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The Cam AM Transmitter

Introduction

This is a simple low power (approx 0.35W) amplitude modulated phone transmitter whose frequency is controlled by its on board ceramic resonator or crystal. The standard kit is intended for 80m or 160m where the ceramic resonators will give a useful tuning range. Modulation is achieved by an audio power amplifier (or modulator) whose quiescent output DC voltage is half the supply voltage. The speech amplifier drives this to achieve the maximum RF output (4 times the nominal carrier power or about 1.5W peak) on speech peaks as the modulator lifts the RF output stage supply up to the incoming main supply voltage (13.8v etc). Provision is made for adjustment of the RF carrier level for use with the Somerset Range Linear amplifier kit which can raise the output to a carrier level of 2.5W with peaks of 10W.

The part numbers of the matching RX, the Cary Regen TRF, start at zero; those for this kit start at 100, with band parts numbered up from 130. Please read right through these instructions before commencing assembly.

Technical Aspects

Principle of operation The Block diagram is given in Fig, 1. An RF oscillator, whose frequency is controlled by a ceramic resonator or crystal, drives a pair of BS170 MOSFETs TR100/1 which are used in the RF output stage. Their supply voltage is normally set to approximately half the incoming supply voltage, but with the much amplified microphone signal superimposed; this allows the RF stage supply voltage to swing between 0 volts and the full incoming supply voltage in response to the microphone signals, so that the RF output stage produces amplitude modulated RF. The normal (no audio) carrier level is thus one quarter of the maximum RF output power. The speech amplifier increases the microphone signals to drive the audio modulator which provides this varying RF stage supply. The RF output stage is followed by a low pass filter to prevent radiation of the unwanted transmitter harmonics.

The following more detailed notes should be read in conjunction with the full circuit given in Fig. 3.

Supplies The normal supply range is from 9 to 16v DC; which can be drawn from the protected supply point of the associated receiver. The RF oscillator and driver use a 5v1 Zener D100 to stabilise their supply. All other circuits use the main incoming V supply.

RF Oscillator One gate IC100B of a digital 74HC02 quad NOR gate is used for the oscillator; it is enabled when its N input is low – either from a Netting switch or when the microphone PTT switch is closed. The frequency is determined by X130 which can be either a ceramic resonator or a crystal. A ceramic resonator will allow a few 10s of KHz of tuning by the trimmer C108A; 2.0 & 3.69 MHz resonators are available for 160 and 80m but it will often be necessary to add C107B and C108B to lower the frequency into the part of those bands normally used for AM. For the higher bands you will need crystals that are likely to be specials and expensive! The tuning range will be very restricted and C107B/108B should not be used. When active, the oscillator output can be monitored by a counter etc on point C.
RF Output stage A pair of BS170 MOSFETs are used for TR100/1. Because of their relatively high gate capacitance, two of the digital gates in IC100 are required (working in parallel) to drive the output devices properly on the higher frequency bands. These driver gates, and hence the RF output, are only enabled when point K is at 0 volts; for AM purposes grounding K is normally done by the PTT switch through D103. (If the transmitter is to be used for CW, the key can be connected between K and 0 volts; the keying will be a little hard owing to the lack of any RF envelope shaping.) The actual level of RF output is directly proportional to the instantaneous supply voltage at the point S - this positive supply to the output devices comes directly from the modulator TR102 whose quiescent output voltage is set to approximately half the incoming supply; under normal AM conditions this has the high level audio from the mic superimposed on it. L100 and C102 provide RF isolation and decoupling of the changing RF supply voltage.
Low pass filters The inevitable harmonics in the signals from TR100/1 are removed by the double pi low pass RF filters - L130/131 and associated capacitors. The filter is designed to attenuate any RF signal from just above the desired output frequency and operates with the 50R load presented by the antenna or aerial matching unit. The inductance required for L130/1, and capacitance needed from C130-135, are band dependent as defined in Table 1. The inductance is altered by changing the number of turns on the powdered iron toroid cores used for L130/1. For 80 and 160m, the required capacitance is achieved by fitting series or parallel combinations of a single type of 1500 pF yellow high voltage capacitor. This is more fully explained later. Table 1 indicates the 'nominal filter capacitance' which is required at each end of the filter for C130/1 and C134/5 – however, the capacitors fitted for C132/3 have to provide twice this nominal figure. For the higher frequency bands, you will need to obtain the different values indicated in Table 1.
Linear & TR switching The Linear kit can be used for higher output powers. It is designed to be inserted between the normal output devices TR100/1 and the low pass filter using the two points marked L, this avoids any extra TR switching or low pass filters. If the rig's AMU is to be connected to this kit, you can insert the TR switch or relay between the points marked R.
Speech amplifier TR105/6 are a pair of DC coupled BS170s arranged to amplify the mic audio signals over a bandwidth of about 300 to 3000 Hz. The input is designed for dynamic microphones which normally expect a load impedance of about 1K. The output stage TR105 is a buffering source follower whose output level is adjusted by R114 to just achieve full modulation of the RF envelope.
Modulator The speech amp drives a second pair of source coupled BS170s TR103/4 that provide the drive for the BD136 modulator output stage TR102. Again DC feedback is provided through R106 so that the quiescent DC level on the collector of TR102 can be controlled by the preset R102. Normally this is set near the middle so that the collector voltage is approximately half the incoming supply – thus providing a quarter of the absolute maximum RF output. R103/C103 provide extra decoupling against supply transients while R107 is a gate stopper to prevent UHF oscillations! In normal use the modulator is shut down during reception, to help keep it cool, by the action of R108 which overrides the normal DC feedback; when the PTT switch is closed D101 isolates R108 from the audio path. The quiescent modulator output can also be controlled at the high impedance point Z. When the Linear is used, the Cam's own RF output has to be adjusted (down) to prevent clipping in the Linear, this is done by reducing R102 and then reducing the audio drive from R114 so as to just achieve full modulation.

General Construction Advice – Double sided PCBs

Not all of the points below maybe applicable to your particular kit but in general you should sort the parts into different types and check against the parts list to make sure all are present and can be identified. If some parts come in a separate band bag do not mix them with the rest! The electrolytic capacitors supplied may have a higher voltage rating than stated in the parts list - this is quite in order - their polarity is indicated by the minus sign on one side of their body. If necessary, use a magnifying glass to read the value of small ceramic capacitors or, if possible, measure them. The number printed on capacitors is the value and does not indicate the temperature characteristics. Comparing the actual number of each size with the parts list can also help. The smaller the capacitance value, the smaller will be the physical size - examine them very carefully because small changes in size will help identify them. If there is any doubt about the colour code of resistors (which are shown in the tables when first encountered), check their value with a meter. When resistors are mounted on end, put them into the board as shown in the layout diagram since the top end maybe used as a test point. There are also pads for additional test points into which you can solder 10mm off cuts of stiff wire or Vero-pins. Turn all presets fully anti clockwise now as a safety precaution.

The PCB is etched on one side, with a continuous ground plane on the other top or component side, so beware of pushing parts in too far and shorting unintentionally to the ground plane at the edge of the countersinking; take particular care with chokes, integrated circuits and the leads of transistors which are more prone to touching the countersinking of non-earthy holes. The PCB has been lacquered to resist oxidation; it is specially designed to be soldered through so do not attempt to remove it! Only insert parts with the power off. Follow the layout diagram *very* carefully and it is a good habit to compare the circuit with the track pattern as you insert parts so as to check for correct part location and to help understanding of the circuit. If you have difficulty finding a particular part on the layout diagram, use the circuit to identify its 'role' and hence to find its general position on the PCB. As you insert parts, cross them off in the construction sequence. The layout diagram shows large black "blobs" on the earthy end of some components (usually resistors or disc capacitors) which are connected to 0 volts; you have to solder these points on the top of the board as well as on the track side in order to make the ground connections. *Failure to make these ground connections is the most common source of trouble.* For these ground connections, disc capacitors may need to be soldered in place with their earthy lead slightly high to be sure of enough lead length to obtain good solder adhesion close to their body. Make all these ground plane top-side connections as you insert each part or you will miss some out! In the construction sequence later, they are marked with an E in brackets. The PCB is arranged so that you only need to solder those parts on the top side of the board that can easily be soldered on both sides. Do not attempt to solder other earthy parts to the ground plane as their shape is not suitable. For each table, do the left column first as this usually contains the earthy parts which are best fitted before others. Earth/0 volt tracks are shown with 'hairs' similar to those of a chassis symbol. Use an 18 Watt iron with 60:40 tin/lead resin cored solder; you may find that the protective lacquer requires the iron to be applied for slightly longer than normal to obtain a good joint – this will not damage the parts. Transistors and integrated circuits can be static sensitive, so it is best to use a proprietary personal earthing strap - especially if your shack is dry and has a synthetic carpet! Keep the semiconductors in the black static conducting bag until needed. Make sure your iron is mains earthed and connect your PSU 0 volt terminal to mains earth through a 1M resistor. The layout diagram shows the position of individual parts as viewed from on top of the component side; the transistors are drawn as though you could see all of their leads to help get their orientation correct but part of their leads will be obscured. Take care with the them as they can easily be put in the wrong way. Transistors may need their central lead (referred to as CL in the building tables) to be bent forwards or backwards from their flat face - possibly the opposite way to that already done by the manufacturer. All parts should be on the ground plane side of the PCB. Load the PCB in the order suggested and test each stage as you go. This approach much increases the chances of it working properly from the start! Do not build the whole thing and hope it will work! Spares parts are available from Walford Electronics.

Assembling the TX

First plan how you intend to mount the PCB; normally this would be immediately behind the associated RX. If this is a Somerset Range kit, they can be joined by the supplied PCB joining strips. Drill any required holes in the front panels etc before joining or loading this PCB. The Cary RX front panel already has a hole drilled for the 3.5mm microphone socket if you wish to mount it there instead of on the Cam PCB. The Cary also has space for a TR relay (if wanted) instead of its PP3 battery holder – this is likely to be unwanted with the transmitter because a PP3 will be flattened quickly! The Cam PCB can be joined later to the RX or now if you prefer. The two PCB strips are soldered vertically to the ground planes across the RX/TX joint on the outside edges of this joint.

The density of parts is low, so you should be able to find the part locations in Fig. 3 without too much difficulty. As a precaution, especially in the early stages, check the part's holes are correct by tracing tracks to other parts. Start assembly of the PCB with the unambiguous parts:-

Four rubber feet underside in corners	C108A	105 pF Violet trimmer	
Four screw terminal block	R102	10K preset	
3.5mm mic skt - if wanted on the PCB?	R114	1K preset	

Next add the supply parts:-

C113	10 nF disc – 103	(E)	C106	10 nF disc	(E)
C112	100 µF 25v electro	?Polarity	D100	5v1 Zener	?Orientation
C102	10 nF disc	(E)	R100	330R – OR,OR,BN	
L100	47 µH choke – 0088		C100	100 µF 25v electro	?Polarity

Carefully connect up your supply to the four screw connector block, taking care over the polarity. Check it again! Prepare to measure the DC voltage on point 5 with respect to 0 volts, switch on and it should be just above 5 volts. Switch off and fit the RF oscillator:-

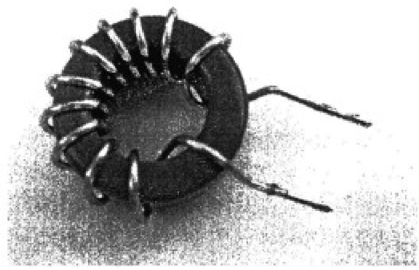
C107A	100 pF cer plate	(E)	R110	100K	
R111	1K – BN, BK, BN		R113	100K	
X130	Resonator or xtal to suit band		D104	1N4148	?Orientation
R112	100K – BN, BK, YL		IC100	74HC02	?Orientation
D103	1N4148	?Orientation			

There is no need to fit C107B or C108B yet – see later. The next task is to detect the RF oscillator – you can use a general coverage RX with its aerial near the Cam, or a DC voltmeter connected to the buffered counter output point C. Switch on and the DC voltage on point C should be 5 volts; if you now enable the oscillator IC100 by grounding point N, the average value of the signal on point C should change 2.5v. If you have a scope, connect it via a scope divide by a 10 probe to point C and you should find the 0 to 5 volt square wave at a frequency near that of your resonator or crystal. You can also use a counter (connected via scope probe to point C) to measure the actual frequency. The general coverage RX should produce a strong heterodyne signal from the Cam when they are tuned within about 2 KHz of each other. The trimmer C108A should alter the frequency – if you are using a ceramic resonator then several KHz change should be possible; but if using a crystal, then only a KHz is possible or so depending on actual frequency! Instead of grounding point N, if you now ground the PTT switch point P, it should have the same effect on point C, but in addition, if you now observe the gate outputs of IC100 on pins 1 and 13, these should change from 0 volts to a similar 5v square wave (average value of 2.5v) when P is grounded. Switch off and fit the output stage:-

C101	470 nF Polyester		TR101	BS170 – CL Fwd	?Orientation
TR100	BS170 – CL Fwd	?Orientation			

Make a temporary connection between point S and point V. There is nothing further that can be tested here. Next fit the output low pass filters – full details are given for all bands in Table 1.

Start by winding inductors L130 and L130 which are identical. For 160m each inductor needs 26 turns of the 24g enamel wire (about 750mm); for 80m they need 18 turns (about 500mm). The wire should be tightly wound on the toroid core as a single layer winding. Having cut the wire to the approximate length, thread the wire through the core and slide it to the middle of the wire. This is the first turn! Remember that each time the wire goes through *the middle of the core*, it counts as one turn. Now wind on the rest of the first half of the winding with one end; then with the other end put on the other half of the winding. Space the turns evenly around about ¾ of the circumference and trim the ends to about 10 mm long. Either carefully scrape the enamel off the wire ends, or burn it off with a hot iron so that the copper wire tins properly with your solder. Do not breathe the fumes! Photo 1 right shows a typical toroid winding but beware this particular example only has 11 turns so the winding technique is more obvious. Then insert the assembly into the holes for L130, solder underside and clip off any excess wire. Repeat the process for L131.



Now fit the capacitors C130 to 135 of the output low pass filter which are also defined in Table 1 for all bands. Note that the PCB has provision for connecting either a single capacitor, or two in parallel, or two in series using the pair of isolated linking pads between the main outer pairs of pads, for each of C130/1 and C134/5. (The parts layout diagram shows C130/1 in series but C134/5 in parallel - this is NOT a valid band combination but it shows what each might look like!) The PCB has pads for only a single or pair of capacitors for C132/3 - there is not a series option for them! If you do not follow these options please do seek advice! Don't forget the topside (E) soldering points!

160m needs a 1500 pF single capacitor (YL 152) at each of C130 and C135, with nothing for C131 or C134. 160m also needs 1500 pF at C132 and another at C133.

For 80m, use two 1500 pF in series at C1310/131 and C134/135, with just a single 1500 pF at C132 - nothing at C133.

Now you can see if it will produce RF! Connect your 50R dummy load, with an output power indicator to the antenna output terminals A and E. Connect an ammeter set for about 1 Amps FSD in your incoming positive supply lead V. Make certain that neither P nor N or K is grounded and that you do have the link between S and V in place. Switch on - the supply current should only be around 30 mA without any RF being produced. Grounding point N should bring on the oscillator as before – check on your RX, scope/counter etc. Then ground point P. This should make it produce RF – about 1.5 Watts when using a nominal 12v supply. The supply current should rise to typically about 250 mA. Release point P to stop the RF output. Do not leave it producing continuous RF like this for more than a minute or so as the output devices will get quite warm! (Note that the TX is producing its maximum possible output under these conditions using the full supply voltage, and hence this is NOT the normal AM carrier level without modulation!) Turn off and remove the link between point S and V.

Fit the modulator parts:-

C103	470 nF Polyester		R106	100K	
R103	100K BN Bk YL		R107	330R	
R105	330R OR OR BN	(E)	C105	470 nF Polyester	
R104	330R		R109	1K	
TR102	BD136 - CL Fwd towards the tab ?Orientation		TR103	BS170 - CL Fwd	?Orientation
R101	1K BN BK BN	(E)	TR104	BS170 – CL Fwd	?Orientation
C104	470 pF disc - 471				

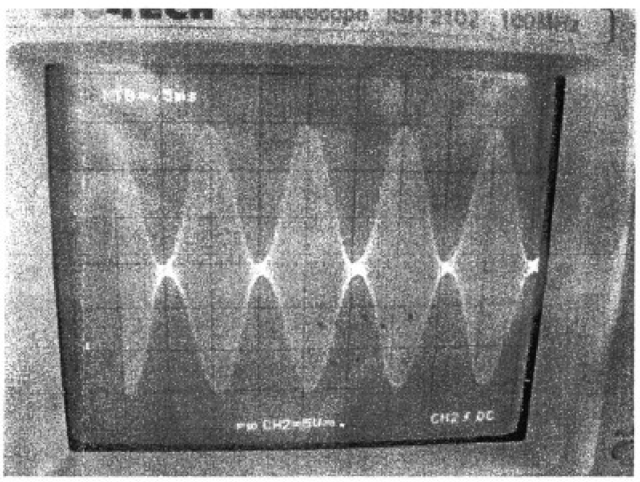
Turn R102 fully anticlockwise. With your dummy load/power meter still attached, switch on. The supply current, without P grounded, should be low as before. If you now ground P, the current might rise slightly but not get anywhere near the level associated with full output. Now gingerly advance the RF Level preset R102 while watching your power meter. It should be possible to obtain nearly maximum output as before with the preset fully clockwise. Return to near half way and set it for one quarter of the previous maximum output power figure. If you now measure the DC voltage on point S, it should be approximately half of the incoming supply voltage. Release P and switch off. Fit the modulator control parts:-

D101	1N4148	?Orientation	D102	1N4148	?Orientation
R108	1K				

If you now switch on, grounding point P should have the same effect as before, but if you were to only ground points K and N, you would not get any RF because point H, which controls the modulator, is not also grounded. With this extra control, the modulator output device is switched off during reception. Switch off and fit the speech amplifier:-

C111	100 µF 25v electro	?Polarity	C110	470 nF Polyester	
R120	1K		R118	1K	
R117	100K		R119	1K	(E)
R116	330R		TR105	BS170 – CL back	?Orientation
R115	100K		TR106	BS170 – CL back	?Orientation
C109	470 pF disc				

The speech amplifier is not controlled by the PTT switch, to avoid unwanted thumps, so you can measure the DC voltage across R114 which should be near 2 volts after switching on. Connect your microphone audio lead to point M which corresponds to the tip contact of the 3.5mm socket; P is the ring contact. (The circuit is designed for the dynamic type of microphone usually used on CB sets etc.) Continue to monitor the RF output and also listen to it on your receiver being careful to make sure the RX is not overloaded. When you press the mic PTT switch, corresponding to grounding point P, the RF output level should be one quarter of the previous maximum without any audio input. Now speak normally and advance the modulation level preset R114. Theoretically the average RF power should not alter but you might see some small upward movement on speech peaks, and of course the audio should sound good on the RX – remember to set it for AM! Set R114 for good sounding received audio - too low and it will sound weak, too high and there will be distortion, in between there will be a point where the modulation is full or even punchy but not distorted!



If you have a scope, display the RF output across the dummy load on the Y axis (5v/div) with the X time-base set for about 0.5mS/div triggered from Y at near the RF peak level. You need to adjust R114, for the onset of clipping (or limiting) of the RF envelope on speech peaks. Photo 2 right shows a 1 KHz sine wave (using one tone from a 2 tone audio source) just fully modulating the RF envelope. You can also use the scope to check that when clipping occurs, it is symmetrical - use R102 to adjust the carrier level up or down as required. Without a scope, leave R102 set to produce a no audio carrier level that is one quarter of the maximum RF output and set R114 for just before the onset of distortion on speech peaks.

It is now complete and should look like Photo 3 later!

Connecting to a RX

You can use it with any brand of RX, but for convenience, I will describe connection to the Cary regen TRF, for which the Cam was designed. You will need to consider at least these aspects:-

O volts/ground When in close proximity, make certain the two ground planes are well bonded together by good joints every 30 mm or so. The two supplied PCB joining pieces can be used to stiffen the construction when an open style is used – see Photo XXX later. Otherwise, mount the PCBs on pillars in their corners and make stout 0 volt links to the RX.

Supplies Connect the V positive terminal on the four screw block to the RX's protected supply output point if it has one. Otherwise use the RX's main supply.

Aerial switching This can be manual via a suitable switch which will also need to mute the RX or alternatively use a relay controlled by the mic PTT switch. The Cary has space to mount such a relay where its PP3 holder is normally located. The circuit for this is shown in Fig. 2 Use short unscreened leads to/from the relay provided the distances are less than about 150mm. If over this, use 50R coax (screens grounded at both ends) for the aerial leads.

Muting of RX This is best done by routing the RX audio output through a second set of contacts on the manual changeover switch or relay – see Fig. 2. If the RX has an audio gain control pot, you can alternatively short the pot output to ground during transmission.

Mic and PTT The supplied 3.5mm stereo socket can be mounted on the rig's front panel instead of on the PCB – the Cary has a hole pre-drilled on bottom front right. Make certain the sleeve contact of the socket is grounded. Connect the tip contact to the mic input M, and the PTT switch or ring contact to the PTT point P.

Netting You might wish to add a Net switch to turn on the Cam's oscillator so that you can easily adjust its frequency to that of the RX, without going fully to transmit. Use a toggle with its centre tag connected to 0 volts/ground. Connect the upper tag, for netting when the toggle lever is down, to point N of the Cam. The oscillator signal is quite likely to be strong so take care! Adjust the TX frequency using C108A for zero beat with the RX's regen stage when it is made to just oscillate, or tune for the middle of the RX's response as they are tuned across each other.

Using the Cam

When radiating for the first time, it is sensible to reduce power just in case the antenna matching is not properly adjusted. This can be done with a resistive matching bridge which will ensure that a safe load is presented to the TX irrespective of the actual impedance of the antenna system. A resonant Antenna Matching Unit (AMU) with link or transformer coupling is desirable since this will provide extra attenuation for the unwanted transmitter harmonics, and also separate the rig's 0 volts (which might be connected to mains earth) from the real RF earth of the antenna system. As a sweeping generality, it is best to get out as much wire as possible for the antenna and get it up as high as possible. Balanced schemes with symmetrical lengths in each arm are preferred. Provided that you have low loss line from the antenna arms, and the matching unit is able to tune out the reactance, it is not essential for the arm lengths to be resonant. Long wire end fed aerials can also give good results provided there is a good RF earth or counterpoise! Although the transmitter has low pass filters, it is always a good thing to use a resonant AMU to improve the matching and out of band rejection. Checking for interference on your own TV, video recorder and VHF FM broadcast receiver is always sensible.

The correct tuning technique for working another station is very simple with AM! Just tune the receiver for best clarity of the other station, then, adjust the transmitter tuning (with the Net switch on) to the middle of the RX passband. As you tune the TX across the RX, it is usually obvious where the middle of its passband is, from the noises either side of that point. If the RX is a regen like the Cary, you can do this more accurately by advancing the Regen control sufficiently to just make it oscillate. Then turn on the Net switch of the Cam and adjust its tuning using C108A for zero-beat with the RX. After turning off the Net switch, lower the Regen setting slightly and just go to transmit with the PTT.

Choose a time when conditions are reasonable and try for a QSO on a clear frequency with someone who has a good signal to you. Ask him to be critical and analyse any comments. There should not be any sign of poor audio quality due to the transmitter being inadvertently frequency modulated - this makes it unusually difficult to find the optimum receiver tuning setting. The rig has plenty of decoupling with conservative circuitry to give trouble free operation. However, beware of long unscreened leads, poorly filtered or inadequate supplies/leads causing either low supply voltage at the rig (which might also be transient with RF output), or PSU shut down after a few minutes transmission due to the PSU's regulator overheating or a low over-current setting. (If using a battery, consider that it might be flagging after a while!) The use of end fed antennas tuned by a poor matching unit, with the PSU mains earth lead acting as RF earth, is quite likely to lead to RF all over the place and a strong possibility of trouble! It is always useful to listen to it on another rig if you can, and to observe if running it off a well charged battery makes any difference. Note whether the problem disappears when using a dummy load - if so, then I am sorry to say your antenna system is probably suspect!

After a little use, feel the temperature of the RF and modulator output devices to see how warm they are getting. For extended use on higher voltage supplies they might need some form of cooling or heatsink.

Options

Here are some possibilities:-

Lowering freq of ceramic resonators You may find that the frequency adjustment range using C108A does not get down to where most of the AM action takes place. If so, fit the two extra 100 pF ceramic plate capacitors C107B and C108B; with these you should be able to get to about 1950 or 3600 KHz when using 2.0 or 3.69 MHz resonators. It is unlikely that further increases in capacitance will provide a worthwhile decrease. You could consider changing to a dual gang air variable capacitor of about 200 to 300 pF instead of C107A/B and C108A/B!

Using a crystal X130 can be a crystal for any band. Use a 30pF parallel resonant HC49 type. C107B and C108B should not be fitted. The tuning range will only be a few KHz.

Using an external RF source Remove R111, X130, C107A, C107B, C108A and C108B; fit original C107B at X130 and feed in external RF signal to old junction of R111 & C107A.

Other bands In principle it can be used on any band up to 10m with suitable crystals. The output low pass filter inductors and capacitors will need changing as per Table 1. Note that the PCB has no linking pads for series connection of C132/3.

Higher supplies Using a higher supply voltage will increase peak power output and hence enable a higher carrier level, needing an increase in audio drive. R102 should not need altering as the supply is changed. Get used to it on 12v nom first and see how warm the devices get before going to higher voltages. The 16v limit can be exceeded but not for long!

Use with Linear A better way to go for higher power is to use the Linear which has a peak output of 10W or 2.5W of AM carrier on nominal 12v supplies. The Linear should be mounted close by the TX, normally just behind it with good connections of the ground planes. Connect the Linear RF in and out leads to the points labelled L after you have cut the track between them. Connect C101 to the Linear input and from it back to C135. The Linear standing current can be controlled from the PTT switch using the Linear's control inverting stage. A little experimentation will be needed to find a Linear standing current that is just sufficient to avoid distortion. Probably less than 0.35W carrier will be required from the Cam - adjust R102 for a drive level that gives 2.5W out. Then adjust the audio drive with R114.

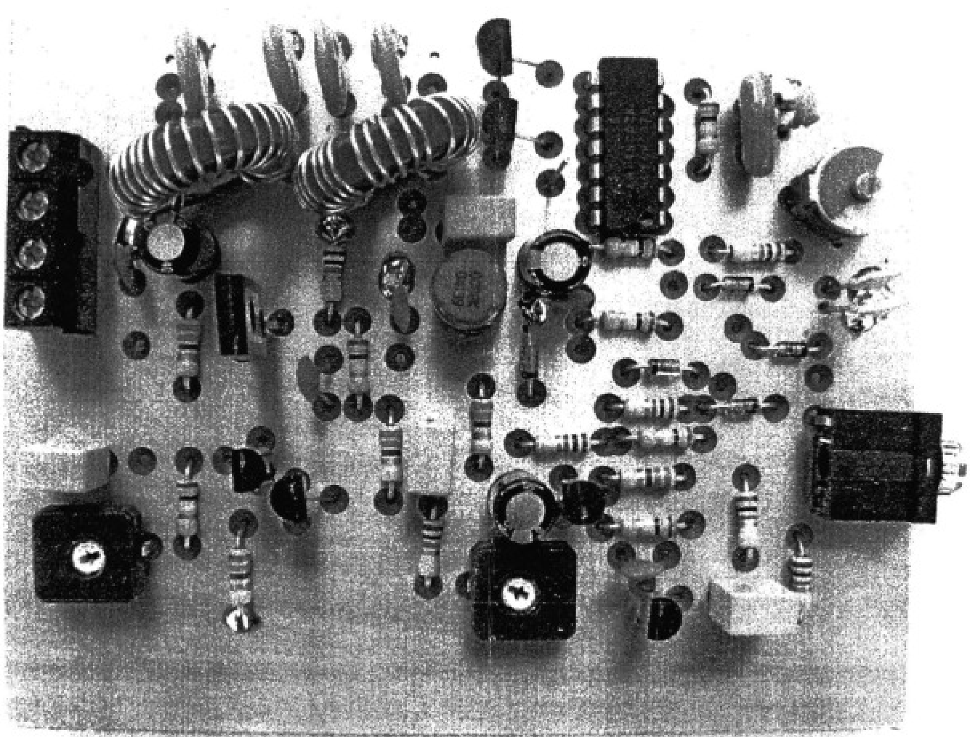
Use on CW The Cam can produce CW at up to 1.5W on nominal 12v supplies. You can join points S and V; or increase the setting of R102 so that the modulator DC output level is high but this will still leave it controlled by point H. The TR switching arrangements need to change over the aerial relay, and also ground point N; the key is connected to point K. Without any shaping the keying maybe a little hard! P should not be grounded!

That's enough from me! As ever I shall be delighted to hear how you have got on and do look out for comments etc in Hot Iron. Tim Walford G3PCJ Jan 31st 2011

Parts List for the Cam

Resistors			Capacitors		
5	330R	R100,104,105,107 116	3	100 pF cer plate	C107A/B, 108B
7	1K	R101,108,109,111 118, 119,120	2	470 pF disc - 471	C104, 109
7	100K	R103,106,110,112 113,115,117	5	1500 pF YL - 152	C130-134
			3	10 nF disc - 103	C102,106,113
1	1K Preset	R114	4	470 nF Polyester	C101,103,105 110
1	10K preset	R102	3	100 µF 25v electro	C100,111,112
			1	105 pF VI trimmer	C108A
Inductors			Miscellaneous		
2	T68-2 Red	L130,131	4	Rubber Feet	
1.5m	24g enam wire	For L130/1	1	4 terminal block	
1	47 µH choke 0088	L100	1	3.5mm stereo skt	
1	3.69 or 2 MHz cer resonator	Alternatives for X130	1	3.5mm stereo plug	For mic
			0.2m	Mulitcore wire	
			2	PCB joining pieces	
Semiconductors			1	Cam DS PCB	Is 2
1	5v1 Zener	D100			
4	1N4148	D101 – 104	TRN Walford G3PCJ Jan 31 2011		
1	BD136	TR102			
6	BS170	TR100,101, 103-106			
1	74HC02	IC100			

Photo 3 of completed prototype Cam.



TX Band parts numbered from 130

Table 1

Cam TX Band data

Band	Crystal' X130 MHz		Low Pass Filter Inductor L130, 131 Turns	Wire Length	Cores	Nominal Filter cap	C130/1,134/5 Form	C130 value	C131	C134	C135	C132/3 Form	C132	C133	Band
160m	2	Cer Res	Each 26t	750mm	T68-2	1600 pF	single	1500 pF		1500 pF		parallel	1500 pF	1500 pF	160m
80m	3.69	Cer Res	Each 18t	500mm	T68-2	800 pF	series	1500 pF	1500 pF	1500 pF	1500 pF	single	1500 pF		80m
40m	7.XX	Special Crystals	Each 13t	300mm	T68-2	400 pF	parallel	470 pF		470 pF		parallel	470 pF	330 pF	40m
20m	14.XX		Each 9t	200mm	T68-2	200 pF	series	470 pF	330 pF	470 pF	330 pF	single	470 pF		20m
15m	21.XX		Each 9t	200mm	T50-6	150 pF	single	150 pF		150 pF		single	330 pF		15m
10m	28.XX		Each 8t	200mm	T50-6	100 pF	single	100 pF		100 pF		parallel	100 pF	100 pF	10m

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Photo 4 When the Cary is made this photo will be changed tothe Cam TX joined to Cary RX!

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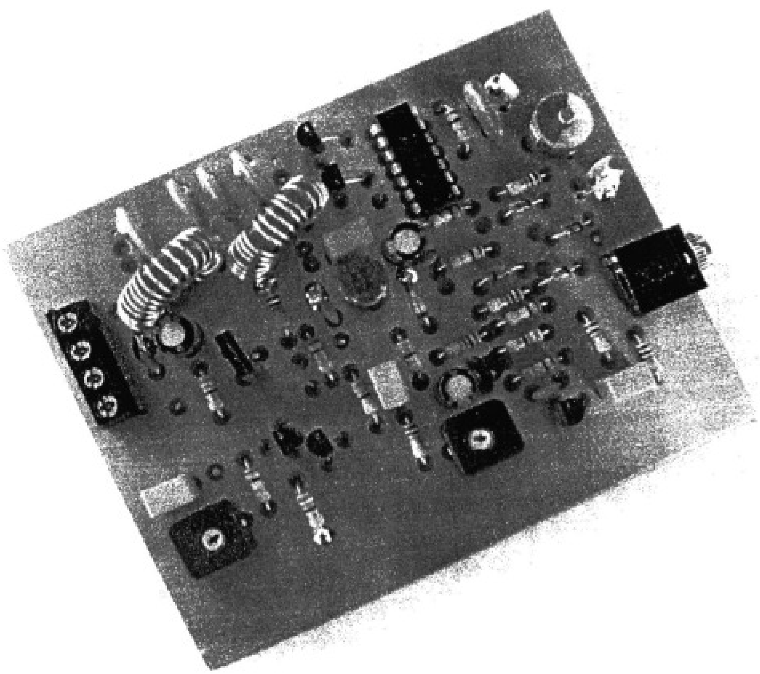
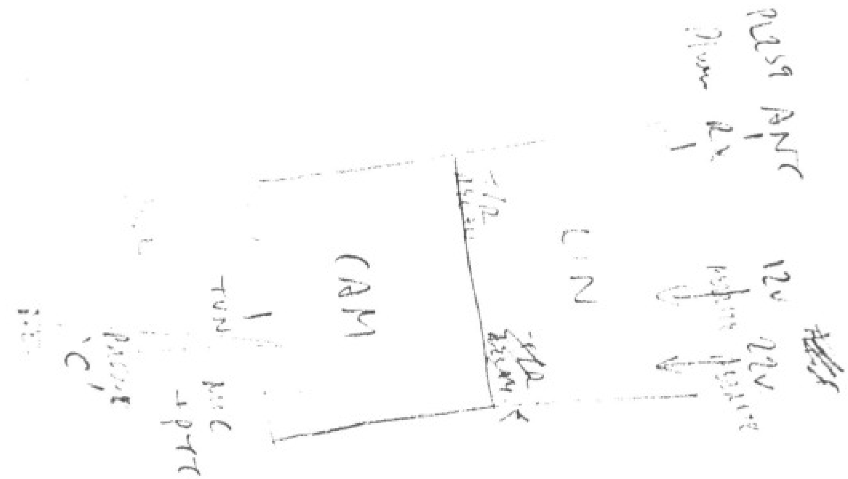




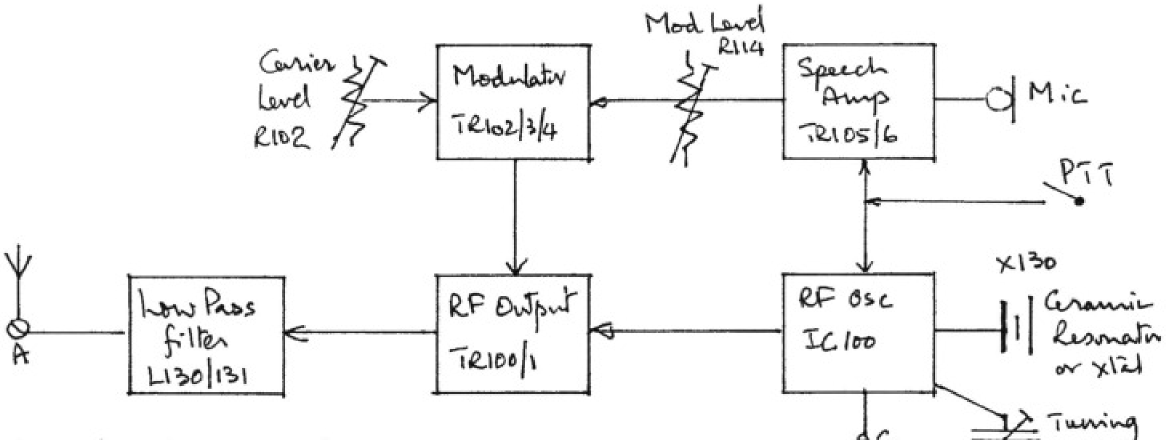


FIG 1: BLOCK DIAGRAM OF CAM

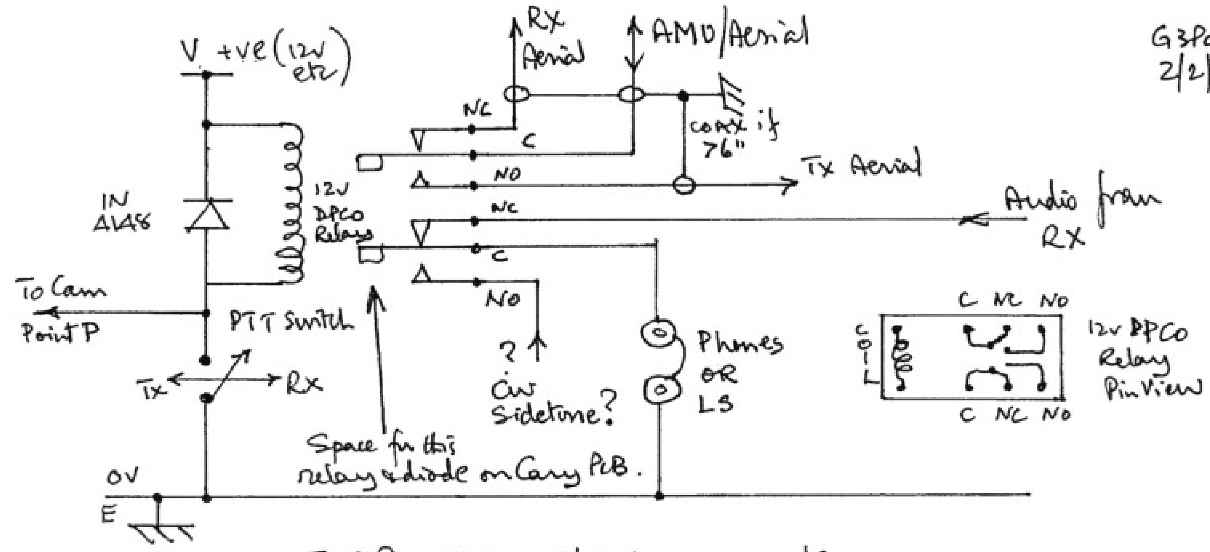
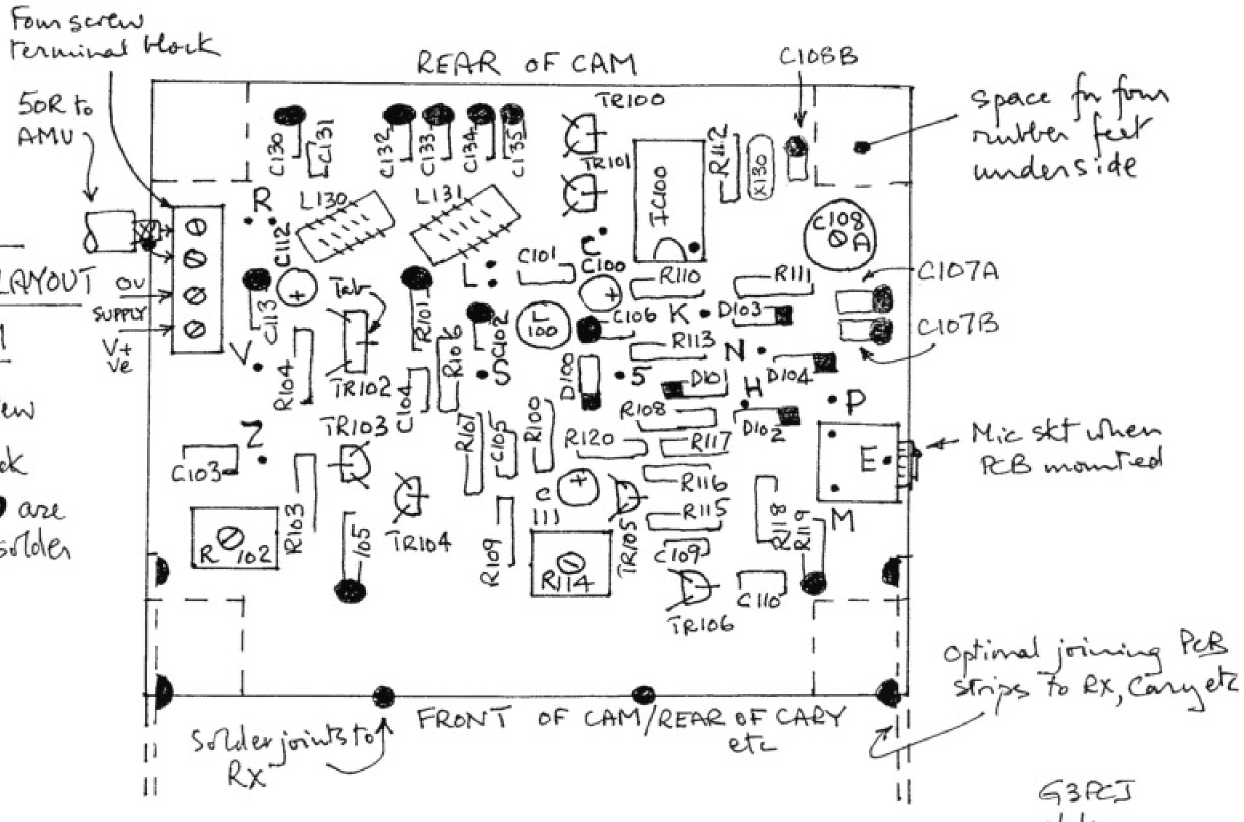


FIG2: TR switching connections

FIG 3

PARTS LAYOUT OF CAM



- Topside View
- Large black blots ● are topside solder points.

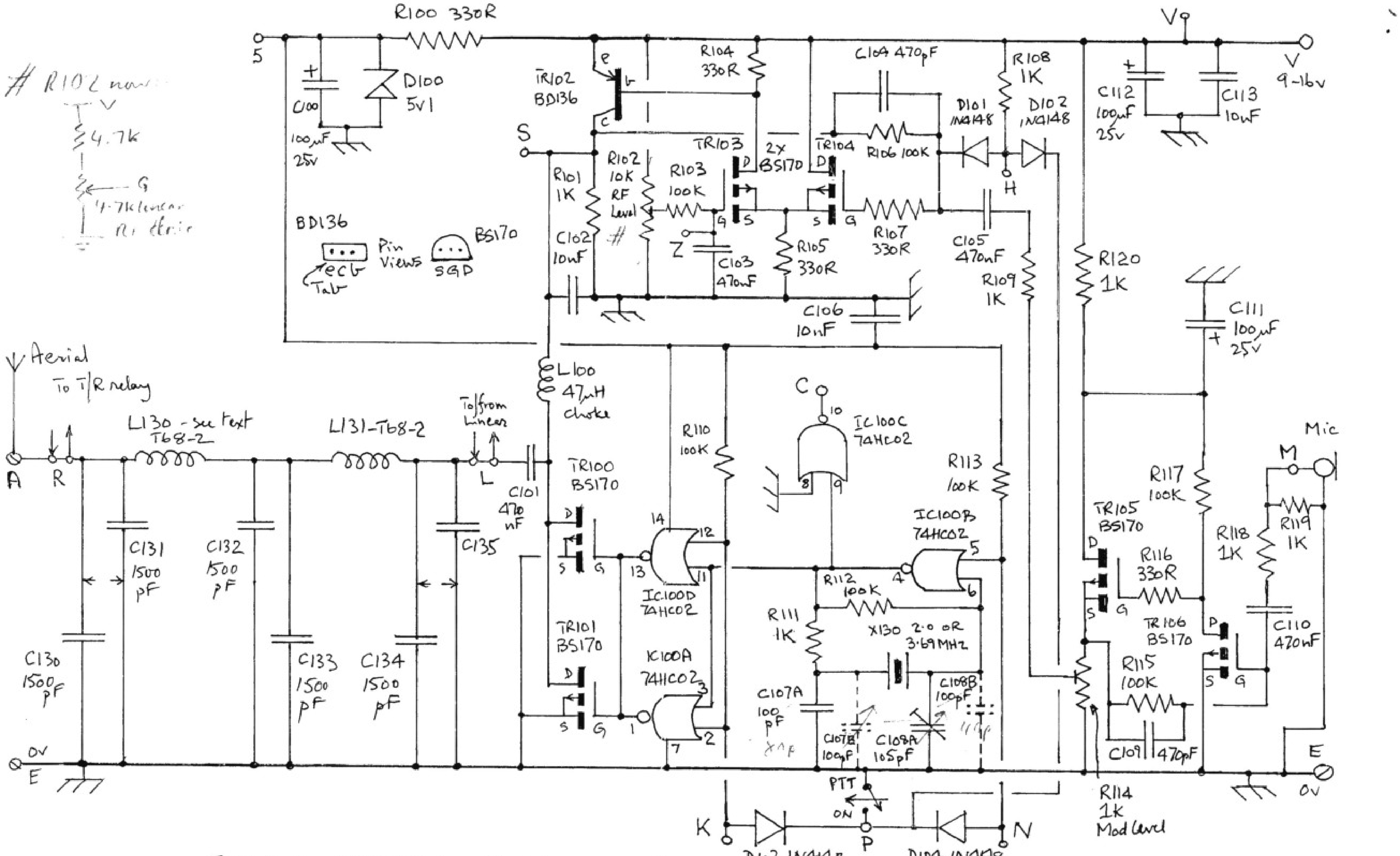


FIG 4: CIRCUIT OF CAM AM TX

G3PCJ
28/1/11