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CW Kit

Introduction

This is a versatile kit for CW purposes. The main uses are to convert a phone transmitter for CW and to provide a Morse practise oscillator. It can be used with either a double sideband or single sideband transmitter. The kit includes an audio 750 Hz low pass filter for receiving Morse. Semi break-in TR control is provided and the transmitter RF is achieved by injecting a pure keyed 750 Hz tone into the transmitter microphone circuits (and into the receiver for monitoring your sending). At the time of writing, it can be used with the Butleigh transmitter and a future intended single band phone SSB TCVR. Although not designed primarily for earlier Somerset Range rigs, it can be used with any phone TCVR.

It is supplied as a 50 x 80 mm single sided PCB which should be mounted close the main rig's PCB. Please read right through these instructions before starting to build it as there are a number of options for different situations. When used to convert a phone rig for CW the parts numbered from 200 are used. When used as a Morse practise oscillator, some of the unused parts are fitted in alternative positions (numbered from 250) as an audio amplifier so that it can drive Walkman type phones.

Technical Description

The block diagram is given in Fig. 1 with the circuits in Figs. 2 and 3.

Supply aspects The CW kit can use any supply in the range 8 to 22 volts. It does not have any protection.

Receive aspects Normally the CW filter provided by the 072 op-amp IC200A is fitted just before the rig's AF gain control. This filter has a humped low pass characteristic which gives the impression of a bandpass filter centred on 750 Hz with a Q of 5. It has good attenuation over 1 KHz and is biased to roughly mid-supply from the 6 volt Zener supply. The switch S200 selects the rig's direct phone output or that from the CW filter.

Sidetone The other half of the op-amp is arranged as a continuously running 750 Hz Wien bridge sinusoidal oscillator. It is biased to mid supply by R221/2 whose parallel value is one of the frequency determining 'resistors'. The output amplitude is stabilised at a low value, so enabling a sinusoidal output, by the limiting action of D204/5 which just keeps the gain at the right figure to maintain oscillation. The op-amp output feeds the two level setting presets RT200/1 for output to the mike circuits and the receiver's audio amplifier. TR202 applies a short across these presets which is normally only turned off when the key is closed.

T/R control Semi break-in control is provided where the rig is kept in transmit after key up by the delay determined mainly by C211/R213. R213 can be changed to a 470K pot if you want the delay front panel adjustable. The point P is connected directly across the rig's push-to-talk (PTT) switch to control the transmit or receive state. C210 provides a little positive feedback which speeds up the T/R changeover action. The diodes D201/2 permit either 'Tuning' with a steady CW signal but no TR hold action for antenna matching adjustments or, 'netting' when S201 grounds the point N – this produces the 750 Hz tone in the RX without transmitting for checking the against the pitch of the wanted signal. A Meter kit can also be controlled by S201.

Practise oscillator In this situation, the TR control circuits associated with TR200/1 are not required. The op-amp IC200A can only drive series connected Walkman type phones (to give a 60R load) or a small loud speaker by including a largish series resistance R252; the attenuation caused by this approach is made up by fitting some of the unused parts as an audio amplifier (around TR250) between the filter and the keyed sidetone outputs from RT201. The track pattern allows TR201 to become TR250 with alternative C/R positions.

General Construction Advice

The same comments apply for this kit as did for the main kit. Sort out you proposed mechanical arrangement (and drill any new holes) before fitting any parts. The CW Kit can be mounted on pillars in its four corners or fitted vertically by soldering its 0 volt track along the bottom edge directly to the main rig's ground plane. Since there are low level audio signals, it is important to make certain the CW kit's 0 volt or E line is well connected in at least two places with short wires! The kit has space on it for the 3.5 mm stereo key socket but this can be relocated on the rig's front panel if you wish.

Building the CW Kit

Take care when deciding the position of individual parts as the PCB layout is pretty dense – check the track pattern and connections of any part whose position is uncertain. If you are building it as a Morse practise oscillator, the parts marked with a hash (#) should not be fitted – see later. Only fit parts with the supply off.

Four rubber feet if required			D200	6v2 Zener	Check orientation
Key socket if required			C203	10 µF 35v electro	Check polarity
RT200	10K preset		C205	10 µF 35v electro	Check polarity
RT201	10K preset		C204	10 nF disc - 103	
R203	1K – BN,BK,RD				

Switch on and measure the DC voltage on the point 6 – it should match its name! Fit the RX filter:-

R200	100K – BN,BK,YL		C202	470 pF disc – 471	
R201	100K		R219	47K – YL,VI,OR	
R202	100K		R221	47K	
C200	10 nF Polyester		R222	47K	
C201	10 nF Polyester		IC200	TL072	Check orientation
C206	100 nF Polyester	#			

First check the bias conditions of the op-amp by measuring the output voltages. The point B should be at half supply. Pin 1 of IC200 should be at 6 volts. If you wish, you can feed in some voice audio into the point U and check that what emerges at point W has a much narrower bandwidth. Now fit the sidetone oscillator parts:-

R216	22K – RD,RD,OR		R220	22K	
C215	100 nF Polyester		C218	10 nF Polyester	
C216	100 nF Polyester		C219	10 nF Polyester	
R217	22K		C217	10 µF 35v electro	Check polarity
D204	1N4148	Check orientation	R218	22K	
D205	1N4148	Check orientation	C214	10 µF 35v electro	Check polarity

Arrange to feed the keyed sidetone audio into an audio amp – either a Hi-Fi etc or the rig's audio output stage by connecting the point ST to the rig's RX ST input point. Check that both presets are fully anti-clockwise before switching on! Gradually advancing RT201 should produce a clean sounding nominal 750 Hz tone. There should be about 0.5 volts p-p on point B if you can measure it. Fit the keying parts:-

R214	10K – BN,BK,OR		C213	10 nF disc	
C212	10 nF disc		TR202	BS170	Check orientation
R215	100K				

Connect up your key to the 3.5 mm plug or be ready to temporally ground the point K. Switch on and there should be no tone! When grounding K the sound should start and stop without thumps. Fit the TR control:-

R210	10K		D201	1N4148	Check orientation - #
R211	1K	#	D202	1N4148	Check orientation - #
R212	100K	#	D203	1N4148	Check orientation - #
R213	100K	#	TR200	BS170 – bend central lead back	Check orientation - #
C210	10 nF Polyester		TR201	BS170 – ditto	Check orientation
C211	10 µF 35v electro	Check polarity - #			

You can observe the TR delay by connecting your voltmeter to the point Q. At switch on this should be 0 volts. Pressing the key should make it immediately go to the supply voltage – it should decay slowly over about 0.5 seconds after the key is released – this is the hold in transmit delay. The PCB is now complete. Remove all temporary connections.

Connection to the rig

First check that your mechanical arrangements are in order! Decide if it is easier to connect it up before mounting the PCB. Make the following connections:-

0 Volts	Make at least two good short connections between the rig's 0 volt and E points
V +ve	Connect V to a suitable positive supply point in the rig
Audio	Remove the existing link between the rig's audio pre-amp to the AFG pot. Link the rig's audio pre-amp output to one side of S200 and the input point U Connect the CW kit output from point W to the other side of S200 Connect the central contact of S200 to the top-end of the AFG pot

Note! If the rig already has a separate CW filter connect the CW kit filter after the existing one.

RX sidetone	Connect the CW kit point ST to the sidetone input (often called ST) of the RX. If this has a ground link across it, such as in the Compton, break or cut any grounding track.
TX sidetone	Connect the CW kit point D to the TX speech amp negative input point. In the Butleigh this is labelled N. Where DC isolation is also required (e.g. For the Taunton, connect from CW kit point M).
Control	Connect from CW kit point P to the rig's PTT switch (often labelled P).

If the key socket is installed on the front panel, connect it to point K. Ground the sleeve contact.

If S201 is installed, connect its central contact to 0 volts, one side contact to TU (and the Tune relay if fitted) and the other outer contact to N.

Setting the CW kit up

The receive aspects have nothing to adjust – it should work straight away with S200 selecting either normal phone audio or restricted bandwidth audio suitable for CW.

The transmitter should already be set up for phone operation. Connect your 50R dummy load and output indicator to the rig's antenna terminals. First check that sidetone operation by operating the Net switch S201 if fitted or alternatively ground the CW kit point N. This should bring on the sidetone in the receiver with a comfortable level being set by RT201. Next check that RT200 is fully anti-clockwise so that no RF should be produced. Put S201 to Tune if fitted, or ground the CW kit point TU. The rig should now be producing sidetone in the LS as a warning that it is now in transmit; it should revert to reception as soon as S201 (or the ground of TU) is released. Closing the key should put it straight into transmit but there should be a delay of about 0.5 seconds before it reverts to reception after key up. While monitoring the RF output and supply current go to transmit with the TU switch S201 (or ground TU), gingerly advance RT200 till it just produces full output. Reduce it a little below the maximum output setting. If the CW kit is being used with a single sideband TX, the envelope of the RF output will be a constant level since only one input tone is being used – the transmitted signal will be a single signal 750 Hz off the nominal phone carrier frequency – up or down depending on which sideband is being used. However, if the TX is double sideband suppressed carrier, then the transmitted signal is actually two carrier signals, 750 Hz each side of the LO frequency. If viewed on a scope, the RF envelope from this DSB TX is the characteristic two modulating sine waves in anti-phase, filled with RF in between – the two sidebands produce the same modulation effect as when a single sideband phone TX is set up with a *two tone audio signal*. When listened to on another RX, the DSB TX has two steady RF carriers 1500 Hz apart. When modulated too hard (RT200 too high), limiting occurs at the RF output device causing the maximum RF voltage at that point to be related directly to the supply voltage. In consequence, the envelope peaks will have flat tops causing splatter which must be avoided.

Using the CW facilities

For a superhet TCVR, the transmitter will automatically produce RF on the frequency of the other station when the receiver is tuned to produce the same frequency beat note as that of the CW kit's sidetone oscillator. All you have to do is tune for maximum received signal (with S200 set to CW) and then press the key! You may find searching for CW signals is initially easier with S200 in the phone position – it will still produce CW 750 Hz from the nominal phone carrier frequency.

For a direct conversion RX with DSB TX, such as the Compton/Butleigh combination, working other stations is equally easy! The DSB TX used with this kit produces two RF signals 750 Hz on each side of the LO frequency. This means that no matter which sideband you use for reception, one of these two transmitted signals will be on the other station's frequency provided your RX is tuned to produce a 750 Hz beat note. Getting another station to respond to your CQ call should also be easy - he can put his carrier on the same frequency as either of your two signals.

Options

Adjustable hold delay R 213 can be removed and a 470K pot connected instead to the holes for R213.

CW drive level Some rigs such as the Taunton may need more sidetone input to the speech amp in order to obtain full output. In this situation reduce R216 to around 4K7.

Use with Meter kit The point TU is connected to the earthy end of the Meter kit's tune relay. The other end of the relay should be connected to the main positive supply.

Use as a Morse practise oscillator

As explained earlier, the parts around TR201 can be re-arranged to provide an audio amplifier to make up for the lost signal level caused by adding a resistance in series with the series connected Walkman type phones. The partial parts layout of Fig. 5 shows the alternative part positions. Making use of the parts marked with # which were not fitted earlier, the changes are:-

D201, 202, 203 are not fitted
TR200 is not fitted
C211 is not fitted but used instead as C251
R211 is not fitted but used instead as R252
R212 is not fitted
R213 is not fitted but used as R250 mounted from the pad adjacent to point Q across the old positions for R211/C211
R210 is used in the same place to become R251
TR201 is used in the same place to become TR250
The point Q is liked by a short wire to the point U
The point ST is linked by a short wire to the point P

The left and right signal wires of the phones are connected between point Y and any E point. The phones common wire is not connected. The phones must be switched to stereo. If two sets of phones have to be driven then connect the second pair across the first and reduce R252 to 470R. (IC200A should not have a load of less than 470R.) The key is connected to the point K as normal and RT201 controls the output level.

I trust all has worked as intended! Tim Walford G3PCJ, June 6th 2002

Parts list for the CW Kit

Resistors			Capacitors		
2	1K	R203,211,	1	470 pF disc – 471	C202
2	10K	R210,214	3	10 nF disc – 103	C204,212,213
4	22K	R216,217,218,220	5	10 nF Polyester	C200,201,210,218, 219
3	47K	R219,221,222	3	100 nF Polyester	C206,215,216
6	100K	R200,201,202,212, 213,215	5	10 uF 35v electro	C203,205,211,214 217
2	10K preset	RT200,201			
	R204 to 209 are not used			C207 to C209 are not used	
Semiconductors			Miscellaneous		
1	6v2 Zener - bent leads	D200	4	Rubber feet	
5	1N4148	D201,202,203,204, 205	1	3.5 mm stereo socket	For key
3	BS170	TR200,201,202	1	3.5 mm mono plug	For key
1	TL072	IC200	1	SPCO toggle switch	S200
			1	Centre off toggle	S201
TRN Walford G3PCJ		June 6th 2002	1	Single sided PCB	Issue 1

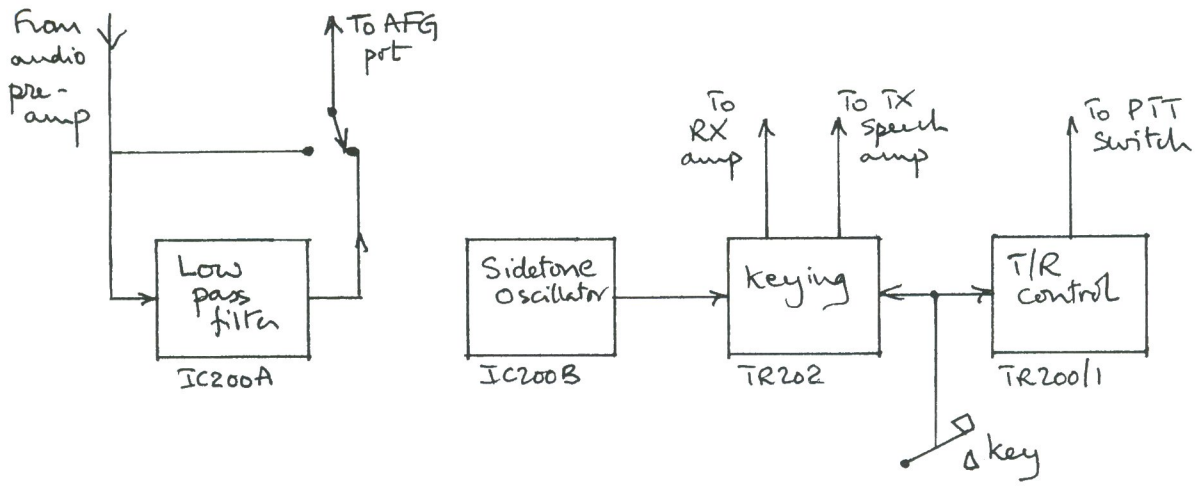
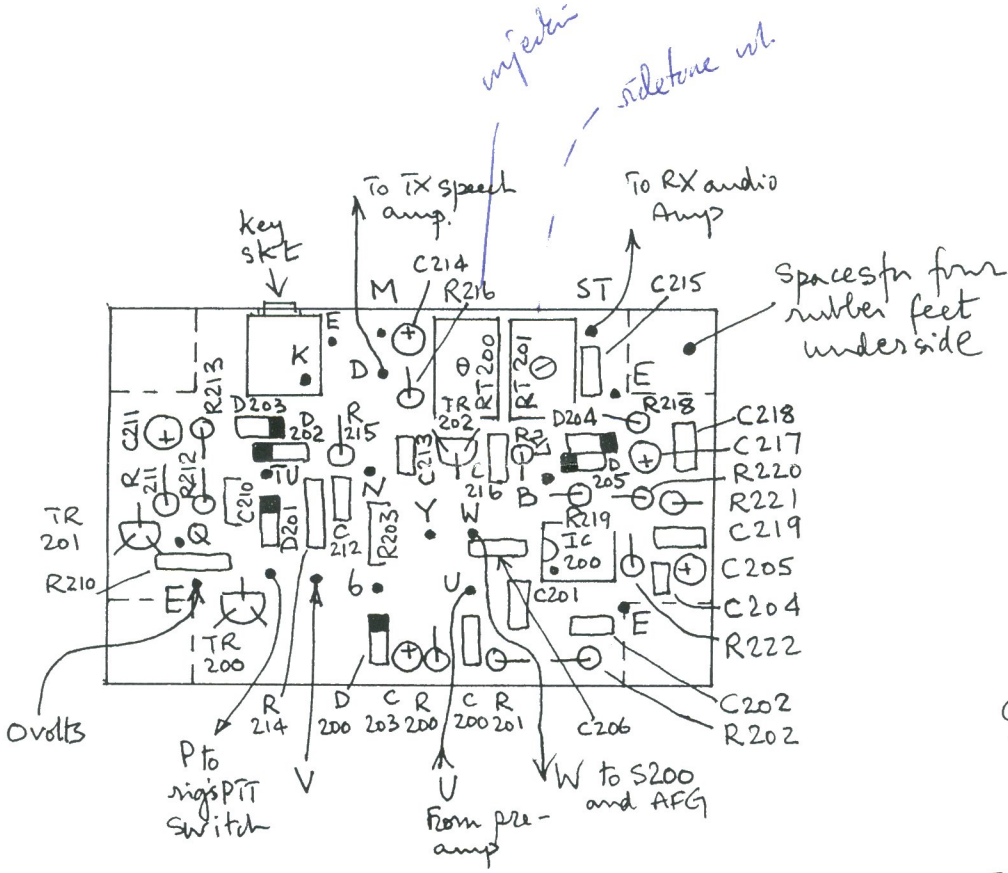


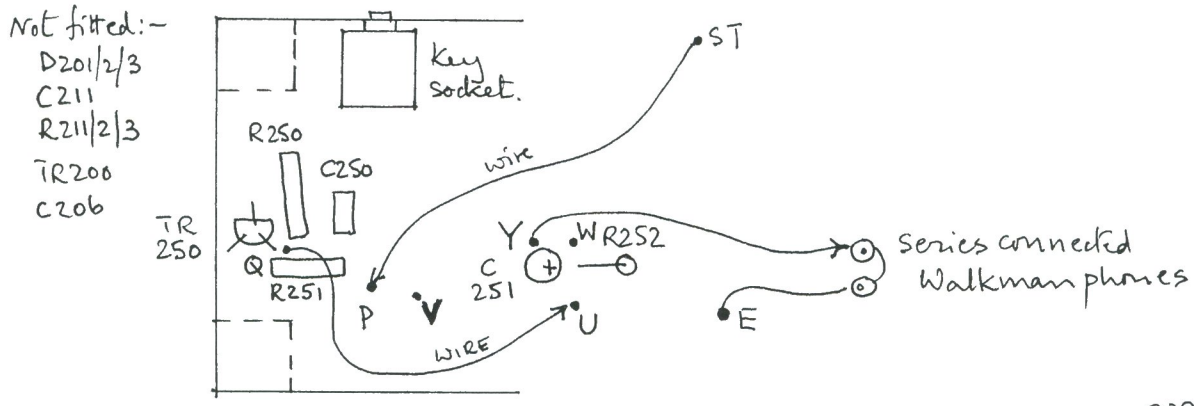
FIG 1: BLOCK DIAGRAM OF CW KIT

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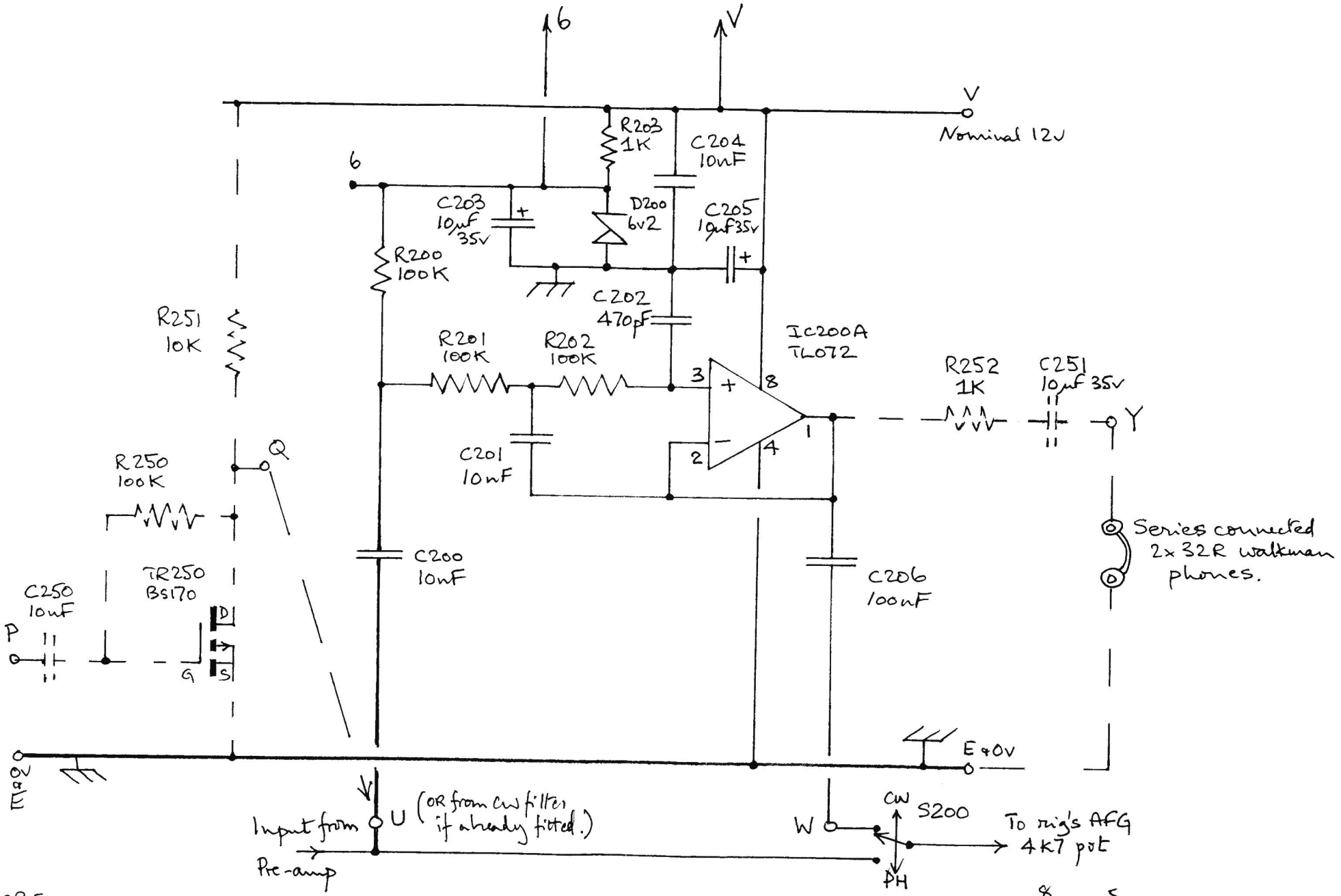
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FIG 4: PARTS LAYOUT OF CW KIT - TOP OR COMPONENT SIDE VIEW



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FIG 5: Partial Parts Layout for Morse Oscillator



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FIG 2 : CIRCUIT OF RECEIVE FILTER

Note : Dotted circuits are for morse practice oscillator use.

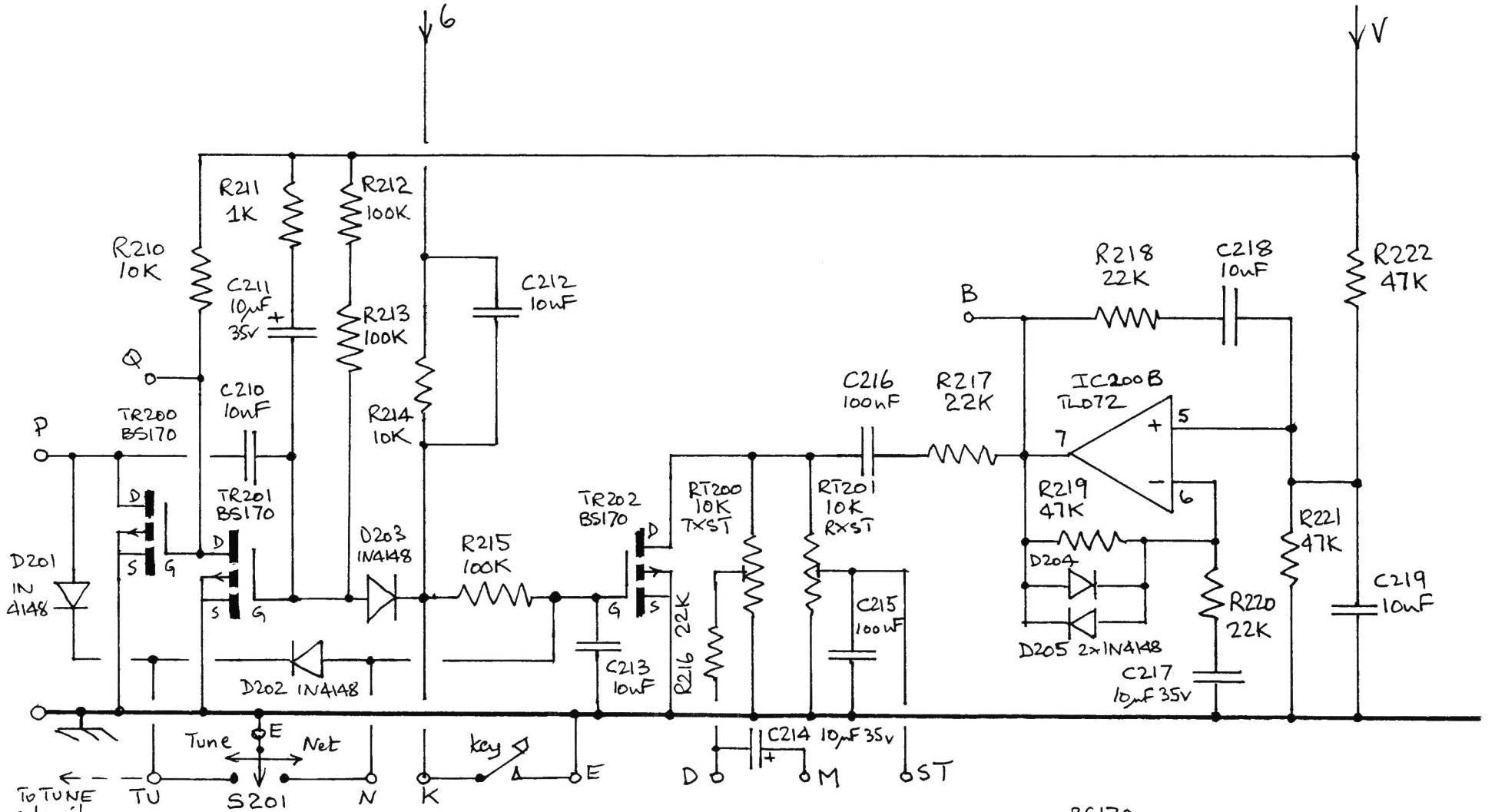


FIG 3: CIRCUIT OF TRANSMIT ASPECTS

BS170 Pin View

S G D

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