

PRO4 STEREO CODER

for FM TRANSMITTERS

CONSTRUCTOR GUIDE

Please read fully before construction starts

First, check that the kit contains all the parts listed on the component list. If any parts are missing or damaged, contact us immediately. Next, is your soldering of a reasonable standard and have you got a soldering iron with a tip size of 2.5 mm or smaller. Only proceed if your answer is yes. Remember that you can change the kit for a ready built unit at this stage if you are unsure. (You only pay the price difference).

The printed circuit board (PCB) has a silk screen print on the topside. You can see component shapes and numbers. With this, and the component parts list you have all you need to identify components and fit them correctly into the PCB. Take care and time to make sure all components are correctly placed. Finally, make sure that you have the following tools:

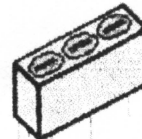
Side Cutters: Long Nose Pliers: Screwdrivers: Soldering Iron: Solder: Please note that you get better results using thin 22 SWG solder rather than the thick 18 SWG type. A magnifying glass can also be very useful, as some of the component markings are tiny.

BUILDING STARTS HERE!

GENERAL: Separate the pages of this manual so you can clearly see this sheet, the component fitting guide, the component list and the large photograph, all at the same time. Fit the smaller components first and work your way through progressively larger components. **Remember this: All components should be pushed down flat to the PCB, (unless stated otherwise).** Use the photograph and the component-fitting guide to help you further.

1. First, fit and solder the **resistors** (R1 – R64). When you have soldered a few components, use your Side Cutters to trim back the excess leads. Resistors can be fitted either way round. Then fit and solder the 2 small BZX7V5 orange diodes (ZD1 & ZD2), **the correct way round!** They have a black band and this **MUST** line up with the component shape on the board. Then do the same with D1 and D2 (1N4001 diodes) which must also be fitted the right way round
2. Fit and solder **IC's 1 - 10**. These are **integrated circuits** and have 8, 16 or 24 pins. They **must be fitted the right way with the notch on the device lining up with the shape on the PCB**. Bend the pins slightly with pliers, if needed, to make them fit the holes in the PCB. Make sure all the pins are through the holes in the PCB before you start soldering. Take special care to make sure that you fit the **79L12AZ** voltage regulator at position IC4 on the board. The **78L12AZ** goes at position IC5 on the PCB.
3. At this stage hold the board under bright light and check that you have soldered every component connection so far in the PCB. Also check that connections close to each other aren't bridged with solder. Do the components look to be reasonably flat to the board?

4. Now fit the **variable resistors** VR1, VR2, followed by the **capacitors** C1 – C32. Have a look at the component-fitting guide for help on fitting capacitors to the PCB. Check the component markings very closely with the component parts list to make certain you fit the right capacitor in the right place! **Remember**, fit the parts flat (or very close to) the PCB. Make sure that you fit all the **electrolytic** capacitors the correct way round. Right, it's time to hold the PCB under the bright light again and check your work carefully for joints you have missed with your iron and also solder splashes.
5. Now fit and solder the rest of the parts, taking a regular glance at the component fitting guide pictures. The two black 3-pin **pre-emphasis jumpers** fit at locations marked J1 and J2. (Near the left and right input markings). Take care to push the **phono sockets** fully home (with the plastic locator pins going through the PCB), they are a tight fit in the board. The AC power socket should sit flat to the PCB when soldering. With **LED1**, the green led, you must line up the flat section on the devices with that on the PCB silk screen. You should fit the **4.864MHz crystal** next. The crystal can fit either way round.
6. The last components to fit are the grey 15 KHz Low Pass Filter blocks. Make certain all the pins are through the holes in the PCB! Solder the pins quickly to avoid damage through overheating. Take care not to bridge any of the pins together with solder. **DO NOT EVER attempt to adjust the filter cores!**



15KHz Low
Pass Filter

Now check the finished PCB by holding it up to the bright light. If you can see light shining through component holes it means you have not soldered that particular component properly, if at all. Check all the electrolytic capacitors are the correct way round and do the same with the integrated circuits. If a soldered component, like an integrated circuit has to be removed, you will need a desoldering pump to do it correctly.

Finally, compare your constructed Stereo Coder unit with the one on the large photograph. Are the components on your PCB fitted neatly and flat down to the board surface, like in the photograph?

PLEASE READ THE NEXT PAGE FOR SWITCHING ON
THE BUILT STEREO CODER

SWITCH ON TIME

1. Set VR1, VR2, and to their mid positions with a small flat blade screwdriver.
2. Make sure that the PCB underside is not sat directly on a metal surface or you may short-circuit the PCB.
3. Plug the supplied Mains AC Adaptor into the mains electricity socket and plug the 2.5 mm power plug into the stereo coder 12 volt ac input socket. The green LED should illuminate immediately. If it does not, **immediately disconnect the power**. Using a single phono lead, make a connection between the **MPX out** socket on the stereo coder, and the input socket on your transmitter. This will make the stereo indicator on your receiver illuminate.
4. Make certain that you disable the pre-emphasis on your FM transmitter (if fitted). **This is most important!**
5. Connect audio at line level to the stereo coder input phono sockets (e.g. A CD player). Whilst listening on a good quality FM radio, adjust the sound level (modulation) control on your transmitter for the correct sound level. If you think you need more output (or less) from the stereo coder you can adjust VR1 and VR2. For the listening tests please use a CD that contains music with plenty of separation of musical instruments.
6. The stereo coder has pre-emphasis fitted to make the sound bright and crisp. You can select the European (75 uS) or (50 uS). Please see the attached photograph for more detail on pre-emphasis setting). However, if you use a **limiter/compressor** in front of the stereo coder (which you should), then please disable the stereo coder pre-emphasis by simply pulling upwards on the pre-emphasis jumpers to remove the link from the pins.

PROBLEMS?

If the unit does not work when you first switch on, then the first thing to do is to carefully re-check your entire construction and component placement. It is unlikely that any parts supplied were faulty to start with, although not unheard of.

1. **Nothing happens when powered, green LED does not illuminate.** Remove the 2.5mm AC power plug from the unit immediately. Measure the AC voltage between the inner and outer connection of the plug. You should get a reading of around 13 volts ac. If you do then the adaptor is ok and you must check the Stereo Coder for construction errors
2. **Low volume and no stereo light on the receiver.** You probably need to increase the transmitter input level control to cure this problem. Faulty phono leads are not uncommon.
3. **One channel dead.** First switch over the left and right phono input leads. If the fault remains on the same channel, then the phono leads are ok. A damaged low pass filter can cause this problem. Solder a wire link from the filter input to filter output, sound will be restored if the filter is at fault.
4. **Tinny sound and possibly very wide stereo with distortion.** You have not disabled the pre-emphasis on your transmitter. Or you are using a

limiter/compressor in front of the coder and have not disabled the pre-emphasis on the stereo coder unit.

5. **Unstable Performance.** Too many components stood up on long legs above the PCB. Dry soldered joints or missed completely.
6. **Not much (or no) separation.** Assuming that the music definitely does have good separation to start with, this problem usually shows up only if you are using a very low quality transmitter that has a poor audio response.
7. **Music comes out quieter on one side.** Either the stereo phono lead to the stereo coder input is faulty or VR1 (or VR2) is turned right down.

COMMON CONSTRUCTOR ERRORS

1. ICs fitted wrong way round or wrong location
2. IC pins bridged with solder
3. Zener Diodes and diodes fitted wrong way round.
4. Joints not soldered at all
5. Very poor soldering quality
6. Solder splashes
7. Components stood up on long leads.
8. Build Instructions not followed closely.

You can check the soldered joints better with a magnifying glass and also find shorted tracks. A multimeter is also very handy at locating shorted or broken tracks.

This is a complex circuit so if it is not working correctly after you have built it, please do not panic. Give us a call for advice on what to do next.

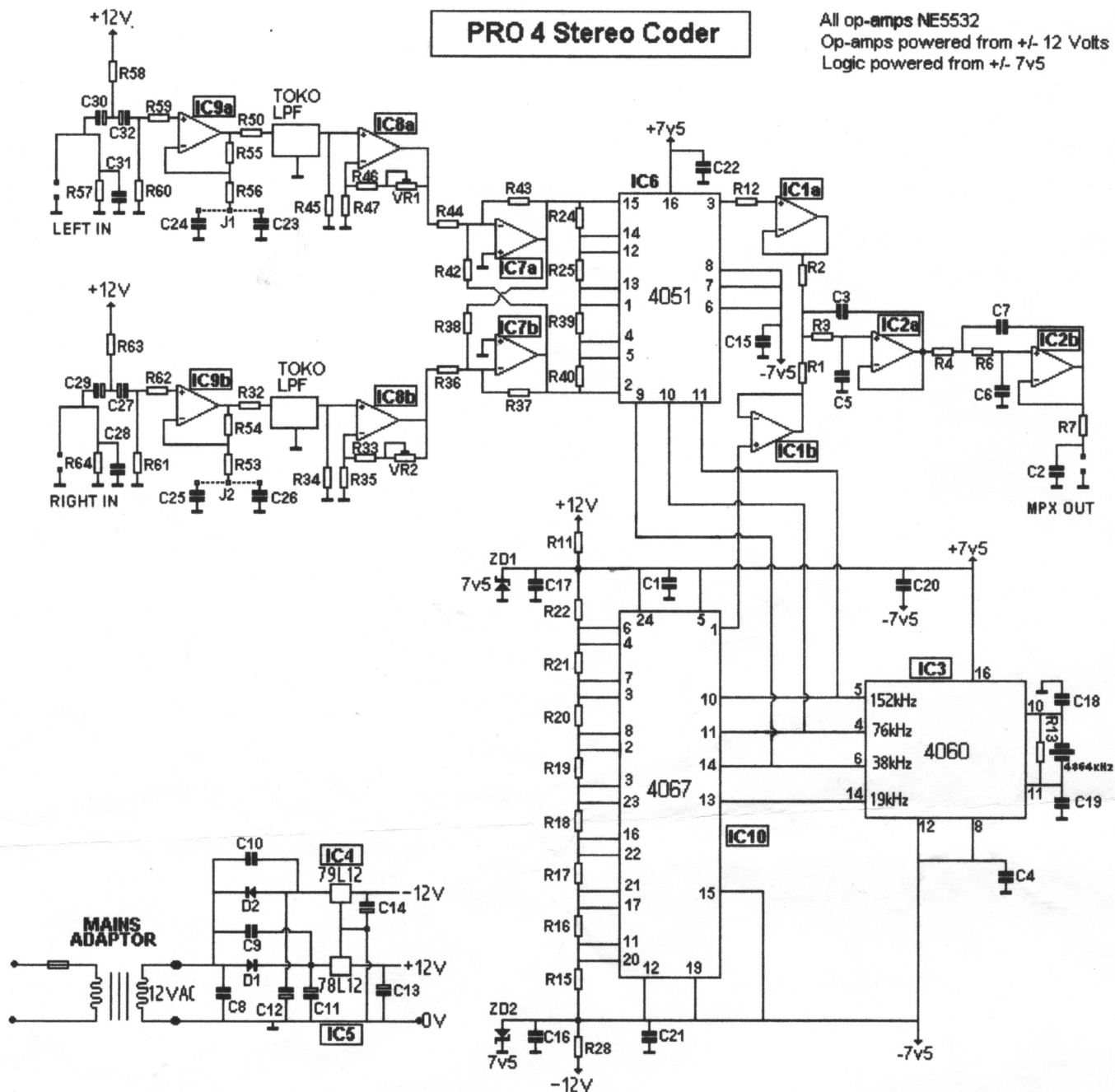
Believe it or not, some people do not bother to even read the instructions that are provided to help build the kit. Of course, YOU followed the instructions to the letter, didn't you?

COMPONENT LIST FOR PRO 4 STEREO CODER

R1	68K	blue grey orange gold	R49	0R	single black band	VR1	2K	PRESET RESISTOR
R2	1K	brown black red gold	R50	3K3	orange orange red gold	VR2	2K	PRESET RESISTOR
R3	1K	brown black red gold	R51	0R	single black band	IC1	KA5532	KA5532
R4	1K	brown black red gold	R52	0R	single black band	IC2	KA5532	KA5532
R5	0R	single black band	R53	220R	red red brown gold	IC3	4060B	4060B
R6	1K	brown black red gold	R54	2K2	red red red gold	IC4	79L12AZ	KA79L12AZ
R7	100R	brown black brown gold	R55	2K2	red red red gold	IC5	78L12AZ	KIA78S12P
R8	0R	single black band	R56	220R	red red brown gold	IC6	4051	CD4051BCN
R9	0R	single black band	R57	100K	brown black yellow gold	IC7	KA5532	KA5532
R10	4K7	yellow purple red gold	R58	100K	brown black yellow gold	IC8	KA5532	KA5532
R11	100R	brown black brown gold	R59	1K	brown black red gold	IC9	KA5532	KA5532
R12	1K	brown black red gold	R60	10K	brown black orange gold	IC10	4067	MC14067BCP
R13	1M	brown black green gold	R61	10K	brown black orange gold	D1	1N4001	1N4001
R14	0R	single black band	R62	1K	brown black red gold	D2	1N4001	1N4001
R15	27R	red purple black gold	R63	100K	brown black yellow gold	ZD1	BZX7V5	BZX7V5 white spot
R16	68R	blue grey black gold	R64	100K	brown black yellow gold	ZD2	BZX7V5	BZX7V5 white spot
R17	100R	brown black brown gold	C1	100nF	.1K63 <u>or</u> 100nK63	LED	GREEN	5mm green LED
R18	120R	brown red brown gold	C2	1nF	102 (brown disc type)	15 KHz FILTER		Grey Filter Block
R19	120R	brown red brown gold	C3	2.7nF	272J	15 KHz FILTER		Grey Filter Block
R20	100R	brown black brown gold	C4	100nF	.1K63 <u>or</u> 100nK63	X	AEL 4.864 MHz CRYSTAL.	
R21	68R	blue grey black gold	C5	1nF	1nK63	MPX OUT Socket		PCB Phono Socket
R22	27R	red purple black gold	C6	1.8nF	182J	LEFT Socket		PCB Phono Socket
R23	0R	single black band	C7	1.8nF	182J	RIGHT Socket		PCB Phono Socket
R24	82R	grey red black gold	C8	1nF	102 (brown disc type)	12V AC INPUT		2.5mm socket
R25	220R	red red brown gold	C9	1nF	102 (brown disc type)	J 1		3 pin Pre-emphasis Jumper
R26	0R	single black band	C10	1nF	102 (brown disc type)	J 2		3 pin Pre-emphasis Jumper
R27	0R	single black band	C11	470uF	470uF 35V	PRO 4 Stereo Coder printed circuit board		
R28	100R	brown black brown gold	C12	470uF	470uF 35V	12 Volt AC 1000mA Mains Adaptor		
R29	0R	single black band	C13	10uF	10uF 16V			
R30	0R	single black band	C14	10uF	10uF 16V			
R31	0R	single black band	C15	100nF	.1K63 <u>or</u> 100nK63			
R32	3K3	orange orange red gold	C16	100nF	.1K63 <u>or</u> 100nK63			
R33	220R	red red brown gold	C17	100nF	.1K63 <u>or</u> 100nK63			
R34	3K3	orange orange red gold	C18	100pF	101J			
R35	1K	brown black red gold	C19	33pF	33J			
R36	3K3	orange orange red gold	C20	100nF	.1K63 <u>or</u> 100nK63			
R37	3K3	orange orange red gold	C21	100nF	.1K63 <u>or</u> 100nK63			
R38	33K	orange orange orange gold	C22	100nF	.1K63 <u>or</u> 100nK63			
R39	220R	red red brown gold	C23	33nF	33nJ 100V			
R40	82R	grey red black gold	C24	22nF	22nJ 100V			
R41	0R	single black band	C25	22nF	22nJ 100V			
R42	33K	orange orange orange gold	C26	33nF	33nJ 100V			
R43	3K3	orange orange red gold	C27	10uF	10uF 16V			
R44	3K3	orange orange red gold	C28	100pF	101J			
R45	3K3	orange orange red gold	C29	10uF	10uF 16V			
R46	220R	red red brown gold	C30	10uF	10uF 16V			
R47	1K	brown black red gold	C31	100pF	101J			
R48	0R	single black band	C32	10uF	10uF 16V			

PRO 4 Stereo Coder

All op-amps NE5532
 Op-amps powered from +/- 12 Volts
 Logic powered from +/- 7v5



This diagram shows the pre-emphasis settings available with J1 and J2. Remove the jumpers to disable Pre-emphasis. Left and Right level gain adjust presets shown also.

PRE-EMPHASIS JUMPER

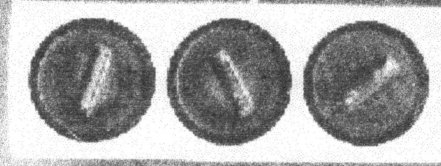
75uS

50uS

15KHz FILTER



15KHz FILTER



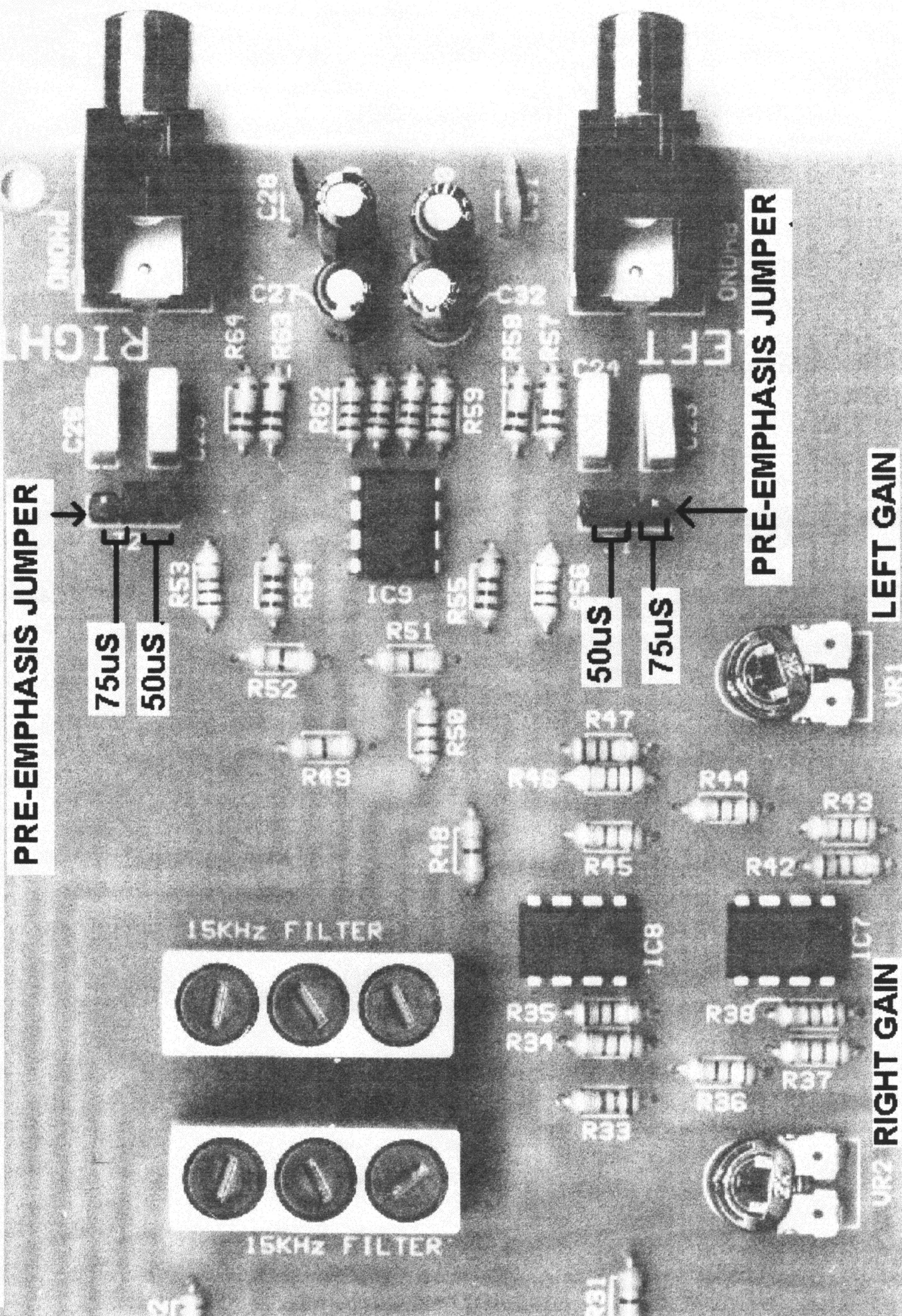
PRE-EMPHASIS JUMPER

50uS

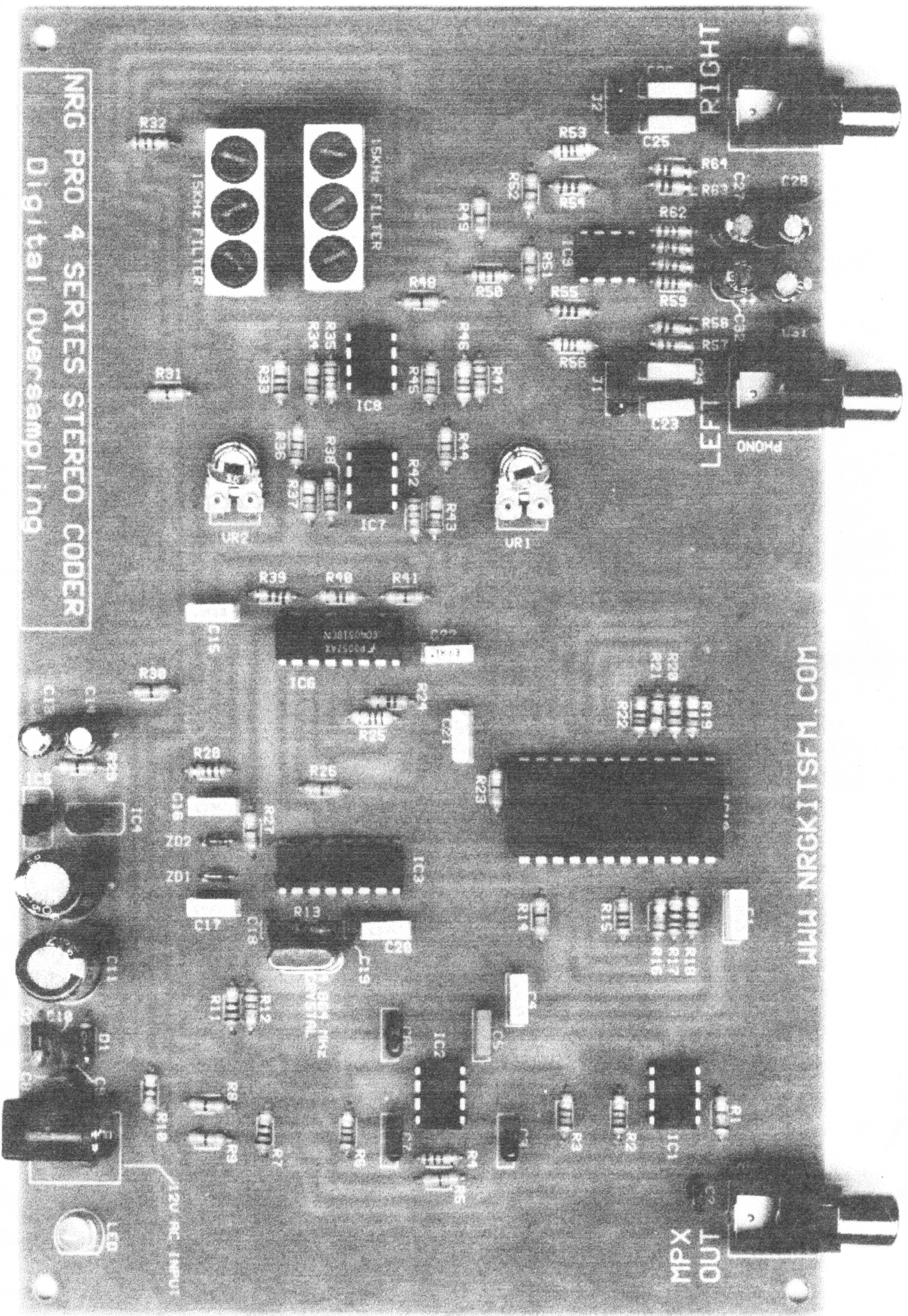
75uS

RIGHT GAIN

LEFT GAIN



NRG PRO 4 SERIES STEREO CODER
Digital Overampling



WWW.NRGKITSFM.COM

MPX
OUT

RIGHT

LEFT

PHONO

LED

12V DC INPUT

15KHz FILTER

15KHz FILTER

2.0MHz
CRYSTAL

F40524X
COM258N

NRG PRO IV OVERSAMPLED STEREO CODER

General overview

The **NRG PRO IV Stereo Coder** is for use with any of our range of FM transmitters. It takes your stereo signal source and encodes it into an industry standard "Zenith GE" multiplex signal. Use of oversampling and digital signal generation gives superb stereo imaging results with ultra-low distortion. Careful design has kept adjustments to a minimum.

Inputs and output are by RCA connectors, and power is indicated by the LED pilot light. Power is provided by an AC adaptor, which is provided with this kit. This Stereo Coder can only be powered by the 12 volt **AC** mains adaptor, please note that **DC** adaptors are **not** suitable

Circuit operation

The **NRG PRO IV Stereo Coder** uses a crystal frequency reference for best pilot tone stability. The 4060 IC is the clock oscillator and includes a frequency divider chain. We use four of the outputs from this IC as clock signals for the pilot tone synthesizer and three of them for the audio processing switching.

The 4067 IC is a 1 of 16 multiplexer, and with the use of the precision resistor chain, synthesizes a sine wave at 19 kHz. This is buffered and then passed to the output filter via an attenuator. The 19 kHz pilot sine wave purity is exceptional in this design, and the digital generation ensures correct and accurate phase relationship with the other multiplex components.

The 4051 is configured as an oversampled switching multiplexer circuit, which generates the sum and difference components required for the composite stereo signal. Again, digital generation provides accurate phase relationships to guarantee best stereo imaging and the use of eight times oversampling provides a superb distortion specification. The output of the multiplexer is buffered, and then passed to the output filter.

The output filter circuits are of the "Bessel" type, chosen for best phase accuracy within the passband, with a turnover frequency of 95 kHz. The filter configuration ensures correct broadcast bandwidth.

The rest of the audio path consists of an input buffer stage, followed by a pre-emphasis circuit. A 50 μ S or 75 μ S characteristic can be chosen by jumper selection as appropriate for the broadcasting standards in your country. The processed audio is then fed to a lowpass block filter. This rolls off at 15 kHz, and ensures no higher frequency audio products can interfere with the 19 kHz pilot or cause aliasing products when fed to the multiplexer.

The final audio stage before the multiplexer is a crosstalk corrector. Time division multiplex generation tends to produce a difference component which is slightly too small. Introduction of a minute amount of crosstalk before the multiplexer corrects this, and ensures correct stereo imaging.

All the audio processing components have been chosen for low noise and low distortion. The use of a dual rail supply allows the maximum headroom and allows us design out many of the DC blocking capacitors that would otherwise be necessary. Capacitors in audio paths can degrade quality, so we have kept them to a minimum!

Construction Tips

Your **NRG PRO IV Stereo Coder** is designed for use as part of a high quality broadcast chain. The dimensions and layout of the board have been chosen to permit easy integration with other products in our range. We recommend that your finished unit be housed in a metal case to provide screening and thus reduce the likelihood of interference pick-up by the sensitive circuitry on the board. **NRG** can provide various suitable enclosures - Please contact **NRG** for further details and advice!