



**FM-25**

**25W STEREO**  
**TRANSMITTER/EXCITER**

**TECHNICAL MANUAL**

**LARCAN USA INC.**

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## **FM-25**

# **25W STEREO TRANSMITTER/EXCITER**

## **TECHNICAL MANUAL**

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## INTRODUCTION

This manual contains the operating, technical and installation information for the LARCAN FM-25 FM Broadcasting Exciter. The Exciter forms part of a new range of Professional FM Broadcast Exciters supplied by LARCAN and manufactured by Broadcast Solutions Electronics (Pty) Ltd.

1. The FM-25 Exciter forms a compact, solid state FM Broadcast transmitter with a RF output in excess of 25W in the FM Broadcasting band (87.5MHz to 108MHz). The unit is housed in a 19 inch rack mount case occupying only a 1U space. The Exciter features a range of customer options including a built in, high quality Stereo coder.
2. The FM-25 25W Transmitter / Exciter is fully compatible with the Ibiuity **IBOC** digital Audio system to be implemented.
3. The FM-25 Exciter offers a standard specification, well above the requirements of major broadcasters in the world. This level of performance is only found in the very best equipment the market has to offer.
4. The following basic versions are available:
  - a) FM-25 (W) Wideband MPX Exciter (For use with composite input).
  - b) FM-25 (S) Stereo Exciter (With built in Stereo coder and Audio Limiter).
  - c) FM-25 (M) Mono Exciter (For use with Mono input).

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## TECHNICAL MANUAL

### General Description

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## GENERAL DESCRIPTION

### 1. STRUCTURE.

The Exciter comprises of the following modules.

- a) Synthesizer/Modulator module (98052100).
- b) Control/Monitoring module (98052200).
- c) 25W RF PA module (98052700).
- d) Power supply module (98053000).
- e) Display module (98052400).
- f) Stereo coder/Limiter (378-Z0021). (optional).

Each module is Field replaceable, in line with LARCAN maintenance philosophy. This allows the customer to change a module, or to upgrade options easily.

### 2. FEATURES.

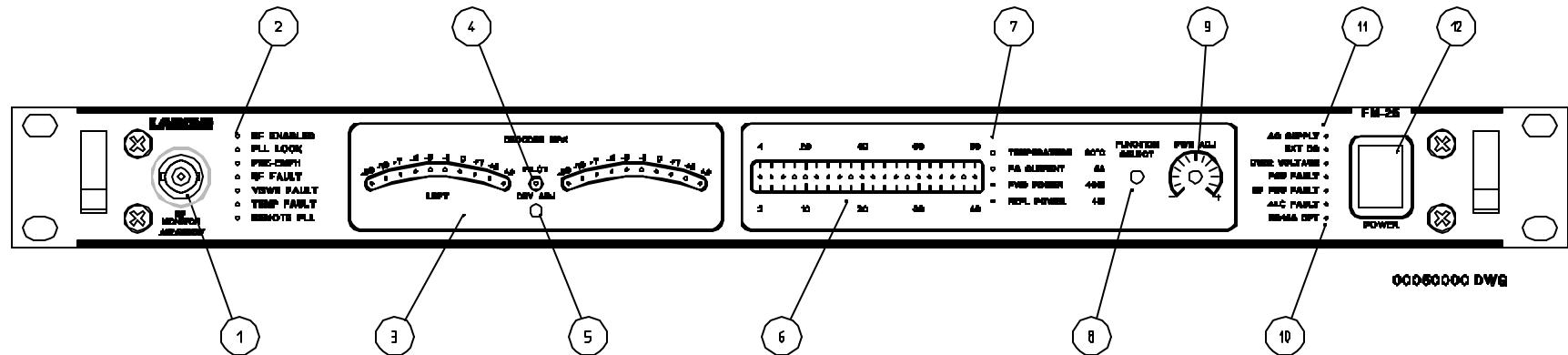
The FM-25 Exciter has standard features including the following;

- a) Remote/Internal frequency selection (standard).
- b) Remote telemetry with voltage free contacts (standard).
- c) +24V 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.

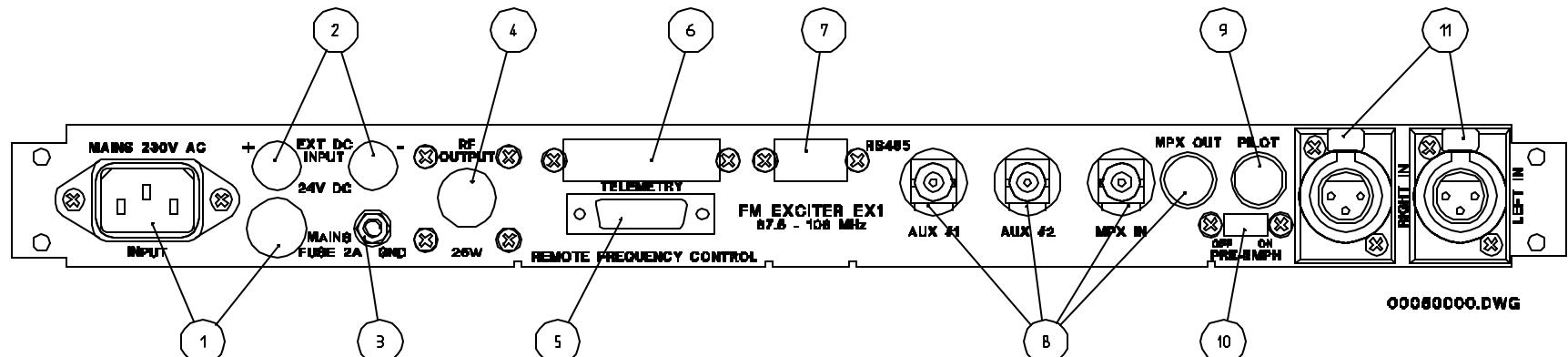
### 3. BLOCK DIAGRAM DESCRIPTION.

Refer to the Front panel layout and Rear panel controls and connectors in figure 1, and the Block diagram of FM-25 in Figure 2

Figure 1: Front panel layout and rear panel connectors and functions



FRONT PANEL



REAR PANEL

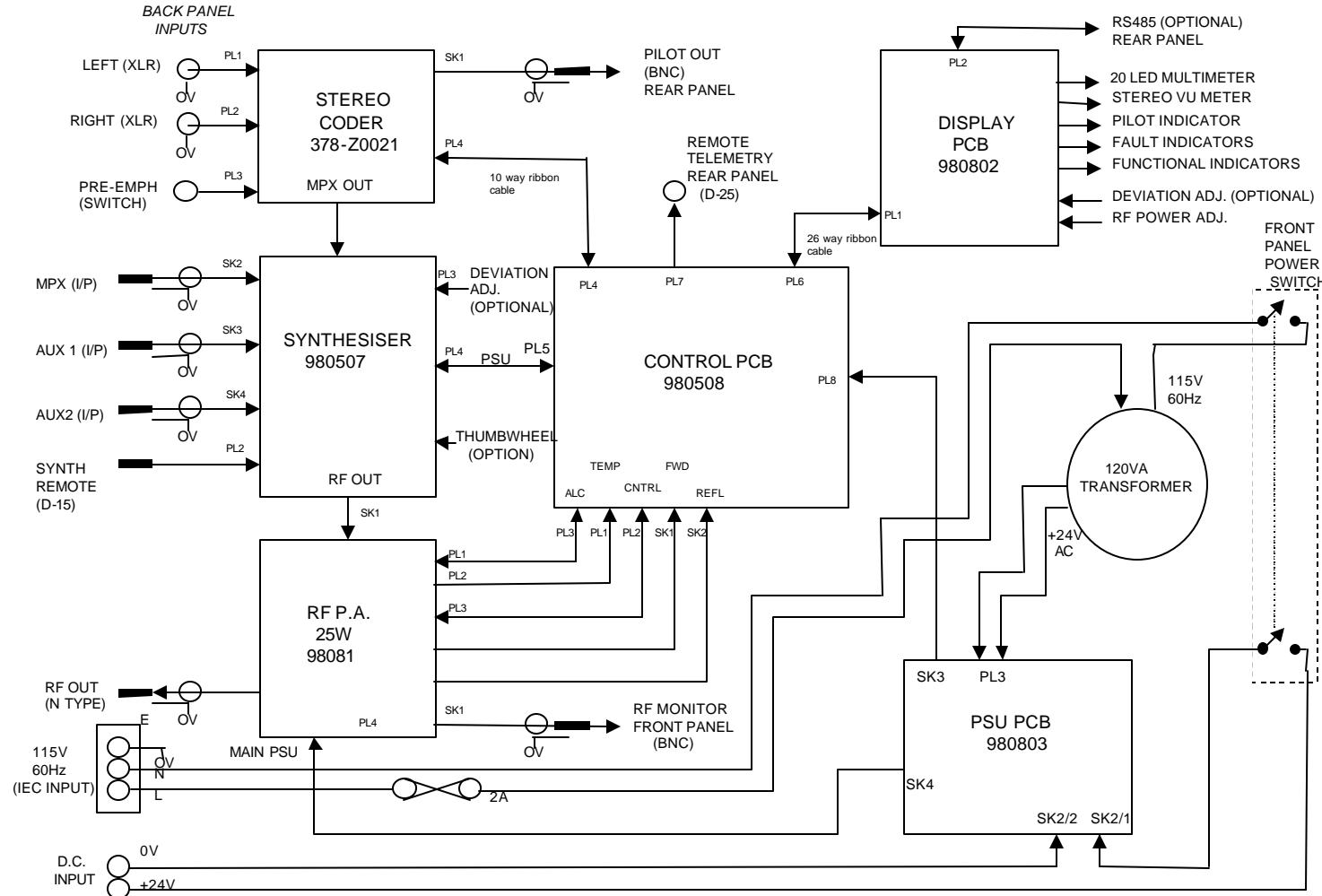


Figure 2: block diagram of EM-25

a) SYNTHESIZER AND MODULATOR (98052100)

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 exist.

b) RF PA MODULE (98052700)

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 >25W. 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 a 3A adjustable voltage type operating at +22.5V.

c) CONTROL MODULE (98052200)

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 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 (9805300)

The power supply module contains the rectification and smoothing capacitors for the off board 230V 50Hz a/c toroidal mains transformer. The +24V nominal external battery supply is combined on this module with the smoothed supply via isolating diodes. Fuses are provided for the +24V dc supply and the rectified dc supply on this module. The various voltages are then distributed to the other modules.

e) DISPLAY MODULE (98052400)

The display module provides the Local user functions and alarm indications at the Exciter front panel. The display has two 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) 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.

Alarms and indications are provided by Front panel Leds enabling instant status 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 (378-Z0021) (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 (98051900)

The 230V 50Hz a/c power input is connected via a IEC connector whilst the +24 dc input is connected via Binding terminals. A back panel Fuse is provided on the a/c input 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 a 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 (98053100) (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.

# **25W STEREO TRANSMITTER/EXCITER**

## **TECHNICAL MANUAL**

### **Technical Specifications**

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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	$\pm 2\text{ppm}$ (10MHz TCXO)
RF OUTPUT POWER	$\geq 25\text{W}$ (Adjustable via front panel control)
RF HARMONIC SUPPRESSION	$\geq 70\text{dB}$
RF SPURIOUS SUPPRESSION	$\geq 75\text{dB}$
OUT OF LOCK ATTENUATION	$\geq 80\text{dB}$
OUT OF BAND ATTENUATION	$\geq 80\text{dB}$ (87.5MHz $\leq F \leq$ 108MHz)
AM NON SYNCHRONOUS NOISE	$\leq -60\text{dB}$ (Filtered 20Hz to 20kHz)
AM SYNCHRONOUS	$\leq -60\text{dB}$ (Filtered 20Hz to 20kHz)
MEAN CARRIER VARIATION	$\leq \pm 200\text{Hz}$

### WIDEBAND COMPOSITE OPERATION

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

### STEREO OPERATION (With built in Stereo coder/Limiter)

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

### MONO OPERATION (With built in Mono filter)

AF RESPONSE	$\leq \pm 0.3\text{dB}$ (30Hz to 15kHz)
MONO DISTORTION	$\leq 0.1\%$ (30Hz to 15kHz)
S/N RATIO	$\geq 80\text{dB}$ (20Hz to 20kHz) 50uS de emph

INPUT IMPEDANCE	600 ohms balanced (XLR)
DEVIATION SENSITIVITY	+6dBm for $\pm 40\text{kHz}$ deviation (adj.)
ATTACK TIME	$\leq 2\text{mS}$ for increased 10dB I/P step
DECAY TIME	$\geq 80\text{mS}$ for a decreased 10dB I/P step
LIMITER DISTORTION	$\leq 0.35\%$ (10dB into limiting)
LIMITER THRESHOLD	Internally adjustable

## ENVIRONMENTAL SPECIFICATIONS

A/C INPUT POWER	115V $\pm 10\%$ (other on request)
A/C FREQUENCY VARIATION	60Hz $\pm 5\%$ (other on request)
DC INPUT POWER	+24V Nominal
STORAGE TEMPERATURE	-40°C to +60°C
OPERATING TEMPERATURE	-10°C to +45°C
RELATIVE HUMIDITY	20% to 90% (non condensing)
OPERATING ALTITUDE	$\leq 3000\text{m}$ above sea level
COOLING SYSTEM	Convection cooled
PHYSICAL DIMENSIONS	480mm x 450mm x 44.4mm
PHYSICAL MASS	Approximately 8kg

## STANDARD ALARM SETTINGS AND LOCAL INDICATIONS

RF FAULT INDICATION	$\leq 18\text{W}$ (Red led on front panel)
VSWR FAULT INDICATION	$\geq 2.5\text{W}$ (Red led on front panel)
VSWR FAULT TRIP INDICATION	$\geq 3.5\text{W}$ (Red led/front panel/10Sec re-cycle)
TEMP FAULT INDICATION	$\geq 55^\circ\text{C}$ (Red led on front panel)
TEMP TRIP INDICATION	$\geq 65^\circ\text{C}$ (Red led on front panel)
ALC FAULT INDICATION	Out of range (Red led on front panel)
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	$\geq +40\text{V}$ 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**

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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 ( $\leq 1W$ ) while clockwise gives maximum power ( $\geq 25W$ ).

#### 3. DEVIATION ADJUST

This single turn potentiometer is used to fine trim the Transmitter final deviation level. The standard variation is  $\pm 1.5\text{dB}$  (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  $100^\circ\text{C}$  f.s.d.
- RF PA Current: RF final stage current with  $3.2\text{A}$  f.s.d.
- RF Forward power: RF Output power with  $32\text{W}$  f.s.d.
- RF Reflected power: RF Output Reflected power with  $3.2\text{W}$  f.s.d.

#### 5. ALC METER

**This meter is only provided with the High power Exciters.** The ALC Alarm is still operational and is indicated on the Front panel.

#### 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.
ALC FAULT	Red led	Indicates ALC fault.

### BACK PANEL

#### a) A/C INPUT

Standard IEC male connector for 115V 60Hz mains operation.

#### b) A/C FUSE

20mm (1 Amp) fuse connected in live line.

#### c) DC INPUT

Terminals for +24V dc operation.

#### d) DC FUSE

**Only on High power Exciters.**

#### 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 (BCD coded).

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
<b>107.6</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>
<b>98.9</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
<b>88.5</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>

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  $\pm 62.5\text{kHz}$ .

The pilot deviation is factory set to  $\pm 7\text{kHz}$ . The total deviation must not exceed  $\pm 75\text{kHz}$ . A fine deviation level adjustment of  $\pm 1.5\text{dB}$  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 (98052100). 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 (115V 50Hz).

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

b) DC SUPPLY (+24V 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 female) 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
ALC FAULT (red led)	OFF

c) ALC METER (not fitted on this unit).

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.

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 25W. (This should be achieved with 16 Leds on).

Now check the PA CURRENT and REFL POWER readings:

PA CURRENT should be approximately 1.9 Amps.

REFL POWER should be less than 2.5W (16 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 cable and connector requirements must be requested by the customer.

# **25W STEREO TRANSMITTER/EXCITER**

## **TECHNICAL MANUAL**

### **Technical Information**

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## TECHNICAL INFORMATION

### 1. SYNTHESIZER MODULE (98052100)

#### 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** which provides the logic 1 signal for the external data on **pin 12 of PL2**. Led **D38** provides indication of remote operation.

**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  $\geq 40$ dB attenuation above 25Hz. The loop delay of the filter is  $\leq 50$ mS 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 to detect the condition of  $\leq 87.5$ MHz.

**IC4/a, IC6/a, IC6/b, IC6/c, IC4/c, IC7/a, IC4/b and IC8/a**, provide the data required to detect the condition of  $\geq 108\text{MHz}$ .

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  $\geq 40\text{dB}$ .

#### 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**.

An 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 (98052200)

#### a) PSU and Internal Monitoring

The Control module has **two dc power inputs**. The dc (+24V battery) input is connected to **PL8 pin 2**, while the rectified and smoothed (a/c supply) input is connected to **PL9 pin 2**. The nominal voltage in this case is +28V.

Each of these inputs are monitored for indication purposes via **R88** and **R89** which drive external Leds on the Exciter front panel.

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 +40V) via **IC6/a** and **TR8**.
- **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). **Leveladjustment** 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 their for protection purposes, by reducing the output power during fault conditions.

- **LK1** is used to insert protection from **High reflectedpower** (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, 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.

### 3. DISPLAY MODULE (98052400)

#### 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 monitoring
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 alarm**

The **ALC Fault** alarm Led (**D22**) derives its signal from **PL1 pin 20**, via **R25/D13** which in conjunction with **D68** turns the Fault Led on at approximately +8V.

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** being 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 (98052600)

##### a) Psu and Regulator

The **+Vin** supply (E22) is the main supply for the PA and is typically between **+24V** and **+32V**.

This supply is connected to the main regulator, **IC2** (+22.5V) via **Fuse F1**, (3.15A). The output of the regulator is at **E24** and is indicated by **LED D4**.

The main regulator can be disabled via **TR3** which effectively reduces the output voltage to 0V when the transistor is On. **TR3** is switched via a external input from the control module.

Resistor **R30** is used to monitor the current in the RF PA section and provision is made for external monitoring via **R31, R32 and R29**.

##### 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 **3 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 **2:1 wideband input transformer T1**.

Resistors **R9** and **R10** 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 **L3** and associated components. **R14** 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). dc blocking capacitors **C7, C8 and C9** are provided to remove the dc component.

##### c) RF Harmonic filter

The output from the final RF stage is routed directly via **C7** to the RF filter stage. The filter used is a **Hybrid eighth order** type utilizing a notch at 180MHz (**C24/L5**). The notch is designed to eliminate the second harmonic. The filter ripple is less than **0.1dB** (0 to 110MHz) 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 E14 and E15 is connected externally to a 50 ohm N Type connector.

##### e) Temperature sensor.

A Thermistor is provided (R16) 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 (98053000)

a) **A/C Supply**

The a/c input to the power supply module is provided by a external **24V Transformer** winding which is connected to **SK1 pin 1** and **pin 3**. A Full wave Bridge rectifier (**D1**) rectifies the a/c input. This raw a/c input is smoothed by capacitors **C1** to **C9** inclusive and is then routed via **Fuse F1** and diode **D2** to **SK4**, which provides the power to the **RF PA**. This supply is also routed to **SK3 pin 1** which provides power to the control module. **Led D4** indicates the presence of the a/c supply.

b) **+24V dc supply (battery)**

The **+24 dc battery supply** input is connected to **SK2 pin 1** which is routed via **Fuse F2** and diode **D3** to **SK4**, which provides power to the **RF PA**. This supply is also routed to **SK3 pin 3** which provides power to the control module. **Led D5** indicates the presence of the dc supply.

## 6. STEREO CODER MODULE (378-Z0021)

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** which 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 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 a external s/c between **PL3 pins 1 and 2**. **R104** and **R129** are provided for setting the required 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	$\geq 23\text{kHz}$
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

The reference oscillator is formed by **IC6/a** and crystal **XL1** with fine frequency adjustment 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  $\leq 0.1\%$  distortion. The filters are adjusted by **R63** and **R67** 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  $\geq 50\text{dB}$  attenuation above **532kHz**. The required filter Passband (**53kHz**) has a flatness characteristic of **f 0.02dB** with a phase variance of **f 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 **f 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).

# 25W STEREO TRANSMITTER/EXCITER

## TECHNICAL MANUAL

### Maintenance Information

#### LARCAN USA INC.

1390 Overlook Drive #2

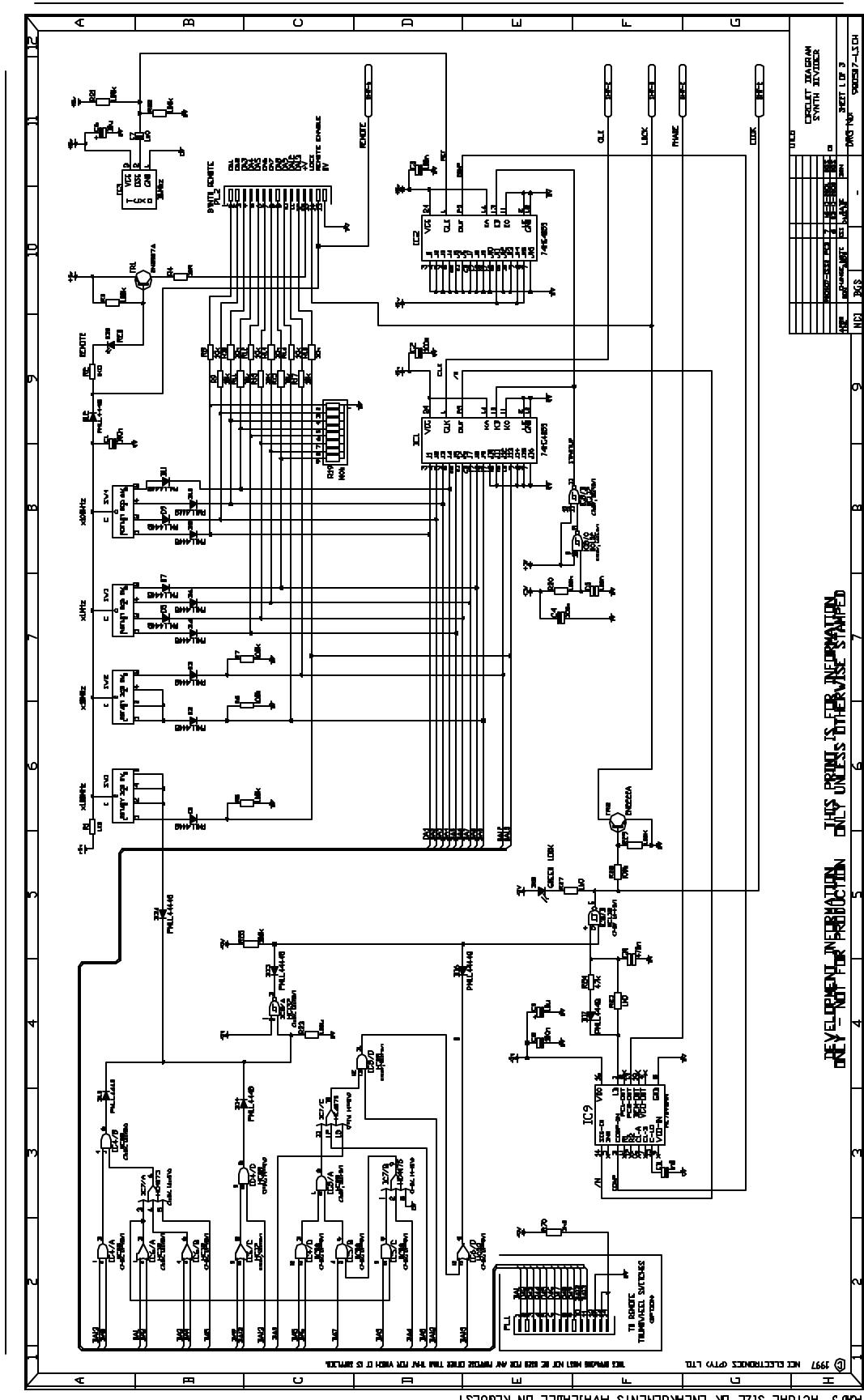
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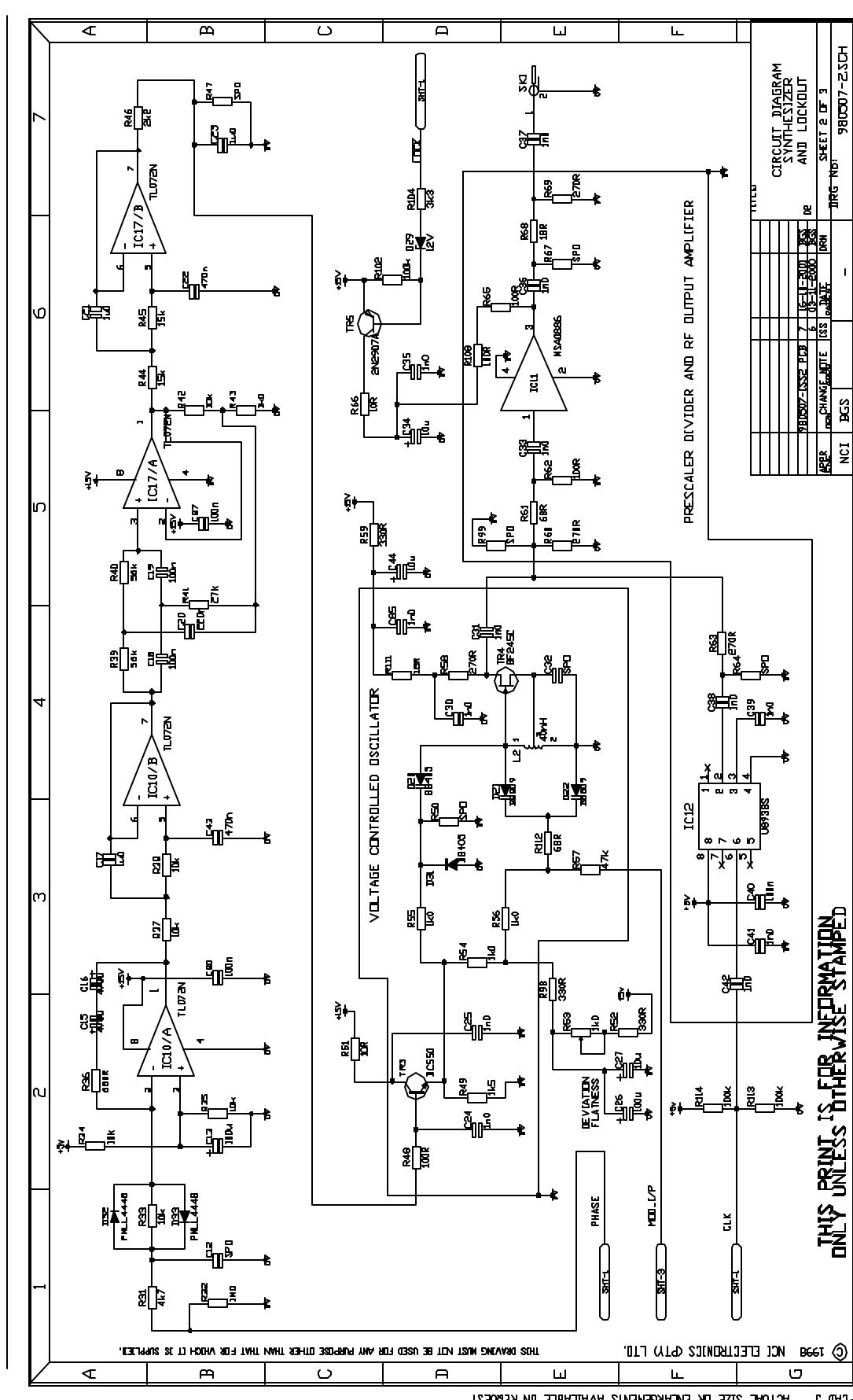
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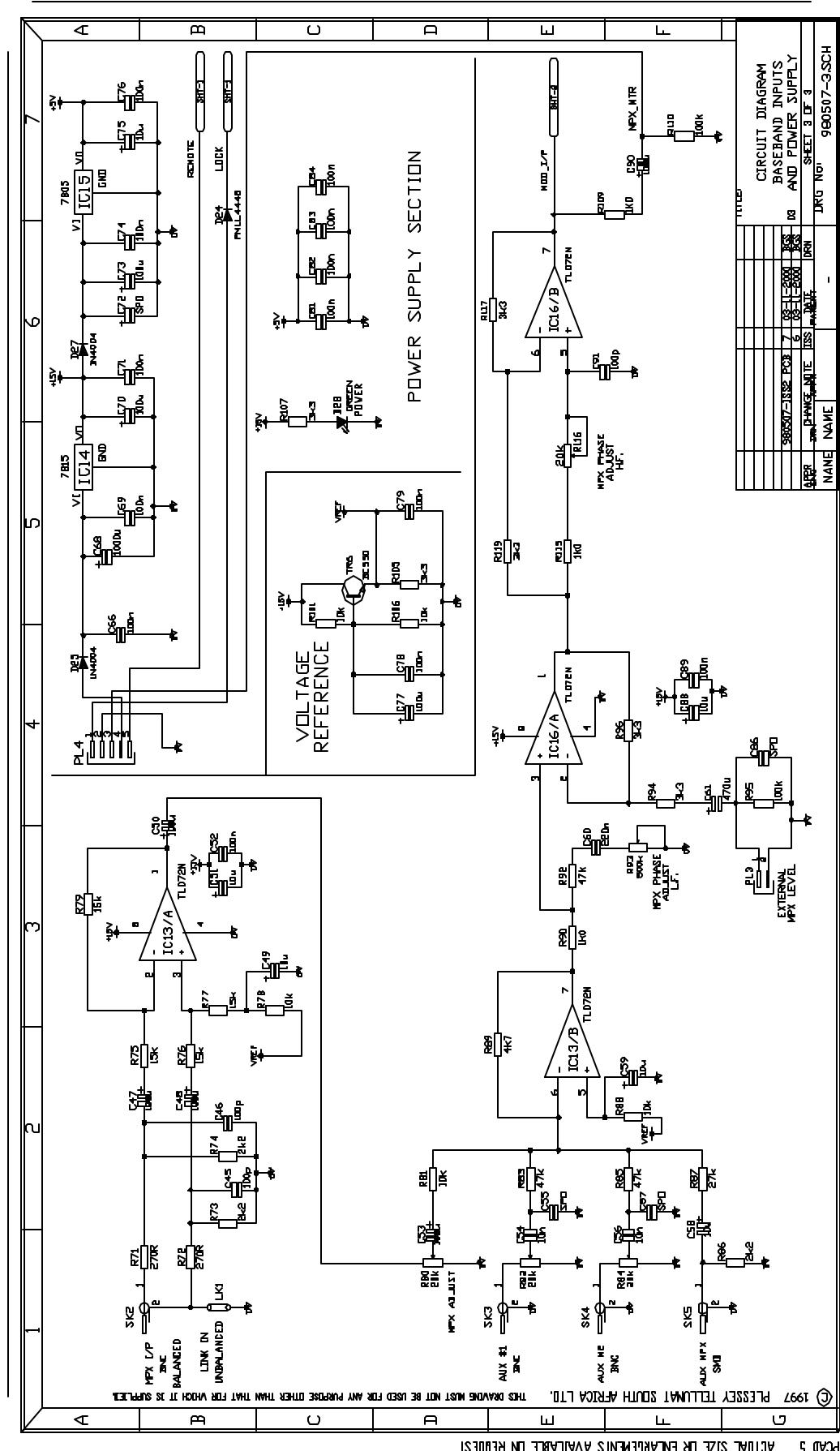
Tel: (303) 6658000 Fax: (303) 6739900

Email: [Sales@earthnet.net](mailto:Sales@earthnet.net) Web: [www.larcan.com](http://www.larcan.com)

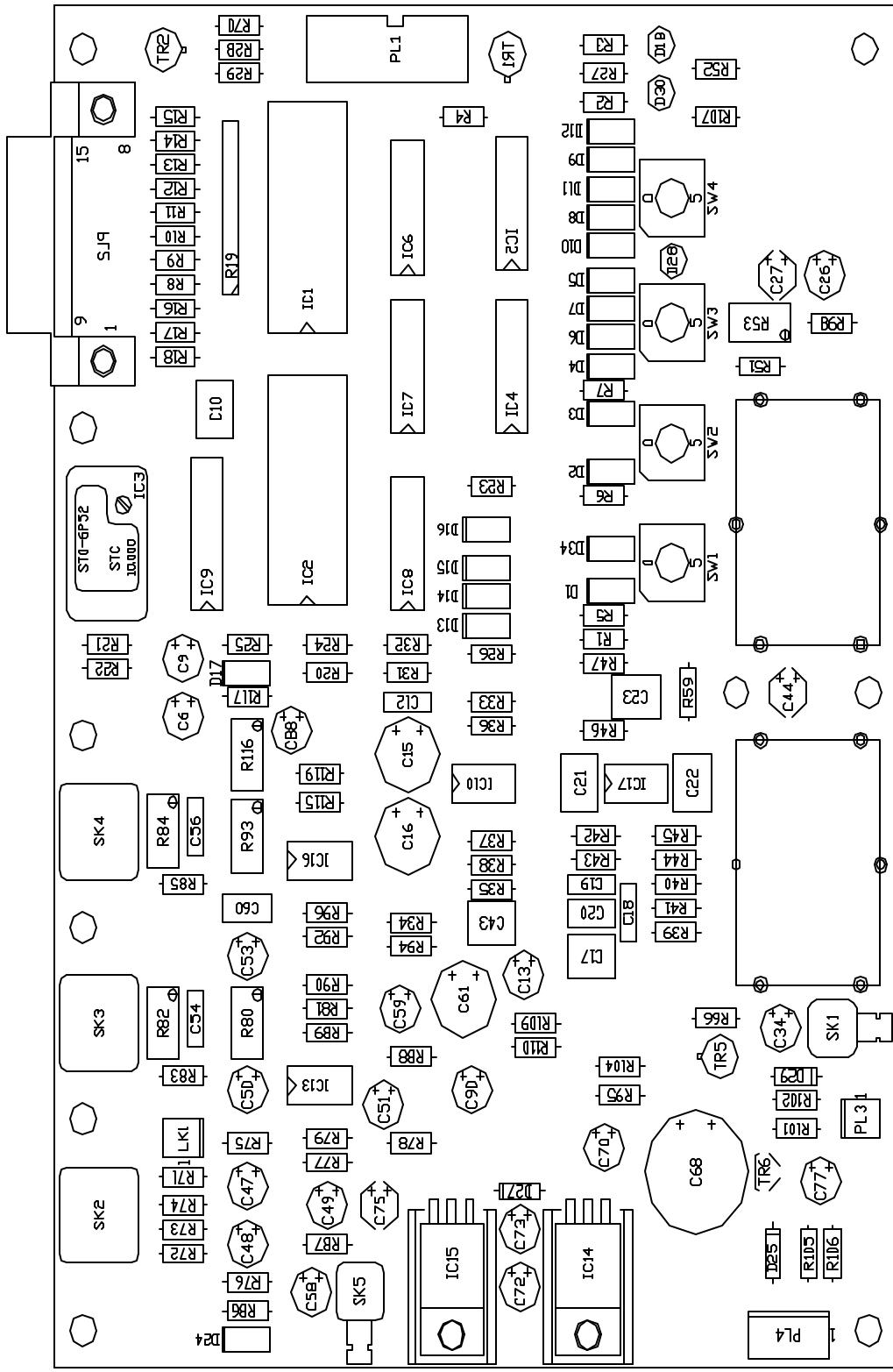




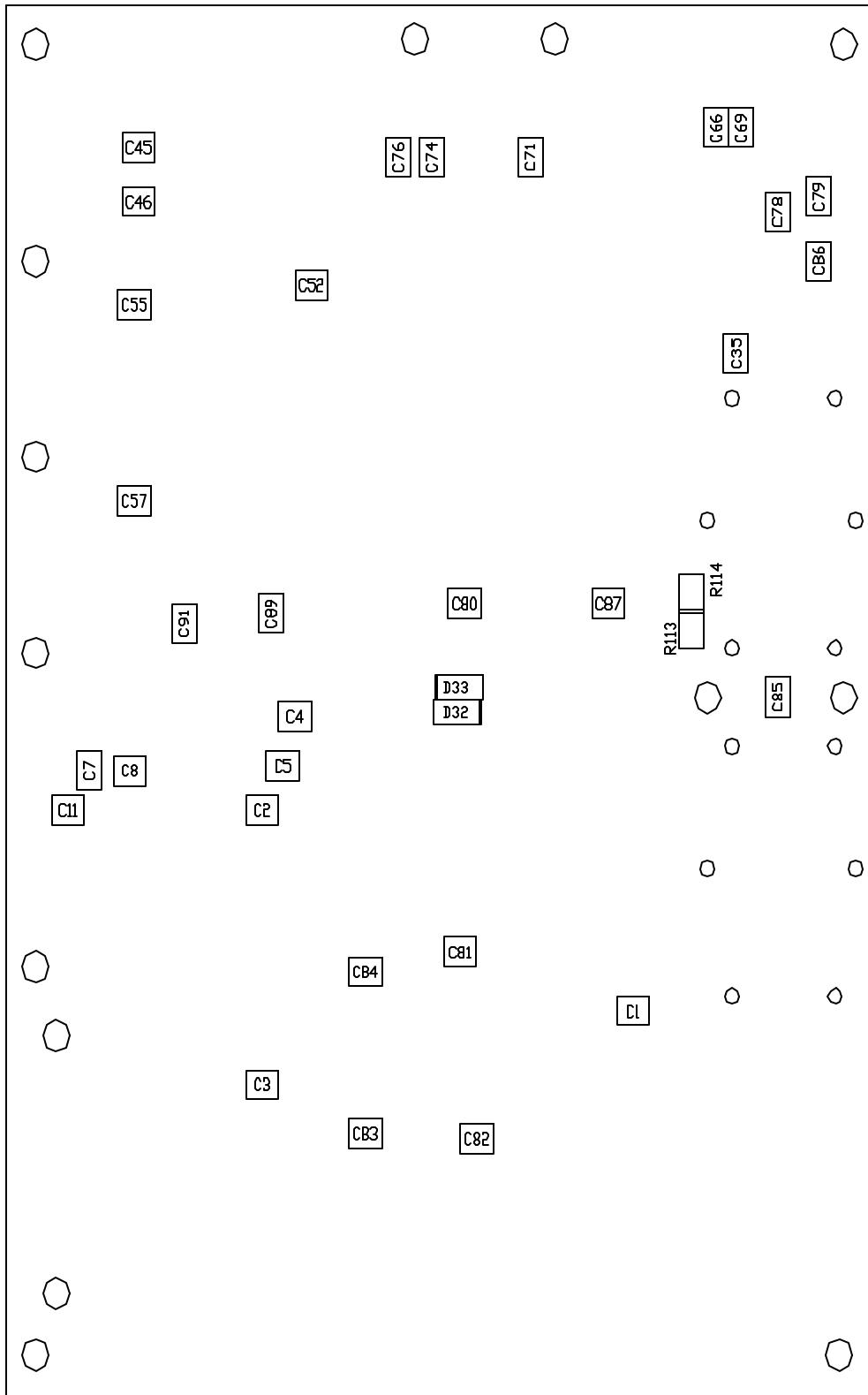




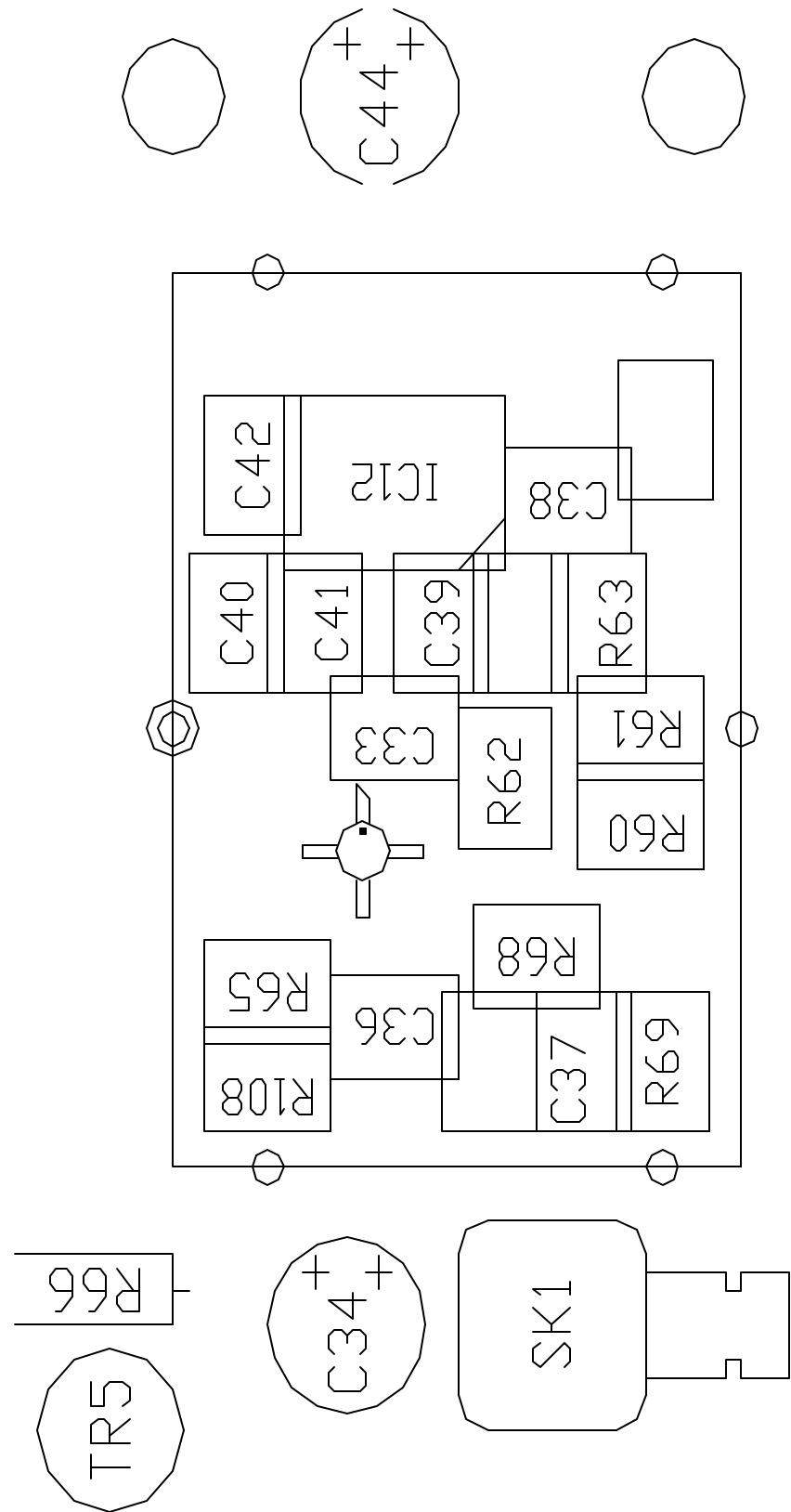
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SYNTHEZIZER PCB 980507 ISS-2 SOLDER SIDE

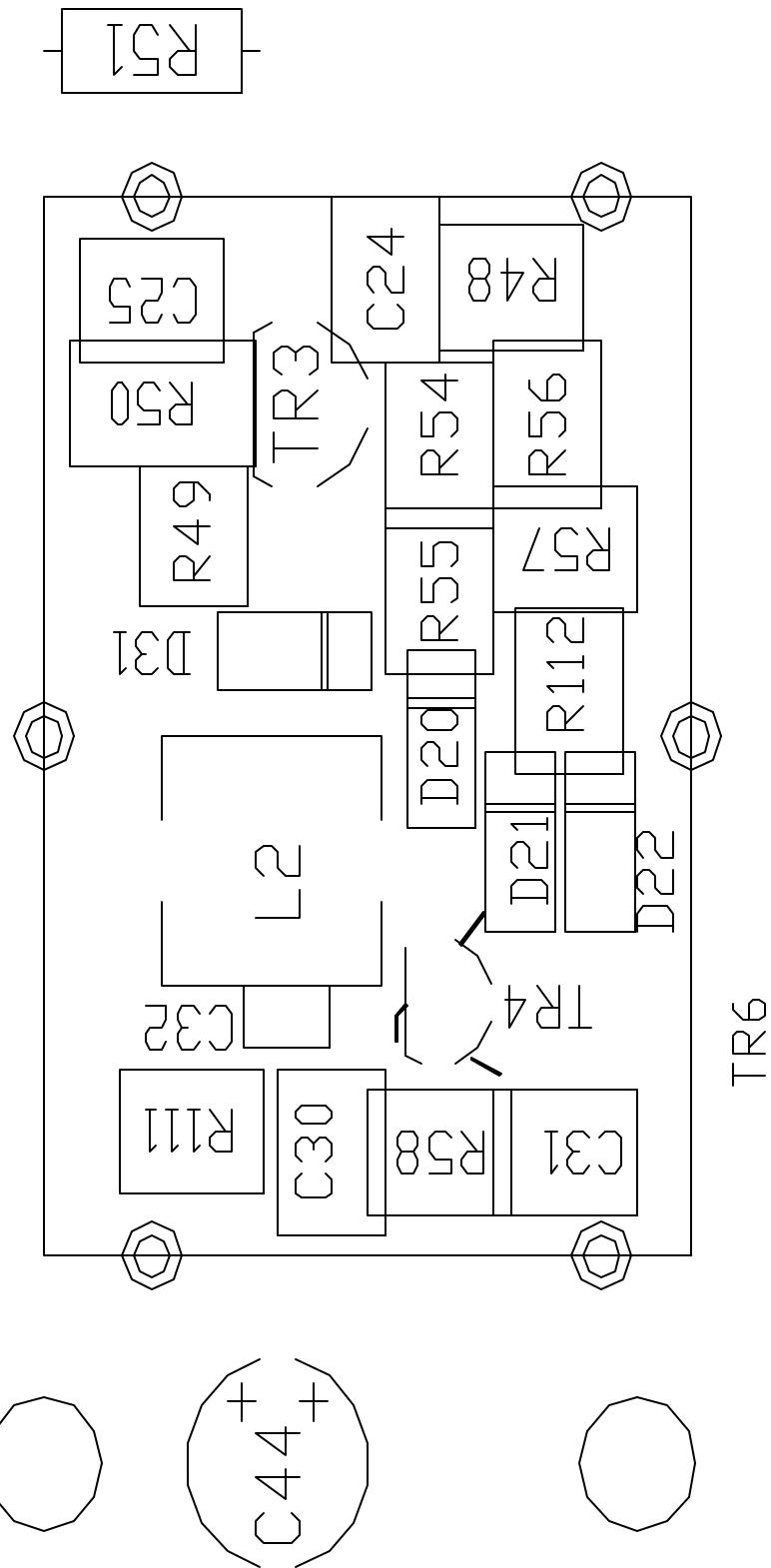


**PRE-SCALER AND BUFFER (EXPLODED) 980507-2 PCB**



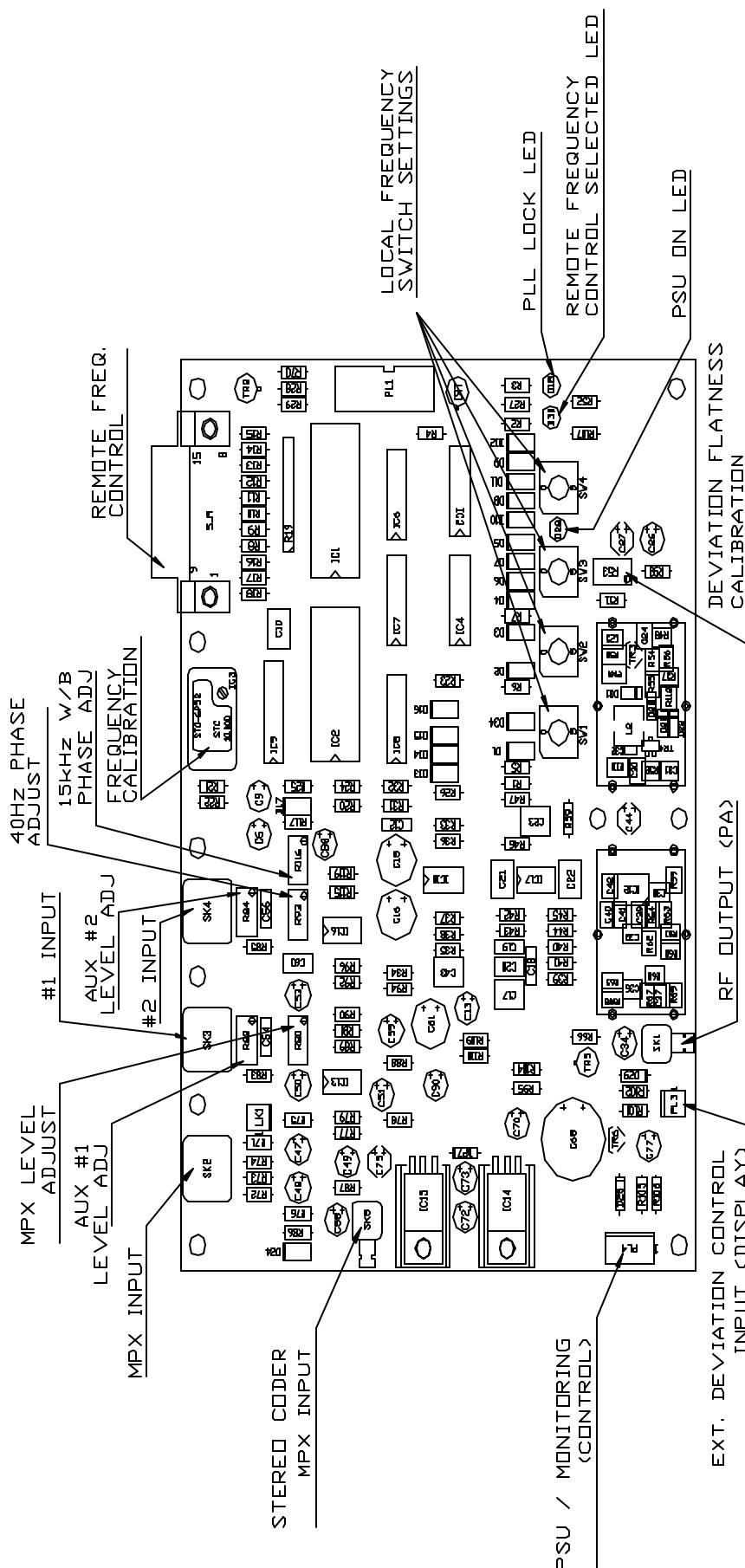
**980507A3.DWG ASSEMBLY SHEET 3 OF 4**

**VCO ASSEMBLY (EXPLODED) 980507-2 PCB**

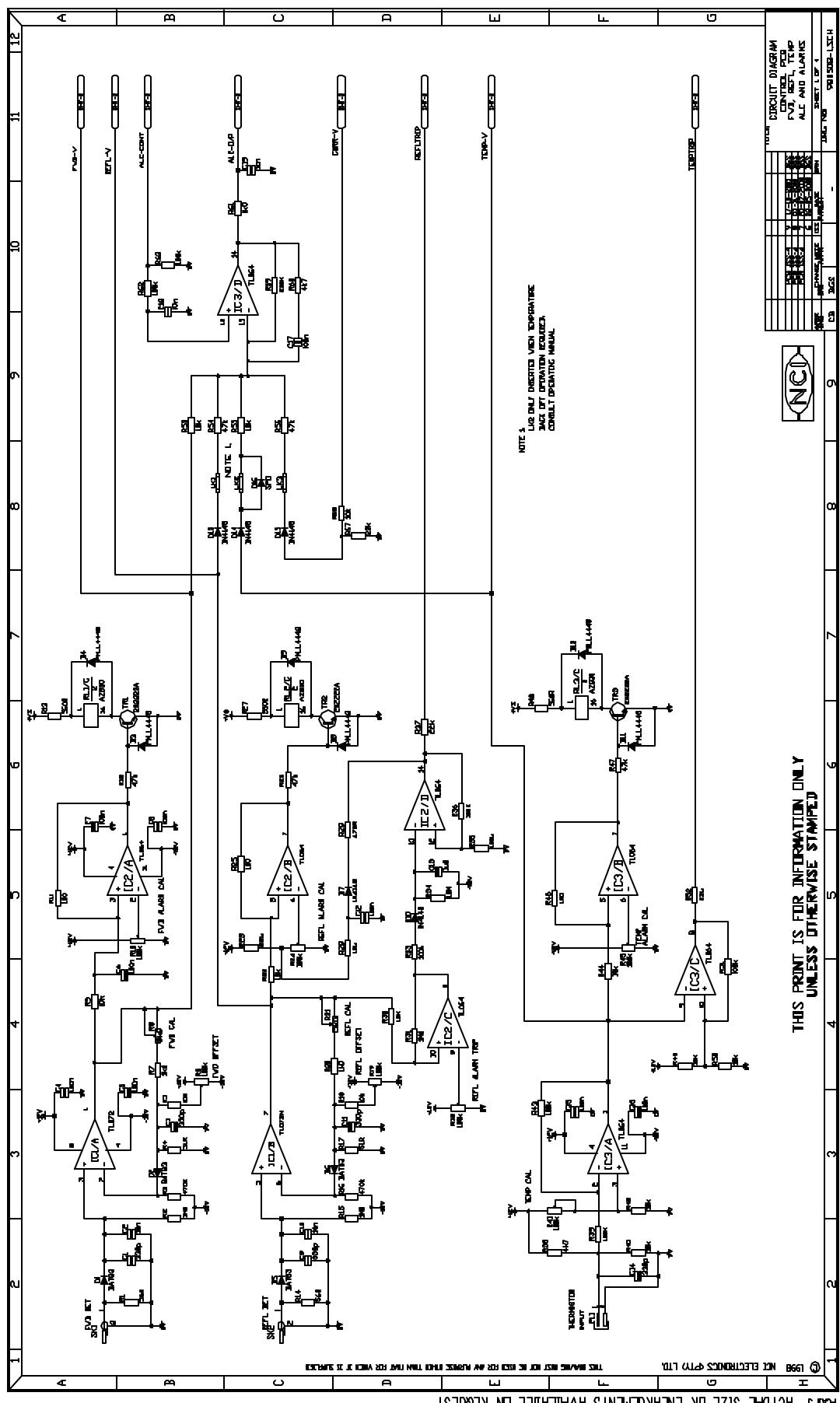


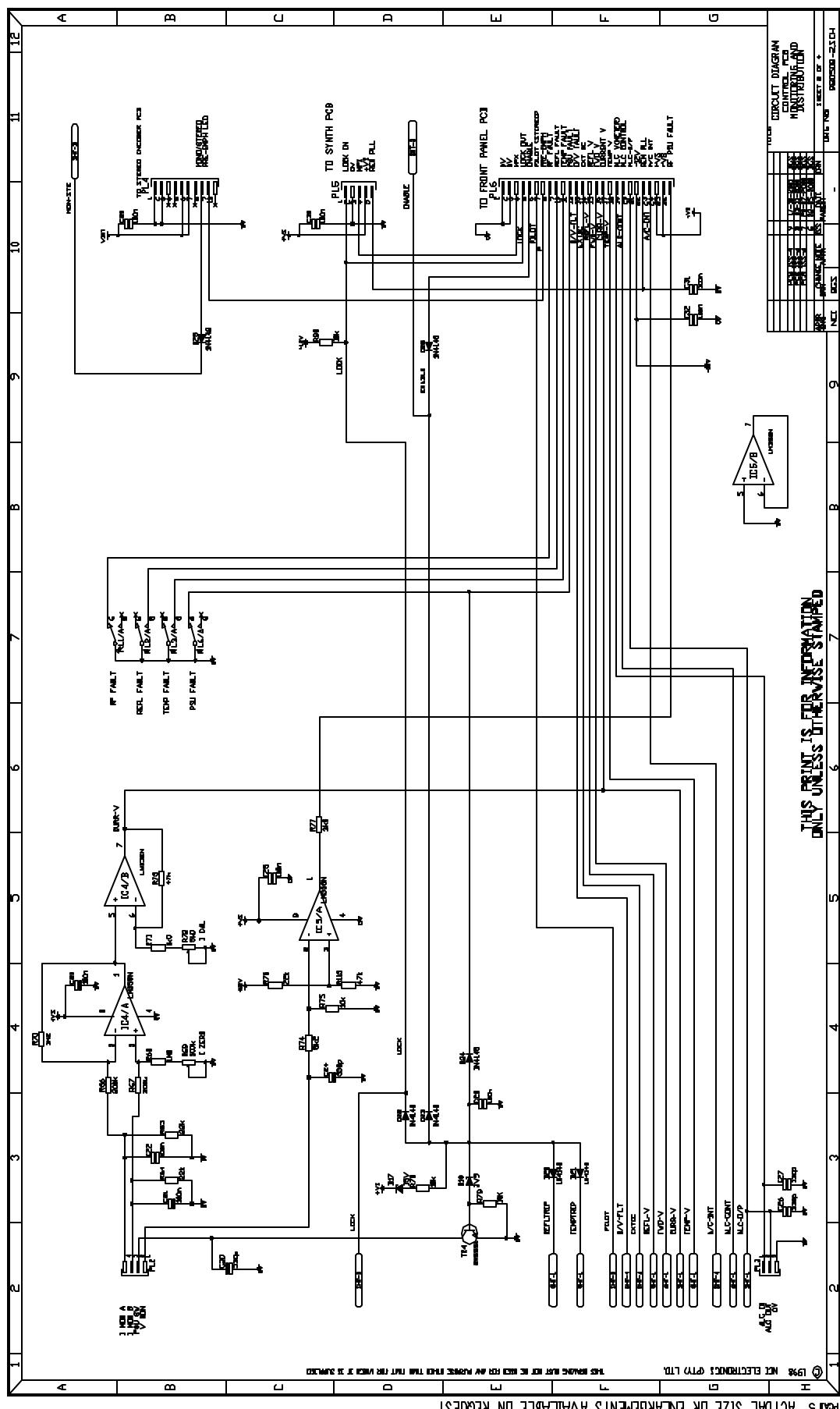
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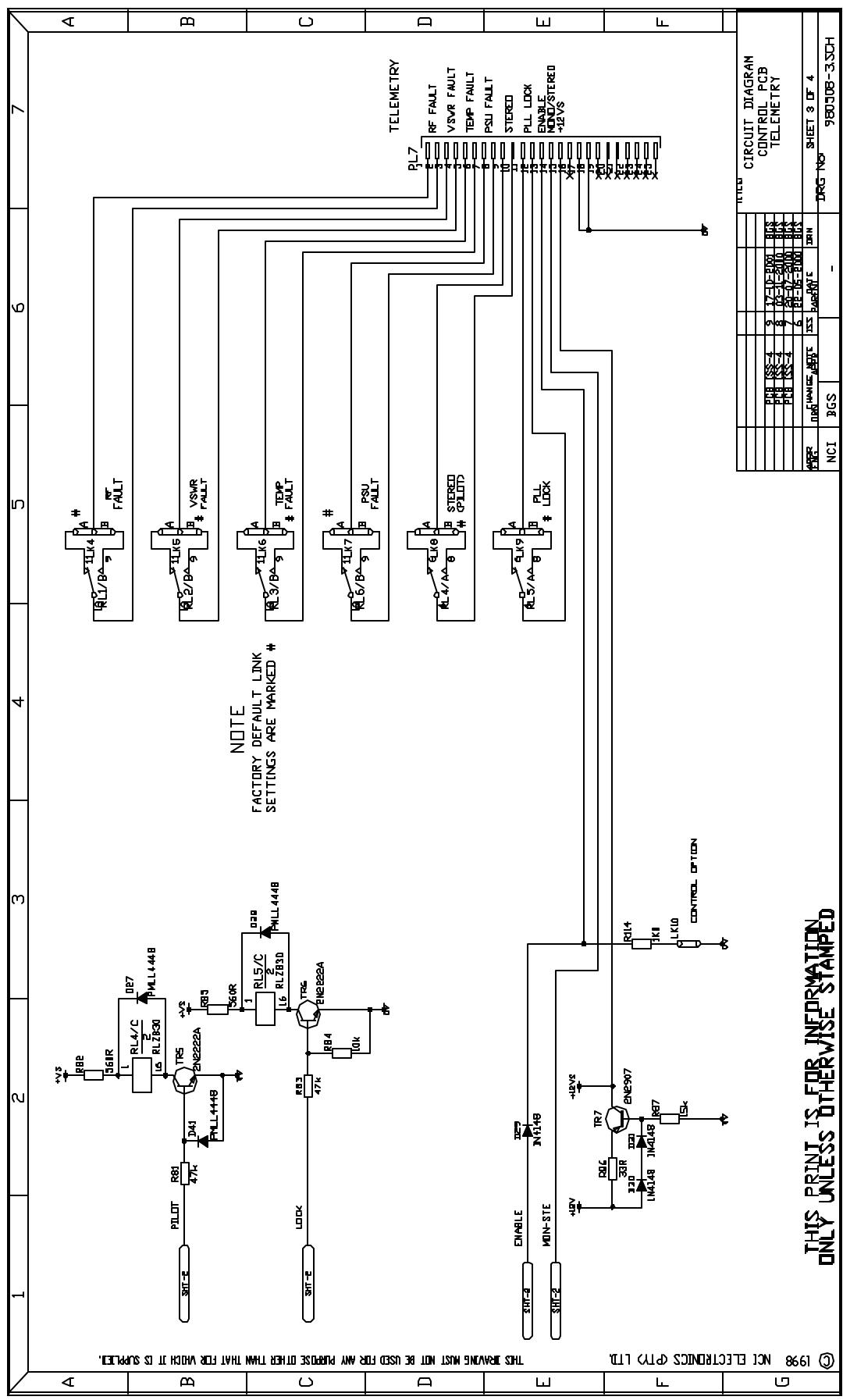
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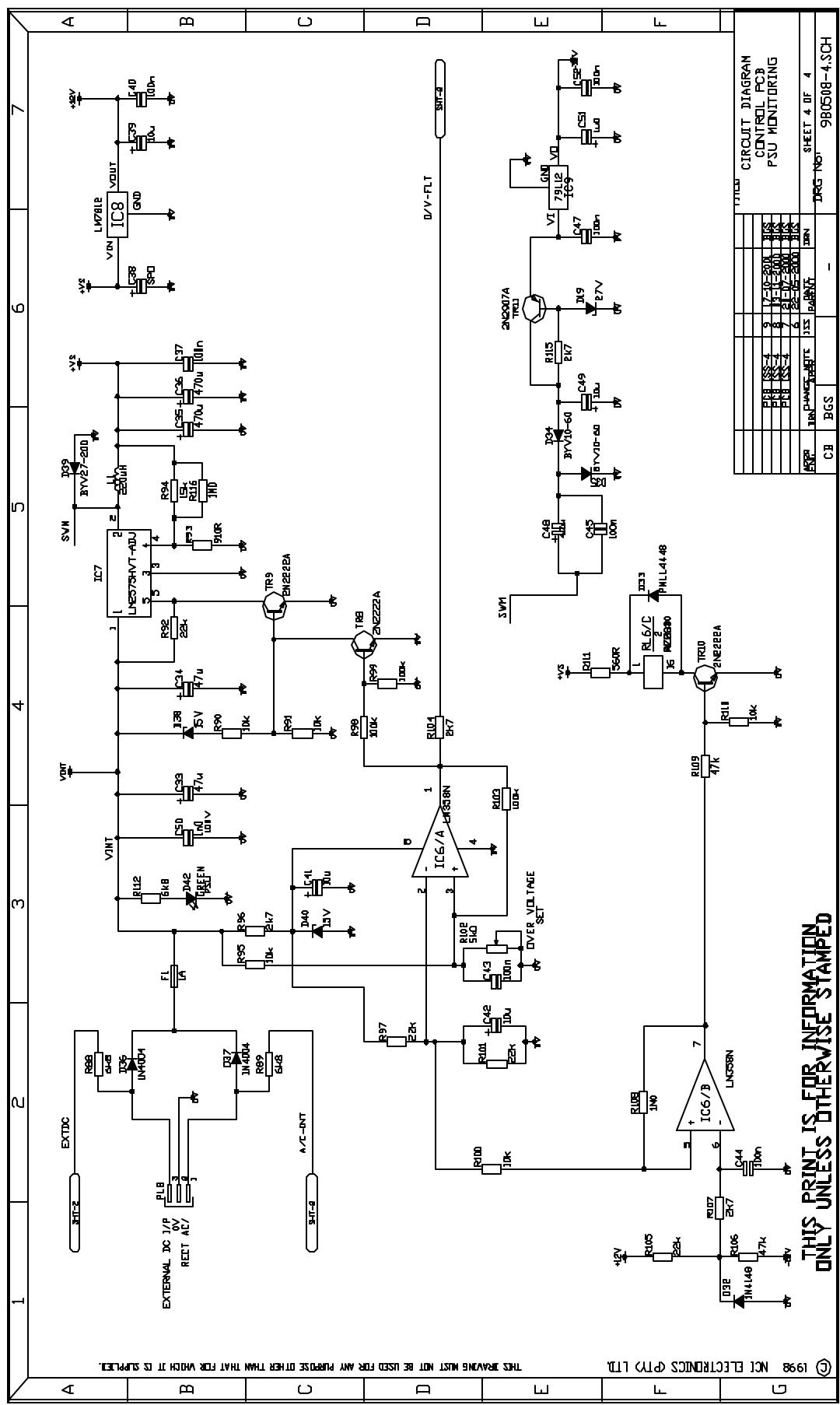
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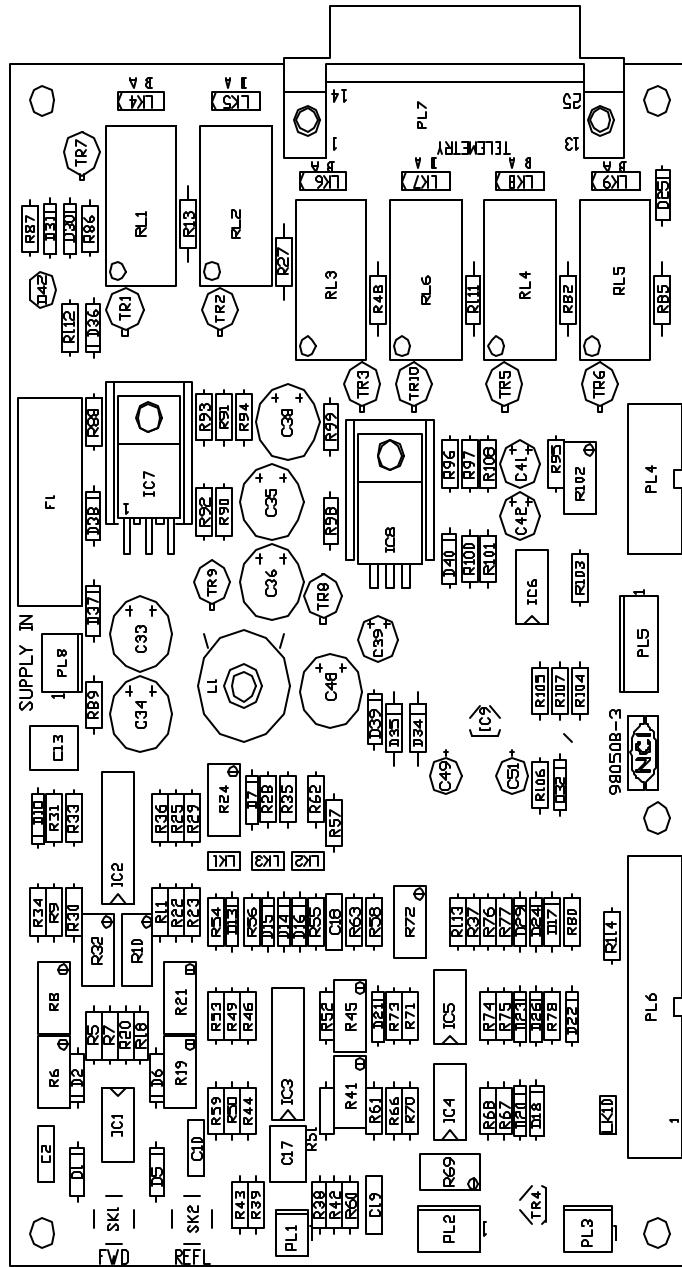


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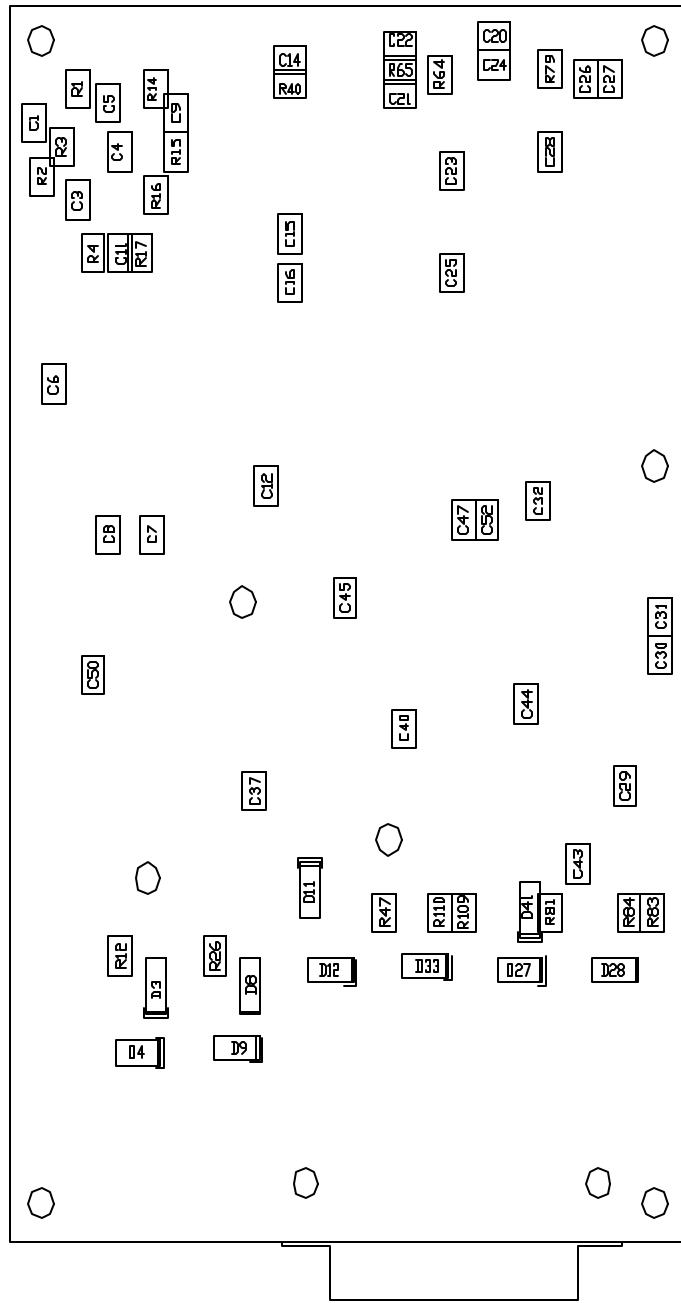
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## CONTROL PCB 980508-3



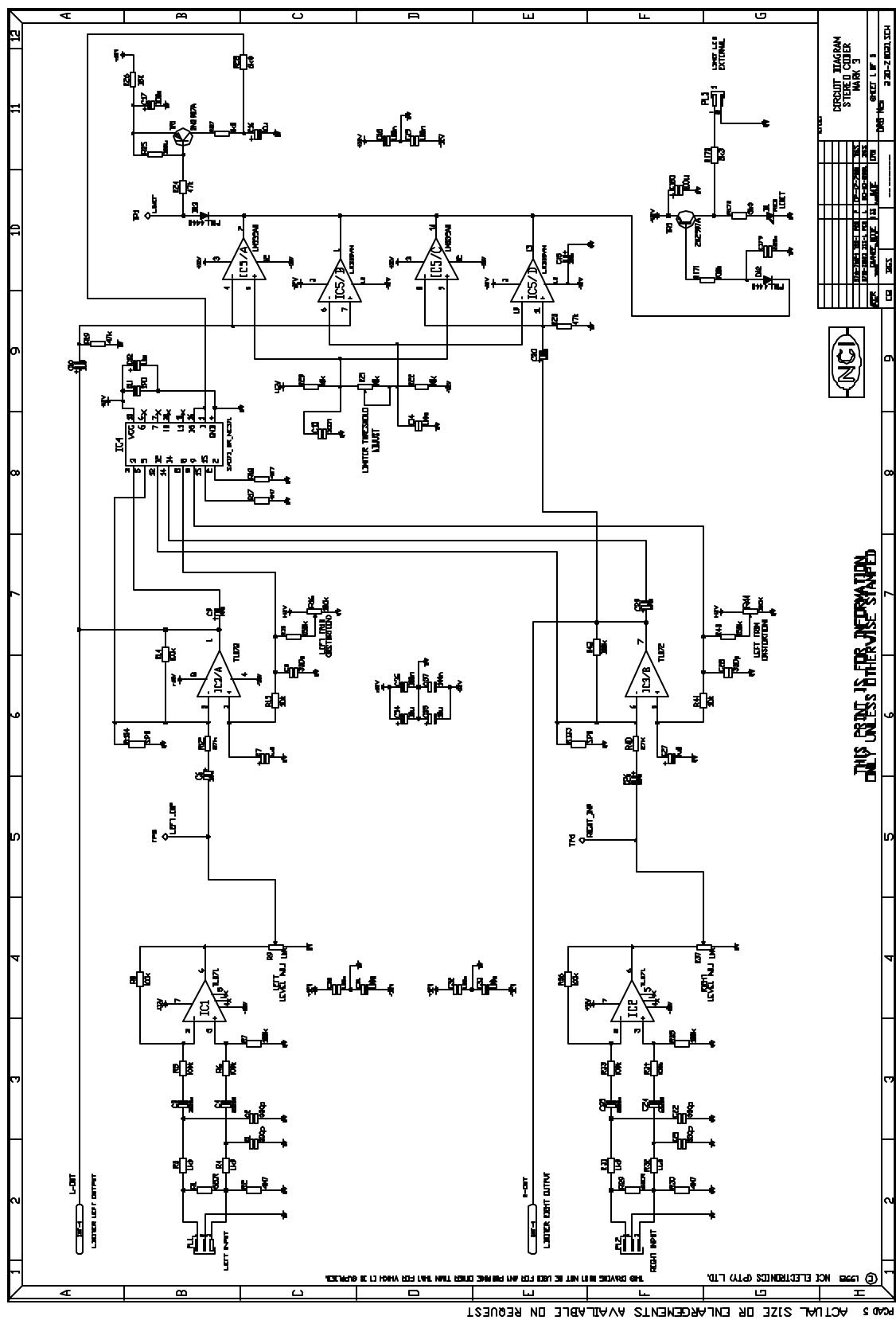
COMPONENT SIDE OF PCB

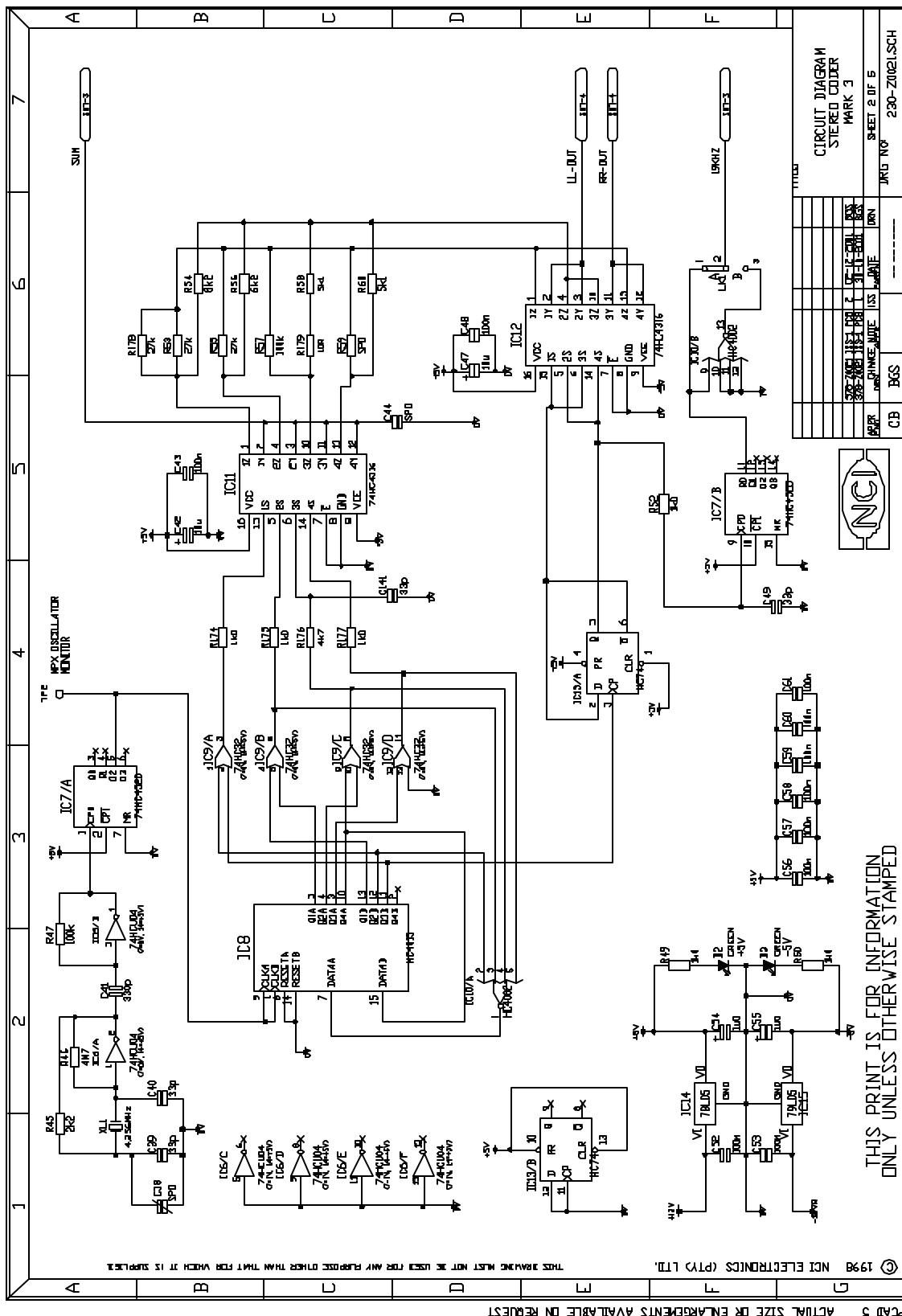
CONTROL PCB 980508-3

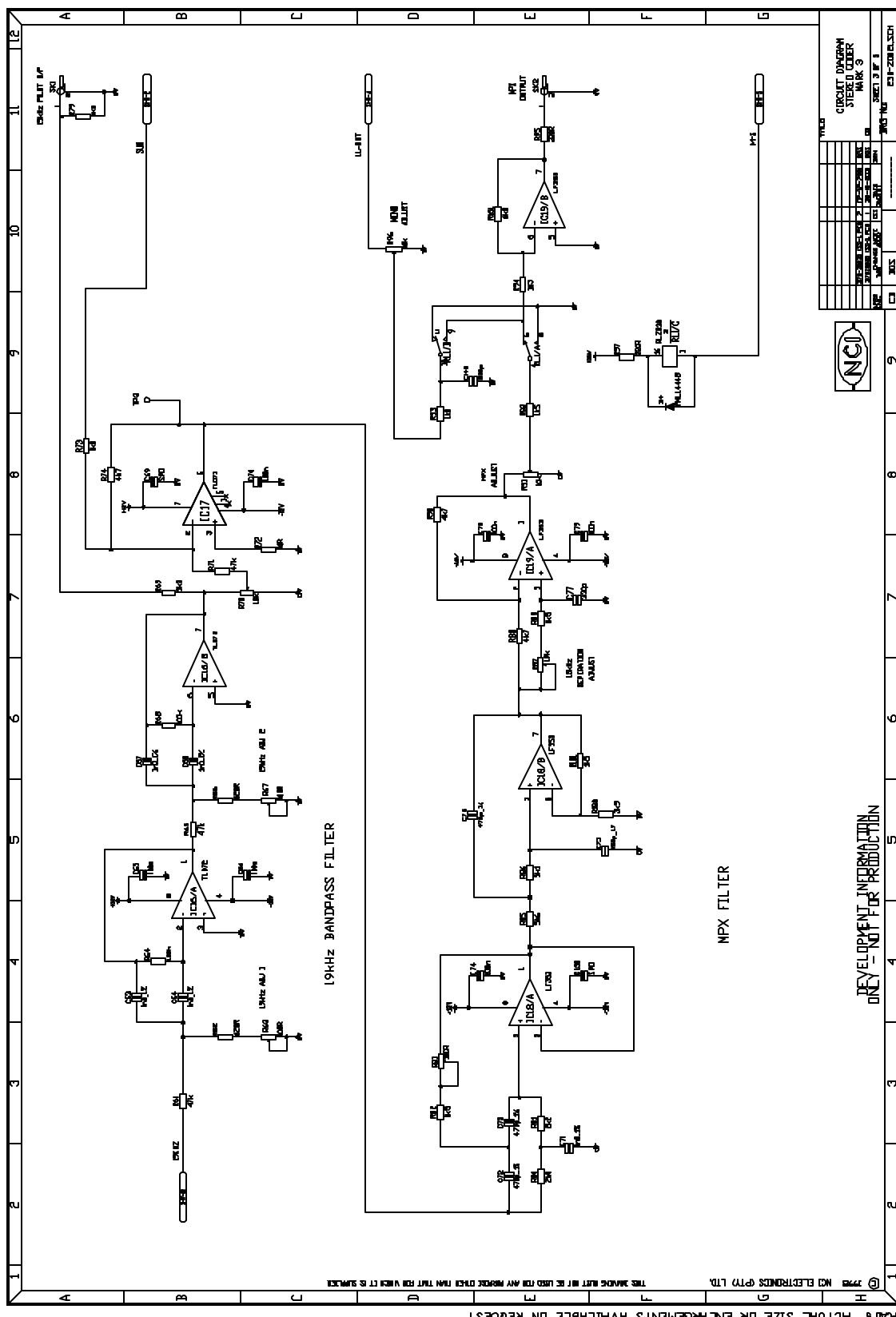


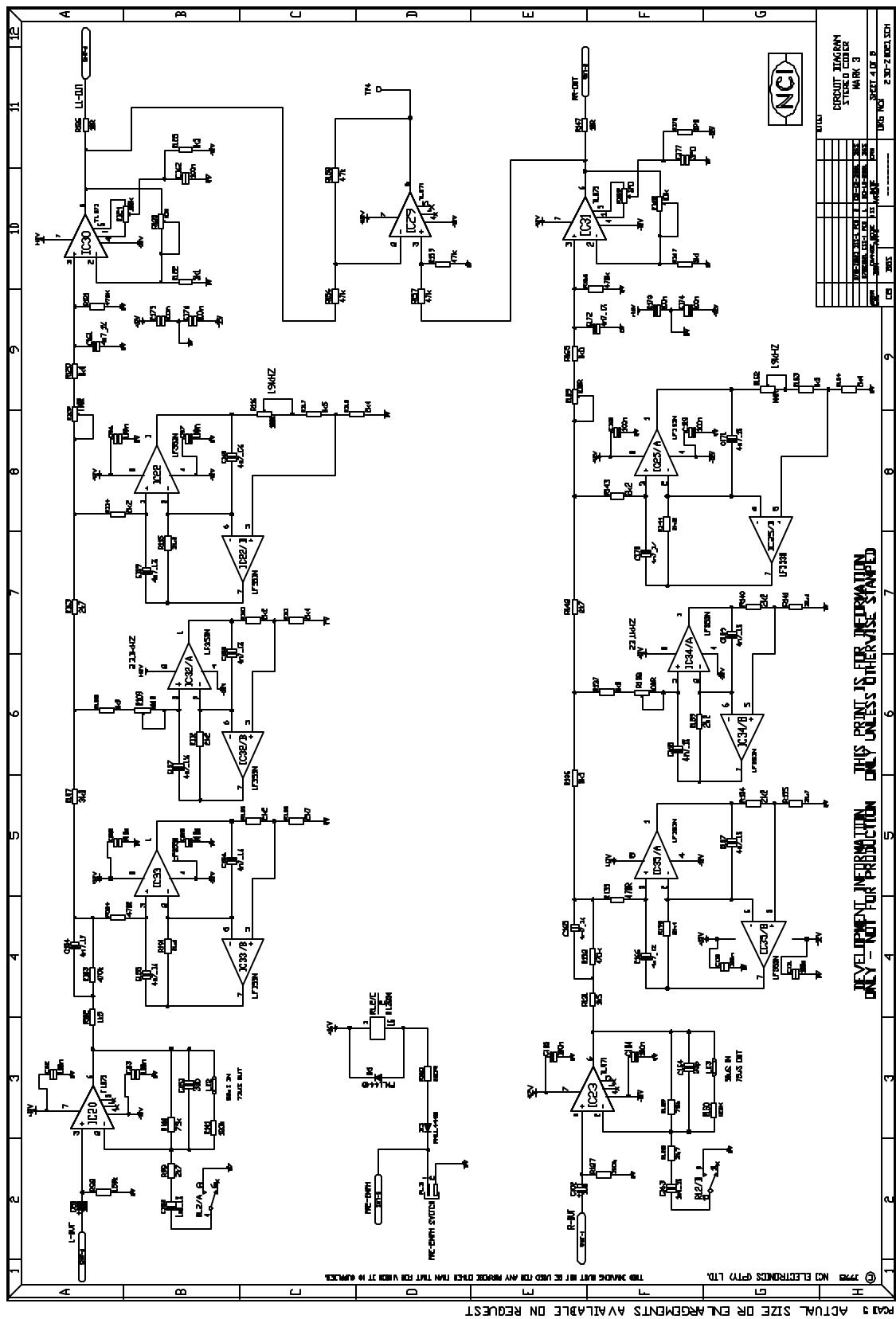
**SOLDER SIDE OF PCB**

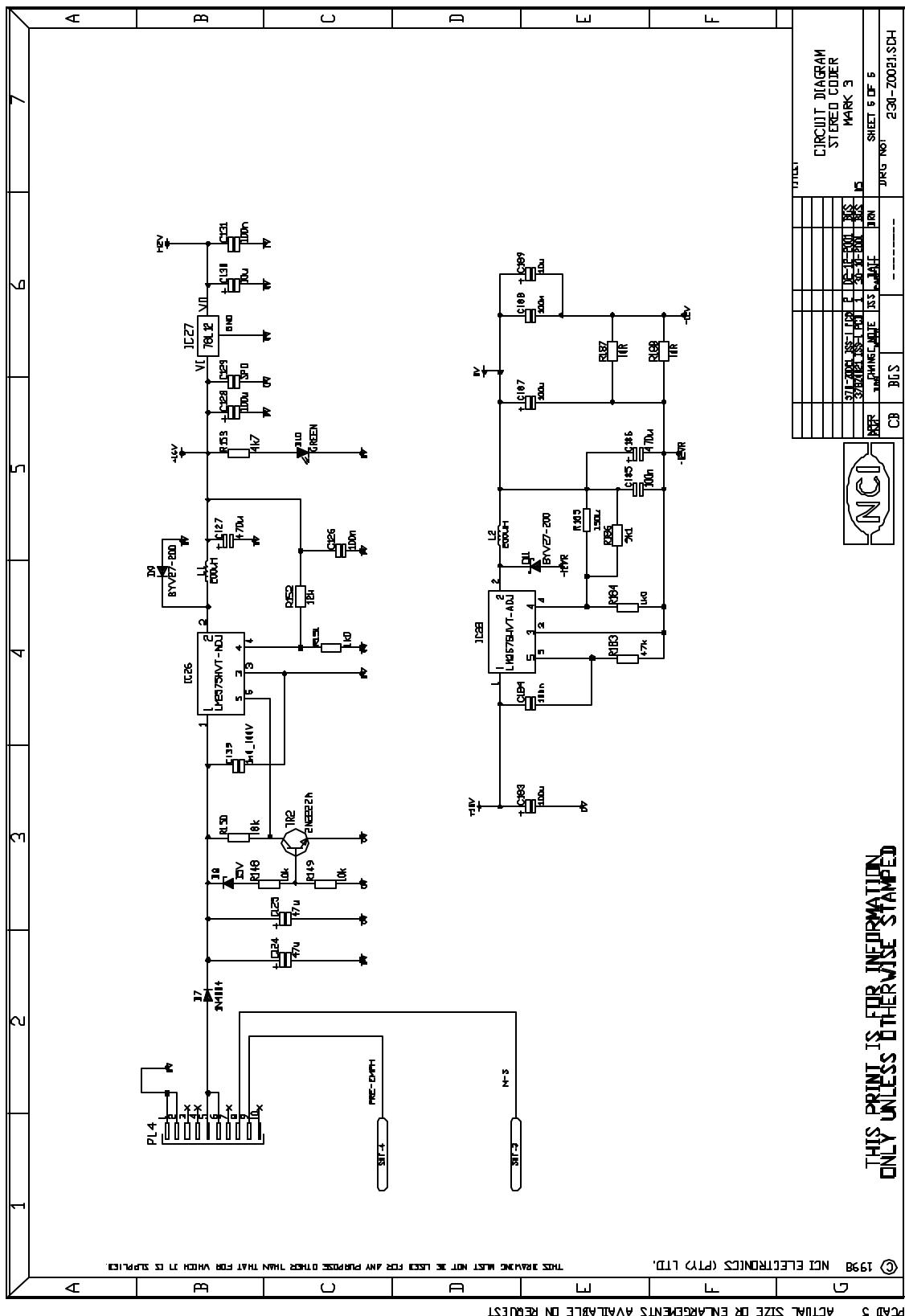
980508A5.DWG ASSEMBLY SHEET 2 OF 2



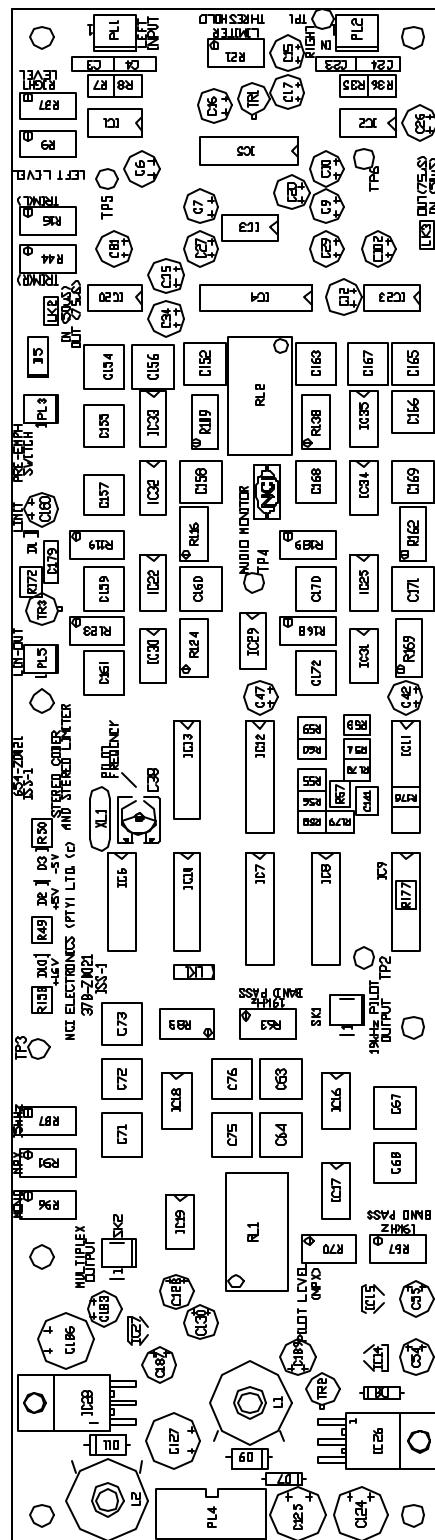








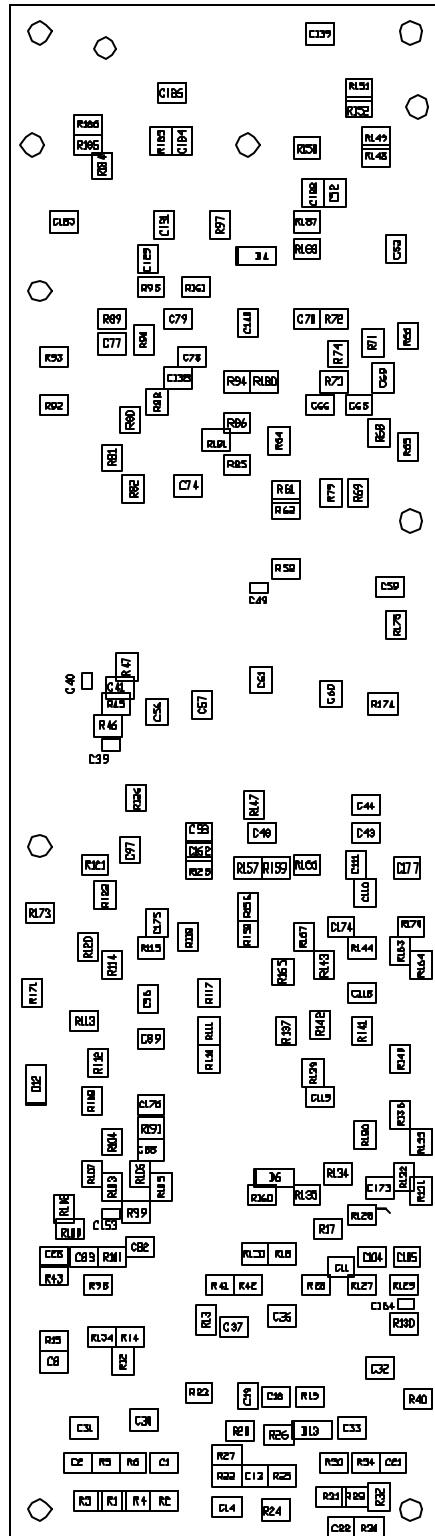
STEREO CODER MARK-3 PCB 378-Z0021 ISS-1 COMPONENT SIDE

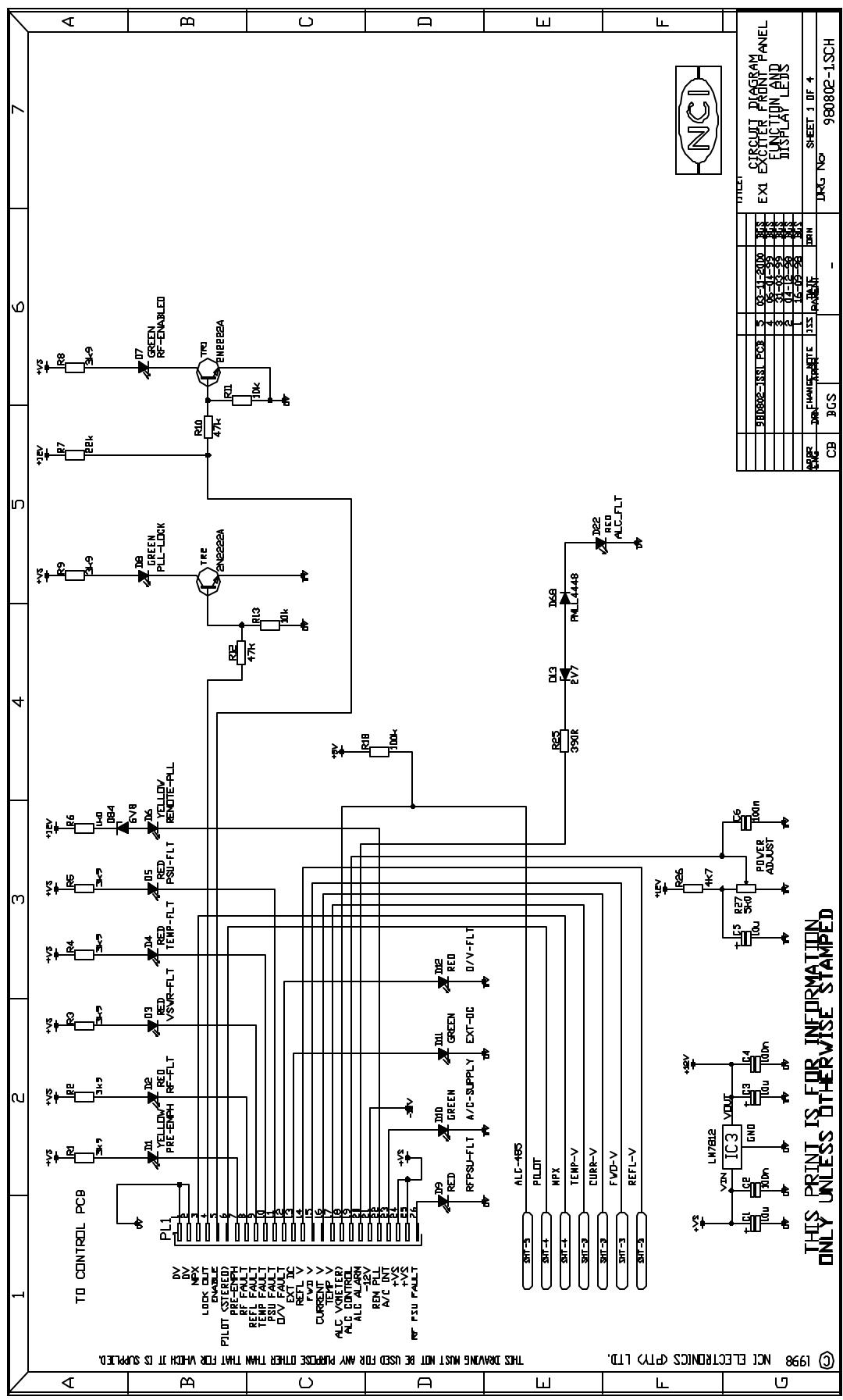


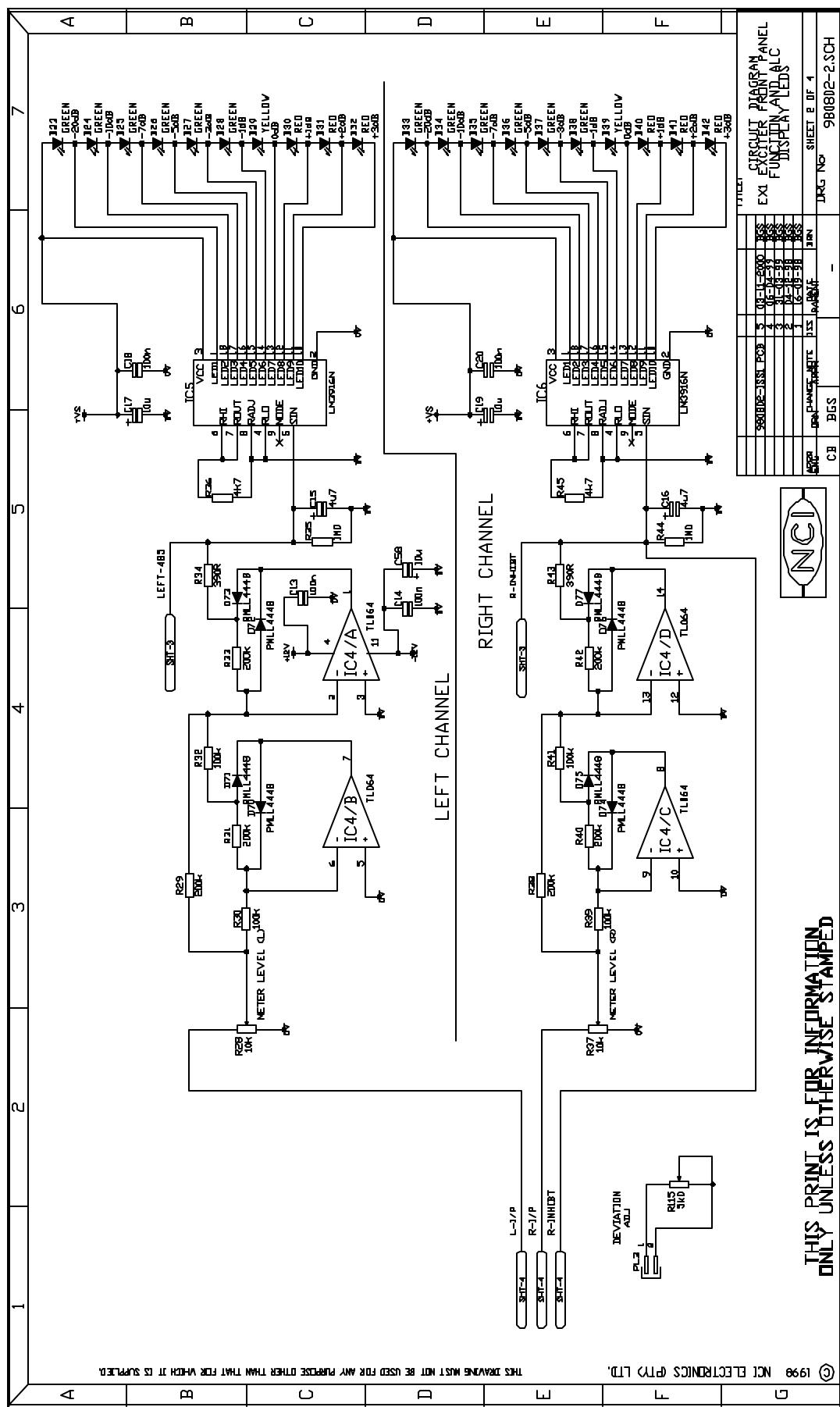
65420021.DWG ASSEMBLY SHEET 1 OF 2

**STEREO CODER MARK-3 PCB 378-Z0021 ISS-1 SOLDER SIDE**

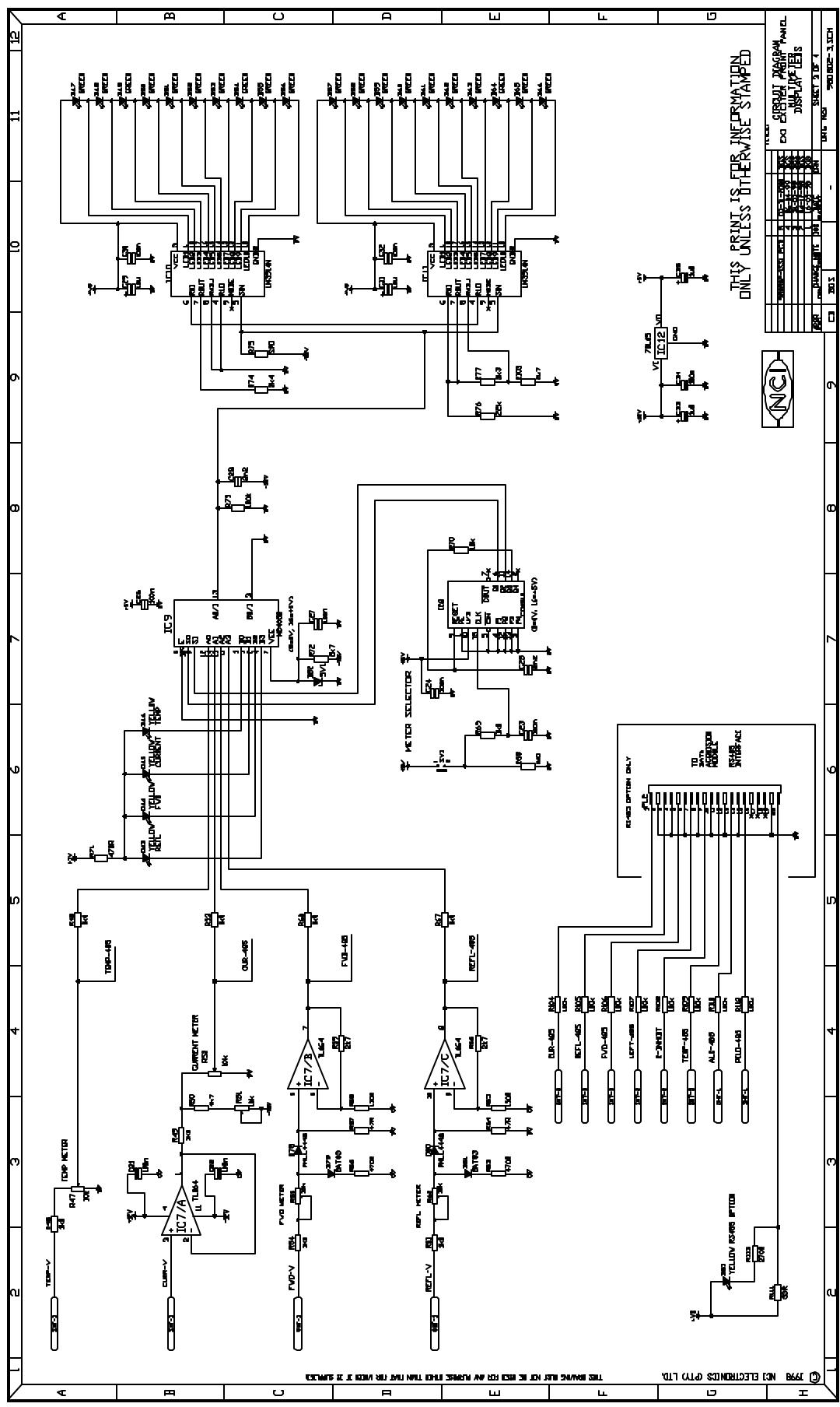
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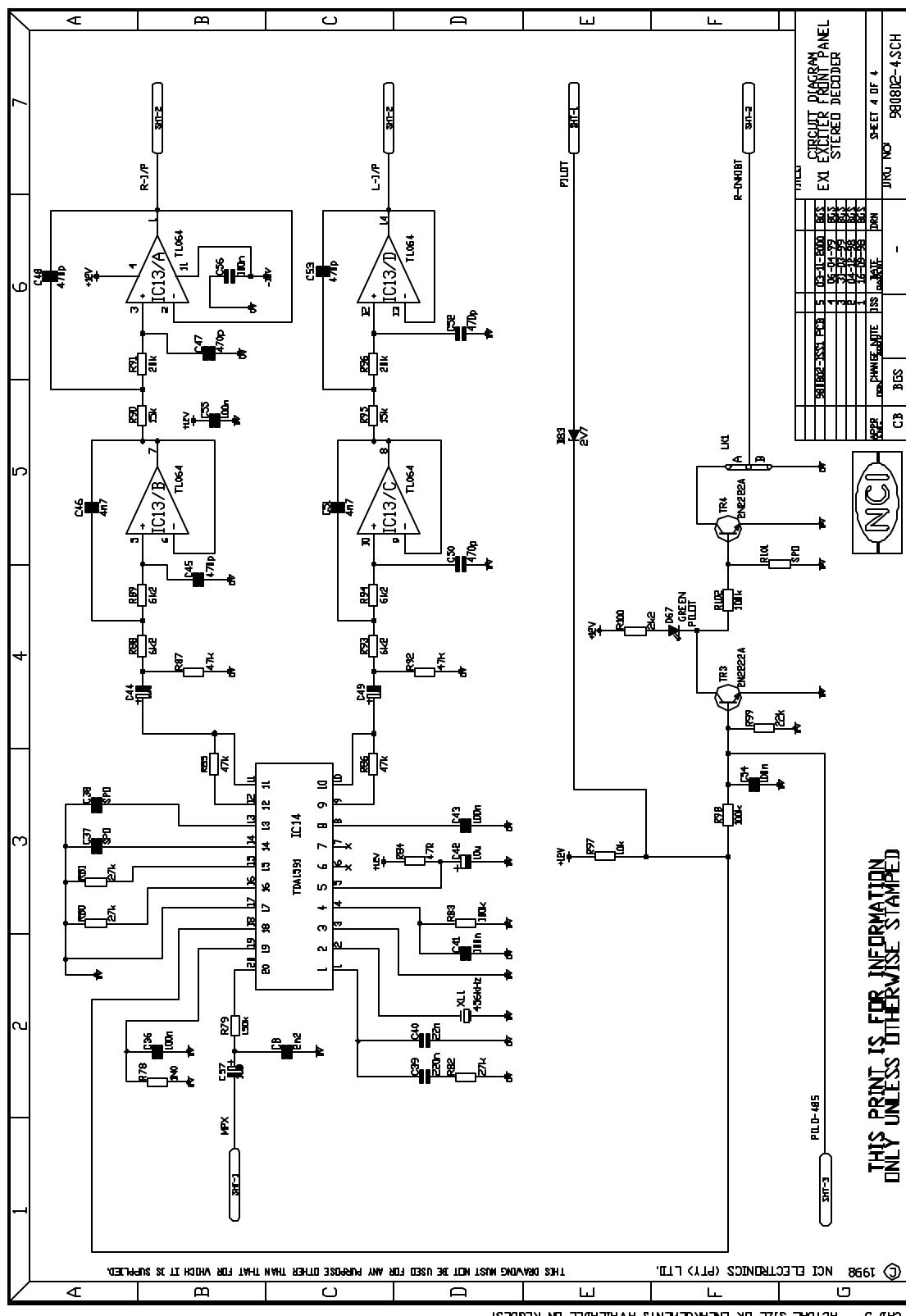






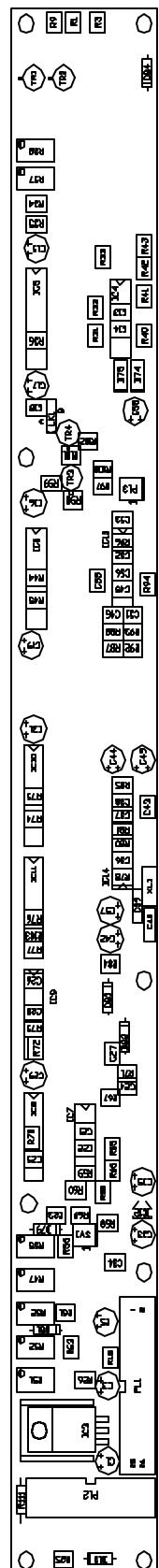
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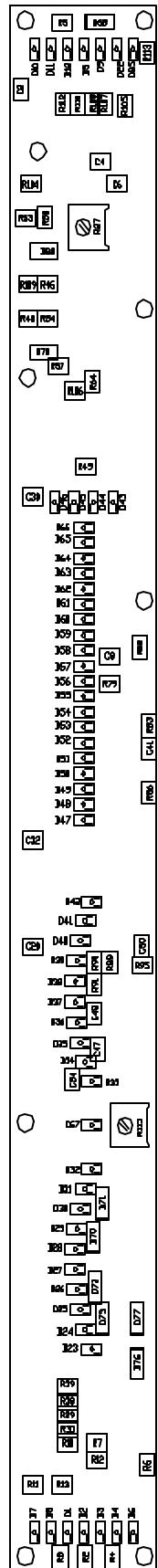
980802 PCB ISS-1 COMPONENT SIDE

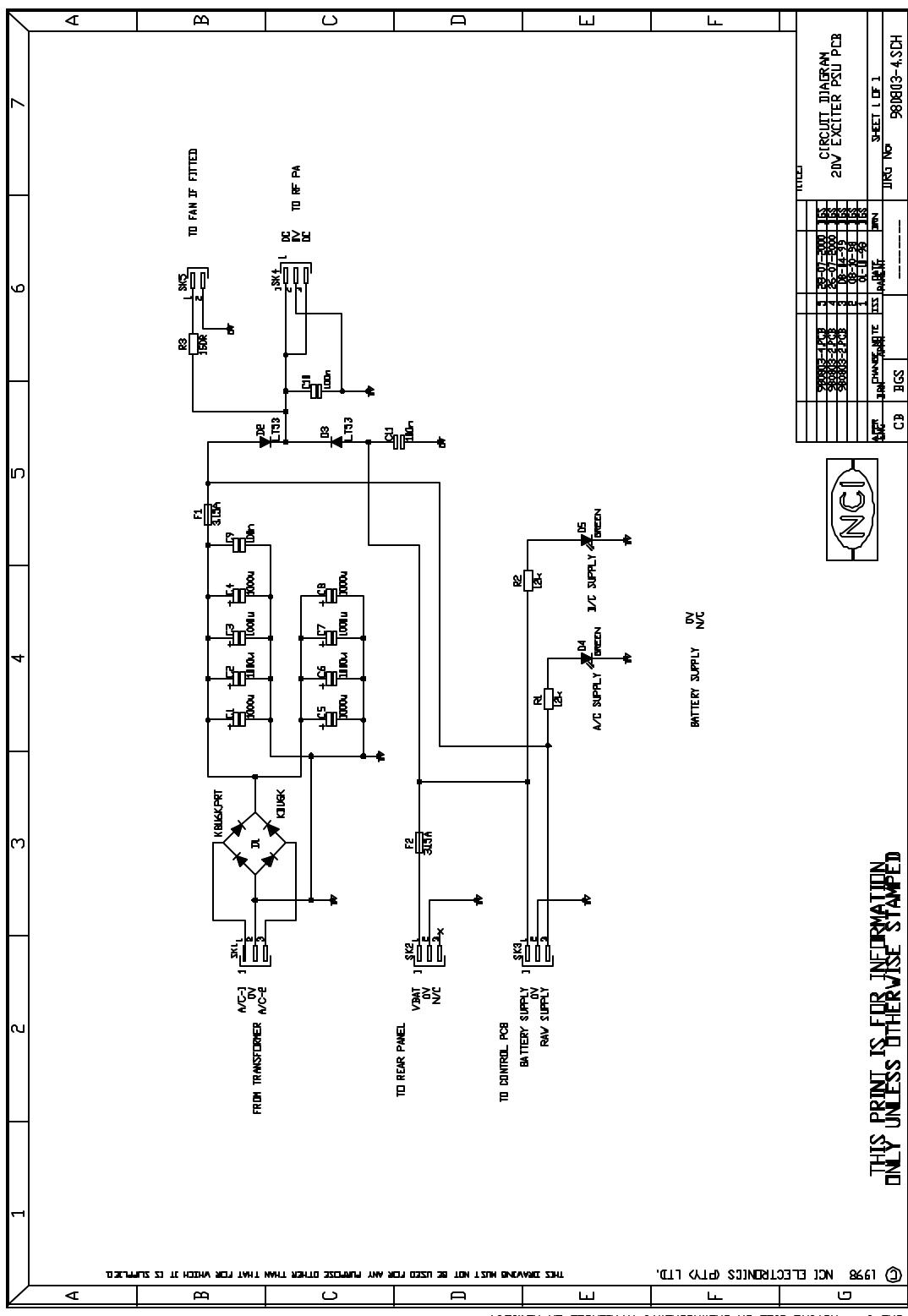
FRONT VIEW OF PCB (COMPONENT SIDE)



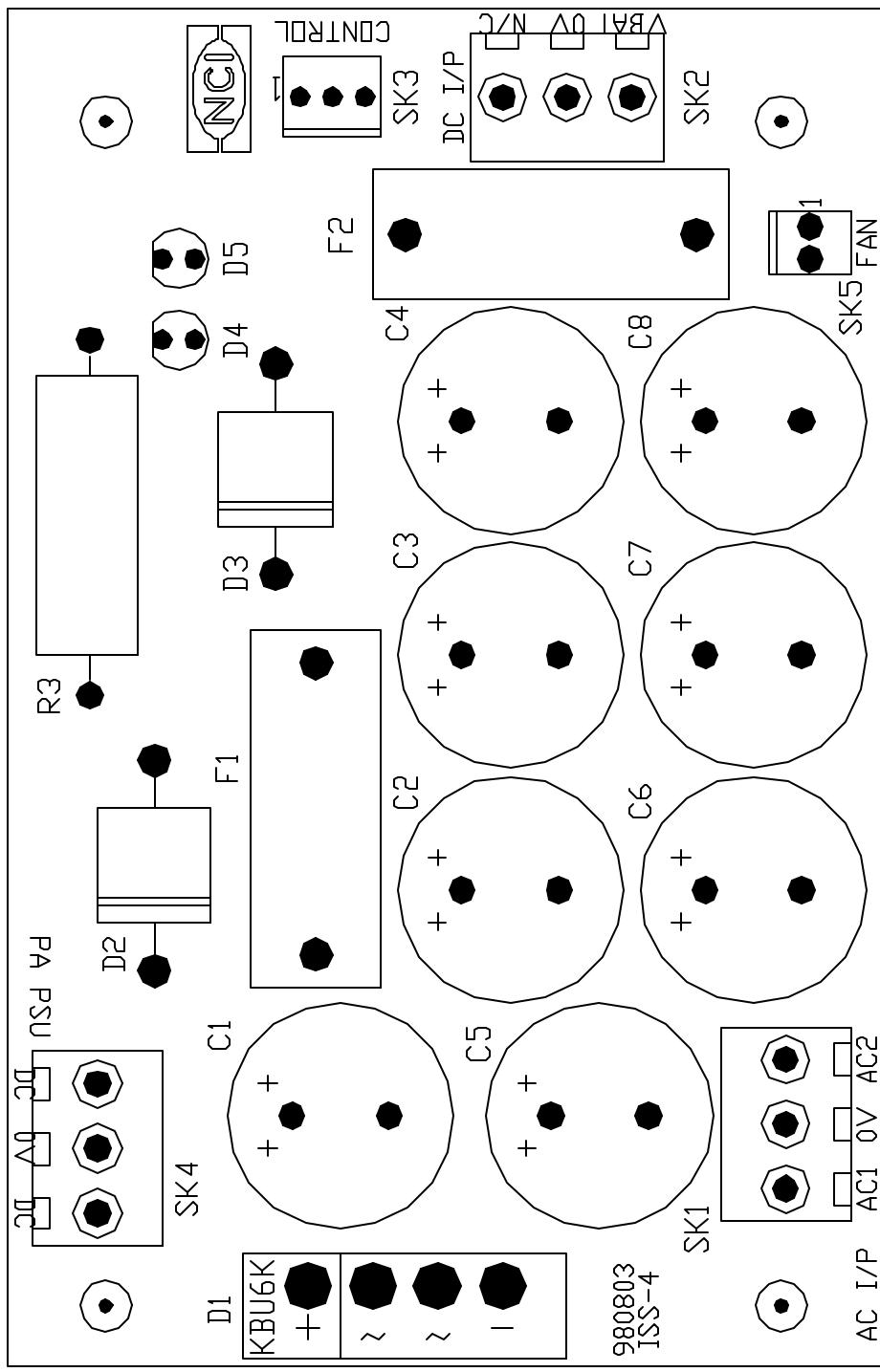
980802 PCB ISS-1 SOLDER SIDE

REAR VIEW OF PCB {SOLDER SIDE}



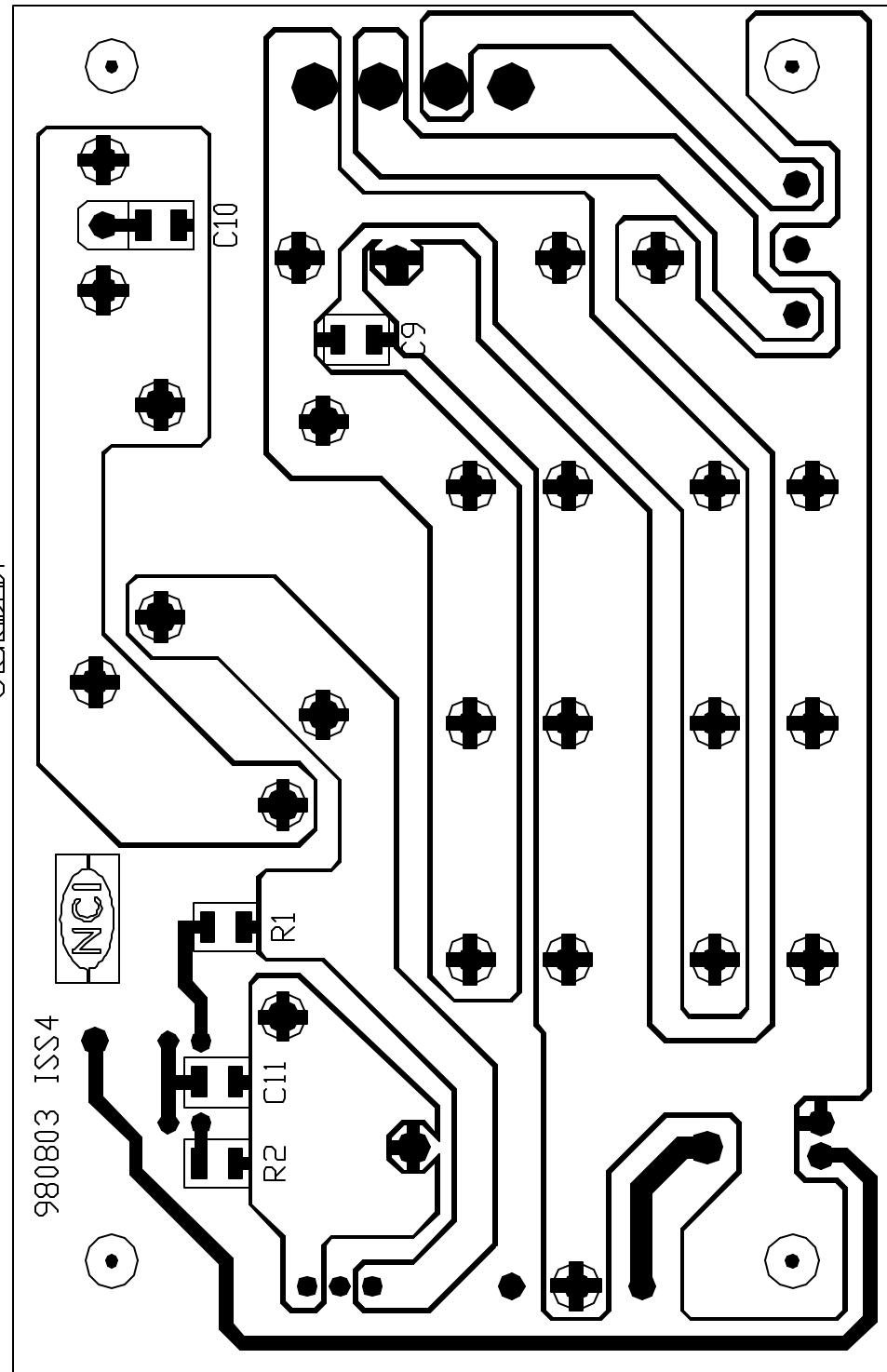


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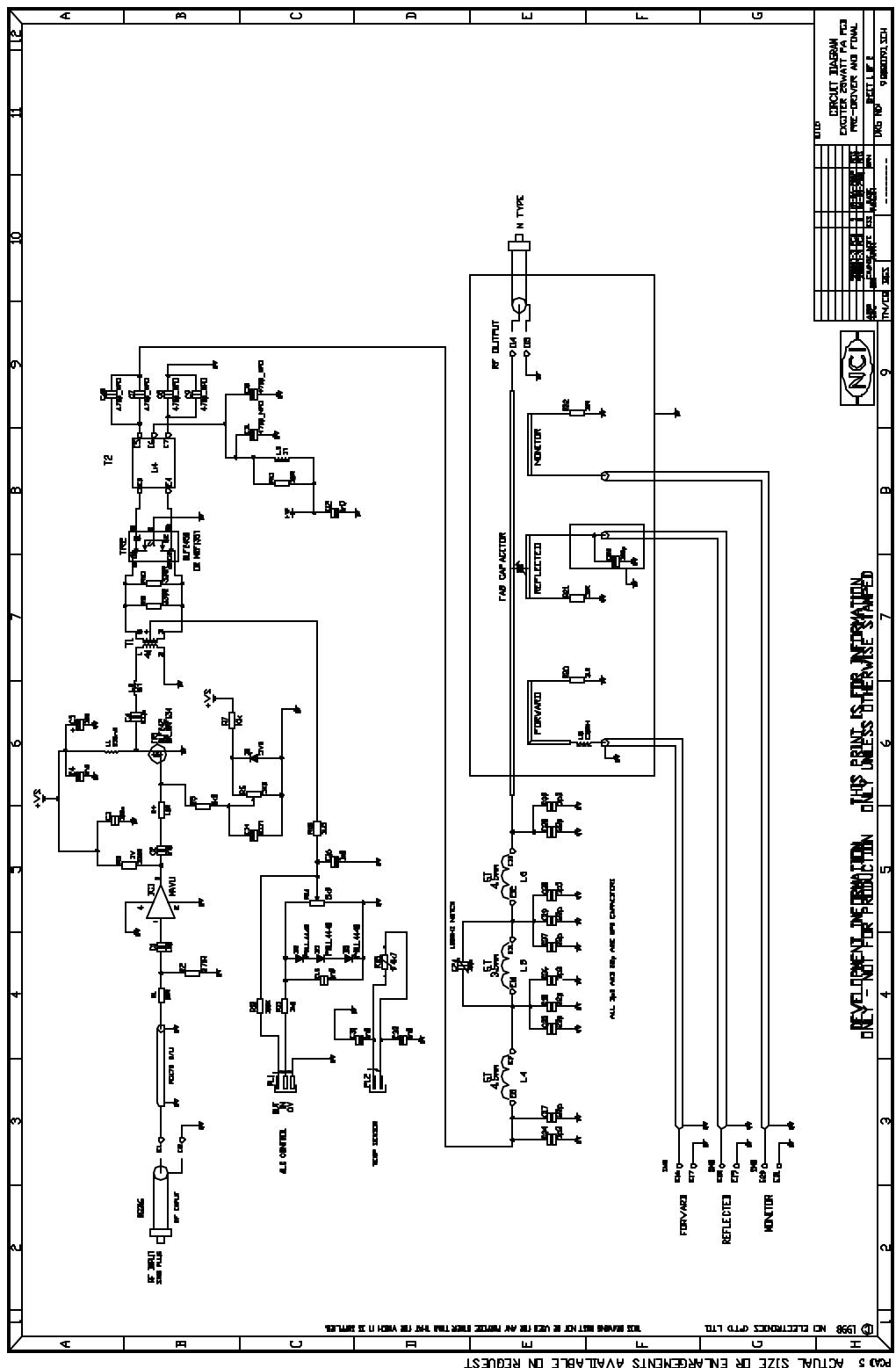


EX1 PSU PCB (FAN) 980803 ISS-4 COMPONENT SIDE

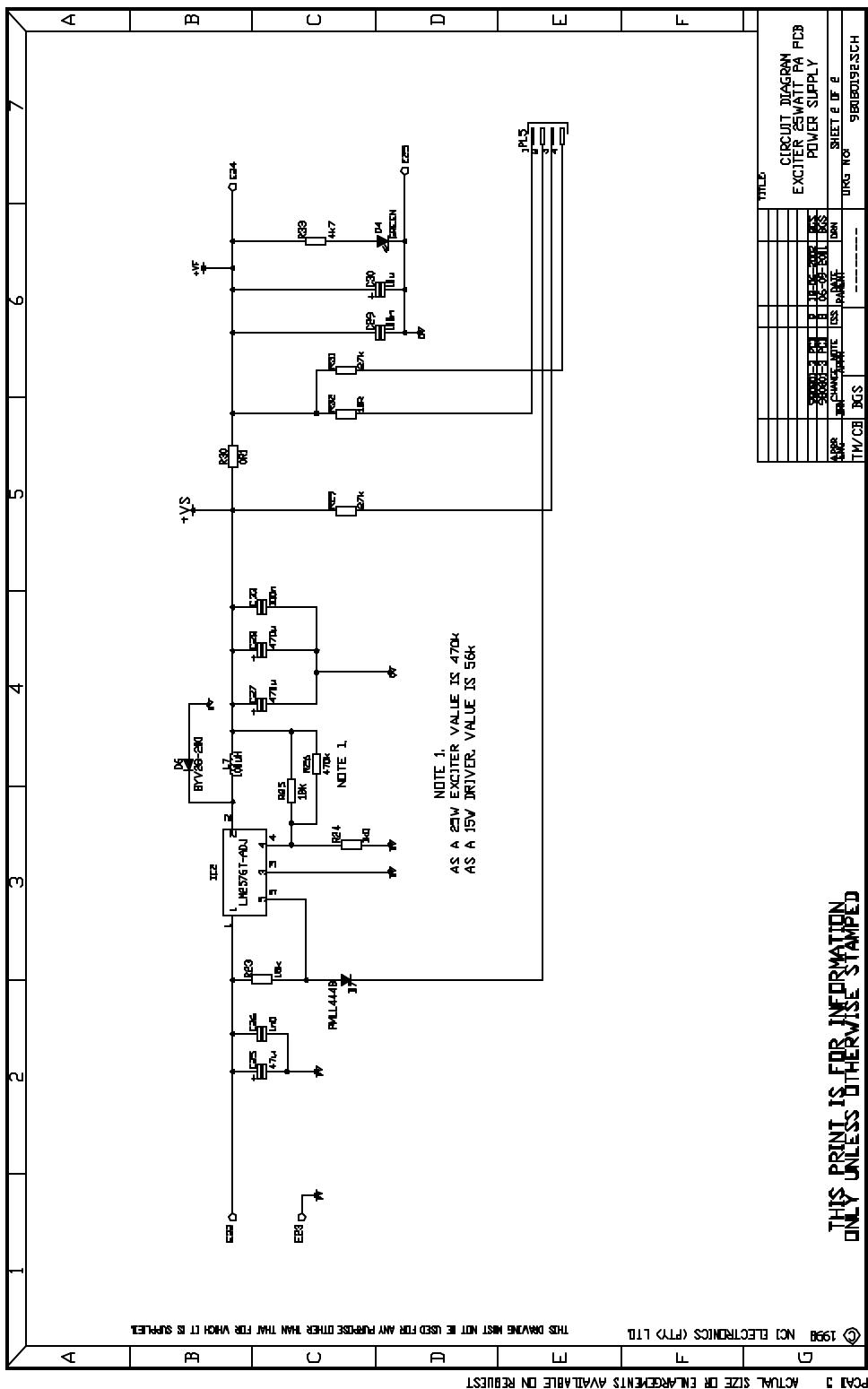
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980803A4.DWG ASSEMBLY SHEET 2 OF 2



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