF out),
2) the sequencer should key any power amplifiers being used, and
3) key up the exciter… in my case the IC706. Most radios that I know of have a keying input line for remote transmit activation.

How long should the time delay be for these steps? It depends on your specific equipment, but typically, 50 milliseconds is long enough between each of the above steps. DEM makes excellent sequencers, although they are a bit large.

DB6NT has a nice series with various current output levels up to >10A DC current. These latter units have less flexible voltage levels, and they use P-channel MOSFETs to switch large currents.

The real beauty of the DB6NT sequencers is that they are a little larger than a postage stamp! Very nice to add inside a power amp or something.

DC Switching

Speaking of P-Channel MOSFETs, these puppies are awesome! Using them, you can implement a small high-side DC switch, using a ground-to-transmit-high-Z input. All you need is about a 22K pull up resistor between the +V input (the source), and the gate lead (control input). When you ground the gate, high-current DC is available at the drain lead. Use a fuse because, if you don't, the low Rds-ON of a good P-channel FET can produce a nice pyrotechnic display and smoke your equipment! Anything that provides a ground will trigger the largest P channel FET. Don't forget to use steering diodes, though, if you plan to switch multiple things from one set of PTT contacts.

Also, many modern rigs have a very limited keying output signal which can only sink a small amount of current...perfect for P-channel MOSFETs. The best FET I have found is the IRF4905 device from International Rectifier. These bad-boys will switch 70 Amperes!! … and they are still very high-Z input … what's not to like? They are available from Digi-Key (albeit at highly inflated prices). For a good deal on these FETs, go to an electronic supplier like Newark, Future, or Avnet where you can get them with a credit card for about $1.00 each! These things are the control element-of-choice for solving many switching problems.

The Rds-on is lower than most pieces of wire!! It's like a true solid-state relay for positive supply currents. Have fun and get those transceivers talking on the microwaves. We're waiting to work you!

Dual-Band Feeds

Dual-band feeds are really handy for roving. W5LUA, W5ZN, and others have done a great job describing these feeds in one of the Microwave Update proceedings. It's wonderful to get 2 dishes for the hassle of just one.

However, if you want to put some horsepower into that feed, BEWARE! The DEM 5.7/10GHz feed has pretty good isolation between the 5.7GHz port and the 10GHz port, when you are transmitting on 5.7GHz, but on 10 GHz, there is a lot of leakage into the 5.7GHz rig. If you are running more than 100mW, I strongly suggest that you consider a simple modification to your hardware. I am using +12V on both band's T/R relays, and I ground one side to close the relay for transmit. (this is a common way that folks use). Here's what you can do...if you also are doing a ground-to key on your RF switches. Run a wire from the ground-to-transmit terminal of the 5.7GHz relay through a diode, with the cathode away from the relay. Run this line to the control line feeding the 10GHz relay. Then, do the same thing from the control terminal of the 10GHz relay, through the diode, and over to the control circuitry of the 5.7GHz hardware. Now, Whenever you transmit on either band, you will throw both RF relays into transmit, but you will only key-up the band that you are transmitting on.

I find that I can leave the GaAsFET preamps fired up without any problems, but some guys like to switch them off during transmit. I don't think it matters, as long as you keep the preamp inputs down to 0dBm or less. (some have reported +20dBm as the threshold of pain...but you could damage the NF with less). This is a really big problem for me on 2304/3456. I have a dual-band feed for these bands, and the isolation from 3.4GHz to the 2.3 GHz port is very low...like 12dB or so. If I light off my 40W on 3456 into this puppy, I get more than 2W of juice into the 2304 preamp. Ouch!!%&*#(@__+!! Fortunately, I haven't done this but I plan to install it before fielding my 2.3/3.4GHz dish assembly again.

Good luck and protect your precious preamps!! Allegedly, the newer dual-band feeds from Directive Systems (& Down East Microwave) are better tuned to optimize isolation, but you could still get reflected RF power from nearby antennas or ground-clutter that could cause problems.

Transverter Interface for the IC746
(and other HF Transceivers)

Andy Talbot, G4JNT

The IC746 transceiver's output power is adjustable over the range 5 Watts to 100W from a front panel control, and the obvious solution is to simply turn this to minimum and use a 5 Watt rated attenuator to reduce the transmit RF to the few milliwatts needed for transverter driving. This, of course, is a recipe for disaster! Remembering to have to set the drive control to minimum each time a transverter is used means that it would be very easy to unintentionally apply 100 Watts to the attenuator, almost certainly destroying it and with the potential of damaging the transverter further up the chain. One solution would be to simply rate the attenuator at 100 Watts but that would just be plain silly!

Automatic Level Control
An ALC input to a phono socket on the back of the rig is intended primarily for use with external linear amplifiers to allow these to operate at the correct level by varying the RF input to them automatically - equivalent ALC input connections are usually available on other makes of transceiver. The handbook specifies an ALC control voltage in the range –1V to –4V and tests with a variable voltage applied to the ALC socket confirmed that the RF output on all bands could be reduced to zero with a voltage that in fact only had to vary over a relatively narrow range around minus 1.6 volts. In practice, the absolute value of this voltage will vary for different transmitters and is likely to shift with temperature but the relatively narrow range needed – which points to a high ALC loop gain – will be a common feature, ensuring constancy of output level from external linear amplifiers in spite of any gain variations over the operating bands. For interfacing to transverters, a negative voltage derived by rectifying the RF from the antenna connection directly, then feeding back to the ALC input ought to make it possible to set the wanted RF level.

Fail Safe Operation
In its simplest case, this is all that is needed for the transmit RF part of a transverter interface – a 50 ohm load with RF pick off, and diode detector across it. However, we still need to provide transmit receive switching since most transverters with low level inputs have separate transmit and receive IF ports and there is still a potential danger here in that the reduction of RF is governed by a physically separate connection. If this connector is forgotten or fails, the full 100 watts could still appear on the transverter input which, if it is now designed to accept just 40mW, could be catastrophic. The method of preventing damage from this failure mode is to add a relay at the interface input, controlled by the rectified voltage, such that if too much RF is applied the relay opens, preventing overdrive and damage. This does mean that the transceiver will now be operating into an open circuit, but its own self protection circuitry - which is always present in any self respecting rig - can now come in to play and prevent damage to the PA stage. An audible warning of this situation such as a buzzer helps to immediately identify a problem. Obviously, the relay contacts need to be normally open and the relay pulled in for normal operation, so

that if RF is applied without DC power being present on the interface no RF can pass into the attenuator elements. As it is difficult to use a negative voltage to control switching circuitry when a can usefully be used here. Having the two separate level detectors for different functions is, in any case, good engineering practice as it separates the level control feedback from the overload warning circuitry.

Other Circuit Elements
A complete transverter interface will provide separate ports for transmit and receive. To do this needs transmit / receive control from the transceiver to direct the RF to the appropriate interface port; and, since this switching function is now available, provision of switched Tx and Rx voltage supplies for transverter hardware might as well be added. All transceivers provide this control output for linear amplifier switching, usually in the form of a switch closure to ground. On the IC746, the Tx/Rx connection is on a second phono socket adjacent to the ALC input – what a coincidence – but, surprisingly, not duplicated directly in the accessory socket.

Complete Transverter Interface
The circuit diagram of the complete interface is shown in Figure 2 and works as follows. The negative ALC voltage is derived from D1/D2, these are driven from a capacitive potential divider to lower the voltage across the diodes should the full 100 Watts be applied. VR1 sets the ALC level and therefore the RF power that needs to be dissipated. A 5 dB power attenuator, capable of absorbing 3 W continuously, follows a normally open relay contact in the RF input path. This attenuator is left in circuit on receive as well, but there should always be sufficient IF gain in a transverter to permit a small amount of attenuation in the return path. The second overload detector sits at the output of this 5dB attenuator and consists of D3/D4 feeding into a level
sensing circuit. This maintains the relay RLA1 pulled in, closing the RF path. The threshold voltage is set by the values of R1, R2 and ZD1. With the values shown, the relay will trip at approximately 1.5W at this point, equivalent to 4.5W from the transceiver.

The DC supplies for Rx and Tx DC power are switched alternately by two P channel MOSFETs controlled by the T/R line. The devices specified can carry 5 Amps continuously but can be directly replaced by higher (or lower) rated devices if needed. Some time ago I adopted a UHF / Microwave transverter driving standard with 144MHz IFs of 0.5 to 1 Watt on a single coax lead, with a DC voltage superimposed on this on receive only for T/R control This standard is compatible with the old IC202 144MHz SSB transceiver with its ALC pot wound to maximum. By connecting the DC coupling link and taking the output connection from point 'X', this control standard could be generated from the interface here, ensuring compatibility with all existing transverters when the IC746 is used for 144MHz.

Construction
Only the RF path is layout-critical and a suitable 80mm x 50mm PCB layout is shown in Figure 1.

This employs mostly surface mount components and wire ended resistors for the higher power attenuator elements. No precise component details or list is shown as most of the components may be substituted by ones of a broadly similar kind.

Depending on the drive frequency chosen, the value of the coupling capacitors and DC chokes may need to be altered. The values shown are optimum for the 5 to 50 MHz range; for a 144MHz drive frequency the 10nF capacitors could be reduced to 1000 pF and the DC chokes to 220nH. VR1 is adjusted to set a level of no more than 5W carrier from the transceiver to avoid cooking the 5dB attenuator. If this level trips the overload circuitry, either reduce the value of R2 slightly or operate at a lower interface level. A suitable point might be to trip at the 7 - 8 watt region as modern metal film resistors should be able to survive this sort of abuse for short periods. By connecting a DC operated piezo sounder at the point Z, audible warning will be given if the interface encounters an overload situation.

Summary

The technique shown here, using a commercial transceiver's ALC input to control the level supplied to a transverter and backed up with additional independent overload detection circuitry, provides a safe interface that will prevent damage to transverter equipment if connections are left off or fail. The only residual danger that can still occur is if the transmitter cannot operate safely into an open circuit - but this is only likely with ancient valve PA rigs and these often have a low level output (with the PA heaters switched off) for driving transverters anyway.........

FIG. 1: PC BOARD LAYOUT – G4JNT INTERFACE
The pc board measures 80mm x 50mm

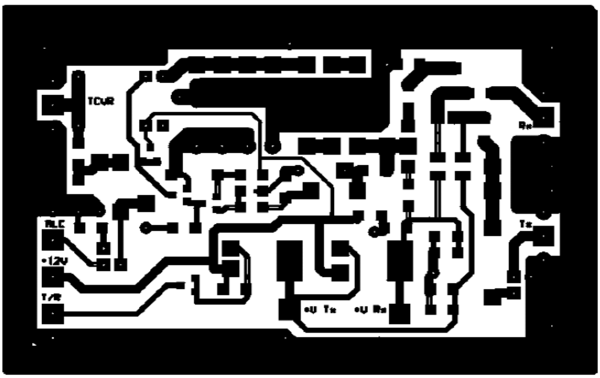


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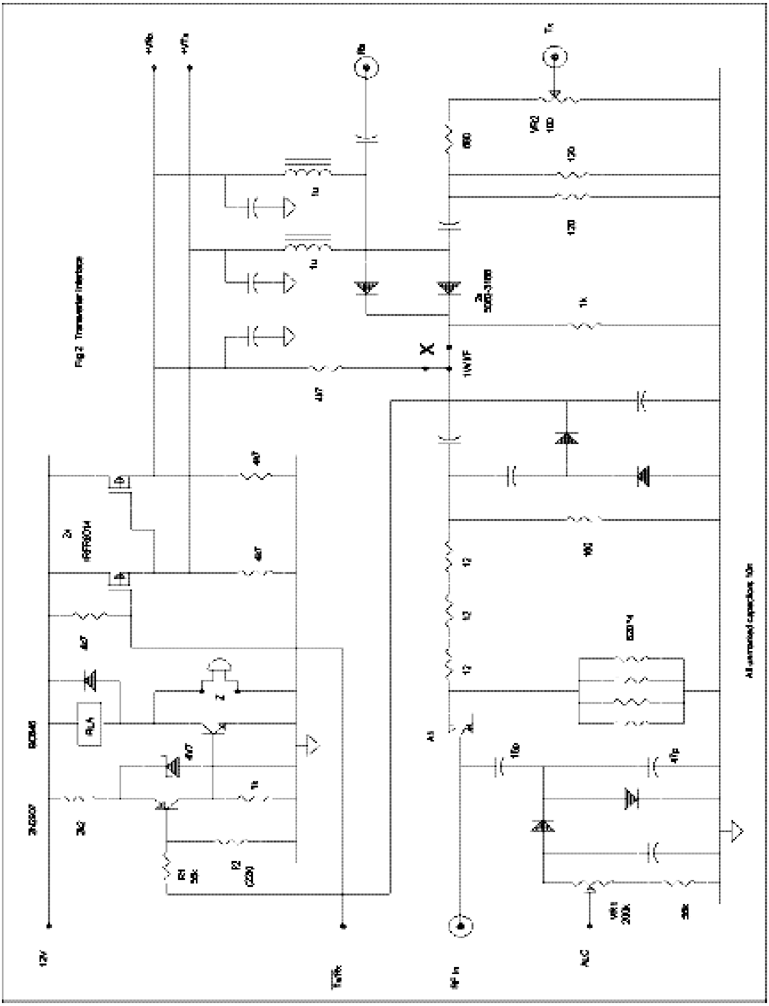
FIG. 2: CIRCUIT DIAGRAM – G4JNT INTERFACE



Modifying the FT736R for Microwave Transverter Switching

Keith, GW3TKH

Until now, I have used a FT290R as the 2m IF for my transverters at home and portable.

In transmit mode, this transceiver has a +9V phantom voltage on the RF at the antenna socket which is used to switch the transverter.

I recently acquired an old FT736R for use as a microwave IF in the home shack and investigated modifying it to provide a similar switching voltage. This turned out to be quite easy, as the FT736R has a switchable receive pre-amp supply applied to the antenna socket and is selectable internally with 'U' links. It is normally deselected (see the handbook), which is the condition we need, as some of the wiring is used in this modification.

Proceed as follows:

1. Remove the top cover, taking care with the speaker lead.
2. Referring to the 144MHz PA UNIT circuit diagram, remove the BLUE wire from feed through insulator 'PRE'. Insulate and tie back the wire.
3. Take a 10k 0.25W resistor, fit a small ferrite bead on each lead, solder between feed through insulators 'TX9V' and 'PRE'. This puts +9V on transmit at the ANT socket. (If a dc short circuit is applied to the ANT socket, i.e. a 2m antenna, the max current drawn is <1mA, so no damage will occur.)
4. If necessary, the power is set up to the required maximum to drive your transverter. (see adjustment details by GM4PLM on www.mods.dk)
5. Replace the top cover, not forgetting to reconnect the speaker lead.

This modification is easily reversed if required and/or can also be applied to the 70cm PA. I have been using the FT736R modified as above, set to a maximum drive level of 500mW, to work with microwave transverters by DB6NT and SSB Electronics. No adverse effects have been noted!