FM-250

250W STEREO TRANSMITTER/EXCITER

TECHNICAL MANUAL

LARCAN Denver Office (LARCAN-TTC)
1390 Overlook Drive #2, Lafayette, CO 80026 USA
Tel: 303-665-8000 Fax: 303-763-9900
E-Mail: sales@earthnet.net Web: www.larcan.com

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NOTE

AMENDMENT

Please take note that any reference to 230V and 50Hz in this manual should be read as 110V and 60Hz respectively.

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CONTENTS:

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INTRODUCTION

This manual contains the operating, technical and installation information for the NCI FM-250 FM Broadcasting Exciter. The Exciter forms part of a new range of Professional FM Broadcast Exciters produced by Broadcast Solutions Electronics (Pty) Ltd and supplied by LARCAN USA in the United States.

1. The FM-250 Exciter forms a compact, solid state FM Broadcast transmitter with a RF output in excess of 250W in the FM Broadcasting band (87.5MHz to 108MHz). The unit is housed in a 19-inch rack mount case occupying only a 2U space. The Exciter features a range of customer options including a built in, high quality Stereo coder.

2. The FM-250 Exciter offers a standard specification, better than the general requirements of the major broadcasters in the world. This level of performance is only found in the best equipment that the market has to offer.

3. The following basic versions are available:

a) FM-250 (W) Wideband MPX Exciter (For use with composite input).

b) FM-250 (S) Stereo Exciter (With built in Stereo coder and Audio Limiter).

c) FM-250 (M) Mono Exciter (With built in Mono input filter and Audio Limiter).

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General Description

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GENERAL DESCRIPTION

1. STRUCTURE.

The Exciter comprises of the following modules.

a) Synthesizer/Modulator module (980507).

b) Control/Monitoring module (980508).

c) 250W RF PA module (980510).

d) 250W Power supply module (980515).

e) Display module (980509).

f) Stereo coder/Limiter (980512). (Optional).

g) Fan Psu module (980518).

2. FEATURES.

The FM-250 Exciter has standard features including the following;

a) Remote/Internal frequency selection (standard) with Thumbwheel switch option available.

b) Remote telemetry with voltage free contacts (standard).

c) +48V Battery operation (standard).

d) Wideband input (MPX) with two auxiliary inputs (SST/SCA/RDS).

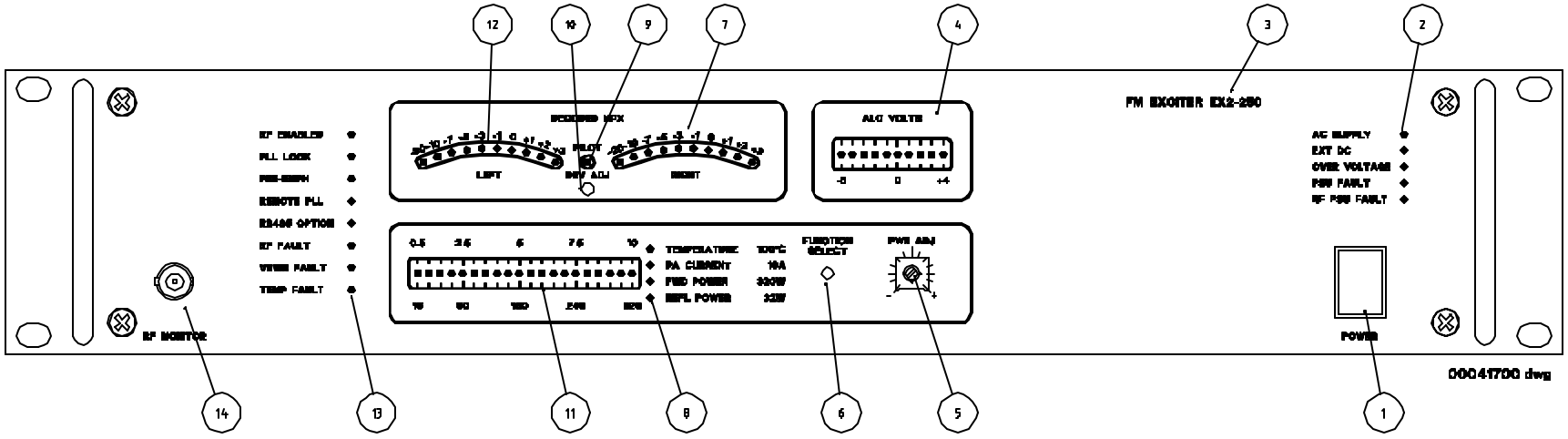
e) Comprehensive metering including VU meters. (Built in Stereo decoder).

f) ALC built in for absolute control of RF output power.

g) Comprehensive protection built in.

3. BLOCK DIAGRAM DESCRIPTION.

Refer to the Front panel layout in figure 1, Rear panel controls and connectors in figure2 and the Block diagram of FM-250 in Figure 3



FRONT PANEL

Figure 1: FM-250 Front Panel Controls

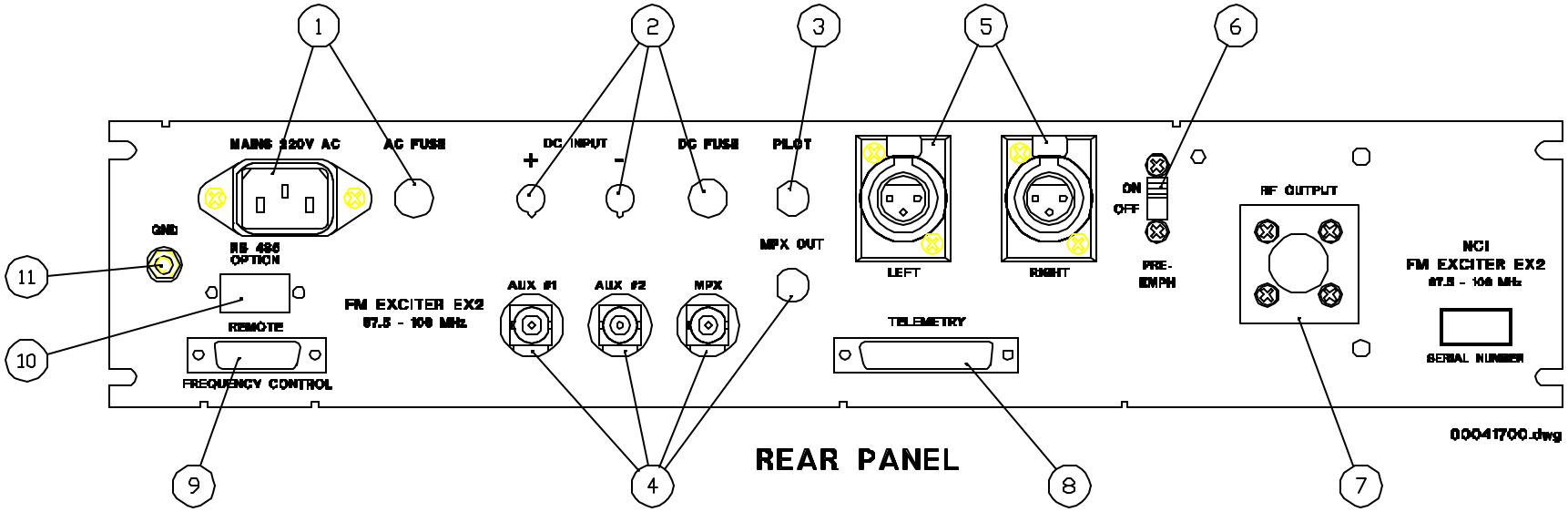


Figure 2: FM-250 Rear Panel Controls and Connectors

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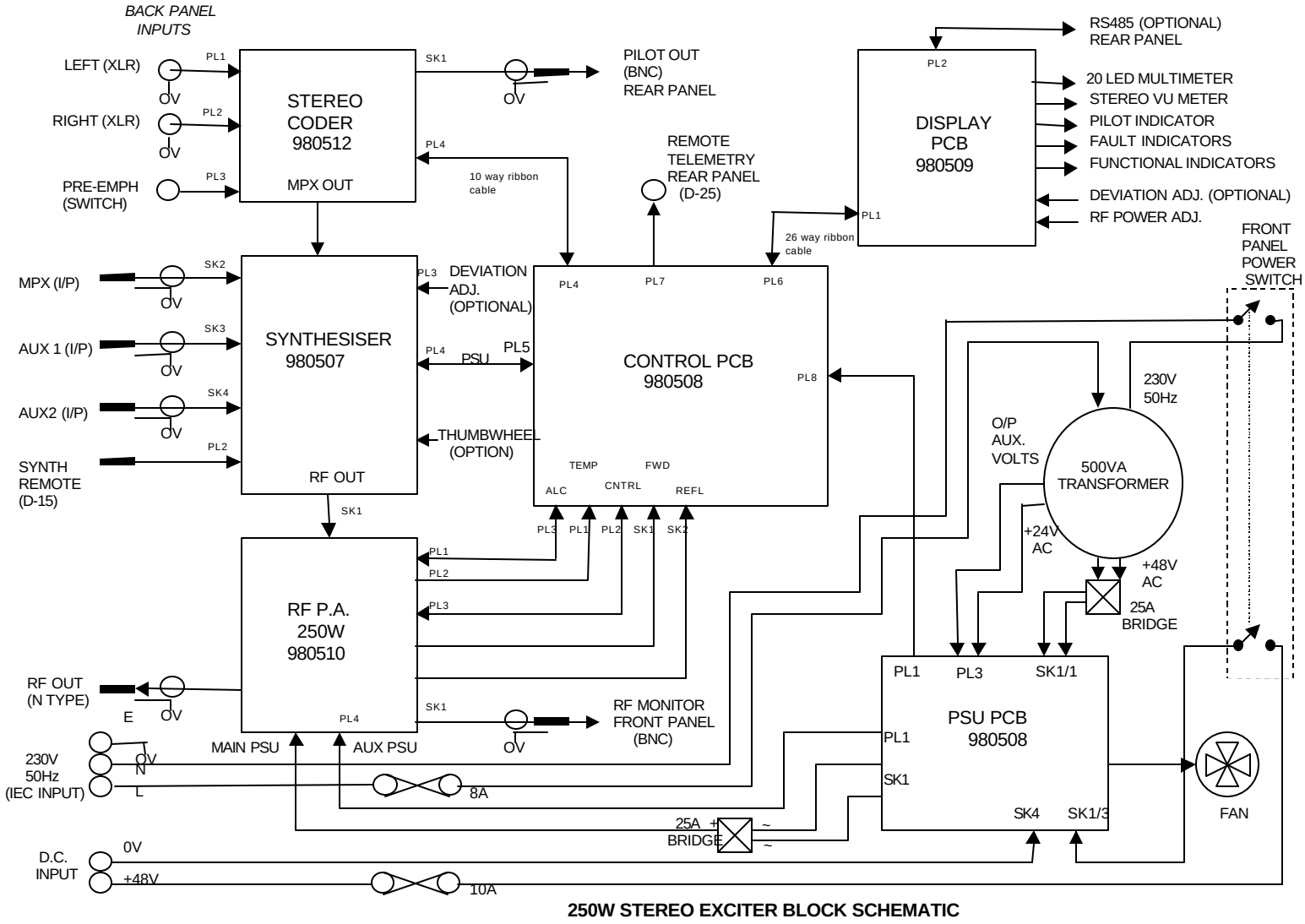

Figure 3: Block diagram of FM-250

a) SYNTHESIZER AND MODULATOR (980507)

The digital synthesizer derives the final operating frequency from a 10MHz reference (TCXO) using a PLL (Phase lock loop) and dividers. The frequency can be selected Locally (In 100kHz steps via rotary BCD switches) or Remotely (via a external parallel control). The direct carrier modulator uses special techniques to obtain very low distortion and high stereo channel separation (>60dB). This level of performance is not normally found on competitive equipment, especially at low audio frequencies.
The Synthesizer is equipped with four modulating inputs, three of which are external (BNC's) and one internal (SMB) for use with optional Stereo coder.
The synthesizer is protected from Out of Lock and Out of Band operation by removing the RF Output when either of these conditions exists.

b) RF PA MODULE (980510)

The RF output (Nominally +10dBm) from the synthesizer buffer is amplified by a three stage RF power amplifier to obtain the final output power of >250W. The final device is operated in push-pull mode to obtain high efficiency. All devices are operated well within their ratings. Wideband techniques are used throughout the PA and a built in harmonic filter is used at the output to suppress all harmonics. Directional couplers are used to sample the output for control and monitoring purposes.
A temperature-sensing device is provided for thermal monitoring. This device is situated at the final RF Stage to provide accurate temperature monitoring of the RF PA Heatsink.
Current and voltage sensing is provided for control and monitoring purposes along with the ALC circuit, which controls and monitors the RF output power.
A Series regulator is used to ensure protection and utilizes three parallel devices for maximum reliability.

c) CONTROL MODULE (980508)

The control Pcb provides the standard telemetry functions and interconnections for the Exciter. The unit receives two dc inputs, one from the external battery supply and one from the rectified a/c supply and has a ‘on board’ low power switching power supply. The various voltages are distributed to the other modules via the Control Pcb.
Forward and Reflected RF Inputs are processed and distributed for ALC control and monitoring purposes. RF PA current, Voltage and Temperature are also processed and their voltages distributed.
Various voltage free contacts are provided for telemetry purposes and are Link selectable for o/c or s/c condition.

d) POWER SUPPLY MODULE (980515)

The power supply module contains the smoothing capacitors for the 'off board' 230V 50Hz a/c mains transformer/bridge rectifier combination. This +52V nominal smoothed supply is then distributed to a choke/capacitor filter at the module. This type of arrangement eliminates all ripple and therefor any AM products on the transmitter, even when the a/c input voltage is extremely low. The +48V (nominal) external battery supply is combined off the module with the smoothed supply via isolating diodes. The various voltages are then distributed to the other modules.
Auxiliary supplies are generated for use in the RF PA regulator stage and Modules.

e) DISPLAY MODULE (980509)

The display module provides the Local user functions and alarm indications at the Exciter front panel. The display has three functional meters, which allow instant viewing of multiple functions.

1) Multimeter: Provides push button selectable functions for Forward power, Reflected power, PA current and Heatsink temperature.
2) ALC meter: Dedicated meter for instant viewing of ALC voltage and alarm.
3) MPX VU meter: Active peak detection meters for Left and Right channels, derived from built in Stereo decoder. This provides instant viewing of Transmitter deviation from Left and Right channels. The Stereo pilot indication is also provided with the meter.

Alarm indications are provided by Front panel LED's, enabling instant viewing of transmitter functions. Front panel adjustments are available for control of RF Output power and Deviation level.
Connection for the optional RS485 Module is provided on the Display, enabling remote viewing of Meter functions.

f) STEREO CODER MODULE (980512) (optional)

This optional module allows the user to facilitate a very high quality stereo signal on board the Exciter and provides all the necessary functions such as Pre emphasis switching, Mono- Stereo switching with the added advantage of a built in Audio Limiter. The module accepts Left and Right audio inputs (600 ohms balanced) and after Limiting and filtering is converted into the Stereo multiplex format via a new digital stereo multiplexer. A 100kHz Linear phase filter is used at the output with comprehensive phase adjustment to obtain absolute transparency.
A 19kHz Pilot signal output is provided for supplementary signal use.

g) BACK PANEL CONNECTIONS

The 110V 60Hz a/c power input is connected via an IEC connector whilst the +24 dc input is connected via Binding terminals. Back panel Fuses are provided for maximum protection. Standard telemetry output is provided via a 25 pin D connector, while the Remote frequency control has a 15 pin D connector.

There is provision for three (50-ohm BNC female) external modulating inputs, one for external MPX (600 ohms unbal. or 1.2k ohms BAL.) And two for auxiliary use (20k ohms unbal.).
The RF Output is via an N Type (50-ohm) connector.
Optional connectors include two XLR (F) connectors (for Stereo coder), plus Pre- emph slide switch with a 9 pin D connector for the RS485 module.

h) MONO FILTER (optional)

The Mono filter option provides the user with a XLR (F) 600 ohm balanced input and 15kHz low pass filter with an internal output connection to the Synthesizer and modulator. Pre-emphasis switching (50uS or 75uS) is provided on board and is switched via the Pre-emphasis switch on the back panel. An Audio Limiter is supplied as standard issue with internally adjustable threshold.
Note: The following modules are common to the range of Exciters produced by NCI Electronics.

- Synthesizer module
- Control module
- Stereo coder (option)
- Mono filter (option)

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TECHNICAL SPECIFICATIONS

GENERAL RF SPECIFICATIONS

FREQUENCY RANGE	87.5 MHz to 108MHz
FREQUENCY CONTROL	PLL Synthesizer
FREQUENCY INCREMENTS	100kHz steps (Local and Remote control)
FREQUENCY STABILITY	± 2ppm (10MHz TCXO)
RF OUTPUT POWER	≥ 250W (Adjustable via front panel control)
RF HARMONIC SUPPRESSION	≥ 70dB
RF SPURIOUS SUPPRESSION	≥ 75dB
OUT OF LOCK ATTENUATION	≥ 80dB
OUT OF BAND ATTENUATION	≥ 80dB (87.5MHz ≤ F ≤ 108MHz)
AM NON SYNCHRONOUS NOISE	≤ -60dB (Filtered 20Hz to 20kHz)
AM SYNCHRONOUS	≤ -60dB (Filtered 20Hz to 20kHz)
MEAN CARRIER VARIATION	≤ ±200Hz

WIDEBAND COMPOSITE OPERATION

BASEBAND RESPONSE	≤ 0.2dB (30Hz to 100kHz)
STEREO SEPARATION	≥ 60dB (30Hz to 15kHz)
STEREO DISTORTION	≤ 0.1% (30Hz to 15kHz)
WIDEBAND S/N RATIO	≥ 80dB (20Hz to 20kHz) 50uS de emph.
INPUT IMPEDANCE	1k2 ohms balanced (other on request)
DEVIATION SENSITIVITY	3.5V p-p for ±75kHz deviation (adj.)

STEREO OPERATION (With built in Stereo coder/Limiter)

AF RESPONSE	≤ ±0.3dB (30Hz to 15kHz)
STEREO SEPARATION	≥ 60dB (30Hz to 15kHz)
STEREO DISTORTION	≤ 0.1% (30Hz to 15kHz)
STEREO S/N RATIO	≥75dB (20Hz to 20kHz) 50uS de emph.
MONO/STEREO CROSSTALK	≥ 50dB (30Hz to 15kHz)
INPUT IMPEDANCE	600 ohms balanced (XLR)
DEVIATION SENSITIVITY	+6dBm for ±40kHz deviation (adj.)
AUDIO LIMITER SENSITIVITY	10dBm nom. for 62.5kHz deviation (adj.)
ATTACK TIME	≤ 2mS for increased 10dB I/P step
DECAY TIME	≥ 80mS for a decreased 10dB I/P step
LIMITER DISTORTION	≤ 0.35% (10dB into limiting)
LIMITER THRESHOLD	Internally adjustable

MONO OPERATION (With built in Mono filter)

AF RESPONSE	≤ ±0.3dB (30Hz to 15kHz)
MONO DISTORTION	≤ 0.1% (30Hz to 15kHz)
S/N RATIO	≥ 80dB (20Hz to 20kHz) 50uS de emph
INPUT IMPEDANCE	600 ohms balanced (XLR)
DEVIATION SENSITIVITY	+6dBm for ±40kHz deviation (adj.)
ATTACK TIME	≤ 2mS for increased 10dB I/P step
DECAY TIME	≥ 80mS for a decreased 10dB I/P step
LIMITER DISTORTION	≤ 0.35% (10dB into limiting)
LIMITER THRESHOLD	Internally adjustable

ENVIRONMENTAL SPECIFICATIONS

A/C INPUT POWER	110V ±10% (other on request)
A/C FREQUENCY VARIATION	60Hz ±5% (other on request)
DC INPUT POWER	+24V nominal Battery
STORAGE TEMPERATURE	-40°C to +60°C
OPERATING TEMPERATURE	-10°C to +45°C
RELATIVE HUMIDITY	20% to 90% (non condensing)
OPERATING ALTITUDE	≤ 2500m above sea level
COOLING SYSTEM	Forced air (4 x 24Vdc blowers)
PHYSICAL DIMENSIONS	480mm x 485mm x 88.8mm
PHYSICAL MASS	Approximately 16kg

STANDARD ALARM SETTINGS AND LOCAL INDICATIONS (adjustable)

RF FAULT INDICATION	≤ 175W (Red led on front panel)
VSWR FAULT INDICATION	≥ 20W (Red led on front panel)
VSWR FAULT TRIP INDICATION	≥ 25W (Red led/front panel/10Sec re-cycle)
TEMP FAULT INDICATION	≥ 55°C (Red led on front panel)
TEMP TRIP INDICATION	≥ 65°C (Red led on front panel)
ALC FAULT INDICATION	Out of range (Red led/front panel meter)
PSU FAULT INDICATION	Internal Psu fault (Red led on front panel)
RF PSU FAULT INDICATION	RF PA Psu fault (Red led on front panel)
OVERVOLTAGE FAULT	≥ +52V at Control (Red led on front panel)

The unit has a number of operational customer link options, which should normally be configured before delivery. Consult Control module technical description section.

- RF Power backed off with high temperature.

- RF Power backed off with high VSWR.
- RF Power backed off with high RF PA Current.

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OPERATING INFORMATION

FRONT PANEL

1. POWER ON/OFF SWITCH

The front panel On/Off switch connects the External A/C and D/C supplies to the equipment.

2. POWER ADJUST CONTROL

This single turn potentiometer is used to set the RF output power via the internal ALC Circuit. Fully anti-clockwise gives minimum power (≤ 25W) while clockwise gives Maximum power (≥ 250W).

3. DEVIATION ADJUST

This single turn potentiometer is used to fine trim the Transmitter final deviation level. The standard variation is ± 1.5dB (other on request). This controls the total deviation Level.

Note: When the stereo coder option is installed, the built in Limiter controls the maximum Deviation level of the Left and Right program inputs and adjustment of this level is done Internally, to customers requested level.

4. MULTIMETER

The Multimeter comprises a linear scale, 20 led (green) custom bar display. The meter has a push button selector with individual LED's (yellow) for indicating the four selectable Functions.

- Temperature: RF PA Heatsink temperature with 100°C f.s.d.
- RF PA Current: RF final stage current with 10A f.s.d.
- RF Forward power: RF Output power with 320W f.s.d.
- RF Reflected power: RF Output Reflected power with 32W f.s.d.

5. ALC METER

This dedicated 10 led (9 green and 1 red) bar display provides instant information on the ALC loop control function and voltage. The meter indicates the dc control voltage at the Gate of the final RF Mosfet stage and as such gives the user instant feedback on the status of the ALC loop.

The meter scale is -5V to +4V (1volt per led) with the +4V led (red) indicating ALC ‘out of range’.

6. VU METERS

This dedicated stereo meter is used to indicate the dynamic peak deviation of the Left and Right channels. This provides the user with instant visual information on the status of the system modulation.

The meters operate to the DIN 45406 specification with precision Full wave peak

detection.
The signals are derived from the built in stereo decoder and calibrated accordingly.
The VU meter scales are as follows:

LEFT CHANNEL	RIGHT CHANNEL	LED STATUS
+3dBm	+3dBm	Over deviation (red)
+2dbm	+2dbm	Over deviation (red)
+1dBm	+1dBm	Over deviation (red)
+0dBm	+0dBm	Peak program (yellow)
-1dBm	-1dBm	Normal program (green)
-3dBm	-3dBm	Normal program (green)
-5dBm	-5dBm	Normal program (green)
-7dBm	-7dBm	Normal program (green)
-10dBm	-10dBm	Normal program (green)
-20dBm	-20dBm	Normal program (green)

The stereo pilot is also monitored by the decoder and is indicated by a led (green) between the Left and Right VU meters. If the pilot is lost the led will extinguish and if desired the Right channel VU meter can be actively disabled in this circumstance (Internal link option). This would normally happen for instance if Mono had been selected.

7. INDICATORS

FRONT PANEL

FUNCTION	INDICATION	STATUS
RF ENABLED	Green led	Indicates ext. command on.
PLL LOCK	Green led	Indicates PLL is in lock.
PRE EMPHASIS	Yellow led	Indicates pre emphasis is on.
REMOTE PLL	Yellow led	Indicates PLL in remote.
RS485 (option)	Yellow led	Indicates RS485 module on.
RF FAULT	Red led	Indicates low RF Forward.
VSWR FAULT	Red led	Indicates high RF Reflected.
AC SUPPLY	Green led	Indicates a/c supply is on.
EXT. DC	Green led	Indicates dc supply is on.
OVERVOLTAGE	Red led	Indicates high voltage.
PSU FAULT	Red led	Indicates internal Psu fault.
RF PSU FAULT	Red led	Indicates RF Psu fault.

BACK PANEL

a) A/C INPUT
Standard IEC male connector for 110V 60Hz mains operation.

b) A/C FUSE (110V a/c operation)
20mm (10 Amp) fuse connected in live line.

c) DC INPUT
Terminals for +48V dc operation.

d) DC FUSE (+48V dc Battery operation)
20mm (10 Amp) fuse in +48V line.

e) WIDEBAND MPX INPUT
BNC (female) for use with external stereo multiplex input.

f) AUXILIARY #1 AND #2 INPUTS
BNC (female), for use with supplementary signals, (RDS/SST/SCA).

g) LEFT INPUT
Balanced 600 ohm XLR (female) input for Left channel (Stereo coder or Mono filter installed).
h) RIGHT INPUT
Balanced 600-ohm XLR (female) input for Right channel (Stereo coder installed).

i) PRE EMPHASIS SWITCH
Slide switch for pre emphasis switching (Stereo coder or Mono filter installed).

j) PILOT OUTPUT
BNC (female) with pilot (19kHz) sine wave output 1V p-p (Stereo coder installed).

k) RF OUTPUT
N Type (female) RF output connector.

l) REMOTE PLL
This 15 pin D type (female) connector is used for remote frequency operation

m) TELEMETRY OUTPUT
This 25 pin D type (female) connector is used for monitoring and control purposes.

n) RS485 OPTION

This 9 pin D type (female) connector is used for remote monitoring of meter functions.

o) TELEMETRY CONNECTIONS (PL7)

FUNCTION	PL7 CONNECTOR PINS	CONTACT STATUS
RF FAULT	Pins 1 and 2	Voltage free contacts s/c for fault
VSWR FAULT	Pins 3 and 4	Voltage free contacts s/c for fault
TEMPERATURE FAULT	Pins 5 and 6	Voltage free contacts s/c for fault
PSU FAULT	Pins 7 and 8	Voltage free contacts s/c for fault
STEREO OPERATION	Pins 9 and 10	Voltage free contacts s/c for stereo
PLL LOCK	Pins 11 and 12	Voltage free contacts s/c for Lock
ENABLE COMMAND	Pins 13	o/c to enable ground to disable
MONO/STEREO COMMAND	Pins 14	o/c for Stereo ground for Mono
+12V / 20mA SOURCE	Pins 15	Supply for Test jig Leds
GROUND	Pins 17 and 18	Connected to chassis

NOTE: Alternative contact positions are available internally, (via Link selections on the Control module), for the Telemetry outputs.

p) **REMOTE FREQUENCY PROGRAMMING (PL2)**

15 pin connector	BCD Parallel Code	Code information
PL2 pin 1	x 0.1MHz	These four data lines contain
PL2 pin 2	x 0.2MHz	the information from 0 MHz to
PL2 pin 3	x 0.4MHz	0.9MHz in BCD code.
PL2 pin 4	x 0.8MHz	
PL2 pin 5	x 1MHz	These four data lines contain
PL2 pin 6	x 2MHz	the information from 1MHz to
PL2 pin 7	x 4MHz	9MHz in BCD code.
PL2 pin 8	x 8MHz	
PL2 pin 9	x 10MHz	These three data lines contain
PL2 pin 10	x 80MHz	the information, 80MHz, 90MHz
PL2 pin 11	x 100MHz	and 100MHz.
PL2 pin 12	Data enabled	+5V Logic '1'output.
PL2 pin 13	Lock indication	Open collector for Lock.
PL2 pin 14	Remote enable	Connect to 0V for Enable.
PL2 pin 15	Ground	0V

Example

Freq.	pin 11	pin 10	pin 9	pin 8	pin 7	pin 6	pin 5	pin 4	pin 3	pin 2	pin 1
107.6	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**1**	**0**
98.9	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**
88.5	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**

The logic '0' condition only requires an open circuit, and logic '1' condition has to be connected to PL2 pin 12.

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INSTALLATION

STAND ALONE CONFIGURATION (Stereo Exciter)

The following information sets out the general requirements for installation and operation of the above equipment in a "stand alone" configuration.

Note: The Audio program inputs (Left and Right), may vary in level from the standard factory sensitivity setting, and adjustment may have to be made internally (due to the Stereo coders built in Limiter). The Limiter threshold level is factory set to limit the deviation of the audio signal to ±62.5kHz. (Adjustable)

The pilot deviation is factory set to ±7kHz. The total deviation must not exceed ±75kHz. A fine deviation level adjustment of 0 to -3dB is available on the front panel to allow for small variations.

The operating frequency will normally be set at factory configuration, but if a different operating frequency is necessary then the unit top cover has to be removed and a new frequency selected on the Synthesizer module (980507). This is simply done by setting the direct readout on the rotary BCD switches.

1. ELECTRICAL CONNECTIONS

Ensure that the power on/off switch on the front panel is switched off before proceeding.

a) A/C MAINS SUPPLY (110V 60Hz).

Connect a/c power cable to IEC connector on back panel.

b) DC SUPPLY (+48V dc).

Connect dc power input to the dc supply terminals on the back panel observing correct polarity.

c) RF OUTPUT.

Connect the Antenna cable to the RF Output on the back panel using an N type connector or via suitable adapters.

d) AUDIO INPUTS.

Connect the Left and Right audio feeds (XLR male) to the Left and Right (XLR male) inputs on the back panel.

e) PRE EMPHASIS.

Set the pre emphasis switch to "ON" at the back panel.

Note: When the Telemetry connector is not in use the unit requires no external commands to enable the RF. The unit is also ready for Stereo operation. These functions can be changed via link commands on the Telemetry connector. See "9" Telemetry connections (PL7).

2. OPERATION

With the electrical connections completed above the unit is now ready for operation.

a) SWITCH ON SEQUENCE

Adjust the RF power control on the front panel, fully acw. then set the power on/off switch to ON.

b) FRONT PANEL LED's:

RF ENABLE (green led)	ON
PLL LOCK (green led)	ON
PRE EMPHASIS (yellow led)	ON
REMOTE PLL (yellow led)	OFF
RF FAULT (red led)	ON
VSWR FAULT (red led)	OFF
TEMP FAULT (red led)	OFF
A/C SUPPLY (green led)	ON
EXT. DC (green led)	ON
OVER VOLTAGE (red led)	OFF
PSU FAULT (red led)	OFF
RF PSU FAULT (red led)	OFF

c) ALC METER

All the Leds on the ALC meter should be OFF when PWR ADJ is set to minimum.

d) MULTIMETER

Select the four functions in turn and check the meter readings:

- TEMPERATURE Room ambient.
- PA CURRENT 0 Amps (no Leds on).
- FORWARD POWER 0 Watts (no Leds on).
- REFLECTED POWER 0 Watts (no Leds on).

e) DECODED MPX (VU Meters).

The Left and Right, VU meters will be indicating the incoming program levels and should be operating in the green zone of the meters with occasional peaks switching the 0dB yellow led on. The program peaks should not be operating in the red zone of the meters. If the meter is operating below the 0dB level (yellow), the internal sensitivity setting may have to be increased on the Stereo coder module to suit the incoming program levels. See calibration section for information.

The front panel deviation adjustment should not be used for the purpose of deviation adjustment in the Stereo operational mode. (This is for use with Wideband operation).
With the standard factory setting, the unit should not be over deviating due to the Limiter operation and protection. The Pilot led should be on, indicating that the stereo pilot signal is present assuming a Stereo signal is present.

f) SETTING THE RF POWER LEVEL

Select FWD POWER on the Multimeter and observe the reading.
Adjust the Front panel PWR ADJ potentiometer clockwise to set the RF output power to 250W. (This should be achieved with 16 LED's on).
Now check the PA CURRENT and REFL POWER readings:

PA CURRENT should be approximately 7 Amps (14 Leds).
REFL POWER should be less than 25W (15 Leds).

Check all the fault Leds on the front panel and ensure that there are no **red Leds** on.
The unit is now operational and only the final temperature must be monitored after approximately 15 minutes. The temperature reading on the front panel Multimeter should settle down to approximately 12°C above Room temperature.

WIDEBAND OPERATION

The connection for this mode of operation is almost the same as for the Stereo mode, the difference being in the connection of the Program inputs.
The Wideband system does not use the Left and Right program inputs or the pre emphasis switch (not normally supplied). The Composite input or MPX is connected to the MPX input on the unit back panel (BNC female).
The Decoded MPX meter is still operational in this mode and displays the Left and Right signals as before with exactly the same operation.
The Deviation adjust control on the front panel is now used to set the level of the modulation on the meters. The pilot led is also still operational if the incoming MPX signal is in stereo and will be off if the pilot is not present.

MECHANICAL

The unit is designed to fit in a standard 19-inch rack, cabinet structure. There is a Slide rail kit (option) available for this purpose which allows the unit to be installed in this manner.
Due to the weight of the unit it is not recommended to mount the unit without proper support.

INTERCONNECTIONS

The external cables and connectors are not normally supplied as standard kit, and due to the various customer configurations the customer must request the cable and connector requirements.

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Tel: 303-665-8000 Fax: 303-763-9900
E-Mail: sales@earthnet.net Web: www.larcan.com

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TECHNICAL INFORMATION

1. SYNTHESIZER MODULE (980507)

a) Power supply.

The single +21.5V dc input at **PL4 pin 4** is routed via diode **D25** to capacitor **C68**, which acts as a dc storage mechanism that allows the synthesizer module to remain temporarily operational during power dips in the final system. The dc voltage is then regulated via **IC14** (+15V) and **IC15** (+5V) before distribution to the other circuits.

Led **D28** indicates +15V supply on.

A voltage divider is formed via **TR6**, (+7V.) which is used to provide the a/c ground inputs to the operational amplifiers.

b) Synthesizer circuit. (refer to circuit diagram)

The **reference** for the synthesized operating frequency is obtained from a **10MHz** TCXO, **(IC3).**

The frequency output is then divided down by **6400** via a fixed divider **(IC2),** which provides the comparison frequency for the **PLL** (Phase lock loop) of **1562.5Hz**.

The frequency **programming** is obtained by another divider **(IC1),** which derives the comparison frequency (1562.5Hz) by a division ratio, set by Rotary BCD switches **SW1 to SW4**. A **pre scalar (IC12)** is used to divide the operating frequency by **64**, which is used as the input for IC1.

The synthesizer can be switched in steps of **100kHz** from **87.5MHz to 108MHz**.

Provision is made for **external operation** of the switching process via **PL2**, which is activated by connecting **pin 14** and **15** on **PL2** which **disables** the rotary BCD switches via diode **D12.** This in turn switches on transistor **TR1** that provides the logic 1 signal for the external data on **pin 12** of **PL2. Led D38** provides indication of remote operation.

Provision is also made for a **thumb wheel** switch option and connector **PL1** is available for this purpose.

IC8/c and IC8/d are used to provide **correct startup** of dividers at switch on.

c) PLL (Phase lock loop)

Comparison of the above 1562.5Hz signals is done by **IC9**, which provides an tri-state output on pin 13, depending on the phase relationship between the two signals. This output is then **integrated by IC10/a** and the dc output is then filtered by a **Low pass** filter IC10/b, IC17/a and **IC17/b.** The filter cuts off above 7Hz and provides ≥40dB attenuation above 25Hz. The loop delay of the filter is ≤50mS, which allows for fast correction of VCO disturbances.

The filtered dc output is now used to control the **VCO** (Voltage controlled oscillator) which is separately screened on the module. The filtered dc input above is buffered by **TR3** (which is a low noise transistor) and the output is used to drive the varactor diodes **D20, D21, D31** and **D22**. This arrangement provides very high linearity and deviation flatness. The

input **sensitivity** of the **VCO** is approximately **2.2MHz/Volt**, with a tuning voltage range between 3 and 12 volts

The Fet oscillator **TR4** is tuned to the operating frequency via **L2** and the above varactor diodes.

The output from the oscillator is **split** and **attenuated** to the separately screened Pre- scalar **(IC12)** and a RF output buffer **IC11**, which provides the final RF output to SK1 (Typically +10dBm).

d) **Out of Band detection**

The synthesizer has a feature to prevent **accidental** or **deliberate** operation outside the standard FM Broadcasting band. The circuit operates by **continuous monitoring** of the frequency programming lines at the synthesizer programmable divider IC1.

IC4/d, IC5/b, IC5/c, IC5/a, IC7/b, IC7/c, IC6/d and IC5/d, provide the data required detecting the condition of ≤ 87.5MHz.

IC4/a, IC6/a, IC6/b, IC6/c, IC4/c, IC7/a, IC4/b and IC8/a, provide the data required detecting the condition of ≥ 108MHz.

The signals are finally gated by diodes **D16** and **D15** which are input to **IC8/b** pin 5, which will force the **Lock led, (D18) off** This will also **inhibit** the **RF output** at **SK1** via **TR5,** which removes the dc supply to **IC11** (RF output buffer). The RF output is attenuated by ≥40dB.

e) **Out of Lock detection**

In the case of an **Out of Lock** condition, the Phase detector **(IC9 pin 1)** will provide an input to **IC8/b pin 4** that will switch off the **Lock led (D18)** and output buffer **(IC11)** as described above.

f) **Signal inputs and Phase correction**

The **MPX input** at **SK2** (BNC) can be operated in a Balanced or Unbalanced mode by insertion of LK1 (unbalanced). The input impedance is 600 ohms (Unbalanced) or 1.2k ohms (Balanced).

The output from **IC13/a** is routed via **R80 (MPX Adjust)** potentiometer, which is used to set the required level for operation.

The summing amplifier **IC13/b** is used to combine all the inputs including the three unbalanced **Auxiliary** inputs on **SK3, SK4** and **SK5** (BNC's). **SK3** and **SK4** have trimming potentiometers **(R82 and R84)** to set their required levels, while **SK5** is input directly (normally from Stereo coder option).

MPX phase correction is now required: Low frequency phase correction **(30Hz)** is done at **IC16/a** via **R93** while High frequency phase correction **(15kHz)** is done at **IC16/b** via **R116** (All pass filter).

A **MPX** output is provided for metering purposes at **PL4 pin 3** while the direct output is routed to the **VCO** via **R57.**

Input is provided for external level control at **PL3,** which is normally used to adjust the final deviation in the **Wideband mode** of operation.

The adjustment to control the **deviation flatness** is provided by **R53.** This is used to provide constant deviation by adjusting the dc conditions to Varactor diodes, **D21** and **D22,** when the synthesizer frequency is changed.

2. CONTROL MODULE (980508)

a) PSU and Internal Monitoring

The Control module has **two dc** power **inputs.** The dc (+48V battery) input is connected to **PL8 pin 3**, while the rectified and smoothed (a/c supply) input is connected to **PL8 pin 1**. The nominal voltage in this case is +28V.

Each of these inputs is monitored for indication purposes via **R88** and **R89**, which drive external Leds on the Exciter front panel. Led **D42** indicates voltage applied.

The two, dc voltages are combined via **D36** and **D37** (providing isolation), to **fuse F1** (protection). The voltage is now distributed to various points as follows:

- **IC7** (Switch mode Psu). This provides **+21.5V** output and has **Undervoltage startup** protection via **TR9** and **overvoltage protection** (nominally +52V) via **IC6/a** and **TR8.** Overvoltage **trip level s**et via **R102.**
- **IC9** (Switch mode Psu). This provides **-12V** output from the +12V supply.
- **IC8** (Linear regulator). This provides **+12V** output from the 21.5V supply.
- **PL4** (pins 5 and 6). This provides the dc output to the Stereo coder module (option).
- **PL5** (pin 4). This provides the +21.5V dc output to the Synthesizer module.
- **PL6** (pins 24 and 25). This provides the +21.5V dc output to the Display module.
- **IC6/b** (-12V Psu sensing). This provides Psu fault indication via TR10/RL6.

b) RF Psu Monitoring

PL2, (pins 3 and 4) provide a differential current monitor for the RF PA power supply via **IC4/a.** This configuration gives good common mode rejection and has an **adjustment (R69)** for zeroing the common mode signal. The output is now amplified by **IC4/b** to give a voltage level proportional to the RF PA Current. (I.e. 1 volt = 1 amp). **Level** adjustment is via **R72** (I Cal). The voltage is then output to **PL6 pin 16.**

PL2 (pin 1) provides the voltage sensing for the RF PA power supply, and **IC5/a** detects for low voltage against the +12V reference. The sense output is then distributed to **PL6 pin 26.**

c) Forward RF detection and Alarm

The Forward RF monitoring input is via **SK1** (SMB), which provides a RF signal (nominally 0dBm), proportional to the RF forward power of the Exciter. A dc output proportional to the input power is achieved via **D1, D2 and IC1/a** (The diodes provide temperature compensation). Adjustments are provided for **Level (R8)** and **Offset (R6).** The Offset voltage is adjusted for **0.8V** nominal with no input signal at SK1. This is done to allow the use of linear metering of the RF Forward power in the Display module. The nominal adjusted dc level is then **+5V/OdBm.**

IC2/a provides the detection for a Forward RF Alarm, with **R10 (FWD Alarm cal)** setting the required threshold when the level is low. The output is used to give an Alarm signal via **TR1/RL1**.

d) **Reflected RF detection and Alarm**

The Reflected RF monitoring input is via **SK2** (SMB), which provides a RF signal (nominally 0dBm), proportional to the RF reflected power of the Exciter. A dc output proportional to the input power is achieved via **D5, D6 and IC1/b** (The diodes provide temperature compensation). Adjustments are provided for **Level (R21)** and **Offset (R19).** The Offset voltage is adjusted for **0.8V** nominal with no input signal at SK2. This is done to allow the use of linear metering of the RF Reflected power in the Display module. The nominal adjusted dc level is then **+5V/OdBm.**

IC2/b provides the detection for a Reflected RF Alarm, with **R24 (REFL Alarm cal)** setting the required threshold when the level is high. The output is used to give an Alarm signal via **TR2/RL2**.

The detected dc output from **IC1/b** is routed via **IC2/c** and **R32 (REFL Alarm trip)**, which sets a threshold to activate the **Timing circuit at IC2/d.** This provides a **10 second** re-cycle time in the Exciter if the High reflected power persists. When the output of **IC2/d** is low the **Reflected Alarm is held on via D7**, which latches the Alarm indication during re-cycling via IC2/b.

e) **Temperature detection and Alarms**

The temperature sensing **Thermistor**, which is mounted in the RF PA module is input at **PL1** (pins 1 and 2). The nominal resistance of the Thermistor is 4700 ohms at 25°C. **R41 (Temp cal)**, is adjusted to obtain a voltage output at **IC3/a** of **2.5V** for **25° C**. The circuit sensitivity is **10° C per Volt**.

The Temperature detected output voltage is now routed via **IC3/b**, **TR3** and **RL3c**. to give an Alarm indication, and **R45 (TEMP Alarm cal)** is provided to set the alarm level (normally 50°C). The voltage is also routed via **IC3/c** to provide a fixed **trip level** at **65° C**. This output switches off the RF PA Power supply.

f) **ALC (Automatic level control)**

The ALC output at PL3 pin 2 is derived from **IC3/d**, which has the following inputs.

- **ALC CONT.** This dc input is derived from the Display module via PL6 pin 19.
- **FWD-V.** This dc input is derived from **IC1/a** (Forward power detected dc).
- **REFL-V.** This dc input is derived from **IC1/b** (Reflected power detected dc).
- **TEMP-V.** This dc input is derived from **IC3/a** (Temperature detected dc).
- **CURR-V.** This dc input is derived from **IC4/b** (RF PA current detected dc)

The circuit operates by **comparing** the set voltage from the **ALC Control** to the **FWD-V** voltage derived from the RF Forward power. This is done to correct any change in the

output power in the Exciter with respect to the Control voltage (The ALC Output is used to control the Gain of the RF PA via the Mosfet gate voltage). This arrangement controls the power output of the RF PA and the other inputs to the circuit are only there for protection purposes, by reducing the output power during fault conditions.

- **LK1** is used to insert protection from **High reflected power**. (option)
- **LK2** is used to change the standard Temperature back off level from **55° C** to **60° C**.
- **LK3** is used to insert protection from **High RF PA Current**. (option)

g) **Telemetry connection (see circuit diagram)**

The Telemetry outputs at **PL7** provide **voltage free** contacts for **six functions**,

- **RF Fault.** This provides indication of low Forward power.
- **VSWR Fault.** This provides indication of High reflected power.
- **TEMP Fault.** This provides indication of High temperature at RF PA.
- **PSU Fault.** This provides indication of internal PSU fault.
- **STEREO Indication.** This provides indication of Stereo Pilot (19kHz)
- **PLL Lock.** This provides indication of Synthesizer in Lock.

The **Pilot detection** is routed from the Display module via **PL6 pin 6** and **TR5/RL4/c**.

The **PLL Lock detection** is derived from the Synthesizer module via **PL5 pin 1** and **TR6/RL5/c**.

The **Enable input,** on **PL7 pin 13** requires a ground connection to disable the RF PA. This is done via **D29, D23, and TR4** to **PL2 pin2**.

The **Mono/Stereo** input, on **PL7 pin 14** requires a ground connection for Mono. This is only used when the Stereo coder option is installed.

The **+12VS** voltage output at **PL7 pin 15,** is a **12V/20mA** current source used for test purposes and external control use.

3. DISPLAY MODULE (980509)

a) Psu and Input requirements

The power supply input is connected at **PL1 pin 24 and 25**. This dc input is nominally **+21.5V** with the **0V** connection at **PL1 pin 1 and 2**. The **-12V** dc input is connected to **PL1 pin 21**. **IC3** provides the internal **+12V** supply and **IC12** provides the **+5V**.

PL1 FUNCTION TABLE

PL1	Function	Comment
PL1 pin 1	0V	Ground connection
PL1 pin 2	0V	Ground connection
PL1 pin 3	MPX Input	MPX metering input
PL1 pin 4	Lock (indication)	Provides data for Led D8
PL1 pin 5	Enable (indication)	Provides data for Led D7
PL1 pin 6	Pilot (Decoder output)	+9V nom. for detection
PL1 pin 7	Pre emphasis (indication)	Provides data for Led D1
PL1 pin 8	RF Fault (indication)	Provides data for Led D2

PL1 pin 9	Reflected Fault (indication)	Provides data for Led D3
PL1 pin 10	Temp Fault (indication)	Provides data for Led D4
PL1 pin 11	Psu Fault (indication)	Provides data for Led D5
PL1 pin 12	O/V Fault (indication)	Provides data for Led D12
PL1 pin 13	Ext. dc (indication)	Provides data for Led D11
PL1 pin 14	Reflected Voltage (input)	dc for Refl power meter
PL1 pin 15	Forward Voltage (input)	dc for Fwd power meter
PL1 pin 16	Current Voltage (input)	dc for Current meter
PL1 pin 17	Temp Voltage (input)	dc for Temp meter
PL1 pin 18	ALC Voltage (input)	dc for ALC meter
PL1 pin 19	ALC Control (Set power)	dc output from R27
PL1 pin 20	ALC Fault	dc input for fault detection
PL1 pin 21	-12V dc	-12V dc input
PL1 pin 22	Remote PLL (indication)	Provides data for Led D6
PL1 pin 23	A/C Internal (indication)	Provides data for Led D10
PL1 pin 24	+Vs	+21.5V dc input
PL1 pin 25	+Vs	+21.5V dc input
PL1 pin 26	RF Psu Fault (indication)	Provides data for Led D9

b) **ALC Meter and alarm**

The ALC Voltage at **PL1 pin 18** is routed via **R17** (ALC meter cal), which is used to calibrate the scale for the ALC Front panel meter. The dc input signal, which is normally between **-5V** and **+3V** is offset via **R19**, which is connected to the +5V supply. This allows the meter to operate on a positive voltage only, at a scale factor of **1V/Led**. (9 Leds). The input signal at **IC1 pin 5** (Linear scale bargraph driver) is used to drive the Leds **(D13 to D21)** of the **ALC Meter**. The Bargraph drivers are operated in **dot** mode but configured to run in **bar** mode by connecting the Leds in series, this reduces the current consumption by a factor of 9 in this case.

The **ALC Fault** alarm Led **(D22)** derives its signal from **PL1 pin 20**, via **IC7/d** which operates as a comparator, turning the Fault Led on at a level set by **R23.**

c) **Multimeter operation**

The **Multimeter** consists of a **20 Led** custom **bar display** using linear scale Bargraph Drivers, **IC10** and **IC11**, which operate the Leds **D47 to D66** inclusive. **D47** is the least significant. The **sensitivity** of the driver input is **1.2V** dc, for Full-scale deflection. The Bargraph drivers are operated in **dot** mode but configured to run in **bar** mode by connecting the Leds in series, this reduces the current consumption by a factor of 10.

A Four-way selector switch using a **Push button (SW1)** is formed via **IC8** and **IC9**. These operate on an increment function that allows a One in Four selection. **IC8** is a counter that counts up from **0 to 3** and resets on the count of **4**. **IC9** is a dual "One in Four" switch whose outputs are controlled by the data from **IC8** (Two lines). **IC9** pins **1,5,2** and **4**

operate **Leds D46, D45, D44 and D43**, which indicate **which** switch selection is in operation.

The four inputs to the switch are as follows:

- **Temperature. R47** is used to calibrate this input function.
- **Current. R52** is used to calibrate this input while **R51** sets the offset null (0 Amps).
- **Forward power. R55** is used to calibrate this input which is converted from a Square law scale to a Linear scale via **IC7/b** and temperature compensated diode arrangement **D78** and **D79**.
- **Reflected power. R62** is used to calibrate this input which is converted from a Square law scale to a Linear scale via **IC7/c** and temperature compensated diode arrangement **D80** and **D81**.

d) **Stereo decoder**

The **Stereo decoder** input is derived from the **MPX input** on **PL1 pin 3**, which is decoded via **IC14** (Stereo decoder chip). The IC provides both Left and Right decoded outputs on **pins 11** and **10** respectively. The IC operates from a **456kHz** ceramic resonator, which provides very good stability while requiring no adjustments. Stereo separation of 40 dB (Typical) is obtained.

The **19kHz Pilot** detection is obtained via **pin 18** of the Stereo decoder chip, and is a open collector output (open when pilot detected). This output is inverted by **TR3** to activate **Led D67 (Pilot)** and is also routed to the **MPX VU Meter** via **TR4/LK1**. The detected pilot signal is also routed via **D83** to **PL1 pin 6.**

The Left and Right outputs are then filtered by Fourth order **Low pass** networks **IC13/a, IC13/b, IC13/c** and **IC13/d**, which remove the **19kHz** and **38kHz** products produced in the Decoding process and prevent errors in the VU meter operation.

e) **VU Meters and peak detection circuits.**

The **Left** and **Right** outputs from the Stereo decoder are routed via **R28 (Left meter level)** and **R37 (Right meter level)** which are used to calibrate the VU meters.

Two identical circuits are used to convert the incoming audio signals to a peak dc level. This is done by IC4/a, IC4/b, IC4/c and IC4/d. Taking one of the sections only for description purposes the circuit operates as a **precision full wave peak detector** which has a very fast attack time (1.7mS) and decay time (650mS), conforming to the **DIN 45406 Specification**. This calls for a response **1dB down** from steady state for a **10mS** tone burst and **4dB down** for a **3mS**-tone burst. The decay time is **20dB** in **1.5 sec's**.

The **VU meters** operate on a standard VU scale and the bargraph driver used to do this is calibrated internally to achieve this. **IC5** and **IC6** form the **Left** and **Right** bargraph drivers, which are operated in dot mode but configured in bar mode by connecting the Leds in series. This is done to reduce current consumption. The sensitivity of the bargraph driver is 1.2V. Leds **D23 to D32** form the display for the Left channel with Leds **D33 to D42** for the Right channel.

The **Right VU meter** bargraph driver has a **inhibit function** at the input. This is provided such that when the unit is operated in **Mono** the customer can choose to have the **Left meter**

operational only (LK1 in position B) or when operated in **stereo**, if the pilot signal fails then the **Right meter** could be **inhibited automatically (LK1 in position A)**. This provides the customer with excellent visual status of the real time program.

f) **RS 485 Option**

The display module has provision via **PL2** to connect a **RS485 module**. The purpose of this is to provide **remote viewing** of the **display meter functions**. The +21.5V internal dc is routed via a fuse (F1) and is connected to **pin 20** of **PL2.** Provision is made for an indication of the RS485 module connection via **Led D85**.

The monitored parameters are:

Parameter	PL2 Connection	Comment
PA Current	pin 1	0 to 1.2Vdc voltage output
Reflected power	pin 3	0 to 1.2Vdc voltage output
Forward power	pin 5	0 to 1.2Vdc voltage output
Left VU meter	pin 7	0 to 1.2Vdc voltage output
Right VU meter	pin 9	0 to 1.2Vdc voltage output
Temperature	pin 11	0 to 1.2Vdc voltage output
ALC meter	pin 13	-5 to +3Vdc voltage output
Pilot status	pin 15	+0.7V for pilot/0V no pilot

These outputs are routed to the Analog to Digital converters in the RS485 module and the meter scales and alarms are calibrated and set in the software.

4. RF PA MODULE (980510)

a) **Psu and Regulator**

The RF PA requires two dc-input supplies:

- The **+VR** supply is the main supply for the PA and is typically between **+50V** and **+60V**. This supply is connected to the main regulator power devices (which are capable of supplying up to 10 Amps current) and connected to **E29 (circuit reference)**. The output of the regulator is at **E33.** The incoming dc has a ripple content of approximately 100mV p-p.
- The **Aux. supply** (which is approximately **2.5V higher** than the main supply) is connected to **TR3** (via PL4) which operates as a **7mA constant current source**, whose current output is supplied to the main regulator devices at **E30, E31 and E32**. Zener diode **D7** controls the maximum voltage at the regulator output to 52**V**. Filter capacitor **C31** ensures that no a/c ripple appears at the regulator output.

The main regulator can be disabled via **TR4 / D10** which effectively shunts the constant current source to ground thus removing the output voltage. **TR4** is switched via an external input from the control module.

Resistor **R35** is used to monitor the current in the RF PA section and provision is made for external monitoring via **R37, R38 and R39**. Led **D13** provides a visual indication of the presence of the regulated supply.

The regulator has the ability to operate at low dc voltages, as the a/c ripple content is always very low in level. This gives a large advantage to the PA operation as there is no AM produced even with a very low a/c mains supply.

b) **RF Amplifier stages**

The RF amplifier comprises a **three-stage amplification** block. The **first stage** (Bipolar) amplifies the RF input (E1, E2) from **10dBm to 20dBm** via **IC1** (Wideband amplifier). The **second stage (Mosfet)** amplifies the RF signal to approximately **5 watts** via **TR1** (Wideband amplifier). TR1 has a **potentiometer R6** to adjust the device gate voltage for optimum operation which requires a idling current of about 100mA (No RF input).

The final stage **(TR2)** is operated in push-pull mode via a **3:1 wideband-input transformer T1** and matching trimmer capacitor **C8**. Resistor **R11** is used to stabilize the dynamic impedance of the Mosfet input. The output **wideband transformer (1:2) T2** has a centre tap in which the dc input is applied. This provides optimum balance in the push-pull mode of operation and ac de-coupling is provided via **L2** and associated components. **R25** is provided to set the gate voltage for the output mosfet, which is operated in Class C. (See manufacturers data sheet for individual gate voltage settings). D.C. blocking capacitors **C41** and **C42** are provided to remove the dc component.

c) **RF Harmonic filter**

The output from the final RF stage is routed via a 50 **ohm 1/8 wavelength Balun** to the RF filter stage. The filter used is a **Hybrid ninth order** type utilizing two notches. The first notch is designed to eliminate the third harmonic source current (by providing high impedance) from the final mosfet and is centered at 185MHz. The filter ripple is less than **0.1dB** (0 to 120MHz) and reduces all harmonics to **£ -70dBc**.

d) **RF Couplers**

Three microstripline couplers are available to provide **Forward**, **Reflected** and **Monitoring** RF signals, two of which are used for control and protection within the Exciter. The 150p capacitors at the coupler outputs are required to ensure a flat RF response. A TAB capacitor is provided on the Reflected coupler to optimise the Directivity. The RF output at E21 and E22 is connected externally to a 50 ohm N Type connector.

e) **Temperature sensor.**

A Thermistor is provided **(R27)** at the base of the Final output device TR2, which is used to monitor the Heatsink temperature and whose output is connected externally.

5. PSU MODULE (980515)

a) A/C Supply

The a/c input to the power supply is provided by a external 48V a/c Transformer and Full wave Bridge rectifier which is connected to **SK1 pin 1** (+) and **SK4 pin 1** (0V). This raw dc input which is indicated by **Led D2** is smoothed by capacitors C1, C2, C3 and C4. (4 x 4700uF) which is then routed via **SK2 pin 1** through an external Inductor (15mH) and back to the Psu Pcb at **SK2 pin 3**. This smoothed dc supply is then filtered by **C5** (4700uF) to eliminate all ripple components. This constitutes the main dc supply from the a/c mains and supplies approximately 8A.

b) +48V dc supply (battery)

The **+48 dc battery supply** input is connected to **SK1 pin 3** (+) and is indicated by **Led D1**. The **0V**-battery return is connected to **SK4 pin 3**.

c) RF PA Main supply

The above supplies in **a)** and **b)** are combined via **SK3 pins 1 and 3** to an external Diode bridge to provide isolation between the supplies. This output is used to supply the main RF PA. **Fuse F1** (10A) provides protection on the a/c supply.

d) RF PA Aux. supply

The battery supply and raw dc supply are combined via **D4** and **D5** (for isolation) to provide the **auxiliary** supply to the RF PA via **R5** and **PL4 pin 1**. This supply is smoothed by **C6** to reduce the a/c ripple.

e) Control supply

The **battery** supply and **raw dc** supply are connected to **PL1 pin 3** and **pin 1** respectively via diodes **D6, D7, D8** via F2/D3 to power the Control, Display, Synthesizer and Stereo coder modules. The dc return **0V** is connected to **PL1 pin 2**.

f) Fan supply

The combined supply at **PL2 pin 1** is connected to power the built in fans at the RF PA assembly. The dc return **0V** is connected to **PL2 pin 2**. The current requirement of the fans is approximately 600mA.

6. FAN PSU MODULE (980518)

a) Power supply

The combined dc supply from the PSU Module is input at SK1 and is regulated by a switch mode power supply IC1 which supplies approximately +23V to the Fans via connectors **SK2 (+)** and **SK3 (0V).**

Four fans are used to cool the RF PA assembly and are industry standard, +24V dc type. 80x80mm.

7. STEREO CODER MODULE (980512)

a) **Psu and distribution**

The dc input is supplied via **PL4 pins 5 and 6**, and is typically between **24V to 40V dc**. The **ground** is connected to **PL4 pins 1 and 2**.

The incoming dc is routed via diode **D7** that is provided for protection against negative voltages. The dc is then applied to **IC26**, which is a **switch mode regulator** providing a dc output of **16V** and indicated by **Led D10**. The regulator is prevented from switching on, (until the dc input reaches approximately 16V), by **TR2** and **D8**.

The +16V supply is applied to **IC27** to obtain a **+12V** stabilized output which is the connected to **IC28** via **D11** to obtain a **-12V** output. (This is also a switch mode supply). **L3** is incorporated to **remove any switching spikes** from the **-12V** switch mode supply before distribution to other circuits.

The ±12V dc supplies are distributed to Linear regulators **IC14 (+5V)** and **IC15 (-5V)** and are indicated by **Leds D2** and **D3** respectively. These supplies are required by the HCMOS digital circuitry.

b) **Audio Input circuits**

(The Left and Right input circuits are identical and only one (Left) needs to be described).

The audio input at **PL1** can be balanced or unbalanced with an input impedance, which is nominally **600 ohms**. Capacitors **C1** and **C2** are provided to remove any RF signals. **IC1/a** is configured as a **differential amplifier**, which is required to remove any common mode signal when the input is operated in balanced mode. The input circuitry has the capacity to operate up to 20V p-p (+19dBm).

Trimmers **R9 (Left) and R37 (Right)** are provided to allow for **level adjustment** to customer requirements which generally vary from -6dBm to +9dBm.

Note: This is the main adjustment in the final Exciter.

IC1/b is a buffer amplifier with a gain of +6dB.

c) **Audio Limiter**

The buffer outputs above are connected to op-amps **IC3/a** and **IC3/b** whose gains are controlled via **IC4 (Limiter gain cell)**. The cell operates by monitoring the outputs of **IC3/a** and **IC3/b** and compares them to a preset level set by **R21 (Limiter threshold adjust)** at **IC5**. Both **Left** and **Right** signals are monitored and if either or both signals exceed the preset threshold (which is equally positive and negative), the **comparator IC5** switches on (open collector output). This activates **TR1** and charges **C16**, increasing the dc level into **pins 1 and 16 of IC4**. This in turn reduces the gain of **IC3/a** and **IC3/b** via their negative feedback loops. The output from the **comparator IC5** is a narrow pulse train and if the Limiter circuit is totally overloaded or faulty, the pulses become much wider and start to illuminate **Led D1**. The nominal input to the Limiter is 3.1V p-p.

The attack time of the Limiter is approximately 1mS and decay time, 100mS. This is achieved by **TR1/C16**, which is essentially a peak detection circuit, which is discharged slowly by the high impedance into **IC4 pins 1 and 16**.

d) **High pass filter**

The output from the Limiter circuit is connected to **IC20/a** and **IC23/a**, which form the High pass filters, removing any low frequencies below **10Hz**. This is done to remove any dc switching transients contained in the incoming audio program.

e) **Pre emphasis**

The outputs of the High pass filters are routed to the pre emphasis circuits **IC20/b** and **IC23/b** which have a time constant of **50uS (LK2 and LK3 In)** or **75uS (Links out**). The pre emphasis is **selected** by operating Relay **RL2,** which requires an external s/c between **PL3 pins 1 and 2**. **R104** and **R129** are provided for setting the required input level to the Stereo coder section (see stereo coding section).

f) **15kHz Low pass filters**

The **Left and Right 15kHz filters** are identical and only the Left will be discussed.

The filter has **three** distinct sections and was designed for **minimum ripple** and **group delay**.

- The first section, **IC21/a** and **IC21/d**, is configured as a notch filter centered at **23.8kHz**. The notch frequency can be adjusted by **R108**.
- The second section, **IC21/b** and **IC21/c**, is configured as a notch filter centered at **19kHz**. The notch frequency can be adjusted by **R113**.
- The third section, **IC22/a** and **IC22/b** is configured as a **fifth order 19kHz** low pass filter. Adjustment is provided by **C101**.

The filter is adjusted by monitoring **TP4**, which is the output of a **differential amplifier IC29**, with very high common mode rejection. This unique feature enables very simple set up of the 15kHz filters by allowing the **Left or Right filter** to be **measured individually** and also allowing simple **differential measurement** with both **Left and Right together**. This is very important when setting up the **Mono into Stereo** calibration in the final Exciter.

The adjustment is made simple by setting the notches as described and adjusting the trimming capacitor for a flat response at **15kHz** (with respect to 1kHz). The response of the filter should be as follows when adjusted:

1kHz	8kHz	12kHz	15kHz	19kHz	≥23kHz
0dBm	+0.15dBm	+0.1dBm	0dBm	-40dBm	-40dBm

The amplitude variance of this filter is very small and should not present any problems in set up, unlike other filters found in competitive equipment.

g) **Stereo coding and switching**

IC6/a and crystal XL1 form the reference oscillator**. F**ine frequency adjustment is via **C38**. The oscillator operates at **4.256MHz** and is buffered by **IC6/b**.

The square wave output is then divided by **8** (via **IC7/a)** to give a frequency of **532kHz**.

The **532kHz** clock signal is applied to **IC8/a** and **IC8/b** (dual 4 bit shift register) which forms a **14 step multiplexer** via **IC9** and **IC10/a**, allowing a count of **7 (532khz/7 = 76kHz)**. Each

output has a pulse repetition frequency of **76kHz** with a **1.879uS** pulse. The outputs of **IC9** are routed to a Quad bilateral switch **(IC11)** which with precision weighting resistors **(R53 to R60)**, a **14 step** replica of a **38kHz sinusoid** is produced. This has a distinct advantage over direct switching at 38kHz, as any spurious products produced appear at frequencies **532kHz and above** and are easy to filter.

The output of **IC8 pin 11** is routed via **IC13/a**, which produces a **38kHz** square wave at its outputs. These outputs are applied to another Quad bilateral switch **IC12** which alternately switches the Left and Right audio signals at the inputs of this switch at 38kHz These signals are applied to the weighting resistors above.

The output of **IC13/a pin 5** is routed via resistors **R51** and **R52**. (R51 is used to vary the phase). This 38kHz signal is divided by **2** (via **IC7/b)**, whose output is at **19kHz**. This signal is then routed to the 19kHz bandpass filters.

The stereo coded signal produced has virtually no commutation products due to the use of High speed CMOS switching and the final output from the weighting resistors is routed to **IC17** via **R73**.

h) **19kHz Bandpass filters**

The **19kHz** square wave above is routed to **IC16/a** and **IC16/b**, which are configured as bandpass filters centered at 19kHz. These filters convert the 19kHz square wave to a sinusoid with ≤0.1% distortion. R63 and R67 adjust the filters for maximum amplitude at 19kHz and the output from **IC16/b** is routed to a **SMB** connector **SK1**. This is for external use and isolation is provided via **R69**.

The signal is also routed to **IC17** to provide the 19kHz pilot signal in the final Composite MPX output. The pilot level is adjusted via **R70**.

i) **MPX Filter**

The output from **IC17** buffer is routed to a **fifth order Linear phase filter** (**IC18/a and IC18/b)** which provides **³ 50dB** attenuation above **532kHz**. The required filter Passband **(53kHz)** has a flatness characteristic of **£ 0.02dB** with a phase variance of **£ 0.1°.** Allpass filter **IC19/a** provides a Fine phase adjustment of the stereo multiplex signal at **15kHz.** The total combination exhibits a group delay variance of **£ 10nS.**

j) **MPX output buffer**

R91 (MPX Level) and **R96** (Mono Level) provide adjustment for their respective functions and **RL1** provides the switching mechanism for **Mono** or **Stereo**. The final signal is routed via buffer **IC19/b** to the output at **SK2** (SMB connector).

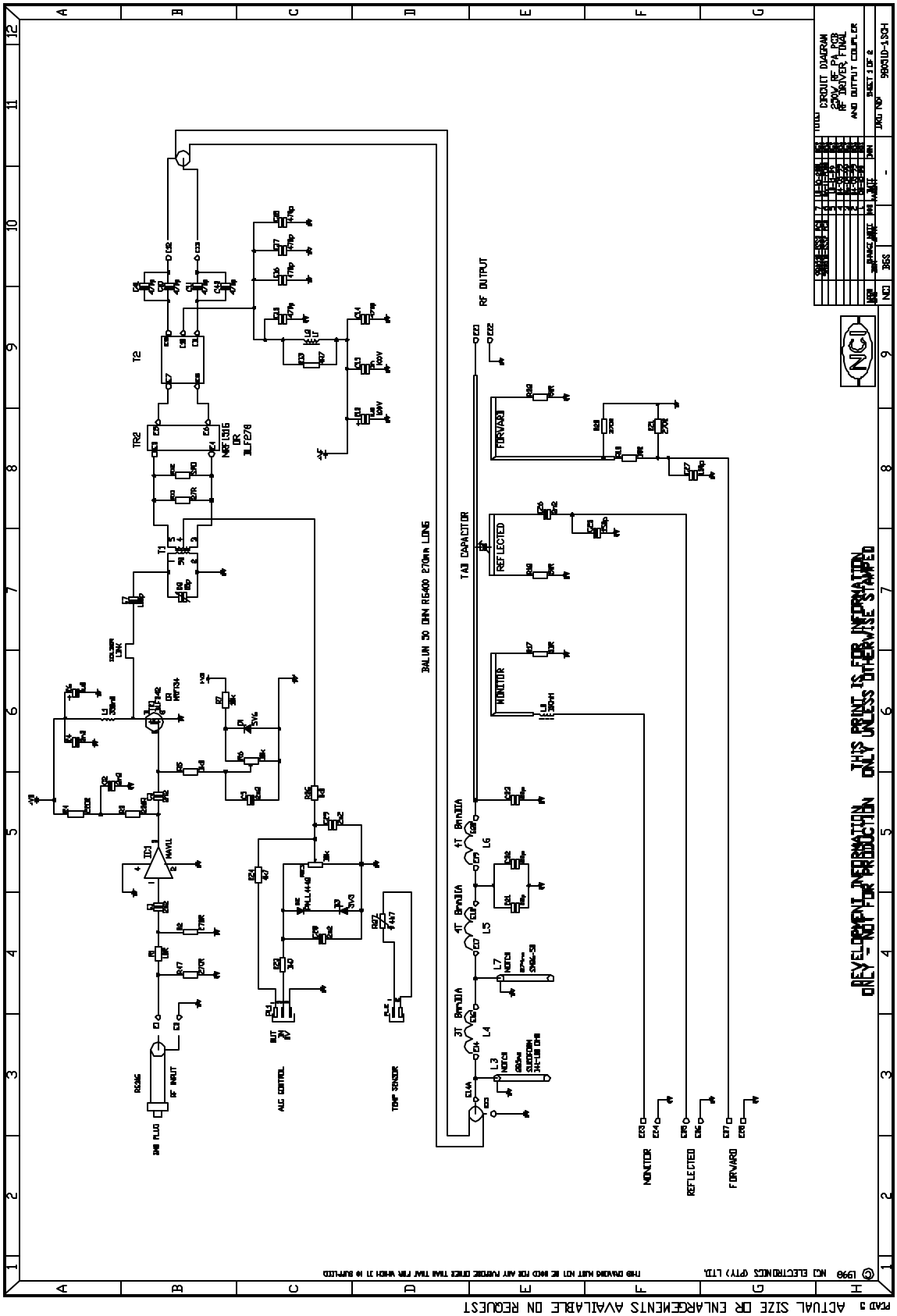
250W STEREO TRANSMITTER/EXCITER

TECHNICAL MANUAL

Maintenance Information

LARCAN Denver Office (LARCAN-TTC)
1390 Overlook Drive #2, Lafayette, CO 80026 USA
Tel: 303-665-8000 Fax: 303-763-9900
E-Mail: sales@earthnet.net Web: www.larcan.com

Issue Date: 21 Jan 2003


DEVELOPMENT INFORMATION
ONLY - NOT FOR PRODUCTION
THIS PRINT IS FOR INFORMATION
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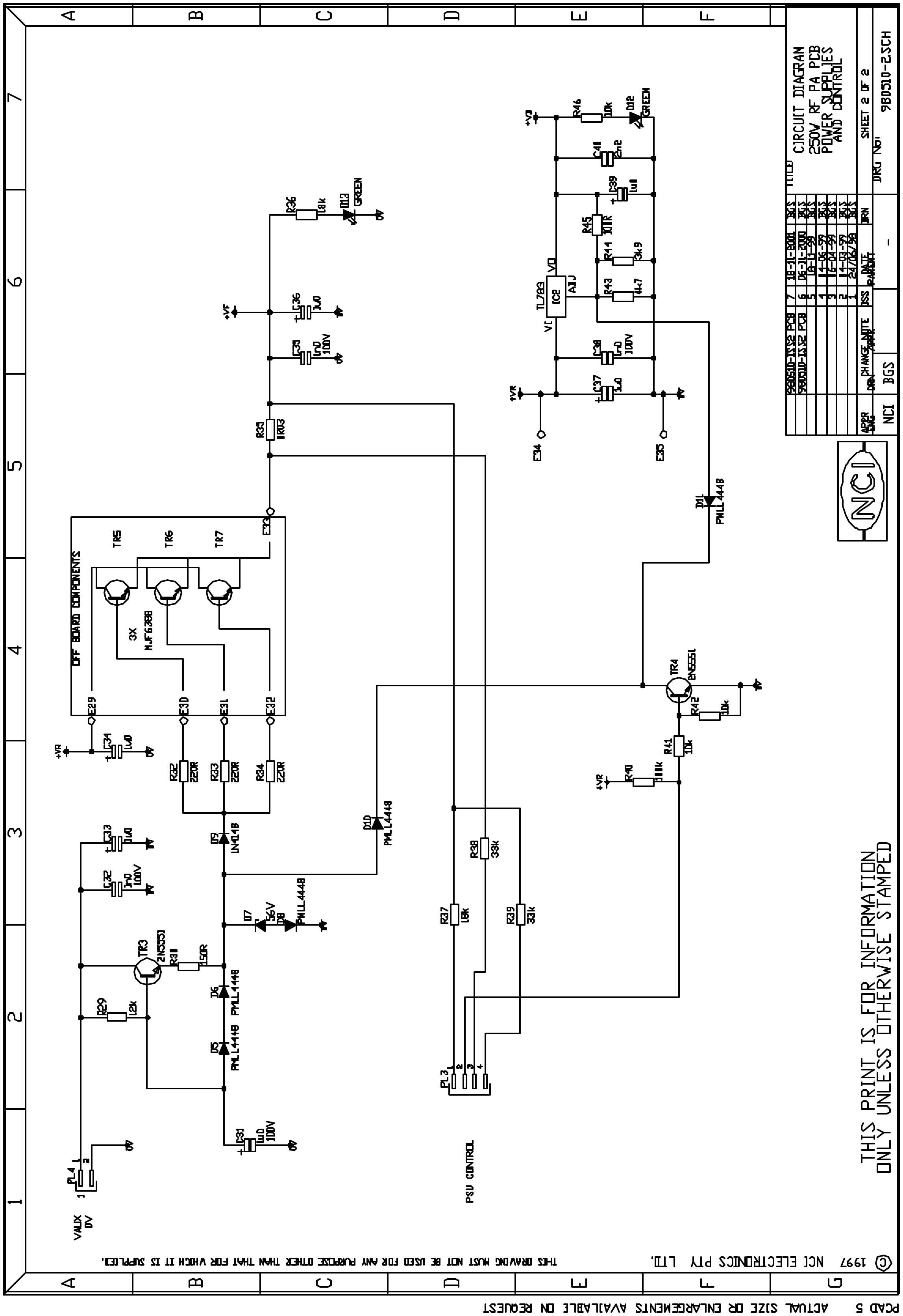
CIRCUIT DIAGRAM
250W RF PA PCB
RF DRIVER FINAL
AND OUTPUT COUPLER
SHEET 1 OF 2
DRG NO 98501D-153H
NCI ELECTRONICS (PTY) LTD.
ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
RF OUTPUT
FORWARD
REFLECTED
MONITOR
TAB CAPACITOR
BALUN 50 OHM RG400 270mm LONG
RF INPUT
AGC CONTROL
TEMP SENSOR
MONITOR
REFLECTED
FORWARD


CIRCUIT DIAGRAM
250V RF PA PCB
POWER SUPPLIES
AND CONTROL
SHEET 2 OF 2
9B0510-2.SCH
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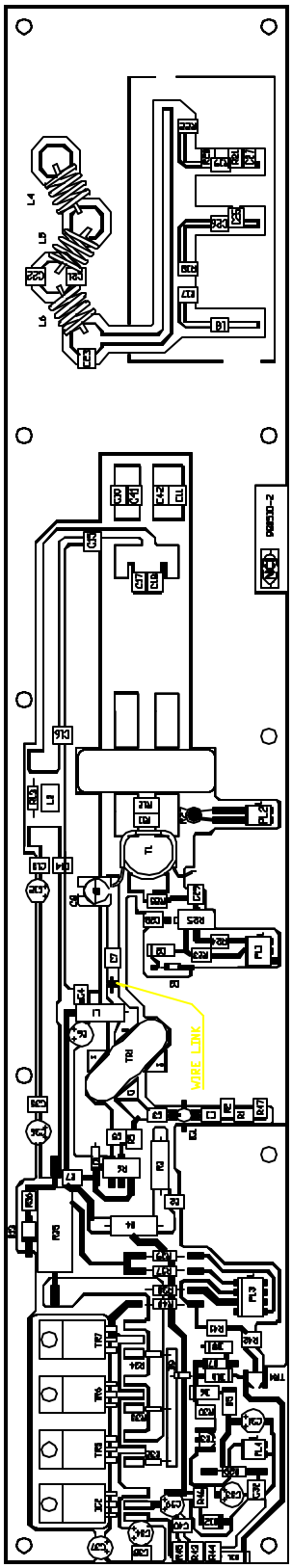
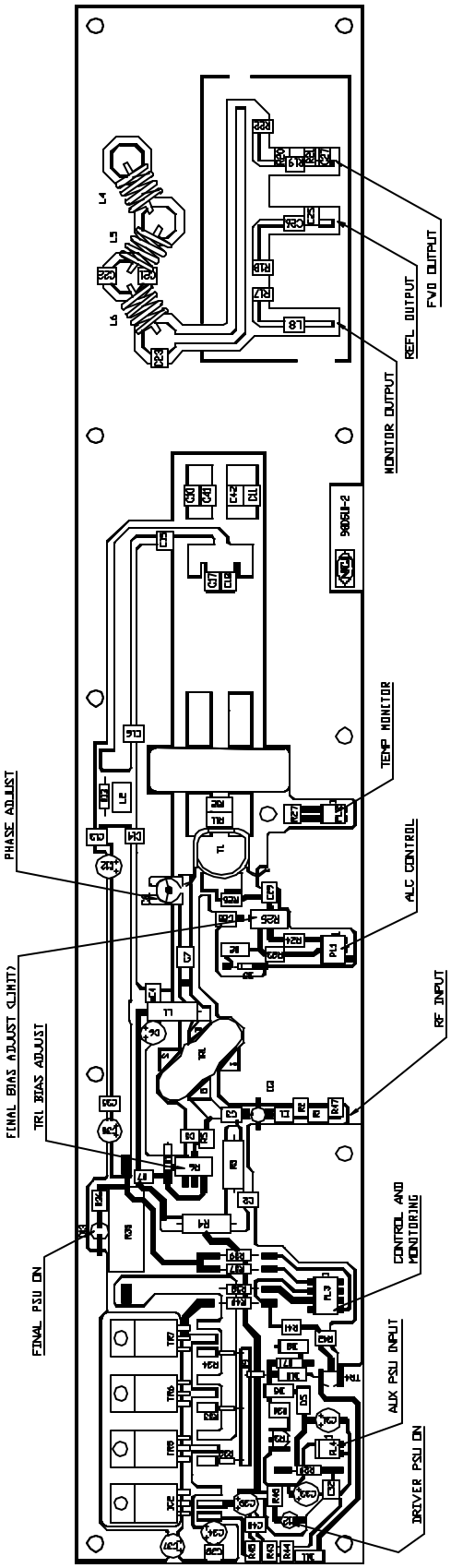
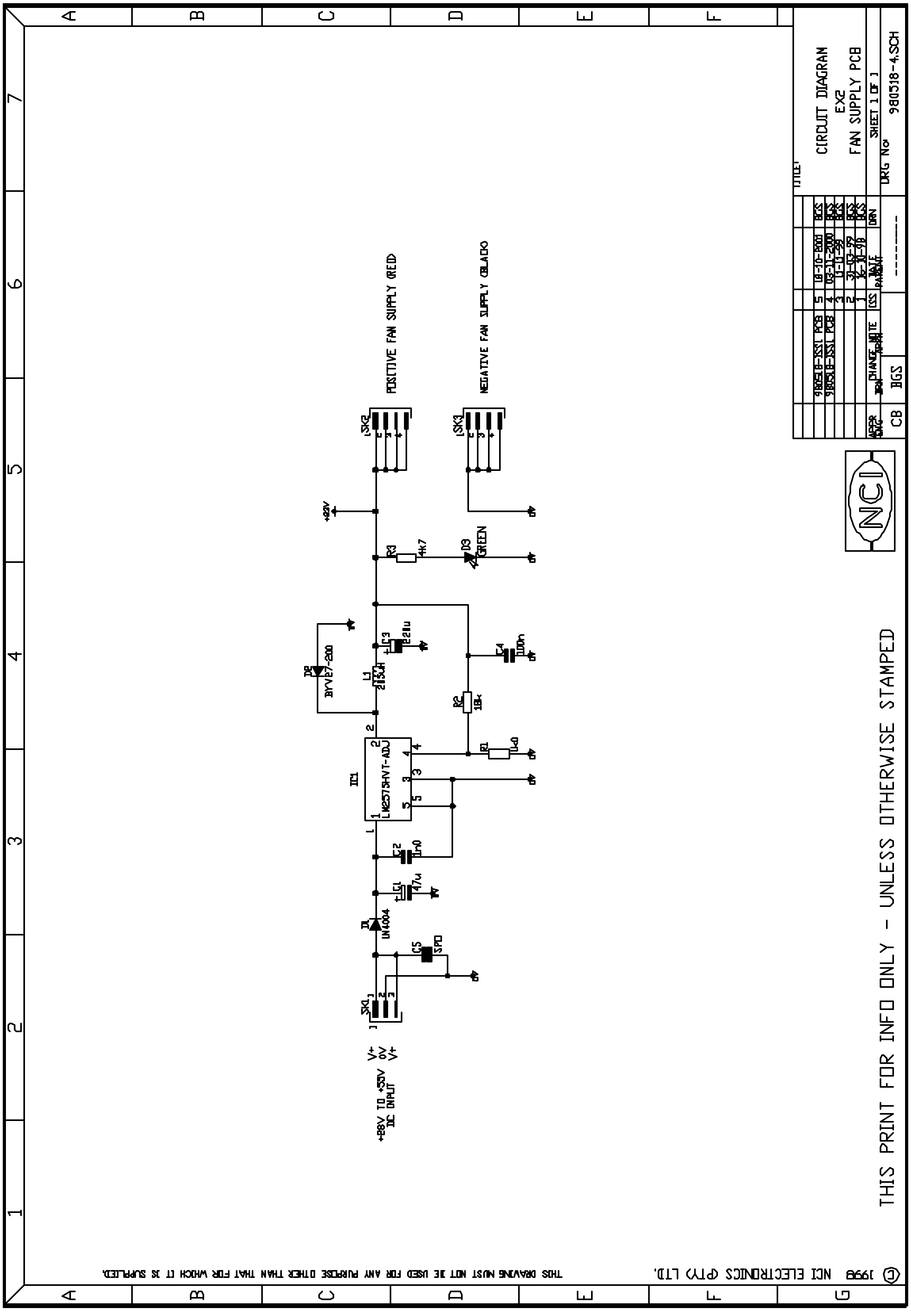
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
OFF BOARD COMPONENTS
3X MJF6388
PSU CONTROL
VAUX 0V

250W PA PCB ASSEMBLY 980510-2.PCB FILE:980510A2.DWG



980510A2 ASSEMBLY SHEET 1 OF 1


FVD OUTPUT
REFL OUTPUT
MONITOR OUTPUT
TEMP MONITOR
ALC CONTROL
RF INPUT
CONTROL AND MONITORING
AUX PSU INPUT
DRIVER PSU ON
FINAL PSU ON
TRI BIAS ADJUST
FINAL BIAS ADJUST (LIMIT)
PHASE ADJUST


CIRCUIT DIAGRAM
EX2
FAN SUPPLY PCB
SHEET 1 OF 1
DRG No 980518-4.SCH
POSITIVE FAN SUPPLY (RED)
NEGATIVE FAN SUPPLY (BLACK)
LM2575HVT-ADJ
+28V TO +53V DC INPUT
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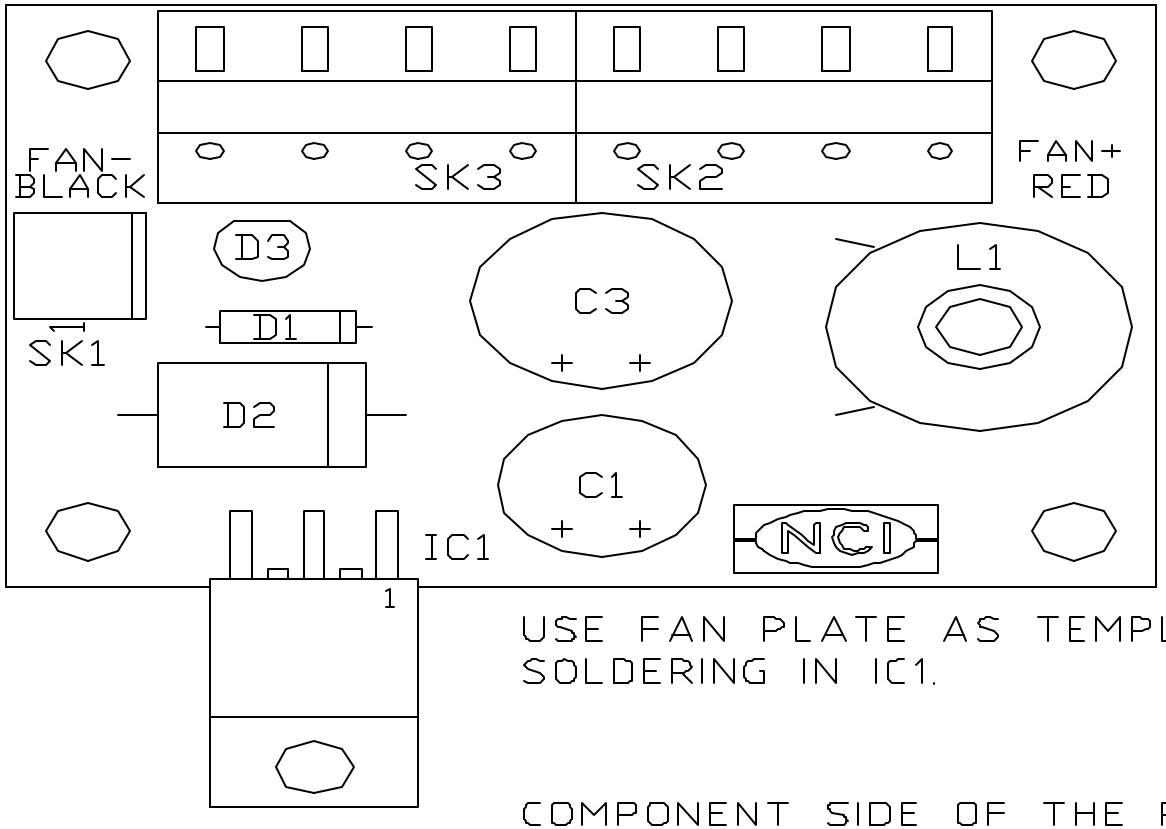
FAN PSU PCB 980518 ISS2

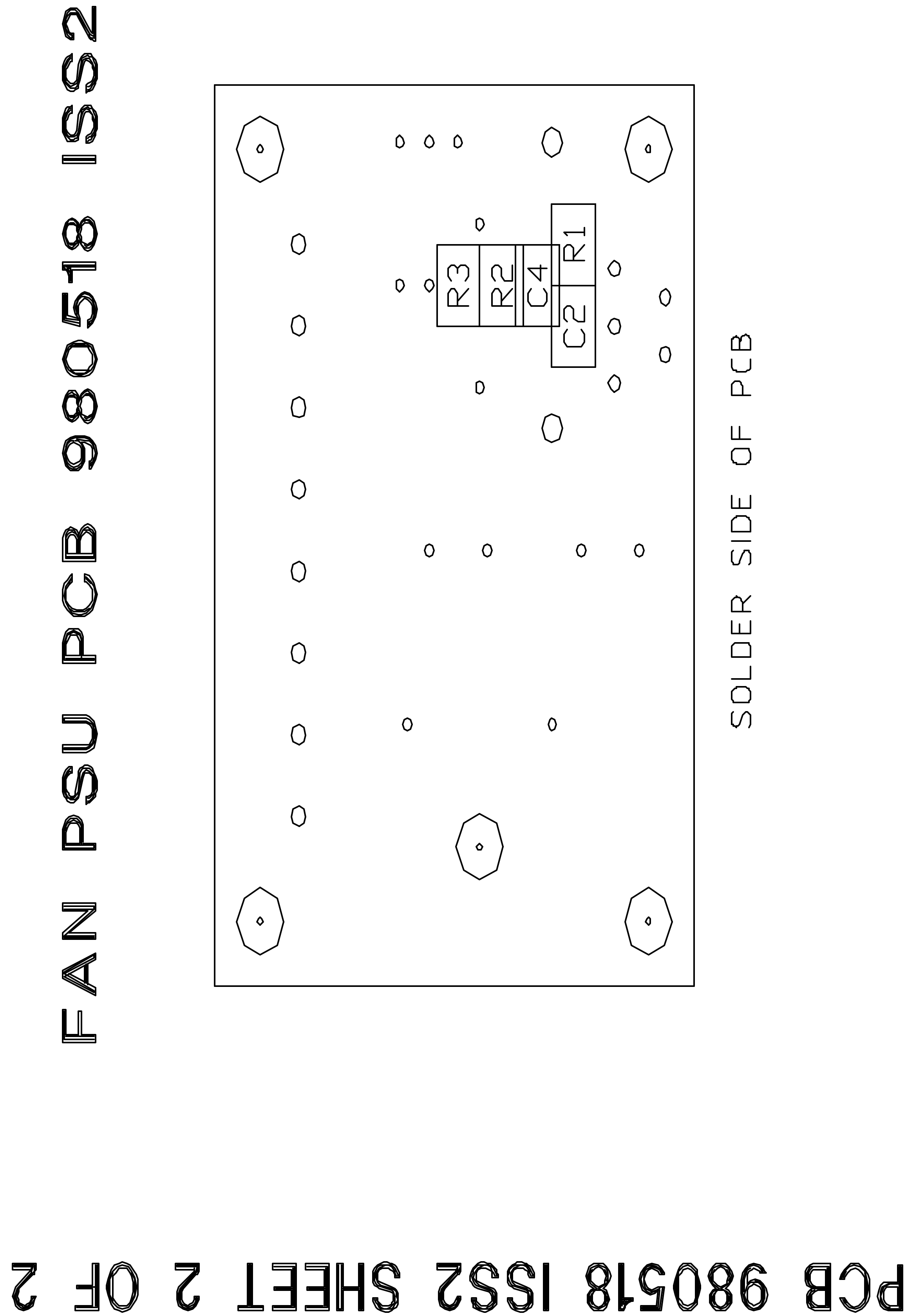
Issue Date: 21 Jan 2003

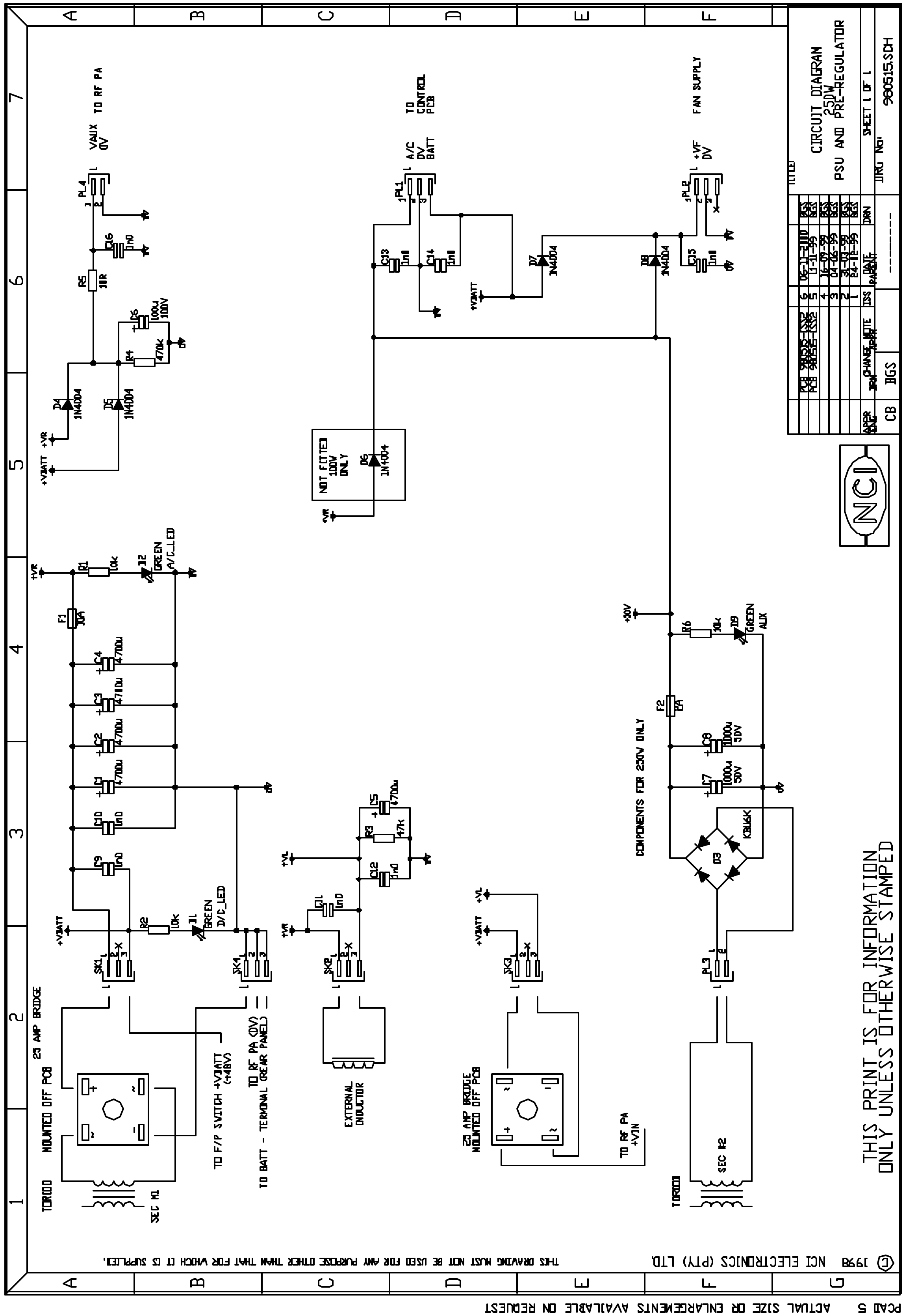
PCB 980518 ISS2 SHEET 1 OF 2



USE FAN PLATE AS TEMPLATE FOR SOLDERING IN IC1.

COMPONENT SIDE OF THE PCB


FAN PSU PCB 980518 ISS2
SOLDER SIDE OF PCB
R1
R2
R3
C2
C4
PCB 980518 ISS2 SHEET 2 OF 2


CIRCUIT DIAGRAM
250W
PSU AND PRE-REGULATOR
980515.SCH
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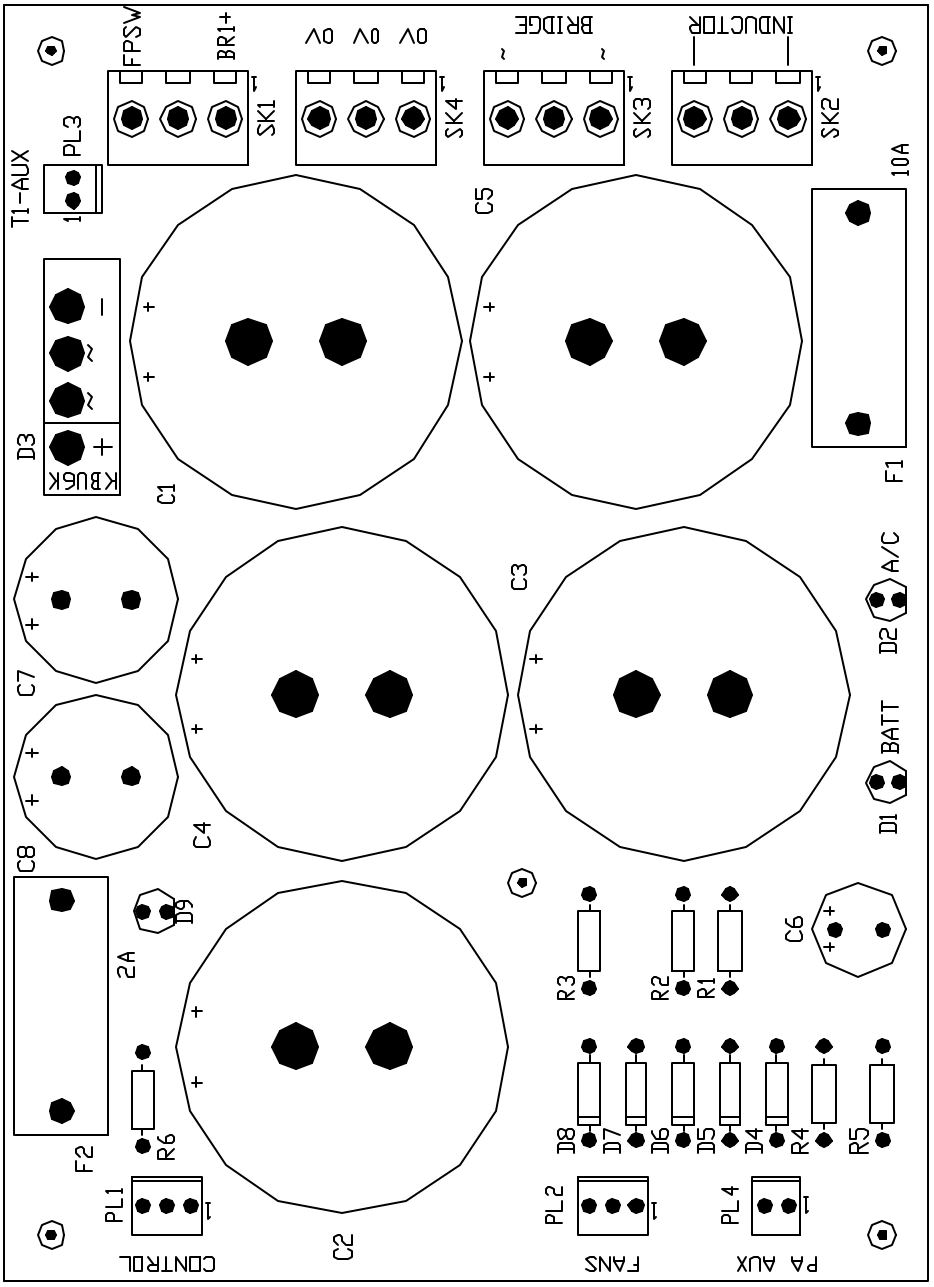
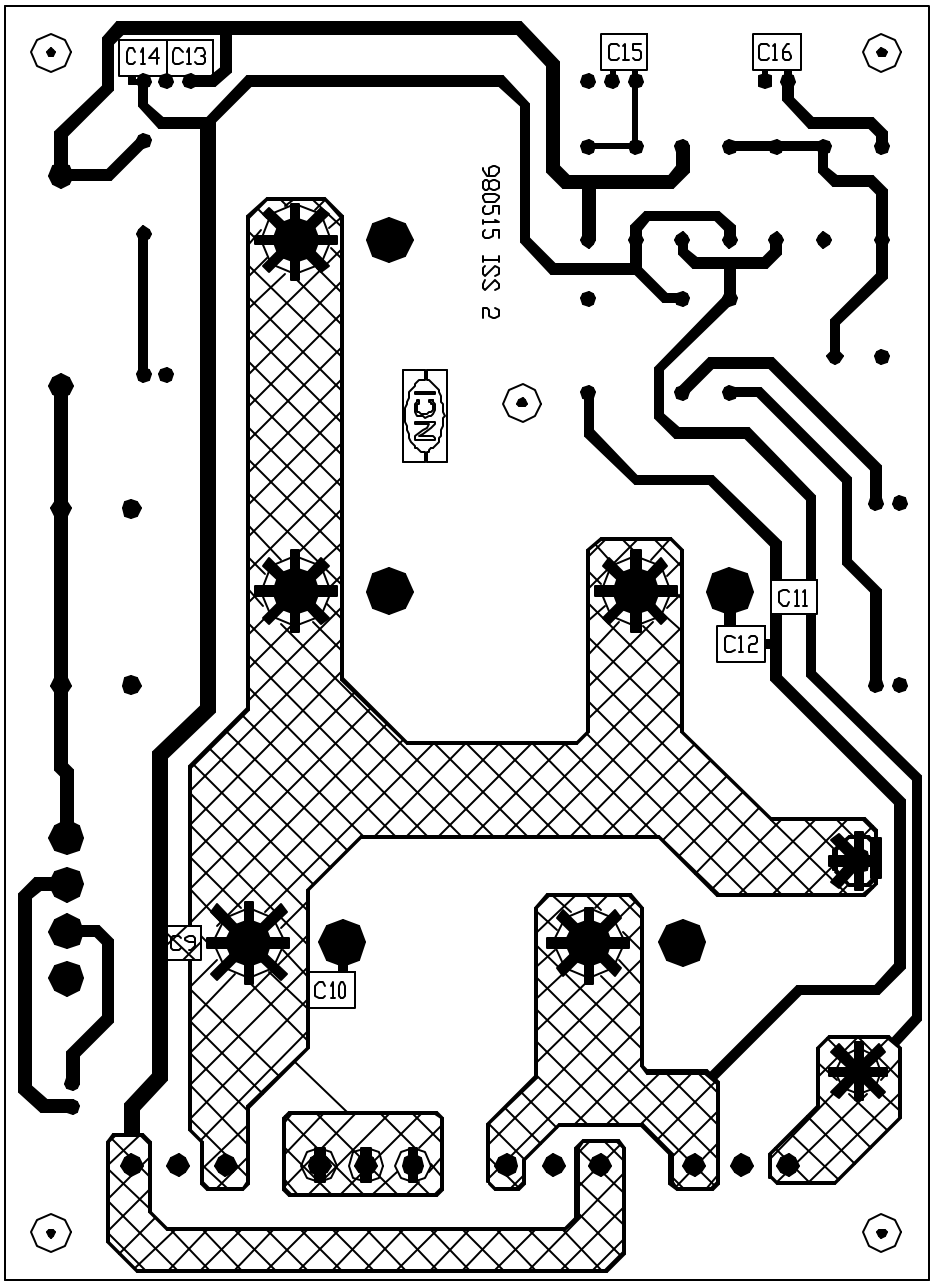
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST

EX2-250W PSU PCB 980518-1 ISS-1 COMPONENT SIDE

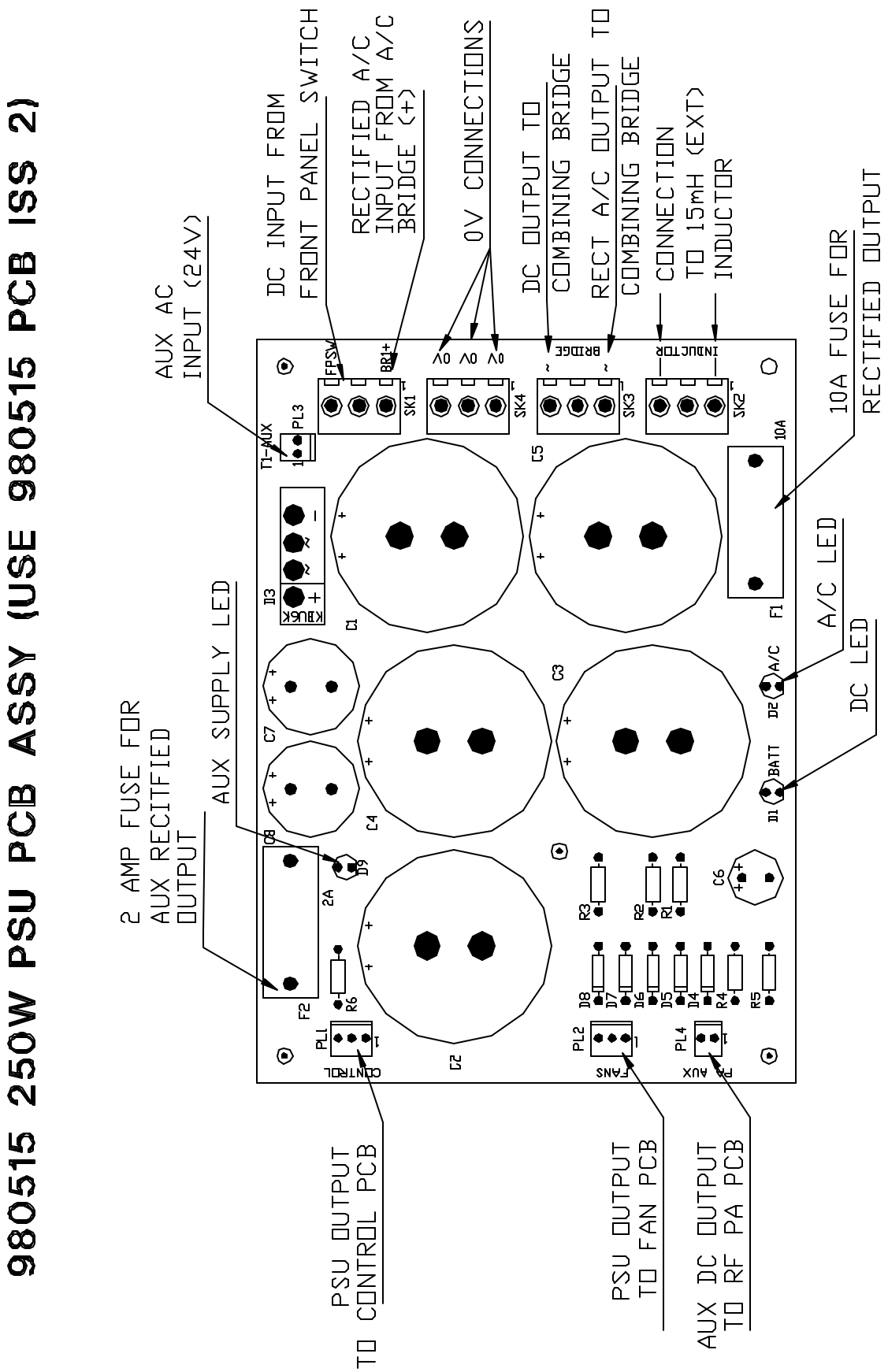


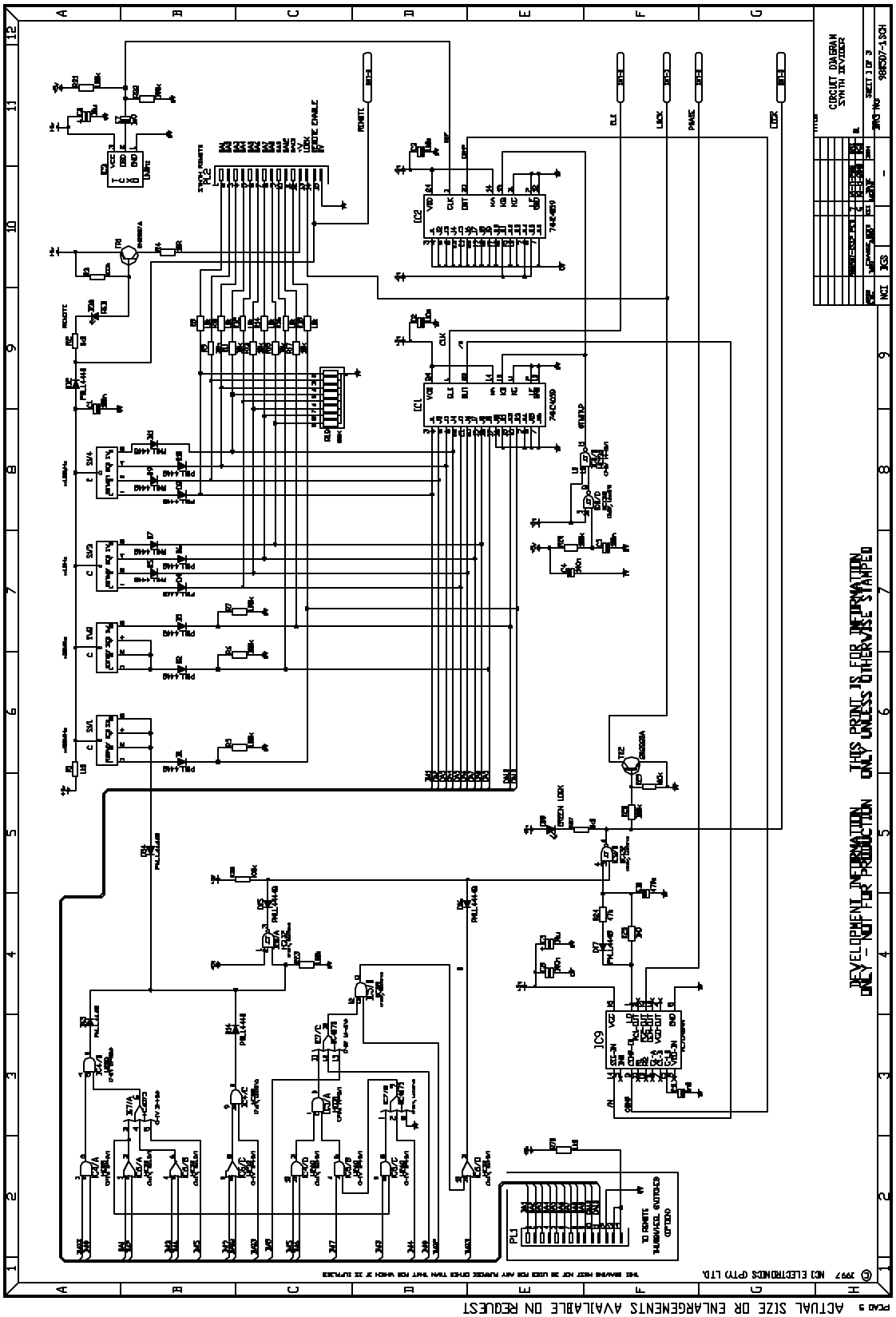
9805183.DWG ASSEMBLY SHEET 1 OF 2

EX2-250W PSU PCB 980518-1 ISS-1 COMPONENT SIDE



9805183.DWG ASSEMBLY SHEET 2 OF 2


980515 250W PSU PCB ASSY (USE 980515 PCB ISS 2)
AUX AC INPUT (24V)
DC INPUT FROM FRONT PANEL SWITCH
RECTIFIED A/C INPUT FROM A/C BRIDGE (+)
0V CONNECTIONS
DC OUTPUT TO COMBINING BRIDGE
RECT A/C OUTPUT TO COMBINING BRIDGE
CONNECTION TO 15mH (EXT) INDUCTOR
10A FUSE FOR RECTIFIED OUTPUT
A/C LED
DC LED
2 AMP FUSE FOR AUX RECITFIED OUTPUT
AUX SUPPLY LED
PSU OUTPUT TO CONTROL PCB
PSU OUTPUT TO FAN PCB
AUX DC OUTPUT TO RF PA PCB
T1-AUX
PL3
FPSW
BR1+
SK1
SK4
SK3
SK2
BRIDGE
INDUCTOR
D3
BLOCK
C1
C5
C7
C8
C4
C3
C2
C6
D9
2A
F2
R6
R3
R2
R1
D8
D7
D6
D5
D4
R4
R5
PL1
CONTROL
PL2
FANS
PL4
PA AUX
10A
F1
A/C
D2
BATT
D1


CIRCUIT DIAGRAM
SYNTH DEVIDER
SHEET 3 OF 3
DEVELOPMENT INFORMATION
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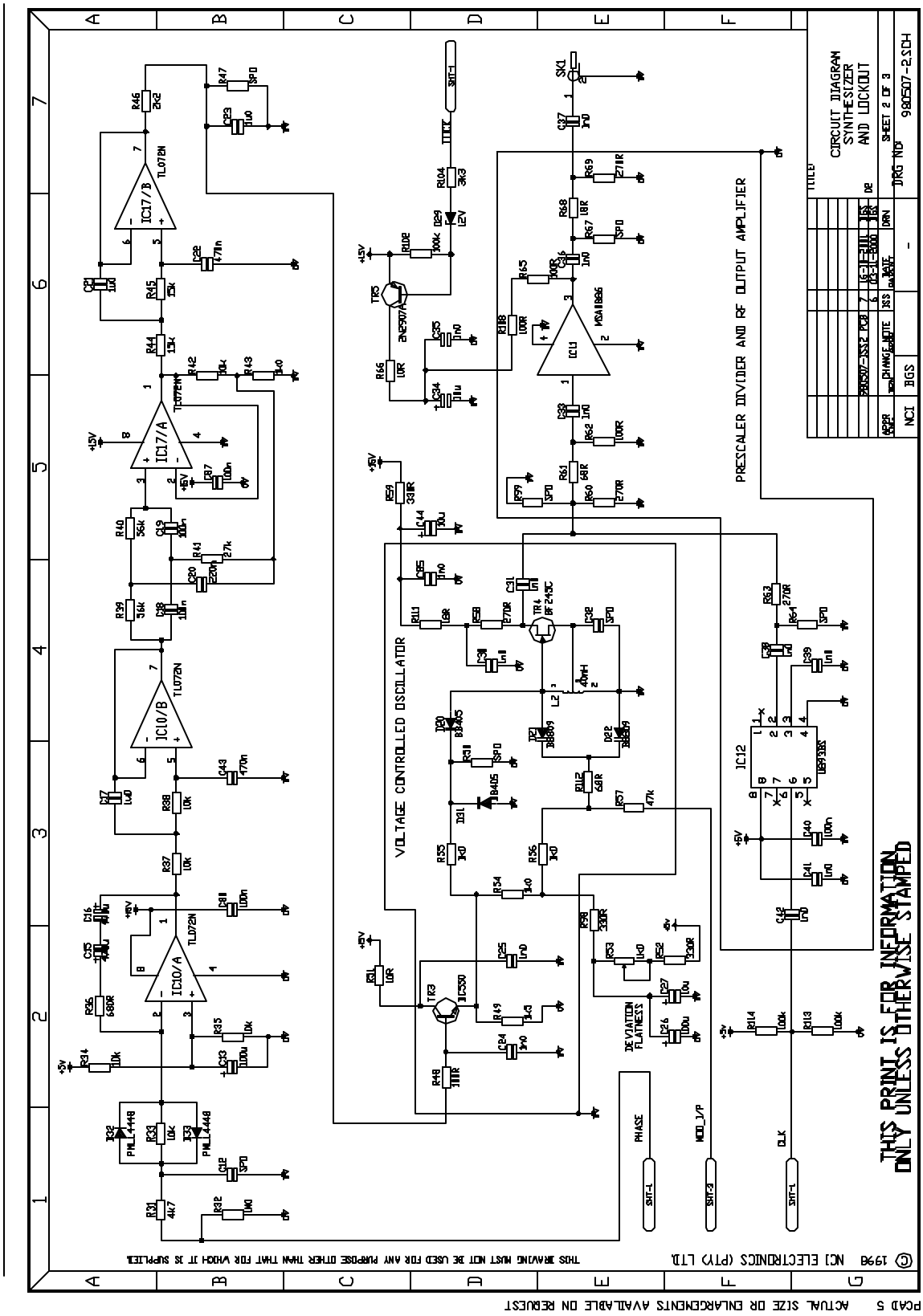
ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST


CIRCUIT DIAGRAM
SYNTHESIZER
AND LOCKOUT
SHEET 2 OF 3
DRG NO 980507-2.SCH
PRESCALER DIVIDER AND RF OUTPUT AMPLIFIER
VOLTAGE CONTROLLED OSCILLATOR
IC17/B
IC17/A
IC10/B
IC10/A
IC11
IC12
TR3
TR4
TR5
PHASE
MOD_I/P
CLK
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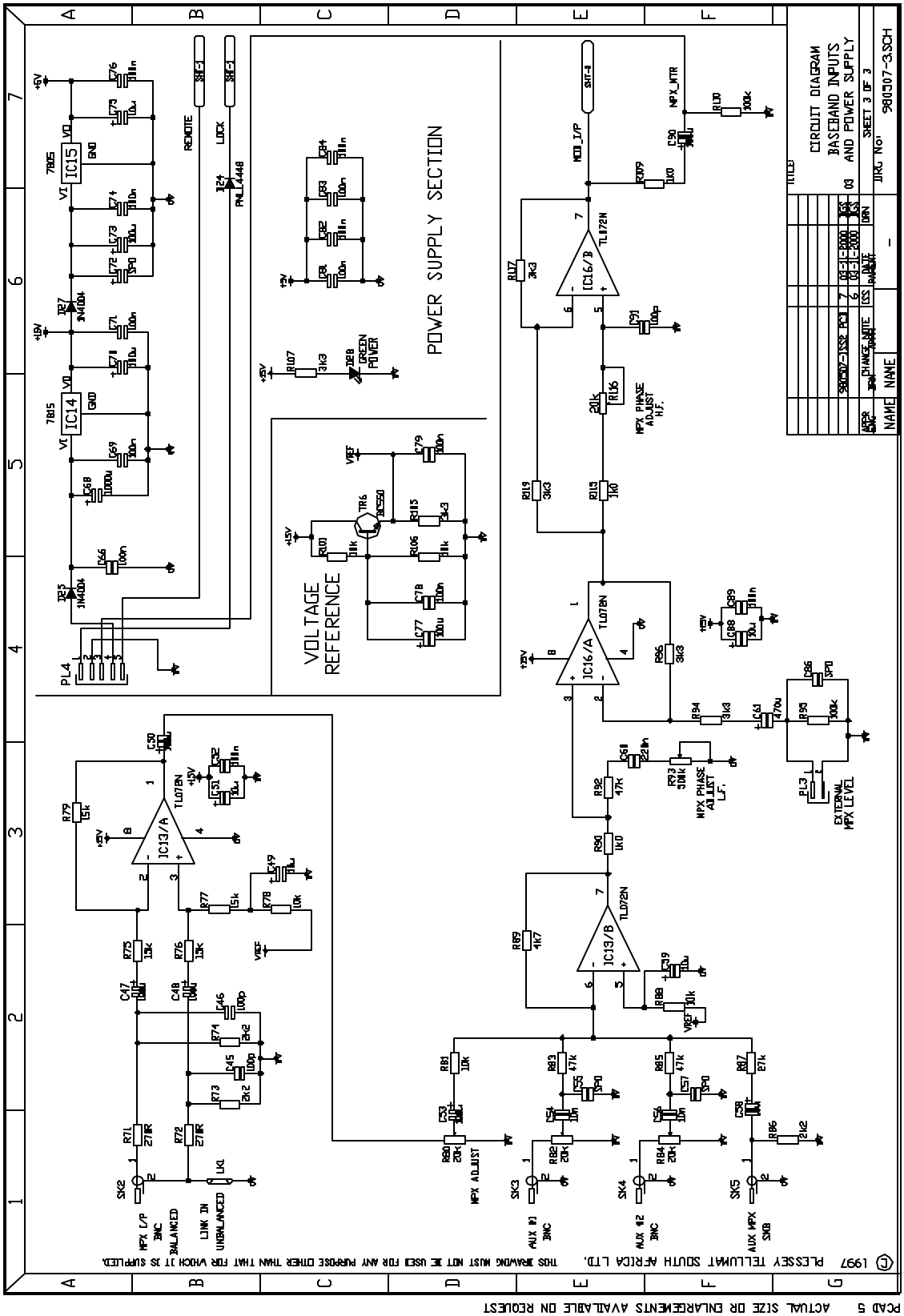
POWER SUPPLY SECTION
VOLTAGE REFERENCE
CIRCUIT DIAGRAM
BASEBAND INPUTS
AND POWER SUPPLY
SHEET 3 OF 3
9801307-3.SCH
MPX ADJUST
AUX #1 BNC
AUX #2 BNC
AUX MPX SKB
MPX I/P BALANCED BNC
LINK IN UNBALANCED
EXTERNAL MPX LEVEL
MPX PHASE ADJUST H.F.
MPX PHASE ADJUST L.F.
REMOTE
LOCK
PLL4448
GREEN POWER
MPX_MTR
MOD_I/P
PLESSEY TELLUMAT SOUTH AFRICA LTD.
1997
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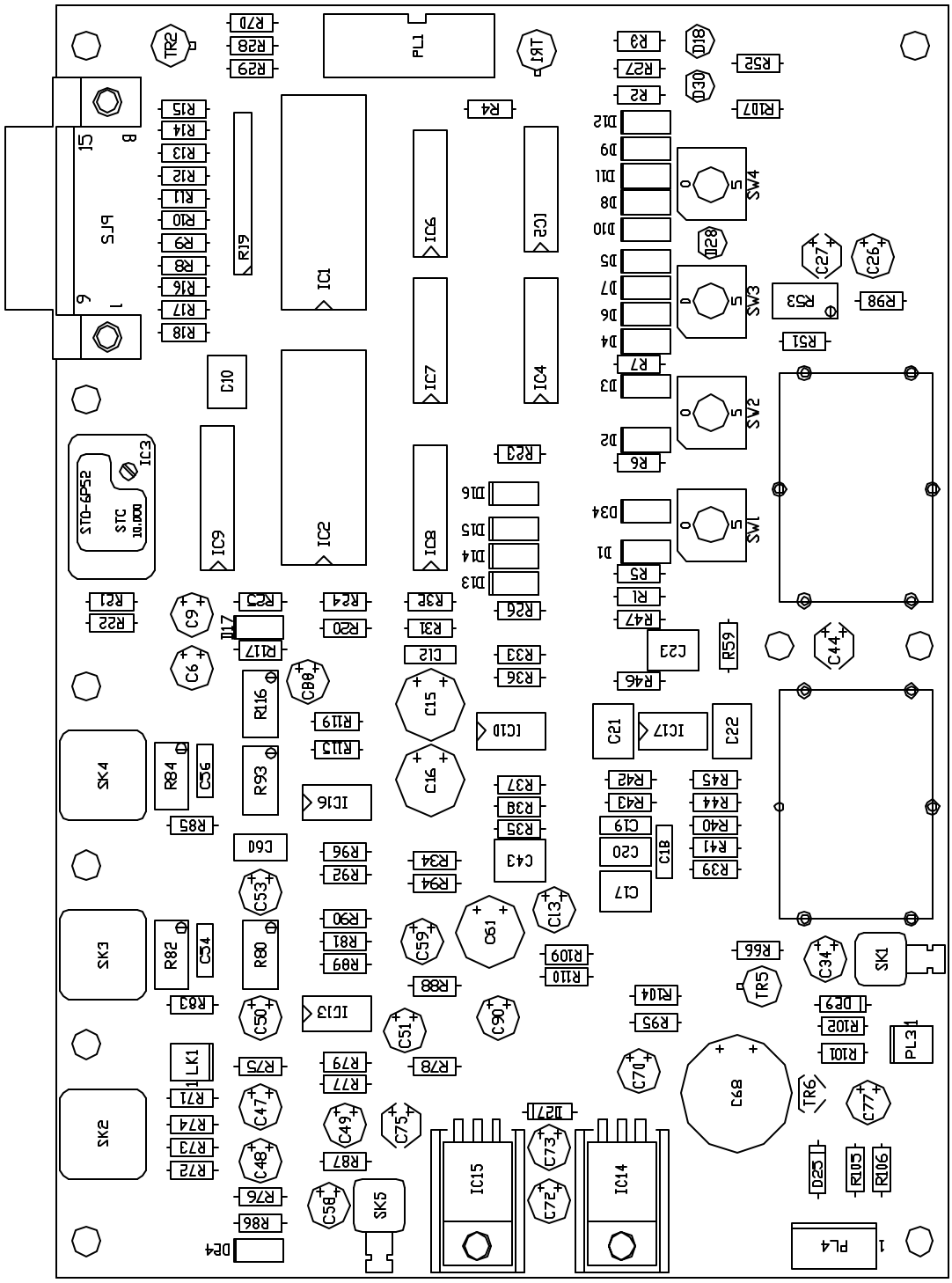
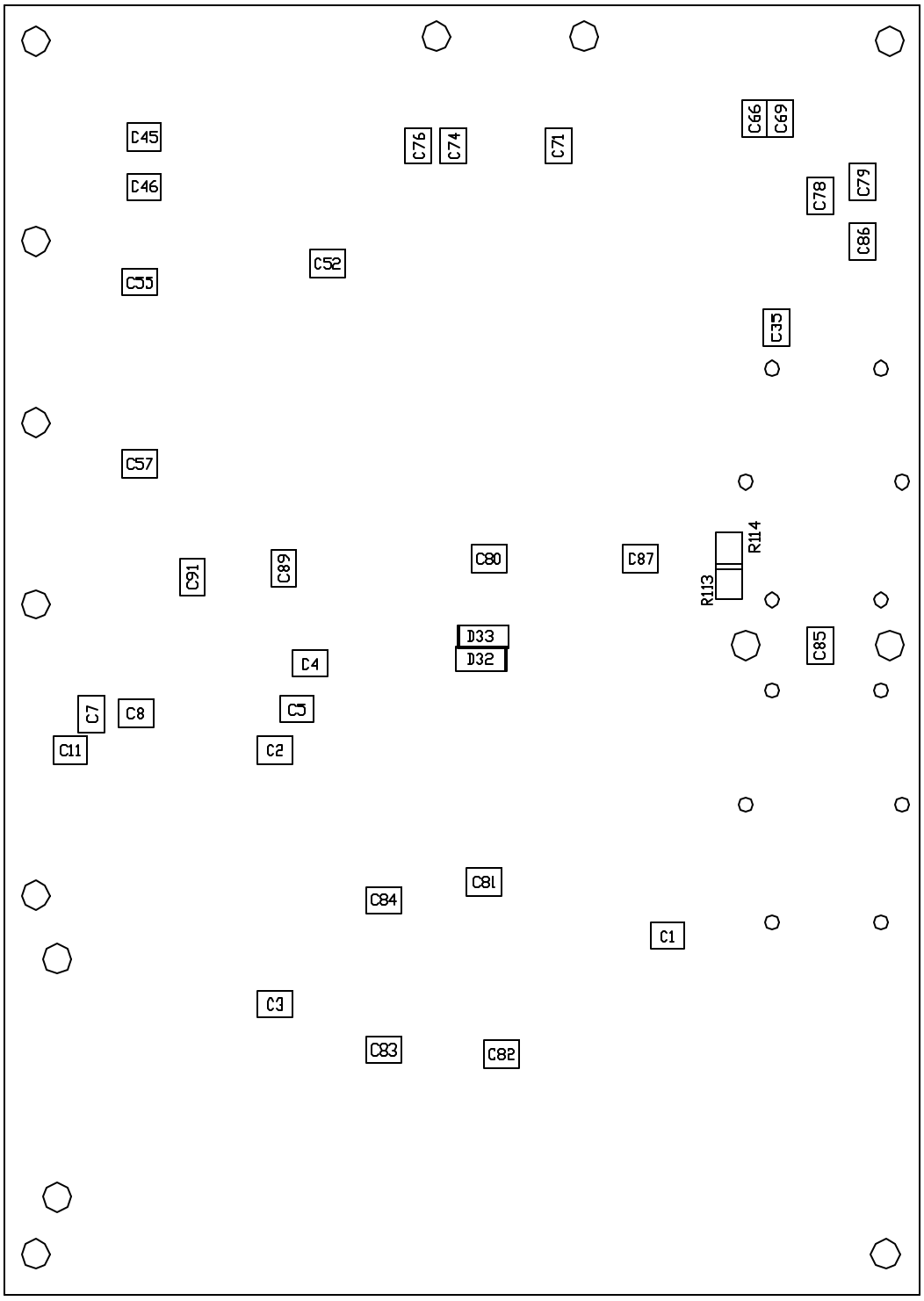
PCAD 5

SYNTHESIZER PCB 980507 ISS-2 COMPONENT SIDE



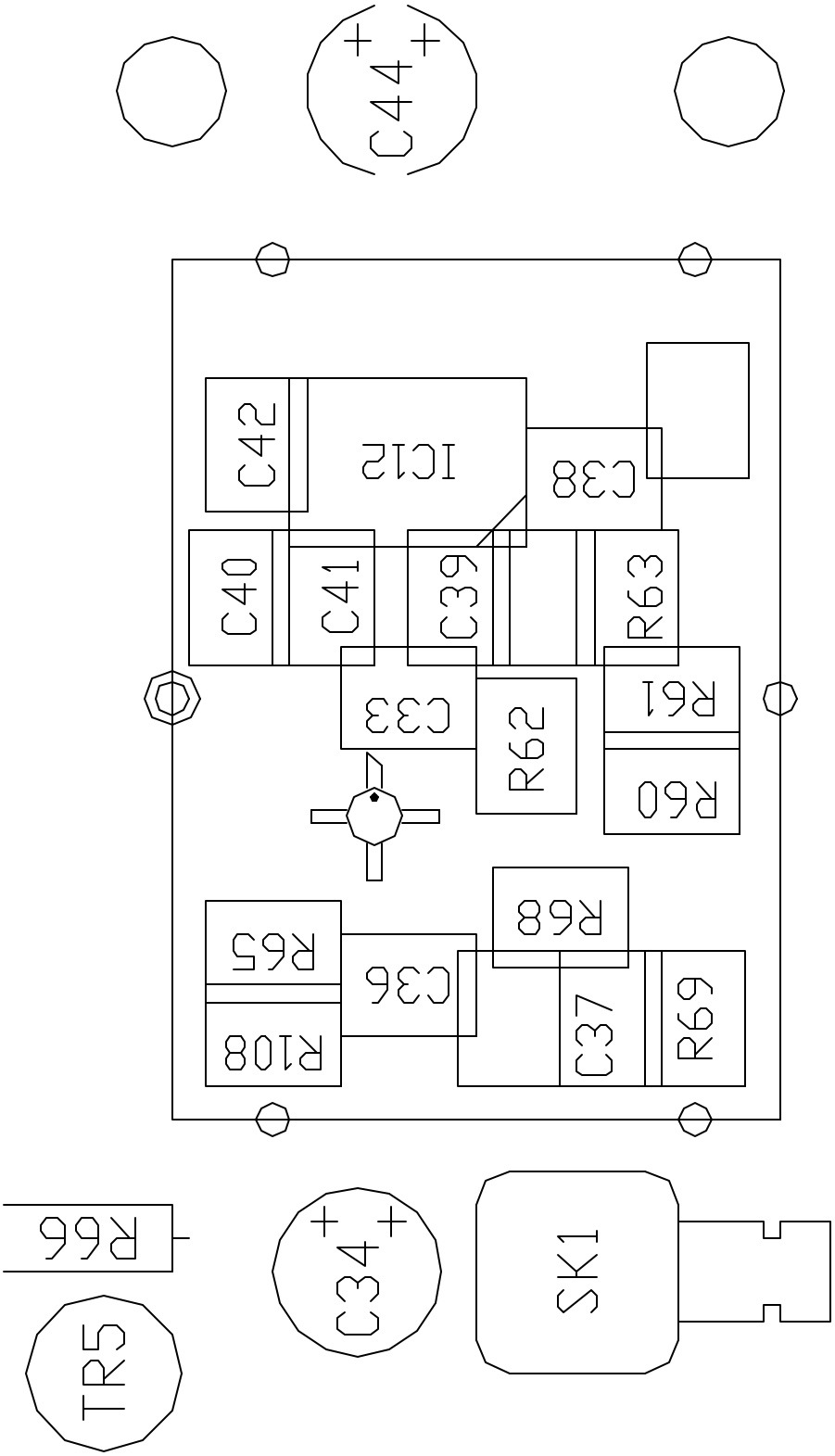
980507A3.DWG ASSEMBLY SHEET 1 OF 4

SYNTHESIZER PCB 980507 ISS-2 SOLDER SIDE



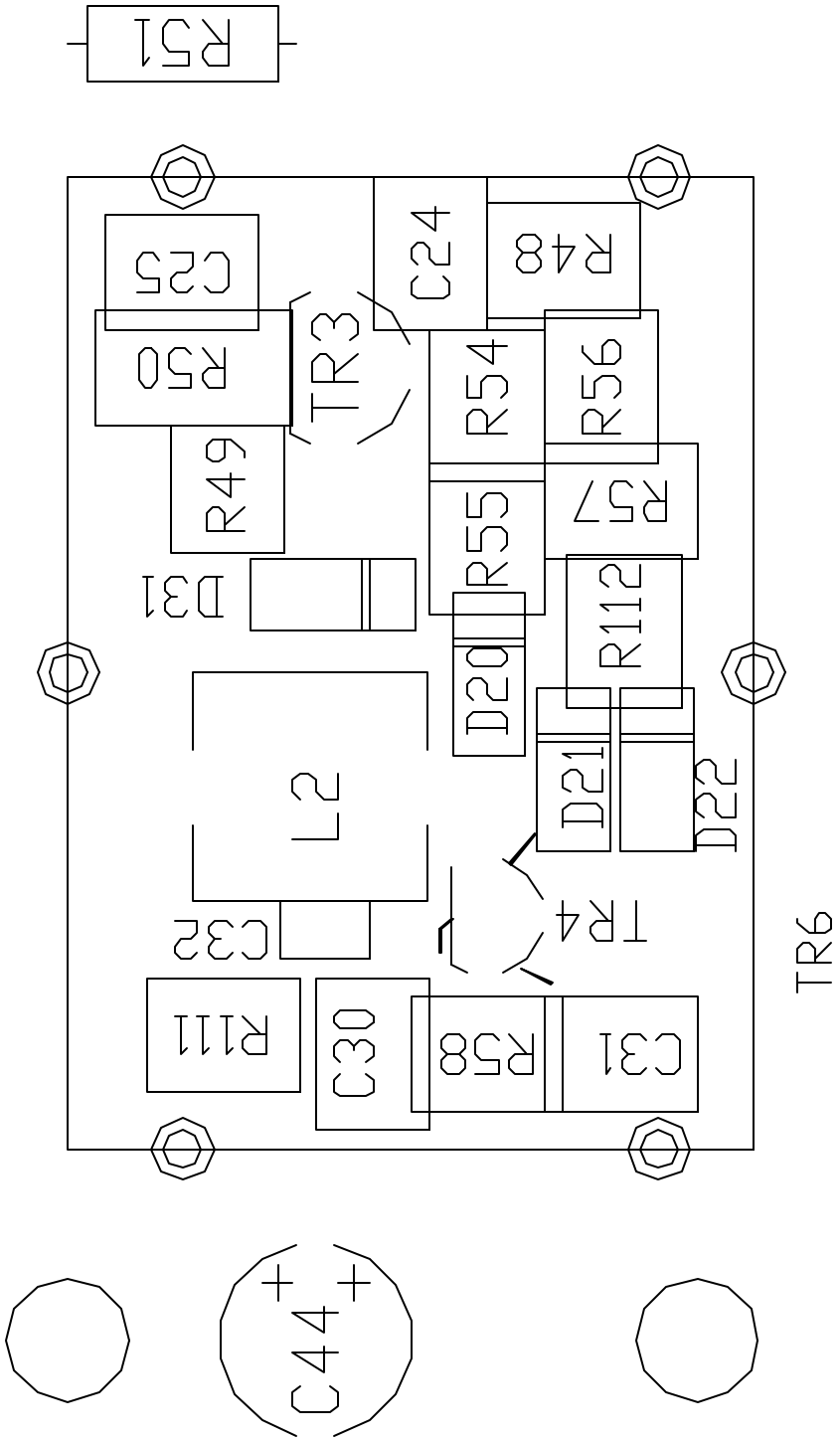
9805073A3.DWG ASSEMBLY SHEET 2 OF 4

PRE-SCALER AND BUFFER (EXPLODED) 980507-2 PCB

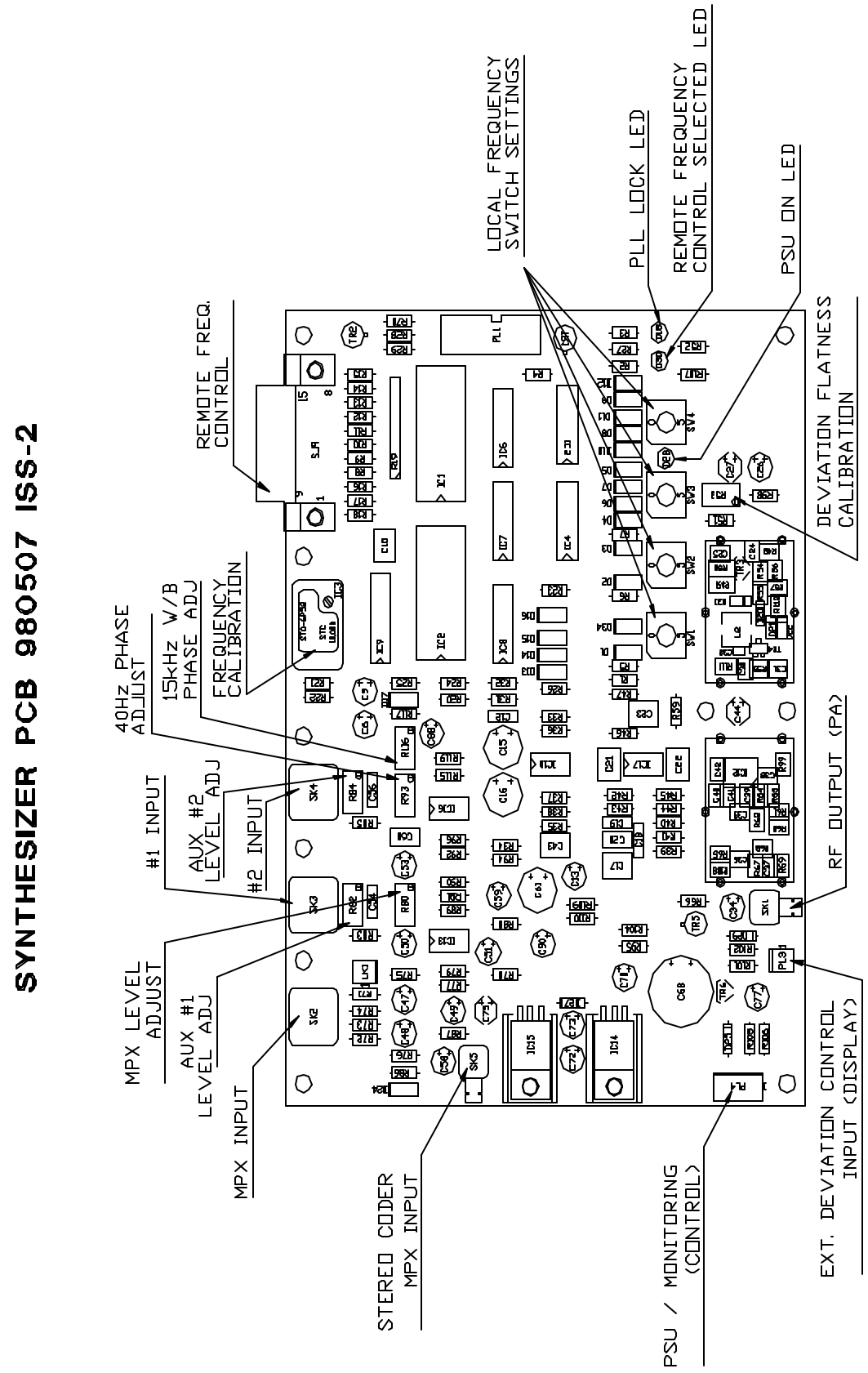


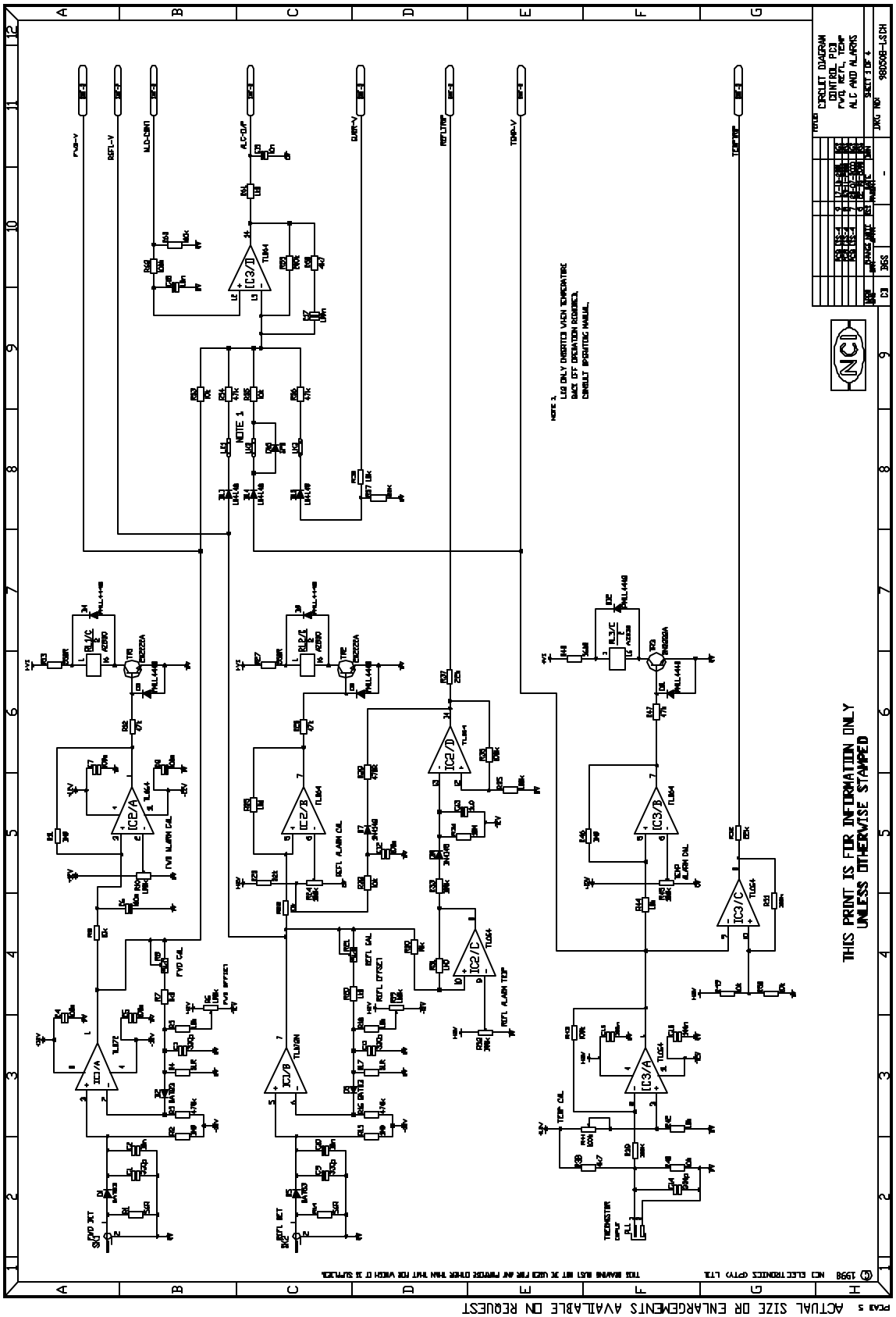
980507A3.DWG ASSEMBLY SHEET 3 OF 4

VCO ASSEMBLY (EXPLODED) 980507-2 PCB



9805073A3.DWG ASSEMBLY SHEET 4 OF 4


SYNTHESIZER PCB 980507 ISS-2
980507A3.DWG
REMOTE FREQ. CONTROL
LOCAL FREQUENCY SWITCH SETTINGS
PLL LOCK LED
REMOTE FREQUENCY CONTROL SELECTED LED
PSU ON LED
DEVIATION FLATNESS CALIBRATION
40Hz PHASE ADJUST
15kHz W/B PHASE ADJ
FREQUENCY CALIBRATION
#1 INPUT
AUX #2 LEVEL ADJ
#2 INPUT
MPX LEVEL ADJUST
AUX #1 LEVEL ADJ
MPX INPUT
STEREO CODER MPX INPUT
PSU / MONITORING (CONTROL)
EXT. DEVIATION CONTROL INPUT (DISPLAY)
RF OUTPUT (PA)


CIRCUIT DIAGRAM
CONTROL PCB
FWD, REFL, TEMP
ALC AND ALARMS
980508-1SCH
SHEET 3 OF 4
THIS PRINT IS FOR INFORMATION ONLY
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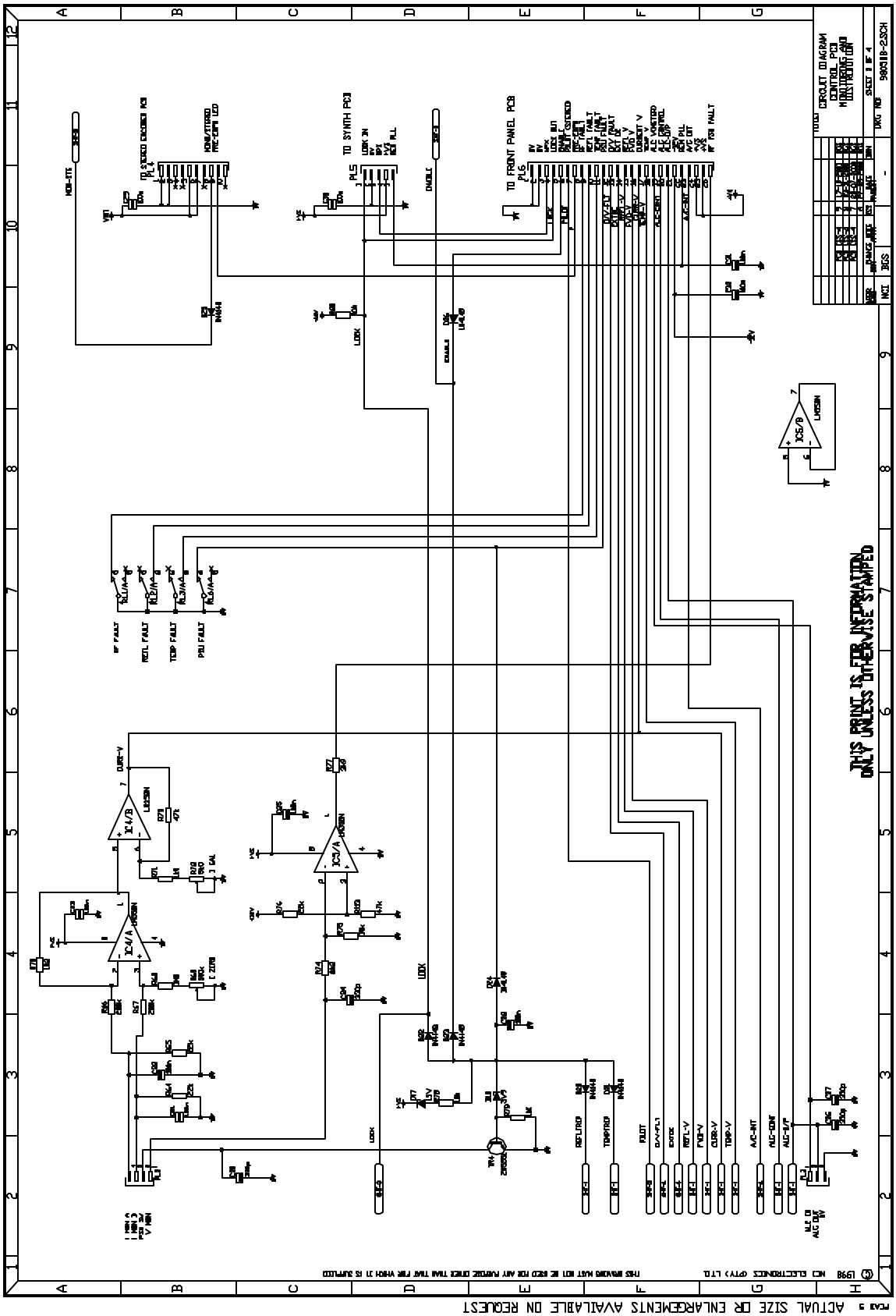
NOTE 1.
LOG ONLY INDICATES VSWR TEMPERATURE
BACK OFF CALIBRATION ADJUSTMENT
CONSULT OPERATING MANUAL.
IC2/A
IC2/B
IC2/C
IC2/D
IC3/A
IC3/B
IC3/C
IC3/D
IC1/A
IC1/B
FWD CAL
REFL CAL
TEMP CAL
ALC CAL
FWD ALARM CAL
REFL ALARM CAL
TEMP ALARM CAL
REFL ALARM TEMP
THERMISTOR
ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST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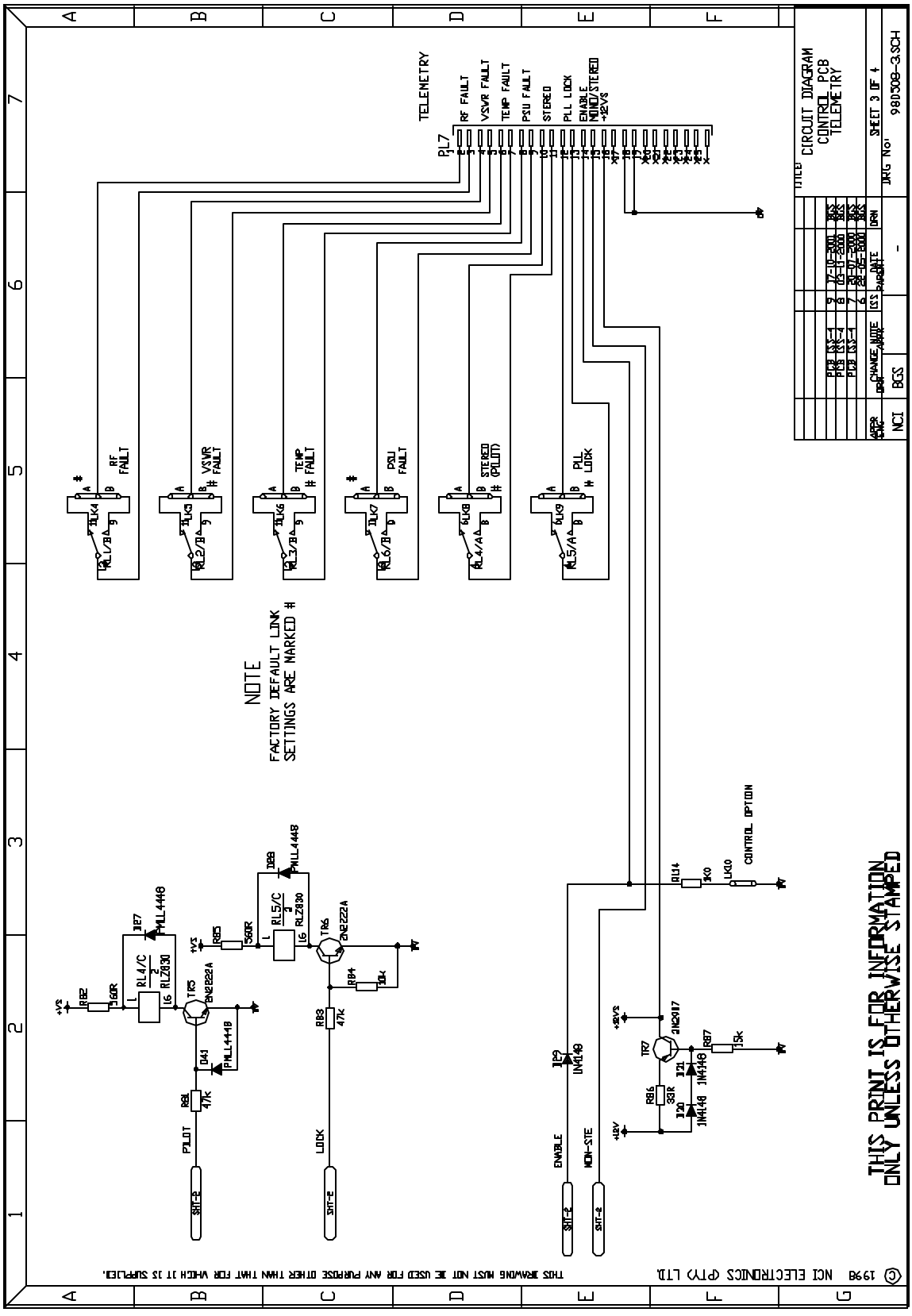
ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST


TELEMETRY
RF FAULT
VSWR FAULT
TEMP FAULT
PSU FAULT
STEREO
PLL LOCK
ENABLE
MONO/STEREO
+12VS
NOTE
FACTORY DEFAULT LINK
SETTINGS ARE MARKED #
CONTROL OPTION
PILOT
LOCK
ENABLE
MON-STE
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ONLY UNLESS OTHERWISE STAMPED
TITLE CIRCUIT DIAGRAM
CONTROL PCB
TELEMETRY
SHEET 3 OF 4
DRG No: 980509-3.SCH
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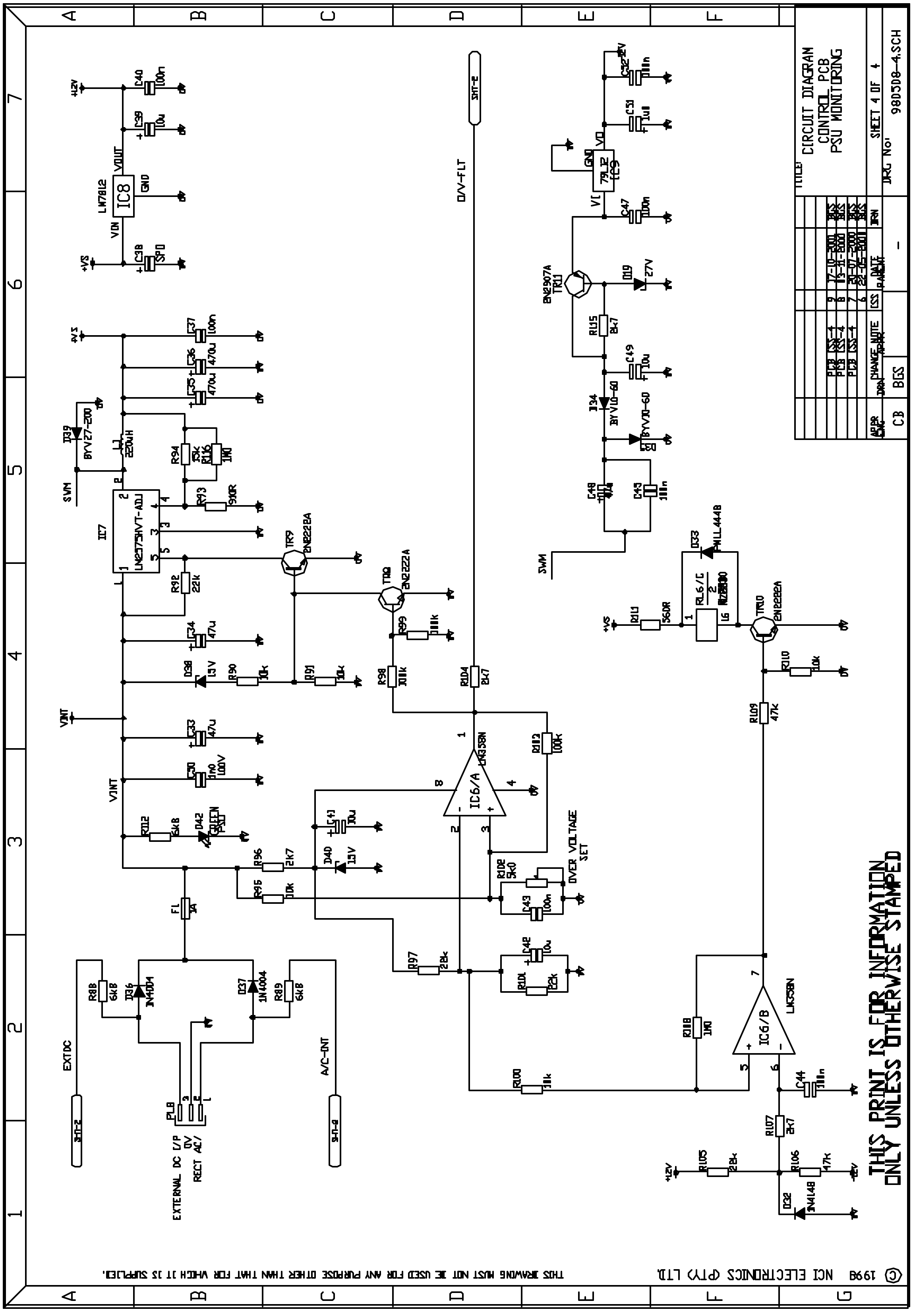
CIRCUIT DIAGRAM
CONTROL PCB
PSU MONITORING
SHEET 4 OF 4
980508-4.SCH
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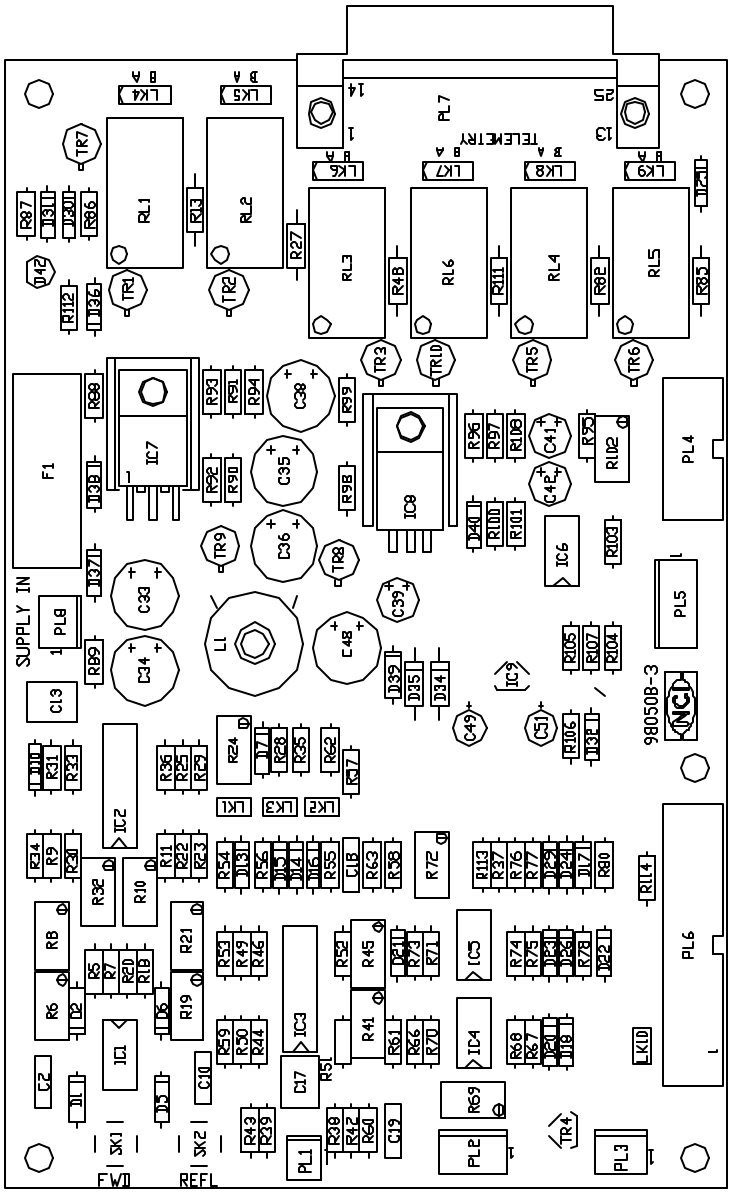
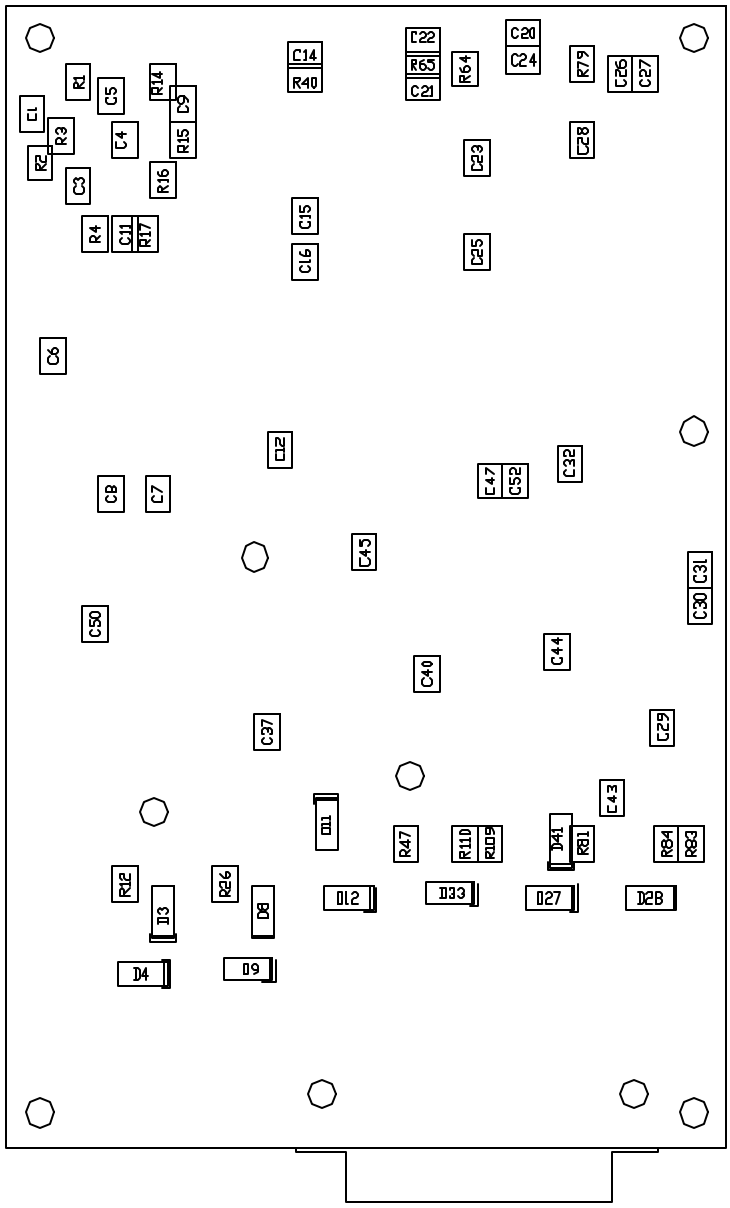
CONTROL PCB 980508-3



COMPONENT SIDE OF PCB

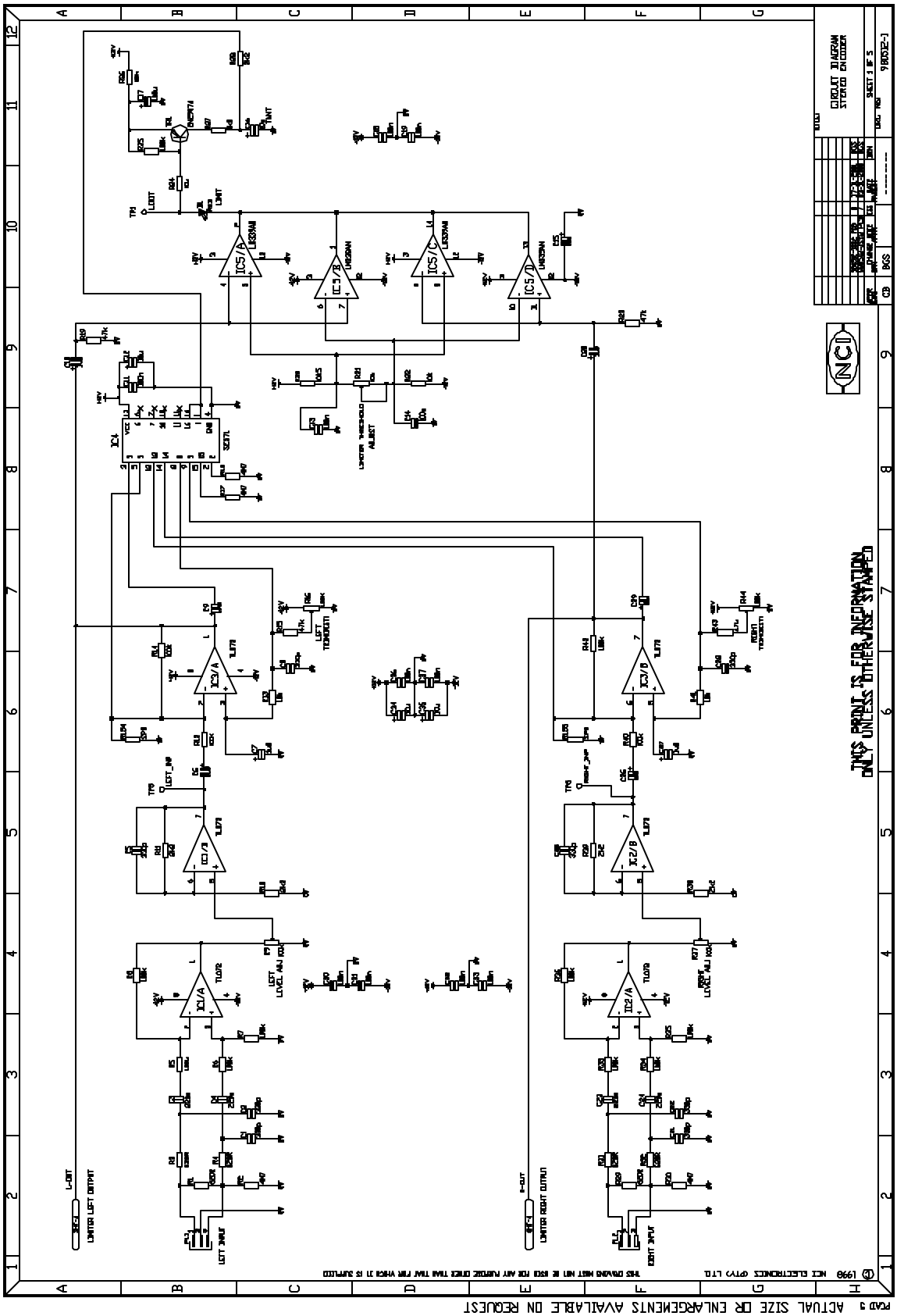
980508A5.DWG ASSEMBLY SHEET 1 OF 2

CONTROL PCB 980508-3



SOLDER SIDE OF PCB

9805085.DWG ASSEMBLY SHEET 2 OF 2


CIRCUIT DIAGRAM
STEREO ENCODER
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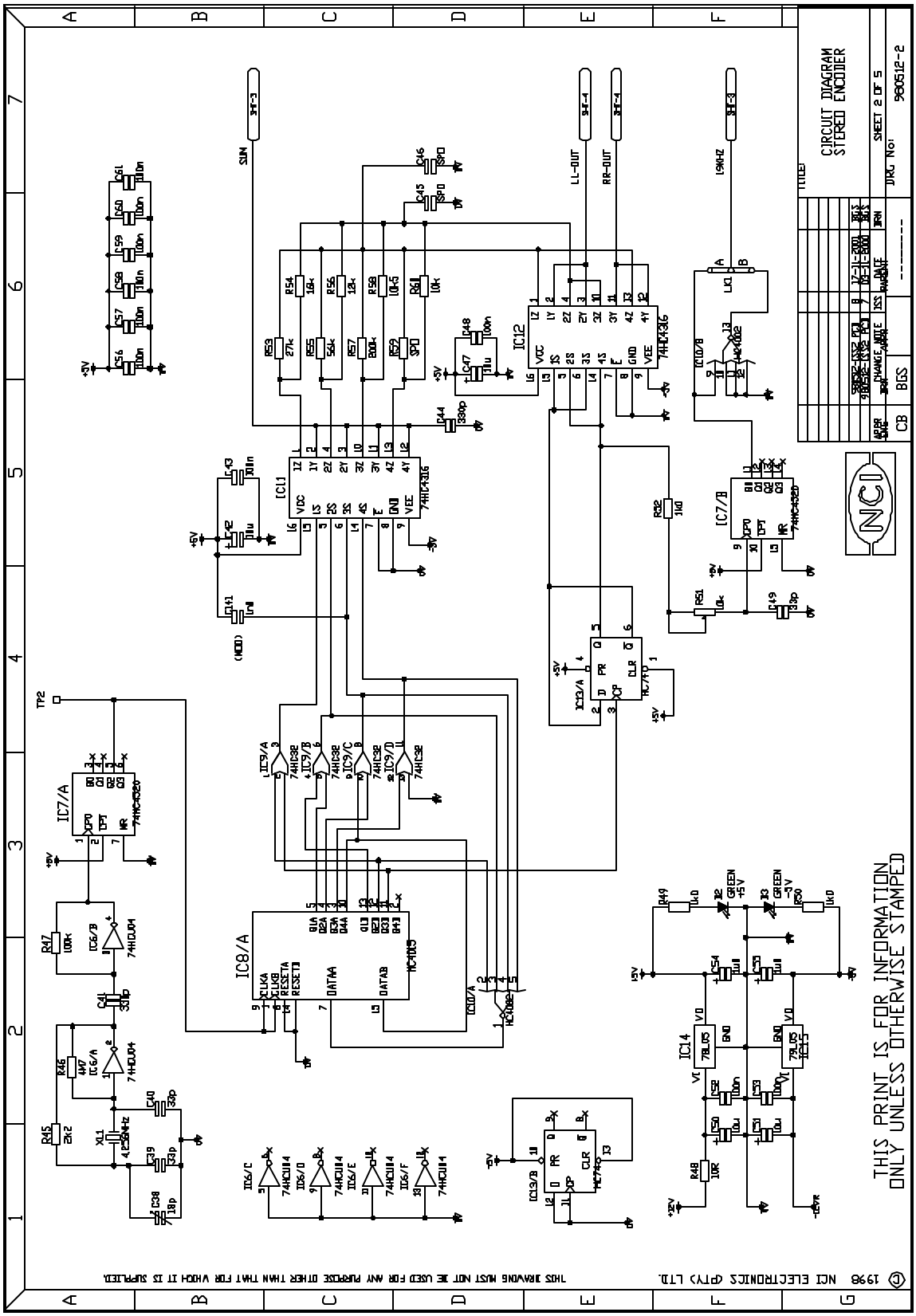
CIRCUIT DIAGRAM
STEREO ENCODER
SHEET 2 OF 5
DRG No: 960512-2
SUM
L1-OUT
R1-OUT
19KHZ
IC11
IC12
IC7/A
IC7/B
IC8/A
IC14
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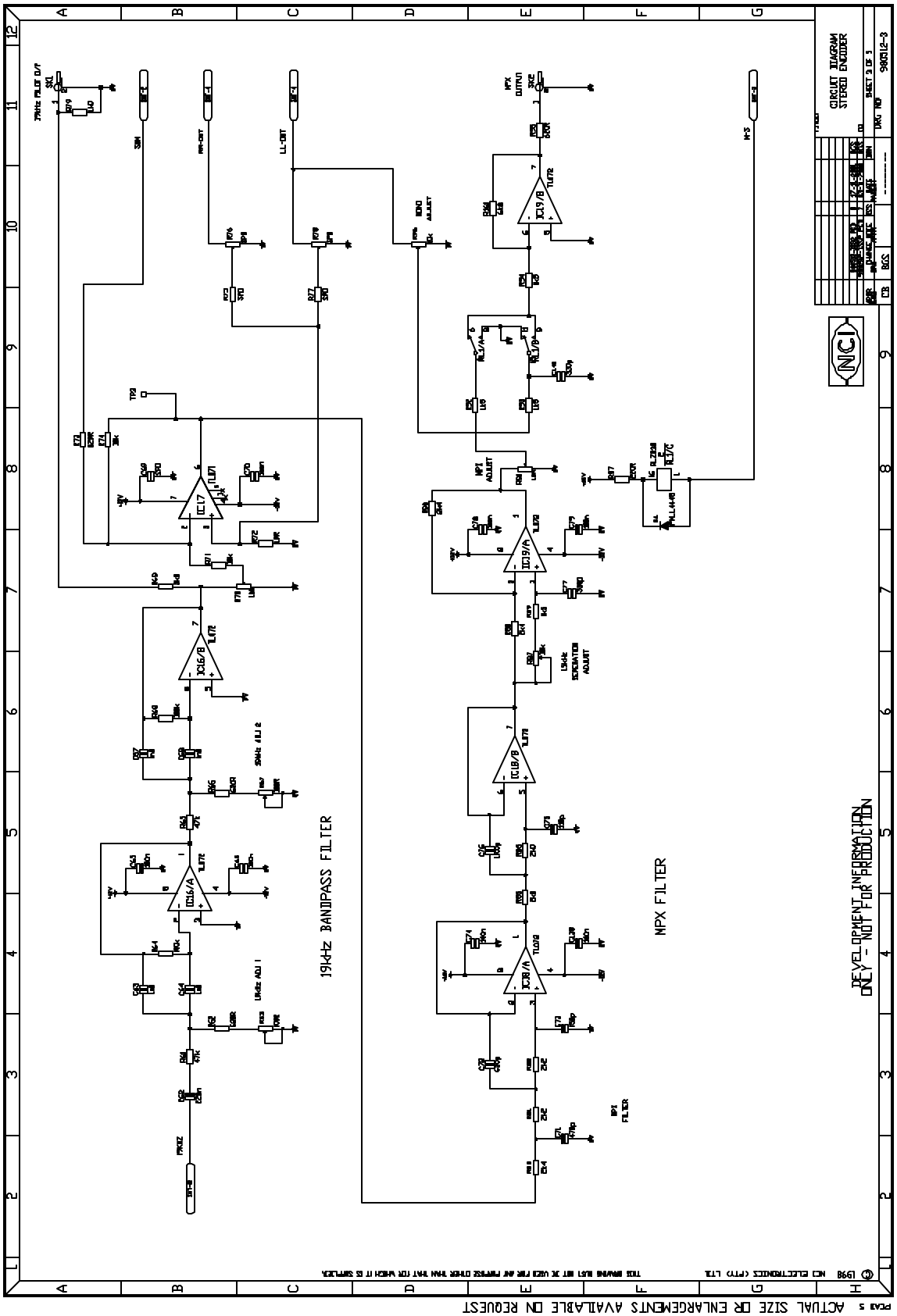
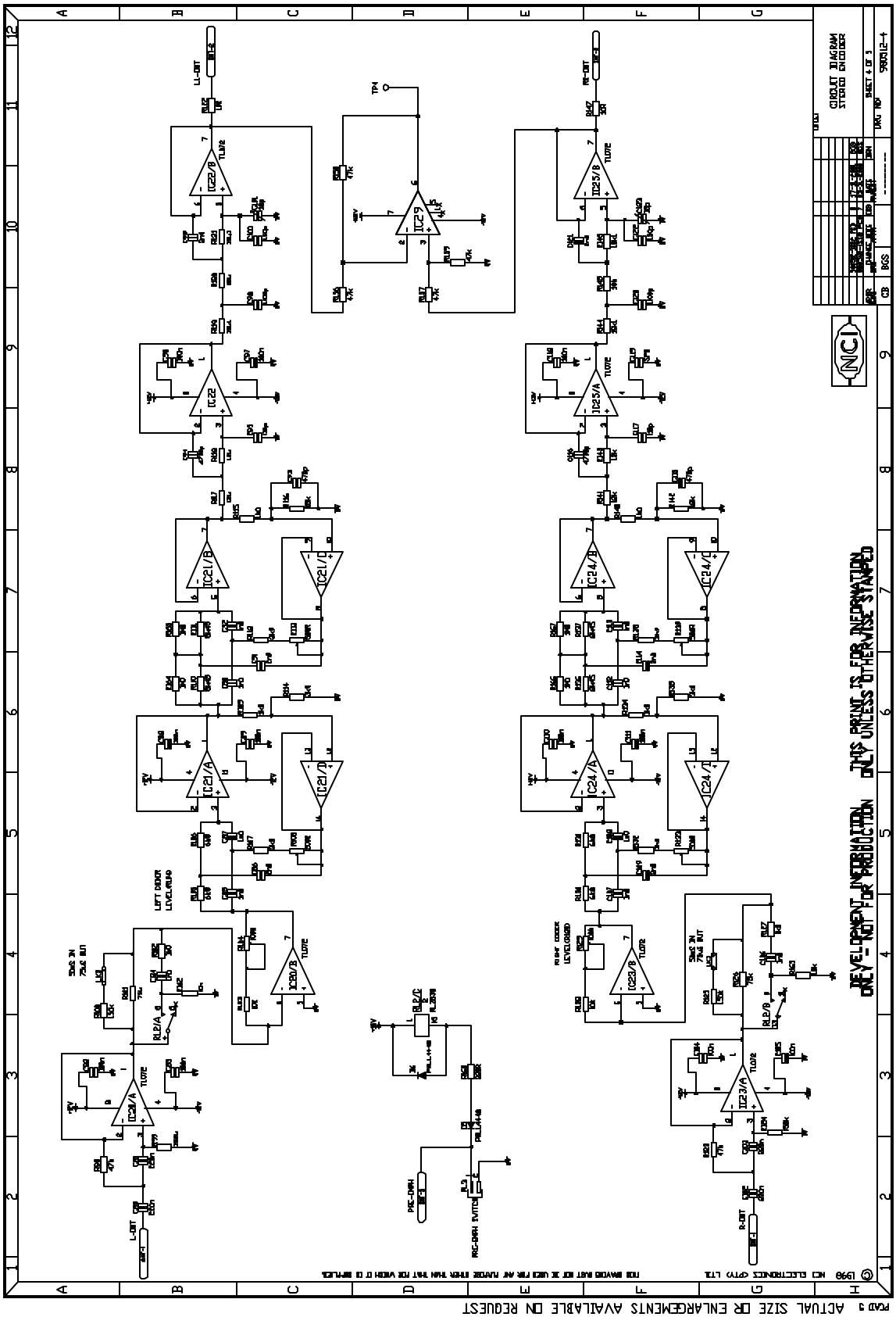
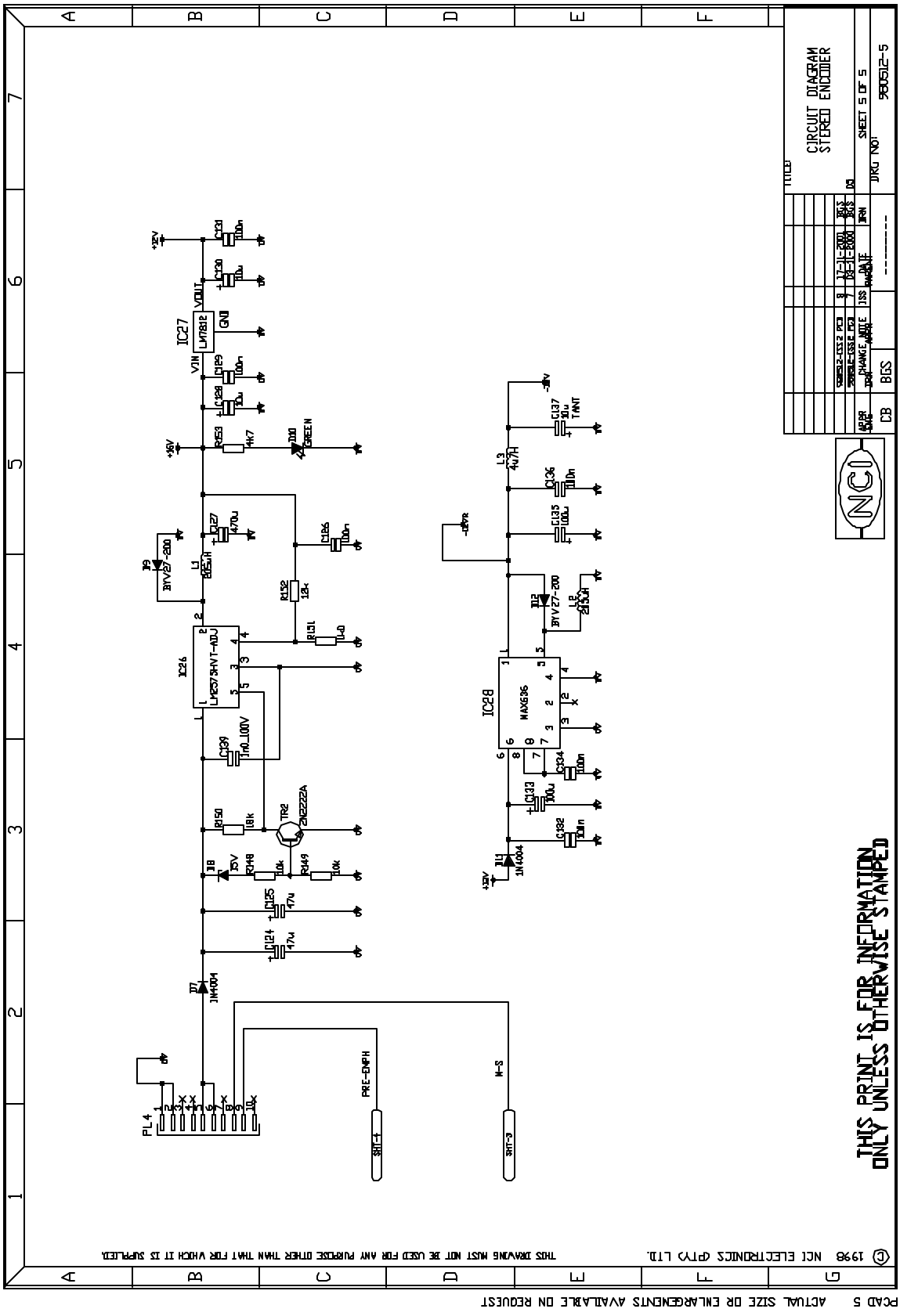
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST


CIRCUIT DIAGRAM
STEREO ENCODER
DEVELOPMENT INFORMATION
ONLY - NOT FOR PRODUCTION
19kHz BANDPASS FILTER
NPX FILTER
ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST




CIRCUIT DIAGRAM
STEREO ENCODER
SHEET 5 OF 5
DRG NO 900512-5
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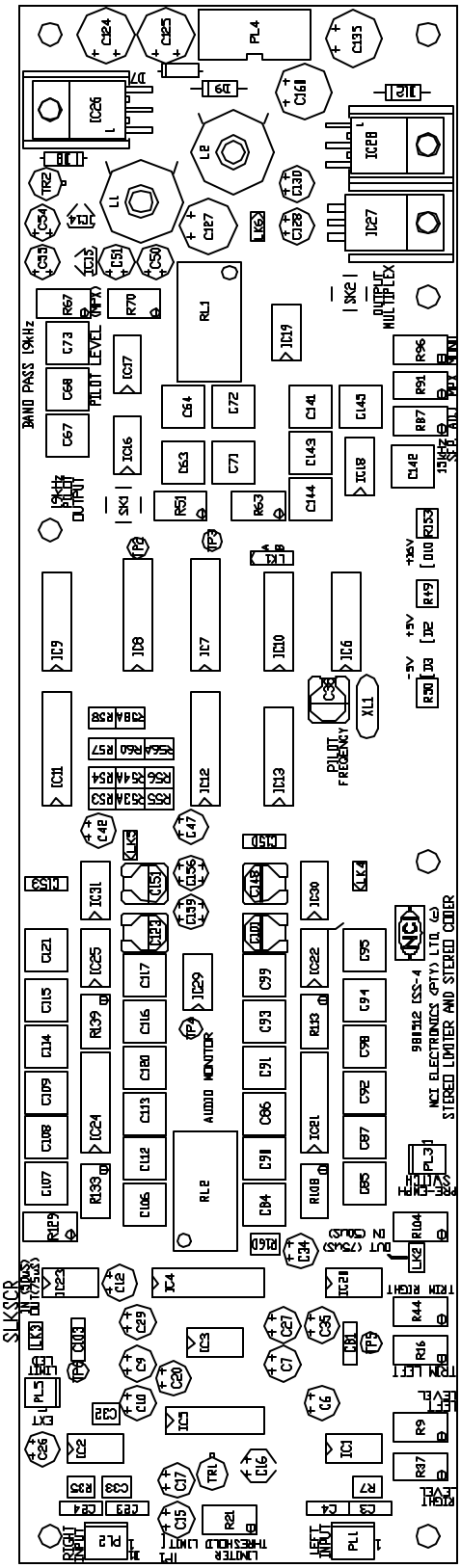
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
PRE-EMPH
M-S
IC27
LM7812
IC26
LM2937IMP-ADJ
IC28
MAX636
TR2
2N2222A
D9
BYV27-200
D10
GREEN
D11
1N4004
D12
BYV27-200
D13
1N4004
D14
1N4004
D18
15V

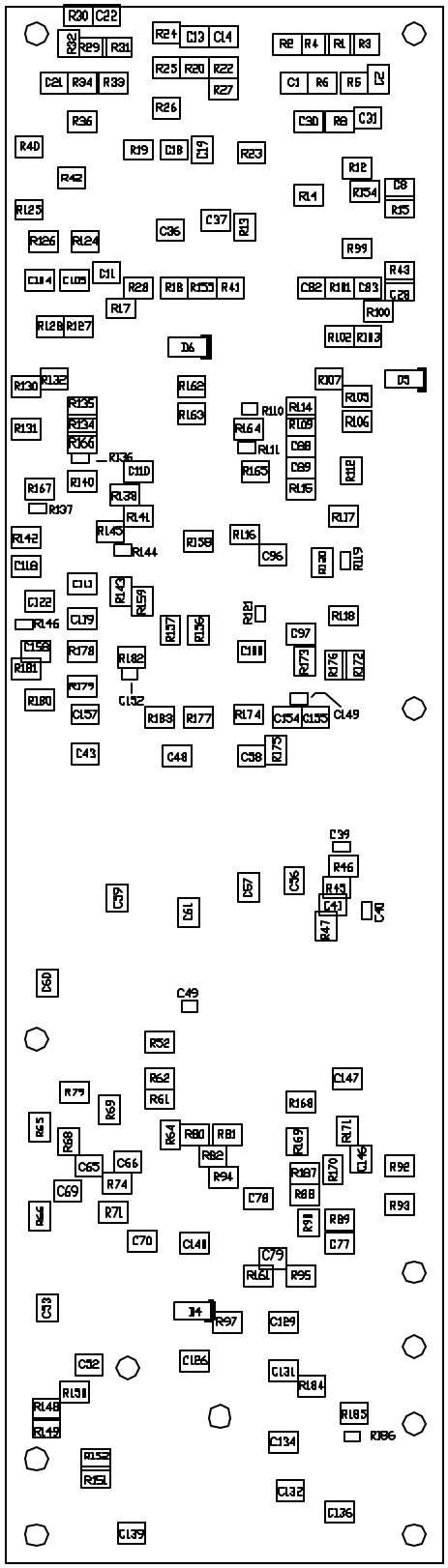
STEREO CODER 980512-4 PCB



COMPONENT SIDE OF PCB

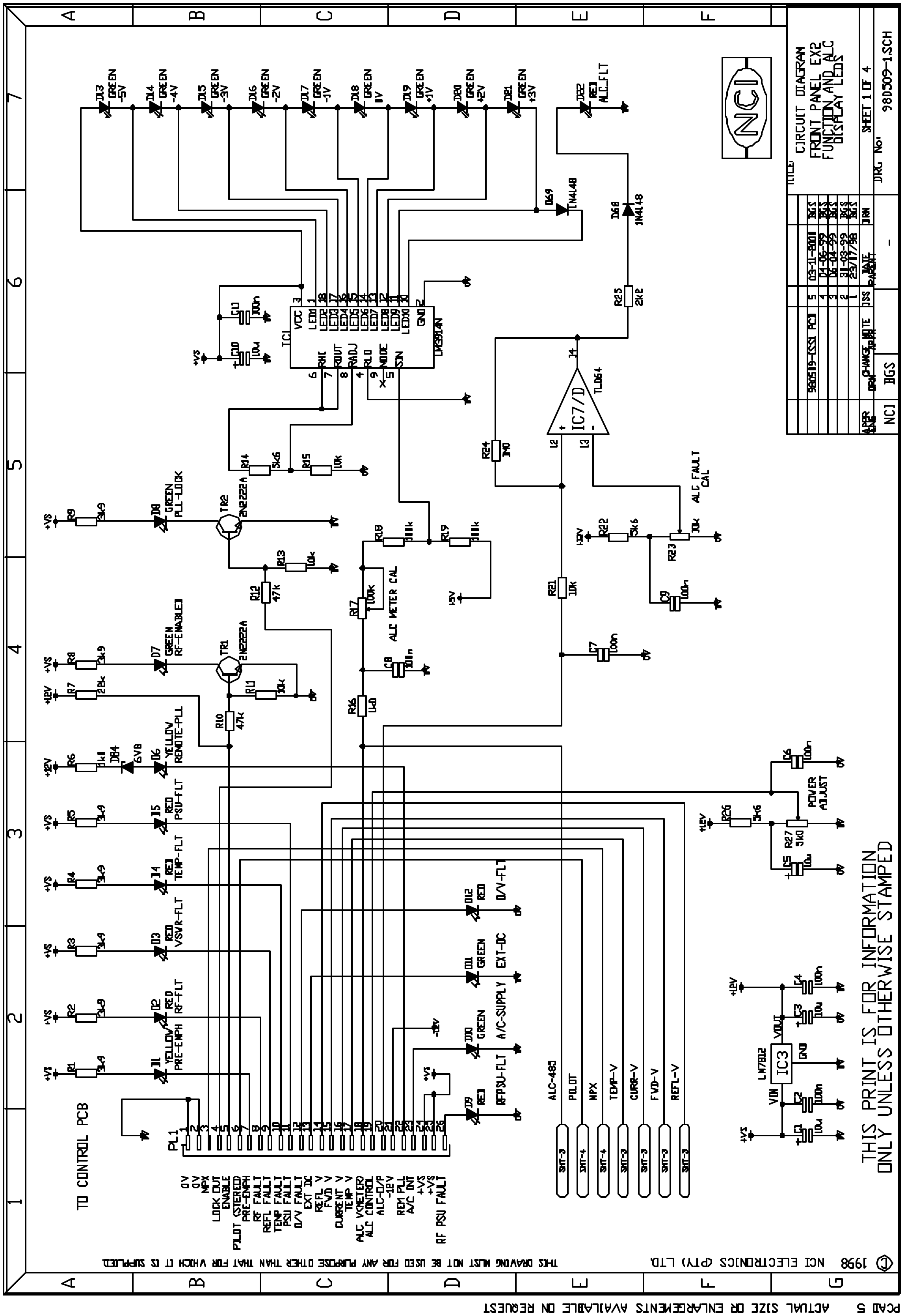
9805124.DWG ASSEMBLY SHEET 1 OF 2

STEREO CODER 980512-4 PCB



SOLDER SIDE OF PCB

9805124.DWG ASSEMBLY SHEET 2 OF 2


CIRCUIT DIAGRAM
FRONT PANEL EX2
FUNCTION AND ALC
DISPLAY LEDS
SHEET 1 OF 4
980509-1.SCH
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TO CONTROL PCB
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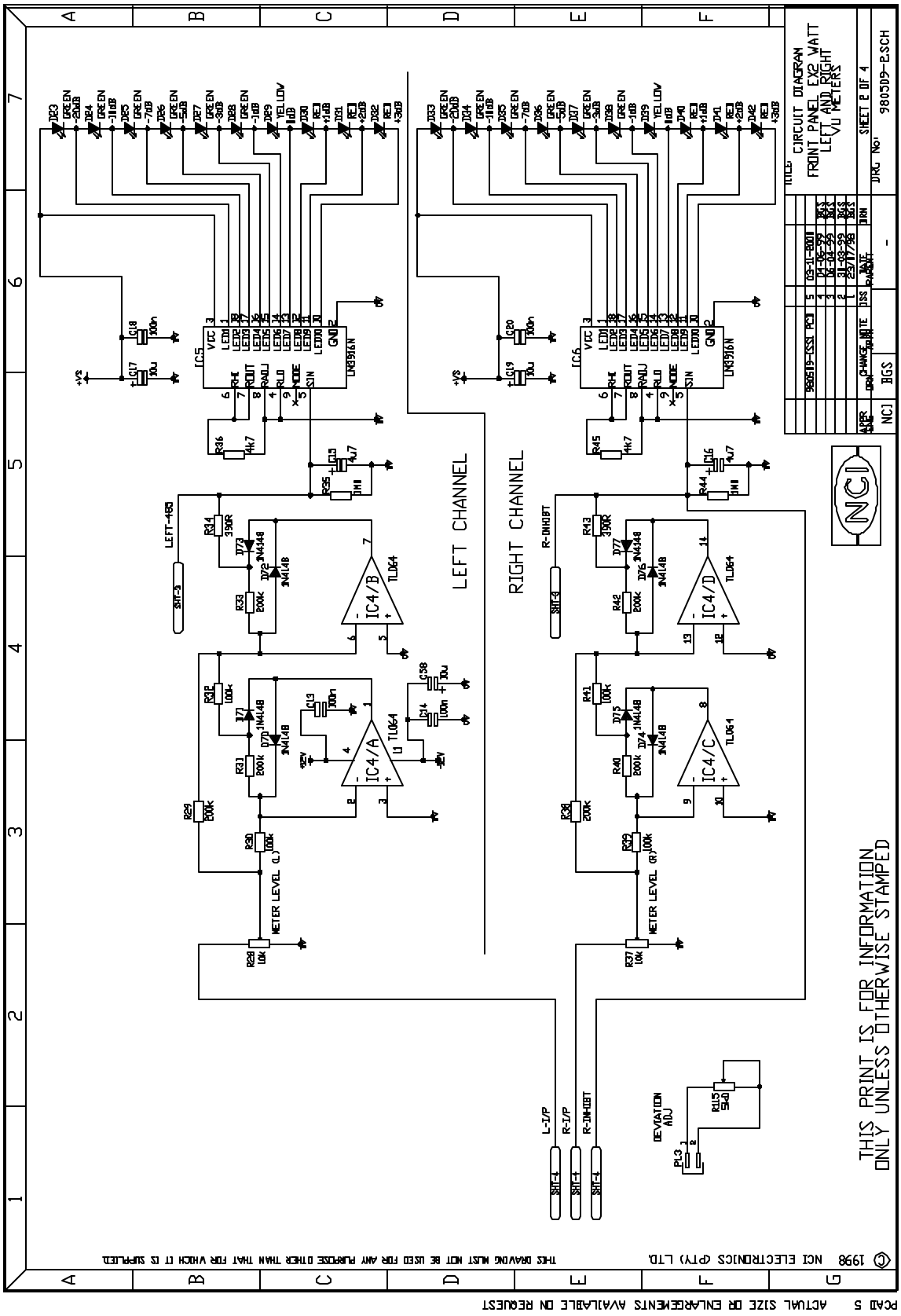
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST


LEFT CHANNEL
RIGHT CHANNEL
IC4/A
IC4/B
IC4/C
IC4/D
TL064
LM3916N
1N4148
METER LEVEL (L)
METER LEVEL (R)
DEVIATION ADJ
L-I/P
R-I/P
R-INHIBT
LEFT-485
SHT-3
SHT-4
CIRCUIT DIAGRAM
FRONT PANEL EX2 WATT
LEFT AND RIGHT
VU METERS
SHEET 2 OF 4
DRG. No. 980509-2.SCH
NCI
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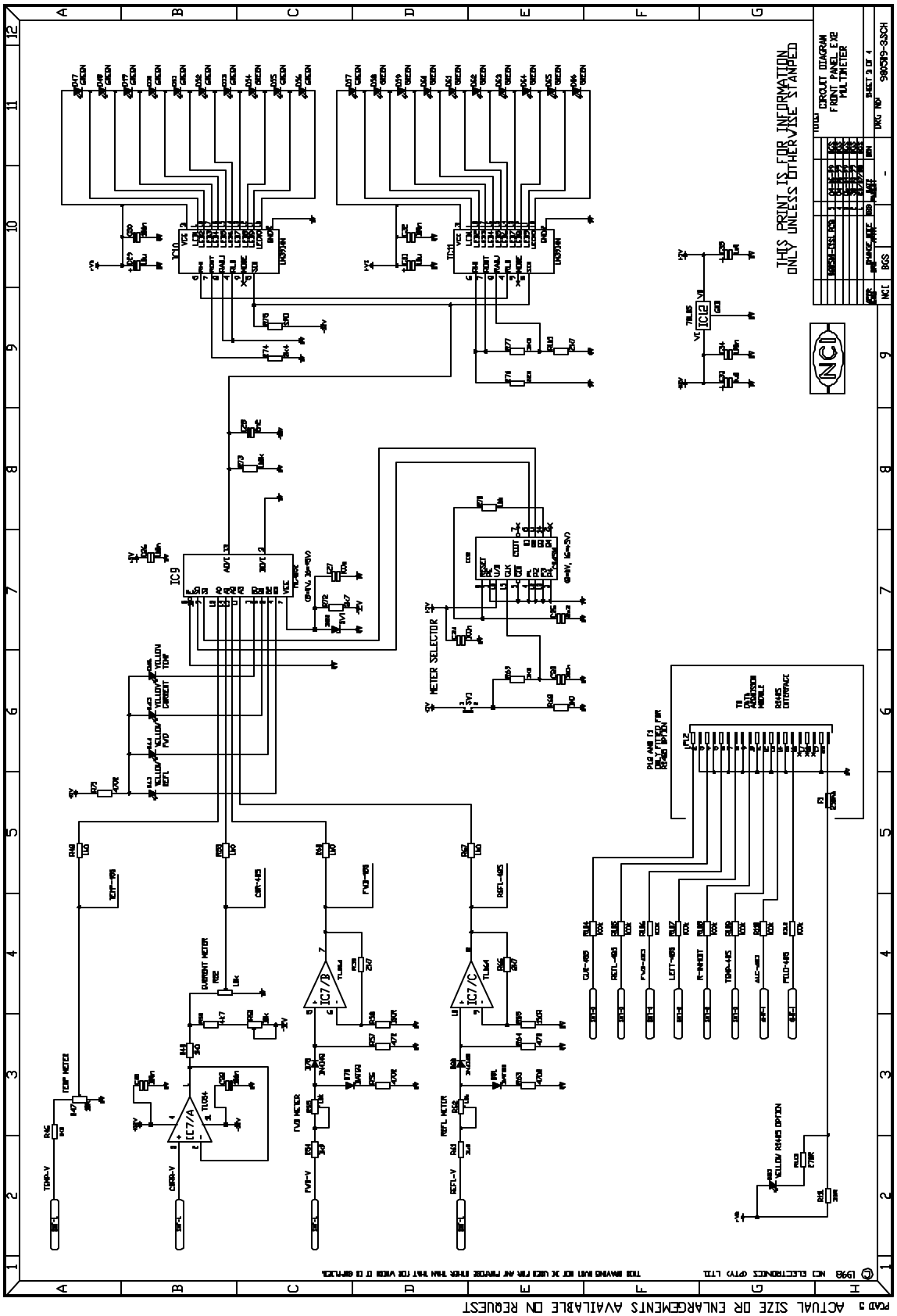
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST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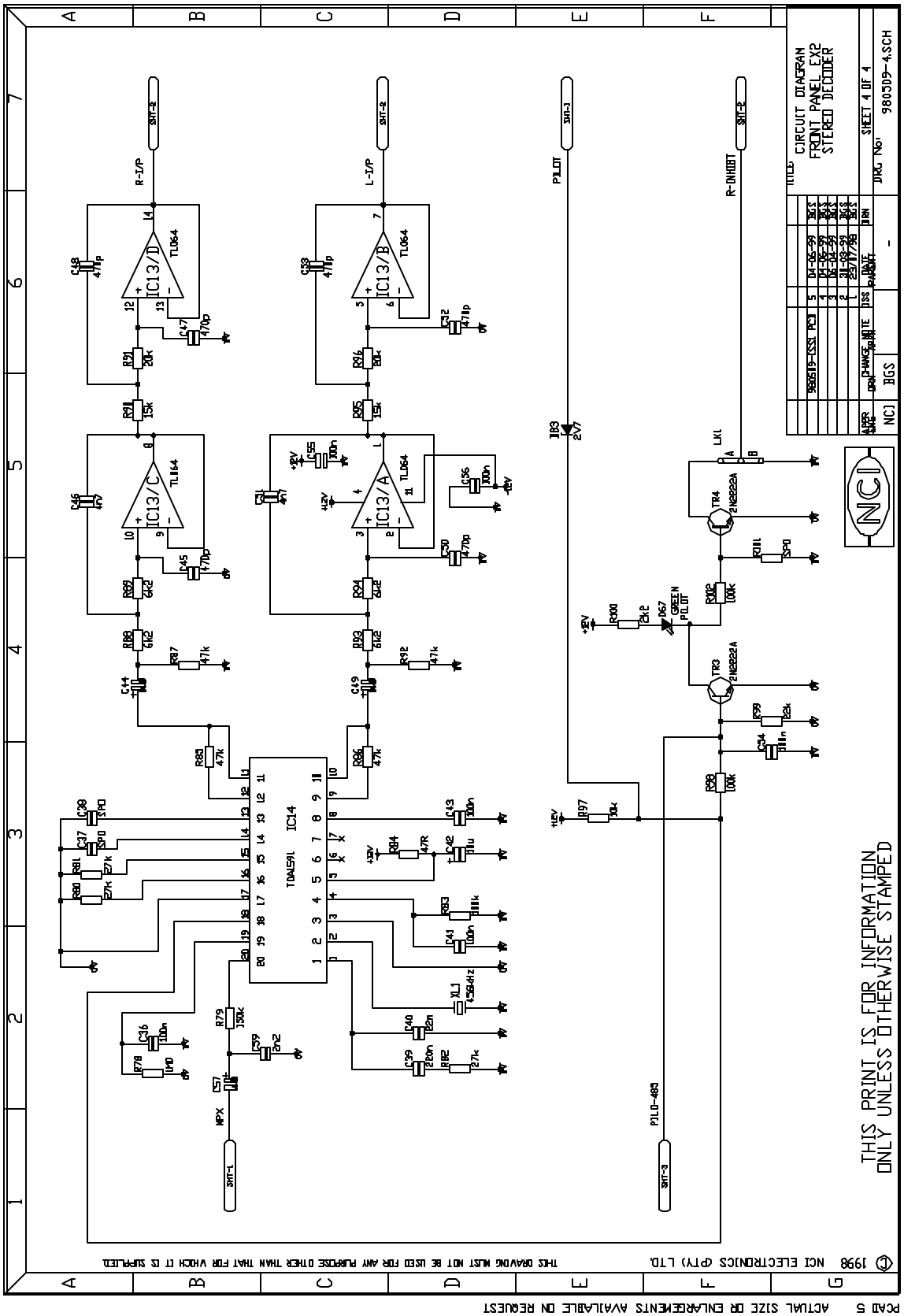
CIRCUIT DIAGRAM
FRONT PANEL EXE
MULTIMETER
SHEET 3 OF 4
DWG NO 980389-3SCH
ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST


TITLE: CIRCUIT DIAGRAM
FRONT PANEL EX2
STEREO DECODER
SHEET 4 OF 4
DRG. NO: 980509-4.SCH
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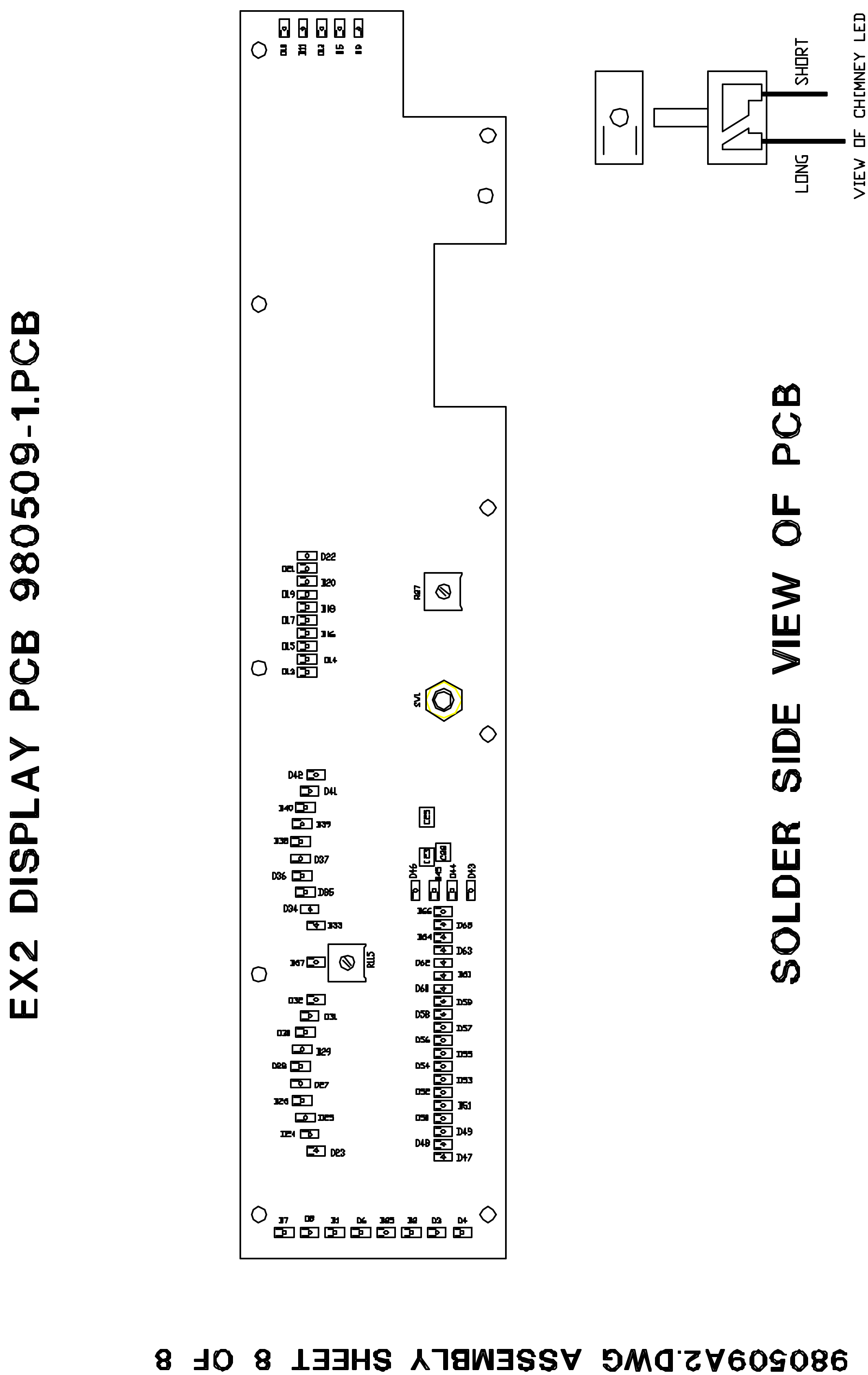
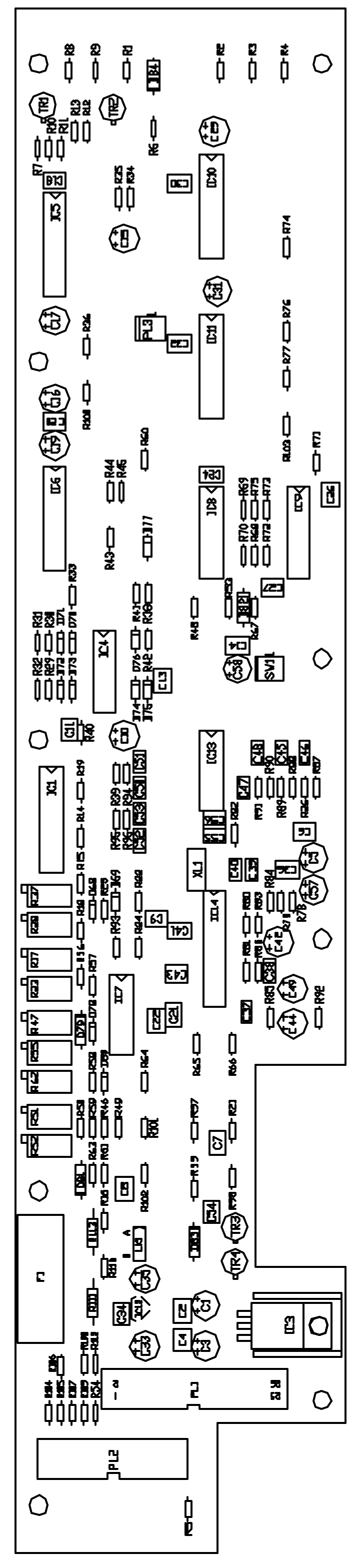
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
IC13/A TL064
IC13/B TL064
IC13/C TL164
IC13/D TL064
IC14 TDA7591
TR3 2N2222A
TR4 2N2222A
D57 GREEN PILOT
D58 2V7
XL1 4.256MHz
LK1
R-I/P
L-I/P
MPX
PILOT
R-DMODBT
PILO-485


EX2 DISPLAY PCB 980509-1.PCB
SOLDER SIDE VIEW OF PCB
VIEW OF CHIMNEY LED
LONG
SHORT
980509A2.DWG ASSEMBLY SHEET 8 OF 8

EX2 DISPLAY PCB 980509-1.PCB

COMPONENT SIDE VIEW OF PCB



COMPONENT SIDE VIEW OF PCB

980509A2.DWG ASSEMBLY SHEET 7 OF 8

EXCITER EX2 DISPLAY PCB 980509 ISS-1 (PCB)