LINEAR BROADCAST

FMT10s STEREO
10W FM TRANSMITTER

TECHNICAL HANDBOOK

LINEAR BROADCAST

FMT10s
SPECIFICATIONS

The Linear Broadcast FMT10 transmitter was designed to meet the needs of the broadcaster requiring high performance and reliability. Self-contained in a 1RU rack case, the FMT10 provides fully adjustable power output up to 12 Watts and a user-programmable Phase Locked Loop frequency via internal rotary switches. This transmitter has a built-in wide-input-range, high efficiency power supply unit.

Audio Input	Mono (RCA) -10 to +10dBm, 47 kΩ unbalanced MPX (BNC) 4V p/p 10 kΩ Stereo(2 x RCA), 1Vp/p , 47 kΩ unbalanced
Left-Right Channel Separation	>50dB @ 400Hz
RDS input level	1v p-p
Output Power	12W max, 50 Ohm, N connector
Controls	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 (75us by request)
Frequency Response	30 Hz – 65 kHz, +/- 2dB, MPX 30Hz – 15 kHz
Total Distortion	<0.15% at 75 kHz deviation
Signal to Noise	>73dB
Dimensions	1RU rack case x 280mm deep
Weight	4kg
Power Supply	100 – 240VAC
Finish	Ironstone grey powder coat
Front Panel Display shows:	Forward Power Frequency Audio Level Supply Voltage

LINEAR BROADCAST

FMT10s 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 an adjustable output power of 12 watts maximum. Simple bias is applied to the oscillator buffer stage. A feedback network is used on the final stage to keep gain fairly consistent across the band. The output level is controlled by adjusting the collector supply voltage of Q3.

FREQUENCY SYNTHESIS

The 87 to 108MHz oscillator signal is fed to the PLL chip U6, type MC145191. The division ratios and operating mode of the MC145191 are set, when the transmitter is powered up, by microcontroller U3, type 68HC08JL3. This microcontroller reads the state of the frequency control switches on power-up 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 as a 4.00MHz reference oscillator, and performs the metering functions displayed on the front panel.

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 12.5 kHz when the PLL is locked.

The 0-5V phase detector output from U6 is filtered and amplified by Op-Amp U5, giving a possible range of 0-10V. 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 RF output is disabled if the 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 off transistor Q9, removing supply from the power control pot and therefore turning off Q3.

MODULATION

The MPX is fed directly to the varicaps with attenuation but no filtering. This gives a wide bandwidth modulation path and 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

FMT10s ALIGNMENT PROCEDURE

TEST EQUIPMENT REQUIRED

- RF power meter capable of 12W at 100MHz
- 12W dummy load 50 Ohm
- Digital multimeter
- Low distortion audio oscillator capable of 4Vp-p
- 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.
Connect 100-240VAC supply and switch on transmitter.

3.Adjust power level by adjusting the RF power control on the front panel display board.

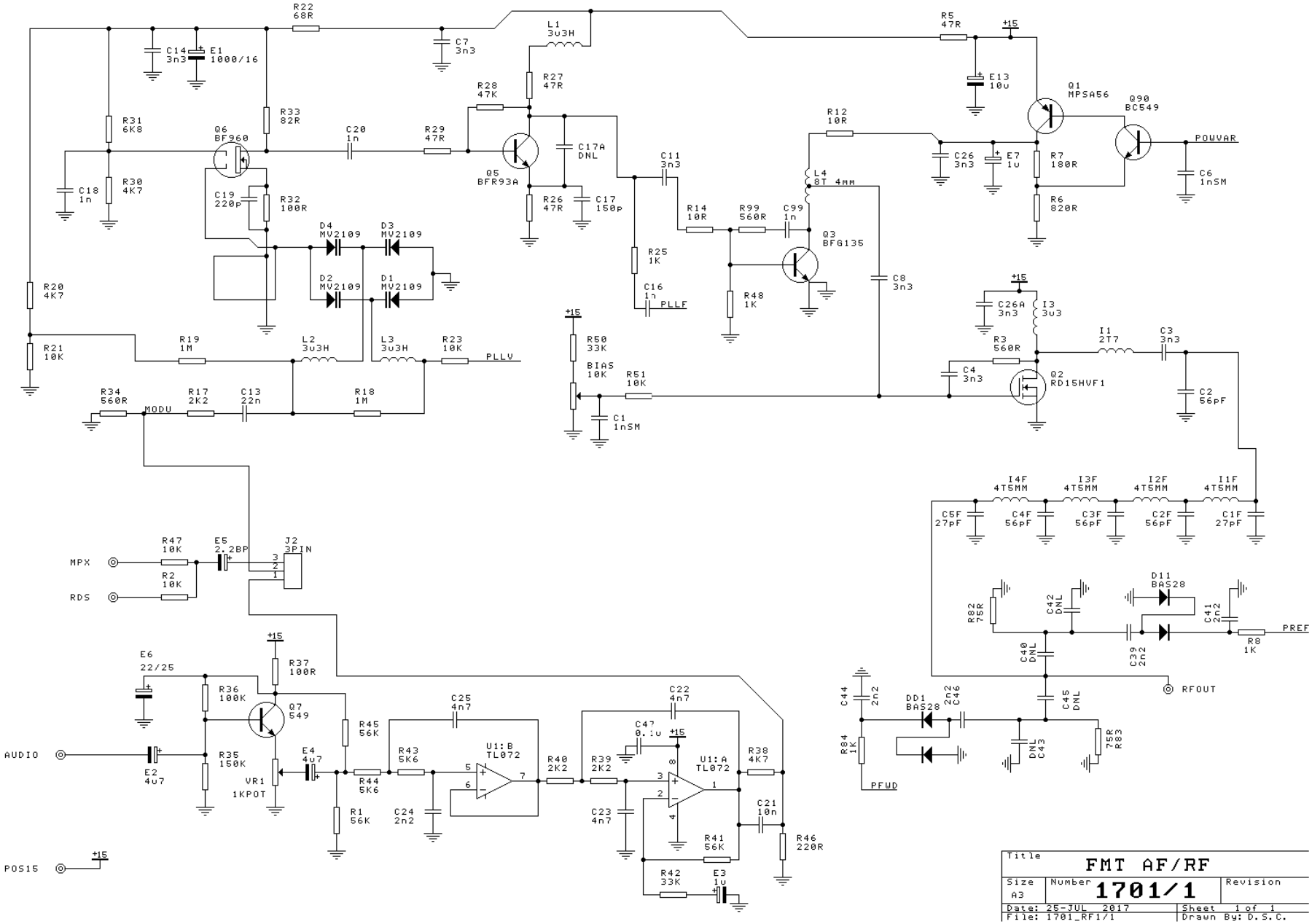
4.Trim the carrier frequency by adjusting C38 on the exciter board. This should be done after allowing an adequate warm up period.

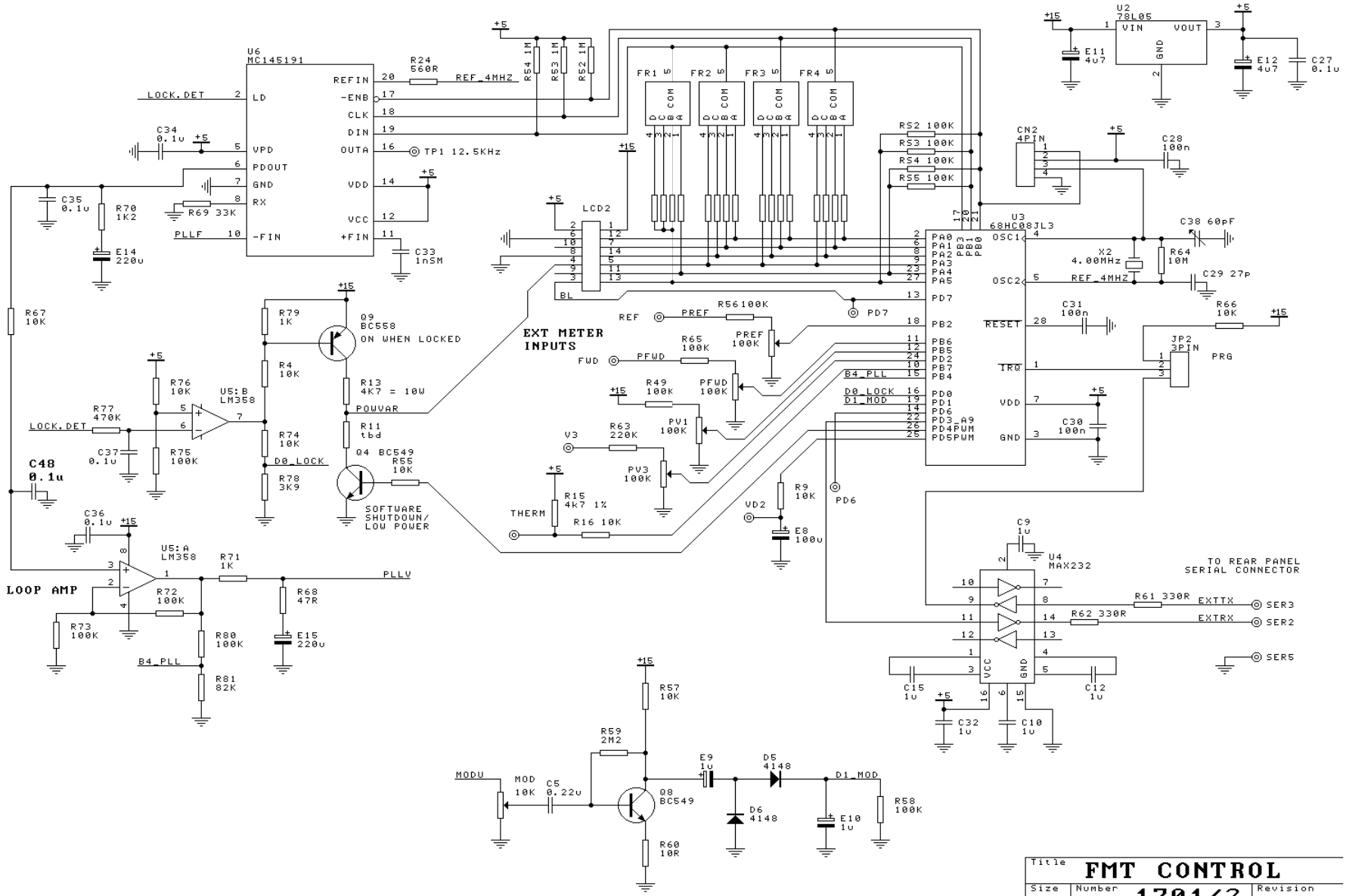
5.Connect the spectrum analyser to sample the RF output and confirm that the second and third harmonics are no higher than 68dB below the main carrier.

6.Connect the deviation monitor to sample RF output and set the monitor's carrier frequency.
Connect a precision receiver/demodulator and Noise and Distortion test set to sample RF output and set to carrier frequency.

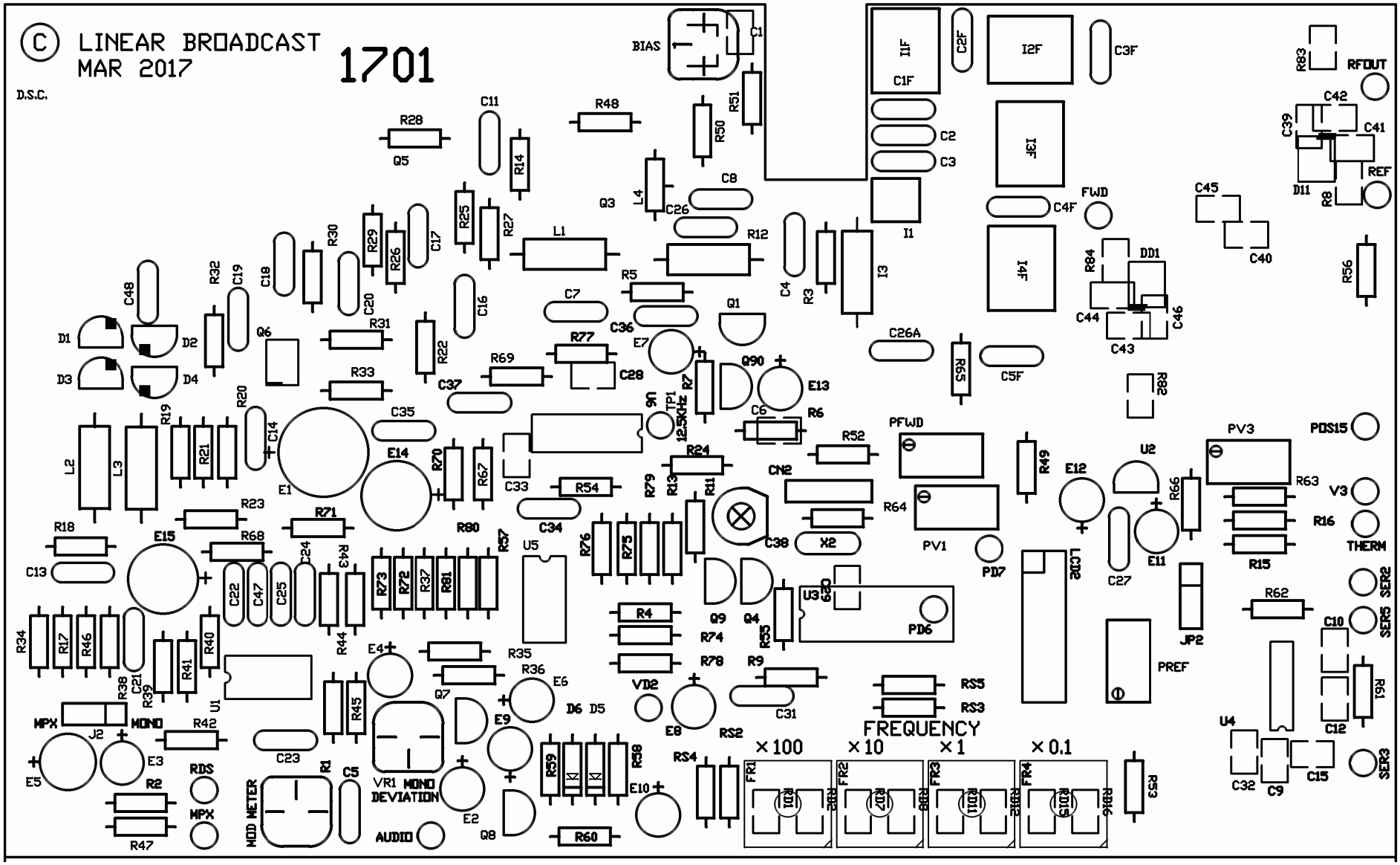
7.Connect the audio generator to the balanced audio input and set for 400Hz at the desired input level.
Adjust VR1 in the exciter board to achieve the required deviation level. NOTE: there is no level control for the MPX input.

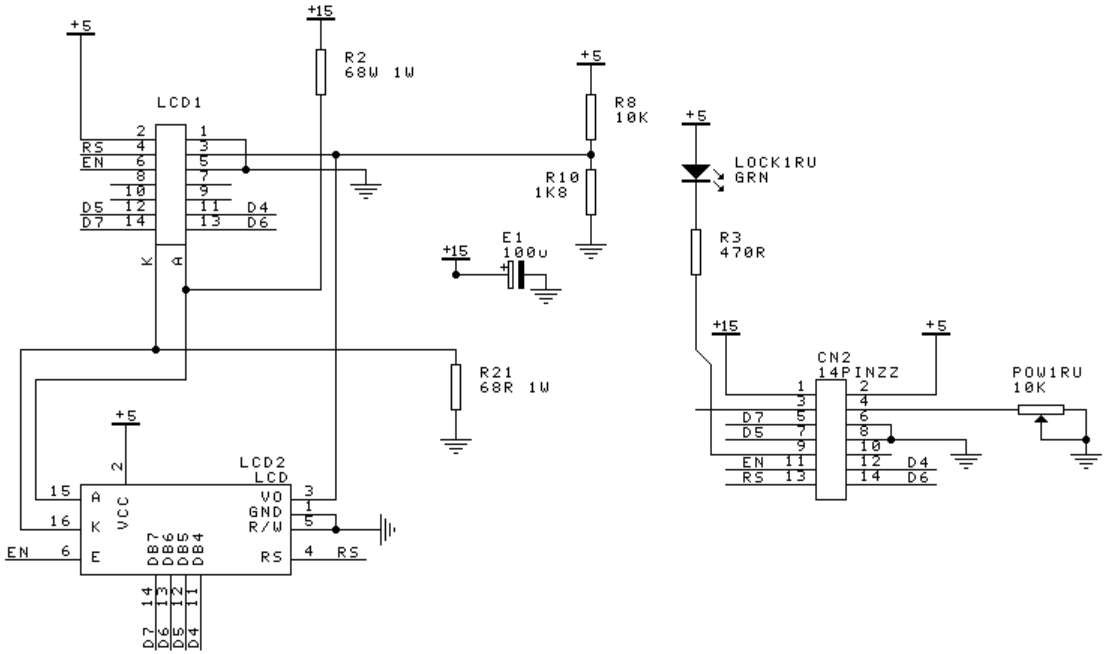
Confirm the signal to noise ratio is greater than 73dB after replacing main lid of the transmitter.


R22 68R
C14 3n3
E1 1000/16
C7 3n3
L1 3u3H
R5 47R
+15
E13 10u
Q1 MPSA56
Q90 BC549
POWVAR
C6 1nSM
R31 6K8
R33 82R
C20 1n
R29 47R
R28 47K
R27 47R
Q6 BF960
Q5 BFR93A
C17A DNL
C17 150p
R26 47R
R12 10R
C26 3n3
E7 1u
R7 180R
R6 820R
C18 1n
R30 4K7
C19 220p
R32 100R
D4 MV2109
D3 MV2109
D2 MV2109
D1 MV2109
C11 3n3
L4 8T 4mm
R14 10R
R99 560R
C99 1n
Q3 BFG135
R25 1K
C16 1n PLLF
R48 1K
C8 3n3
R20 4K7
R21 10K
R19 1M
L2 3u3H
L3 3u3H
R23 10K
PLLV
R50 33K
BIAS 10K
R51 10K
C1 1nSM
C26A 3n3
I3 3u3
R3 560R
I1 2T7
C3 3n3
C4 3n3
Q2 RD15HVF1
C2 56pF
R34 560R
MODU
R17 2K2
C13 22n
R18 1M
I4F 4T5MM
I3F 4T5MM
I2F 4T5MM
I1F 4T5MM
C5F 27pF
C4F 56pF
C3F 56pF
C2F 56pF
C1F 27pF
MPX
RDS
R47 10K
E5 2.2BP
J2 3PIN
R2 10K
D11 BAS28
R82 75R
C42 DNL
C41 2n2
R8 1K
C40 DNL
C39 2n2
RFOUT
C44 2n2
DD1 BAS28
C46 2n2
C45 DNL
C43 DNL
R83 75R
R84 1K
PFWD
E6 22/25
R37 100R
R36 100K
Q7 549
AUDIO
R35 150K
E2 4u7
VR1 1KPOT
E4 4u7
R45 56K
R44 5K6
R1 56K
R43 5K6
C24 2n2
C25 4n7
U1:B TL072
R40 2K2
C22 4n7
C47 0.1u
R39 2K2
C23 4n7
U1:A TL072
R38 4K7
C21 10n
R41 56K
R46 220R
R42 33K
E3 1u
POS15
Title
FMT AF/RF
Size A3
Number 1701/1
Revision
Date: 25-JUL 2017
File: 1701_RF1/1
Sheet 1 of 1
Drawn By: D.S.C.

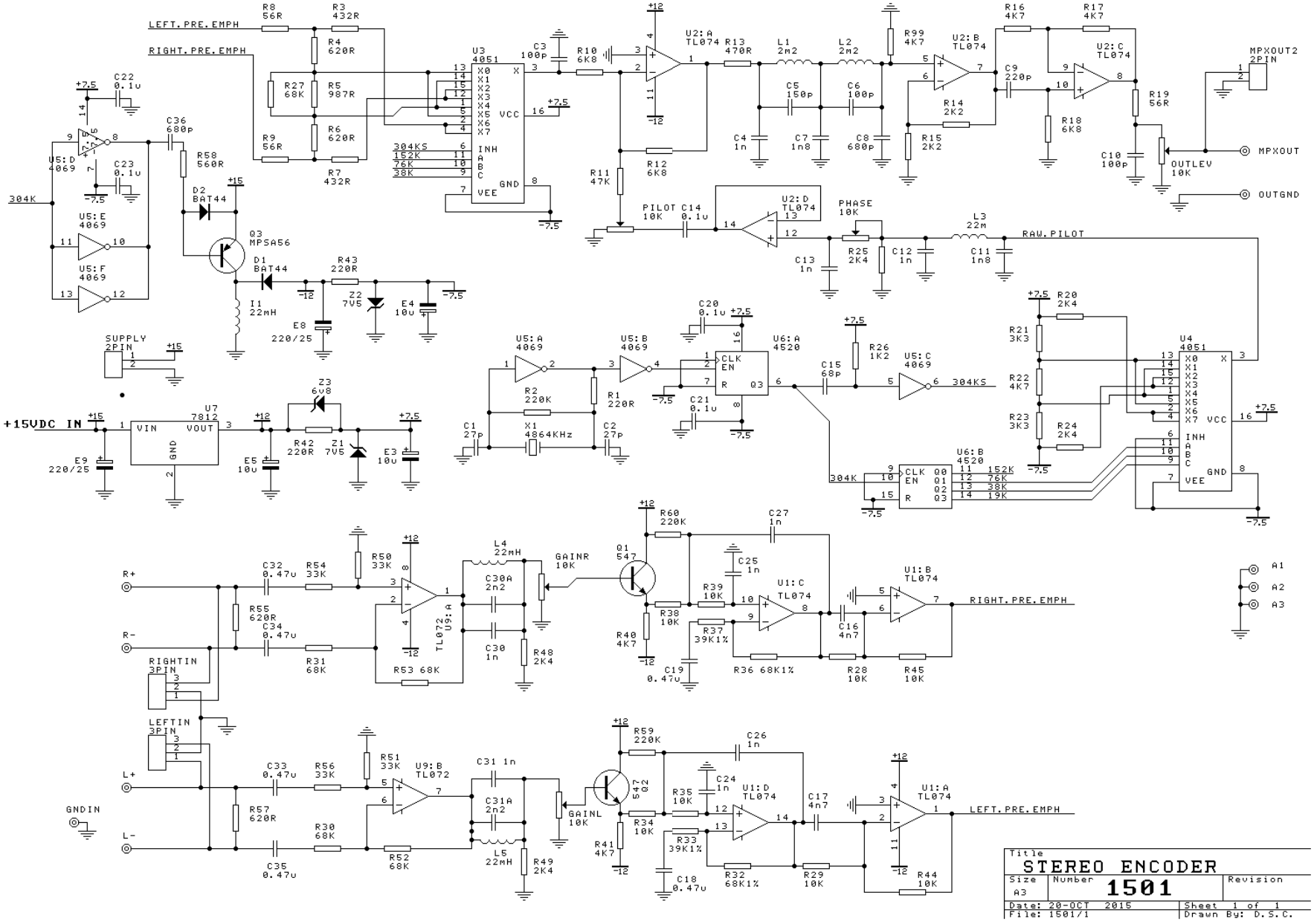


Title	FMT CONTROL	
Size A3	Number 1701/2	Revision
Date: 17-JUL 2017	Sheet 1 of 1	
File: 1701_CON/1	Drawn By: D.S.C.	

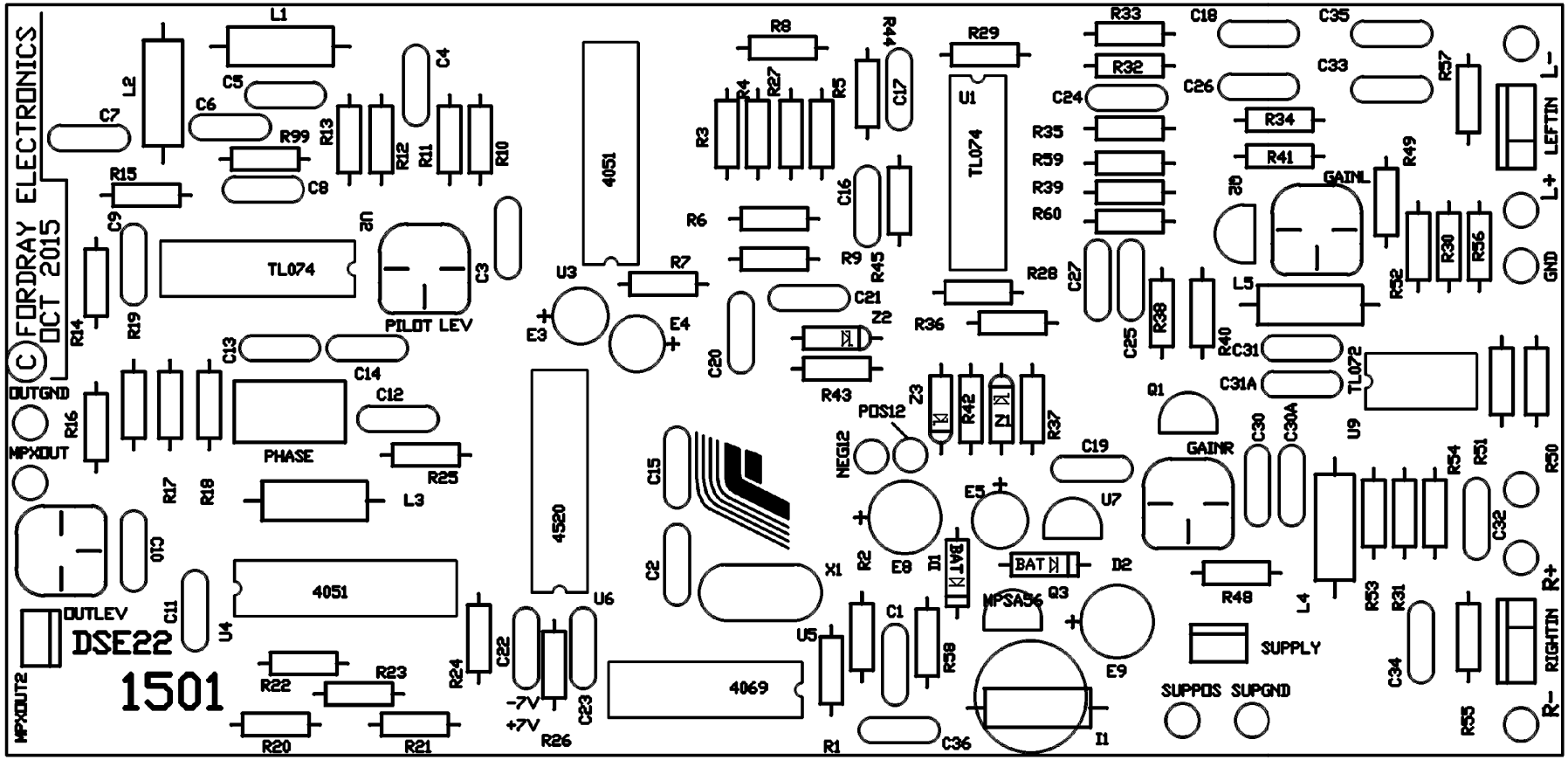

© LINEAR BROADCAST
MAR 2017
1701
D.S.C.
BIAS
C1
I1F
C1F
C2F
I2F
C3F
C2
C3
I3F
I1
C4F
I4F
I3
C4
R3
FWD
RFOUT
C42
C41
C39
REF
D11
R8
R83
C45
C40
R56
R84
DD1
C44
C46
C43
C26A
R65
C5F
R82
C48
D1
D2
D3
D4
R32
C19
C18
R30
R29
R26
C17
C20
R25
R27
C16
L1
R28
Q5
C11
R14
R48
R51
R50
Q3
L4
C8
C26
R12
R5
C7
C36
E7
Q1
R31
R33
R77
C28
R69
C37
R22
Q6
R20
R19
R21
C14
L2
L3
E1
C35
E14
R70
R67
C33
TP1
12.5KHz
U6
R7
Q90
E13
C6
R6
R24
R54
R79
R13
R11
C38
CN2
X2
R52
PFWD
PV1
PD7
R64
R49
E12
U2
C27
E11
R66
PV3
PDS15
R63
V3
R16
THERM
R15
SER2
SER5
SER3
R62
C10
R61
C12
C32
C9
C15
U4
JP2
PREF
LCDE
R18
C13
E15
R23
R71
R68
R80
R57
U5
C22
C47
C25
C24
R43
R44
R73
R72
R37
R81
R76
R75
R4
R74
R78
R9
C31
Q9
Q4
R55
U3
620
PD6
RS5
RS3
FREQUENCY
×100
×10
×1
×0,1
FR1
FR2
FR3
FR4
R34
R17
R46
C21
R38
R39
R41
R40
U1
E4
R35
R36
E6
Q7
D6
D5
VD2
E8
RS2
RS4
R59
R58
R60
E10
Q8
E9
E2
MPX
MONO
J2
E3
E5
R42
C23
RDS
MPX
R2
R47
R1
C5
MOD METER
VR1 MONO DEVIATION
AUDIO
R45
R53



Title: 1701 DISPLAY		
Size: A4	Number:	Revision:
Date: 17-JUL 2017	Sheet of	
File: 1701_MET/1	Drawn By:	



Title	STEREO ENCODER	
Size A3	Number 1501	Revision
Date: 20-OCT 2015		Sheet 1 of 1
File: 1501/1		Drawn By: D.S.C.


FORDRAY ELECTRONICS
OCT 2015
DSE22
1501
L1
L2
C5
C6
C7
C8
C4
R99
R13
R12
R11
R10
R15
C9
R14
R19
TL074
PILOT LEV
C3
C13
C14
C12
R25
OUTGND
MPXOUT
R16
R17
R18
PHASE
L3
C10
OUTLEV
C11
U4
4051
R22
R23
R20
R21
MPXOUT2
R24
C22
-7V
+7V
R26
C23
U6
4520
4051
U3
E3
E4
R7
R8
R4
R27
R3
R5
R44
C17
R6
C16
R9
R45
C21
C20
Z2
R43
C15
C2
X1
4069
R1
U5
R2
E8
NEG12
POS12
Z3
R42
R37
C19
E5
U7
BAT
D2
BAT
D1
MPSA56
Q3
C1
R36
E9
I1
C36
U1
TL074
R29
R28
R33
R32
C24
R35
R59
R39
R60
C18
C26
C35
C33
R34
R41
R57
L-
LEFTIN
L+
GND
GAINL
R49
R32
R30
R56
C27
C25
R38
R40
L5
C31
C31A
TL072
U9
Q1
GAINR
C30
C30A
C19
R48
L4
R54
R51
R50
R53
R31
C32
C34
R55
R+
RIGHTIN
R-
SUPPLY
SUPPOS
SUPGND