ELECTRONICS PTY LTD

(ACN 089 050 564 ABN 44 089 050 564)

8 Victoria Grove

Hawthorn East

VIC 3123

Australia

STLTX Manual

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.

1 GENERAL DESCRIPTION

The STLTX is a high quality 5W UHF transmitter intended for point-to-point aural transmission.

Its features include:

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

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

The STLTX is designed and built in Australia.

2 UNPACKING

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

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

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

- This manual
- Mains lead
- Spare fuse

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

3 INSTALLATION

3.1 General

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

The STLTX has been designed to be mounted in a standard 19" rack frame, where it will occupy 2 rack units.

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.

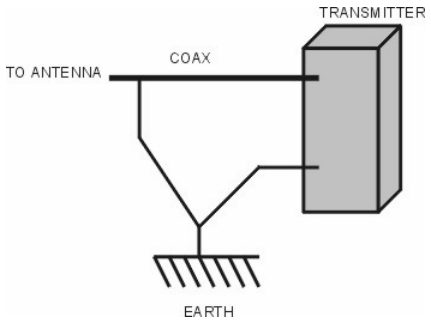
3.3 Electrical supply

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.



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.

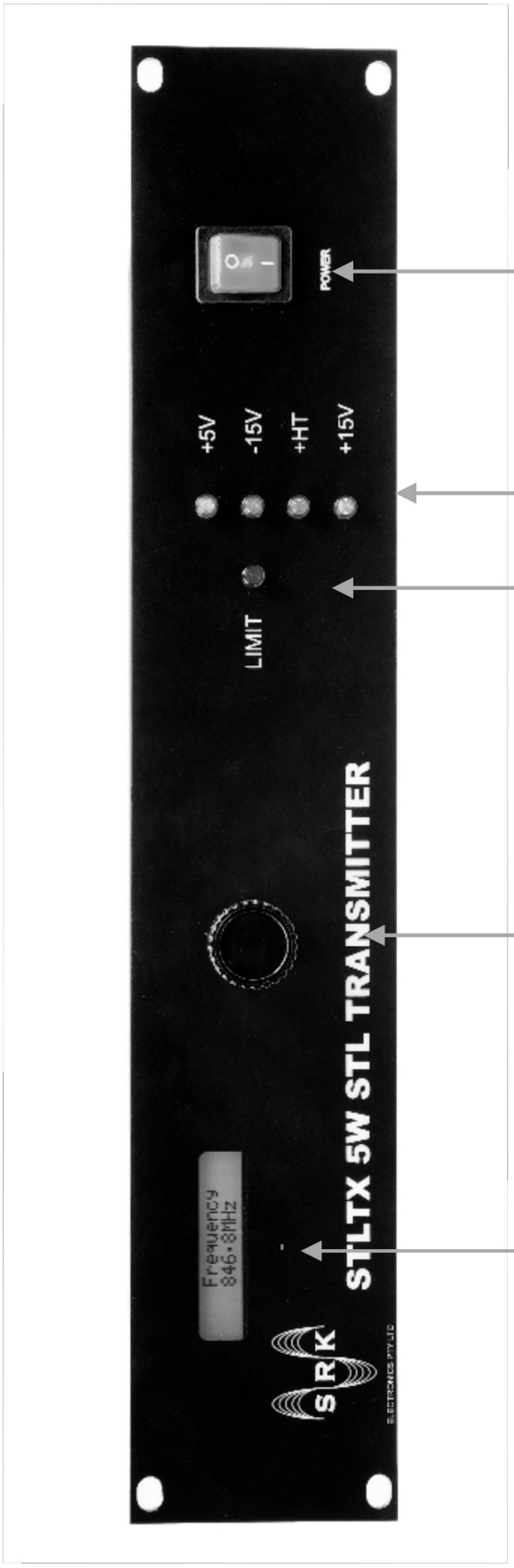


Fig 4.1 Front View

Fig 4.2 REAR VIEW

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 Switch
Switches the transmitter on and off.

2 Power Supply LEDs
Lights green to indicate the presence of internal power supply voltages

3 Limiter LED
Lights red if the modulation is being peak limited.

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

5 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.

6 Remote connector

Remote operation is performed by making connection to this DB9 socket. Please refer to section 4.12 for details

7 Audio input

This is a balanced audio input to the transmitter. Pin designation is as follows:

1	GND (screen)
2	+ve audio
3	-ve audio

The mating connector should be a male XLR (cannon) type.

Input impedance can either be 600Ω or high impedance, as shown on the LCD.

Note that should it be desired to use these inputs as un-balanced, pin1 should be connected to pin 3 in the mating connector. This will be the return, with pin 2 as signal.

8 Air inlet.

This is the inlet for the air cooling. On no account should this be obstructed.

9 Earth stud.

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

10 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.

11 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.

12 Fuse.

This is the primary mains fuse and is rated 2A slow blow. Use only ceramic cased replacements.

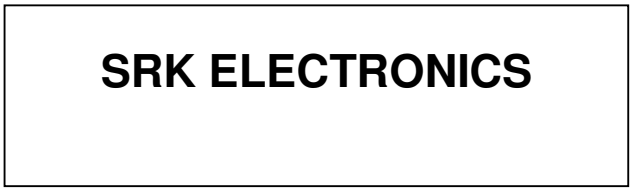
13 Remote

Completing this connection causes the transmitter to be enabled.

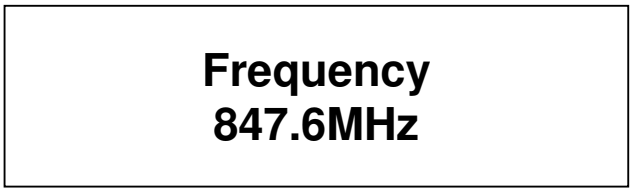
4.3 Switching on and off

The STLTX is switched on by depressing the power switch (1) to the down position.

If mains voltage is present then the switch should illuminate. The LCD display will initially show:



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



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

The STLTX may be switched off at any time by depressing the power switch to the up position.

4.4 Setting output power

The RF output power of the STLTX may be read by rotating the front panel knob until the display reads "Forward Power". The current forward power is displayed in watts.

Pressing the knob momentarily will make the “Forward Power” 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 “Forward Power” 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 STLTX is switched on.

Reverse output power may be measured by rotating the knob until the display reads “Reflected Power”. The current reflected power is displayed in watts.

4.5 Setting Channel Frequency

The STLTX is fully frequency agile and may be set to any 200KHz channel in the range 845.2MHz to 851.8MHz. This is accomplished by rotating the knob until the display shows “Frequency”. The current frequency is shown on the second line of the display.

Pressing the knob momentarily will make the “Frequency” characters flash. Whilst they are flashing, rotating the knob clockwise will increase the frequency. Rotating the knob anticlockwise will decrease the frequency.

When finished adjusting the frequency, press the knob again momentarily. The “Frequency” characters will stop flashing and the selected frequency will be programmed into the PLL. The frequency will not change until the “Frequency” characters are not flashing.

Note that, whilst the STLTX can work at any frequency in the STL 850MHz band, it is generally not advisable to change the channel at full output power unless the antenna system is broadband. This is particularly true if the STLTX is being used to drive a high power amplifier. The correct procedure is to reduce RF power to zero, change to the new frequency, then slowly increase the RF power, whilst monitoring the reflected power from the antenna.

The channel frequency is stored in non-volatile RAM, so it is not necessary to set the frequency each time the STLTX is switched on.

4.6 Setting audio gain

The audio gain of the STLTX 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/Deviation”.

Pressing the knob momentarily will make the “Gain/Deviation” 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/Deviation” 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 100KHz.

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

4.7 Selecting pre-emphasis.

The STLTX allows the user to select either 75µS, 50µS or no pre-emphasis.

To view the current pre-emphasis setting, rotate the knob until the display shows “Pre-emphasis”. The current pre-emphasis setting is shown on the second line of the display.

Pressing the knob momentarily will make the “Pre-emphasis” characters flash. Whilst they are flashing, rotating the knob in either direction will sequence through the available pre-emphasis time constants.

When finished adjusting the pre-emphasis, press the knob again momentarily. The “Pre-emphasis” characters will stop flashing and the selected pre-emphasis will remain set.

Note that within Australia, 50µS pre-emphasis is standard.

The pre-emphasis setting is stored in non-volatile RAM.

4.8 Audio input impedance.

The audio input impedance may be set to either 600Ω or high impedance, depending upon the characteristics of the equipment providing the audio feed.

To view the current input impedance setting, rotate the knob until the display shows “Input Impedance”. The current input impedance setting is shown on the second line of the display.

Pressing the knob momentarily will make the “Input impedance” characters flash. Whilst they are flashing, rotating the knob clockwise will set the input impedance to high Z. Rotating the knob anticlockwise will set the input impedance to 600Ω.

When finished setting the impedance, press the knob again momentarily. The “Input impedance” characters will stop flashing and the selected impedance will remain set.

Correct selection of input impedance is important to ensure a high level of audio fidelity. As a general rule of thumb, if the STLTX is being driven over land lines or from very old audio equipment, 600Ω should be selected. For all other applications use high Z

4.9 Enabling/disabling audio limiter.

The STLTX incorporates a peak deviation limiter which may be switched on or off as desired.

This limiter is preset to prevent deviation in excess of 100KHz.

To view the current limiter setting, rotate the knob until the display shows “Peak limiter”. The current limiter setting is shown on the second line of the display.

Pressing the knob momentarily will make the “Peak limiter” characters flash. Whilst they are flashing, rotating the knob clockwise will turn the limiter on. Rotating the knob anticlockwise will turn the limiter off.

When finished setting the limiter, press the knob again momentarily. The “Peak limiter” characters will stop flashing and the limiter will remain off or on as selected.

4.10 Audio Filter

The STLTX incorporates an audio low pass filter which may be switched on or off as desired.

This is a Bessel filter with a cutoff of 15KHz.

To view the current filter setting, rotate the knob until the display shows “LPF”. The current filter setting is shown on the second line of the display.

Pressing the knob momentarily will make the “15KHz LPF” characters flash. Whilst they are flashing, rotating the knob clockwise will turn the filter on. Rotating the knob anticlockwise will turn the filter off.

When finished setting the filter, press the knob again momentarily. The “15KHz LPF” characters will stop flashing and the filter will remain off or on as selected

4.11 Protection

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

If the reflected power from the antenna exceeds 1W then the output RF power will be automatically reduced to bring the reflected power back to 1W. Under this condition the STLTX 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 “TEMPERATURE HIGH”.

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

4.12 Remote operation.

The STLTX may be monitored and controlled remotely via the “REMOTE” 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 STLTX 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)
5.00W<LF><CR> (response from transmitter)
>

Note that for forward powers of 0.99W and below, the leading zero is replaced with a space

RP?<CR>

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

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

Note that for reflected powers of 0.99W and below, the leading zero is replaced with a space.

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

CF?<CR> (command)
851.2MHz<LF><CR> (response from transmitter)
>

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

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

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 XX%<LF><CR>> or XX.XX%<LF><CR>>. For example:

AG?<CR> (command)
95%<LF><CR> (response from transmitter)
>

Note that any leading zeros are set to spaces.

PE?<CR>
Returns the current pre-emphasis time constant in the form None<LF><CR>>, 75uS<CR><LF>> or 50uS<CR><LF>>. For example:

PE?<CR> (command)
None<LF><CR> (response from transmitter)
>

II?<CR>
Returns the current audio input impedance in the form High_Z<CR><LF>> or 600_R<CR><LF>>. For example:

II?<CR> (command)
High_Z<CR><LF> (response from transmitter)
>

AF?<CR>
Returns the current audio LPF status in the form IN<CR><LF>> or OUT<CR><LF>>. For example:

AF?<CR> (command)
IN<CR><LF> (response from transmitter)
>

PL?<CR>
Returns the current peak limiter status in the form On<CR><LF>> or Off<CR><LF>>. For example:

PL?<CR> (command)
Off<CR><LF> (response from transmitter)
>

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 transmitter indicating a high SWR condition)
>
or
0000<LF><CR> (response from transmitter indicating no failures)
>

FP=XX.X<CR>
Allows the forward power to be set to the value X.XX, up to 5.00W. Valid range for X.XX is 00.0 to 5.00. For example:

FP=3.06<CR> (command, sets forward power to 3.06W))
Ok<LF><CR> (response from transmitter 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 845.2 to 851.8. For example:

CF=848.8<CR> (command, sets channel frequency to 848.8MHz)
Ok<LF><CR> (response from transmitter indicating that command has been executed)
>

AG=XX<CR>
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 transmitter indicating that command has been executed)
>

PE=NONE<CR>, PE=75US<CR>, PE=50US<CR>
Allows the pre-emphasis to be set. For example:

PE=75US<CR> (command, sets pre-emphasis to 75µS)
Ok<LF><CR> (response from transmitter indicating that command has been executed)
>

II=600R<CR>, II=HIGH_Z<CR>
Allows the audio input impedance to be set. For example:

II=600R<CR> (command, sets input impedance to 600Ω)
Ok<LF><CR> (response from transmitter 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 transmitter 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 transmitter indicating that command has been executed)
>

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

Any data received by the transmitter, 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 remote port using cables running external to the building housing the STLTX, it is recommended that external filtering and transient protection be installed on these lines.

5 MAINTENANCE

5.1 Recommended maintenance schedule

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

It is advisable to replace the fuse every 5 years. This will prevent un-expected failures due to fuse fatigue. Note that replacement fuses should be of the ceramic cased variety.

6 CIRCUIT DESCRIPTION

6.1 Equipment Overview

The STLTX consists of the following assemblies.

- 12V Switch Mode PSU
- DC-DC converter board
- Main board
- RF Amplifier
- Front panel

6.2 12V SMPSU

The SMPSU is an OEM unit, rated 12V at 100W.

6.3 DC-DC Converter Board

This board takes in 12V from the SMPSU and generates +/-12V, 5V and +18V for the main board.

6.4 Main Board

Balanced audio enters on J4. Possible MF interference is attenuated by C28, C29, L4 and L5. R60 and R61 can be switched in by relay to set the audio impedance to 600Ω.

Transient protection is provided by D5-D8, D17-D20, R58 and R59.

U17 is a professional quality line receiving amplifier which turns the differential input signal to a single sided version for processing by the rest of the circuit.

Gain control is provided by U8 (a four quadrant multiplying DAC) and U19A. The output of U19A is directly proportional to the digital values held on the eight data lines. These are latched in from the front panel by U10 and level shifted by U9 and Q2.

Selectable pre-emphasis is provided by the network feeding U21. The control signals for this switch are provided by the front panel. In this way it is possible to set the pre-emphasis to 75, 50 or none.

Peak limiting is provided by the circuitry around U23 and U5B. This can be disabled by the switch formed by U27 going open. This is also controlled by the front panel.

U25 is a window comparator which detects when the limiter is clipping. This causes a pulse stretcher, formed by U26, to light the “LIMITING” LED. This provides a clear indication of the limiting action.

U22 forms an 8 pole Bessel low pass filter with a cutoff frequency of 15KHz. This can selectively be enabled or disabled by the front panel, using the change over switch formed by U27. U5A is a wide band amplifier of the same pass band gain as the filter so that when switching the filter in and out of circuit, no adjustment to audio is necessary.

This signal is then used to frequency modulate the PLL.

The PLL is based on a highly integrated device, U2. This takes in a highly stable 10MHz clock from J7 and divides it down to a 100KHz reference frequency.

VR7 sets the carrier frequency to with 1KHz of nominal.

The PLL chip generates a control voltage for the low noise VCO (U13) which is filtered and level shifted by C15-18, R42, R44 and U1.

The VCO signal is fed back to the PLL chip to ensure a the carrier frequency is as programmed by the front panel.

6.5 Front Panel

The front panel allows the user to set and measure all of the parameters of the STLTX. Please refer to the appropriate schematic.

The heart of the front panel is U1, an MCU. This device generates all of the control signals and provides all of the metering for the STLTX, as well as the telemetry functions. It runs at a clock frequency of 8MHz, determined by X1. U1 performs the following functions:

The analogue signals on pins 37, 39 and 40 (forward volts, reverse volts and peak deviation) are digitised and processed so that these parameters can be read on the LCD or via telemetry.

The status of the digital line on pins 38,21, 20, 19 and 16 are monitored to allow the status of the various parts of the transmitter to be displayed on the LCD or via telemetry.

The LCD is controlled by the lines on pins 24, 26 and 27. The data bus for the LCD is on pins 1 to 8.

The audio input impedance is controlled by the level on pin 25.

The forward power is set by the average value on pin 18. This is a PWM signal running at approximately 20KHz. This signal is filtered by U4 to generate an analogue voltage between 0V and +5V.

As there are more signals required than available pins on the MCU, an external latch is used to give extra outputs., U3.

This device generates the signals to program the PLL, audio gain, pre-emphasis peak limiter and audio filter status.

Telemetry is provided by the internal USART of U1, and brought to RS232 levels by U2.

All parameters may be set manually using the rotary encoder, S1. The three lines from S1 are monitored by U1.

Power supply and limiter status are shown by the appropriate LEDs.

7 TROUBLE SHOOTING

7.1 Auto diagnostics

The STLTX 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

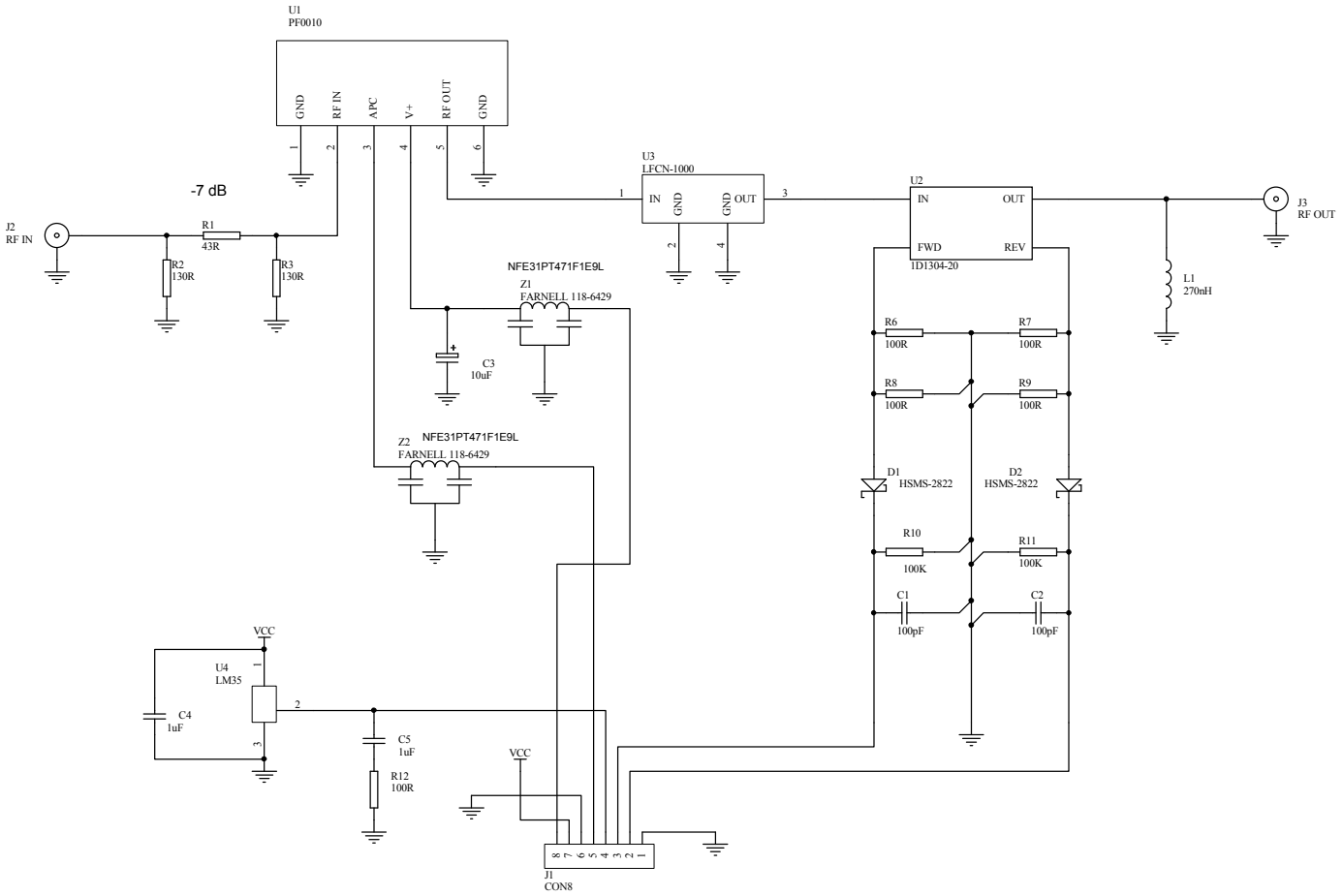
This message indicates that the reflected power is greater than 1W and is usually indicative of an antenna failure.

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.



Title	STL Power Amplifier		
Size	Number		Revision
A3			
Date:	13-Jan-2011	Sheet of	
File:	C:\Client98\Files\STL amp 2.sch	Drawn By:	