Walford Electronics

Upton Bridge Farm, Long Sutton
Langport, Somerset TA10 9NJ
Tel 01458 241224 Fax 01458 241186
E mail walfor@globalnet.co.uk
Designers & suppliers of kits for radio enthusiasts
Proprietor Tim Walford BSc MIEE CEng G3PCJ

Mini AGC kit

Introduction

This kit provides audio derived AGC which can be added to most receivers that do not already have such facilities. To keep the cost low S meter facilities have not been included although they can be added. The PCB is single sided 50 x 80 mm and should be mounted as close as conveniently possible to the audio stages and AFG pot of the associated RX. It needs a supply in the range 9 to 22 volts, drawing just a few milli-amps.

Please read right through these instructions before starting on assembly.

Technical Description

Principle of operation The audio input signals are first passed to an electronically controlled attenuator which is controlled by the audio output level. After attenuation, they are amplified to bring them back to the 'normal' levels for the rig's AF gain control. A further stage of amplification is needed to provide the higher AF voltage, which when rectified, is used to control the attenuator in a negative feedback loop. This has the effect of maintaining the audio out to the AFG pot constant. The kit is thus placed immediately before the AFG pot.

Input and attenuator The AGC kit has an input impedance of 4K7 to directly replace the normal load provided by the rig's AFG pot on the preceding stage so as to not change the low frequency bandwidth. The attenuator is formed by the 100K series resistance R2 working with the 'on resistance' of TR1 which is controlled by the AGC control voltage derived from the audio output. When the control voltage is below about 1.75 volts, TR1 is off so that there is no attenuation; above this level the amount attenuation increases rapidly as the gate voltage on TR1 increases positively. The change between zero and full attenuation is only about 0.5 volts on the control point VA.

Amplifiers A dual TL072 op-amp is used for both stages – their outputs are biased to mid supply by the divider R3/4. The bandwidth of both stages encompasses normal speech (and CW) in the 300 to 3000 Hz range. The first stage has a voltage gain of just over 20 and has a pair of diodes in the feedback path to minimise the disturbance caused by spiky forms of interference – they reduce the gain for large signals that do not last long enough to affect the AGC control loop. The kit's audio output is taken from the first stage and it can directly drive the normal 4K7 AFG pot. The second stage has a voltage gain of about 20 also. Because TR1 needs a DC gate voltage of about 2 volts before it is turned on, and allowing for real loaded diodes D3/4 in the full wave rectifier etc, the corresponding peak audio voltage at the input to IC1b needs to be near 250 mV p-p. The corresponding minimum input level (the threshold for AGC action) is then about 12 mV p-p. Hence the kit will maintain a constant audio output of near 250 mV p-p for all inputs above about 12 mV p-p (up to the point where TR1 is fully on).

Decay time The AGC control loop uses a long time constant of about 10 seconds, due to R10 and C9, to smooth over speech peaks and gaps between words. The hold time can be altered up or down by changing either component.

Muting Audio signals during transmission, and transients during changeover, will make the AGC think there are huge signals; hence it is necessary to prevent these reaching the AGC loop. This is most easily done by altering the rig's muting to operate on the input to the AGC kit. The output of the rig's muting transistor (usually the drain of a BS170) is connected directly across TR1 at point M. This provides maximum attenuation during transmission so that the AGC loop is operating at full gain when the rig reverts to reception. This will provide the desired quick recovery. In some rigs, despite the action of TR1, transmitted speech can get into the AGC kit, leading it to think there is a genuine signal and slower than normal recovery; the cure for this is to clamp the AGC line to 0 volts during transmission by an additional BS170 TR2. Details of this are described later.

Signal strength indication The DC voltage on point VA can be used to drive an S meter but it is very high impedance, additionally it has only small variations and is offset from 0 volts! This means that an op-amp must be used to buffer and amplify the signal to drive a meter, with presets to adjust the gain and offset. The circuit shown in the right-hand part of Fig. 1 can be used; the design is intended to provide 10 volts maximum S meter signal output corresponding to a very strong S9 + 30 or 40 dB signal! The meter is not properly calibrated but will give a relative indication of received signal strength. The diode at its output allows the same meter to be used by an RF output voltmeter acting as a power/matching indicator when the transmitter is suitably equipped. These parts can be mounted by any convenient method close the Mini AGC kit.

Construction Advice

Please refer to the general advice that came with the kit to which this project is being attached. Take the usual precautions for avoiding electro-static charge build up etc..

The most important point when connecting the two together is to ensure a low impedance link between the two 0 volt lines. Since point M is relatively high impedance, it is desirable to keep the muting lead as short as is reasonably possible.

Building the kit

The parts layout is given in Fig. 2. Start with the basic op-amp biasing parts:-

R3	4K7 – YL, VI, RD		R6	100K – BN, BK, YL	
R4	4K7		R9	100K	
C1	10 µF 25v electro	?Polarity	C10	10 µF 25v electro	?Polarity
R5	1M – BN, BK, GN		IC1	TL072	?Orientation

Carefully connect up your supply noting that there is NOT any reverse supply protection. Negative to any E point and positive to point V. Check the polarity. Switch on and measure the DC voltage on pin 7 of the chip – it should be half the incoming supply voltage. Switch off and fit the remaining parts of the first stage:-

R1	4K7		C4	10 µF 25v electro	?Polarity
R2	100K		C5	220 nF Polyester	
C2	220 nF Polyester		D1	1N4148	?Orientation
C3	470 pF disc - 471		D2	1N4148	?Orientation
R7	4K7				

Arrange for some means of listening to the audio from the kit, an external audio amp or the output stage of the receiver to which it is going to be connected eventually. If using the latter, feed the output from point O to the hot end of the rig's AFG pot. Switch on and perform the screwdriver finger hum test on the input point A. Applying your finger to the shaft of a metallic screwdriver touching point A should produce some rough noise or hum as you act as an aerial for 50Hz! You can also feed in the rig's signal to point A that was previously connected to its AFG pot. But beware of the extra gain (x 25) of this circuit so turn the AFG pot right back before switching on! The audio should come through much louder than previously! Switch off and fit the second stage:-

R8	4K7		R10	1M	
C7	470 pF disc		C9	10 µF 25v electro	?Polarity
C6	10 µF 25v electro	?Polarity	D3	1N4148	?Orientation
C8	220 nF Polyester		D4	1N4148	?Orientation

Now arrange to measure the DC voltage on point VA with a high impedance voltmeter, ie an input resistance of over 1M. When you now switch on, with large input audio signals, the DC voltage on point VA should rise to possibly several volts positive! It should decline relatively slowly when you tune away from the strong station etc.

The last two items to fit are the BS170 MOSFETs TR1 and TR2 – TR1 centre lead back and TR2 centre lead forward - check their orientation carefully. When you now switch on and tune across a strong signal, the AGC should cut it right back down so that most signals will be of comparable audio strength.

That's all there is to it!

Connecting to the rig

You may already have made these connections:-

0 volts	Make at least two good connections between the 0 volts or E points of the kit and the rig's ground plane. It is important that this is a low impedance link!
Supply	Connect point V to the rig's main 12 volt supply, or its diode protected main supply line.
Audio in	Take the audio signal that was previously feeding the AFG pot to point A.
Audio out	Take the signal from the output O back to the hot end of the AFG pot.
Muting	See below.

Muting Assuming that there is an associated transmitter, with muting facilities, arrange for point M of the AGC kit to be grounded during transmission. In most Somerset Range rigs there is a suitable muting output from the transmitter which comes from the drain of a BS170 that is turned hard on during transmission. See Fig 3. This transistor usually has a slightly delayed switch off to mask any thumps due to DC level changes. This BS170 is usually used to apply a short across the output of the receiver's AFG pot during transmission, so silencing the RX. This should now be changed to apply that short to point M of the AGC kit instead, to make the AGC think it has no received signal and hence have full gain available on reversion to reception. You may need to cut a track on the RX to separate the BS170 drain (it is often labelled M) from the rest of the RX.

With some rigs, there is an RF transient on reversion to reception which can delude the AGC into thinking there is a huge normal received signal; for these situations the extra BS170 TR2 can be used to ground the AGC control voltage until the normal muting has been released as shown in the lower part of Fig. 3. This will also help ensure any S meter circuit does not interfere with any transmitter RF voltmeter output circuits.

Issue 1 PCBs do not have provision for the mounting of TR2, so it should be soldered to the Mini AGC kit tracks directly as detailed below. Issue 2 onwards PCBs do have provision for mounting TR2 when required but it is still necessary to connect its gate the muting delay circuit of the driving rig. For issue 1 AGC kit PCBs, connect the extra BS170 TR2 as follows:-

Source to 0 volts,

Gate to the delayed TR control signal that normally mutes the RX – ie to the gate of the normal muting BS170 in the TX,

Drain to the AGC control line point VA.

Options

S Meter driving The AGC control voltage can be used to drive an S meter. The required circuit is shown in right-hand part of Fig. 1 This also allows for the same meter to be used during transmission as an RF power out or matching indicator when fed by a bridge having a max output of 10 volts DC. The two diodes from RX and TX circuits can therefore feed a single meter. The off set preset is adjusted to make the meter just conduct with a very weak signal, and then the gain preset is adjusted for full scale (about 10v DC out) on an extremely strong signal. There is interaction between these presets so check their settings 2 or 3 times in turn. The S meter scale is not calibrated but gives a relative indication of signal strength.

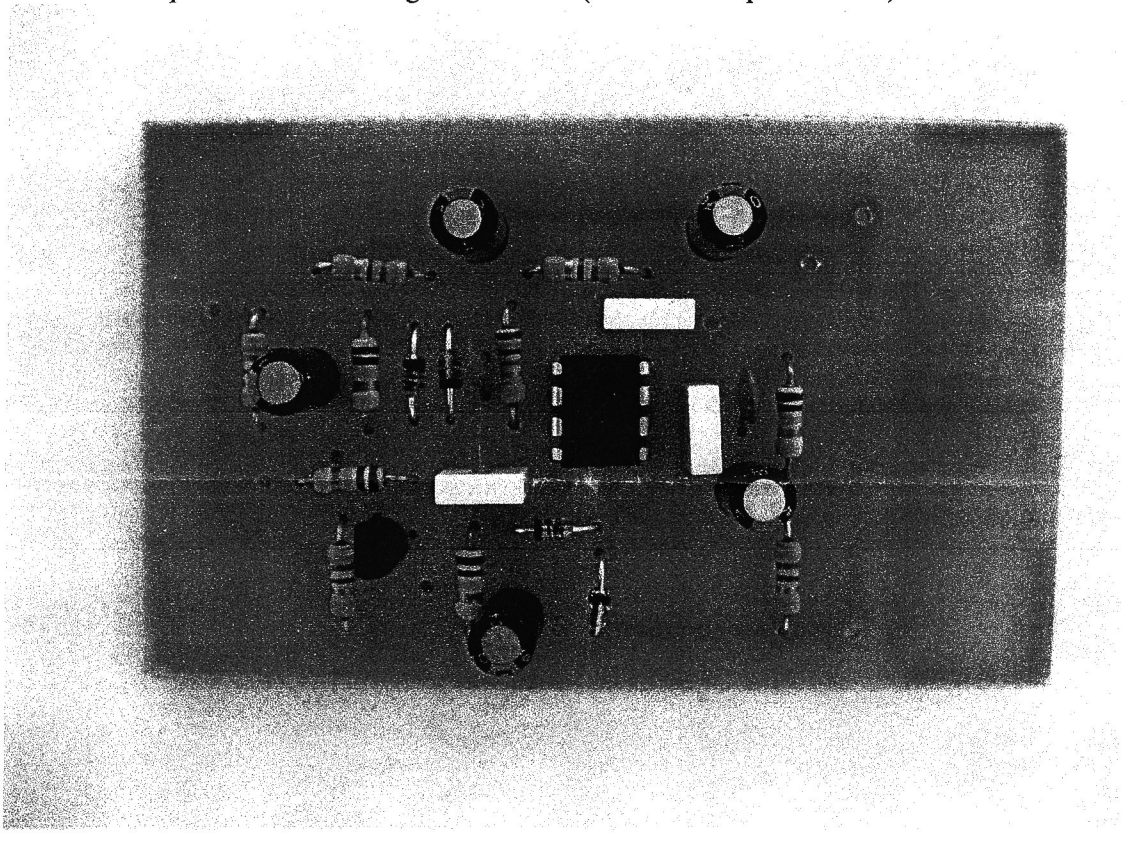
That is all there is to it – it should work well with all Walford Electronic RX/TX designs so let me know if you have any problems. (The Fivehead does need some slight alterations – please consult me about using them together.) Any comments are always very welcome.

Tim Walford G3PCJ Aug 18th 2010

Parts List for Mini AGC kit

Resistors			Capacitors		
5	4K7	R1,3,4,7,8	2	470 pF disc	C3,7
3	100K	R2,6,9	3	220 nF Polyester	C2,5,8
2	1M	R5,10	5	10 uF 25v electro	C1,4,6,9,10
Miscellaneous					
1	TL072	IC1	Single sided AGC PCB		Is 1/2
4	1N4148	D1,2,3,4			
2	BS170	TR1, 2	TRN Walford G3PCJ Aug 13th 2010		

Photo of completed AGC kit using issue 1 PCB (without the optional TR2):-



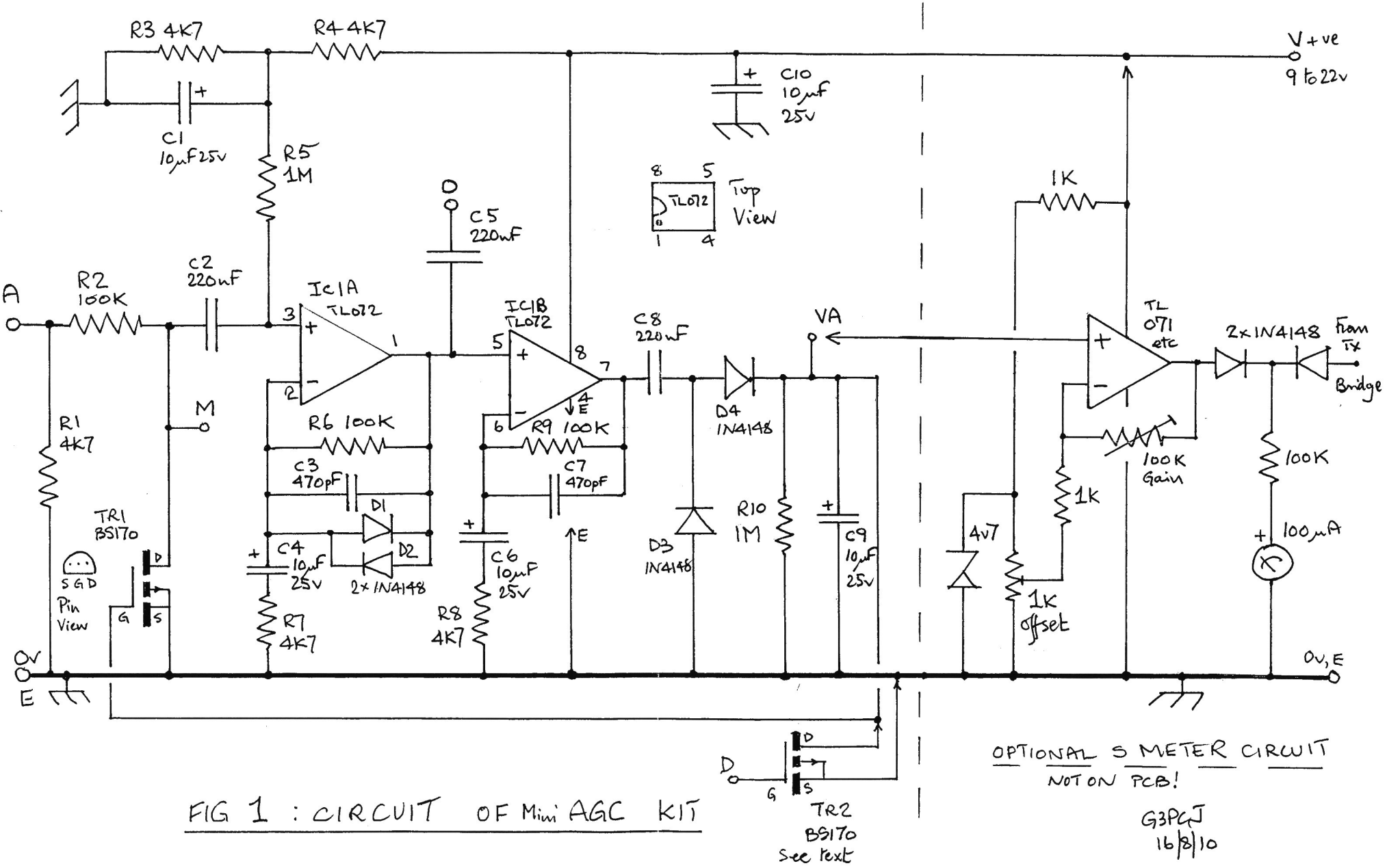
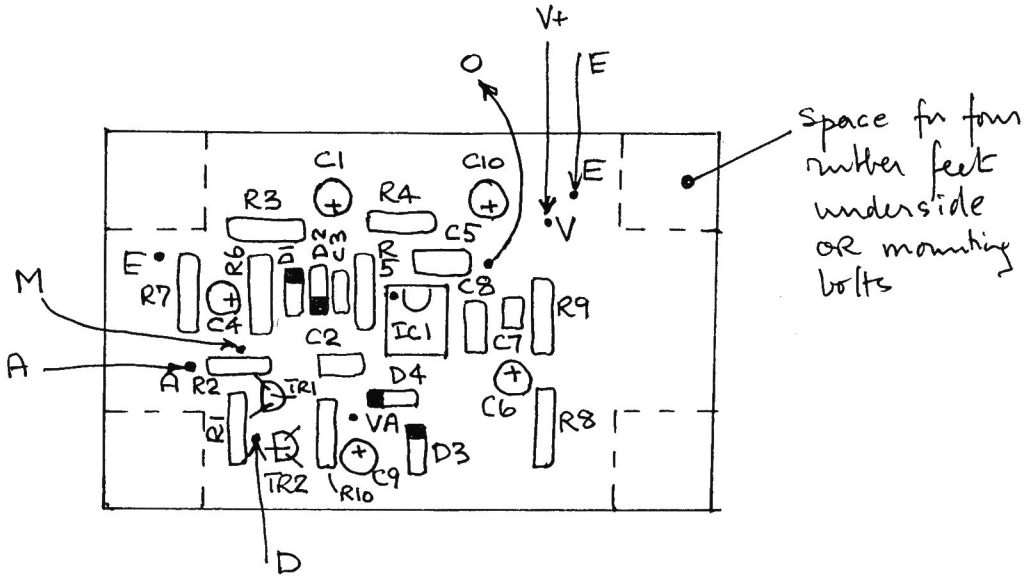


FIG 1 : CIRCUIT OF Mini AGC KIT



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FIG 2: PARTS LAYOUT OF MINI CW KIT

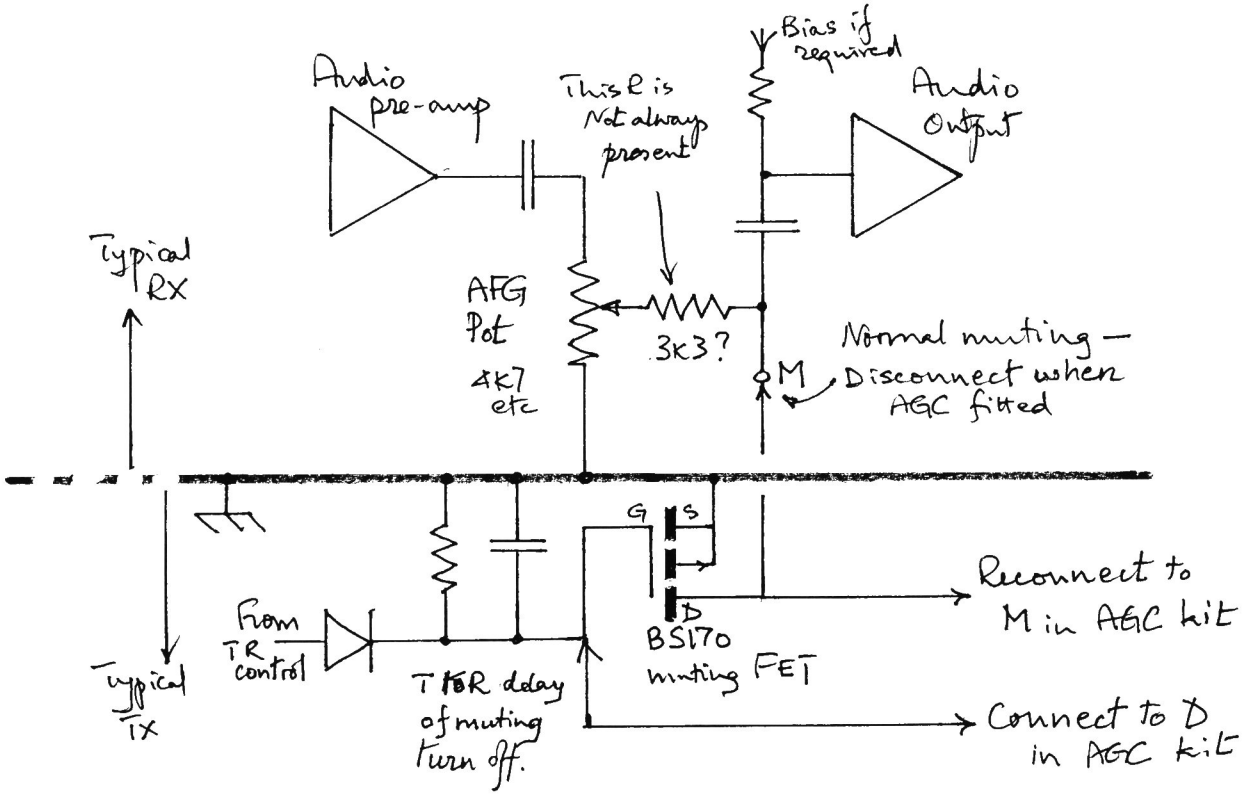


FIG 3: CONNECTION OF AGC KIT

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