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Australia

FMX4+ Manual

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Safety note

This equipment uses high voltages internally. Any servicing should be performed by competent individuals.

Prolonged exposure to high level RF radiation has been shown to pose a health risk. Whilst the equipment is intrinsically safe, its use in conjunction with an antenna system may generate large RF fields. Appropriate precautions should be taken by individuals that habitually work close to the transmitting antenna.

The RF power devices of this equipment employ Beryllium Oxide. This substance is extremely toxic if pulverised. On no account should any RF power devices be smashed. Please refer to attached Material Safety Data Sheet for further information.

WARNING

THIS EQUIPMENT IS SUPPLIED WITH A MAINS LEAD INCORPORATING AN EARTH WIRE. IT IS IMPERATIVE THAT THIS EQUIPMENT IS CONNECTED TO A MAINS OUTLET THAT HAS AN EARTH. IN COUNTRIES WHERE EARTHED OUTLETS ARE NOT MANDATORY, IT IS THE CUSTOMER'S RESPONSIBILITY TO ENSURE THAT THIS EQUIPMENT IS APPROPRIATELY EARTHED.

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1 GENERAL DESCRIPTION

The FMX4+ is a high quality 4W-exciter intended for audio broadcast service in the FM band.

Its features include:

- Frequency agile.
- Extensive self test and auto diagnostics.
- Rugged design.
- Conservatively rated.
- Excellent audio quality
- Comprehensive telemetry.

Applications include low power broadcast, narrowcast, community broadcast, rebroadcast for tunnels, student radio stations and as a driver for high power transmitters.

The FMX4+ is designed and built in Australia.

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2 UNPACKING

This section details the way in which the FMX4+ should be unpacked upon receipt by the customer.

The FMX4+ should be removed from its packing, and the packing stored and used should it be necessary to return the FMX4+ to the manufacturer.

Along with the transmitter, the following items should also be present:

- This manual
- Mains lead

The customer should ensure that all items are present and then store them in a safe place.

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3 INSTALLATION

3.1 General

This section describes the installation and infrastructure requirements for the FMX4+. Departure from the instructions contained herein may void any warranty provided by SRK.

The FMX4+ has been designed to be mounted in a standard 19" rack frame, where it will occupy 1 rack unit.

However, the transmitter may also be used in a free standing situation, so long as all other requirements are met as below.

3.2 Environmental

The transmitter is intended for indoor use. The transmitter should be protected from rainfall and direct sunlight, extremes of temperature and humidity and from conditions of high dust levels. The transmitter shall not be operated at altitudes in excess of 3500m above sea level. The transmitter must be installed on a flat, stable surface. The transmitter must be installed in the upright position. The transmitter must be installed in a location free from vermin and the ingress of other animals. The transmitter shall not be installed in locations prone to flooding. All ventilation orifices must be clear to allow adequate air flow.

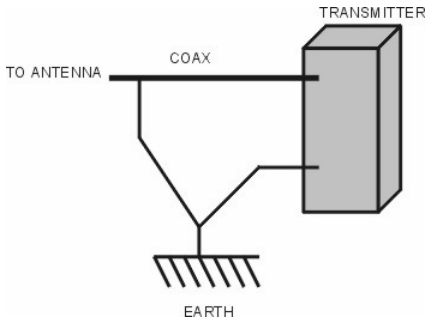
3.3 Electrical supply

The electrical supply to the transmitter must be of the voltage, form and frequency described in the specifications. All electrical wiring must be carried out in accordance with local laws, standards and regulations. If power supply voltages regularly fall outside specifications then a voltage regulator must be installed between the supply inlet and the transmitter.

3.4 Earthing

Adequate earthing of the transmitter is vital to ensure long term reliability and user safety. The electrical supply must be earthed, via the earthing pin of the IEC connector. In countries where power outlet earthing is merely optional, an earthed outlet **must** be used. See safety notice at the front of this manual. A separate, independent, earth is required for the transmitter/antenna system and must be connected to the earthing point indicated on the rear of the transmitter. The cable used to connect the earth should be as thick as possible, with 8 AWG being the smallest size acceptable. Where possible, broad earthing band should be used.

In addition to the earth connection to the transmitter, the outer conductor of the coax feed to the antenna should be connected to the earth, as indicated below.



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The earth itself must be of high quality buried copper, at least 1.5m deep and preferably in ground that is habitually humid (eg, the base of a gutter down pipe).

3.5 Antenna

The antenna load connected to the transmitter must be tuned to minimise reflections. Whilst the transmitter is designed to withstand high levels of reflection for short periods, continually high levels of reflected power will degrade the long term reliability of the transmitter. Operating SWR should be kept to below 1.9:1.

3.6 Audio feed

In situations where the audio feed to the transmitter is over any form of land line, suitable protection must be included external to the transmitter to ensure voltage transients do not enter the transmitter. These may be in the form of high power zener diodes and/or gas discharge tubes.

Where the transmitter is co-sited with an AM installation, suitable filtering must be included in the audio feed to ensure that excessive RF voltages do not enter the transmitter.

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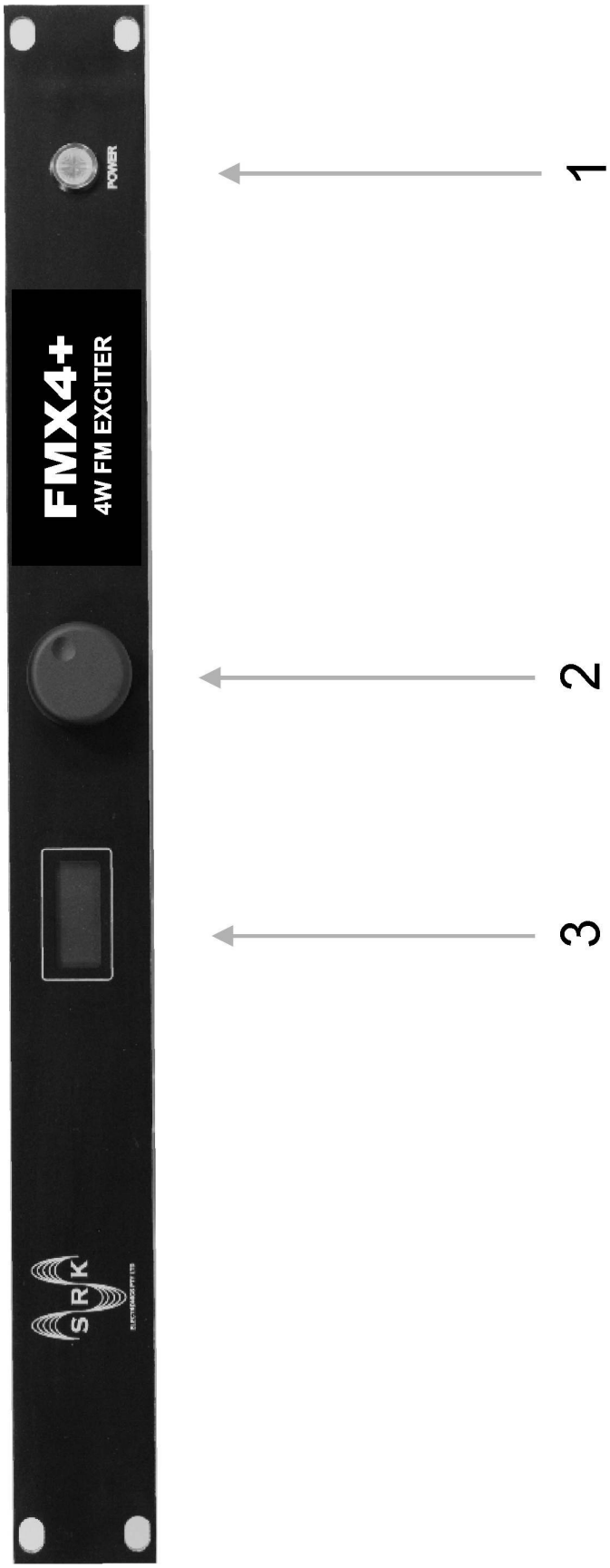

Fig 4.1 Front View

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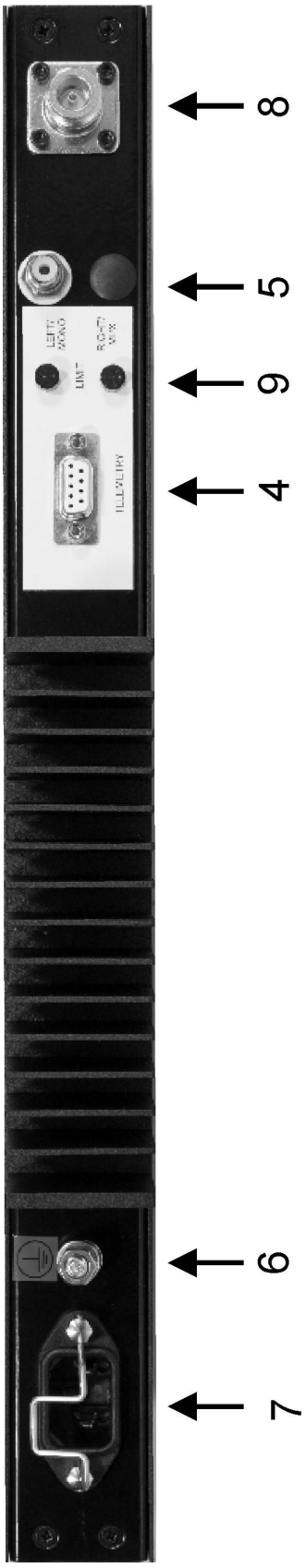

Fig 4.2 FMX4+ REAR VIEW

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4 OPERATION

4.1 Front Panel

Please refer to figure 4.1. The numbers of the following paragraphs refer to the controls shown in figure 4.1.

1 Power Indicator
When lit, indicates the presence of mains voltage.

2 Control knob
This allows all parameters to be read or modified.

3 LCD
Displays current parameter value and any error messages.

4.2 Rear panel.

Please refer to figure 4.2. The numbers of the following paragraphs refer to the controls shown in figure 4.2.

4 Remote connector

Remote operation is performed by making connection to this DB9 socket. Please refer to section 4.8 for details

5 Audio input

This is an unbalanced audio input to the transmitter. Mating connector is RCA male.

Input impedance is >10K.

6 Earth stud.

This is an M6 stud for connecting an earth. This is recommended for superior lightning protection.

7 Mains input.

This is the mains input, 240V AC unless specified by the customer. Mating connector is IEC female. Any connection made to this socket must incorporate a safety earth.

8 RF out.

This is the RF output and is connected to either the antenna (for stand-alone applications), or the RF amplifier unit. Mating connector is N type male, 50Ω.

9 Limit LEDs

Lights when limiting peak deviation.

4.3 Switching on and off

The FMX4+ is switched on as soon as mains power is applied.

If mains voltage is present then the power lamp will illuminate.

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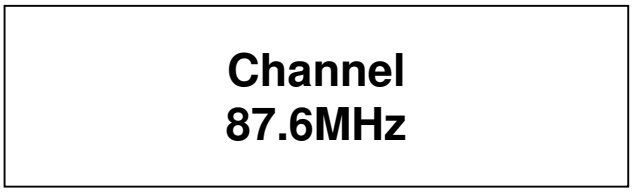
When self diagnostics have completed successfully the display will show the current operating frequency. For example:



The FMX4+ is now in operative mode. The user may set the unit's parameters by either the front panel or remote control.

The FMX4+ may be switched off at any time by removing mains power.

4.4 Setting output power

The RF output power of the FMX4+ may be read by rotating the front panel knob until the display reads "Fwd Pwr". The current forward power is displayed in watts.

Pressing the knob momentarily will make the "Fwd Pwr" characters flash. Whilst they are flashing, rotating the knob clockwise will increase the power. Rotating the knob anticlockwise will decrease the power.

When finished adjusting the power, press the knob again momentarily. The "Fwd Pwr" characters will stop flashing and the selected power will remain set.

The power setting is recorded in non-volatile RAM, so it is not necessary to set the power level each time the FMX4+ is switched on.

Reverse output power may be measured by rotating the knob until the display reads "Ref Pwr". The current reflected power is displayed in watts.

4.5 Setting audio gain

The audio gain of the FMX4+ may be set between 0 and 100%.

The actual deviation is a function of the audio input level and the audio gain and can be measured by rotating the knob until the display shows "Gain/Dev".

Pressing the knob momentarily will make the "Gain/Dev" characters flash. Whilst they are flashing, rotating the knob clockwise will increase the gain. Rotating the knob anticlockwise will decrease the gain.

When finished adjusting the gain, press the knob again momentarily. The "Gain/Dev" characters will stop flashing and the selected gain will remain set.

Upon installation, the transmitter should be driven with program audio at the normal level, and the audio gain adjusted to give an approximate peak deviation reading of 75KHz.

The audio gain is stored in non-volatile RAM, so it is not necessary to set the gain each time the FMX4+ is switched on.

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4.6 Protection

The FMX4+ incorporates a number of protective features that make it extremely rugged.

If the reflected power from the antenna exceeds 0.4W then the output RF power will be automatically reduced to bring the reflected power back to 0.4W. Under this condition the FMX4+ will continue to function, albeit at a reduced output power, indefinitely until the reflected power reduces. The LCD will show “SWR HIGH”.

If the temperature of the RF amplifier becomes excessive, then the RF output power will be reduced to zero until the amplifier temperature falls to an acceptable level. During this time the LCD will show “TEMP HIGH”.

If the RF output power cannot be made to equal the value demanded by the microprocessor then the LCD will show “RF FAILURE”.

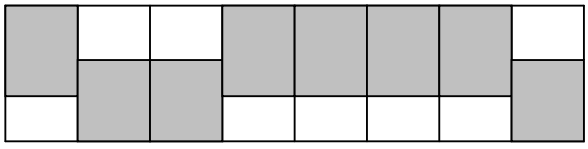
4.7 Setting Channel Frequency

The FMX4+ is frequency agile and may be set to any 100KHz channel in the range 87.5MHz to 108.0MHz. This can be done by setting the eight internal jumpers on the main PCB, marked JP2, or using the “CF=” command via the telemetry link.

The lid of the FMX4+ must be removed to allow access to these jumpers.

To set the frequency using telemetry, all 8 of the jumpers that make up JP2 must be in the “ON” position. The “CF=” command can then be sent to set the frequency. See section 4.8 for more specific information regarding the use of telemetry.

Alternatively, the jumpers may be used to set the frequency, which also disables the “CF=” command. Each of the eight jumpers may be in one of two positions, designated binary “0” or “OFF” and “1” or “ON”, as indicated below. Furthermore each jumper represents a single bit of an eight bit number, using conventional binary weighting (ie, 1, 2, 4, 8 etc). Thus the settings of these jumpers can define any number between 0 and 255 decimal.



ON, binary “1”

OFF Binary “0”

128	64	32	16	8	4	2	1

weighting (in 100s of KHz)

In the example above, the number represented by the jumpers is 158 (2+4+8+16+128).

This number determines the operating frequency of the FMX4+, where 0 equates to 87.5MHz and 205 equates to 108.0MHz. Thus in the example above the operating frequency is set to 103.3MHz (158 x 100KHz + 87.5MHz).

To work out the number for any given frequency (in increments of 100KHz), take the desired frequency in MHz, subtract 87.5 and multiply by ten. This number, when converted to eight bit binary, will define each of the eight jumper positions.

Note that the FMX4+ must be powered down then up again after each new set of jumper positions is arranged, otherwise all changes are ignored by the FMX4+.

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Note also that any attempt to set a channel frequency higher than 108.0MHz will result in the FMX4+ displaying the error message “Invalid Channel”. Under this condition, no RF is generated and the jumpers must be set correctly before the unit will function. The exception to this is the value 255, which enables frequency setting by telemetry.

4.8 Remote operation.

The FMX4+ may be monitored and controlled remotely via the “TELEMETRY” connector on the rear of the unit. This is an RS232 standard connection with the following characteristics:

Baud rate: 9600
Data bits: 8
Parity: NONE
Stop bits: 1
Flow control: NONE

The pinout for the DB9 connector is as follows: pin 2, transmit data, pin 3, receive data, pin 5, common (0V). All other pins are not connected.

The FMX4+ responds to the following commands. <CR> indicates the ASCII character 0D hex. All letters are upper case, spaces (20 hex) are indicated by “_”. All commands must be terminated by <CR>. Note that a line feed (0A hex) must not be sent before or after <CR>. After a response is sent, a carriage return, line feed and “>” are sent.

FP?<CR>
Returns forward power in the form X.XXW<LF><CR>>. For example:

FP?<CR> (command)
1.00W<LF><CR> (response from exciter)
>

Note that the leading zeros are replaced with a space (or spaces).

RP?<CR>
Returns reflected power in the form X.XXW<LF><CR>>. For example:

RP?<CR> (command)
_.00W<LF><CR> (response from exciter)
>

Note that the leading zeros are replaced with a space (or spaces).

CF?<CR>
Returns channel frequency in the form XXX.XMHz<LF><CR>>. For example:

CF?<CR> (command)
_98.7MHz<LF><CR> (response from exciter)
>

Note that for frequencies of 99.9MHz and below, the leading zero is replaced with a space.

PD?<CR>
Returns the measured peak deviation in the form XXXKHz<LF><CR>>. For example:

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PD?<CR> (command)
_45KHz<LF><CR> (response from exciter)
>

Note that any leading zeros are set to spaces, except for the special case of 0KHz.

AG?<CR>
Returns the current audio gain in the form XXX%<LF><CR>>. For example:

AG?<CR> (command)
_92%<LF><CR> (response from exciter)
>

Note that the leading zero is set to spaces, except for the special case of 09%.and below.

AT?<CR>
Returns the current amplifier temperature in the form XXC<LF><CR>>. For example:

AG?<CR> (command)
32C<LF><CR> (response from exciter)
>

ST?<CR>
Returns the current self test status in the form XXXX<LF><CR>>, where X can be either 0 or 1. A 1 indicates a failure, a 0 indicates a pass. The first byte indicates the locked/unlocked status of the PLL, the second indicates an RF failure, the third indicates a high SWR condition and the fourth indicates an over temperature condition. For further information consult the section on self test. For example:

ST?<CR> (command)
0010<LF><CR> (response from exciter indicating an RF failure condition)
>
or
0000<LF><CR> (response from exciter indicating no failures)
>

FP=X.XX<CR>
Allows the forward power to be set to the value X.XX, up to 4.00W. Valid range for X.XX is 0.00 to 4.00. For example:

FP=0.76<CR> (command, sets forward power to 0.76W))
Ok<LF><CR> (response from exciter indicating that command has been executed)
>

CF=XXX.X<CR>
Allows the channel frequency to be set to the value XXX.X. Valid range for XXX.X is 087.5 to 108.0. For example:

CF=097.4<CR> (command, sets channel frequency to 97.4MHz)
Ok<LF><CR> (response from exciter indicating that command has been executed)
>

AG=XX<CR>

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Allows the audio gain to be set to the value XX. Valid range for XX is 00 to 99. For example:

```
AG=67<CR>          (command, sets audio gain to 67%)
Ok<LF><CR>         (response from exciter indicating that command has been executed)
>
```

FE<CR>
Unlocks the front panel to allow parameters to be altered locally. For example:

```
FE<CR>             (command to enable the front panel)
Ok<LF><CR>         (response from exciter indicating that command has been executed)
>
```

FD<CR>
Locks front panel. Parameters can be measured but not changed locally. For example:

```
FD<CR>             (command to disable front panel)
Ok<LF><CR>         (response from exciter indicating that command has been executed)
>
```

HP?<CR>
Returns a summery of the above commands.

Any data received by the exciter, other than the commands listed above will generate the following error string:

```
Invalid_command.__Send_HP?(CR)_for_command_syntax.<LF><CR>
>
```

Any data outside the valid range for the parameter concerned will generate the following error string:

```
Incorrect_value_or_syntax.__Send HP?(CR)_for_help.<LF><CR>
>
```

Should it be necessary to make connection to the telemetry port using cables running external to the building housing the FMX4+, it is recommended that external filtering and transient protection be installed on these lines.

4.9 Audio limiter

The audio processor incorporates hard peak limiters. These are factory preset to limit the audio channel to a peak deviation of 75KHz. Whilst operational, the LIMITING lamp(s) will light. Depending upon the quality of the compression applied to the audio, this lamp may be lit most of the time without any noticeable distortion.

In practice the user should increase the audio drive level until distortion just becomes noticeable, then reduce the gain slightly. The operation of the peak limiters will ensure that no adjacent channel interference is generated.

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5 MAINTENANCE

5.1 Recommended maintenance schedule

The FMX4+ will give many years of trouble free service with little or no attention

The heatsink should be kept clean to ensure adequate cooling.

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6 CIRCUIT DESCRIPTION

6.1 Equipment Overview

The FMX4+ consists of the following sub-assemblies:

- Main Board
- Amplifier board
- Power Supply board
- +28V SMPSU

These assemblies are interconnected as per “FMX4+ wiring diagram”.

The Power Supply Board takes a nominal 28V from the SMPSU and generates +/-15V and 5V for the main board.

The main board takes in audio and generates a low power RF signal to drive the amplifier. All control, protection and communication functions are handled by the main board.

The RF power amplifier takes the low level RF output of the PLL and amplifies it up to a nominal 4W, with gain controlled by the front panel.

The SMPSU generates a nominal 28V from the incoming mains.

6.2 Power Supply board.

This board generates the auxiliary power supply voltages for the transmitter Please refer to the appropriate schematic.

+28V is generated off-board by the switched mode power supply unit (SMPSU) and supplies the linear regulators (U1 and U2). These generate +15V and +5V.

-15V is generated by the DC-DC converter (U2).

All these power supply voltages are passed to the main board by connector J1.

6.3 Main Board

The main board has most of the functionality of the transmitter.

Audio enters the board on J1. This is filtered by Z1 to ensure no RF enters the board.

Transient protection is provided by D5, D6 and R45.

A digitally controlled variable gain amplifier is formed by U13 and U9B. U13 is a four-quadrant multiplying DAC. The control bits are set by the microprocessor in accordance with the audio gain setting. U14, Q3 and R44 provide level shifting.

U15 allows the microprocessor to output serial data, which is then converted to eight bit parallel. This cuts down on the number of digital lines that must be routed around the board.

U9A has a feedback network formed by R58, R56 and C40 which provides pre-emphasis at a time constant of 50uS.

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U3, U4 and associated circuitry form a hard peak clipper. This circuit has VR1 to set the peak deviation to 75KHz. U6 monitors the clipper and triggers U8 when a limit occurs. U8 lengthens this pulse to about 100mS and then drives the “LIMIT” LED to give a clear indication that limiting is occurring.

The output of the limiter is passed through a 15KHz low pass filter formed by U1. This is configured as a Bessel response to give minimal distortion due to overshoot.

The output of the filter is then passed onto the voltage controlled oscillator (U16), which part of the PLL circuit..

The PLL is the heart of the FMX4+ and is responsible for generating and modulating the RF carrier. The careful design and construction of this circuit ensures excellent audio performance.

The majority of the PLL function is performed by U17. This contains phase detectors, programmable feedback and reference dividers, and serial interface. This device is programmed by the microprocessor via the three digital lines. These lines are filtered to ensure fast edges from the microprocessor do not enter the PLL.

The reference oscillator is generated from the microprocessor and runs at 100KHz which is internally divided down to 20KHz by U17. The reference frequency is compared to the output RF frequency via the programmable divider in U17, by the phase comparator in U17. The output error signal is filtered by C57-60 and R27, 72 and 68 and buffered by U10A. U10A is configured with a DC gain of +2.5. This allows the VCO to achieve its full tuning range. The error voltage is then passed into the tuning voltage terminal of U16, an extremely stable, low noise, VCO.

The power supply for the VCO is smoothed and filtered by Q4 to ensure the lowest possible phase noise.

The RF output of the VCO is fed to the output via a small resistive pad to mitigate frequency pulling, and a small amount is sampled by U17 for its feedback loop.

The audio modulation is also applied to the VCO input via R73, C63 and R67. The loop cutoff frequency is below the lowest frequency of modulation, in this way FM is achieved.

U17 generates a status signal to indicate the locked condition. This is monitored by the microprocessor. Thus the microprocessor can detect the most likely form of PLL failure. If the PLL fails to lock due to a fault, the microprocessor sets the RF output power to zero to ensure that no damage occurs to the RF amplifier when driving tuned loads (such as an antenna).

The audio modulation signal is amplified by U10B and peak detected by U18. This thus gives a DC voltage proportional to peak carrier signal. This is fed to the microprocessor for the deviation display.

Presence of +5V, +15V and -15V is indicated by LEDs D20-22, mounted on the board. This is intended as a diagnostics aid.

The LCD on the front panel is fitted with a back lighting LED. This is supplied with a constant 100mA nominal current by R66/65.

The directional coupler connected in the main RF output path generates two DC voltages proportional to the square of the forward and reflected output RF power. These voltages enter the board on J6. Both voltages are amplified by U2C and D. The gain of these amplifiers is adjusted to ensure that 4W on the RF output generates 5V on outputs of the amplifiers. Both the forward and reverse voltages are passed to the microprocessor.

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The reverse voltage is also passed to the inverting input of U2B. This continually monitors the level of reverse power and compares it with a reference generated by VR4. Should the level of reverse power exceed about 0.4W, then U2B proportionally reduces the forward power to bring the reverse power back within limits. In this way, seamless and smooth over SWR protection is achieved. U7B monitors the status of U2B and generates a digital low signal for the microprocessor should the over SWR condition eventuate.

Forward power is controlled by the loop formed by U2A. The control input is driven by a DC voltage generated by the microprocessor. This is compared to the DC voltage representing the forward power. The output of U2A is used to control the gate voltage of the driver MOSFET in the RF power amplifier.

This control voltage is passed to U7A. This constantly compares the control loop status and generates a digital low signal for the microprocessor should the output RF level fall below the reference. In this way, RF output failure may be detected by the microprocessor.

The digital section of the main board contains the microprocessor. This has a number of control and metering functions.

The LCD is controlled via J5. This is an 8 bit parallel interface.

The desired channel is read in at power up on the same interface when the signal READ_CHANNEL goes low. This signal is only asserted at power up, so and changes to the frequency settings will only take affect after a power off-on cycle.

LCD contrast is set by VR3.

The rotary encoder is read when the signal READ_PB goes low. This is performed by the microprocessor every few milliseconds.

The desired forward power is determined by the duty cycle of the PWM signal on pin 18 of the microprocessor. This is filtered by U11. The output of U11 is a voltage proportional to the square root of the demanded RF power, where 5V represents 1W. This voltage is passed to the forward power control loop as previously described.

Telemetry is provided by a UART in the microprocessor. U20 is a TTL to RS232 transceiver.

6.4 RF Power Amplifier

The RF power amplifier takes the low level RF output from the PLL and amplifies it up to in excess of 4W. Please refer to the appropriate diagram.

RF enters the amplifier on J2. C16 provides DC isolation. L6 in conjunction with the input capacitance of Q2 forms an impedance match into the gate of Q2. Bias for Q2 is provided by VR2, and filtered by R7,8 and 14 and C10/C14.

Power control is implemented by sinking current from the bias circuit via D3.

Impedance matching between the drain of Q2 and the gate of Q1 is performed by the transformer T2

Q1 generates in excess of 1W. Bias is provided by VR1. The output from Q1 is passed to the output filter to remove harmonics.

The output filter removes the harmonics from the RF coming from the amplifier. There is also a directional coupler which allows the forward and reflected output power to be monitored.

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The filter is formed by a 11 pole Chebishev filter that provides at least 50dB of attenuation at 175MHz (87.5MHz second harmonic).

The directional coupler consists of two 50Ω micro-strip lines. Both incident and reflected voltage is rectified and filtered, then passed to the main board.

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7 TROUBLE SHOOTING

7.1 Auto diagnostics

The FMX4+ incorporates extensive self test and auto diagnostics. This section describes this.

The auto diagnostics is performed by the front panel, the results of which are displayed on the LCD. In addition to the protection functions, the following messages are able to be generated to aid the user in faultfinding, should it become necessary:

PLL FAILURE

This message indicates that the PLL is out of lock. This will mean that the carrier frequency is not correct. As this could lead to high reflections from the antenna system, the front panel reduces RF power to zero for the duration of this failure.

HIGH SWR

This message indicates that the reflected power is greater than 0.4W and is usually indicative of an antenna failure.

RF FAIL

This message indicates that the power control loop is unable to generate the required RF power. This usually indicates that the RF power amplifier has failed.

OVER TEMPERATURE

This message indicates that the amplifier temperature is in excess of 85ºC. RF power will be reduced until the amplifier temperature falls below 70ºC.

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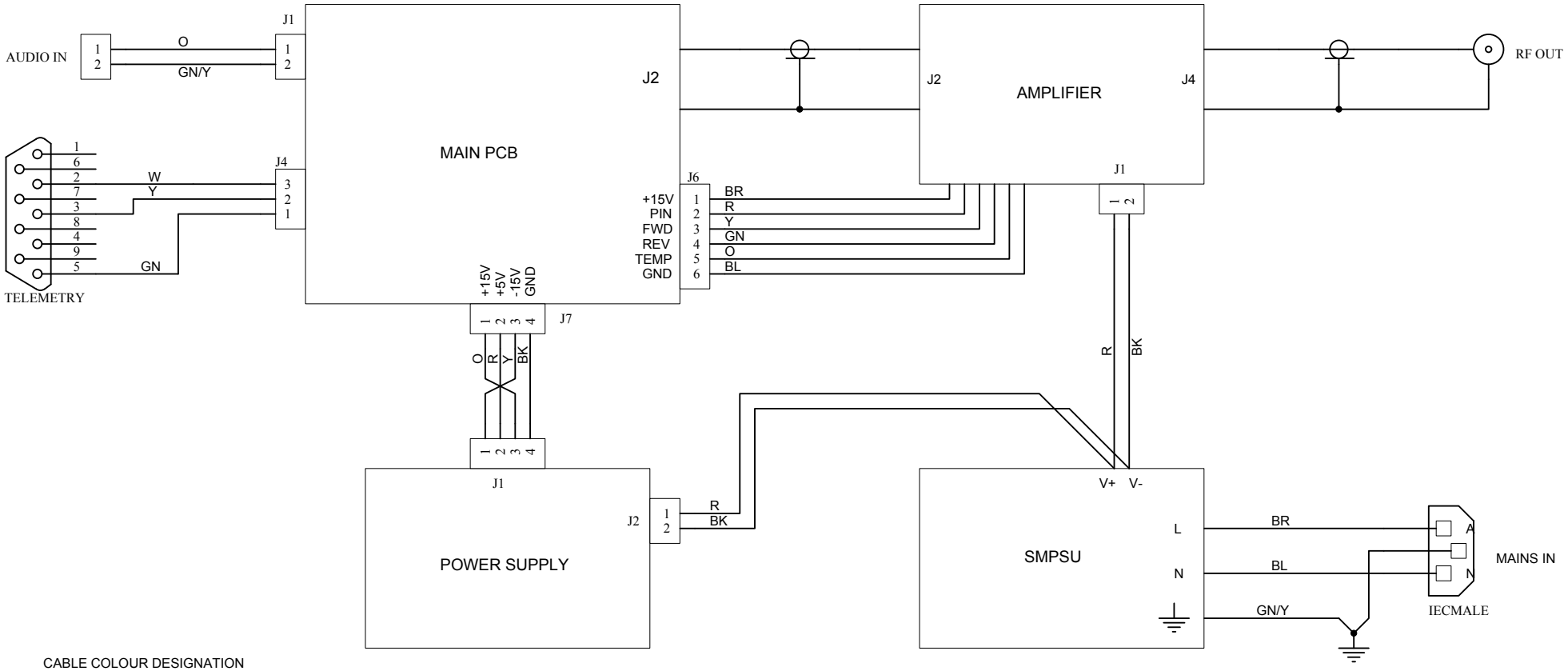
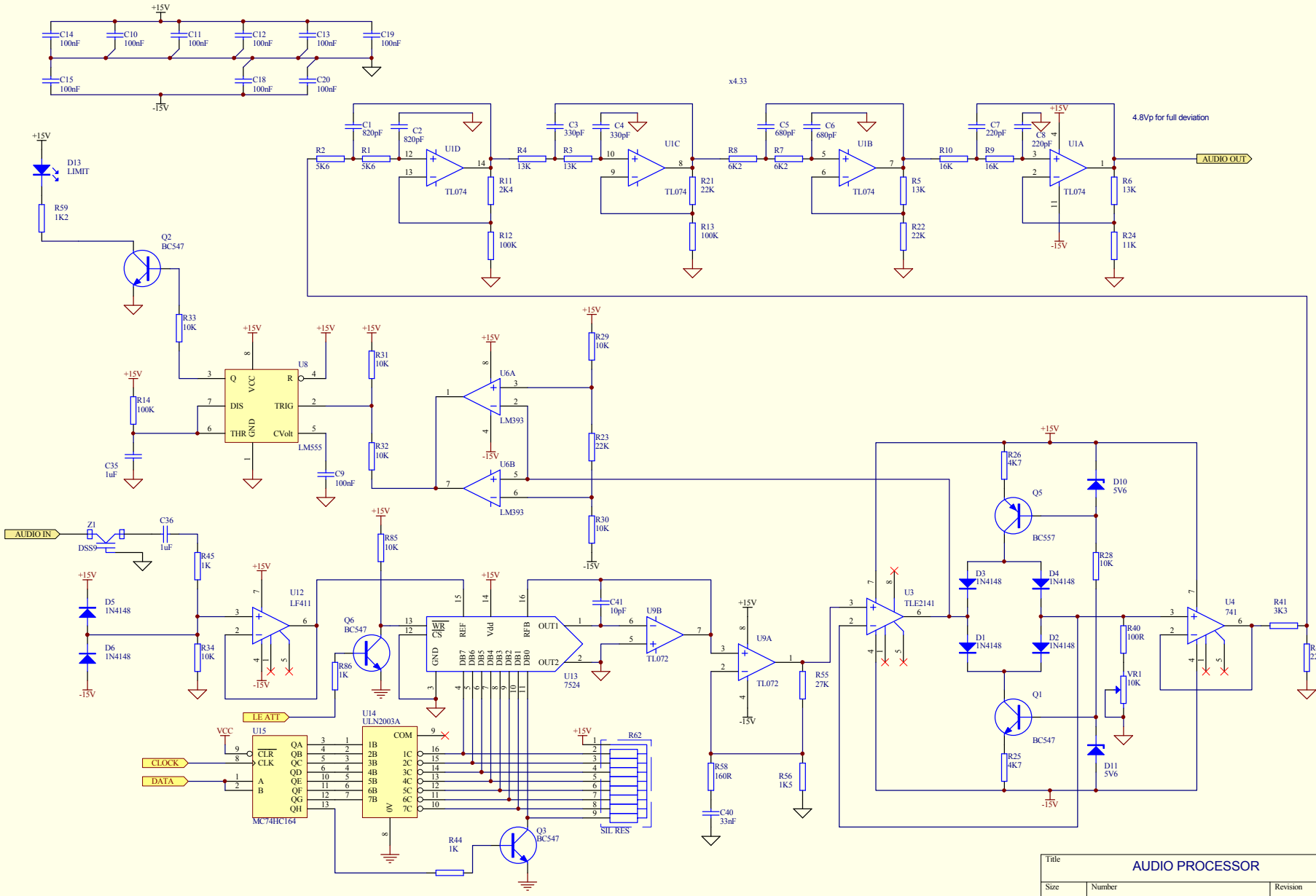


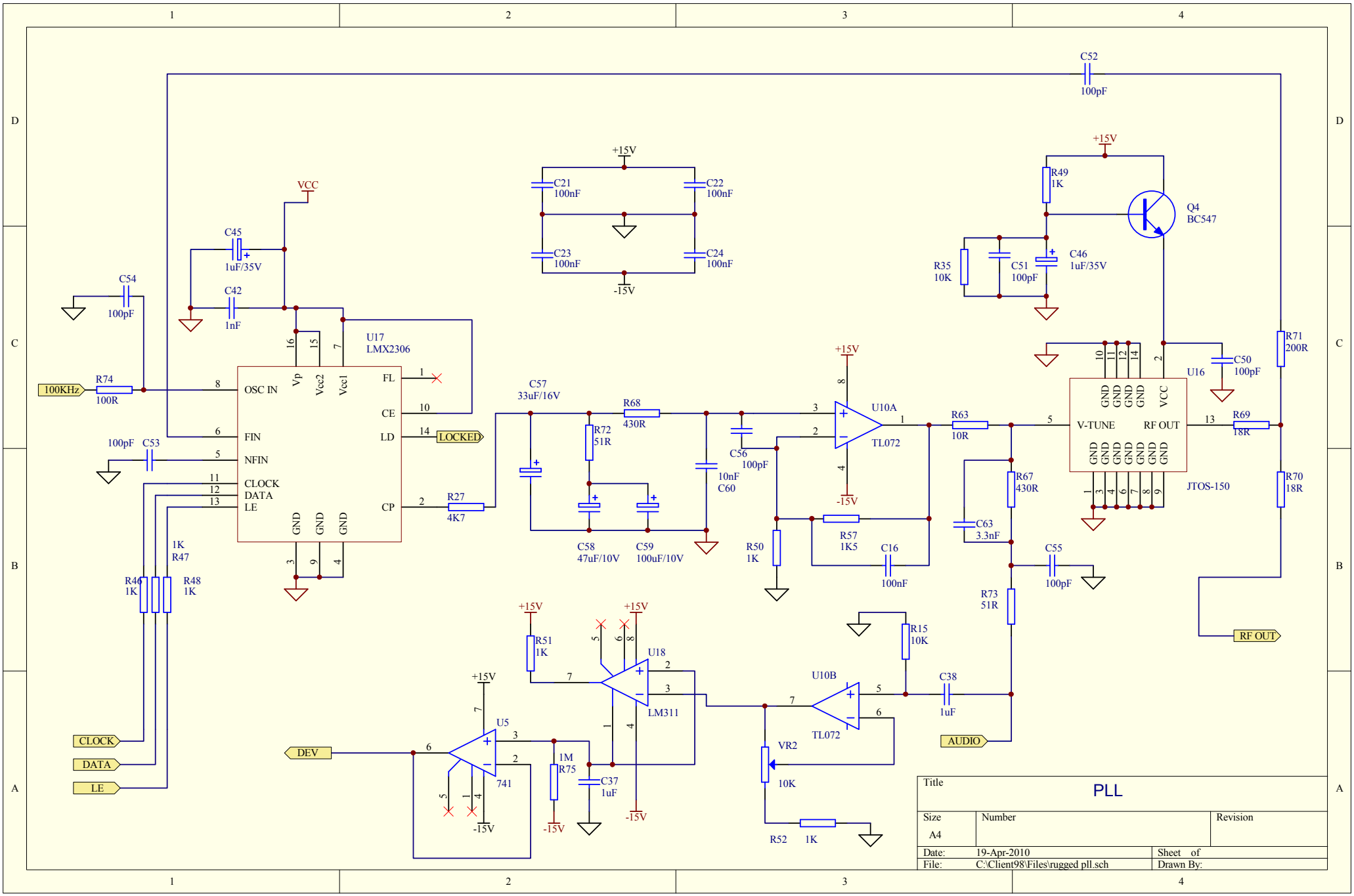
CABLE COLOUR DESIGNATION

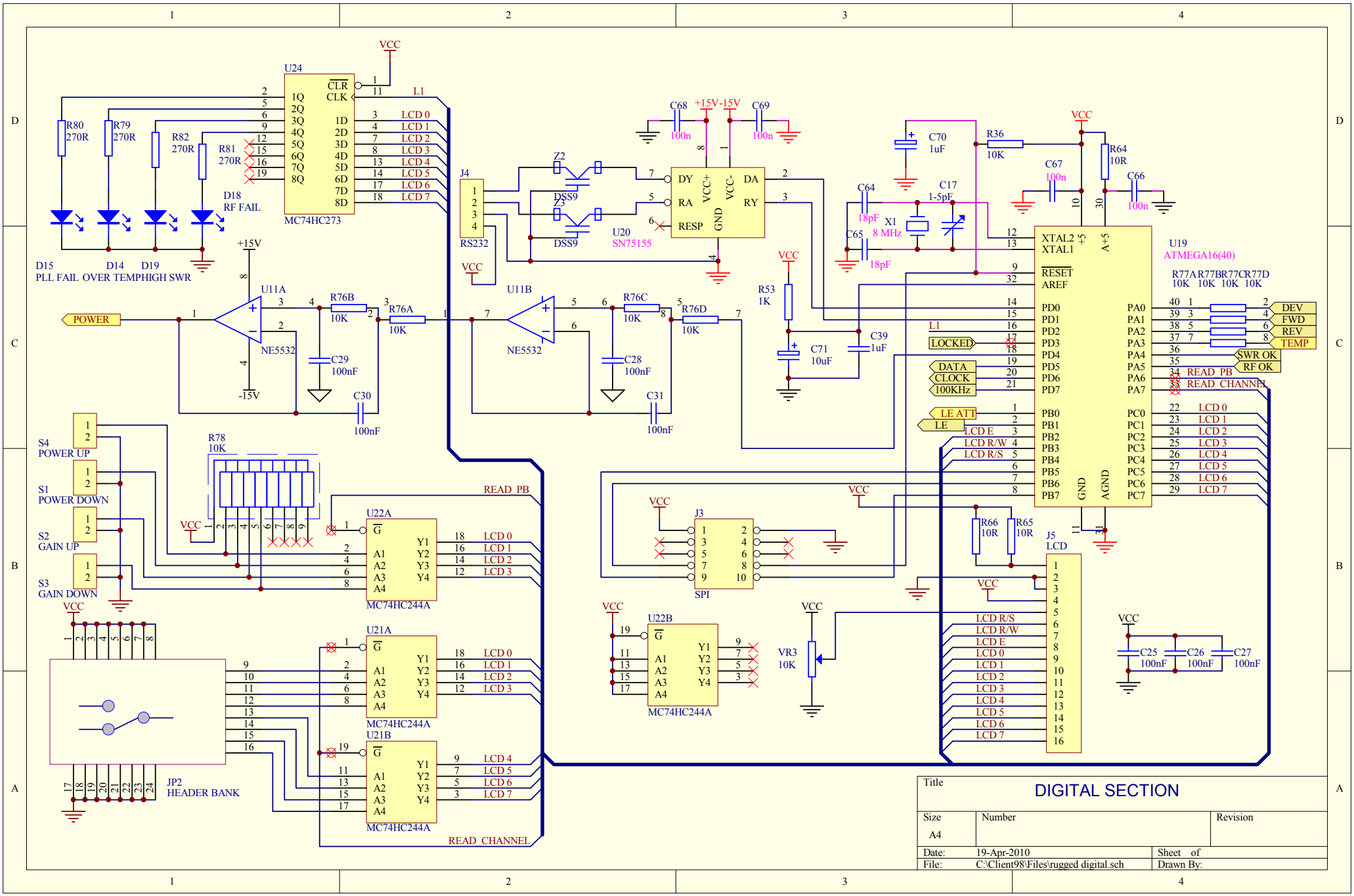
BK BLACK
BR BROWN
R RED
O ORANGE
Y YELLOW
GN GREEN
BL BLUE
V VIOLET
GY GREY
W WHITE
P PINK
BK/R BLACK/RED
GN/Y GREEN/YELLOW

Title	FMX4+ WIRING DIAGRAM	
Size A4	Number	Revision
Date: 1-Dec-2014		Sheet of
File: C:\Client98\Files\FMX4+ conv.sch		Drawn By:



Title	AUDIO PROCESSOR	
Size: A3	Number	Revision
Date: 19-Apr-2010	Sheet of	
File: C:\Client98\Files\rugged audio.sch	Drawn By:	


C52
100pF
+15V
C21
100nF
C22
100nF
C23
100nF
C24
100nF
-15V
VCC
C45
1uF/35V
C42
1nF
C54
100pF
U17
LMX2306
100KHz
R74
100R
OSC IN
FIN
NFIN
CLOCK
DATA
LE
Vp
Vcc2
Vcc1
FL
CE
LD
CP
LOCKED
R27
4K7
100pF
C53
1K
R47
R46
1K
R48
1K
GND
C57
33uF/16V
R68
430R
R72
51R
C58
47uF/10V
C59
100uF/10V
10nF
C60
C56
100pF
U10A
TL072
R63
10R
R49
1K
Q4
BC547
R35
10K
C51
100pF
C46
1uF/35V
U16
V-TUNE
RF OUT
VCC
JTOS-150
C50
100pF
R69
18R
R71
200R
R70
18R
RF OUT
R67
430R
C63
3.3nF
C55
100pF
R73
51R
R50
1K
R57
1K5
C16
100nF
R51
1K
U18
LM311
U5
741
DEV
1M
R75
C37
1uF
U10B
TL072
R15
10K
C38
1uF
AUDIO
VR2
10K
R52
1K
CLOCK
DATA
LE
Title
PLL
Size
A4
Number
Revision
Date:
19-Apr-2010
Sheet of
File:
C:\Client98\Files\rugged pll.sch
Drawn By:


U24
MC74HC273
L1
LCD 0
LCD 1
LCD 2
LCD 3
LCD 4
LCD 5
LCD 6
LCD 7
R80 270R
R79 270R
R82 270R
R81 270R
D18 RF FAIL
D15 PLL FAIL
D14 OVER TEMP
D19 HIGH SWR
J4
RS232
U20
SN75155
Z2
Z3
DSS9
C68 100n
C69 100n
+15V
-15V
VCC
U11A
U11B
NE5532
POWER
R76A 10K
R76B 10K
R76C 10K
R76D 10K
C29 100nF
C30 100nF
C28 100nF
C31 100nF
R53 1K
C71 10uF
C39 1uF
C70 1uF
C17 1-5pF
C64 18pF
C65 18pF
X1 8 MHz
R36 10K
C67 100n
R64 10R
C66 100n
U19
ATMEGA16(40)
R77A R77B R77C R77D
10K 10K 10K 10K
XTAL2
XTAL1
RESET
AREF
PD0
PD1
PD2
PD3
PD4
PD5
PD6
PD7
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PC0
PC1
PC2
PC3
PC4
PC5
PC6
PC7
DEV
FWD
REV
TEMP
SWR OK
RF OK
READ_PB
READ_CHANNEL
L1
LOCKED
DATA
CLOCK
100KHz
LE ATT
LE
LCD E
LCD R/W
LCD R/S
S4 POWER UP
S1 POWER DOWN
S2 GAIN UP
S3 GAIN DOWN
R78 10K
U22A
U21A
U21B
U22B
MC74HC244A
JP2 HEADER BANK
J3
SPI
J5 LCD
R66 10R
R65 10R
VR3 10K
C25 100nF
C26 100nF
C27 100nF
Title
DIGITAL SECTION
Size
A4
Number
Revision
Date: 19-Apr-2010
Sheet of
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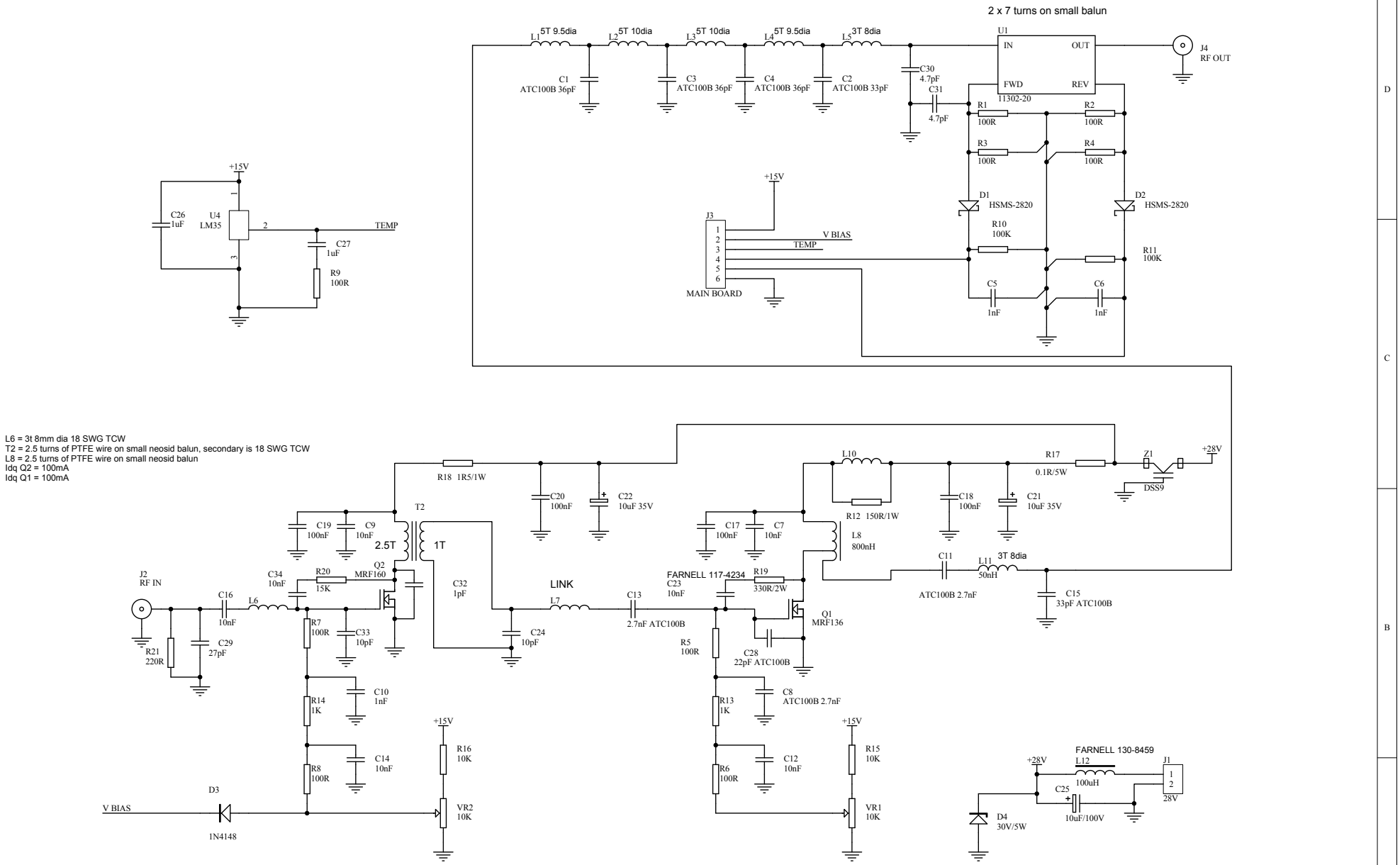
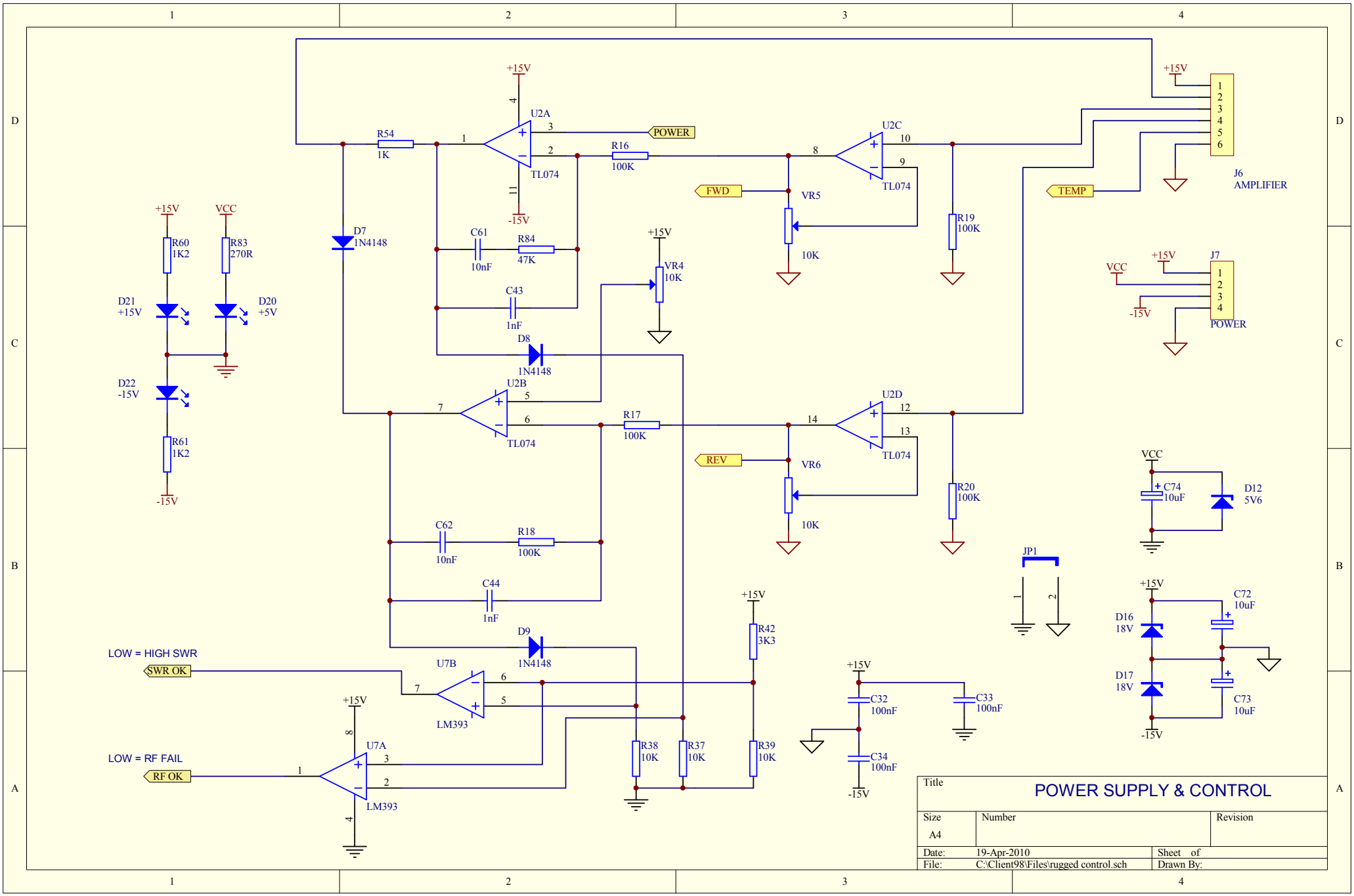
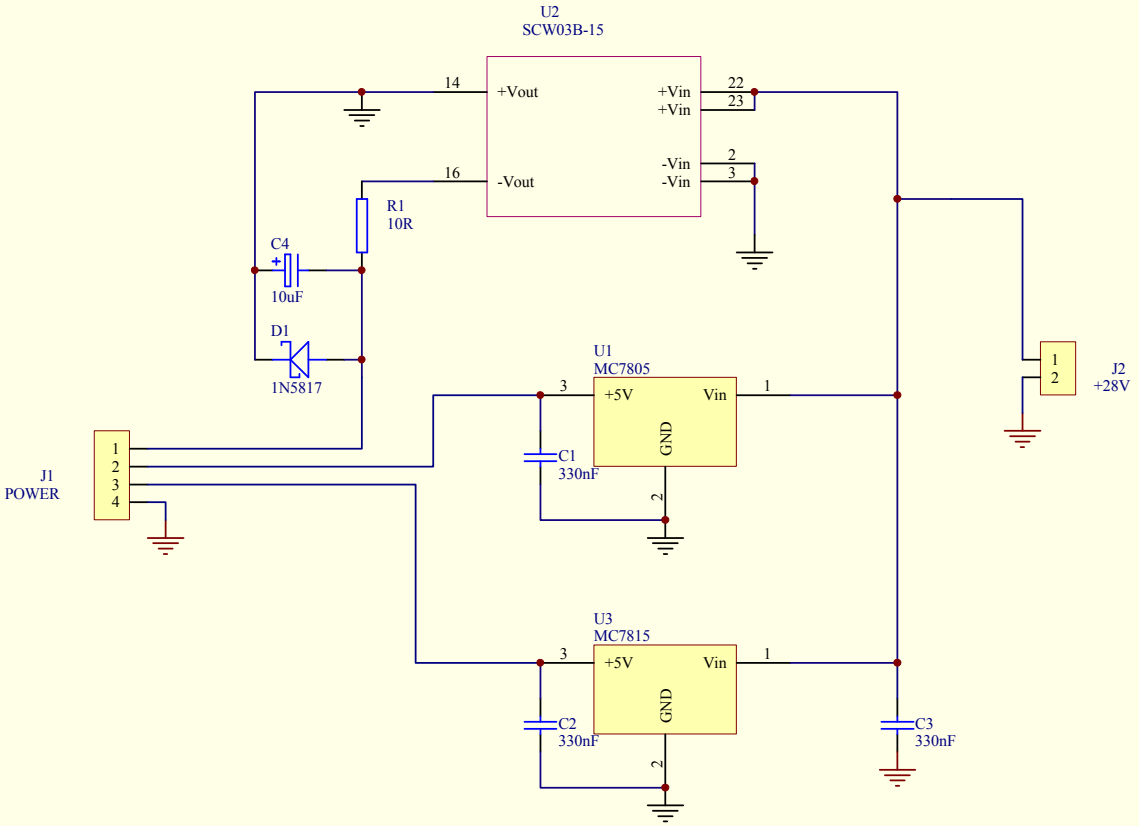
Drawn By:

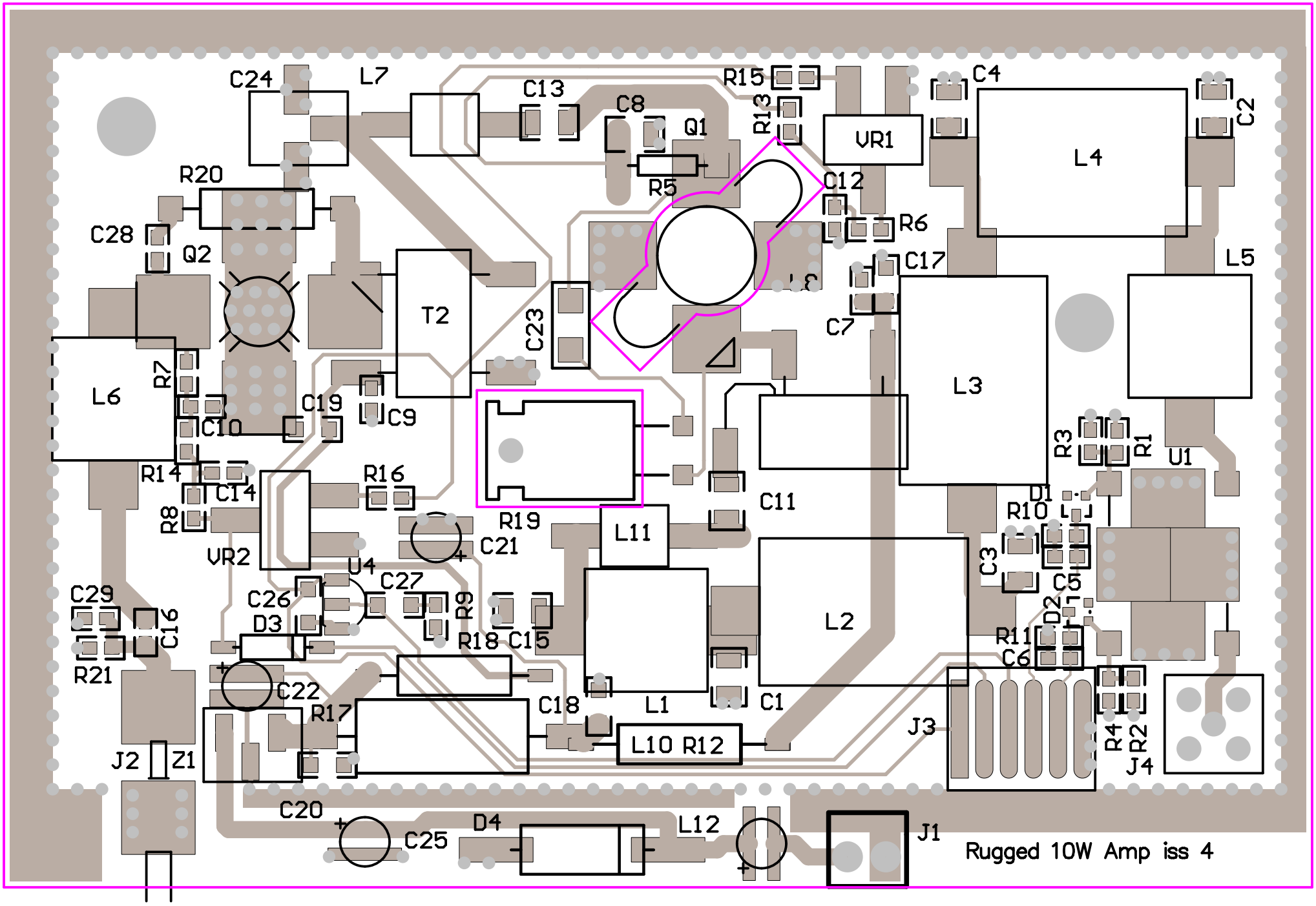


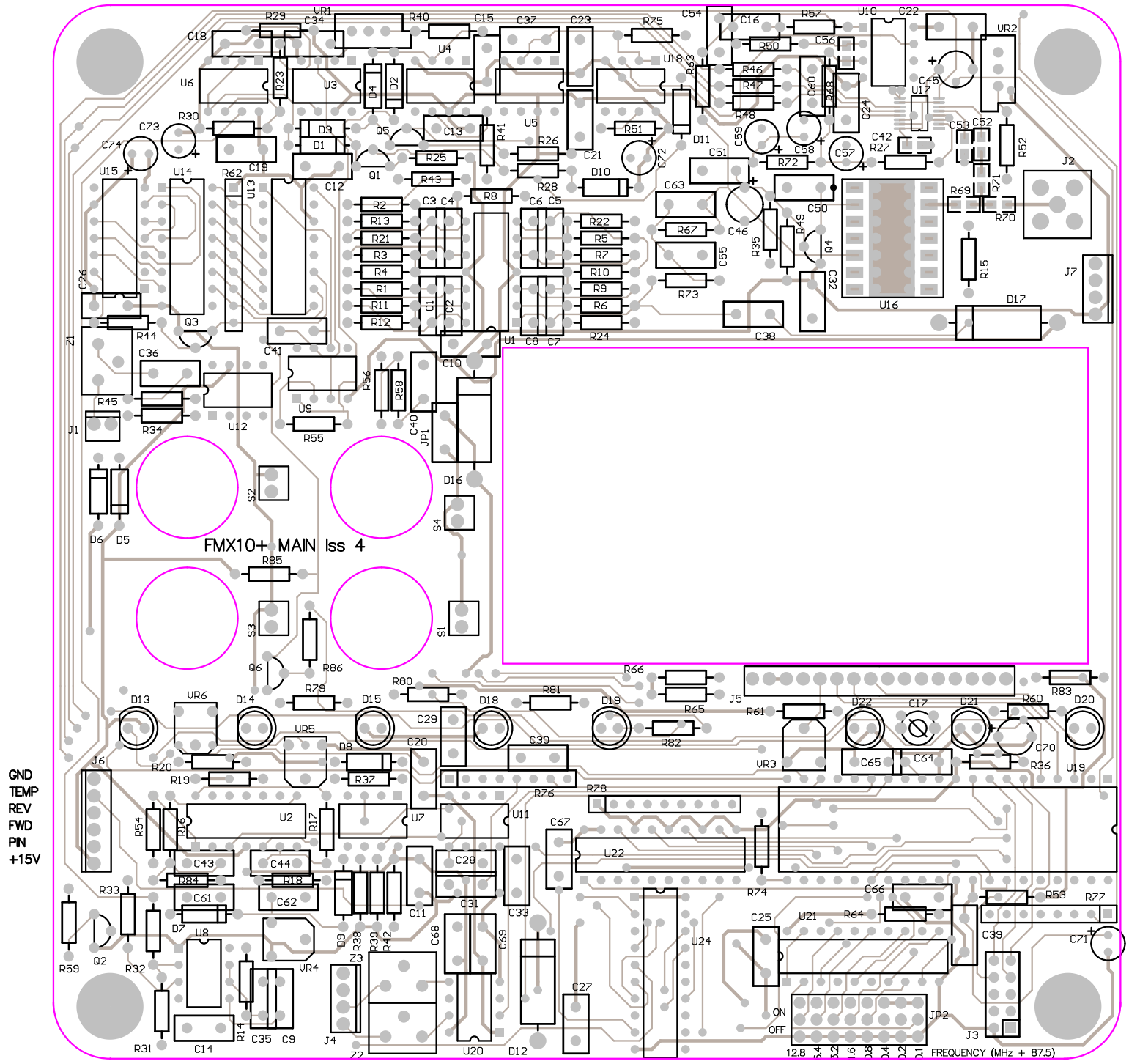
Title	FMX10+/4+ AMPLIFIER	SRK Electronics Pty Ltd 34 Queens Avenue Hawthorn VIC 3122 Australia
	Revision:	


+15V
VCC
R60
1K2
R83
270R
D21
+15V
D20
+5V
D22
-15V
R61
1K2
-15V
U2A
TL074
R54
1K
R16
100K
POWER
D7
1N4148
C61
10nF
R84
47K
C43
1nF
D8
1N4148
VR4
10K
U2B
TL074
R17
100K
C62
10nF
R18
100K
C44
1nF
D9
1N4148
U2C
TL074
FWD
VR5
10K
R19
100K
U2D
TL074
REV
VR6
10K
R20
100K
TEMP
J6
AMPLIFIER
J7
POWER
JP1
C74
10uF
D12
5V6
C72
10uF
D16
18V
D17
18V
C73
10uF
R42
3K3
R38
10K
R37
10K
R39
10K
C32
100nF
C34
100nF
C33
100nF
LOW = HIGH SWR
SWR OK
U7B
LM393
LOW = RF FAIL
RF OK
U7A
LM393
Title
POWER SUPPLY & CONTROL
Size
A4
Number
Revision
Date:
19-Apr-2010
Sheet of
File:
C:\Client98\Files\rugged control.sch
Drawn By:



Title	FMX10+ POWER SUPPLY	
Size A4	Number	Revision
Date: 19-Apr-2010		Sheet of
File: C:\Client98\Files\rugged power.sch		Drawn By:


C24
L7
C13
C8
Q1
R15
R13
VR1
C4
L4
C2
R20
R5
C12
R6
C28
Q2
T2
C23
C17
C7
L5
L6
R7
C19
C9
C10
L3
R3
R1
U1
R14
C14
R16
R8
R19
C11
D1
R10
L11
VR2
C21
U4
C27
C3
C5
C29
C26
D3
R9
R18
C15
D2
L2
C16
R11
C6
R21
C22
R17
C18
L1
C1
J3
R4
R2
J4
J2
Z1
L10 R12
C20
C25
D4
L12
J1
Rugged 10W Amp iss 4


FMX10+ MAIN Iss 4
GND
TEMP
REV
FWD
PIN
+15V
ON
OFF
FREQUENCY (MHz + 87.5)