

# LINEAR BROADCAST

## FMT SERIES 25W FM TRANSMITTER

### TECHNICAL HANDBOOK



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# **LINEAR BROADCAST**

## **FMT25**

### **SPECIFICATIONS**

The Linear Broadcast FMT25 transmitter was designed to meet the needs of the broadcaster requiring high performance and reliability. Self-contained in a 2RU rack case, the FMT25 provides fully adjustable power output up to 25 Watts and a user-programmable Phase Locked Loop frequency via internal rotary switches.

Audio Input	Mono (RCA) -10 - +1dBm, 47 kOhm unbalanced MPX (BNC) 4V p/p 10 kOhm
Output Power	25W, 50 Ohm, N connector
Controls	Mono deviation, RF Output Power, 4 frequency rotary switches
Frequency Range	87 to 108 MHz in 100 kHz steps
Carrier Freq. Stability	0.0005%
PLL Phase Jitter	0.001%
Spurious Emissions	> - 68dB at maximum output, in and out of band
Pre-Emphasis	Flat/50us
Frequency Response	30 Hz – 65 kHz, +/- 2dB MPX / 30 Hz – 15 kHz
Total Distortion	<0.08% at 75 kHz deviation
Signal to Noise	>73dB
Dimensions	2RU rack case x 400mm deep
Weight	9kg
Power Supply	220 – 250VAC
Finish	Stone Beige powder coat

# **LINEAR BROADCAST FMT25 THEORY OF OPERATION**

The operation of the transmitter can be broken down into functional blocks, each of which will be discussed in isolation

## **OSCILLATOR AND RF AMPLIFIERS**

The oscillator is a modified Hartley type with a printed circuit inductor on the underside of the board. The active device is a dual gate FET, the bias of which is set by resistors R30 and R31. Frequency and modulation of the oscillator are controlled by two separate pairs of varicap diodes, giving low distortion and consistent deviation across the band.

The oscillator is followed by three stages of amplification resulting in 2 watts of power output. Simple bias is applied to all three stages of and feedback networks are used on the final two stages to keep gain fairly consistent across the band. The output level is controlled by adjusting the collector supply voltage to the final transistor, Q2. This is achieved by Q1 a BD681 Darlington transistor. Q90 lowers the base voltage of Darlington Q1 if the detected reflected power at the output of the transmitter reaches a critical level, set by RV90.

## **FREQUENCY SYNTHESIS**

The 87 to 108MHz oscillator signal is fed to the PLL chip U4, type MC145191. The division ratios and operating mode of the MC145191 are set when the transmitter is powered up by microcontroller U2, type 68HC05J1. This microcontroller reads the state of the frequency control switches and sends serial data on the three wire interface (ENB, DIN and CLK) to set the programmable dividers in the MC145191 to achieve the correct output frequency. This operation is complete a fraction of a second after power up and the microcontroller then serves only a 4.00MHz reference oscillator. Consequently the transmitter must be powered down for about four seconds before a new frequency setting will take effect. Test point 1 near the PLL chip will have narrow positive 4.5V pulses at a rate of 1.5 kHz when the PLL is locked.

The 0-5V phase detector output from U4 is filtered and amplified by Op-Amp U5, giving a possible range of 0-11V. The frequency range 87-108 MHz corresponds to a voltage range of approx 1.5V to 8.5V. This DC voltage is applied to varicaps D2 and D1 in the VCO.

## **TRANSMITTER SHUTDOWN**

The supply to the 2W RF stage is removed if either of two things occurs;

### PLL fails to lock

If the PLL is set to a frequency outside the 87-108Mhz range, or the PLL or VCO malfunctions, an out of lock state will be detected by U5B, turning of transistor Q8, extinguishing the PLL lock LED on the front panel and removing volts from the power control pot.

### TXEN connections on rear of the transmitter are not tied together.

This allows the transmitter to be placed in a low supply drain "standby" mode with no power output but PLL lock and power supplies maintained.

## **MODULATION**

The MPX is fed directly to the varicaps with attenuation but no filtering. This allows SCA signals to be included with the MPX if required.

The mono signal is buffered by emitter follower Q7 and level set by VR1. It is then low pass filtered to 15 kHz by active filter U1, a TL072 FET op amp. The output of the filter is then pre-emphasised at 50us by network R38, C21 and R46 before being applied to the varicaps. A jumper block must be set to either MPX or mono.

# **LINEAR BROADCAST FMT25 ALIGNMENT PROCEDURE**

## **TEST EQUIPMENT REQUIRED**

- RF power meter capable of 30W at 100MHz
- 30W dummy load 50 Ohm
- Digital multimeter
- Low distortion audio oscillator capable of +12dBm 600 Ohm, balanced
- Deviation monitor
- Noise and distortion test set
- FM receiver/demodulator
- Stereo demodulator test set
- Digital frequency counter
- Spectrum analyser

## **TRANSMITTER**

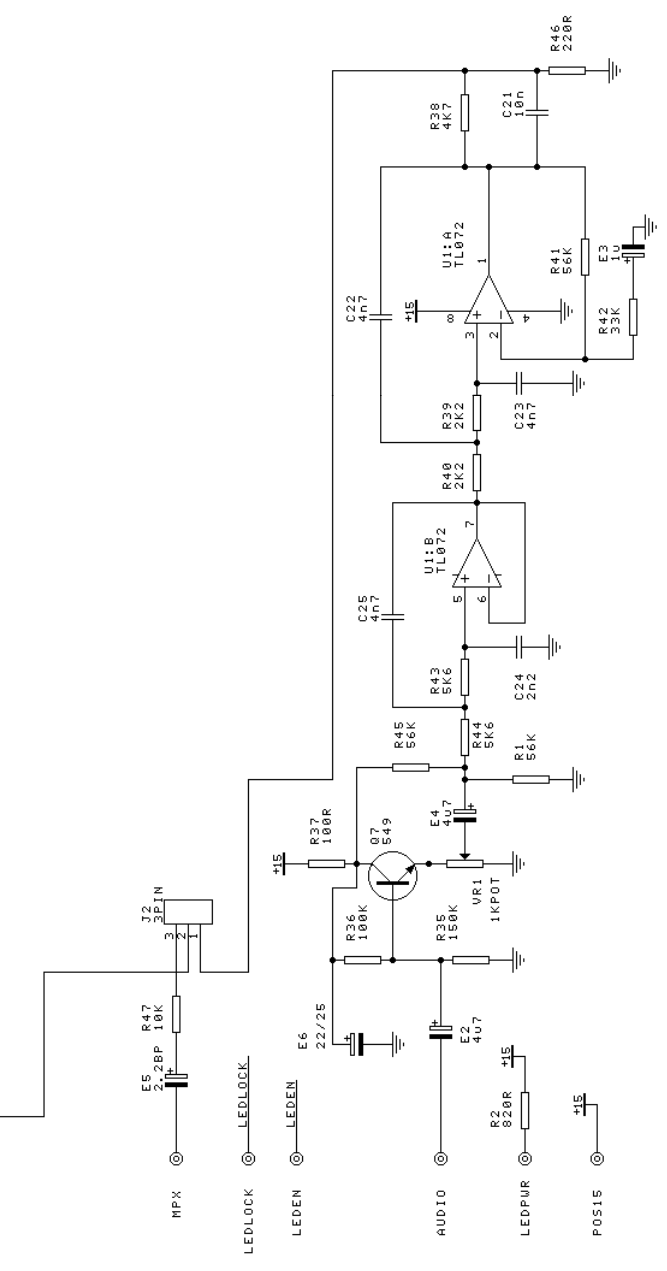
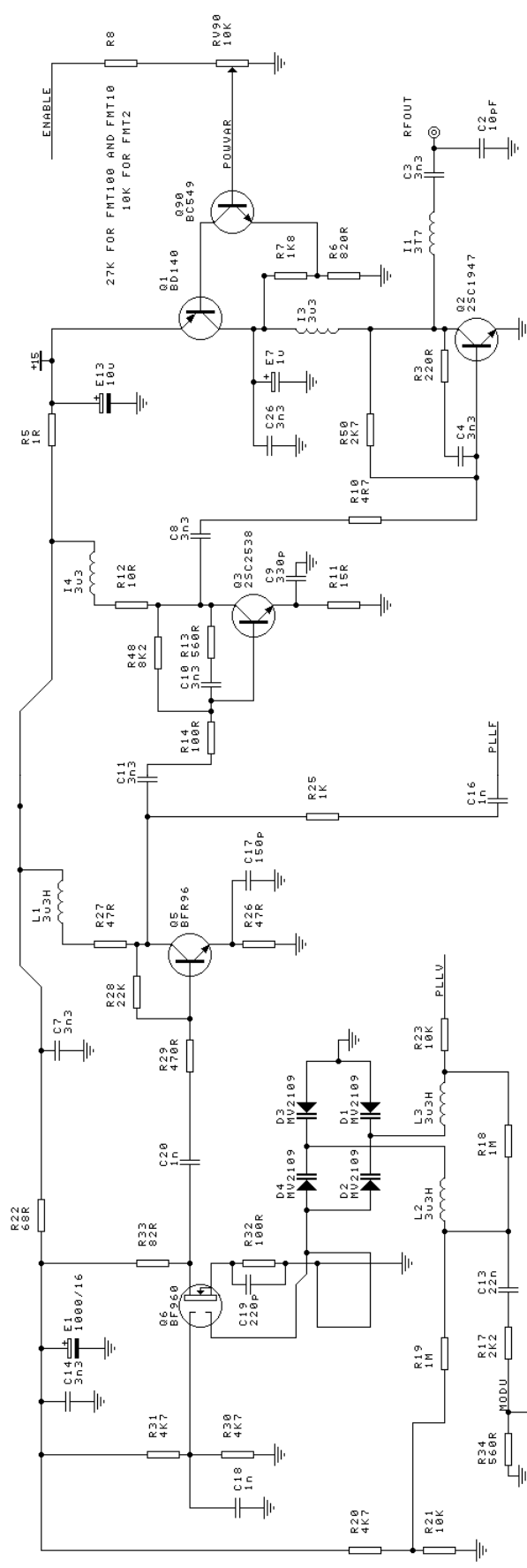
1. Connect power meter and dummy load to Antenna socket, select appropriate power range.
2. Select the desired frequency using the rotary switches on the exciter board.
3. Connect 240VAC supply and switch on transmitter.
4. Adjust power level by adjusting RV90 on the exciter board.
5. Trim the carrier frequency by adjusting C29 on the exciter board. This should be done after allowing an adequate warm up period.
6. Connect the spectrum analyser to sample the RF output and confirm that the second and third harmonics are no greater than 63dBc below carrier.
7. Connect the deviation monitor to sample RF output and set the carrier frequency.
8. Connect a precision receiver/demodulator and Noise and Distortion test set to sample RF output and set to carrier frequency.
9. Connect the audio generator to the balanced audio inputs and set for 400Hz at the desired input level. Adjust VR1 in the exciter board to achieve the required deviation level. NOTE: there is no level control for the MPX input.
10. Confirm the signal to noise ratio is greater than 65dB after replacing main lid of the transmitter.

## **METER ADJUSTMENTS**

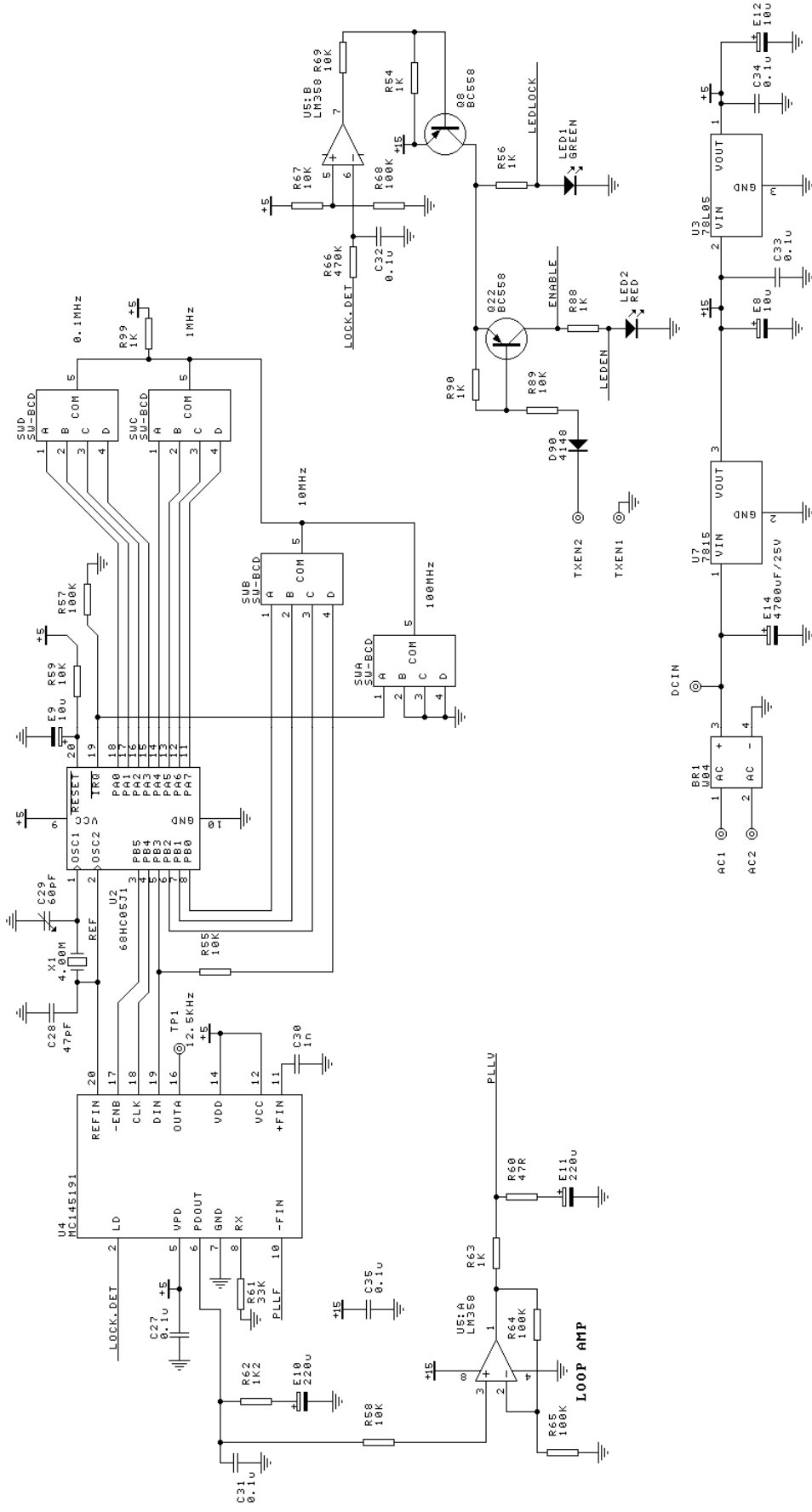
The calibration controls for the front panel meter are located on the back of the meter function switch on the front panel. Connect an external wattmeter and dummy load to the transmitter and adjust to the required power output. Adjust RV4 on the meter function switch board (0207B) so the front panel meter reads 0dB on the forward power setting.

The reverse power metering is calibrated by setting RV3 to the same position RV4. This relies on the forward and reverse detectors being symmetrical. Follow the following steps;

1. Set front panel meter switch to forward power.
2. Measure resistance between METPOS and TP1 on board 0207B.
3. Set front panel meter switch to reverse.
4. Measure resistance between METPOS and TP2 on boards 0207B and adjust RV3 to read the same resistance as in step 2.

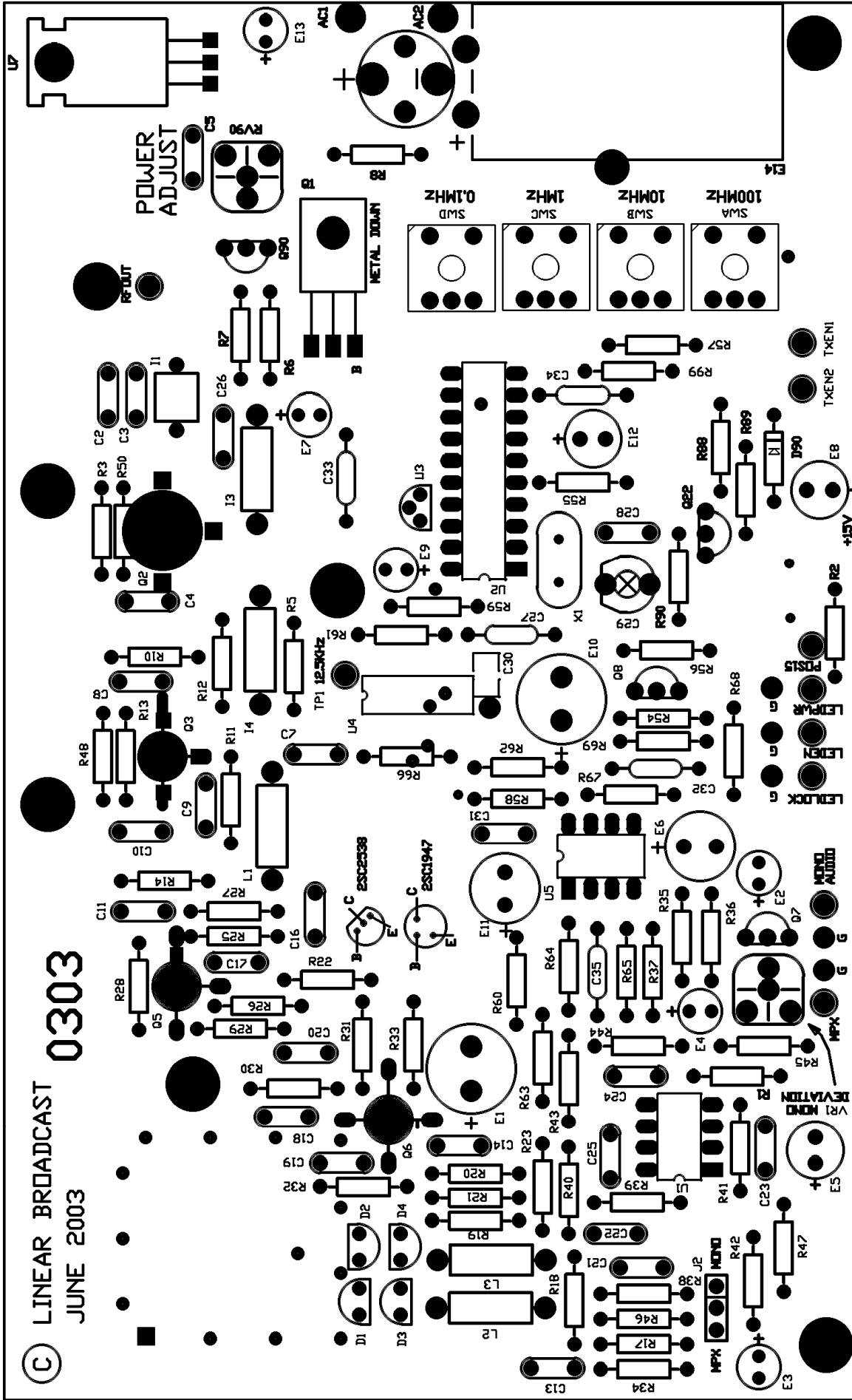


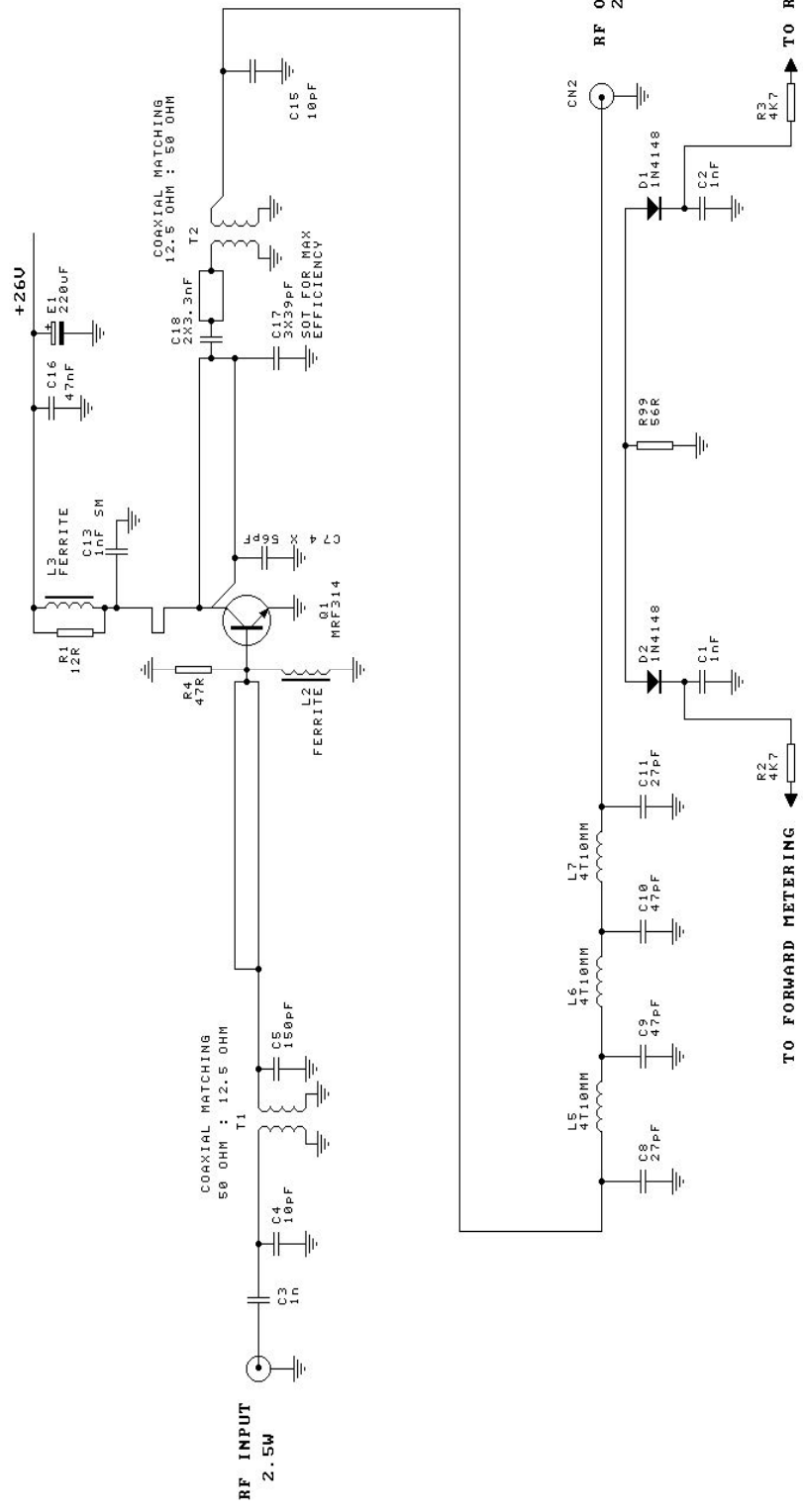
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File:	0303/1	Drawn	By: D.S.C.



Title		PLL/POWER CONTROL	
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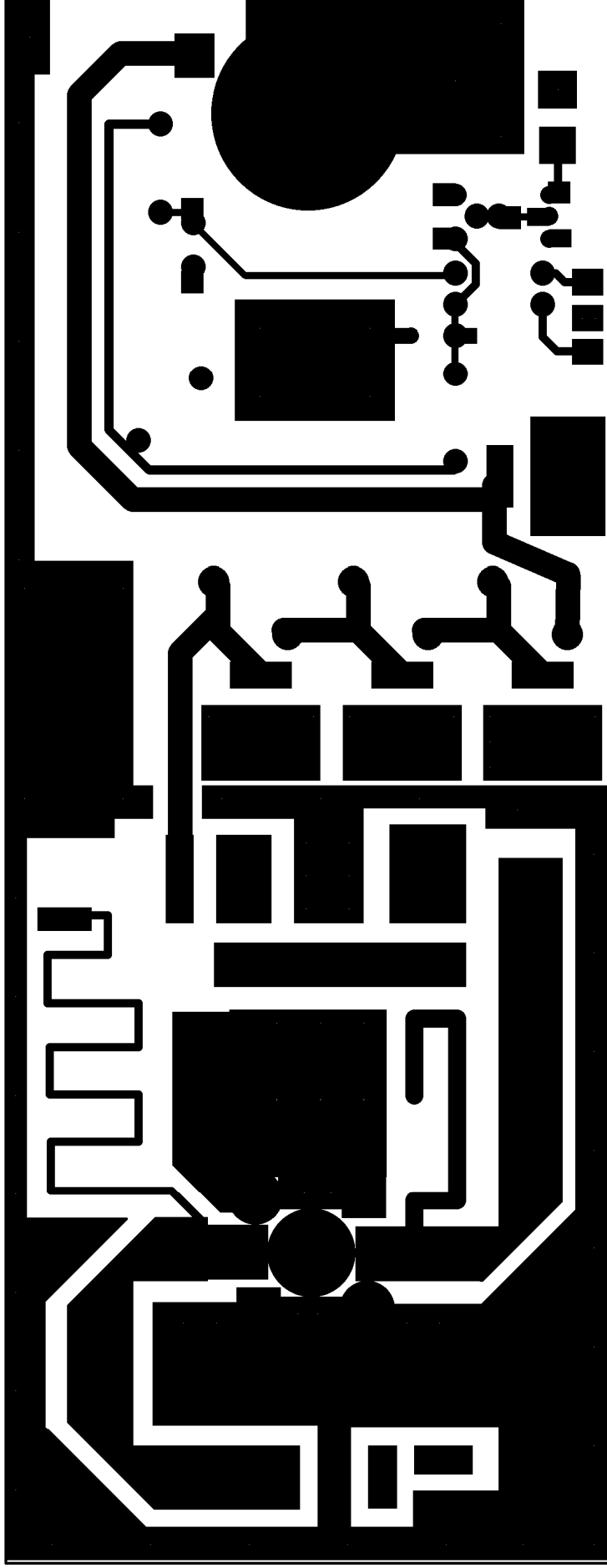
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JUNE 2003



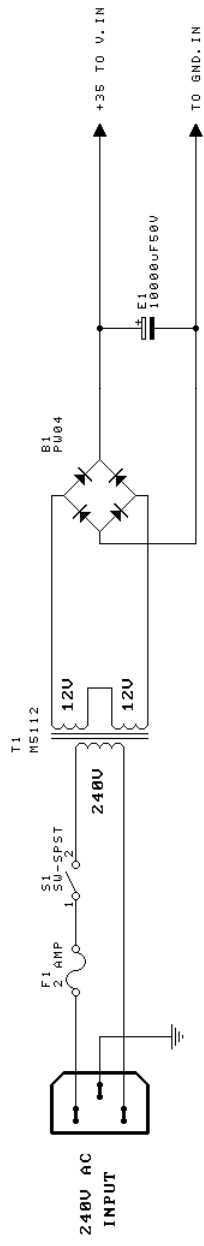


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File:	FM250213/1	Drawn By:	D.S.C



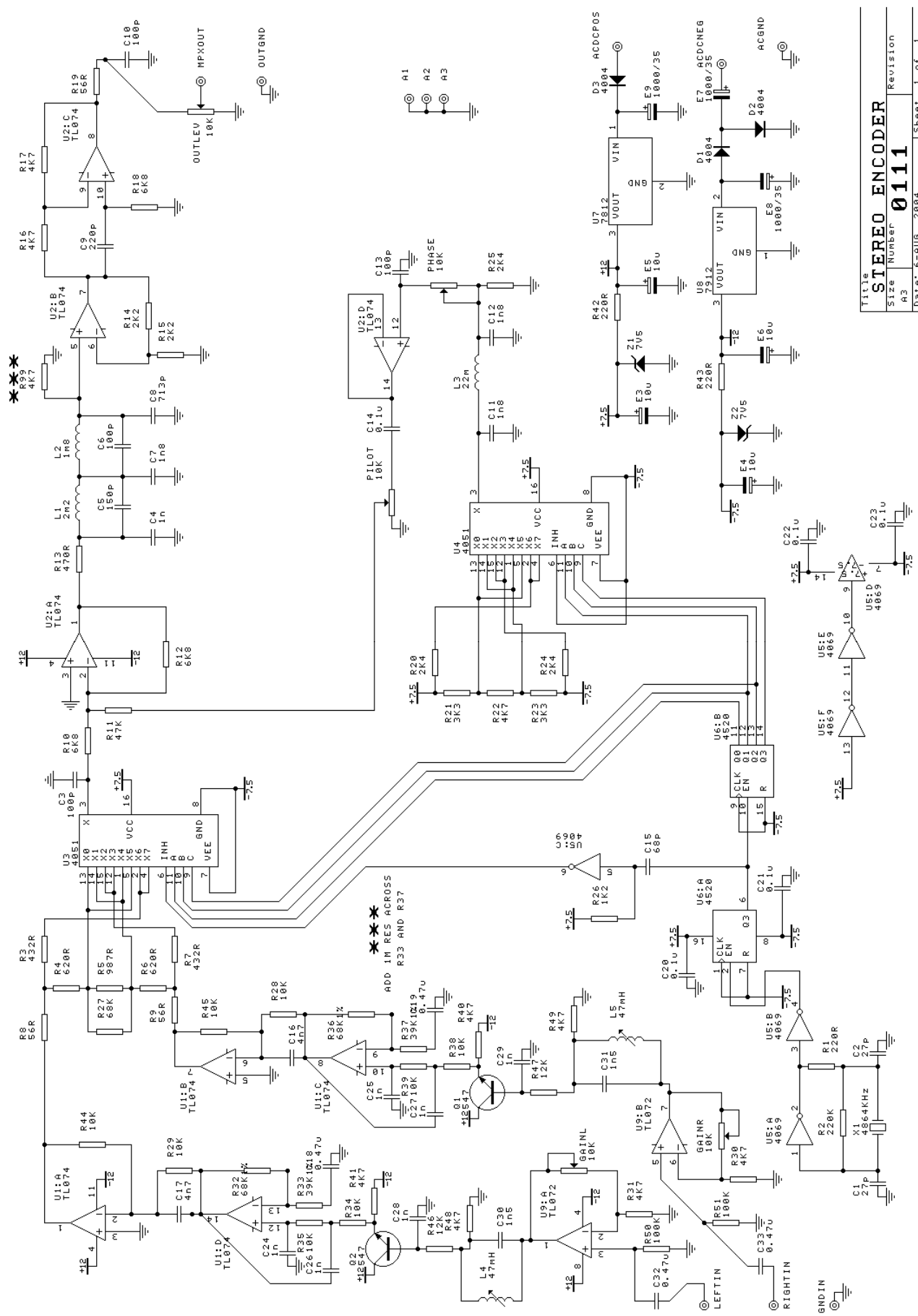


0213 Top Layer

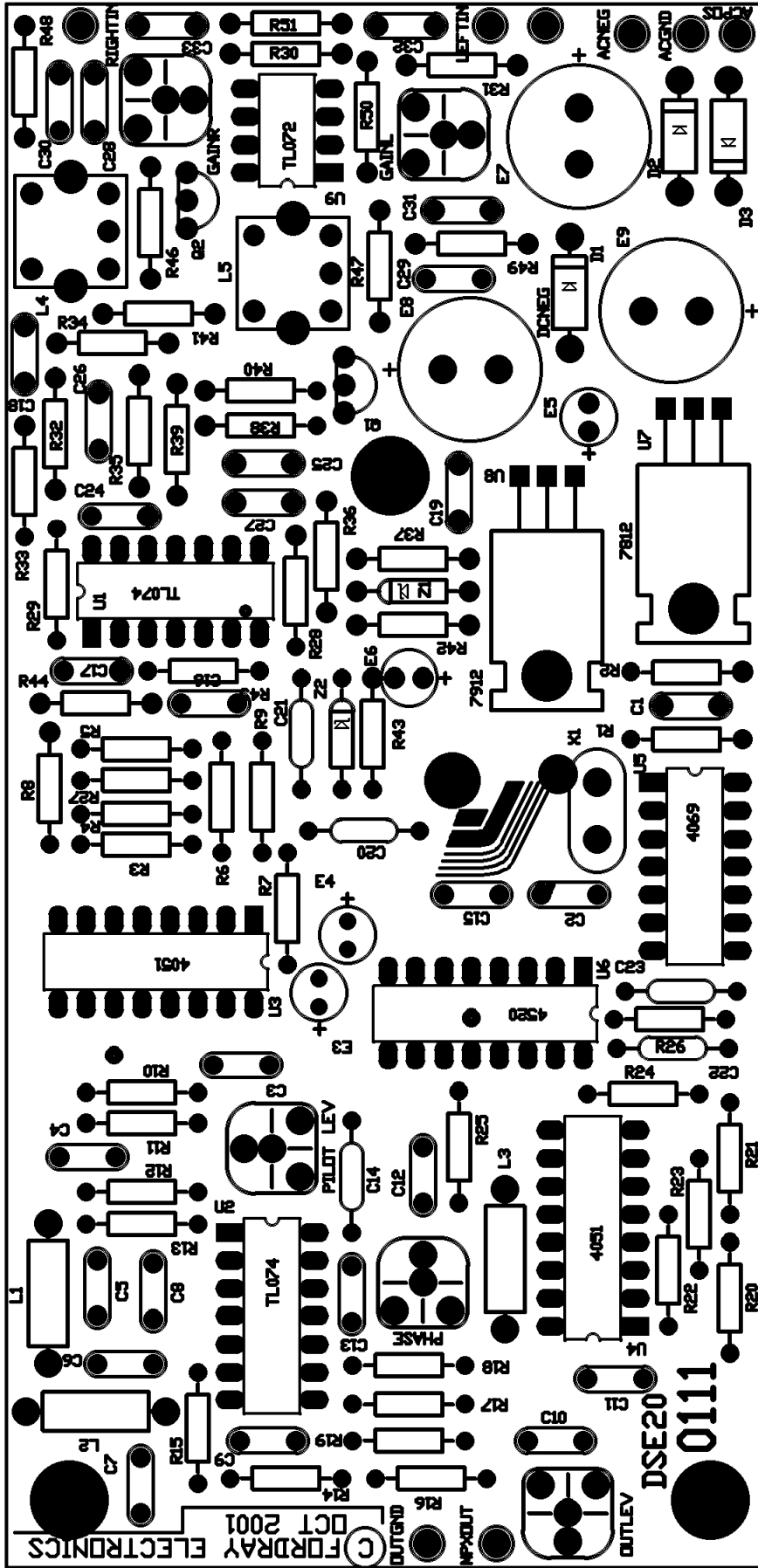


# LINEAR BROADCAST

Title	
UNREGULATED SUPPLY	
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A3	
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File: TUTPS73	Drawn By: D. C.



Title		STEREO ENCODER	
Size	Number	Revision	
A3	0111		
Date:	6-10-05	2004	
File:	0111/1		
Sheet			1 of 1
Drawn By:			D.S.C.



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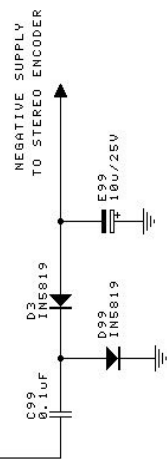
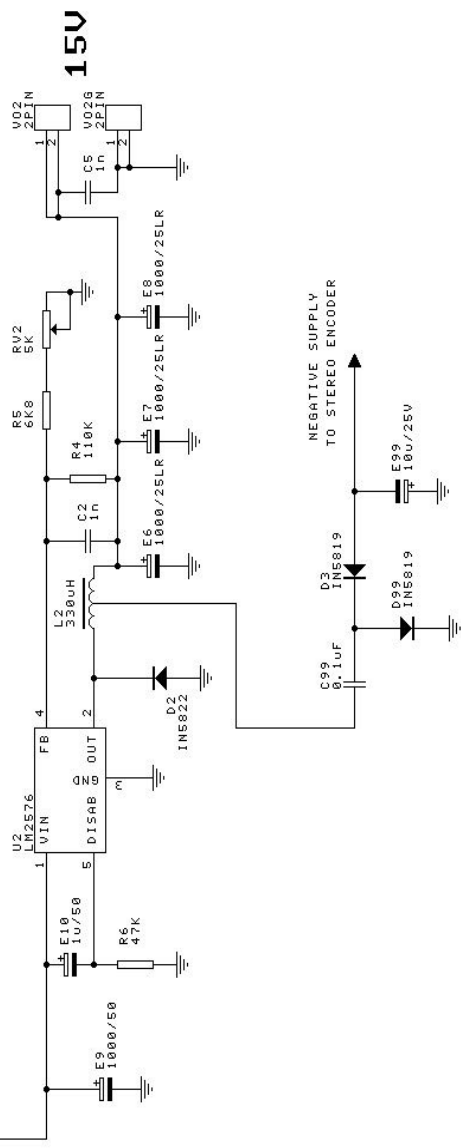
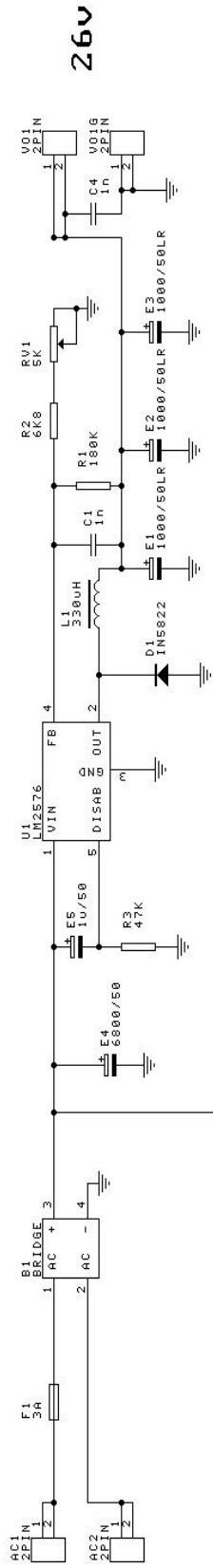
0111

DSE20

OUTLEV

MPXOUT

OUTGND



Title		DUAL SWITCH SUPPLY	
Size	Number	Revision	Revision
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File:	FN250405/1	Drawn By:	D.S.C.

