

Eclipse Series

RF Technology

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Revision 2

R50 Receiver

Operation and Maintenance Manual

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WARNING

Changes or modifications not expressly approved by RF Technology could void your authority to operate this equipment. Specifications may vary from those given in this document in accordance with requirements of local authorities. RF Technology equipment is subject to continual improvement and RF Technology reserves the right to change performance and specification without further notice.

1 Operating Instructions

1.1 Front Panel Controls and Indicators

1.1.1 Monitor Volume

The Mon. Volume control is used to adjust the volume of the internal loudspeaker and any external speaker connected to the test socket. It does not effect the level of the 600 Ohm line output level, nor the direct audio output level.

1.1.2 Monitor Squelch

The MON. SQ. switch allows the normal squelch functions controlling the monitor output to be disabled. When the switch is in the MON. SQ. position the audio at the monitor speaker is controlled by the noise detector. The CTCSS, carrier, tone, DCS, and external squelch functions will not stop the audio from being broadcast by the speaker. This can be useful when you are trying to trace the source of on channel interference or when setting the noise squelch threshold. The audio from the 600 Ohm line output, and the direct audio output, is not effected by the switch position.

1.1.3 N.SQ

The N.SQ trimpot is used to set the noise squelch sensitivity. Use the following procedure to set the noise squelch to maximum sensitivity.

- (a) Set the toggle switch to the MON.SQ. position and set the MON VOLUME control to 9 o'clock.
- (b) Turn the N.SQ. adjustment counter clockwise until the squelch opens and noise is heard from the speaker. Adjust the VOLUME to a comfortable listening level.
- (c) In the absence of any on channel signal, Turn the N.SQ. screw clockwise until the until the noise in the speaker is muted.

1.1.4 C.SQ

The C.SQ trimpot is used to set the carrier squelch sensitivity. Carrier squelch is useful at higher signal levels than noise squelch and can be used from 1 - 200 uV input.

It is provided mainly for use in fixed link applications where a high minimum signal to noise ratio is required or where very fast squelch operation is required for data transmission. The carrier squelch will open and close in less than 2 mSec.

In most base station applications carrier squelch is disabled by turning the adjustment counter clockwise until the screw clicks.

The carrier squelch may be set to a predetermined level with the WinTekHelp software or by using the following procedure:

- (a) First turn the adjustment fully counter-clockwise. Then set the noise squelch as above.
- (b) Connect a source of an on channel signal with the desired threshold level to the receiver's RF input.
- (c) Turn the screw clockwise until the SQ LED goes OFF. Then turn the screw back until the LED just comes ON.

1.1.5 LINE

The LINE trimpot is used to set the line and direct audio output levels. It is normally set to output 0dBm on the Line output when the carrier is modulated with a 1kHz audio signal at 60% of maximum deviation. NB that 0dBm is equivalent to 774 mV to an open circuit, or 387mV into a 600 ohm load.

1.2 Front Panel Indicators

1.2.1 PWR LED

The PWR LED shows that the dc supply is connected to the receiver and that the microprocessor is not being held in a RESET state.

1.2.2 SQ LED

The SQ LED comes on when the audio to the line and direct outputs is un-squelched.

The LED and squelch function are controlled by the external squelch input, and/or the noise, carrier, tone, or DCS squelch circuits.

1.2.3 ALARM LED

The ALARM LED can indicate several fault conditions if they are detected by the self test program. The alarm indicator shows the highest priority fault present. See Table 1.

LED Flash Cadence	Fault Condition
5 flashes, pause	Synthesizer unlocked
4 flashes, pause	Tuning volts out of range
3 flashes, pause	Low RSSI
2 flashes, pause	The current channel is not programmed or the frequency

	is out of range.
1 flash, pause	Low dc supply voltage
LED ON continuously	External squelch is active

Table 1: Interpretations of LED flash cadence

2 Receiver Options

There are many software selectable options. Some options are selected on a per channel basis, and some are defined globally (i.e. the parameter is fixed irrespective of which channel is selected). Below is a description of these global parameters

2.1 Serial I/O Parameters

There are two serial ports. There is the main serial port which is brought out to the front panel connector. This is referred to as PORT0. There is another serial port which is for factory use only. It is referred to as PORT1.

The baud rate, can be defined for PORT0. PORT0 is set by default to 57.6Kbps, with No parity.

2.2 Receiver Low Battery Level

This is factory set to 24.0V, and defines the level of the DC supply that will cause a Receiver dc supply low alarm.

2.3 LOOP Volts Select

By default, when the squelch opens and the Line output audio is enabled, 12V is applied to the Line+/Line- pair through 680 ohms. The 12V power source is removed when the squelch closes.

In Rev. 2 receivers, the user can select to reverse the application of 12V, ie 12V is applied when the squelch is closed, and removed when the squelch opens.

In Rev. 3 (or later) receivers, the user can select to apply a DC loop to the Line+/Line- pair instead of applying 12V. Similarly, they can select to reverse the application of the Loop, or the voltage, depending on the squelch state.

2.4 COS Source/Sink Select

The COS output can have four possible states:

- 12V: 12V is applied to COS+/COS- through 680 ohms,
- 0V: ie COS+ is shorted to COS- which is shorted to GND,
- shorted: COS+ and COS- are shorted together, but both are electrically isolated,
- open: COS+ and COS- are not shorted together, but both are electrically isolated

In states (a) and (b), the receiver applies either 12V to the COS+ pin, or GND. The COS- pin is connected to GND in both states. The receiver acts as a “source” when in either of these two states.

In states (c) and (d), the COS+/COS- pair can “sink” current, or not sink current, that is sourced elsewhere.

The receivers will either toggle between states (a) and (b), or toggle between states (c) and (d), depending on the state of the squelch.

The user can select which of these two modes they wish to use.

The default COS mode is to toggle between states (a) and (b)

2.5 COS Polarity

By default, +12V is applied to COS+ when the squelch opens, and COS- is connected to ground, ie the COS+/COS- pair are placed into state (a) when the squelch opens, and are in state (b) when it is closed. (see 2.4 above).

The user can optionally select to reverse this.

Similarly, if , the user has chosen to operate COS as a “sink” (see 2.4 above), the default is to short COS+ to COS- when the squelch opens (state (c) above), or open them when the squelch closes. The user can reverse this as well.

2.6 Noise Blanker

The R50 has a noise blanker. This circuit detects RF impulses and quenches the RF before it is de-modulated. This prevents “clicks” and “pops” from being detected and passed through to the audio. The noise blanker can be enabled or disabled by the user.

2.7 Advanced Slot Selectable Parameters

WinTekHelp receivers have several advanced features. These features can be programmed for each channel.

One of these advanced features is to program up to 8 frequencies on a channel. When this is done, we refer to the “channel” as a “slot” to avoid confusion, as many people equate the word “channel” with the word “frequency”.

When more than one frequency is assigned to a “slot”, and that slot has been selected from the channel input, the receiver will automatically scan all the assigned frequencies, tuning to the first that has sufficient carrier strength and/or SINAD, and a correct CTCSS tone, or correct DCS code.

In this “scanning” mode, one of the frequencies can be given “priority”. If this is done, the receiver will check, every few seconds, if there is a signal on the priority frequency, and if so, it will switch to the priority frequency. It will stay tuned to the priority signal, whilst signal is present on it, but it will then resume its usual scanning function, if the signal is lost.

Another advanced feature is the ability to assign more than one CTCSS tone to a frequency. When this is enabled, the receiver checks if the received CTCSS tone is one of up to 6 tones rather than just one.

Another advanced feature is to inhibit the assertion of COS, or loop, (or both) when the squelch opens depending on either the frequency received or the tone detected.

For example, in a scanning situation, with two possible frequencies, LOOP can be programmed to be asserted if one frequency is detected, or COS to be asserted

if the other frequency is detected. Similarly, one can enable/disable the default assertion of COS and/or loop depending on which CTCSS tone is detected.

Other advanced features are:

- a) de-emphasis: enabled or disabled, depending on frequency
- b) start and end delays for COS and LOOP.
- c) scanning interval for the priority frequency,
- d) increments or decrements in the carrier level or noise level thresholds, depending on the frequency. For example one frequency can be set to have a higher noise threshold than another. Units are in dB of carrier signal, or SINAD dB.

2.8 Standard Channel Parameters

Each channel can set the following standard parameters:

- a) frequency,
- b) one CTCSS tone, or DCS code.

3 Receiver I/O Connections

3.1 25 Pin Connector

The female D-shell, 25 pin, connector is the main interface to the transmitter. The pin connections are described in Table 3.

Function	Signal	Pins	Specification
DC Power	+28Vdc(in) 0 Vdc +5Vdc(out) +12Vdc(out) Vref	13, 25 1, 14 17 15 4	+15 to 32 Vdc Common Voltage Output for external Logic(100mA) Output for an external relay(120mA) Reference voltage
Serial Communi cations	SCLK MOSI CH_EN SPARE_I/O1 SPARE_SEL	12 6 18 16 5	Serial Clock Bi-directional Data Pin Enables Channel Select Shift Register Spare Input or Output (for future use) Spare Select (for future use)
600Ω Line Output	Line+ Line-	8 19	Transformer Isolated Balanced 600Ω 0dBm Output
Carrier Operated Switch Output	COS+ COS-	10 22	Opto Coupled Transistor Switch Output (10mA)
External Squelch Input	EXT_SQ	11	<1 VDC to force the squelch to close. >2 VDC or open ckt, to enable the squelch

			to open
External Speaker Output	EXT_SPK	24	AC Coupled External Speaker Output, 5W @ 4Ω Load
Direct Audio Output	DIR_AUD	21	>10kΩ, AC Coupled Audio Output 2Vp-p @ 3kHz System Deviation
Discriminator Audio Output	DISC_AUD	20	>10kΩ, AC Coupled Un-Squelched 2Vp-p @ 3kHz System Deviation
Sub-Audible Tone Output	SUBTONE	9	>10kΩ, AC Coupled Un-Squelched, 2Vp-p @ 3kHz System Deviation

Table 3: Pin connections and explanations for the main 25-pin, D connector

3.2 9 Pin Front Panel Connector

The female D-shell, 9 pin, front panel connector is an RS232 interface for serial communications to a terminal, a terminal emulator, or to a computer. The pin connections are described in table 4.

Function	Pins	Specification	Pin name on IBM PC
TXD	2	Transmit Data (Output)	RxD
RXD	3	Receive Data (Input)	TxD
RTS	8	Request To Send (Output)	CTS
CTS	7	Clear To Send (Input)	RTS
DTR	6	Data Terminal Ready(Output)	DSR
DSR	1	Data Set Ready (Input)	DCD
GND	5	GND	GND

Table 4: Pin connections for the front panel 9 pin D connector

The pinout for the connector has been chosen so that a straight-through BD9 male to DB9 female cable can connect the transmitter to any male DB9 serial port on an IBM PC compatible computer.

Note that for connection to a modem, a cross-over cable will be required.

4 Channel Programming and Option Selections

Channel and tone frequency programming are most easily accomplished with RF Technology WinTekHelp software. This software can be run on an IBM compatible PC and can be used to calibrate a T50, R50, and PA50 as well as

program channel information. See the WinTekHelp users manual for further information.

5 Circuit Description

The following descriptions should be read as an aid to understanding the block and schematic diagrams given in the appendix of this manual.

There are 7 sheets in the schematic in all.

5.1 R50 Master Schematic (Sheet 1)

Sheet 1, referred to as the "R50 Master Schematic", is a top level sheet, showing four circuit blocks, and their interconnection with each other, as well as the interconnection with all connectors and external switches.

P1 is the front panel DB9 RS-232 connector for attachment to a terminal, a terminal emulator, or to an IBM PC running the WinTekHelp software.

P3 represents the rear female DB25 connector.

J1 is the terminal on print circuit board, it is connected to the internal load speaker.

JP2 is for the attachment of an LCD display module. This has been included for later development.

JP3 is a specialised connector for test and factory configuration use only.

D102, D103, and D104 represent the three front panel LEDs.

5.2 Microprocessor (Sheet 2)

Sheet 2 describes the basic microprocessor circuitry.

The core CPU is the Motorola XC68HC12A0. It is configured in 8 bit data width mode.

The CPU is clocked by a 14.7456MHz crystal oscillator circuit (top left) comprising the JFET Q202, and two switching transistors Q203 and Q204.

The CPU contains an 8 channel A/D converter whose inputs are identified as AN0, AN1, ..., AN7.

AN7 is used as LOCK detect inputs from the Locked Loop (PLL) circuits (see 5.6)

AN6 is used to sense the noise squelch level setting.

AN5 is used to sense whether or not the dc supply is within spec or not.

AN4 is used to sense the audio from the discriminator, so the R50 receiver can be used as a deviation meter.

AN3 and AN1 are inputs from the PLL circuits that sense the bias voltage on the VCO control varactor for each VCO.

AN2 is used to sense the carrier squelch level setting.

AN0 is used to sense the RF input signal strength which is detected by the IF chip.

FRDY is an output from the flash. It goes low when the Flash starts to write a byte of data, or erase a block, or erase the whole chip, and it returns to its default high state when the action requested has completed.

FPSW1, FPSW2 and FPSW3 are three pins that have been reserved for future use as switch inputs.

LOOP/VOLTS_SEL is a CPU output that when high applies 12V of dc feed to the audio output.

LINE_LEVEL_U/D and LINE_LEVEL_INC are CPU outputs which are reserved for controlling a digital potentiometer in future.

COS_VOLTS_ON/OFF is a CPU output that when high applies 12VDC feed to COS+ terminal, so that the COS can be selected as +12VDC source or a free switch.

COS_POLARITY is CPU output that when low turns Opto-coupled transistor switch U601on. It is controlled by the noise squelch detect, carrier squelch, or external squelch signal

SQ is a CPU output that when low, enables the 600 ohm line output, and the direct audio output. It is controlled by the noise squelch detect, carrier squelch, or external squelch signal

N_BLK_EN is a CPU output that when low turns noise blanker option off.

CTCSS_SEL is a serial bus select pin. It is used to select the FX805 chip(U500), which is used to decode CTCSS tones. (see 5.5)

PLL_SEL is a serial bus select pin. It is used to select the PLL chip in the PLL circuit (U302). (See 5.6)

RCV_ADSEL is a serial bus select pin. It selects the quad Digital to Analogue converter (DAC) that sets the levels for the 12MHz reference oscillator bias voltage, 21.855MHz oscillator bias voltage, noise squelch comparator bias voltage and the LCD bias circuit. (see 5.4)

CH_EN is a serial bus select. It is brought out to the rear panel and is used to interface to the channel encoder on the rear daughter-board. (See 5.1)

FLAT and DE_EMPHA are outputs which are the logical inverse of one another. When the FLAT pin is low, the audio output is flat response, when DE_EMPHA pin low, audio is 750uSec de-emphasized.

Fo_PLL is derived from the the Fo output of the PLL chip. It is Fo after being divided by 100. They should be 312.5Hz square waves, except for brief periods when frequencies are being changed. (See 5.6)

MON_SW is a digital input which represents the state of the front panel MON.SQ switch.

LCD_DB7 is a signal that has been reserved for interfacing to an LCD display.

ECLK is a pin that at start-up only, should have the CPU system clock of 7.3728MHz on it.

SQ_LED, ALARM_LED, are CPU outputs that drive (when low) the SQ LED, and the ALARM LED.

T/R_RELAY_H is a spare pin which is not used in the R50 receiver.

SCLK, and MOSI are used as the core of a serial bus. SCLK is a clock pin, and MOSI is a bi-directional data pin.

DBGTX_TTL, DBGRX_TTL are RS232 transmit and receive (TTL) data pins which are connected to the debug port after conversion to/from RS232 compatible voltage levels by U202 and U201.

TXD_TTL, RXD_TTL, RTS_TTL, CTS_TTL, DTR_TTL, DSR_TTL, are RS232 data pins which are connected to the main front panel serial port, after conversion to/from RS232 compatible voltage levels by U202 and U201.

N_DET is used to sense the noise squelch output of the receiver section. (see)

SUBTONE_IRQ is connected to the interrupt pin of the FX805 (U500). When CTCSS tones change state, ie a new tone is detected, or an existing tone stops being received, or 8 bits of NRZ data (when decoding DCS codes) are received, this signal is asserted to force the CPU to read data from U500.

INT is a dedicated CPU interrupt input pin. It is used to detect the state of the external squelch signal.

BKGD is a bi-directional I/O pin used to communicate with the core of the CPU. It is connected to the debug port and is utilised by specialised hardware to control the CPU externally, even without any firmware being present in the Flash.

The RESET pin is both a low active input and a low active output to the CPU. If generated externally to the CPU, it forces the CPU into reset, and if the CPU executes a RESET instruction this pin will be driven low by the CPU.

Whenever there is insufficient volts (< 4.65V) on pin 2 of the MC33064D (U203), it will keep its RES output low. After the voltage has met the right level it will assert its output low for another 200 milliseconds. Thus the CPU will be held in reset until VCC is at the correct level. Thus the PWR_OK LED will only light when VCC is within specification, and RESET has been released.

S200 is a momentary push-button switch that, when pressed, will cause the CPU to be reset.

MON_SQ is a CPU output which is used to enable (when low), or disable (when high) the audio at the monitor speaker.

LCD_RS, LCD_R/W, and LCD_E are reserved for interfacing to an LCD display module. Note that this feature has not been implemented.

U205 is used to select whether the Flash or RAM is to be read or written.

U207 is a single supply, 5V, TSOP40 Flash chip of size 8, 16, or 32 Megabits, and is used to store the firmware.

U208 is a 1, or 4, Megabit Static RAM in an SOP-32 package, and is used for both code and data. The code in the RAM is copied from the Flash, at start-up.

5.3 RF Section (Sheet 3)

Sheet 3 is a schematic of the RF section, which itself refers to two other subsheets.

U301 is a quad Digital to Analogue converter (DAC). OUTA (pin2) is used to adjust the 3rd local oscillator frequency. OUTB (pin1) is used to adjust the frequency of the 12MHz reference. OUTC(pin16) is used to set the noise squelch comparator offset voltage. OUTD (pin15) is reserved for future use. Communication between U301 and the MicroController, U204, is via the serial bus.

U302 is a dual channel PLL chip, X301 is the reference for both PLL channels. PLL channel 1 is for the 1st VCO, and channel 2 is for the 2nd VCO. C315, C317, C327, R316 and R317 are components of the loop filter for the 1st VCO, C316, C328, C329, R330 and R331 are for the loop filter of the 2nd VCO.

U303A, U303D are buffers that isolate the bias voltage. The Microcontroller, U204, has both of these buffered voltages connected to two of its A/D ports.

U304A, U304B divide the FoLD of the PLL chip by 100, and send it to a Timer input pin of the MicroController, U204.

5.4 Receiver Section (Sheet 4)

The RF input signal (25MHz-50MHz) is first filtered with a band-pass filter. This is implemented with two filters, firstly a high pass filter (C401, C402, C403, C407, C415, C416, C417, C419, C420 and L401, L404, L405, L406) and then a low pass filter (C404, C405, C406, C421, C422 and L402, L403, L407, L408).

After band-pass filtering, the signal is amplified. Q401 is the front-end amplifier. After amplification, unwanted products generated by the amplifier are filtered. The capacitors and coils between Q401 and C457 provide this additional filtering for the RF signal amplified by Q401.

This amplified RF input signal is referred to on the schematic as RF_AMP. It is up-converted by mixer MX401 to create the 1st IF. It is also amplified by Q405, and Q406, which are the front-end amplifiers for the Noise Blanker circuit.

The output of Q406 is “detected” by D401, and if the waveform “envelope” exceeds approximately 3.3V, the output of U403 will go high. U404 is a retriggerable monostable multivibrator, which produces a pulse at least 2usecs long after each rising edge detected on the output of U403. If rising edges re-occur during each pulse, the pulse period keeps extending until they stop.

The output of U404 is level shifted and inverted by Q408 to create the blanking signal N_BLK. C470, R416, and R414, act to slew the negation of N_BLK, without affecting the slew rate of the assertion of N_BLK.

U303C provides some AGC for the RF amplifier formed by Q405 and Q406. They also reduce the intermodulation which is produced by Q405 and Q406.

MX401 is a double balanced mixer which converts the RF signal to the 1st IF. The frequency of the 1st IF is at least three times higher than the highest RF frequency to obtain good image and spurious rejection. In the R50 receiver, the 1st IF frequency is approximately 246MHz. The actual frequency depends on the frequency tuned to, and may vary by as much as +/- 120kHz. The 1st LO is set to be approximately 264MHz above the frequency being tuned to.

Q402 is used to amplify the 1st IF signal before it is filtered by FIL401.

FIL401 is a SAW filter, which provides an excellent spurious rejection for the 1st IF.

The filtered IF signal is then fed to double balanced mixer MX402. The output of MX402 produces the 2nd IF, which is then amplified by Q403. The 2nd IF frequency is set at exactly 21.400MHz, to avoid interference from any in-band RF signals. The 2nd LO is set to approximately 224.6MHz. Again the LO frequency may vary from 224.6MHz by as much as +/-120kHz depending on which frequency the receiver is tuned to.

Q404 and Q409 gate the 2nd IF signal. If the N_BLK signal is high, then the 2nd IF is quenched. N_BLK is generated by the impulse noise detector.

FIL404 and FIL405 are two 21.4MHz crystal filters. Combined they form a four pole crystal filter. The filter has a minimum of 40dB attenuation at the adjacent channel frequencies (25kHz channel spacing). C448, C477, L423 and

components between FIL405 and U401 form the matching network for the filter.

U401 is an IF receiver IC which includes mixer, oscillator, amplifiers and discriminator. It down-converts the 2nd IF to the 3rd IF at 455kHz, which is filtered by ceramic filters FIL402, and FIL403, before the signal is demodulated(discriminated). The discriminator uses ceramic resonator X401 as its 455kHz reference.

X402 is a crystal used to create a 21.855MHz oscillator that becomes the 3rd LO. The frequency can be varied slightly by varactor D406, and thus it can be adjusted by the 3rd_LO_ADJ voltage. This is done as part of calibration.

Pin9 of U401 is the recovered audio output. C411, C412, C413, R441, R444 and U402A form a 5th order elliptical high pass filter with 3dB cut-off at 7.5kHz. Any “signal” at such frequencies is assumed to be noise, as excitors sharply attenuate all signals above 3kHz. U402B amplifies this FM “noise” signal, and D403 and C438 act as a peak detector. The voltage on C438 is proportional to the square root of the noise energy. U402C works as a comparator which asserts the low active digital signal, N_DET, if the noise voltage is higher than the D/A output, NSQ_SET.

Pin8 of U401 is the other recovered audio output which can be muted by pin5. Capacitor C484, and D407, ensure that the audio remains muted until the +10V is at the right voltage. The discriminated audio signal is amplified by U605A and then fed into the Audio Section (Sheet 6).

Pin7 of U401 is the Radio Signal Strength Indicator (RSSI) output. U402D is a buffer. The RSSI voltage is converted to a digital value by one of the A/D inputs of the MicroController.

5.5 Voltage Controlled Oscillator (Sheet 5)

There are two similar VCO circuits in this sheet, the difference between these two VCO is component values, so only one VCO circuit is illustrated in this section.

Q501, C532, C533, C534 and L501 form a Colpitts oscillator, the frequency of the oscillator is decided by the tuning voltage of varactor D501. The capacitance of D501 is in series with C531, and this total capacitance is in parallel with C501 and also with the series connection of the feedback capacitors C533 and C534. The net capacitance forms a tank resonance with the, high Q, air coil inductor, L501.

The bias for varactor D501 comes from the loop filter of the 1st PLL. Q503 forms a gyrator circuit which reduces noise that might be injected from the power supply.

The parameter, $V_{GS(off)}$, of Q501 can vary from 1 to 4V. D503, R517 and C519 provide some AGC, in order to reduce the dependence of the output level on this parameter.

MMIC amplifier MA501 provides about 20dB gain for the VCO signal and feeds it to the PLL chip.

MA502 and MA503 provide about 30dB gain of the VCO signal to drive the LO port of the double balanced mixer MX401 at a nominal level of +7dBm.

NB that Q506, R547, R531, L508, C510, C540, R537, and R536 are not fitted. Place for these components has been provided on the printed circuit board to allow

the possibility of replacing MX401 with a mixer that requires a higher level of LO drive (but an improved IP3 figure).

5.6 Audio Processing Section (Sheet 6)

The discriminator output from the RF section is connected, in this audio section, to a peak detector formed by U604 and C623. This peak detector output is passed to an A/D input of the Microcontroller to be used as a simple deviation meter.

This raw detected audio is then attenuated by R642 and R655 before being filtered. This attenuation is required to ensure that the audio signal will fit into the dynamic range limitation of the CTCSS chip, U602.

The raw, unfiltered Discriminator Audio signal is attenuated by R658 and R657 before being connected to the rear panel connector P3.

U605B, R642, R643, R644, C626, C627 and C628 form a 5th order elliptical low pass filter with 3dB cut-off at 4.2kHz.

U602 is a CTCSS tone encoder and decoder. U602 can receive and transmit NRZ data, and as such can be used, with suitable firmware, to receive or detect DCS codes.

The CPU accesses U602 via the serial bus using MOSI, SCLK, and the low active Select signal CTCSS_SEL. When U602 detects new CTCSS tones, or detects the absence of a tone, or receives bytes of NRZ data, it signals the Microcontroller by asserting the low active signal SUBTONE_IRQ.

The 4MHz crystal, X401, is used as the reference for decoding CTCSS tones, or setting the bit rate for NRZ data. U602 has a built-in high pass filter, between pins 10 and 11, which can eliminate any subtone, or low frequency NRZ data. Whilst the Microcontroller can enable or disable this filter, in the R50, it is always enabled. The subtone output from Pin17 is amplified by U605C. The output from U605C is ac-coupled to the rear panel connector P3, through capacitor C604.

The audio paths in U602 are all dc-biased to Vcc/2. The audio paths before and after U602 are zero-biased.

U609B is set up as an inverting amplifier with a nominal gain of unity at 1kHz. If the signal FLAT, is asserted low, analogue switch U607A is enabled. This sets the gain at unity across the audio band. If, on the other hand, the digital signal DE_EMPHA is asserted low, analogue switch U607B is enabled, and the gain becomes proportional to frequency. Thus de-emphasis is applied to compensate for any pre-emphasis applied at the exciter.

The audio is connected to the Line outputs and the DIR_AUD output, when the digital signal SQ is asserted low.

The audio is connected to the speaker amplifier when the digital signal MON_SQ is asserted low.

U609C is the amplifier for the 600 ohm line output. U609D is the amplifier for the direct audio output (DIR_AUD). The output level of the 600 ohm output is adjustable via VR601 on the front panel.

U604 is the power amplifier for internal and external speaker. The volume can be adjusted by VR602 on the front panel.

RL602 may apply, or remove, 12VDC to the 600 ohm line output. Whether this occurs or not, and whether the voltage is applied when the squelch opens or

closes depends on the way in which the channel is programmed by the user. The position of RL602 is controlled by the signal LOOP/VOLTS_SEL from the MicroController.

Opto-coupled transistor switch U601 provides a COS (Carrier Operated Switch) output which is controlled by the digital COS_POLARITY signal from the MicroController. The output COS+ and COS- can be used as +12V DC source or a free switch depending on the status of the relay RL601. RL601 is controlled by the digital COS_VOLTS_ON/OFF signal from the MicroController.

5.7 Power Generation Section (Sheet 7)

U909 converts the +12V rail to +5V for all the digital circuitry.

The +12V rail is used to power the two on-board relays, as well as up to one extra off-board relay. It is also dropped, via a linear regulator (U910) to produce the +10V rail, which in turn is dropped by another linear regulator U911 to produce +5Q, which, in turn, is dropped by a further linear regulator (U912) to produce +2.5V.

Similarly U913, U914, and U915 are linear regulators that produce -10V, -5V, and -2.5V from the -12V output of U908.

+10, +5Q, and +2.5V, -10V, -5V, and -2.5V rails are used in the audio and RF sections.

D911 is a 4.096V (3%) reference diode. Its output is buffered by U906 which then produces a reference voltage rail Vref, which is used by the CPU's A/D converter, and the DACs, and also in the voltage to current converters of the VCAs (see Sheet 4, and Sheet 7).

There are three switch-mode dc-dc converters in the board. These use monolithic converters based on the National LM2595. Two of the converters are 12V converters and one is a 5V converter.

The power in to the whole exciter is the voltage rail 28V.

U907 converts this down to 12V.

U908 is set up as an inverter, and uses the 12V rail to create -12V.

U909 converts the +12V rail to +5V for all the digital circuitry.

The +12V rail is used to power the two on-board relays, as well as up to one extra off-board relay. It is also dropped, via a linear regulator (U910) to produce the +10V rail, which in turn is dropped by another linear regulator U911 to produce +5Q.

Similarly U913 and U914 are linear regulators that produce -10V and -5V from the -12V output of U908.

NB -2.5V is not used in the R50 receiver. In case, it is ever required in a future release of the R50, it has been included in the schematic. U915, though is not fitted to the printed circuit board.

D911 is a 4.096V (3%) reference diode. Its output is buffered by U906 which then produces a reference voltage rail Vref, which is used by the CPU's A/D converter, and the DACs.

6 Field Alignment (Calibration) Procedure

6.1 Standard Test Equipment

Some, or all of the following equipment will be required:

- Power supply set to 28Vdc, with current >0.25A.
- RF Signal Generator with 50 Ohm Output impedance, and Frequency range 25-50MHz. The signal generator must be capable of generating a carrier with output level adjustable from -60dBm to -128dBm. It must be able to FM modulate the carrier with a 1kHz audio signal with deviations of 3 and 5kHz.
- Frequency Counter, or spectrum analyser, capable of measuring frequency accurate to 0.5ppm.
- True RMS AC voltmeter with bandwidth > 20kHz, and,
- a DC voltmeter.

6.2 Invoking the Calibration Procedure Manually

From Version 4 of the firmware, and version 1.4 of WinTekHelp, the calibration procedure can be performed through a Windows front end program. This is documented in the WinTekHelp manual. It is recommended that you use the new Windows based procedure for calibrating each R50.

The firmware still supports the older command prompt method, which is described in this section.

The firmware will request the user for information as to meter readings, and/or to attach or adjust an AF signal generator.

The firmware based calibration program can be accessed from a terminal, a terminal emulator, or the WinTekHelp terminal emulator.

If the user selects the "Go to the Prompt Window" option from the main menu, they can manually type commands to invoke the calibration procedure. When the exciter is ready to accept commands it echoes the following prompt:

R50>

Via a terminal, or a terminal emulator, a user can type various commands in. The basic command to start the calibration procedure is:

R50> cal calibration_type

Where "calibration_type" is one of:

- (a) misc: Miscellaneous parameters are defined and calibrated
- (b) line: Line1, Line2, Dir Aud (Tone), and microphone inputs are tested and calibrated.
- (c) ref: The reference oscillators are adjusted and calibrated

6.3 The "Miscellaneous" Calibration Procedure

R50> cal misc

This procedure should not normally be invoked as part of any field maintenance.

The program will print out the Model Name and Serial Number of the exciter. If these parameters haven't already been defined (e.g. at an initial calibration, at the factory, the service personnel will be prompted to enter these values).

Then it will ask the operator to enter the value of Vref (as measured at TP913, see 5.7).

*Measure the voltage, at TP913 (Vref)
and type it on the command line...*

Unless the reference diode D911 has been replaced, this should not be done. The user should simply hit the Enter key to bypass this operation. If, though, D911 has been replaced for some reason, then, the lid of the unit should be removed, and the voltage measured. TP913 can be found just above JP12 (near the centre of the exciter).

Then the receiver low battery alarm level will be asked for. If the current value is acceptable, the User need only hit the Enter key on the keyboard. If another value is preferred, then that value can be typed in.

For example:

*The Exciter's Low Battery Alarm is 24V
If this is correct enter <RET>,
else enter the new value: 26*

In this example, the low Battery Alarm level is changed to 26V.

Then the user will be prompted for serial port baud rates, etc. Please leave these parameters unchanged unless you are familiar with how to change such parameters on your PC. The WinTekHelp software will expect 57600 BPS, and No Parity. Note well, that if you do change any of these, the change will not take effect until you power down the receiver and then power it up again. (As an alternative to power cycling the receiver, and if the cover is off the receiver, you may simply press switch momentary push-button S200 (see 5.2).

Then the following questions are:

Is Flat frequency response on by default (Y/N)?

Is COS purely a sink of current (Y/N)?

Is COS Asserted when the Squelch is closed (Y/N)?

Is COS UnAsserted when the Squelch is open (Y/N)?

Is LOOP Asserted when the Squelch is closed (Y/N)?

Is LOOP UnAsserted when the Squelch is open (Y/N)?

Always hit "Enter key" unless the value other than default is required. Note the user should use the "Y" key if the default value needs to be changed.

6.4 Line Calibration Procedure

R50> cal line

This procedure is used for calibrating the RF RSSI level reading, FM modulation (deviation) reading. Also this procedure is used to set the 600 Ohm audio line output level, Noise squelch level and Carrier squelch level. Simply follow the instruction of the software as bellow:

*Attach an RF signal generator to the input.
Set the RF output to 37.5MHz,
and an input level of -110dBm
with a 1kHz tone and 3kHz deviation.
Adjust the Volume Pot until the DIR AUD output*

is 388mV.(eqvt to 0dBm into 600 ohms)
Enter <RET> when done.
Set the RF signal generator's output to -60dBm
Enter <RET> when done.
rssi_scale is 0.417dBm/dac step, and rssi offset is -137.500dBm)
Adjust the Modulation to only 1KHz max deviation
Enter <RET> when done.
deviation_scale is 1.000dBm/dac step, and
deviation offset is .000dBm
Adjust the Carrier Squelch to the desired level
Enter <RET> when set.
-99.5 --- for example

Enter the Fast Noise Threshold(in dBm):
Enter the Carrier Alarm Threshold(in dBm):
Set the RF generator output to the desired level (< -105dBm),
and adjust the N.SQ adjustment counter clockwise
until the squelch opens, thence turn it clockwise
until the noise is muted.
Enter <RET> when done

6.5 The "Reference" Calibration Procedure

R50> cal ref

To compensate for crystal ageing and other parameters that drift, the following procedure should be performed approximately once per year.

Open the cover of the receiver, find out the test point TP209 on receiver PCB, using a frequency counter to measure the frequency and follow the instruction as bellow:

Measure the ECLK frequency, accurate to 0.5Hz
and enter the result(in MHz, eg 7.3727965)
Measure the E clock frequency again, and enter yes(y/Y)
if less than 1Hz from prev. freq, or re-enter the frequency
Connect an RF generator to the input
and with output freq of 37.5MHz and output level of -100dBm
Enter <RET> when done.

7 SPECIFICATIONS

7.1 Overall Description

The receiver is a frequency synthesized, narrow band, HF/VHF, FM unit which can be used in conjunction with transmitter and power supply modules as a base station, or it can operate as a stand alone receiver. All necessary control and 600 ohm line interface circuitry is included.

7.1.1 Channel Capacity

Although most applications are single channel, the R50 can be programmed for up to 256 channels, numbered 0-255. This allows a network administrator to program every receiver, in every site, the same way. By setting each site up to select which of the 256 channels is appropriate, any receiver can be plugged

into any position, in any site, without the need to perform on-site re-programming. This can be convenient in maintenance situations.

The parameters that can be defined on a per channel basis are:

- The frequency, or if scanning is enabled, the list of frequencies to be scanned.
- If scanning is enabled, the selection of a priority frequency (if there is one), and how often it is checked.
- The CTCSS tone, or tones, expected on each frequency, or, DCS code expected on each frequency.
- The delay from the opening of the squelch till the assertion of the COS output, or LOOP output.
- The delay from the closing of the squelch to the negation of the COS or LOOP output.
- Whether or not LOOP and/or COS should be asserted when the squelch opens, depending on which frequency, and/or CTCSS tone, is detected.
- Whether de-emphasis should be applied to the tuned signal or not depending on which frequency the receiver is tuned to.
- Offsets for carrier strength or SINAD: the user can allow individual frequencies to have higher or lower thresholds for SINAD or carrier strength.

7.1.2 CTCSS

Full EIA subtone Capability is built into the modules. The CTCSS tone can be programmed for each channel. This means that each channel number can represent a unique RF and tone frequency combination.

7.1.3 DCS

From Rev. 4 hardware and Rev. 4 firmware, support for DCS codes is supported. DCS code generation can be enabled on a per channel basis. If enabled, the receiver will not open the squelch unless it is receiving the nominated DCS code, or one of its valid transformations. If it stops receiving these DCS codes, the squelch will close.

7.1.4 Channel Programming

The channel information is stored in non-volatile memory and can be programmed via the front panel connector using a PC, and/or RF Technology software.

7.1.5 Channel Selection

Channel selection is by eight channel select lines connected to the rear panel that mounts on the rear DB25 female connector.

A BCD active high code applied to the lines selects the required channel. This can be supplied by pre-wiring the rack connector so that each rack position is dedicated to a fixed channel. Alternatively, thumb-wheel switch panels are available.

By redefining “illegal” BCD codes, users can also encode channels from 100 – 255.

7.1.6 Microprocessor

A microprocessor is used to control the synthesizer, tone squelch, calibration, fault monitoring and reporting, RSSI reading, deviation measuring, option setting and facilitate channel frequency programming.

7.2 Physical Configuration

The receiver is designed to fit in a 19 inch rack mounted sub-frame. The installed height is 4 RU (178 mm) and the depth is 350 mm. The receiver is 63.5 mm or two Eclipse modules wide.

7.3 Front Panel Controls, Indicators, and Test Points

7.3.1 Controls

Mute Defeat Switch - Toggle
(Overrides CTCSS and carrier squelch at the monitor output)

Monitor Speaker volume - Knob

Line output Level - screw driver adjust multi-turn pot

Noise Squelch setting - screw driver adjust multi-turn pot

Carrier Squelch Setting - screw driver adjust multi-turn pot

7.3.2 Indicators

Power ON - Green LED

Squelch Open - Yellow LED

Fault Indicator - Flashing Red LED

7.3.3 Test Points

There are no front panel test points. All important test points are monitored by the firmware.

7.4 Electrical Specifications

7.4.1 Power Requirements

Operating Voltage - 16 to 32 Vdc

Current Drain - 0.5A Maximum

Polarity - Negative Ground

7.4.2 Frequency Range and Channel Spacing

The R50, as a single model, covers the frequency range 25MHz to 50MHz in one model. All frequencies, that are an integer multiple of 1250Hz, are allowed within this band.

The R50, by default, has a 3rd IF filter whose bandwidth is suitable for 20kHz or 25kHz channel spacings.

The R50 can, optionally, be supplied with a filter which is suitable for 10.0 or 12.5kHz, or 15kHz channel spacing. Similarly, a third filter is also available which is suitable for 5.0, 6.25kHz, or 7.5kHz.

7.4.3 Frequency Synthesizer Step Size

The specified frequency can be any multiple of 1250Hz.

7.4.4 Frequency Stability

±5 ppm over 0 to +60 C, standard

±12 ppm over -30 to +60 C.

7.4.5 Number of Channels

256, numbered 00 - 255

7.4.6 RF Input Impedance

50 ohms.

7.4.7 IF Frequencies

1st IF frequency 246MHz +/- 120kHz

2nd IF frequency 21.4MHZ

3rd IF frequency 455KHz

7.4.8 Sensitivity

-119 dBm for 12dB SINAD

-116 dBm for 20dB Quieting

7.4.9 Selectivity

80dB per RS204C

7.4.10 Spurious and Image Rejection

90dB

7.4.11 Intermodulation

80dB

7.4.12 Modulation Acceptance BW

7.5KHz

7.4.13 Noise Squelch

(a) Adjustment range: 6-26dB SINAD

(b) Attack time: 20mSec. Above 20dB Quieting

(c) Release Time: 150mSec. At 20dB Quieting decreasing to 20mSec. Above 2uV preset threshold

(d) Hysteresis Equal to approximately 2-3dB noise quieting

7.4.14 Carrier Level Squelch

Carrier level squelch can be used when it is necessary to set the opening point above 26 dB SINAD as may be required in link applications. The minimum adjustment range is 0.35uV(-116dBm) to 700 uV(-50dBm).

7.4.15 Receiver Frequency Spread

Less than 1dB change in sensitivity over the band

7.4.16 Receiver Conducted Spurious Emission

Less than -67dBm from 1 to 3000MHz

7.4.17 Audio Frequency Response

(a) 600 Ohm Line and Direct Output:

+1/-3 dB 300 - 3000 Hz relative to either a flat response or 750 uSec. de-emphasis

(b) Sub-Audio Output:

+1/-3dB 67 - 250 Hz @ 3kHz deviation

7.4.18 Audio Output Level

(a) 600 Ohm Line:

Adjustable -10 to +10 dBm

(b) Monitor Loudspeaker:

5 Watts with external speaker, 0.2 Watt with internal speaker

(c) Discriminator and Sub-Audio:

Nominally equal to 1 volt peak at rated system deviation

7.4.19 Audio Distortion

With 750 uSec. De-Emphasis:

Less than 3% at 1 KHz and 60% of rated system deviation

With Flat Response:

Less than 3% at 1 KHz and 60% of rated system deviation

7.4.20 Channel Select Input/Output

Coding - 8 lines, BCD coded 00 – 99; illegal BCD codes used to encode channels 100 – 255.

If the MSN (Most Significant Nibble) is greater than 9, then the channel number is defined by the formula:

$$16 * \text{MSN} + \text{LSN};$$

where the LSN is the Least Significant Nibble.

If the MSN is less than 9, but the LSN is greater than 9, then the channel number is defined by the formula:

$$10 * \text{LSN} + \text{MSN};$$

Logic Input Levels - High for <1.5V, Low for >3.5V

Internal pull up resistors select channel 00 when all inputs are O/C.

7.4.21 Carrier Operated Switch (COS) Output

The carrier operated switch output is via an Opto-coupler. Collector and emitter connections are available to allow connection for source or sink.

The Opto-coupler can be linked inside the receiver to be on when a carrier is detected or to be on in the absence of carrier.

Internal connections are provided by a relay so that 12VDC can be connected to the 600 Ohm line for use over a single pair.

7.4.22 COS Output Current Source/Sink, Collector Voltage

$I_c = 10 \text{ mA}$ Maximum

$V_c = 30 \text{ Volts}$ Max

7.4.23 CTCSS

The CTCSS decoding is provided by U602. This provides programmable decoding of all 38 EIA and 12 other common tones. See Appendix C for the full list of tone squelch frequencies.

U602 is accurate to within +/- 0.2Hz. The firmware will accept as valid any received tone that is within $\pm 1.5 \%$ of the nominated tone.

7.4.24 DCS

From Rev. 4 hardware and Rev. 4 firmware, support for DCS codes is supported. If DCS is enabled, the receiver will set the CTCSS chip (U602) into a mode whereby it expects NRZ data at 134.4 bps. On the reception of each bit of data, that bit and the previous 22 bits of data, are parsed to check if they are a valid Golay code with 3 or less bit errors. If these 23 bits are valid, then the code is extracted and compared with the code defined for that channel, or one of the transformations of that code. If the squelch is closed, and a period of 120 milliseconds occurs during which all valid codes tested match, then the squelch will open. If the squelch is open, and no valid match is found for a period of 120 milliseconds, then the squelch is closed. When the carrier level is below the fast noise threshold, the firmware increases the delay used to close the squelch to 300 milliseconds.

DCS codes are received inverted by U602, ie "0" to "1" transitions are received as decreases in carrier frequency. To compensate, the firmware inverts all NRZ data received by U602.

Most DCS codes have more than one transformation, for example code 023 can be detected as 340 and 766. If any of these codes are defined to be the code for a channel, then the receiver will accept the others as being equivalent.

Some receivers will allow the inverted codes to also be equivalents. For example the inverted codes for the previous example are 754, 437, and 011. The R50 does not treat them as equivalents. If the transmitter being tuned to inverts the code, then the user should program the receiver with one of the inverted codes

7.4.25 External Squelch Input

An external input is provided to squelch or mute the receiver audio output. This may be used in conjunction with an external decoder or to mute the receiver during transmissions.

The External Squelch Input can be connected to the T/R Relay pin on Eclipse transmitters mute the receiver during transmission.

7.5 Connectors

7.5.1 Antenna Connector

Type N Female Mounted on the module rear panel

7.5.2 Power & I/O Connector

25 pin "D" Male Mounted on the rear panel

7.5.3 Test Connector

9 pin "D" Female mounted on the front panel

APPENDIX A

EIA CTCSS TONE FREQUENCIES

Frequency	EIA Number
No Tone	
67.0	A1
71.9	B1
74.4	C1
77.0	A2
79.7	C2
82.5	B2
85.4	C3
88.5	A3
91.5	C4
94.8	B3
100.0	A4
103.5	B4
107.2	A5
110.9	B5
114.8	A6
118.8	B6
123.0	A7
127.3	B7
131.8	A8
136.5	B8
141.3	A9
146.2	B9
151.4	A10
156.7	B10
162.2	A11
167.9	B11
173.8	A12
179.9	B12
186.2	A13
192.8	B13
203.5	A14
210.7	B14
218.1	A15
225.7	B15
233.6	A16
241.8	B16
250.3	A17

B R50 Parts List

Main PCB Assembly Parts

Ref.	Description	Part Number
C101	EMI Filter ARRY 100PF SMD	34/NFA3/1100
C102	EMI Filter ARRY 100PF SMD	34/NFA3/1100
C103	EMI Filter ARRY 100PF SMD	34/NFA3/1100
C201	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C202	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C203	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C204	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C205	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C206	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C207	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C208	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C209	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C210	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C211	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C212	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C214	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C215	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C216	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C217	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C219	Capacitor Electrolytic 10U 16V 6032	42/3300/010U
C220	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C221	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C222	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C224	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C225	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C226	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C301	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C302	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C303	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C304	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C305	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C306	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C307	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C308	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C309	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C310	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C311	Capacitor Electrolytic 10U 16V 6032	42/3300/010U
C312	Capacitor Electrolytic 10U 16V 6032	42/3300/010U
C313	Capacitor Electrolytic 10U 16V 6032	42/3300/010U
C314	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C315	Capacitor 100N+/-10% X7R 50V 0603	46/63X1/100N
C316	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C317	Capacitor 10N+/-5% NPO 50V 1206	46/26N1/010N
C318	Capacitor Electrolytic 10U 16V 6032	42/3300/010U
C319	Capacitor Electrolytic 10U 16V 6032	42/3300/010U
C320	Capacitor 100P+/-5% NPO 50V 0603	46/63N1/100P
C321	Capacitor 100P+/-5% NPO 50V 0603	46/63N1/100P

R50 PARTS LIST

C322	Capacitor 18P+/-5% NPO 50V 0603	46/63N1/018P
C323	Capacitor 8P2+/-5% NPO 50V 0603	46/63N1/08P2
C324	Capacitor 33P+/-5% NPO 50V 0603	46/63N1/033P
C327	Capacitor 1U5+/-10% 10V TANT 1206	42/STA1/01U5
C328	Capacitor Electrolytic L ESR 16V 100U 7343	42/STA1/02U2
C329	Capacitor 10N+/-5% NPO 50V 1206	46/26N1/010N
C330	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C401	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C402	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C403	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C404	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C405	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C406	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C407	Capacitor 1N+/-5% NPO 50V 1206	46/3300/01N0
C408	Capacitor 1N+/-10% X7R 25V 0603	46/63X1/001N
C409	Capacitor 1N+/-10% X7R 25V 0603	46/63X1/001N
C410	Capacitor 1N+/-10% X7R 50V 0603	46/63X1/001N
C411	Capacitor 330P+/-5% NPO 50V 1206	46/63N1/330P
C412	Capacitor 330P+/-5% NPO 50V 1206	46/63N1/330P
C413	Capacitor 330P+/-5% NPO 50V 1206	46/63N1/330P
C415	Capacitor 100P+/-5% NPO 50V 0603	46/63N1/100P
C416	Capacitor 150P+/-5% NPO 50V 0603	46/63N1/150P
C417	Capacitor 150P+/-5% NPO 50V 0603	46/63N1/150P
C418	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C419	Capacitor 270P+/-5% NPO 50V 0603	46/63N1/270P
C420	Capacitor 180P+/-5% NPO 50V 0603	46/63N1/180P
C421	Capacitor 68P+/-5% NPO 50V 0603	46/63N1/068P
C422	Capacitor 68P+/-5% NPO 50V 0603	46/63N1/068P
C423	Capacitor 390P +/-5% NPO 50V 0603	46/63N1/390P
C424	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C425	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C426	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C427	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C428	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C429	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C430	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C431	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C432	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C433	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C434	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C435	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C436	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C437	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C438	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C439	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C440	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C441	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C442	Capacitor 68P+/-5% NPO 50V 0603	46/63N1/068P
C443	Capacitor 100P+/-5% NPO 50V 0603	46/63N1/100P
C444	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C445	Capacitor 68P+/-5% NPO 50V 0603	46/63N1/068P
C446	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C448	Capacitor 8P2+/-0.25 NPO 50V 0603	46/63N1/08P2

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C449	Capacitor 8P2+/-0.25 NPO 50V 0603	46/63N1/08P2
C450	Capacitor 2P7+/-0.25 NPO 50V 0603	46/63N1/02P7
C451	Capacitor 15P+/-5% NPO 50V 0603	46/63N1/015P
C452	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C453	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C454	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C455	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C456	Capacitor 68P+/-5% NPO 50V 0603	46/63N1/068P
C457	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C458	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C459	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C460	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C461	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C462	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C463	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C464	Capacitor 56P+/-5% NPO 50V 0603	46/63N1/056P
C466	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C467	Capacitor 5P6+/-0.25 NPO 50V 0603	46/63N1/05P6
C468	Capacitor 33P+/-5% NPO 50V 0603	46/63N1/033P
C469	Capacitor 15P+/-5% NPO 50V 0603	46/63N1/015P
C470	Capacitor 470P+/-10% NPO 50V 0603	46/63N1/470P
C471	Capacitor 4P7+/-0.25 NPO 50V 0603	46/63N1/04P7
C473	Capacitor 2P7+/-0.25 NPO 50V 0603	46/63N1/02P7
C474	Capacitor 56P+/-5% NPO 50V 0603	46/63N1/056P
C475	Capacitor 15P+/-5% NPO 50V 0603	46/63N1/015P
C476	Capacitor 15U /6.3V A-CASE ELECTROLYTIC	45/STSA/10U6
C477	Capacitor 18P+/-5% NPO 50V 0603	46/63N1/018P
C478	Capacitor 18P+/-5% NPO 50V 0603	46/63N1/018P
C479	Capacitor 33P+/-5% NPO 50V 0603	46/63N1/033P
C480	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C481	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16
C482	Capacitor 15P+/-5% NPO 50V 0603	46/63N1/015P
C483	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C484	Capacitor Electrolytic L ESR 16V 33U 6032	41/SELC/033U
C486	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16
C487	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C488	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16
C489	Capacitor 390P +/-5% NPO 50V 0603	46/63N1/390P
C491	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C492	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C493	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C494	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C495	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C496	Capacitor 10P+/-5% NPO 50V 0603	46/63N1/010P
C501	Capacitor 2P2+/-0.25 NPO 50V 0603	46/63N1/02P2
C503	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C502	Capacitor 2P7+/-0.25 NPO 50V 0603	46/63N1/02P7
C504	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C505	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C506	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16
C507	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C508	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C509	Capacitor Electrolytic 10U 16V 6032	42/3330/010U

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C511	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C512	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C513	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C514	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C515	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C516	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C518	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C519	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C520	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C521	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C522	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C523	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C524	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C525	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C526	Capacitor 150P+/-5% NPO 50V 0603	46/63N1/150P
C527	Capacitor 1N+80/-20% Y5V 25V 0603	46/63X1/001N
C528	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C529	Capacitor 150P+/-5% NPO 50V 0603	46/63N1/150P
C530	Capacitor 22P+/-5% NPO 50V 0603	46/63N1/022P
C531	Capacitor 22P+/-5% NPO 50V 0603	46/63N1/022P
C532	Capacitor 15P+/-5% NPO 50V 0603	46/63N1/015P
C533	Capacitor 4P7+/-0.25 NPO 50V 0603	46/63N1/04P7
C534	Capacitor 10P+/-5% NPO 50V 0603	46/63N1/010P
C535	Capacitor 10P+/-5% NPO 50V 0603	46/63N1/010P
C536	Capacitor 15P+/-5% NPO 50V 0603	46/63N1/015P
C537	Capacitor 15P+/-5% NPO 50V 0603	46/63N1/015P
C538	Capacitor 15P+/-5% NPO 50V 0603	46/63N1/015P
C539	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C541	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C542	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C543	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C544	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C545	Capacitor 10N+/-10% X7R 50V 0603	46/63X1/010N
C547	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C548	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C549	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C550	Capacitor 22P+/-5% NPO 50V 0603	46/63N1/022P
C551	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C552	Capacitor 330P+/-5% NPO 50V 1206	46/63N1/330P
C553	Capacitor 330P+/-5% NPO 50V 1206	46/63N1/330P
C554	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C555	Capacitor 4P7+/-0.25 NPO 50V 0603	46/63N1/04P7
C556	Capacitor 22P+/-5% NPO 50V 0603	46/63N1/022P
C557	Capacitor 22P+/-5% NPO 50V 0603	46/63N1/022P
C558	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C559	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C560	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C561	Capacitor 4P7+/-0.25 NPO 50V 0603	46/63N1/04P7
C563	Capacitor 150P+/-5% NPO 50V 0603	46/63N1/150P
C564	Capacitor 22P+/-5% NPO 50V 0603	46/63N1/022P
C601	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16
C602	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16

C604	Capacitor Electrolytic BIPOL 50V 22U+/-20% RB.2.4	41/BP01/022U
C605	Capacitor 15U /6.3V A-CASE ELECTROLYTIC	45/STSA/10U6
C606	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16
C607	Capacitor 47N+/-10% X7R 50V 1206	45/3310/047N
C609	Capacitor 15U /6.3V A-CASE ELECTROLYTIC	45/STSA/10U6
C610	Capacitor 10N+/-5% NPO 50V 1206	46/26N1/010N
C611	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C612	Capacitor 33P+/-5% NPO 50V 0603	46/63N1/033P
C613	Capacitor 33P+/-5% NPO 50V 0603	46/63N1/033P
C614	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16
C615	Capacitor 1U+80/-20% Y5V 25V 1206	45/Y5X7/1U16
C616	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C617	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C618	Capacitor ELC BIP 50V 22U+/-20% RB.2.4	41/BP01/022U
C619	Capacitor ELC BIP 50V 22U+/-20% RB.2.4	41/BP01/022U
C620	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C621	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C622	Capacitor 22N+/-10% X7R 50V 0603	45/X7R1/022N
C623	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C624	Capacitor Electrolytic 470U 25V RB.2.4	41/2001/470U
C625	Capacitor Electrolytic 470U 25V RB.2.4	41/2001/470U
C626	Capacitor 2N2+/-5% NPO 50V 1812	46/26N1/02N2
C627	Capacitor 10N+/-5% NPO 50V 1206	46/26N1/010N
C628	Capacitor 120P+/-5% NPO 50V 0603	46/63N1/120P
C629	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C630	Capacitor 22N+/-10% X7R 50V 0603	45/X7R1/022N
C632	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C633	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C634	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C635	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C636	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C901	Capacitor Electrolytic L ESR 16V 33U 6032	41/SELC/033U
C902	Capacitor Electrolytic L ESR 470U 35V RB.2/.4	41/200L/470U
C903	Capacitor Electrolytic L ESR 16V 33U 6032	41/SELC/033U
C913	Capacitor Electrolytic 1000U 16V RB.2/.4	41/2001/1000
C915	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C920	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C923	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C924	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C925	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C926	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C927	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C928	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C929	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C930	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C931	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C933	Capacitor 100N+80/-20% Y5V 25V 0603	46/63Y1/100N
C935	Capacitor Electrolytic L ESR 470U 35V RB.2/.4	41/200L/470U
C936	Capacitor Electrolytic L ESR 16V 33U 6032	41/SELC/033U
C937	Capacitor Electrolytic L ESR 16V 33U 6032	41/SELC/033U
C938	Capacitor Electrolytic L ESR 16V 100U 7343	41/SELD/100U
C939	Capacitor Electrolytic L ESR 16V 100U 7343	41/SELD/100U

C940	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C941	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
C943	Capacitor Electrolytic 10U 16V 6032	42/3330/010U
D102	Diode LED Red RT ANG MTG	21/1010/LEDR
D103	Diode LED Yellow RT ANG MTG	21/1010/LEDY
D104	Diode LED Green RT ANG MTG	21/1010/LEDG
D200	Diode Dual GP BAV99 SOT23	21/3010/AV99
D301	Diode V Capacitor MMBV109 SOT23	21/3060/V109
D401	Diode Schotky BAT17 SOT23	21/3010/0017
D403	Diode Dual GP BAV99 SOT23	21/3010/AV99
D404	Diode Dual GP BAV99 SOT23	21/3010/AV99
D405	Diode Schotky BAT17 SOT23	21/3010/0017
D406	Diode V FilterCapacitor MMBV109 SOT23	21/3060/V109
D407	Diode Zen 5V1 BZX84C5V1 SOT23	21/3040/C5V1
D501	Diode VCapacitor MMBV105G SOT23	21/3060/105G
D502	Diode VCapacitor MMBV109 SOT23	21/3060/V109
D503	Diode Schotky BAT17 SOT23	21/3010/0017
D504	Diode Schotky BAT17 SOT23	21/3010/0017
D601	Diode GP 50V 1A SMD	24/SMA1/4004
D602	Diode GP 50V 1A SMD	24/SMA1/4004
D603	Diode Dual GP BAV99 SOT23	21/3010/AV99
D604	Diode Dual GP BAV99 SOT23	21/3010/AV99
D605	Diode Dual GP BAV99 SOT23	21/3010/AV99
D906	Diode Schotky 40V 1A SMD	24/BRM1/40T3
D907	Diode Schotky 40V 1A SMD	24/BRM1/40T3
D908	Diode Schotky 40V 1A SMD	24/BRM1/40T3
D909	Diode Schotky 40V 1A SMD	24/BRM1/40T3
D910	Diode GP 50V 1A SMD	24/SMA1/4004
D911	Diode Zen 4.096V +/-3% SOT-23	29/VREF/0001
Filter401	SAW Filter 246MHz+/-130KHz SMD	33/SAWF/0001
Filter 402	Ceramic Filter 455K SMD	34/2000/CFUC
Filter403	Ceramic Filter 455K SMD	34/2000/CFUC
Filter 404	Crystal Filter 2 Pole 21.4MHZ HC45U	33/2000/214W
Filter 405	Crystal Filter 2 Pole 21.4MHZ HC45U	33/2000/214W
JP3	Connector 2X5PIN	35/7026/0010
L100	Ferrite Bead 2A 1206	37/P034/0001
L101	Ferrite Bead .5A 1206	37/P033/0001
L102	Ferrite Bead .5A 1206	37/P033/0001
L200	Choke 220UH+/-20% 50mA 1812	37/3320/P103
L202	Ferrite Bead .5A 1206	37/P033/0001
L203	Ferrite Bead .5A 1206	37/P033/0001
L204	Ferrite Bead .5A 1206	37/P033/0001
L205	Ferrite Bead .5A 1206	37/P033/0001
L301	Ferrite Bead .5A 1206	37/P033/0001
L401	Inductor 246NH+/-5%	37/AC52/246N
L402	Inductor 246NH+/-5%	37/AC52/246N
L403	Inductor 246NH+/-5%	37/AC52/246N
L404	Inductor 422NH+/-5%	37/AC52/422N
L405	Inductor 558NH+/-5%	37/AC52/558N
L406	Inductor 380NH+/-5%	37/AC52/380N
L407	Inductor 169NH+/-5%	37/AC52/169N
L408	Inductor 169NH+/-5%	37/AC52/169N
L409	Inductor 680NH+/-10% 1008	37/3320/680N

L410	Inductor 270NH+/-5% 0805	37/8551/270N
L411	Inductor 270NH+/-5% 0805	37/8551/270N
L412	Inductor 220NH+/-5% 0805	37/8551/220N
L413	Inductor 220NH+/-5% 0805	37/8551/220N
L414	Inductor 220NH+/-5% 0805	37/8551/220N
L417	Inductor 100NH+/-5% 0805	37/8551/100N
L419	Inductor 100NH+/-5% 0805	37/8551/100N
L420	Inductor 150NH+/-5% 0805	37/8551/150N
L421	Inductor 680NH+/-10% 1008	37/3320/680N
L422	Inductor 100NH+/-5% 0805	37/8551/100N
L423	Inductor 2U2H+/-5% 1008	37/3320/02U2
L424	Inductor 2U2H+/-5% 1008	37/3320/02U2
L425	Inductor 560NH+/-5% 0805	37/8551/560N
L426	Inductor 3U3H+/-10% 1008	37/3320/03U3
L501	Inductor 18N5H+/-5%	37/AC5118N5
L502	Inductor 3U3H+/-10% 1008	37/3320/03U3
L503	Inductor 3U3H+/-10% 1008	37/3320/03U3
L504	Inductor 220NH+/-5% 0805	37/8551/220N
L505	Inductor 220NH+/-5% 0805	37/8551/220N
L506	Inductor 3U3H+/-10% 1008	37/3320/03U3
L507	Inductor 220NH+/-5% 0805	37/8551/220N
L509	Inductor 220NH+/-5% 0805	37/8551/220N
L510	Inductor 220NH+/-5% 0805	37/8551/220N
L511	Inductor 3U3H+/-10% 1008	37/3320/03U3
L512	Inductor 220NH+/-5% 0805	37/8551/220N
L514	Inductor 27NH+/-5% 0805	37/8551/027N
L515	Inductor 39NH+/-5%	37/AC52/039N
L517	Inductor 560NH+/-5% 0805	37/8551/560N
L516	Inductor 33NH+/-5% 0805	37/8551/033N
L901	BLM31 FERRITE BEAD 100mA 1206	37/P034/0001
L902	Inductor MSLD 500mA 330U+/-20% SMD	37/MSP1/330U
L903	Inductor MSLD 500mA 330U+/-20% SMD	37/MSP1/330U
L904	Inductor MSLD 500mA 330U+/-20% SMD	37/MSP1/330U
L905	BLM31 FERRITE BEAD 100mA 1206	37/P034/0001
L906	Ferrite Bead 2A 1206	37/P034/0001
L907	Ferrite Bead 2A 1206	37/P034/0001
L908	Ferrite Bead 2A 1206	37/P034/0001
L909	Ferrite Bead 2A 1206	37/P034/0001
MA501	Amplifier MMIC VAM-6 SOT143	24/3010/VAM6
MA502	Amplifier MMIC VAM-6 SOT143	24/3010/VAM6
MA503	Amplifier MMIC VAM-6 SOT143	24/3010/VAM6
MA504	Amplifier MMIC VAM-6 SOT143	24/3010/VAM6
MA505	Amplifier MMIC MWA0211L SOT143	24/3010/211L
MA506	Amplifier MMIC MWA0211L SOT143	24/3010/211L
MX401	Mixer Double BAL Level 7 SMD	37/MIXR/P028
MX402	Mixer Double BAL Level 7 SMD	37/MIXR/P028
P1	Connector DB9 RT ANG FML PCB MT	35/5012/025M
P3	Connector DB25 RT ANG FML PCB MT	35/5032/025F
Q200	Transistor NPN GP SOT23	27/3020/3904
Q202	FET NJ MMBF5484 SOT23	27/3030/5484
Q203	Transistor NPN MMBT2369 SOT23	27/3020/2369
Q204	Transistor NPN MMBT2369 SOT23	27/3020/2369
Q205	Transistor PNP GP SOT23	27/3010/3906

Q206	Transistor NPN GP SOT23	27/3020/3904
Q301	Transistor NPN GP SOT23	27/3020/3904
Q401	Transistor NPN RF BFQ17 SOT89	27/300B/FQ17
Q402	Transistor NPN RF BFQ193 SOT89	27/30BF/Q193
Q403	Transistor NPN RF BFQ17 SOT89	27/300B/FQ17
Q404	FET NJ MMBFJ309 SOT23	27/3030/J309
Q405	Transistor PNP RF BFR92A SOT23	27/3020/R92A
Q406	Transistor PNP RF BFR92A SOT23	27/3020/R92A
Q407	Transistor NPN GP SOT23	27/3020/3904
Q408	Transistor PNP GP SOT23	27/3010/3906
Q501	FET NJ MMBFJ309 SOT23	27/3030/J309
Q502	FET NJ MMBFJ309 SOT23	27/3030/J309
Q503	Transistor NPN GP SOT23	27/3020/3904
Q504	Transistor NPN GP SOT23	27/3020/3904
Q601	Transistor PNP GP SOT23	27/3010/3906
Q602	FET NMOS BSS138 SOT23	27/30B5/5138
Q603	FET NMOS BSS138 SOT23	27/30B5/5138
R103	Resistor 1206 180R+/-5% 1/4W	51/3380/0180
R104	Resistor 1206 180R+/-5% 1/4W	51/3380/0180
R201	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R202	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R203	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R204	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R205	Resistor 0805 2K7+/-5% 1/8W	51/8511/02K7
R206	Resistor 0805 2K2+/-5% 1/8W	51/8511/02K2
R207	Resistor 0805 68K+/-5% 1/8W	51/8511/068K
R209	Resistor 0805 270R+/-5% 1/8W	51/8511/270R
R210	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R211	Resistor 0805 220R+/-5% 1/8W	51/8511/220R
R212	Resistor 0805 220R+/-5% 1/8W	51/8511/220R
R213	Resistor 0805 1M+/-5% 1/8W	51/8511/01M0
R217	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R218	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R219	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R220	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R221	Resistor 0805 470R+/-5% 1/8W	51/8511/470R
R222	Resistor 0805 2K2+/-5% 1/8W	51/8511/02K2
R223	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R224	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R225	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R226	Resistor 1206 180R+/-5% 1/4W	51/3380/0180
R228	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R229	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R230	Resistor 0805 120R+/-5% 1/8W	51/8511/120R
R231	Resistor 0805 120R+/-5% 1/8W	51/8511/120R
R232	Resistor 0805 560R+/-5% 1/8W	51/8511/560R
R233	Resistor 0805 22K+/-5% 1/8W	51/8511/022K
R234	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R235	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R236	Resistor 0805 18K+/-5% 1/8W	51/8511/018K
R237	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R238	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R239	Resistor 0805 1K+/-5% 1/8W	51/8511/001K

R50 PARTS LIST

R240	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R241	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R242	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R243	Resistor 0805 220R+/-5% 1/8W	51/8511/220R
R244	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R245	Resistor 0805 12K+/-5% 1/8W	51/8511/012K
R301	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R302	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R303	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R304	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R305	Resistor 0805 5K6+/-5% 1/8W	51/8511/05K6
R306	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R307	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R308	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R309	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R310	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R311	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R312	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R313	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R314	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R315	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R316	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R317	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R318	Resistor 0805 150K+/-5% 1/8W	51/8511/150K
R319	Resistor 0805 150K+/-5% 1/8W	51/8511/150K
R320	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R321	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R322	Resistor 0805 22K+/-5% 1/8W	51/8511/022K
R323	Resistor 0805 22K+/-5% 1/8W	51/8511/022K
R324	Resistor 0805 12K+/-5% 1/8W	51/8511/012K
R325	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R326	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R327	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R330	Resistor 0805 1K8+/-5% 1/8W	51/8511/01K8
R331	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R332	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R333	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R401	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R402	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R403	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R404	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R405	Resistor 0805 2R2+/-5% 1/8W	51/8511/02R2
R406	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R407	Resistor 0805 18K+/-5% 1/8W	51/8511/018K
R408	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R409	Resistor 0805 15K+/-5% 1/8W	51/8511/015K
R410	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R411	Resistor 0805 330R+/-5% 1/8W	51/8511/330R
R412	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R413	Resistor 0805 47R+/-5% 1/8W	51/8511/047R
R414	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R415	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R416	Resistor 0805 10K+/-5% 1/8W	51/8511/010K

R50 PARTS LIST

R417	Resistor 0805 680R+/-5% 1/8W	51/855/11/033K
R418	Resistor 0805 680R+/-5% 1/8W	51/855/11/033K
R419	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R420	Resistor 0805 100K+/-5% 1/8W	51/8511/100K
R421	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R422	Resistor 0805 100K+/-5% 1/8W	51/8511/100K
R423	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R424	Resistor 0805 680R+/-5% 1/8W	51/855/11/033K
R425	Resistor 0805 18K+/-5% 1/8W	51/8511/018K
R426	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R427	Resistor 0805 3K3+/-5% 1/8W	51/8511/03K3
R428	Resistor 0805 100K+/-5% 1/8W	51/8511/100K
R429	Resistor 0805 470K+/-5% 1/8W	51/8511/470K
R430	Resistor 0805 150K+/-5% 1/8W	51/8511/150K
R431	Resistor 0805 100K+/-5% 1/8W	51/8511/100K
R432	Resistor 0805 22K+/-5% 1/8W	51/8511/022K
R433	Resistor 0805 680R+/-5% 1/8W	51/855/11/033K
R434	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R435	Resistor 0805 390R+/-5% 1/8W	51/8511/390R
R436	Resistor 0805 220K+/-5% 1/8W	51/8511/220K
R437	Resistor 0805 220K+/-5% 1/8W	51/8511/220K
R438	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R439	Resistor 0805 390R+/-5% 1/8W	51/8511/390R
R441	Resistor 0805 22K+/-5% 1/8W	51/8511/022K
R442	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R443	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R444	Resistor 0805 100K+/-5% 1/8W	51/8511/100K
R445	Resistor 0805 2K2+/-5% 1/8W	51/8511/02K2
R446	Resistor 0805 22K+/-5% 1/8W	51/8511/022K
R448	Resistor 0805 220K+/-5% 1/8W	51/8511/220K
R449	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R450	Resistor 0805 6K8+/-5% 1/8W	51/855/11/06K8
R452	Resistor 0805 82K+/-5% 1/8W	51/8511/082K
R453	Resistor 0805 470R+/-5% 1/8W	51/8511/470R
R454	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R455	Resistor 0805 120R+/-5% 1/8W	51/8511/120R
R456	Resistor 0805 120R+/-5% 1/8W	51/8511/120R
R457	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R458	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R459	Resistor 0805 680R+/-5% 1/8W	51/855/11/033K
R460	Resistor 0805 330R+/-5% 1/8W	51/8511/330R
R461	Resistor 0805 330R+/-5% 1/8W	51/8511/330R
R462	Resistor 0805 150R+/-5% 1/8W	51/8511/150R
R463	Resistor 0805 470R+/-5% 1/8W	51/8511/470R
R464	Resistor 0805 22K+/-5% 1/8W	51/8511/022K
R465	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R466	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R467	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R468	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R469	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R507	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R508	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R509	Resistor 0805 10K+/-5% 1/8W	51/8511/010K

R50 PARTS LIST

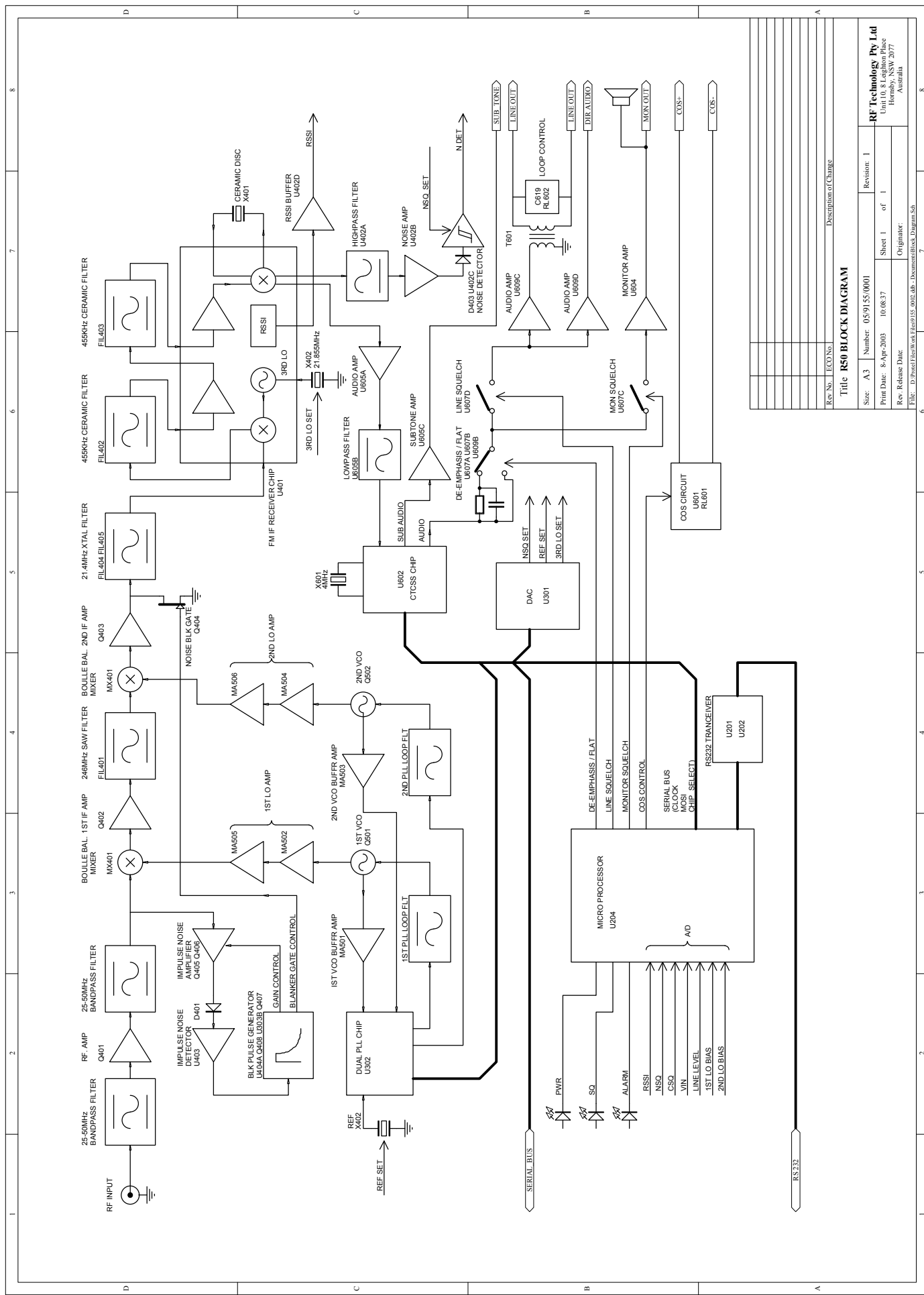
R511	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R512	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R514	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R515	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R516	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R517	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R518	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R519	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R520	Resistor 0805 100R+/-5% 1/8W	51/8511/100R
R521	Resistor 0805 270R+/-5% 1/8W	51/8511/270R
R522	Resistor 0805 270R+/-5% 1/8W	51/8511/270R
R523	Resistor 0805 270R+/-5% 1/8W	51/8511/270R
R524	Resistor 0805 270R+/-5% 1/8W	51/8511/270R
R526	Resistor 0805 2K2+/-5% 1/8W	51/8511/02K2
R529	Resistor 0805 2K2+/-5% 1/8W	51/8511/02K2
R530	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R532	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R533	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R535	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R538	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R541	Resistor 0805 150R+/-5% 1/8W	51/8511/150R
R542	Resistor 0805 150R+/-5% 1/8W	51/8511/150R
R543	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R544	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R549	Resistor 0805 47R+/-5% 1/8W	51/8511/047R
R601	Resistor 0805 2K7+/-5% 1/8W	51/8511/02K7
R602	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R603	Resistor 0805 3K3+/-5% 1/8W	51/8511/03K3
R604	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R605	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R606	Resistor 0805 18K+/-5% 1/8W	51/8511/018K
R607	Resistor 0805 18K+/-5% 1/8W	51/8511/018K
R608	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R609	Resistor 0805 680R+/-5% 1/8W	51/8511/680R
R610	Resistor 0805 0R Jumper	51/8511/000R
R611	Resistor 0805 1K5+/-5% 1/8W	51/8511/01K5
R612	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R613	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R614	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R615	Resistor 0805 3K3+/-5% 1/8W	51/8511/03K3
R616	Resistor 0805 1K5+/-5% 1/8W	51/8511/01K5
R617	Resistor 0805 12K+/-5% 1/8W	51/8511/012K
R618	Resistor 0805 12K+/-5% 1/8W	51/8511/012K
R619	Resistor 0805 12K+/-5% 1/8W	51/8511/012K
R620	Resistor 0805 22R+/-5% 1/8W	51/8511/022R
R621	Resistor 0805 680R+/-5% 1/8W	51/855/11/033K
R622	Resistor 0805 12K+/-5% 1/8W	51/8511/012K
R623	Resistor 0805 330K+/-5% 1/8W	51/8511/330K
R624	Resistor 0805 1M+/-5% 1/8W	51/8511/01M0
R625	Resistor 0805 100K+/-5% 1/8W	51/8511/100K
R626	Resistor 0805 100K+/-5% 1/8W	51/8511/100K
R627	Resistor 0805 22K+/-5% 1/8W	51/8511/022K

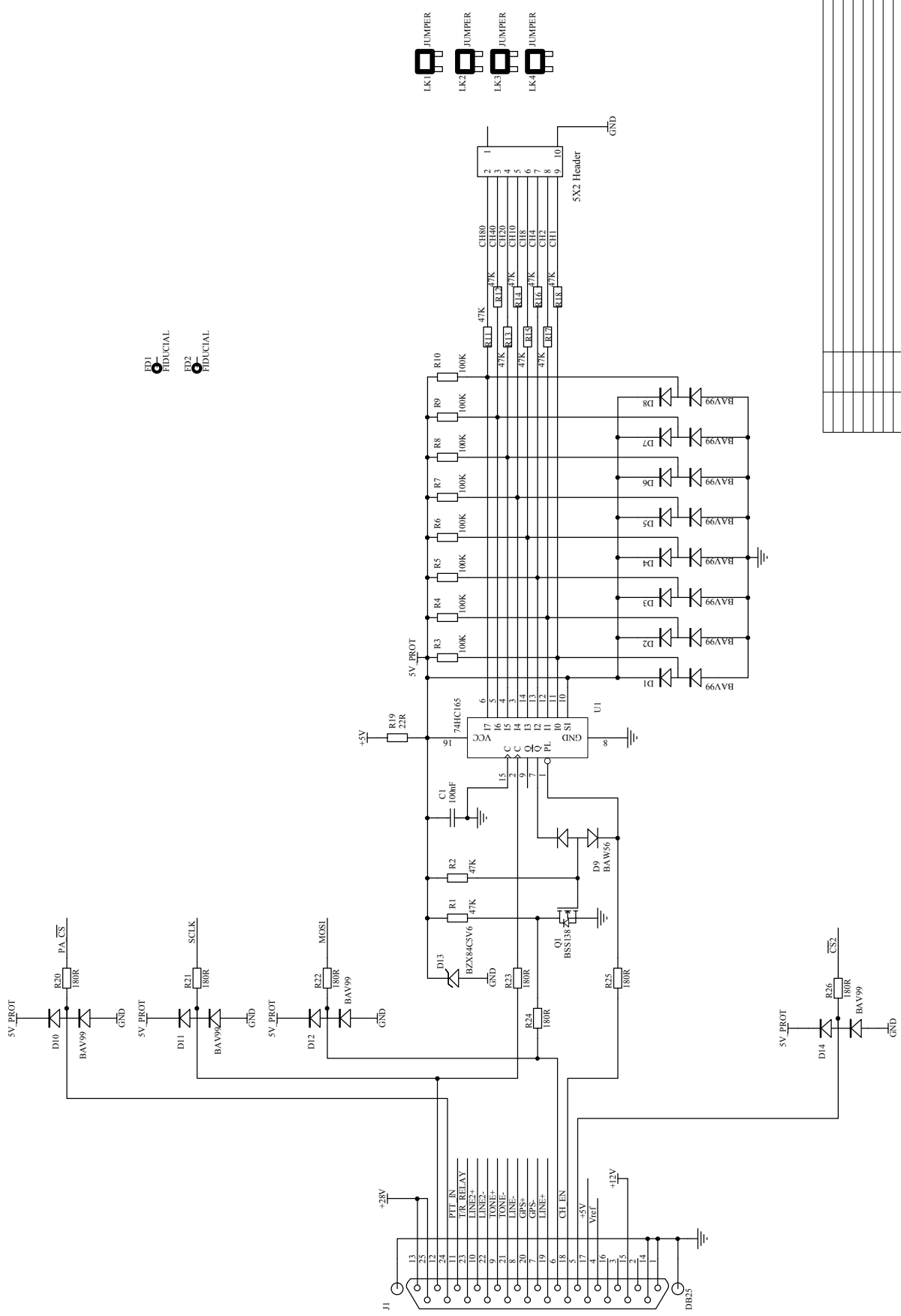
R50 PARTS LIST

R628	Resistor 0805 15K+/-5% 1/8W	51/8511/015K
R629	Resistor 0805 15K+/-5% 1/8W	51/8511/015K
R630	Resistor 0805 75K+/-5% 1/8W	51/8511/075K
R631	Resistor 0805 12K+/-5% 1/8W	51/8511/012K
R632	Resistor 0805 470K+/-5% 1/8W	51/8511/470K
R633	Resistor 0805 560R+/-5% 1/8W	51/8511/560R
R634	Resistor 0805 10R+/-5% 1/8W	51/8511/010R
R635	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R636	Resistor 0805 100K+/-5% 1/8W	51/8511/100K
R637	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R638	Resistor 0805 3K3+/-5% 1/8W	51/8511/03K3
R639	Resistor 0805 39R+/-5% 1/8W	51/8511/039R
R640	Resistor 0805 220R+/-5% 1/8W	51/3380/0220
R641	Resistor 0805 2R2+/-5% 1/8W	51/8511/02R2
R642	Resistor 0805 39K+/-5% 1/8W	51/8511/039K
R643	Resistor 0805 680R+/-5% 1/8W	51/855/11/033K
R644	Resistor 0805 680R+/-5% 1/8W	51/855/11/033K
R645	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R646	Resistor 0805 3K3+/-5% 1/8W	51/8511/03K3
R647	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R648	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R649	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R650	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R651	Resistor 0805 2K2+/-5% 1/8W	51/8511/02K2
R652	Resistor 0805 680R+/-5% 1/8W	51/8511/680R
R653	Resistor 0805 0R Jumper	51/8511/000R
R654	Resistor 0805 2K2+/-5% 1/8W	51/8511/02K2
R655	Resistor 0805 220K+/-5% 1/8W	51/8511/220K
R656	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R657	Resistor 0805 10K+/-5% 1/8W	51/8511/010K
R658	Resistor 0805 4K7+/-5% 1/8W	51/8511/04K7
R659	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R910	Resistor 0805 0R Jumper	51/8511/000R
R911	Resistor 0805 0R Jumper	51/8511/000R
R918	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R919	Resistor 0805 47K+/-5% 1/8W	51/8511/047K
R920	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R921	Resistor 0805 47R+/-5% 1/8W	51/8511/047R
R922	Resistor 0805 270R+/-5% 1/8W	51/8511/270R
R923	Resistor 0805 1K5+/-5% 1/8W	51/8511/01K5
R924	Resistor 0805 390R+/-5% 1/8W	51/8511/390R
R925	Resistor 0805 150R+/-5% 1/8W	51/8511/150R
R926	Resistor 0805 1K8+/-5% 1/8W	51/8511/01K8
R927	Resistor 0805 270R+/-5% 1/8W	51/8511/270R
R928	Resistor 0805 270R+/-5% 1/8W	51/8511/270R
R933	Resistor 0805 1K+/-5% 1/8W	51/8511/001K
R934	Resistor 0805 680R+/-5% 1/8W	51/8511/680R
R935	Resistor 0805 0R Jumper	51/8511/000R
R936	Resistor 0805 120R+/-5% 1/8W	51/8511/120R
RL601	Relay DPDT 12V 500mW	96/2000/012V
RL602	Relay DPDT 12V 500mW	96/2000/012V
T601	Transformer 600OHM Line	37/2040/5065
S200	Switch Tack SMD 4.8 X 5	31/SMPB/0001

R50 PARTS LIST

U201	IC Quad CMOS RS232 RCV SO14	29/14C8/9A01
U202	IC Quad CMOS RS232 DRV SO14	29/14C8/8001
U203	IC Reset Generator S08	29/MC33/064D
U204	IC MCU 68HC12, TQFP112	29/68HC/12A0
U205	IC 3-8 Line Decoder SO16	29/2030/C138
U207	IC Flash 5V TSOP40	29/P006/0001
U208	IC SRAM 4M SOP-32	29/SRAM/P013
U301	IC Quad 8BIT DAC MAX534 SSO16	29/00MA/X534
U302	IC Dual PLL 1.1G RFIN SSO16	29/LMX2/335L
U303	IC Quad OPAmplifier LM224 SO14	29/000L/M224
U304	IC Dual 4BIT Counter SO16	29/2030/C390
U401	IC FM IF Receiver NE615	29/000N/E615
U402	IC Quad OPAmplifier LM224 SO14	29/000L/M224
U403	IC High Speed COMP SOT23-5	29/COMP/U001
U404	IC Dual Oneshot HCOMS SO16	29/2030/C123
U601	IC Opto-Isolator 4N35	25/1010/4N35
U602	IC CTCSS/DCS En/Decoder	29/00FX/805L
U604	IC Audio Amplifier 5W TDA2003	25/2070/2003
U605	IC Quad OP Amplifier LM224 SO14	29/000L/M224
U607	IC Quad SPST DG411 SO16	29/00DG/411C
U609	IC Quad OP Amplifier LM224 SO14	29/000L/M224
U907	IC Switch Volt Regulator 12V 1A SMD	29/REG1/0N12
U908	IC Switch Volt Regulator 12V 1A SMD	29/REG1/0N12
U909	IC Switch Volt Regulator 5V 1A SMD	29/REG2/00N5
U910	IC Volt Regulator Positive ADJ 800mA LM1117	29/00LM/1117
U911	IC Volt Regulator Positive ADJ LM317 SO8	29/000L/M317
U913	IC Volt Regulator Negative ADJ LM337 SO8	29/000L/M337
U914	IC Volt Regulator Negative ADJ LM337 SO8	29/000L/M337
VR201	Trimpot 100K Multi Turn Horizontal	53/THH1/100K
VR202	Trimpot 100K Multi Turn Horizontal	53/THH1/100K
VR601	Trimpot 100K Multi Turn Horizontal	53/2060/010K
X200	Crystal Resistor 14.7456MHZ SMD	33/14M7/0001
X301	Crystal Resistor 12MHZ SMD	33/12M0/0001
X401	Ceramic Discriminator SMD	34/2000/CDBC
X402	Crystal Resonator 21.855M HC45U	32/2045/21M855
X601	Crystal Resonator 4MHZ HC49	32/2049/04MO





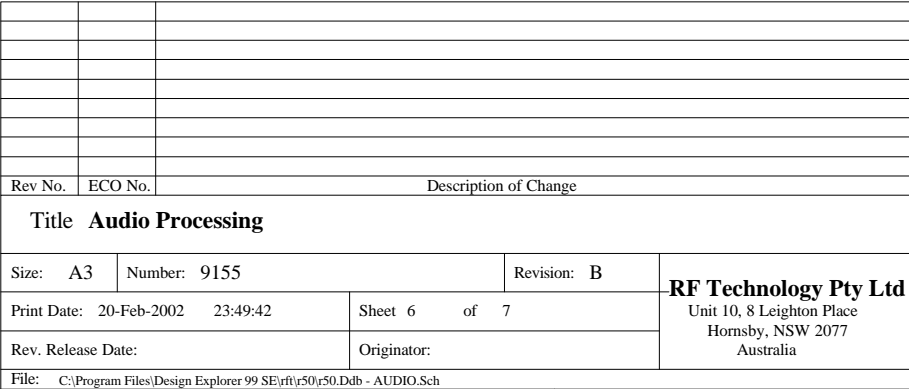
Rev No. ECO No. Description of Change

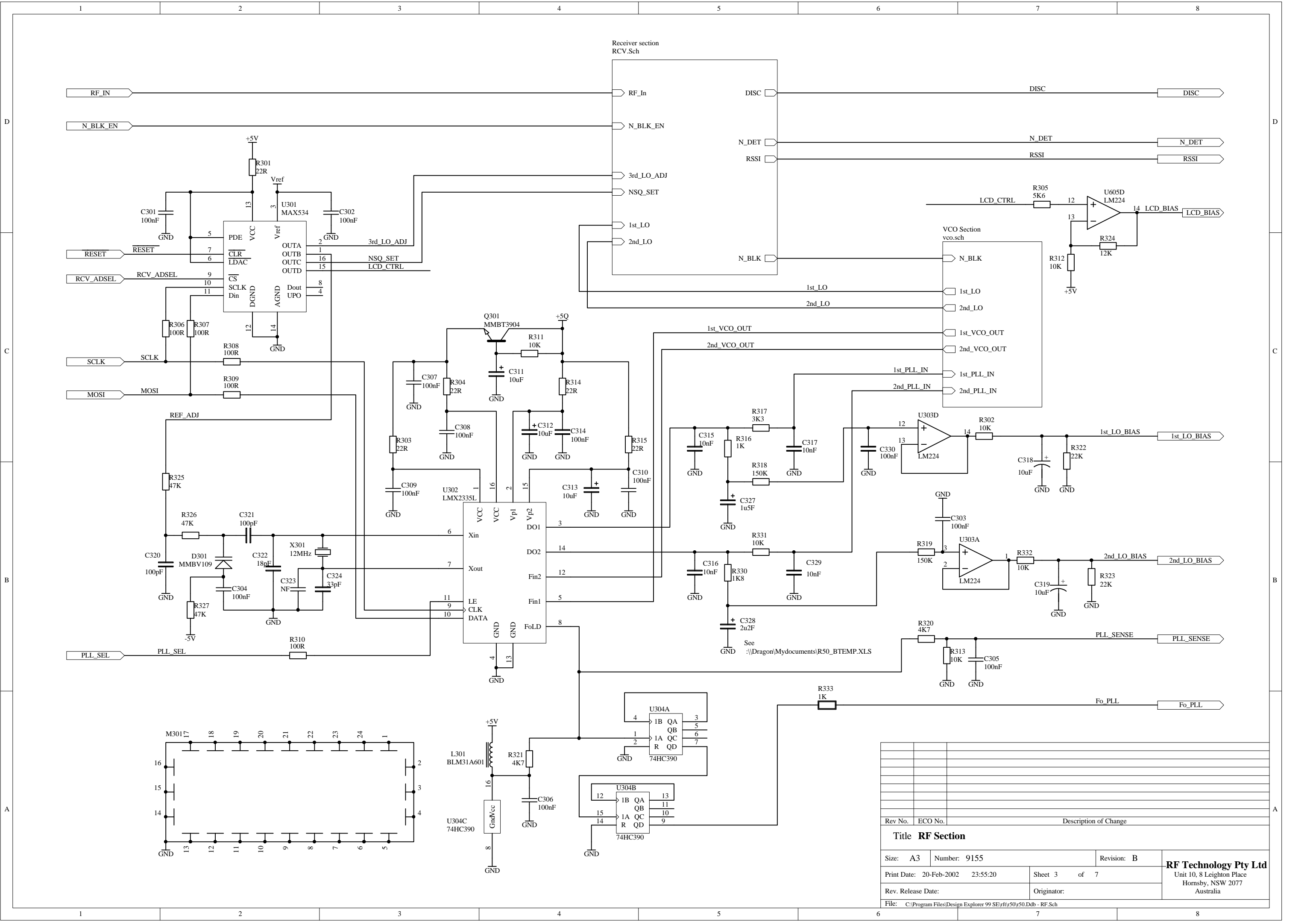
Title Rear Panel Board for 9154 (150) and 9155 (R50)

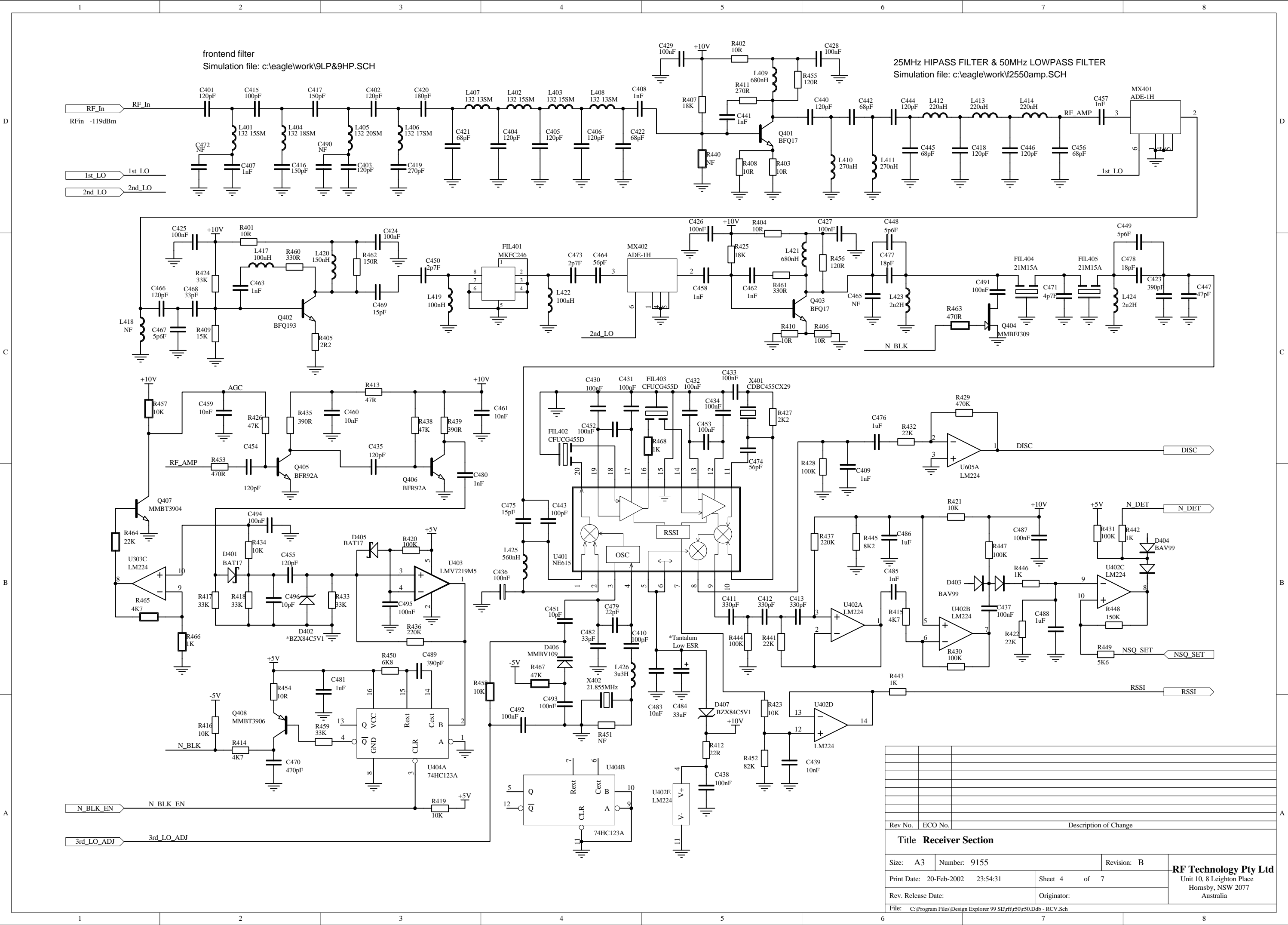
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Title Receiver Section		
Size: A3	Number: 9155	Revision: B
Print Date: 20-Feb-2002 23:54:31	Sheet 4 of 7	RF Technology Pty Ltd Unit 10, 8 Leighton Place Hornsby, NSW 2077 Australia
Rev. Release Date:	Originator:	
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