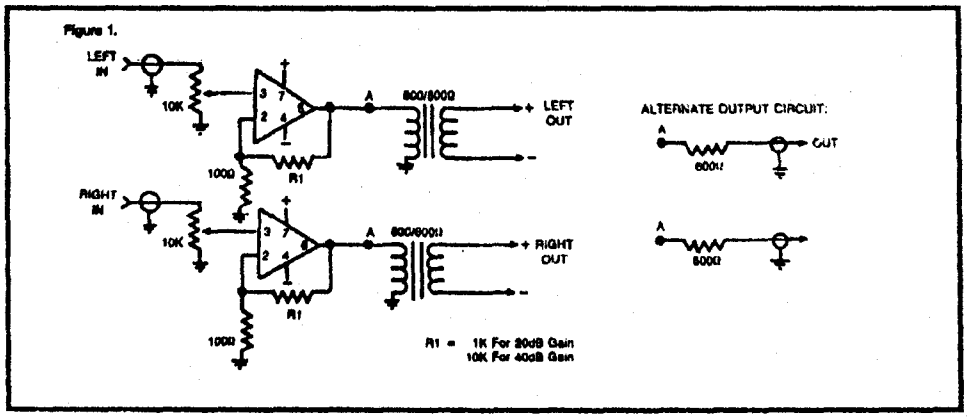
Experimental Broadcaster's Newsletter

Volume 6, Number 6
June 1989



Several subscribers have had similar problems recently. They have a device which has a 600 Ohm broadcast standard input, but are attempting to feed it with consumer type (medium to high output impedance) audio gear. Additional amplification may or may not be needed. The Panaxis stereo MacroMod Compressor would do the job of course. So would the Panaxis universal pre-amp (adjusted for zero gain).

No sooner do I finish answering someone's questions about this, up pops my newest copy of Radio World, and.... an article on line drivers. It's just what the doctor ordered. The circuit is similar to those found in National Semiconductors' Linear IC Handbook, Panaxis' USP plans and other such publications.

The circuit uses any good low-noise op-amp IC. Each can be in its own separate package or in one package as a "dual" op-amp. Although some op-amps require only a positive power supply, best results are obtained where both a + and - supply is required. A good op-amp can yield an output of +15dBm or so which allows ample "headroom".

The input is a simple potentiometer whose resistance is high enough so as not to load the source device (CD player, inexpensive mixer, etc.). Gain is set by the ratio of the feedback resistor and inverting input terminating resistor. Assuming the terminating resistor is 100 Ohms then the feedback resistor = 100 Ohm (zero gain), 330 Ohms (about 10 dB gain), 1000 Ohms (20 dB gain), 10K Ohms (40 dB gain).

The output can be "balanced" by using a good grade of 1:1 audio transformer. A single ended output can be taken directly through a 600 (or 620) Ohm resistor.

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Letters From Our Readers

Dear EBN,

The last two months have brought a substantial turnabout in my outlook. I finally got my new ten watt transmitter working. It performs exceptionally well, especially when I have it tune right. My four-bay antenna system is providing an excellent signal in my intended coverage area. The two-bay vertical, two bay-horizontal combination seems to be quite effective in aiming a signal a particular direction. In late March my work paid off at 1 A.M. when I finally heard my strong signal in town, four miles away. Since then I have been working on achieving maximum signal and audio tone. I had been perplexed by an intermittent loud hum in my audio. I finally realized that it started every time the nearby furnace came on.

With most of my trouble gone, I am now looking to establish some programming. Unfortunately, I've only got about fifty CD's, records, and tapes, hardly enough to sustain a radio station. I hope to get at least thirty more CD's this summer and operate six hours per day starting this fall. I have calculated that with about ninety different CD's, I can run the station six hours a day, six days a week without repeating many songs.

As far as running the station, I was interested in the subject of automation. I have been considering putting programs on six or seven stereo VHS tapes and running them throughout the week, except Friday and Saturday nights. While this would be a lot of work at first, I could run them for weeks or maybe months before people ever figured out that they were hearing the same sequence of songs once a week. I am a very critical radio listener, and in most cases, I couldn't tell you a sequence of songs I heard an hour ago, let alone a week. We'll see, though. I wonder if there are any automation techniques that anyone out there has adopted that work well?

I will be going to England in June, and will have my ears peeled for any experimental stations there. I guess there are quite a few. I have never heard an experimental station before as there are none around here. It would be interesting to hear one. Well, until next time, keep doing a good job of turning out the EBN.

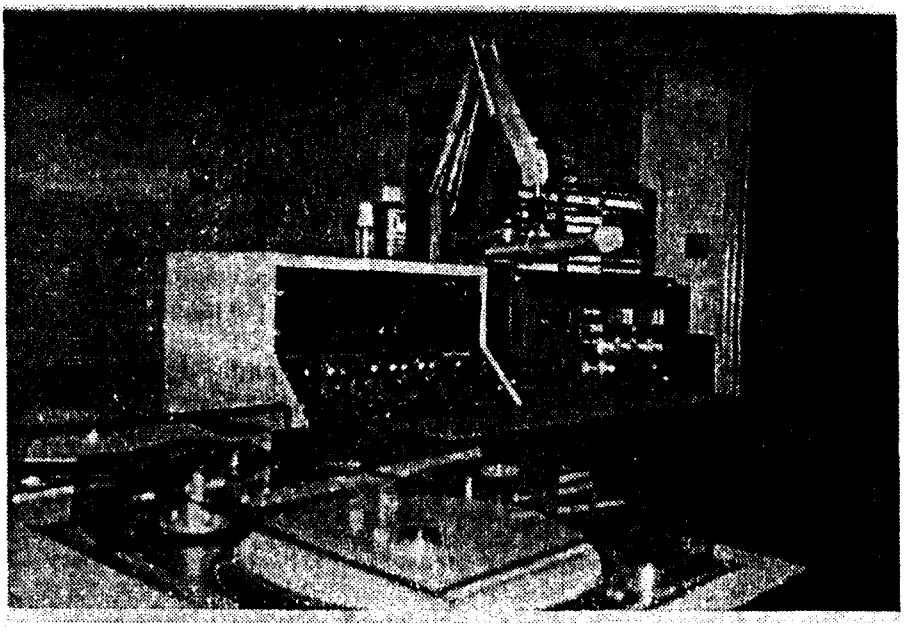
J. Z.

Dear EBN,

Just recently I completed my new portable console for weddings and etc. Enclosed you will find some pix. Haven't had much time to go on the air recently. Also I am living in a Condo and I am not allowed to erect any outside antennas. Maybe that would be a good mini lesson - an inside effective antenna? Also the frequency that I have been using all these years will soon be used by a new commercial station now being built.

Keep up the good work. When I get some better pix I'll send you some.

W.B. - WRZ



FCC and Other Stuff

$18.75 PER WATT

WGAR AM and FM in Cleveland apparently were upset when a low-power broadcaster invaded their territory. They notified the FCC in Detroit. The FCC in turn investigated and located WKEY, a 40 Watt unlicensed station, in South Euclid. The operator was using an Army surplus T-14 transmitter. Reportedly the FCC will levy the customary $750.00 fine.

MONEY, MONEY, MONEY!

Commercial stations have tried to catch habitual dial twiddlers since radio began. If you can't get them to stop on your frequency with good music, then by all means make it the loudest station on the air. When you've compressed, limited, equalized, and done everything short of nailing your VU's pointer at 99% modulation - what do you do next? Get louder than the other stations - NO MATTER WHAT?

Some Chief Engineers in the Los Angeles market fear they may be headed for a MODULATION WAR. New to the area is Scott Shannon who, when at WHTZ-FM in New York, made news with his heavy processed "Morning Zoo" format. Some feel that show may have started a modulation war. They don't want that in L.A.

It seems the primary goal of most commercial stations is not necessarily in the "public interest" - it's the owner's interest. That goal is to make MONEY. You get money by getting advertisers. You get advertisers by getting (or appearing as if you have) listeners. You get listeners by being LOUD (a good format helps also). In other words, "It pays well to be loud as hell".

WHAT? NO PIRATES?

The FCC says there are 4,948 AM stations, 4188 FM stations, and 1388 non- commercial FM stations. They don't make mention of unlicensed stations, but Brooklyn would stand high on the list.

THINGS ARE LOOKING UP FOR AM

At one time AM radio stations were limited to an upper audio response of 5,000 Hz. AM channels are spaced 10 KHz apart. The channel spacing allows room for upper and lower sidebands of 5 KHz each. Later, a few AM stations were allowed 7,500 Hz response, provided their sidebands would not interfere with other channel sidebands.

Then came a proposal to add pre-emphasis to AM, somewhat like what is done with FM. This was known as the NRSC standard. That has given way to the NRSC-2 standard which incorporates a 10 KHz stop band. Supposedly this will give AM a higher quality sound yet reduce sideband interference. The FCC has now made these standards mandatory - stations are expected to adopt the standards within four years.

Receiver manufacturers must now hit the old drawing board. A de-emphasis circuit must be added. It in turn must be switchable in\out so the radio is compatible with standard AM.

THINGS LOOKING DOWN FOR FM?

Several years ago the FCC put a stop to new licenses for class D (10 Watt) FM stations. Schools, colleges, small communities and small churches lost the opportunity to serve their immediate surroundings. Station licenses it seems were only available for the "big boys". With no outlet it's no wonder that some small churches "pirate" their services once a week; schools bootleg small stations; and other unlicensed stations are on the increase.

Next came deregulation, a part of which is circumventing the intent of the Rules governing physical spacing between classes of stations. This proposal makes use of directional antennas to "shoe-horn" stations into areas where they normally would not be allowed. This gets more "big" stations into the act, but still no hope for the little guy.

The latest proposal is to establish a "Class A1". The main idea of this thrust is so small daytime AM stations can simulcast on FM! This is another effort to help ailing AM radio, unfortunately at the expense of FM radio. With the FM channels already pretty much accounted for where does one find a channel for Class A1? Easy, take it from the channels reserved for low-power educational (non-commercial) stations. This would further reduce the possibility that Class D (10 Watt) stations would ever make a come back.

This seems to be a possibility for abuse, much like FM translators. If a broadcaster is not happy about his natural coverage area, extend it! Get a translator or add an FM station. Those that have stations, get more stations while the little guy gets none.

Mini-Lesson, FM Power Amplifier Analysis

We have two submissions of FM amplifiers this month. One is from Italy and the other apparently marketed in the U.S.

The circuit is one that is used in Italy by radio pirates. Apparently it was designed for either 88-108 MHz or 145-146 MHz. It uses a bi-polar transistor rated for 60 Watts.

Transistors exhibit a capacitance between each of the junctions. The junctions are between the emitter and base, and between the base and the collector. Bi- Polar transistors exhibit a greater capacitance value than do Field Effect Transistors (FET's). FET's exhibit this capacitance between the source and gate, and between the gate and drain.

The capacitance between emitter and base (source and gate) tends to "short out" the input signal. In addition this input capacitance is seen as a reactive load for the driver (oscillator, exciter, etc.). The transistor can give a greater output if the input circuit capacitance can some how be reduced or be compensated for.

Inductive reactance is exactly opposite of capacitive reactance. This is why you often see an inductor in series with the base (drain) of the transistor. The coil has been designed to exactly cancel the effects of the input capacitance.

A similar situation is present in the output circuit. In addition the amount of internal capacitance shunting the output is related to the power output. The greater the power the greater the capacitance. This makes design of the output tuning circuit a bit difficult. It often requires multiple coils to change the very low output impedance (caused by large capacitance) to a usable antenna impedance.

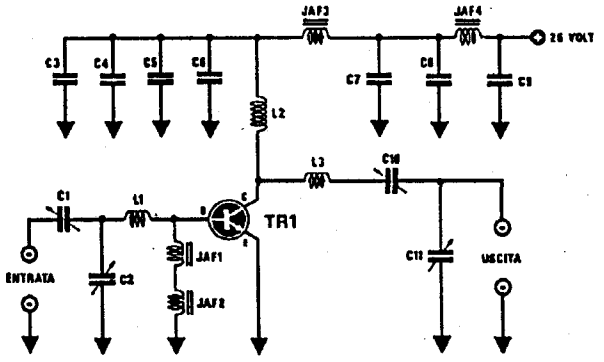
Power amplifiers operate by means of "pulses". While the output from the oscillator or exciter is a sine wave, the amplifier only uses a portion of the positive half-cycle. These this short "pulses" cause large current pulses to flow between emitter and collector (source and drain).

When these pulses are fed to a resonant circuit they are transformed back into sine waves. Each pulse produces a damped oscillation in the circuit. The frequency of the oscillation is determined by the values of inductance and capacitance. Because one pulse follows another the damped oscillation doesn't have time to die out but is instead reinforced. This produces a continuing sine wave. (See page 6, Resonance Experiment)

These heavy current pulses are of course furnished by the power supply. This means that all wires which supply the current to the amplifier are part of the output circuit. Each of those wires can therefore radiate RF energy. This is not good. To eliminate that problem "by-pass" capacitors and RF chokes are placed in the current path.

Now let's examine the circuit:

Fig. 1 Schema elettrico

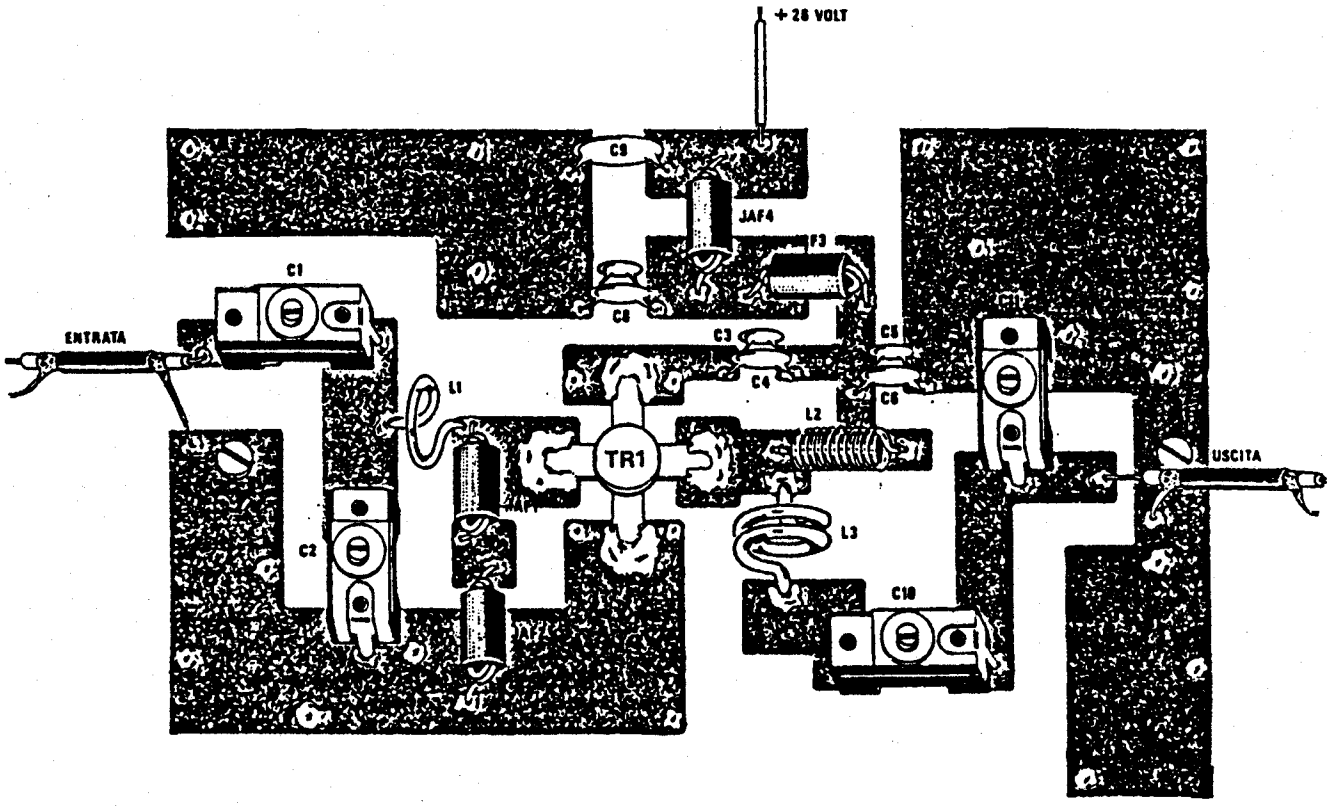


An input signal enters at ENTRADA, passes through C1 and L1 to the transistor's base. L1 is the inductance that compensates for the base capacitance. C1 and C2 adjust the input impedance so it matches the output impedance of the oscillator or exciter. The base operates without bias (no D.C. voltage present) by connecting it to circuit "ground". The RF however sees the RF chokes JAF1 and JAF2 as a very high impedance and therefore goes to the base instead of ground.

The large current pulses pass through the transistor (emitter-collector) and L2. The power supply and associated wires are isolated by means of JAF3, JAF4, and by-pass capacitors C3, C4, C5, C6, C7, C8, and C9.

The output signal is developed across L2 which also compensates for the large output capacitance of the transistor. L3, C10 and C11 make the resonant circuit required. C10 and C11 also act as an impedance adjustment. They allow one end of the circuit (L3) to match the output impedance of the transistor, while the point between them matches the load (antenna) at USCITA.

Mini-Lesson, FM Power Amplifier Analysis



Actual Size - 60 Watt Bi-Polar FM Amplifier (Heat Sink of the same size required)

The second FM amplifier submitted uses a MOS-FET transistor. As someone is apparently marketing the plans for it we've been asked not to show it in its entirety. So, for analysis sake we'll simply show the schematic with the component values removed.

MOS-FET transistors have a very low input capacitance (see previous discussion) and often do not require compensation. A simple resistance termination may be used for the gate to ground through a bias source.

The FET's output capacitance however must have compensation. This is done with L2 and L1 in combination. C4 resonates L1 to the desired frequency. C3 couples and matches the amplifier output to the load.

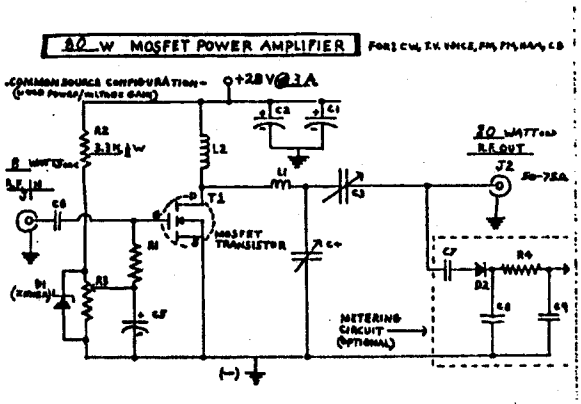
There are a couple of points the designer should consider.

(1) There appears to be insufficient RF suppression for the power supply wires (see previous discussion).

(2) The optional metering circuit won't work. C7 has no current return path. When the diode begins to rectify the RF signal it charges C7. Having no way of discharging C7 blocks the diode from further action. Unless the antenna has a D.C. current path C7 can't discharge.

Simple cure: Place an RF choke from the center of J2 to ground. It won't hurt the RF any and it provides a D.C. return path for the diode.

(3) The wire specified for coils L2 and L1 is #18. This is a shade small for 80 Watts. Wire size should be at least #14 to #12. Remember, RF currents travel on the SURFACE of the conductor, not through the cross sectional area. A larger diameter (wire size) gives a larger surface area.



Experiment in Mechanical Resonance

A mechanical equivalent of an electrical "resonant circuit" can easily be demonstrated. Take a yard-stick and place it on a table. Adjust it so 1 foot of it is on the table while 2 feet are hanging over the edge. Place your hand firmly on the 1 foot portion and near the edge of the table.

With your other hand slightly pull down the end of the 2 foot portion and let it go. It should vibrate up and down fairly fast and may produce a sound. This vibration dies out after a short while. This is what we call a "damped oscillation". If you were fast enough to tap the yard-stick at its end at exactly the time it was moving downward, and do that continually, the vibration would be continuous at that frequency.

Also note that it takes less force to push the stick down at its end. This would be its "high impedance" point. If you move along the 2 foot portion toward the table it would require greater effort to push it down. This would be the low impedance point. This may seem reversed to you but think of it this way. High impedance electrically represents a relative high voltage/low current relationship (greater movement at end of the stick). Low impedance electrically means a low voltage/high current relationship (less movement at the table end of the stick).

If you adjust the stick to 2 1/2 feet off the table, with your hand holding the remaining 6 inches on the table, you have changed its frequency. Again pull down slightly on the end and let go. The sound you hear is lower pitched, and the motion you see, is slower. This is electrically equivalent to increasing the inductance and/or capacitance of the circuit. If the stick is shortened the frequency will increase. You are now able to tune your stick! Isn't science wonderful?

Bulletins, For Sale, Wanted, Etc.

FOR SALE: FM-2 Stereo Transmitter, operates and sounds great! Asking $125.00. Call Joe (717) 965-2270 after 6 PM EDT.

WANTED - Dead or Alive: RCA microphones models 44-B, 44-BX, 77-D, 77-DX, also other RCA ribbon microphones wanted. CASH PAID! If found, CALL IMMEDIATELY 615- 691-0821, Julian Burke, 1423 Marconi Dr. Knoxville, TN 37909.

FOR SALE: EPSON PX-8 lap top computer - - complete with word processor, calc., basic and more software! Included are an internal modem and one external modem (for when on the road) and EPSON printer! Computer and accessories are only six months old - - have to sell! Asking $500.00. Call Jim for more info. (518) 7902-9290

WANTED: AM100 with PS700 power supply and AMA5000 in working condition. Albert, (714) 531-6052

WANTED: Contacts with U.S. low power broadcasters and free radio stations. I can provide you with mixeed format music programmes. I also have many mega mix/ 12" remites as these are for the European market they could well be different to the ones in your collection. Please send replies to the EBN. Mark Richards - NFM Radio - England

FOR SALE: CBS AUDIMAX III (AGC)$200.00. HARRIS Peak Limiter M-6631 - Solid Statesman FM limiter, $250.00 or $400.00 for both. Also SONY 377 reel-reel 1/4 trach tape deck $150.00 plus shipping. Contact H. Edgar Cole, 1108 Bartow Rd #i-101, Lakeland, FL 33801

FOR SALE: Versacount V-322 10 W FM exciter, tuned to any frequency, recently rebuilt, $850.00. M. Patton, WXON 6819 Cesanne, Baton Rouge, LA 70806 (504)-292-4189

FOR SALE: BE FS-30 stereo generator, like new, $1200.00 G Gray, WRQR, PO Box 1546, Greenville NC 27835 (919) 830-0944

End