

# CW Magic Eye

The Magic Eye is available in two kits;

Kit 1 Module Only

Kit 2 Full kit including case and all sockets and connectors

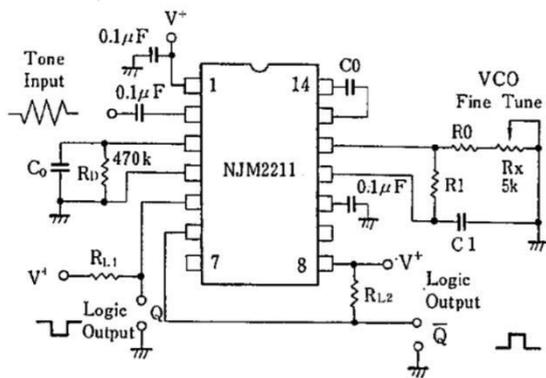
## Module assembly Instructions

Old radios often had a 'Magic Eye' tuning indicator, normally green, that responded to the tuning, it was a nice visual way to tune in a signal, many modern radios are fitted with a CW centre tune indicator, often like on my FTDX-1200 its very small and hard to see. This little circuit can be connected into the audio out circuit, (just connect to the Data out of the radio/across extension speaker) or if it's a kit /homebrew rig just put it across the outer pins of the volume control, its fairly high impedance input and should have little effect on the circuit it connected to.

The module will accept a wide range of input voltages from just a few mV up to 3 V of audio.

It's a simple little circuit but I thought some of you may like to understand how it was designed. If you're not into maths you may want to skip this bit!

The data sheet is very helpful and shows the basic design for what we want



The manufacture as been very kind and explain what each of the parts does and how to calculate the critical values.

For this design I will work on an 600Hz CW offset (although that's the centre freq and it is tuneable anyway)

They tell us that there are key circuit components that we need to calculate for our application, R0, R1, C0, C1, and CD .

The first R0, this is not to critical they tell us any value between 15k to 100K, Now R0 is the total resistance between pin 12 and ground, since we want to be able to tune our indicator to match our own radios we need to allow for an adjustable trim pot here, the total value I have gone for at design stage is 22k ohms, mostly because I had built one of these before and happen to have a 12k ohm resistor and a 10K trim pot at hand, it worked great.

OK so we will break this 22k to a fixed 12k ohm resistor and a 10K trim pot, that's R0 sorted.

Next we need to calculate the value of the VCO timing capacitor between pin 14 and 13. The formula for this is  $f_o(\text{Hz}) = 1/(R_0 \times C_0)$  for use  $f_o=600\text{Hz}$  so rearrange the formula gives us

$$C_0 = 1/(R_0 \times f_o) \text{ for us } R_0 = 12\text{K} + \text{half value of trimer} = 5\text{K so } R_0 = 17\text{K}, f_o = 600\text{Hz}$$

$$C_0 = 1/(17\text{k} \times 600) = 0.000000098 \text{ Farads} = 98\text{nF}, \text{ the nearest real value for us is } 100\text{nf} (0.1\mu\text{F Disk})$$

$$R_1 = R_0(f_o/\text{bandwidth}(\text{Hz})) \text{ if we design to have a bandwidth of } 24\text{Hz } R_1 = 17\text{K} (600/25) = 430\text{K ohms}$$

$$C_1 = C_0/4 \text{ if we used } 100\text{nf from above then } 100/4 = 25, \text{ nearest value } 22\text{nf.}$$

Cd has a more complicated formula but in practice I have found C0 /3 does the job rather well.

So now we have our values for 600Hz centre tone and around 24Hz bandwidth.

$f_0=600\text{Hz}$

$R_0=12\text{K}$  Fixed and  $10\text{K}$  trim pot set half way

$C_0=100\text{nF}$  (Marked 104)  $R_1=430\text{K}$   $C_1=22\text{nF}$  (223)  $C_d =330\text{nF}$  (334)

## Building the Magic Eye

*On a scale of 1 to 10 with 1 being very easy (no soldering) and 5 being complex and difficult this would be rated as 3, suitable for beginners.*

### Parts List

IC1 2211D Tone Decoder IC

IC Socket

PCB

C1, C3, C5, C6 0.1uF Disk (Marked 104)

C4 0.022uF Disk (Marked 223)

R1 470K ¼ W Resistor

R2, R3 4K7 ¼ W Resistor

R4 430K ¼ W Resistor

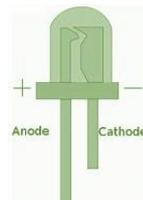
R5 12k ¼ W Resistor

R7 2K2 ¼ W Resistor

R6 10K 25 Turn Trim Pot

Q1 2N2222A Transistor

1 x Green 5mm LED



C2 0.33uF disk (Marked 334)

The Build Is very easy, first fit the IC socket, there is a little notch at the top of the socket and this should be near the edge of the PCB.

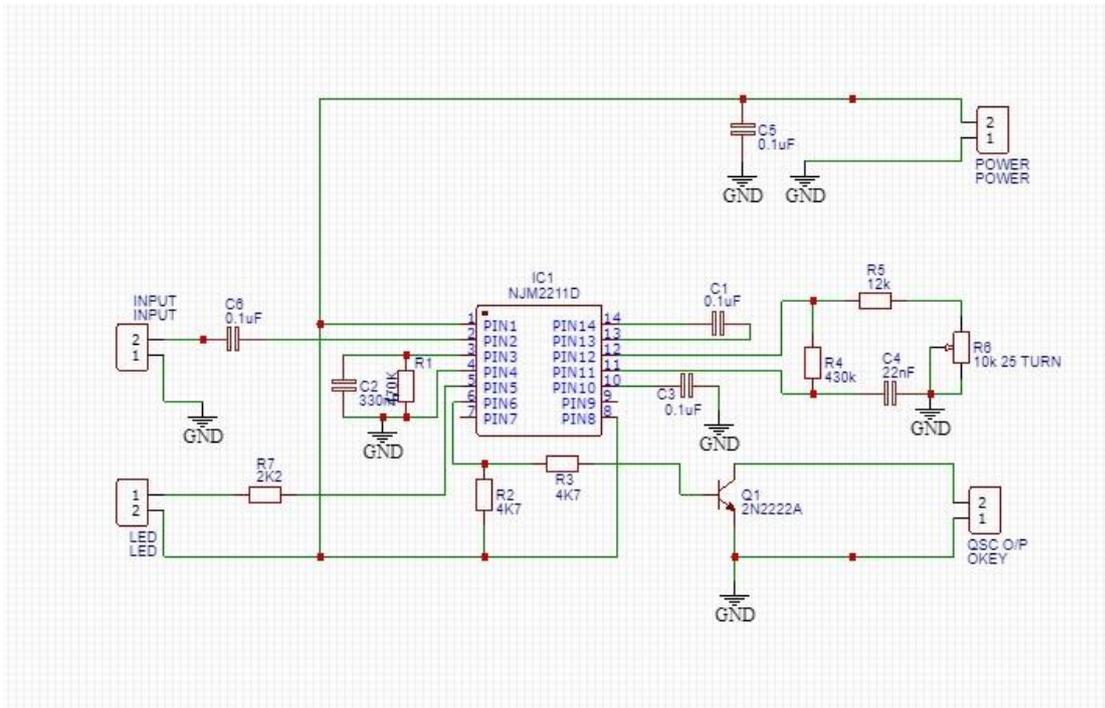
There are 6 resistors, R1 to R5 and R7 Fit these. Make sure the right value is fitted in the correct place. It is always a good idea to check each value with a meter first, follow the parts list and the markings on the PCB.

Fit the 10K trim pot, make sure you fit this so it lines up with the outline on the PCB. The small brass screw should be near the mounting hole.

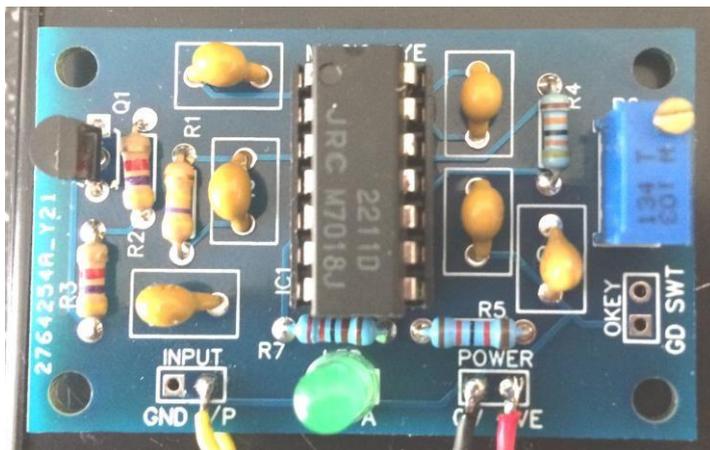
Now fit the capacitors, there are 6 of them. Check the value of each against the board layout and parts list.

Now the final part, there is a 2N2222A transistor. This acts as a switch when the magic eye detects the matching tone, this can be used to switch an external oscillator on and off. This can reform the CW being received but is really for experimentation.

That is the board completed but you will need to connect it to your radio and power supply.



The Magic Eye Circuit



The PCB after the build. The LED would normally be remote from the board

The AF input can be from a few mV up 3V so very flexible, you can wire it across a volume pot , use the AF data output on the back of your rig or even mount it in an external speaker case (like I have)

If you connect this across your speaker then make sure you connect the input the right way around, make sure the AF GND is connected to the 0v or speaker ground and the AF I/P wire to the speaker +Ve.

### How to setup the Magic Eye.

First you need to find a nice steady CW signal. Take time and tune it in, once you're happy with the tuning we can set the PLL to activate on this tone by SLOWLY adjusting the trim pot. The bandwidth on the active region is designed to be about 25Hz but in practice due to component tolerances the

real life bandwidth will likely be a little higher. As you turn the trim pot you will see the LED come on, make a mental note of the position of the pot at the LED on point, carry on adjusting the pot till the LED goes out, the on and off points are the bandwidth of the PLL. Adjust the trim pot to half way between these two points and check the tuning, it should be set now and in future you can just adjust the radio tuning till the LED illuminates in sympathy with the incoming Morse.

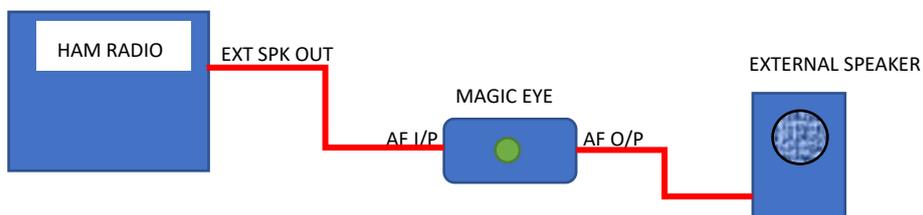
Another option is to use the rig's own side tone when you key the radio and adjust the modules tune to light on this tone. Of course if you have a calibrated signal generator you can always feed the magic eye with a signal at the frequency you have set for your rigs side tone.

That's it, job done. Module ready to be mounted. Let me know what you think.

73 Paul MOBMM

[paul@phoenixkitsonline.co.uk](mailto:paul@phoenixkitsonline.co.uk)

#### Option 1 :-With external loudspeaker



#### Option 2: Low level AF source

