FMT-25

VHF FM TRANSLATOR

TECHNICAL MANUAL

Issue 1A:

FMT-25

VHF FM TRANSLATOR

TECHNICAL MANUAL

CONTENTS:

INTRODUCTION

This Manual contains the Operating, technical and installation information for the **FMT-25 VHF FM Translator**. The FMT-25 forms part of a new range of Professional VHF FM Re-broadcasting equipment produced by **Broadcast Solutions Electronics.**

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General Description

GENERAL DESCRIPTION

The **FMT- 25 VHF FM Translator** is a compact unit requiring only 1U Rack space. The unit is designed for use in VHF FM Stereo Broadcasting in the 87.5MHz to 108MHz, band. The unit will perform the function of a **"Relay receiver" and "25W FM Exciter"**, providing **Local** (Display) and **Remote** (Telemetry) functions.

The **FMT- 25** offers **standard features** that include:

- **Automatic tuning of Rx Front-end filters.**
- **Fully synthesized in 50kHz steps (Tx and Rx).**
- **Rx Diversity operation capability.**
- **A/C and DC (+24V) operation.**
- **ALC for RF Power control.**
- **Telemetry output.**
- **Rx Headphone output.**
- **RF Monitor output.**
- **Comprehensive metering and indicators.**

The **FMT- 25** offers a range of **customer options** that include:

- **ID Module for internal SCA insertion.**

The **FMT- 25** provides a High quality, compact and versatile solution for VHF FM Re-broadcasting and only requires 1U rack space.

The unit includes a **fully synthesized** FM Receiver with Front-end **tracking filters** and a **highly selective** Ceramic IF Filter. A **Tracking demodulator** and **100kHz Low pass** filter are also standard features of the receiver section. The unit also includes a **fully synthesized** FM Modulator with provision for internal and external Baseband inputs. The **FMT- 25** has a **25-Watt RF Power amplifier** module with integral SMPSU. Low pass RF Filter and couplers are standard on this module.

The **FMT- 25** is equipped with a **+24V dc input**, which can be used for Battery/Solar-powered operation or as back up for mains failure condition. The dc input is internally fused for protection purposes. The rectified a/c input is also fused internally, while the a/c mains input is fused on the rear panel.

The schematic diagram of the FMT-25 is shown in figure 2 below.

3. STRUCTURE.

The FMT- 25 comprises of the following modules.

a) Display PCB (378-Z0028).

b) Main PCB (378-Z0027).

c) RF PA Module (980801).

d) PSU Module (980808).

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

4. FUNCTIONAL DESCRIPTION.

Refer to the **Front** and **Rear** panel layout in **figure 1.**

1) **RF monitor** (BNC 50 ohms female)**.**
2) **Rx Headphone monitor** (Stereo ¼ inch Jack socket)**.**
3) **Tx indicators and alarms.**
4) **Bargraph meter** (20 dot)**.**
5) **Bargraph meter function selector** (Selects one of four metered parameters)**.**
6) **Tx Power adjustment** (potentiometer)**.**
7) **PSU / Rx indicators and alarms.**
8) **Power on/off switch:** Switches a/c (Mains) and dc (+24V) supplies**.**
9) **A/C Mains input** Europlug (IEC) connector for a/c supply**.**
10) **Ext. 24V dc input**: Positive (+) and negative (-) dc binding terminals**.**
11) **A/C Mains Fuse**: Fuse (1Amp/230V or 2A/115V)**.**
12) **Ground:** M5 Screw for chassis ground.
13) **Telemetry**: D15 (female) connector for **remote** commands and alarms.
14) **RF Output** (N Type 50 ohm female)**.**
15) **Tx Auxiliary baseband input** (BNC female for SCA/SST Sub-carrier injection)**.**
16) **Tx Baseband input** (BNC female for composite/MPX injection)**.**
17) **Rx Baseband output** (BNC female for Rx composite/MPX output)**.**
18) **Input Receiver** (BNC 50 ohms female for received RF input)**.**

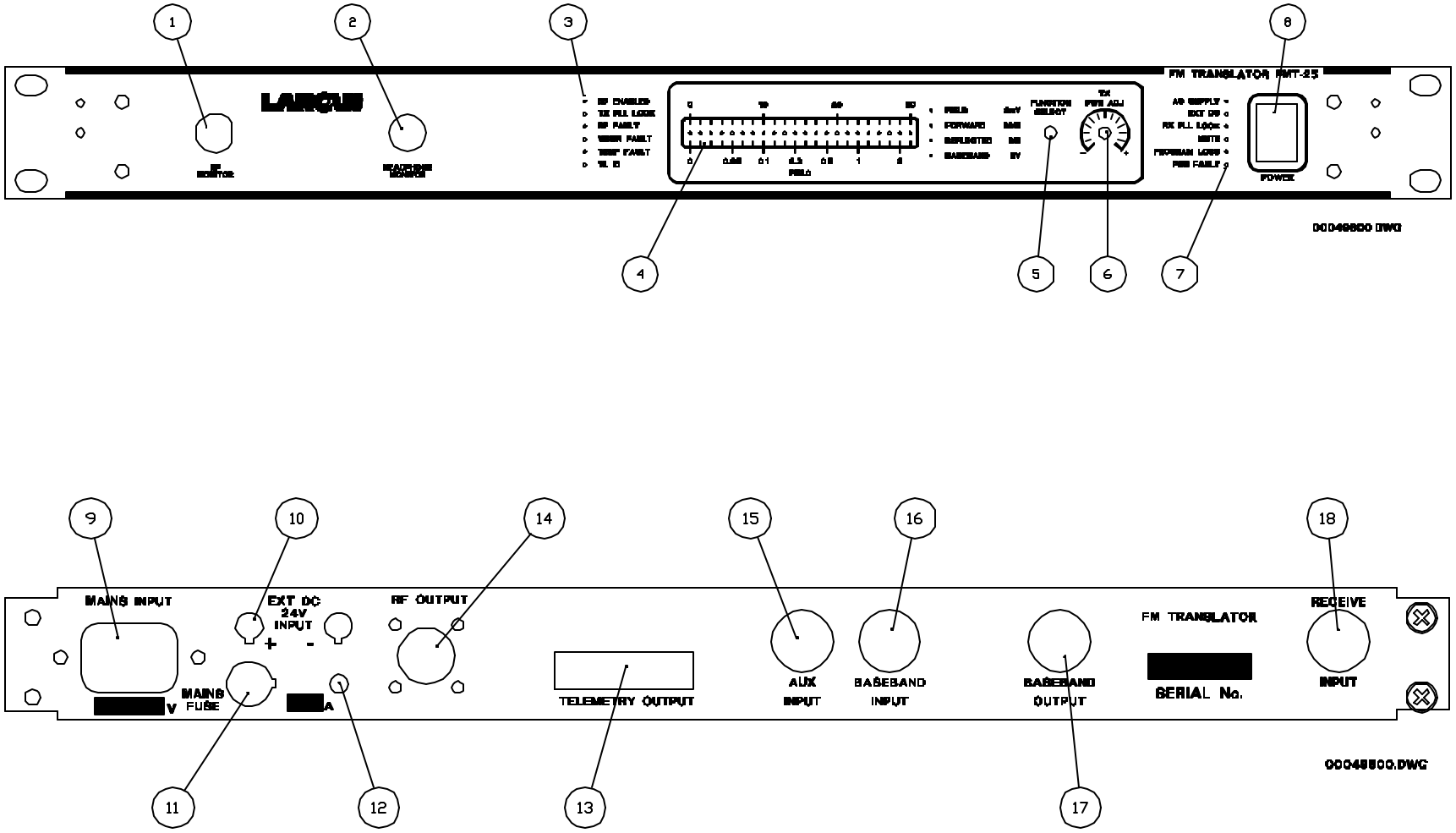

Figure 1: Front and Rear panel layout.

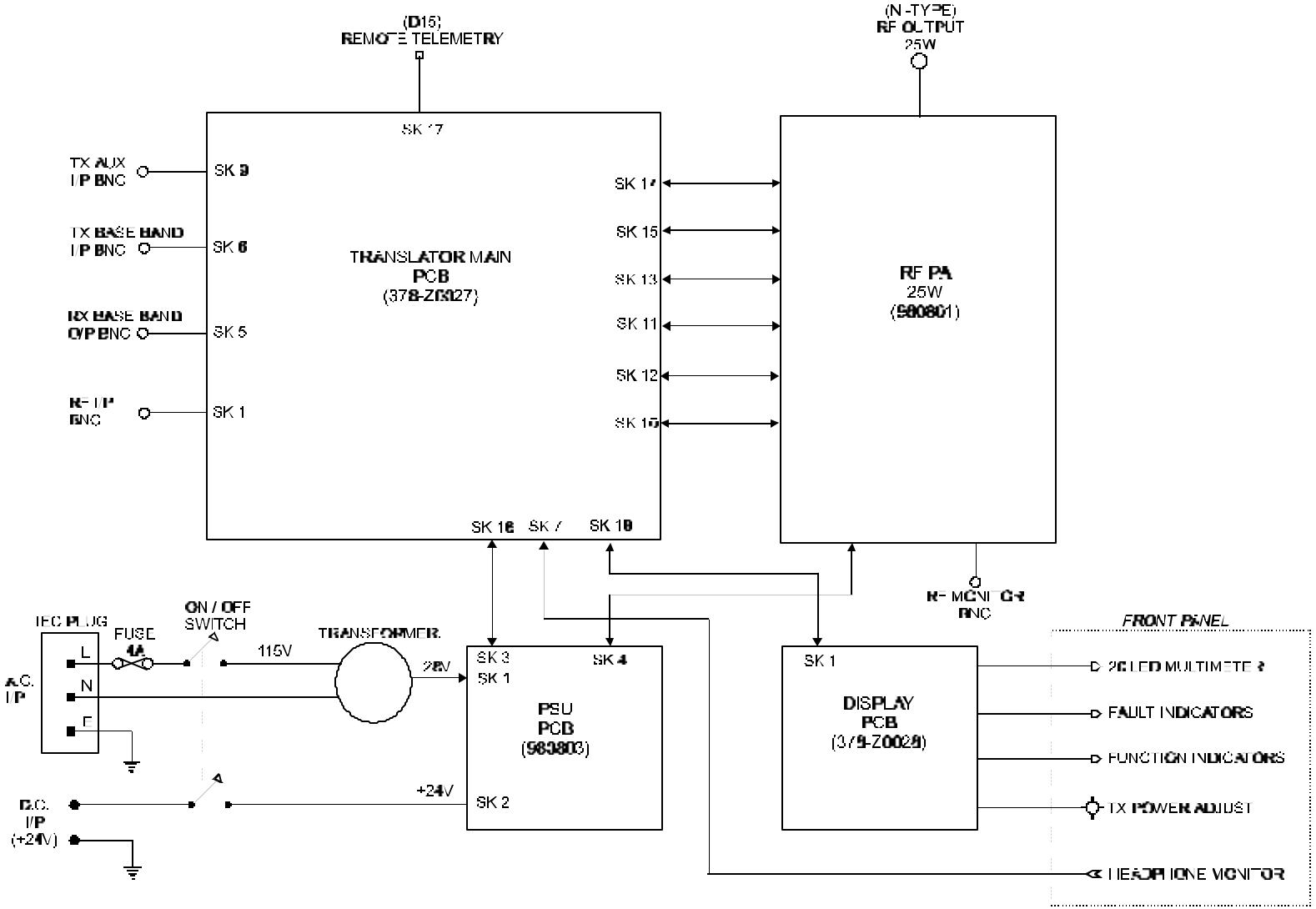

Figure 2: Schematic Diagram of FMT-25

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Technical Specifications

Issue 1A:

FMT- 25 SPECIFICATIONS

Electrical characteristics

Typical Rx Sensitivity: 75kHz-deviation reference with 75uS de-emphasis (Stereo)

RF Input level	Stereo S/N ratio
20uV	50dB
50uV	56dB
100uV	60dB
500uV	70dB
1000uV	75dB

Rx Static selectivity: RF Filter, IF Filter and Rx baseband filter

Frequency offset	Selectivity
± 100kHz	0dB
± 200kHz	-65dB
± 300kHz	-90dB
± 400kHz	-100dB
± 500kHz	-110dB

Rx Dynamic selectivity: 75kHz deviation reference and 75uS de-emphasis for 54dB S/N ratio (Stereo).

Frequency offset	Selectivity
0kHz	-46dB
± 100kHz	-30dB
± 200kHz	+6dB
± 300kHz	+27dB
± 400kHz	+35dB

Rx baseband amplitude response:

Frequency	Response
30Hz to 53kHz	± 0.1dB
53kHz to 95kHz	± 1dB
≥200kHz	≤ -65dB

Rx baseband performance: Stereo with 75kHz deviation and de-emphasis off. Tested at 1mV, RF input.

Frequency	Distortion	Separation	Crosstalk
30Hz	≤ 0.25%	≥ 50dB	≥ 50dB
1kHz	≤ 0.25%	≥ 50dB	≥ 50dB
5kHz	≤ 0.25%	≥ 50dB	≥ 50dB
15kHz	≤ 0.25%	≥ 50dB	≥ 45dB

Tx baseband amplitude response: Input via Tx baseband input.

Frequency	Response
1Hz	- 3dB
30Hz to 53kHz	± 0.1dB
53kHz to 100kHz	± 0.25dB

Tx baseband performance: Stereo with 75kHz deviation. Tested with FM Stereo demodulator and decoder.

Frequency	Distortion	Separation	Crosstalk
30Hz	≤ 0.15%	≥ 50dB	≥ 50dB
1kHz	≤ 0.15%	≥ 50dB	≥ 50dB
5kHz	≤ 0.25%	≥ 50dB	≥ 50dB
15kHz	≤ 0.25%	≥ 50dB	≥ 50dB

General Tx/Rx specifications:

Tx/Rx Frequency range	87.5MHz to 108MHz
Tx/Rx Frequency separation	≥400kHz
Tx/Rx Frequency increments	50kHz steps (synthesized)
Tx/Rx Frequency stability	± 2ppm
Tx RF Output power	≥25W (Adjustable via front panel)
Tx Harmonics and spurious	≤ -60dBc
Tx out of lock attenuation	≥ 70dB
Tx AM Non synchronous	≤ -60dBc
Tx baseband i/p Z	10k ohms
Tx baseband i/p sensitivity	3.5V p-p for 75kHz peak deviation
Tx Aux. baseband i/p Z	10k ohms
Tx Aux. baseband i/p sensitivity	3.5V p-p for 3kHz peak deviation

Environmental Specifications

A/C Input power	115V ± 10% (230V Optional)
A/C Frequency variation	50Hz to 60Hz
DC Input power	+24V Battery (+24V to +28V)
Power consumption	Approximately 70W
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	Convection (Blower option)
Dimensions	480mm x 450mm x 44.4mm
Physical mass	Approximately 7kg

Back Panel connectors and Functions.

Function	Connector
RF output	N Type Female (50 ohm)
Rx input	BNC Female (50 ohms)
Rx baseband o/p	BNC Female
Tx baseband i/p	BNC Female
Tx Aux. baseband i/p	BNC Female
Telemetry (input/output)	D15 Female
Ext. dc Input (+24V Battery)	2 x Terminal posts
A/C Mains input	IEC Europlug
A/C Fuse (1A/230V 2A/115V)	20mm Type
Chassis Ground	5mm screw Fixing

Front panel controls and indicators.

Control / indicator	**Function**
RF Enabled led (green)	Indicates Remote enable function
Tx PLL Lock led (green)	Indicates Tx PLL is in Lock
RF Fault led (red)	Indicates Forward power is low
VSWR Fault led (red)	Indicates Reflected power is high
Temp Fault led (red)	Indicates RF PA Temp is high
TL ID led (yellow)	Indicates TL ID Module installed
A/C Supply led (green)	Indicates A/C Supply is present
EXT DC led (green)	Indicates +24V DC Supply is present
Rx PLL Lock led (green)	Indicates Rx PLL is in Lock
Mute led (red)	Indicates Rx is Muted
Program loss led (red)	Indicates Loss of program
PSU Fault led (red)	Indicates PSU Failure
Function select LED's (yellow)	Indicates meter function selected
Tx Power adjust potentiometer	Sets required Tx RF Power
Headphone stereo monitor jack	600 ohm headphones for Rx program
RF Monitor BNC (50 ohm)	Samples Tx output for test purposes

Telemetry controls and alarms (via 15-pin D type female connector).

Pin number on SK17	Description
Pin 1	OV Ground
Pin 2	Rx Mute (Contact s/c to ground when muted)
Pins 3 and 4	RF PA Temperature Fault (Voltage free contact, s/c when fault)
Pins 5 and 6	RF PA VSWR Fault (Voltage free contact, s/c when fault)
Pins 7 and 8	Low RF power Fault (Voltage free contact, s/c when fault)
Pins 9 and 10	PSU Fault (Voltage free contact, s/c when fault)
Pin 11	Tx Enable S/c to Ground to disable
Pin 12	Jig supply +22V at 20mA
Pin 13	Stereo indicator npn open collector / ground for stereo
Pin14	PLL Lock indicator npn open collector / ground for lock
Pin 15	14 sec. Program loss indicator npn open collector / ground for program

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Operating Information

OPERATING INFORMATION

Translator Applications:

- Stand alone Translator: When used with VHF receive and Transmit antennas.
- High power Translator: When used with VHF receive and Transmit antennas and Wideband VHF RF Amplifier.
- Translator with Space Diversity: When used with VHF receive and Transmit antennas with a Reserve Receiver connected in Diversity mode.

Operating and interface information.

Refer to the **Front** and **Rear** panel layout in **figure 1.**

1) **RF monitor** (BNC 50 ohms female)**.**
2) **Rx Headphone monitor** (Stereo ¼ inch Jack socket)**.**
3) **Tx indicators and alarms.**
4) **Bargraph meter** (20 dot)**.**
5) **Bargraph meter function selector** (Selects one of four metered parameters)**.**
6) **Tx Power adjustment** (potentiometer)**.**
7) **PSU / Rx indicators and alarms.**
8) **Power on/off switch**: Switches a/c (Mains) and dc (+24V) supplies**.**
9) **A/C Mains input** Europlug (IEC) connector for a/c supply**.**
10) **Ext. 24V dc input**: Positive (+) and negative (-) dc binding terminals**.**
11) **A/C Mains Fuse**: Fuse (1Amp/230V or 2A/115V)**.**
12) **Ground:** M5 Screw for chassis ground.
13) **Telemetry**: D15 (female) connector for **remote** commands and alarms.
14) **RF Output** (N Type 50 ohm female)**.**
15) **Tx Auxiliary baseband input** (BNC female for SCA/SST Sub-carrier injection)**.**
16) **Tx Baseband input** (BNC female for composite/MPX injection)**.**
17) **Rx Baseband output** (BNC female for Rx composite/MPX output)**.**
18) **Input Receiver** (BNC 50 ohms female for received RF input)**.**

Metered parameters

- **Field strength:** 3mV full scale (bottom scale).
- **Forward RF Power level:** 30W full scale (top scale).
- **Reflected RF Power level:** 3W full scale (top scale).
- **Baseband level: 3**V-rms full scale (top scale).

To adjust **RF output** power, select **"Forward"** on function select switch and adjust **TX PWR ADJ** control to set desired RF output power.

Indicating LED's:

- **A/C Supply:** Green led indicates A/C power is On.
- **EXT DC:** Green led indicates +24V ext. DC power is On.
- **Rx PLL Lock:** Green led indicates PLL lock is achieved.
- **Mute:** Red led indicates Rx is muted.
- **Program Loss:** Red led indicates loss of Rx program/modulation.
- **PSU Fault:** Red led indicates psu failure.
- **RF Enabled:** Green led indicates RF is enabled.
- **Tx PLL Lock:** Green led indicates PLL lock is achieved.
- **RF Fault:** Red led indicates low RF output.
- **VSWR Fault:** Red led indicates high-reflected power.
- **Temp Fault:** Red led indicates high temperature in RF PA module.
- **TL ID:** Yellow led indicates ID module is connected.

Rear panel

(a) A/C Input: IEC male connector for prescribed a/c operation. **(7)**
(b) A/C Fuse: Accepts 1 Amp 20mm type fuse. **(9)**
(c) DC Input: Red/Black terminal posts for +24V Battery operation. **(8)**
(d) Ground post: 5mm screw for grounding purposes.
(e) Telemetry: 15 pin D type (female) for remote control/monitoring. **(11)**
(f) De-emphasis: Switch to enable stereo decoder de-emphasis. **(10)**
(g) Diversity input: BNC input for Wideband/MPX reserve. **(12)**
(h) Baseband outputs: BNC outputs for re-broadcast purposes. **(12)**
(i) Remote PLL: 15 pin D type (female) to set remote frequency. **(14)**
(j) RF Input: N Type 50 ohm (female) for RF input. **(15)**

Frequency Selection

The operating frequency will normally be set at factory configuration, but if a different operating (receive or transit) frequency is necessary then the unit top cover has to be removed and a new frequency selected on the Translator main PCB (378-Z0027). This is done by setting the DIL switches as detailed in Table 3 in the Installation Section of this manual.

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Installation Information

INSTALLATION

INSTALLATION

STAND ALONE CONFIGURATION (FM Translator)

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

Note: The operating frequency will normally be set at factory configuration, but if a different operating (receive or transit) frequency is necessary then the unit top cover has to be removed and a new frequency selected on the Translator main PCB (378-Z0027). This is done by setting the DIL switches as detailed in Table 3.

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) RF INPUT.
Connect RF input to BNC input, Input Receiver, on the back panel.

Note: When the Telemetry connector is not in use the unit requires no external commands to enable the RF.

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

TX PLL LOCK (green led)	ON
RF FAULT (red led)	ON
VSWR FAULT (red led)	OFF
TEMP FAULT (red led)	OFF
TL ID (yellow Led)	OFF
AC SUPPLY (green led)	ON
EXT DC (green led)	ON
RX PLL LOCK (green led)	ON
MUTE (red led)	OFF
PROGRAM LOSS (red led)	OFF
PSU 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:

- FIELD Indication of received RF level.
- FORWARD POWER 0 Watts (no Leds on).
- REFLECTED POWER 0 Watts (no Leds on).
- BASEBAND Indication of received RF level.

e) SETTING THE RF POWER LEVEL

Select FWD POWER on the Multimeter and observe the reading.
Adjust the Front panel TX 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.

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.

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Technical Information

TECHNICAL INFORMATION

CIRCUIT DESCRIPTIONS

❖ **MAIN PCB ASSEMBLY (378-Z0027)**

♦ Receiver Circuits operation.

Synthesizer and Local Oscillator (76.8MHz-97.3MHz)

The synthesizer consists of a single modulus loop with a divide by **64 pre-scaler (IC6).** A **12.8MHz TCXO (IC7)** provides an accurate and stable reference for the synthesizer. The reference is then, divided by two by **IC30/A** to **6.4MHz**. This reference is applied **direct** to the fixed divider in the synthesizer (**IC8).** This divides by **8192** to obtain a **comparison frequency** of **781.25Hz**. This mode of operation provides **frequency steps of 50kHz** via the 12 way DIP switch **SW2**. (64 x 781.25Hz = 50kHz).
The **LD** output on **IC8** provides a lock detect function and is routed to **IC21/C** for Telemetry and Metering purposes. **LED D18** provides the **Rx Lock function** indication.

The Local oscillator **(TR1** and Buffer/amplifier **IC5)** is routed via the **pre-scaler (IC6)** to the programmable divider in the synthesizer **(IC8),** whose division ratio is set by DIP switch **(SW2).** The DIP switches set the **L.O. Frequency (76.8MHz-97.3MHz)**, which is **10.7MHz** lower than the required **receive frequency (87.5MHz-108MHz)**.
The Phase comparator output of **IC8** (PD-OUT) has a 3-state output and is applied to a Loop integrator **(IC3)** and **Loop filter (IC14),** whose dc output in turn, controls the frequency of the **Local oscillator** via Varactor diode **D7.** (Control sensitivity is approximately 2MHz/Volt).
The Local oscillator output can be monitored via **SK2**.

Front End Filters and Amplifier.
The **Front End Filter** is **Self-Tuning** and is configured into two sections, pre and post amplifier. The RF input is routed from **SK1** to the First filter stage **(L2 and L3)**. The amplifier **(IC1)** is configured to accept **high overload** levels with a gain of 30dB and low Noise Figure of 3dB. This is done to ensure high sensitivity and low intermodulation products.
The pre-amplifier filter consists of a seventh order bandpass, which is tuned via Varactor diodes **D1,** and **D2** and inductors **L2** and **L3.** The Tuning voltage is derived from the L.O. Locking voltage at **IC14.**
The output of **IC1** is applied via a fixed attenuator to the Post-Amplifier filter stage **(L4 and L5)** which is identical to the above filter.
This attenuator is used to provide a good match (50 ohms) to the filter and amplifier while limiting the input level to the **Mixer (MX1).** The mixer is a **passive double balanced** type with a Local oscillator drive level of +7dBm from **IC5.**
The overall performance of the **Front End** is typically 15dB, conversion gain with a noise figure of 5dB. **Image rejection** is better than **65db** across the entire band without any tuning.

10.7MHz IF Filter section.

The 10.7MHz IF output from the Mixer MX1, is routed via Links LK1 and LK2 which are usefully configured to allow testing of the Rx Front-end or IF Filter.
With **LK1 'in'** and **LK2 'out'** the Front-end IF output can be monitored at **SK3.**
With **LK1 'out'** and **LK2 'in'** the IF Filter can be tested separately via **SK3/SK4.**
LK1 and LK2 must both be inserted at final test.

The **10.7MHz filter** consists of **three Ceramic filters (FL1, FL2 and FL3),** that have **controlled group delay** and **excellent attenuation** characteristics. Each filter has tuning capacitors at the input side **(C65, C70 and C75)** to obtain optimum Baseband distortion and Stereo characteristics. Each filter is buffered by a **J-Fet** high impedance amplification stage to recover the insertion loss of the individual filters (approximately 8db). The filters are terminated with optimum, 330 ohms resistive loads. The complete filter gives attenuation of approximately 20dB at 200khz offset and 60dB at 300khz offset. Spurious response is better than 75dB.

The **High Q** of the **ceramic** filters ensure **excellent performance** and **stability** compared to normal LC Filters.

IF Demodulator (10.7MHz).

The IF demodulator consists of a **double tuned, self correcting quadrature demodulator (IC9).** This is done to ensure **optimum** performance with **temperature, aging and input frequency offset error.**

The **balanced output** of the demodulator at pins 8 and 9 contain the **recovered baseband** and also a differential **dc offset** proportional to the **10.7MHz RF input frequency offset.** This dc offset is applied to **IC11/B**, which amplifies the dc offset and applies it to **Varactor diodes D8 and D9,** which in turn **tune** the demodulator. This **corrects** the **error** and ensures the **distortion is minimized. C90** and **C96** are provided to initially optimally tune the demodulator.

A dc voltage proportional to the Field strength is provided on **pin 13** of **IC9** which is applied to buffer **IC10/A** whose output is applied to **IC10/B** which is used to set the **Rx Mute** level via **R80.** The output from IC10/A is also routed to **SK18 pin 5** for Field strength metering purposes.

Baseband correction.

The Baseband output of the demodulator is **amplified by IC11/A** and applied to the **amplitude correction** circuit at **IC12/A**. This circuit is used to **correct the Roll-off of the IF Filter** and correct the **amplitude response to 100kHz (adj. C109).** The circuit also acts as a band-reject filter attenuating frequencies at 200kHz by approximately 30dB. A group delay correction circuit, **IC12/B** is also provided for optimal **Stereo separation** at **15kHz (adj. R92).**

The **performance** of the complete IF demodulator is **excellent,** providing superb Stereo separation and distortion at full 75kHz deviation of the **10.7MHz** RF input, with ≥75db S/N at only 1mV RF input level.

Rx Baseband Filter and output distribution.

The Baseband output signal on **IC12/B pin 7** is applied to a **100kHz low pass filter (IC13).** This filter consists of a band reject at 150kHz **(IC13/A)** and a two- pole section at

100kHz **(IC13/B).** The total filter is flat (± 0.25dB) to 95kHz and gives ≥20dB attenuation at 150kHz. **No adjustment** of the filter is necessary.

The baseband output from buffer IC15 pin 6 is routed via **R112** to **SK5** (Rx baseband output) this output, whose **level** is adjustable via **R111**, is used for external use. The output is also routed to **LK4/A**, which allows connection to **RL5/B** for internal loopback purposes to the Tx modulator. When internal loopback is used **LK5** can be inserted and **SK6** (Tx baseband input/diversity) can be used for 'standby' receiver baseband input. LK4/B can be used to switch the outputs for different switching configurations.

Stereo Decoder circuit. (Audio monitor and Pilot detection).

The output from **IC15** is routed via **R113 (Decoder level adjust),** which sets the optimal input level to **IC16** (Stereo decoder). The Stereo decoder chip provides some interesting internal features such as **Image low pass filtering** on input at **114kHz** (3x38kHz), **Ceramic resonator** (XL1) tuning **(no adjustment of oscillators), Pilot detection** with pilot **cancel** circuit.
The stereo pilot signal, when present at the input, forces pin 18 'high' via **R119** which in turn switches on **TR8** and provides a Telemetry signal for external use on **SK17** pin 13.

The Audio outputs are provided at **pin 11 (Right)** and **pin 10 (Left)** on **IC16**. The outputs are de-emphasized via **C129** and **C130** and are routed to stereo headphone buffers **IC17/A** and **IC17/B**. the outputs are routed to **SK7** (Headphone output).

♦ Transmitter Circuits operation.

Synthesizer and modulator (87.5MHz-108MHz)

The synthesizer consists of a single modulus loop with a divide by **64 pre-scaler (IC6).** A **12.8MHz TCXO (IC7)** provides an accurate and stable reference for the synthesizer. The reference is then, divided by two by **IC30/A** to **6.4MHz**. This reference is applied **direct** to the fixed divider in the synthesizer (**IC18).** This divides by **8192** to obtain a **comparison frequency** of **781.25Hz**. This mode of operation provides **frequency steps of 50kHz** via the 12 way DIP switch **SW3**. (64 x 781.25Hz = 50kHz).
The **LD** output on **IC18** provides a lock detect function and is routed to **IC21/A** for Telemetry and Metering purposes. **LED D17** provides the **Tx Lock function** indication.

The modulator/oscillator **(TR11** and Buffer/amplifier **IC23)** is routed via the **pre-scaler (IC22)** to the programmable divider in the synthesizer **(IC18),** whose division ratio is set by DIP switch **(SW3).** The DIP switches set the **Oscillator Frequency (87.5MHz-108MHz).**
The Phase comparator output of **IC18** (PD-OUT) has a 3-state output and is applied to a Loop integrator **(IC19)** and **Loop filter (IC20),** whose dc output in turn, controls the frequency of the **oscillator** via Varactor diodes **D23** and **D24.** (Control sensitivity is approximately 2MHz/Volt).

Diodes **D25** and **D26** provide the modulation function and the dc control voltage tuning the oscillator is also applied to these diodes. This dc voltage is offset via R160 and R161, which equalizes the deviation level across the 87.5MHz to 108MHz band.

The Loop filter provides ≥40dB of attenuation at frequencies greater than 30Hz. This is done to ensure that the Stereo modulation, phase and amplitude are uninfected by the Synthesizer loop to provide excellent stereo separation, even at 30Hz. The modulation is inserted via **IC24** and **R167. SK6, SK8 and SK9** provide the input to the modulator.

R182 provides the adjustment for the Tx baseband input, and **R183** provides the Auxiliary input (SCA or SST).
The **RF output** at **SK10** and the **RF Buffer amplifier (IC23)** is switched via **TR12** to ensure the output is switched off when the synthesizer is out of lock.

Control, and RF detection.

Forward power circuit:

The **Forward power sample** from the RF Power amplifier is input at **SK11** and this RF signal is converted to a dc level via diode **D28** and amplifier **IC25/A.** Diode **D29** is provided to give temperature compensation for diode **D28**. The dc output at TP4 is normally set to +5V dc via **R197** (FWD cal) for 25W RF output in the RF Power amp module.
The output of **IC25/A** is routed to comparator **IC26/A**, which controls the alarm condition for a Low RF Fault set by **R199** (FWD Alarm cal). The output is then routed to **TR13** and **RL1/C** to provide contacts for Telemetry and Alarm indications.
Reflected power circuit:

The **Reflected power sample** from the RF Power amplifier is input at **SK12** and this RF signal is converted to a dc level via diode **D32** and amplifier **IC25/B.** Diode **D33** is provided to give temperature compensation for diode **D32**. The dc output at TP5 is normally set to +5V dc via **R208** (REFL cal) for 2.5W RF reflected output in the RF Power amp module.
The output of **IC25/B** is routed to comparator **IC26/B**, which controls the alarm condition for a High Reflected RF Fault set, by **R215** (REFL Alarm cal). The output is then routed to **TR14** and **RL2/C** to provide contacts for Telemetry and Alarm indications.
The output from **IC25/B** is also routed to comparator IC26/C that sets the Reflected Trip level via **R211** (REFL Alarm trip). When activated the output is routed to **IC26/D**, which performs the function of the timer. The timer allows the Reflected power re-cycle and activation approximately every 14 Seconds.
Diode **D34** allows the Reflected RF Fault to be latched during re-cycle periods during which the Forward power is zero.

Temperature detection circuit:

The Thermistor in the RF Power amplifier is input at **SK13.** The resistance of the Thermistor (4700 ohms at 25°C) reduces as the temperature increases and a dc output is obtained at **IC27/A** pin 1 representing the actual temperature. The output voltage at TP6 is set to actual temperature divided by 10 via **R227** (Temp cal).
The output is then routed to comparator **IC27/C** (Temp trip) whose reference is set to +6.5V. This allows the output of this IC to switch at a temperature of **65° C**, which in turn switches off **TR15** via **D39** and this allows the command to the RF Power amplifier to be switched off via **SK15**.
The output is also routed to comparator **IC27/B** (Temp fault) whose reference is adjustable via **R234** (Temp alarm cal). The output is routed to **TR16** and **RL3/C** for Telemetry and alarm purposes.

ALC Circuit:

The output dc from **IC25/A** (Forward detect voltage) is routed to via **R239** to **IC27/D.** This voltage is compared to the dc voltage on the **ALC input** (RF Power set) which is derived

from the Display module. The output of this IC is routed via **R243** to **SK14** (PA ALC) and is used to control the RF output on the RF Power amplifier module.
The output of the Temperature alarm circuit **IC27/B** is also routed to the ALC circuit via **R237** such that when the Temperature alarm is activated it reduces the RF output power.

Forward and Reflected meter correction.

The circuits of **IC31/A** and **IC31/B** are used to correct the non-linear dc detection voltages (which are proportional to power) to linear voltages useful for driving a linear scale meter.

❖ **FMT DISPLAY PCB (378-Z0028)**

Multimeter display.

The display consists of a **20 Led matrix** driven by **IC4** and **IC5** (Linear Bargraph drivers). The dc signal input to the Bargraph drivers is on pin 5. A **push button** selection switch **SW1** is provided to enable operation/selection. **1C1** provides the **selection function** while **IC2** provides **switching** and **indication** function. **LED's D1 to D4** are provided to indicate **parameter selected**.

The display has 4 functions:

Parameter	Adjust/calibrate	Switch selection
Field strength	R1	Position 1
Forward power	R2	Position 2
Reflected power	R3	Position 3
Baseband level	R4	Position 4

The Field, Forward and Reflected signals are dc voltages whilst the Baseband signal is a dynamic a/c signal (These inputs are on **SK1**). The signals are routed via **IC2** to a **full wave, peak detection** circuit **(IC3/C and IC3/D)** which has a **fast attack** time and **slow decay** time to enable **visual operation** of the **dynamic signal.** This output is routed to the Bargraph driver input on **IC4** and **IC5.**

Program loss detector.

The incoming **Baseband** signal on **SK1 pin 19** is routed to **1C3/B**, which is **a Half wave peak detector** circuit with **fast attack** and **slow decay** time. This circuit gives a dc output proportional to the peak a/c input and capacitor **C17** maintains the dc charge during program durations. The circuit of **IC3/A** detects the dc output of the peak detector and enables an **alarm** when it is low via **SK1 pin 3** and **TR1/LED D35.** The **program loss** condition takes approximately **12 seconds** to register and is indicated by **Led D35**. The **filter R23, R24, R25 and C5,** ensure that the stereo pilot signal does not activate the program loss detector circuit.

Indicators and alarms (via **SK1** inputs)

TX PLL Lock is indicated by **Led D6** and is on when Lock condition exists.
RX PLL Lock is indicated by **Led D33** and is on when Lock condition exists.
Mute is indicated by **Led D34** and is on when Mute condition occurs.

RF Enabled is indicated by **Led D5** and is on when Tx is enabled.
Temp fault is indicated by **Led D9** and is on when temperature is high.
PSU fault is indicated by **Led D36** and is on when power supply is faulty.
RF fault is indicated by **Led D7** and is on when RF power is low.
VSWR fault is indicated by **Led D8** and is on when RF Reflected power is high.
A/C Supply is indicated by **LED D31** and is on when A/C supply is present.
EXT DC is indicated by **LED D32** and is on when dc supply (+24V) is present.
TL-ID is indicated by **LED D10** and is on when ID Module is installed.

Front panel adjustments.

R5 adjusts the level of the Forward power via **SK1.**

Power supply.

The incoming power supply voltages are **+22V (SK1 pin1 and 2),** and **–12V (SK1 pin 23). IC6** regulates the **+12V** supply and **IC7** regulates the **+5V** supply.

❖ **FMT POWER SUPPLY PCB (980808)**

A/C Input supply:

The a/c input to the power supply module is provided by an external 24V a/c winding on the A/C Mains transformer. The winding is connected to **SK1 pin 1 and pin 3**. A Full-wave Bridge rectifier **(D1)** is used to rectify the a/c input, with capacitors **C1** to **C9** providing the smoothing. The resulting raw dc is routed via **Fuse F1** (3 Amp) and Isolating diode **D2** to **SK4. LED D4** indicates the presence of the a/c supply.

+24V dc supply:

The **+24V** dc supply is connected to **SK2 pin 1** with the return connected to **SK2 pin 2**.
The dc is routed via **Fuse F2** (3Amp) and Isolating diode **D3. LED D5** indicates the presence of the dc supply.
The combined supply at **D2** and **D3** cathode provides the power to the RF PA module via **SK4** and also to the MAIN PCB via **SK3**.

SK5 provides an output for a +12V Fan.

❖ **FMT RF PA Module (980801)**

Power supply and regulation:

The power supply input to the RF PA Module is routed to a **Switch-mode regulator, IC2.** This is a 3Amp device with built-in current limiting and requires +24V minimum and +45V maximum. The output is set to +22.5V via **R24/R25**. **PL5** is provided for current sensing (via R30) and monitoring/enabling purposes. **LED D4** indicates the presence of the regulated supply.

RF Power amplifier:

The **+6dBm** RF input is routed via **R1/R2** to a MMIC amplifier **IC1**. This amplifier gives a gain of +11dB and provides drive to Mosfet TR1. The Gate voltage for TR1 is set via **R6** and diode D1 provides protection. The Mosfet operates in Class AB, with an operating current of 200mA and Gate voltage of approximately 5V.
The output from **TR1** is routed via **C6/L2** to Wideband 4:1 transformer **T1**, which is made using coaxial cable. The transformer provides a balanced output to input of the Final RF stage **TR2** (Class 'C' Push-pull Mosfet). The gate bias voltage for this device is provided via **PL1/R14**, and **R14** is adjusted to limit the maximum output power of the device.
The output of **TR2** is routed to Wideband Transformer **T2**, which converts the balanced output of **TR2** to unbalanced. The output from **T2** is routed to the RF Low pass filter.
The RF filter consists of a seventh order network **(L4, L5, L6, C17, C18, C19 and C20)** with a Band-reject circuit around **L5**. The Band reject section is adjustable via **C21**, which is normally adjusted to 180MHz.
The filter attenuates all harmonics to ≤ -60dBc.

RF output coupler:

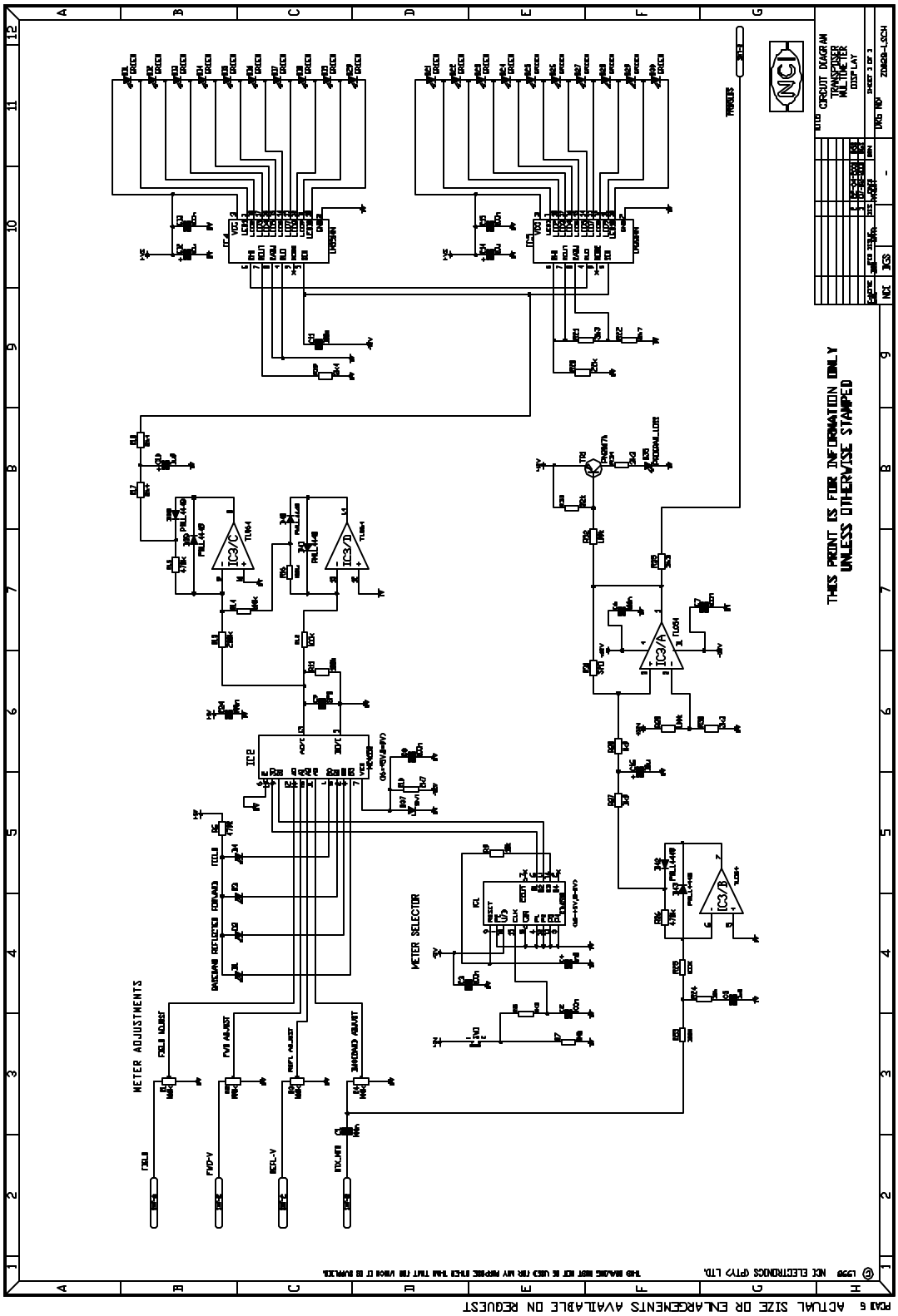
The output from the RF Filter is routed to a RF coupler (microstripline) that provides a **Forward** sample at **E20/E21**, a **Reflected** sample via **E18/E19** and a **Monitor** output via **E16/E17**. The capacitors **C22** and **C23** on the Forward and Reflected outputs flatten off the +6db/octave slope of the coupler section. The inductor **L8** provides the Monitor coupler with its flat response.
The RF output is provided by **E14/E15**. The output power of the RF power stage is typically ≥ 25 Watts.

FMT-25

VHF FM TRANSLATOR

TECHNICAL MANUAL

Maintenance Information


METER ADJUSTMENTS
METER SELECTOR
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MILLIMETER
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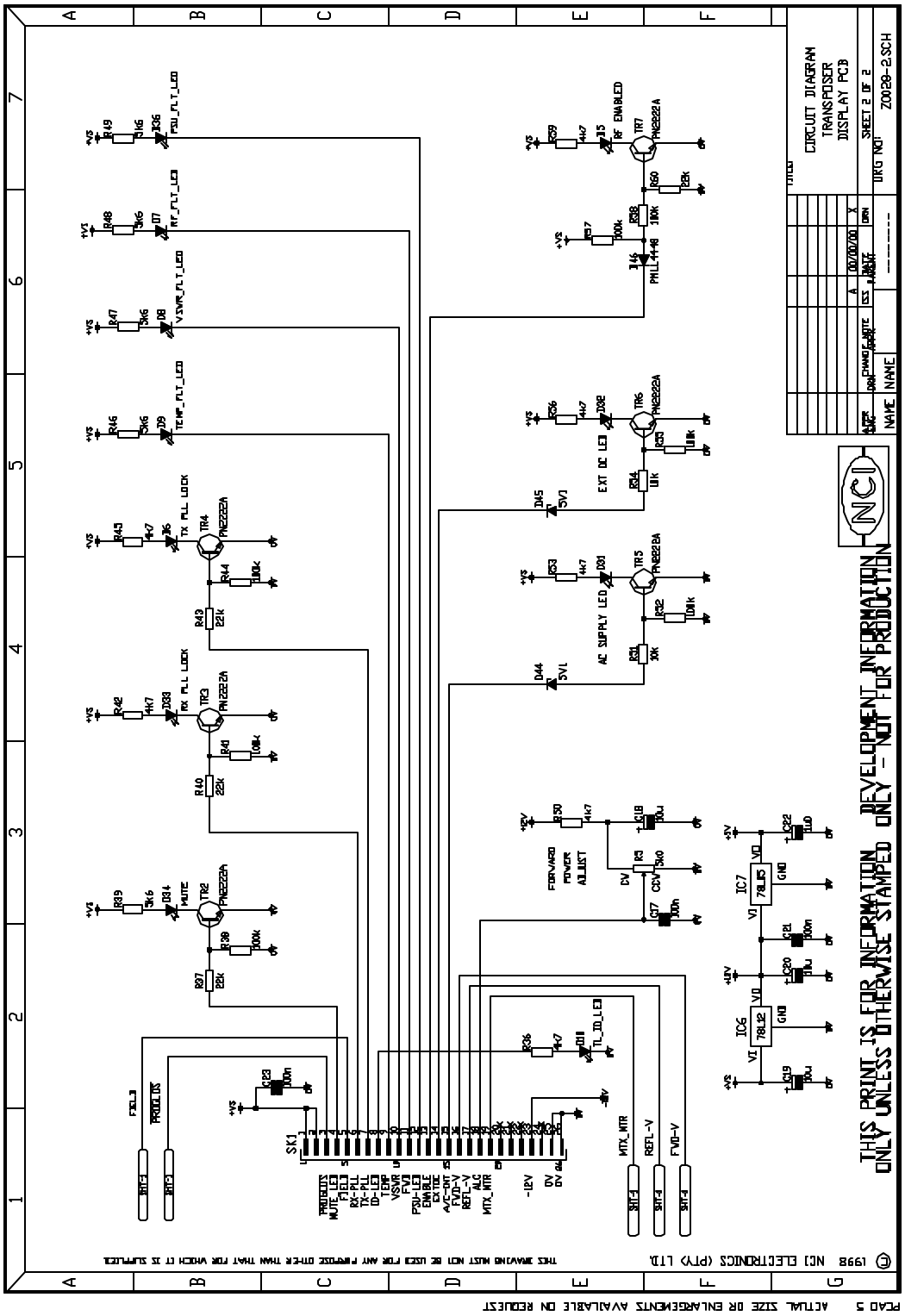
CIRCUIT DIAGRAM
TRANSPOSER
DISPLAY PCB
SHEET 2 OF 2
Z0028-2.SCH
654Z0028.DWG
DEVELOPMENT INFORMATION
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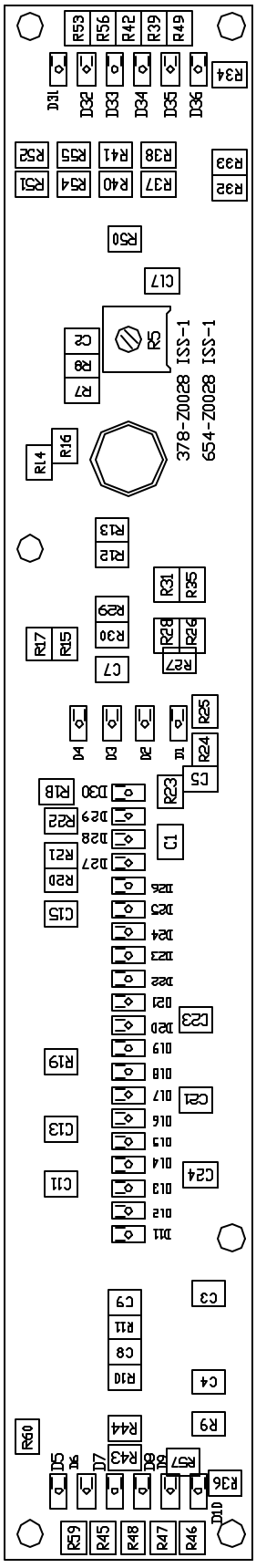
PCAD 5
TX PLL LOCK
RX PLL LOCK
MUTE
EXT DC LED
AC SUPPLY LED
RF ENABLED
FORWARD POWER ADJUST
PSU_FLT_LED
RF_FLT_LED
VSWR_FLT_LED
TEMP_FLT_LED
TL_ID_LED
MTX_MTR
REFL-V
FWD-V
IC7 78L05
IC6 78L12
SK1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COMPONENT SIDE
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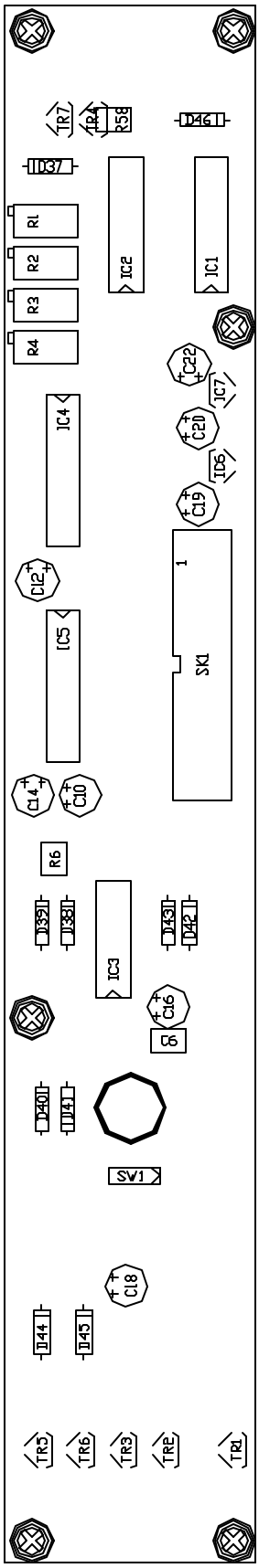
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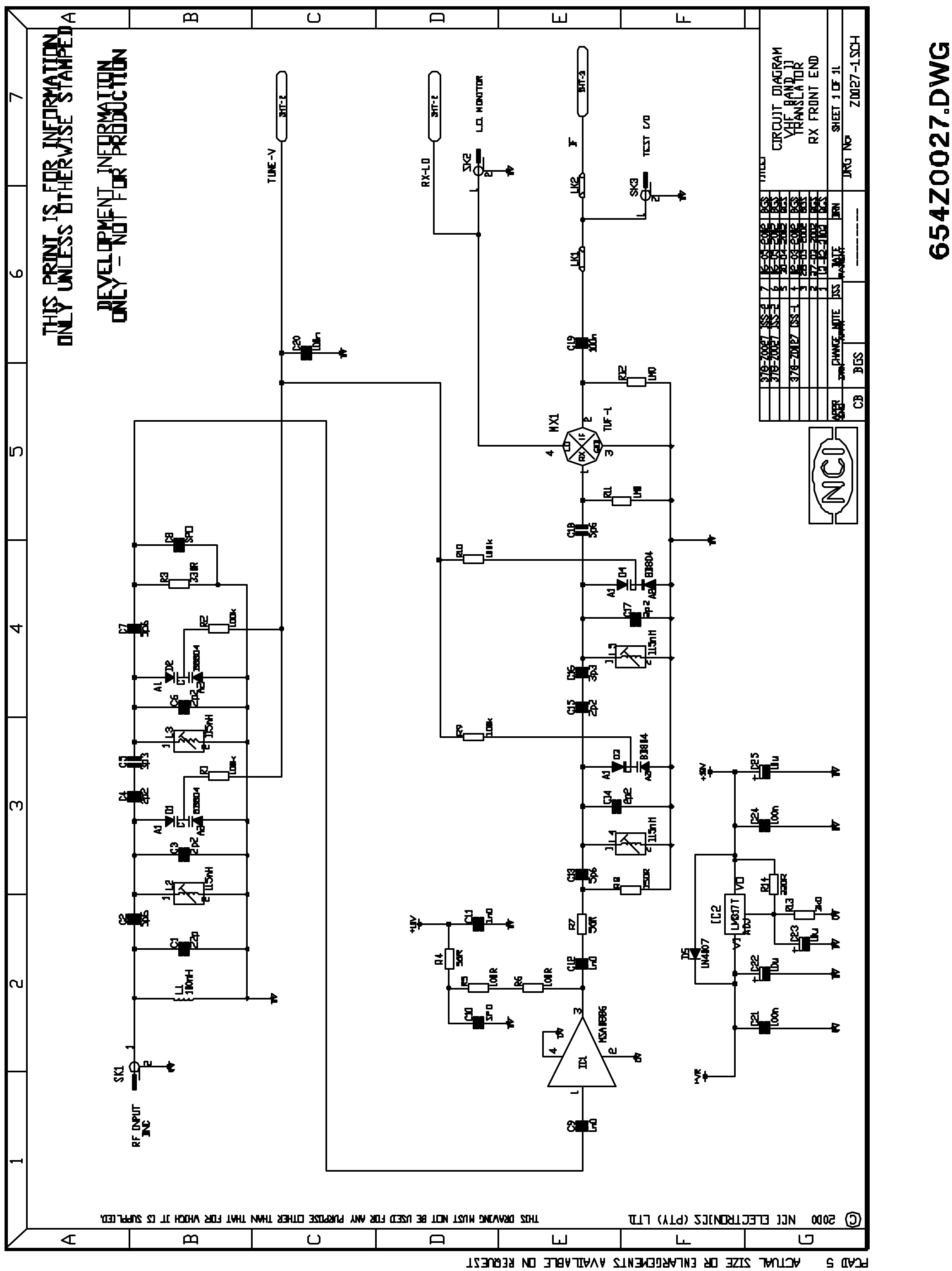
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DEVELOPMENT INFORMATION ONLY - NOT FOR PRODUCTION
CIRCUIT DIAGRAM
VHF BAND II
TRANSLATOR
RX FRONT END
SHEET 1 OF 11
Z0027-1.SCH
RF INPUT
TUNE-V
RX-LO
LO MONITOR
TEST I/O
MX1
TUF-1
IC1
MSA0886
IC2
LM317T
NCI
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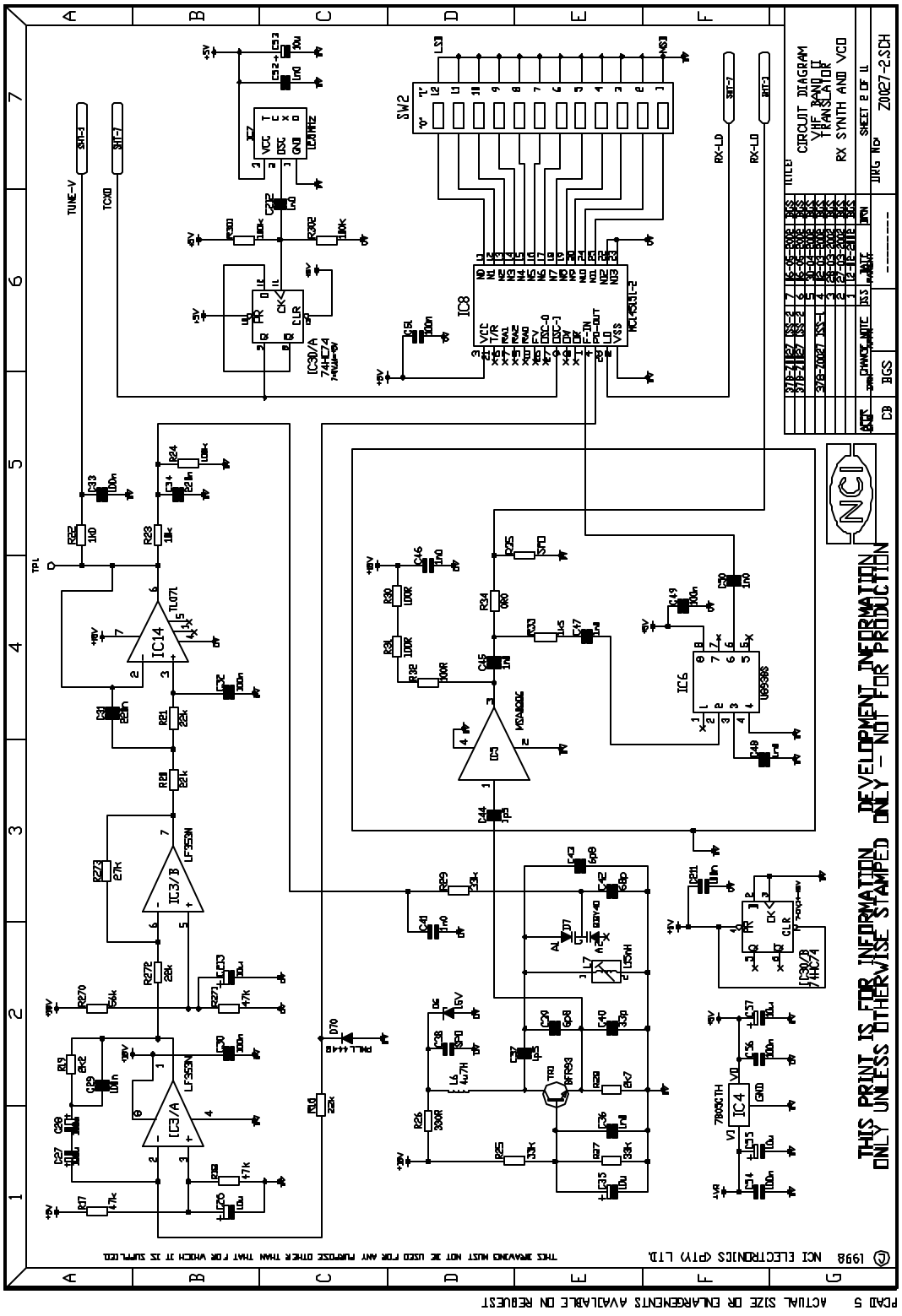
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CIRCUIT DIAGRAM
VHF BAND II
TRANSLATOR
RX SYNTH AND VCO
SHEET 2 OF 11
DRG NO Z0027-2.SCH
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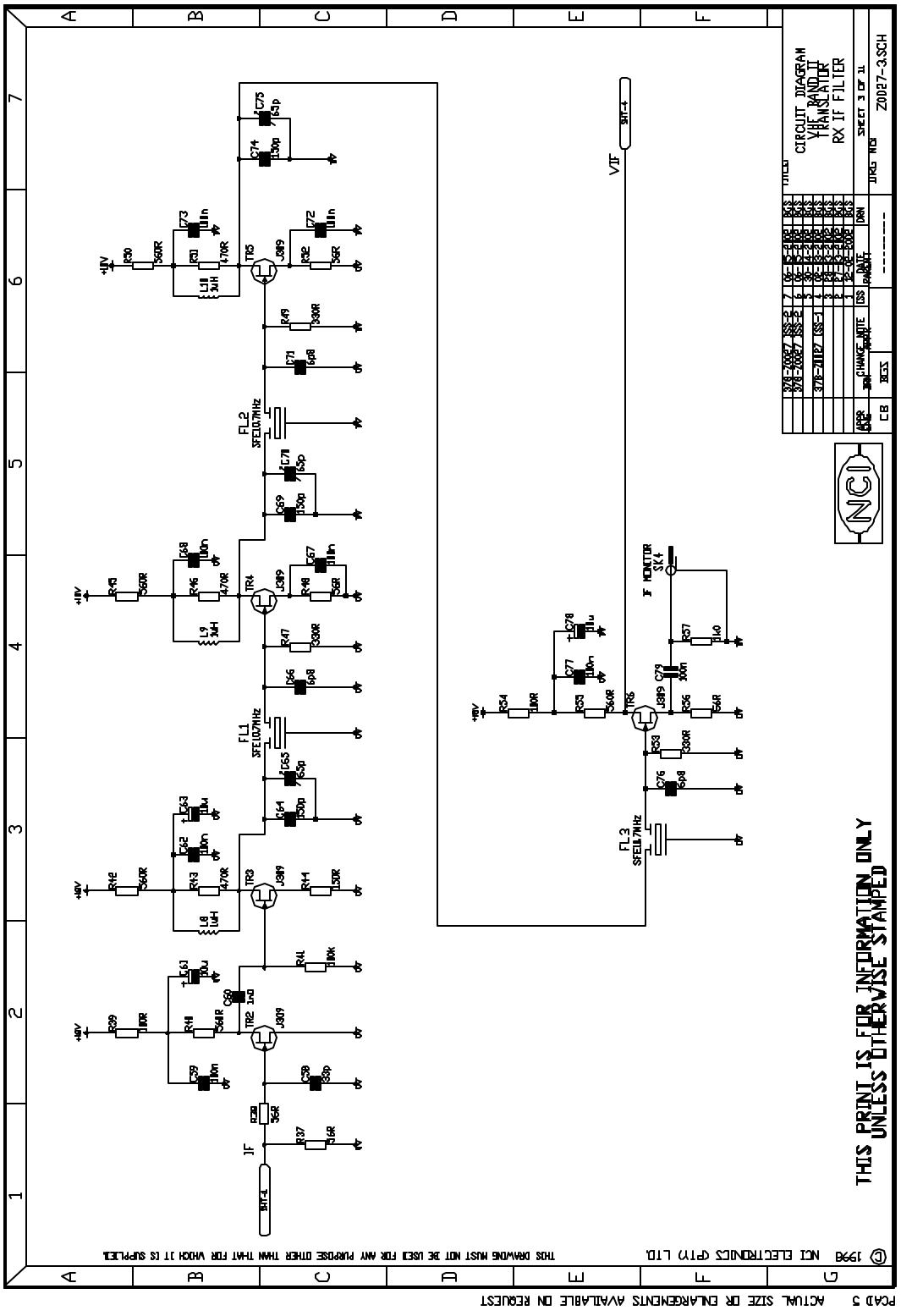
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
IC14
IC3/B
IC3/A
IC5
IC6
IC8
IC4
SW2
TUNE-V
TCXO
RX-LO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CIRCUIT DIAGRAM
VHF BAND II
TRANSLATOR
RX IF FILTER
Z0027-3.SCH
SHEET 3 OF 11
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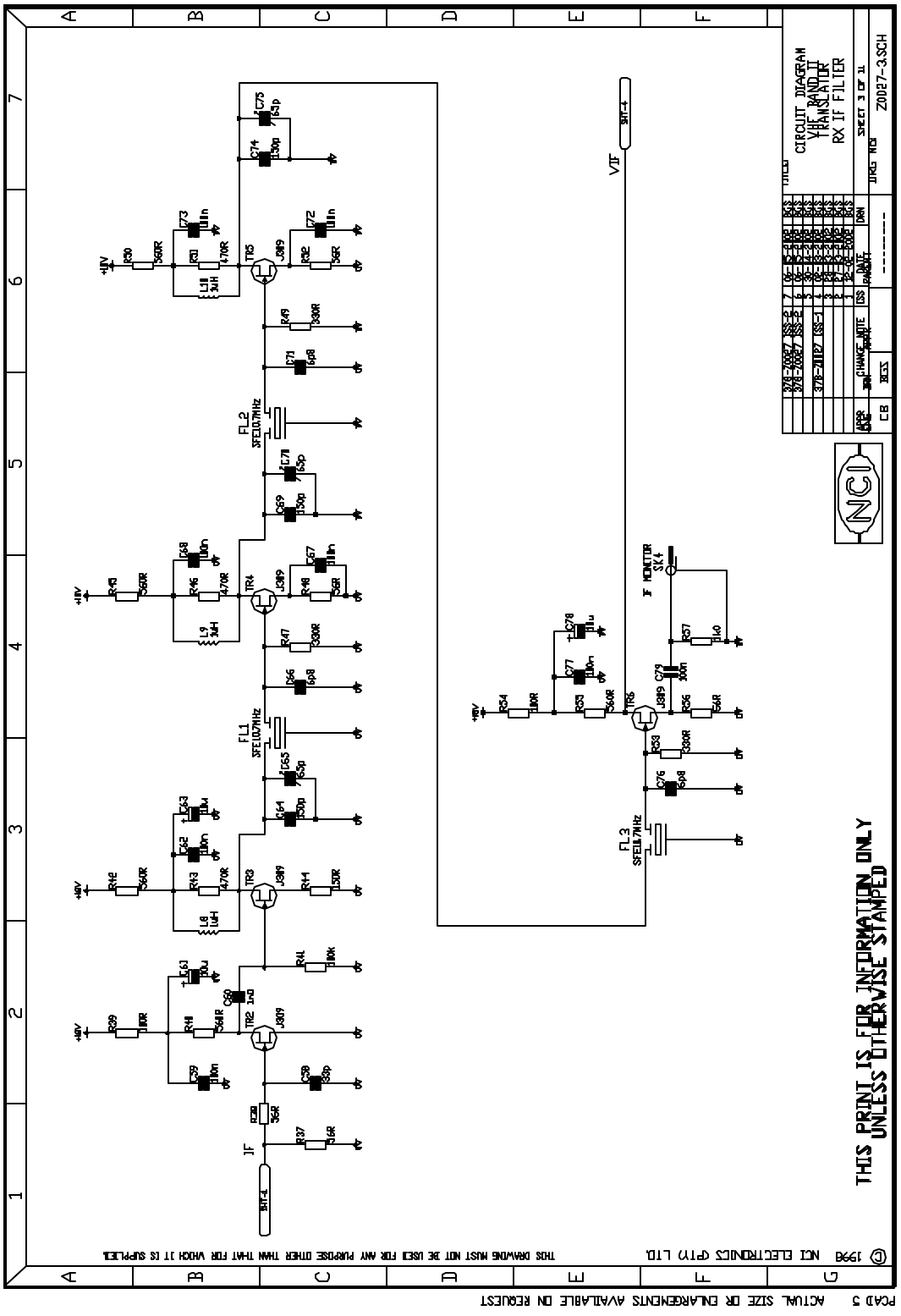
ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
VIF
IF MONITOR
FL1 SFE10.7MHz
FL2 SFE10.7MHz
FL3 SFE10.7MHz
TR2 J309
TR3 J309
TR4 J309
TR5 J309
TR6 J309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CIRCUIT DIAGRAM
VHF BAND II
TRANSLATOR
RX IF FILTER
Z0027-3.SCH
SHEET 3 OF 11
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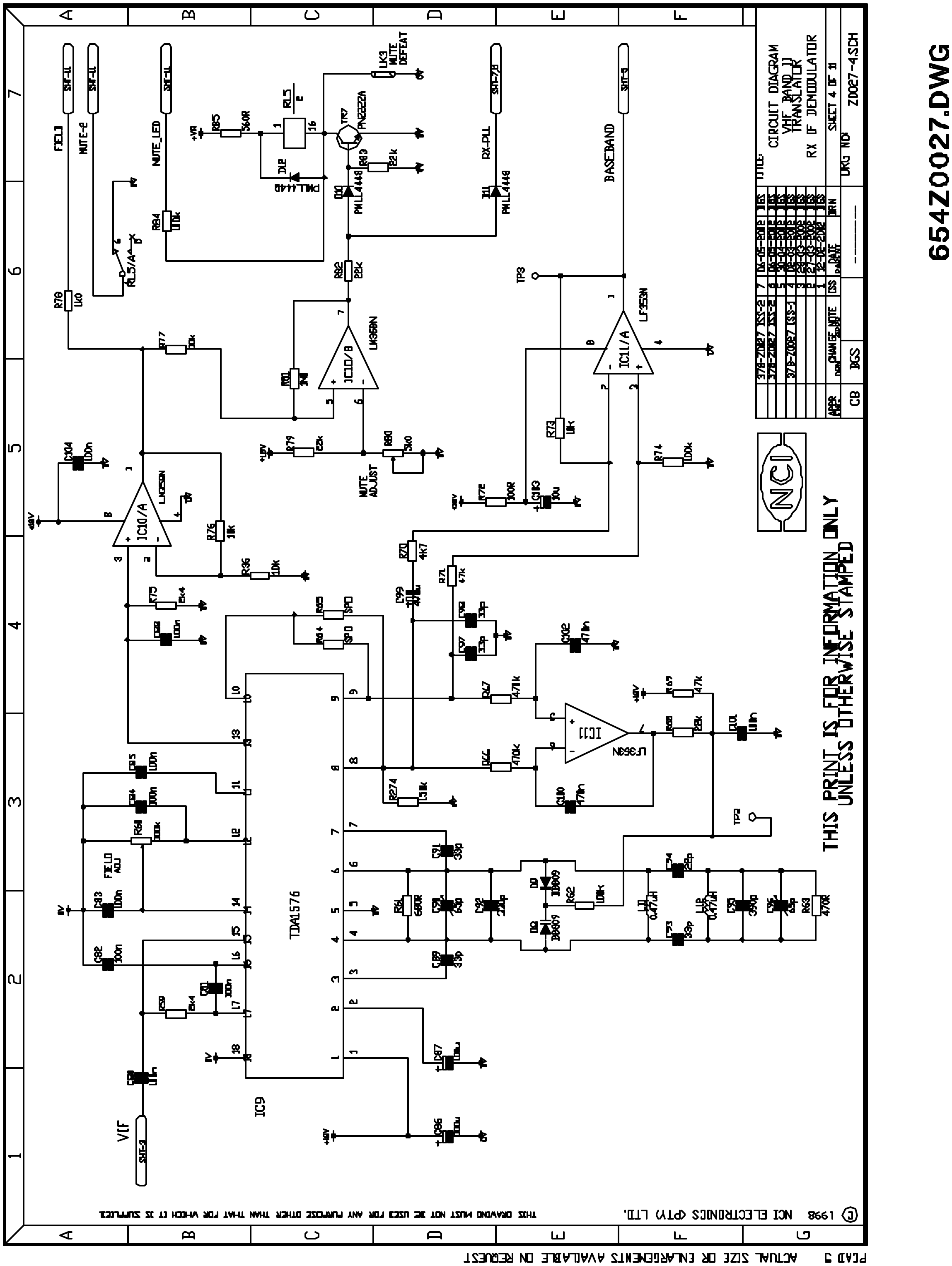
ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
VIF
IF MONITOR
FL1 SFE10.7MHz
FL2 SFE10.7MHz
FL3 SFE10.7MHz
TR2 J309
TR3 J309
TR4 J309
TR5 J309
TR6 J309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VHF BAND II
TRANSLATOR
RX IF DEMODULATOR
Z0027-4.SCH
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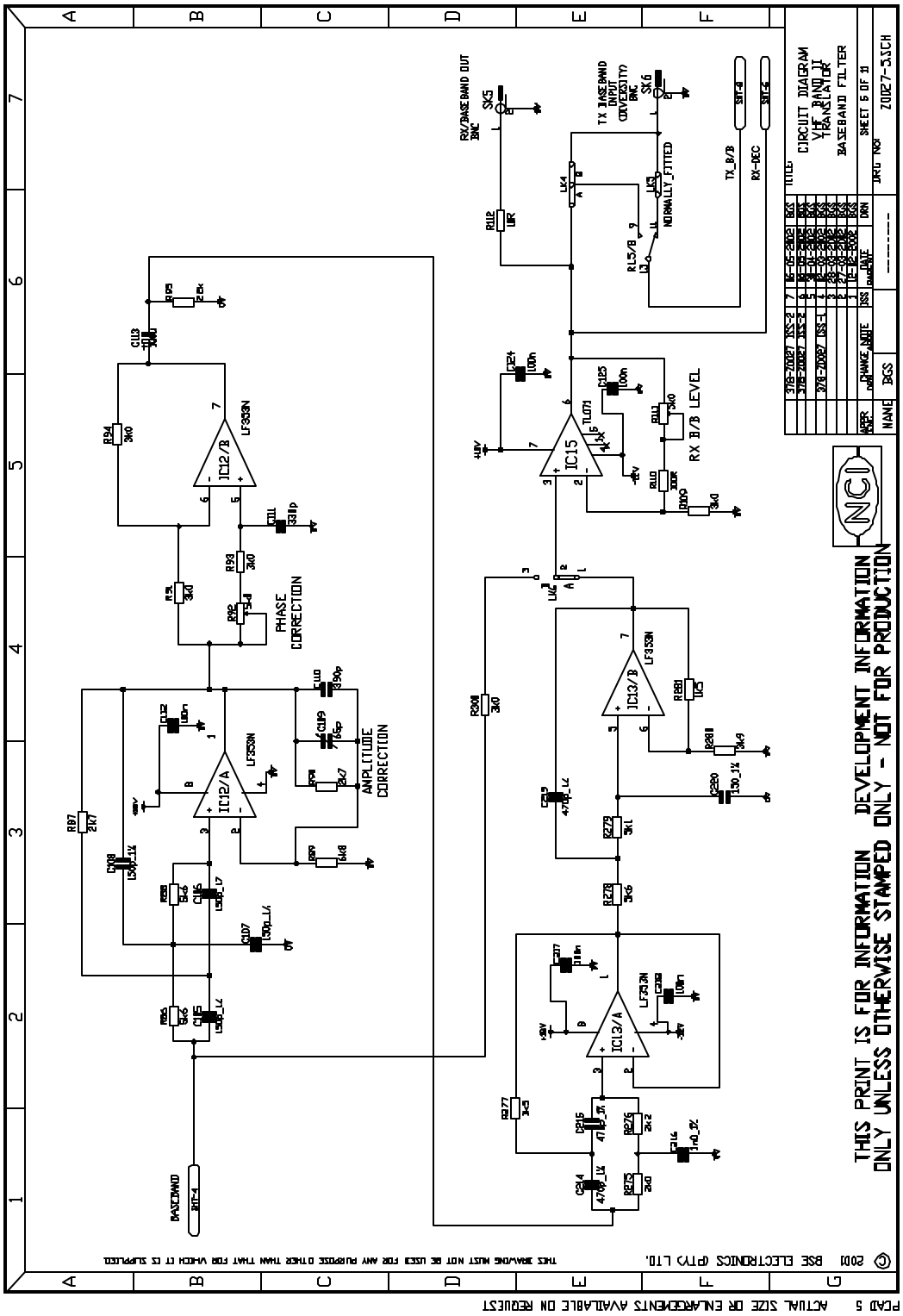
TDA1576
IC9
654Z0027.DWG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CIRCUIT DIAGRAM
VHF BAND II
TRANSLATOR
BASEBAND FILTER
SHEET 6 OF 11
20027-5.SCH
PHASE CORRECTION
AMPLITUDE CORRECTION
RX B/B LEVEL
RX/BASEBAND OUT
TX BASEBAND INPUT
NORMALLY_FITTED
IC12/B
IC12/A
IC13/B
IC13/A
IC15
LF353N
TL071
BASEBAND
RX-DEC
TX_B/B
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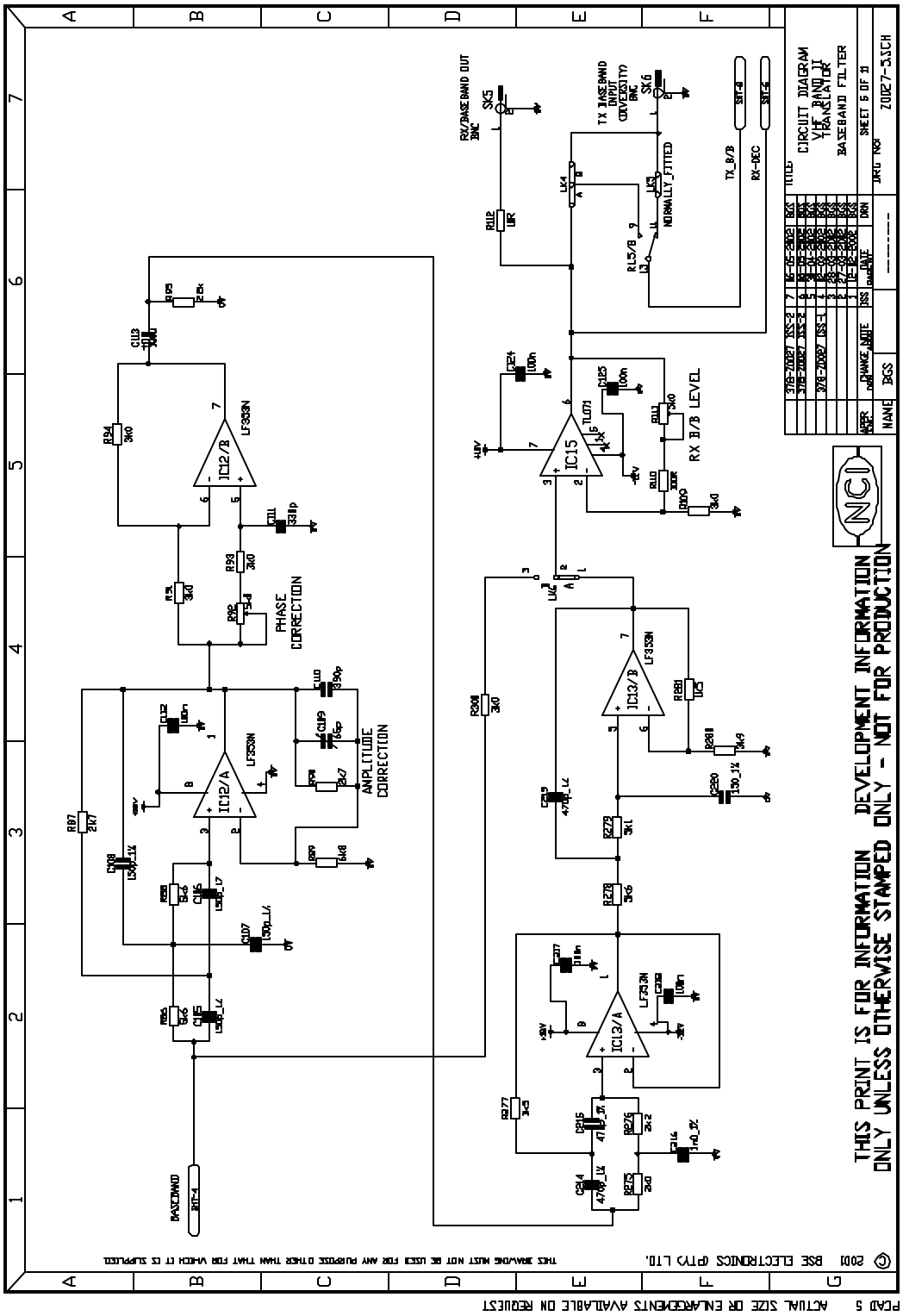
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CIRCUIT DIAGRAM
VHF BAND II
TRANSLATOR
BASEBAND FILTER
SHEET 6 OF 11
20027-5.SCH
PHASE CORRECTION
AMPLITUDE CORRECTION
RX B/B LEVEL
RX/BASEBAND OUT
TX BASEBAND INPUT
NORMALLY_FITTED
IC12/B
IC12/A
IC13/B
IC13/A
IC15
LF353N
TL071
BASEBAND
RX-DEC
TX_B/B
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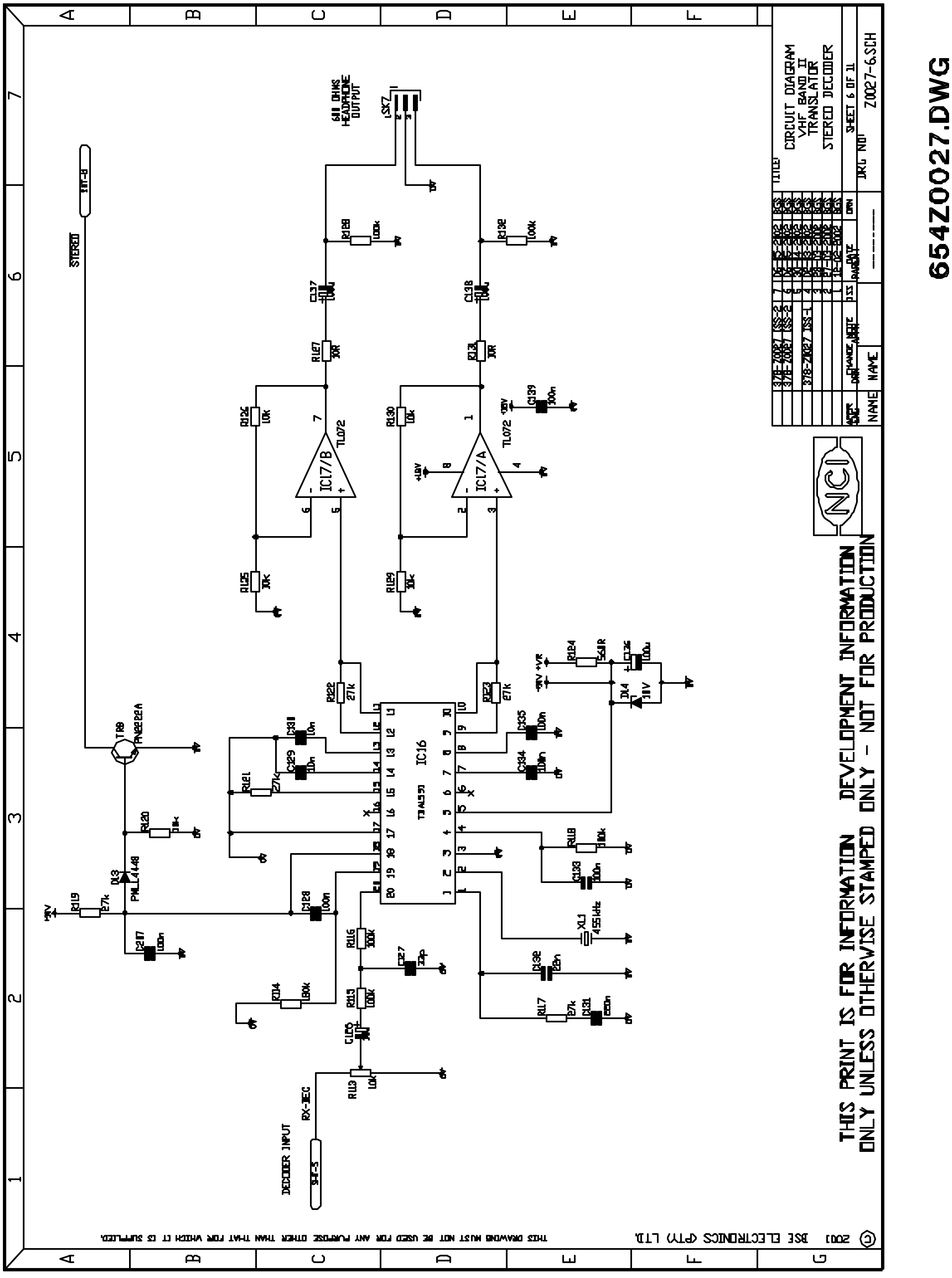

CIRCUIT DIAGRAM
VHF BAND II
TRANSLATOR
STEREO DECODER
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Z0027-6.SCH
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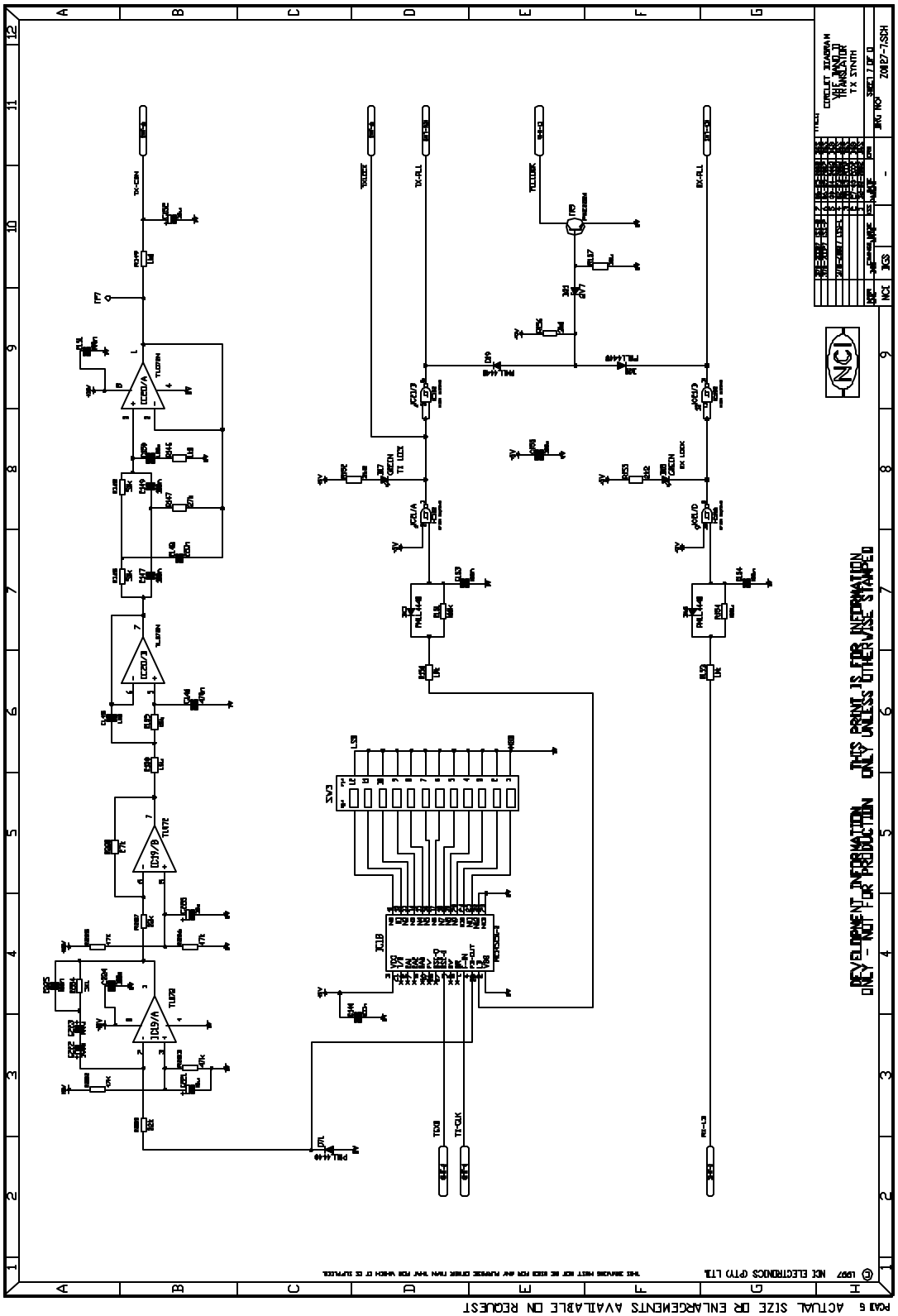

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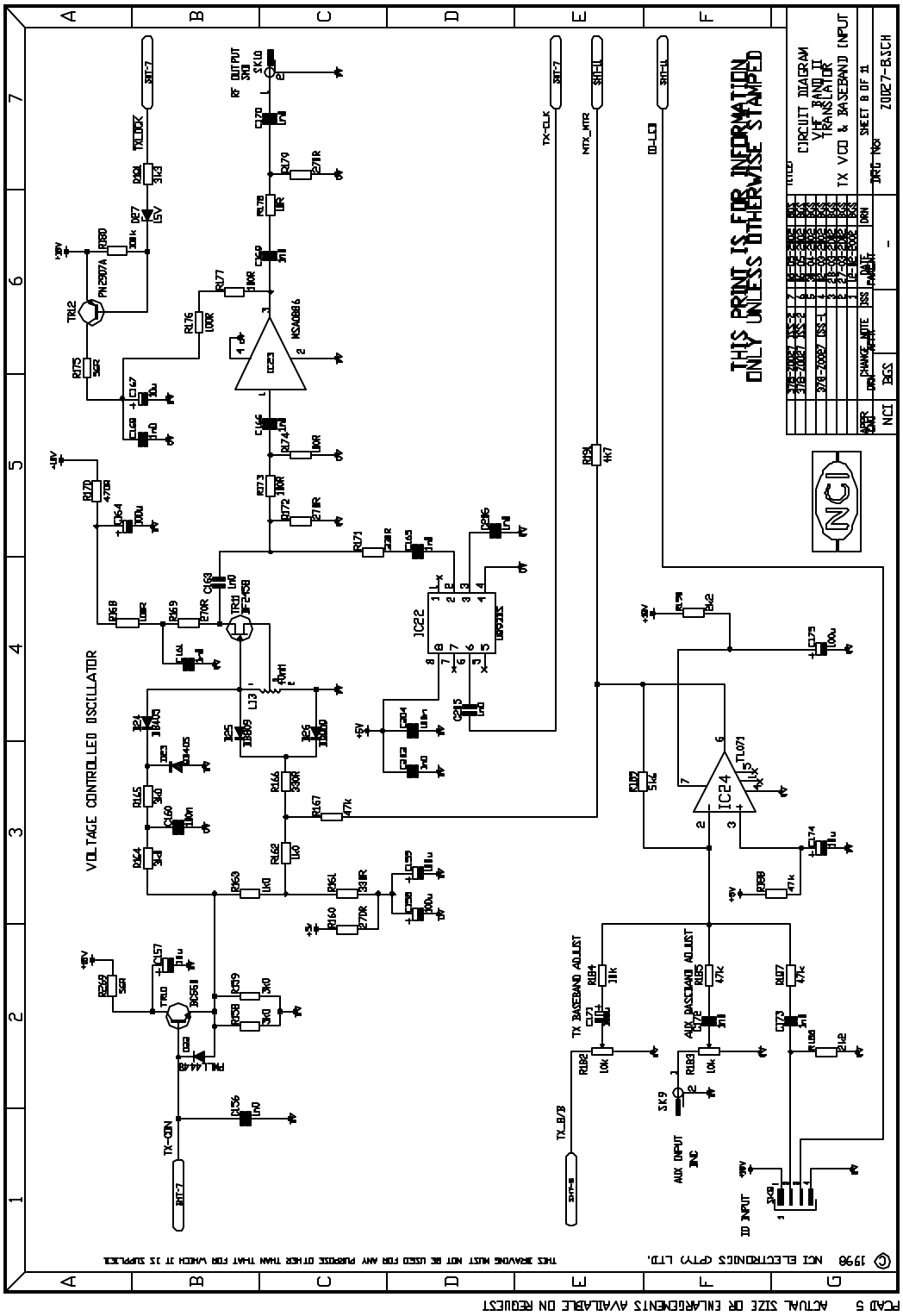

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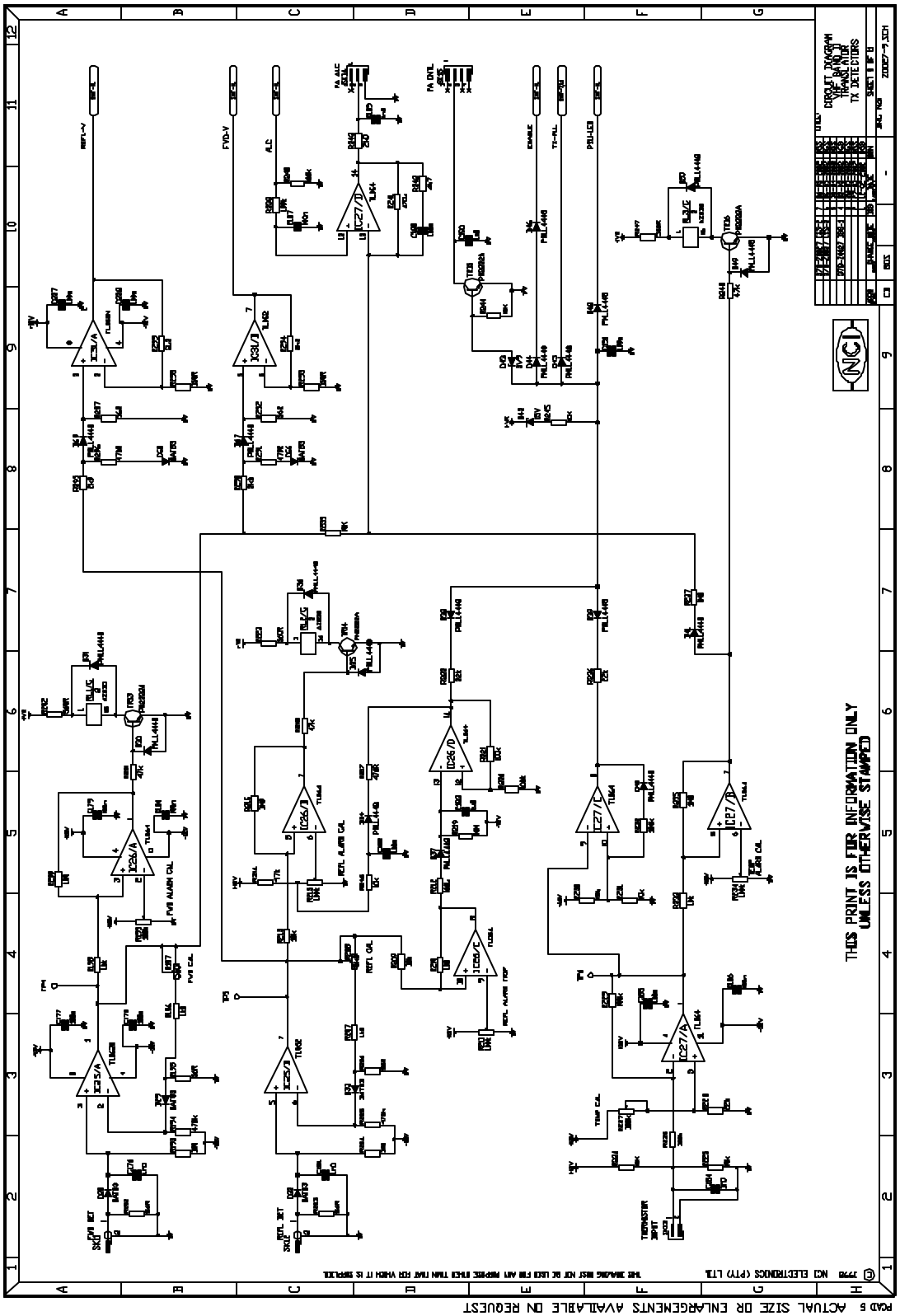
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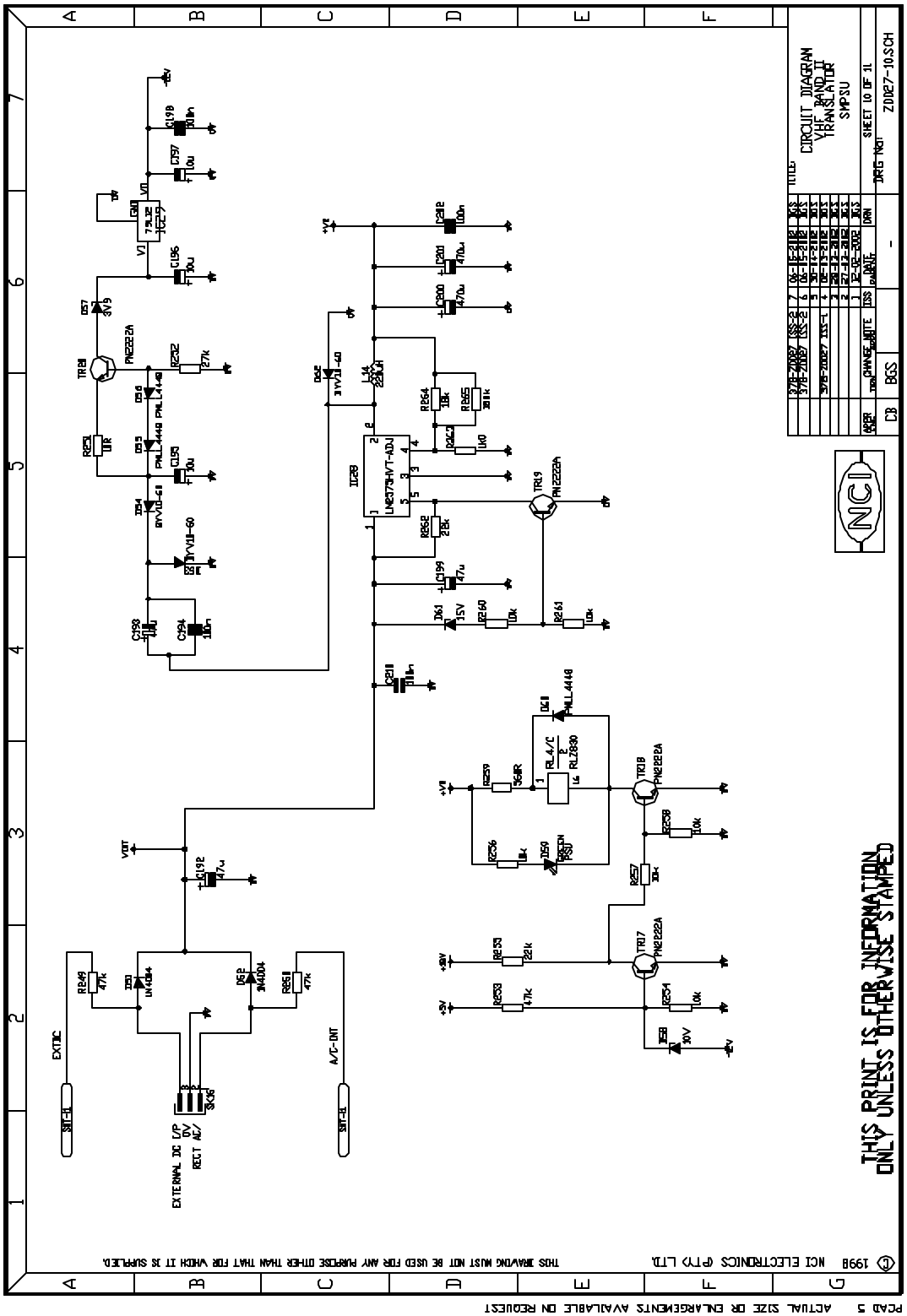
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CIRCUIT DIAGRAM
VHF BAND II
TRANSLATOR
SMPSU
SHEET 10 OF 31
Z0027-10.SCH
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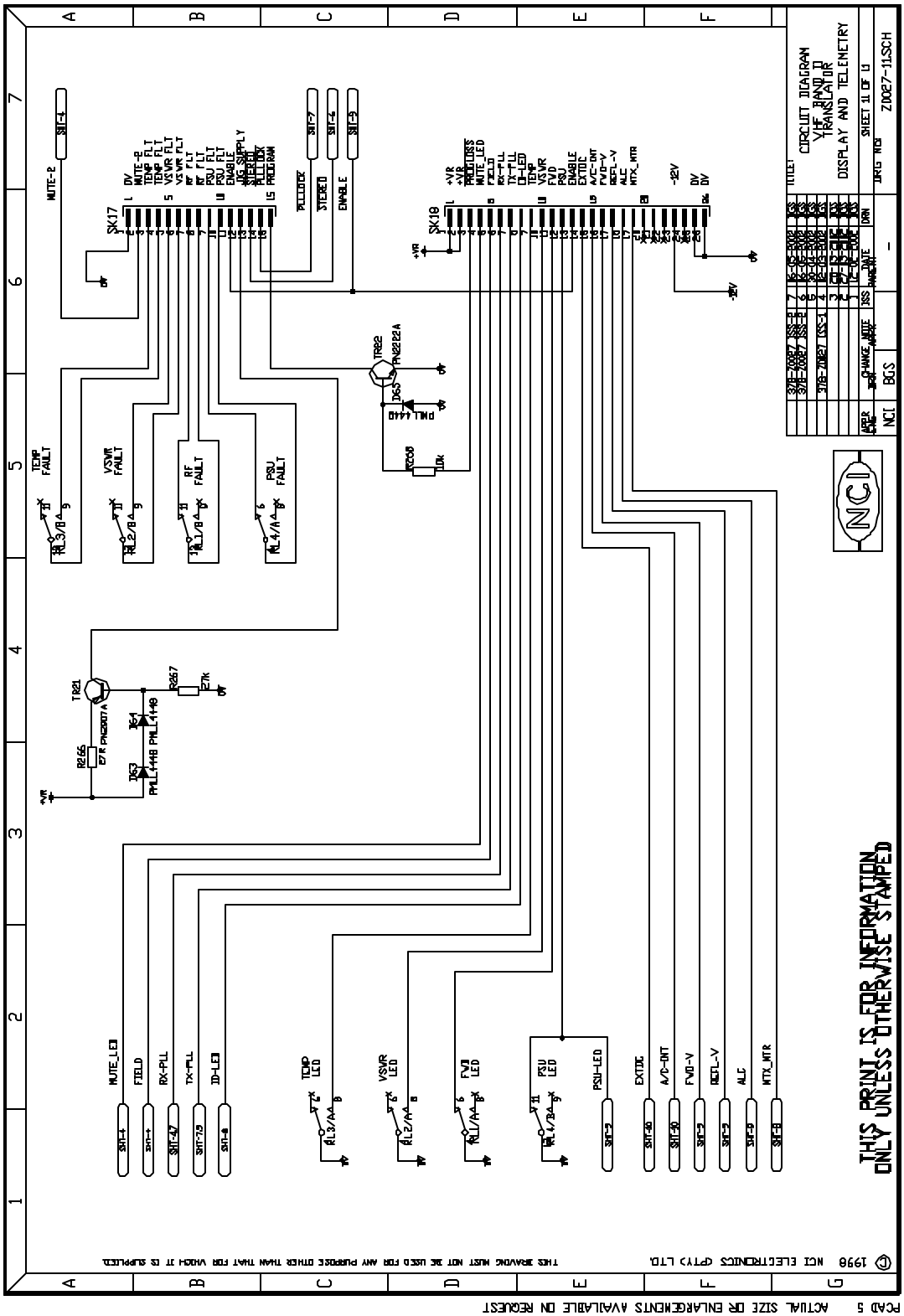
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CIRCUIT DIAGRAM
VHF BAND II TRANSLATOR
DISPLAY AND TELEMETRY
SHEET 1 OF 1
Z0027-11SCH
SK17
SK10
TEMP FAULT
VSWR FAULT
RF FAULT
PSU FAULT
MUTE_LED
FIELD
RX-PLL
TX-PLL
ID-LED
PSU-LED
EXTDC
A/C-ONT
FWD-V
REFL-V
ALC
MTX_MTR
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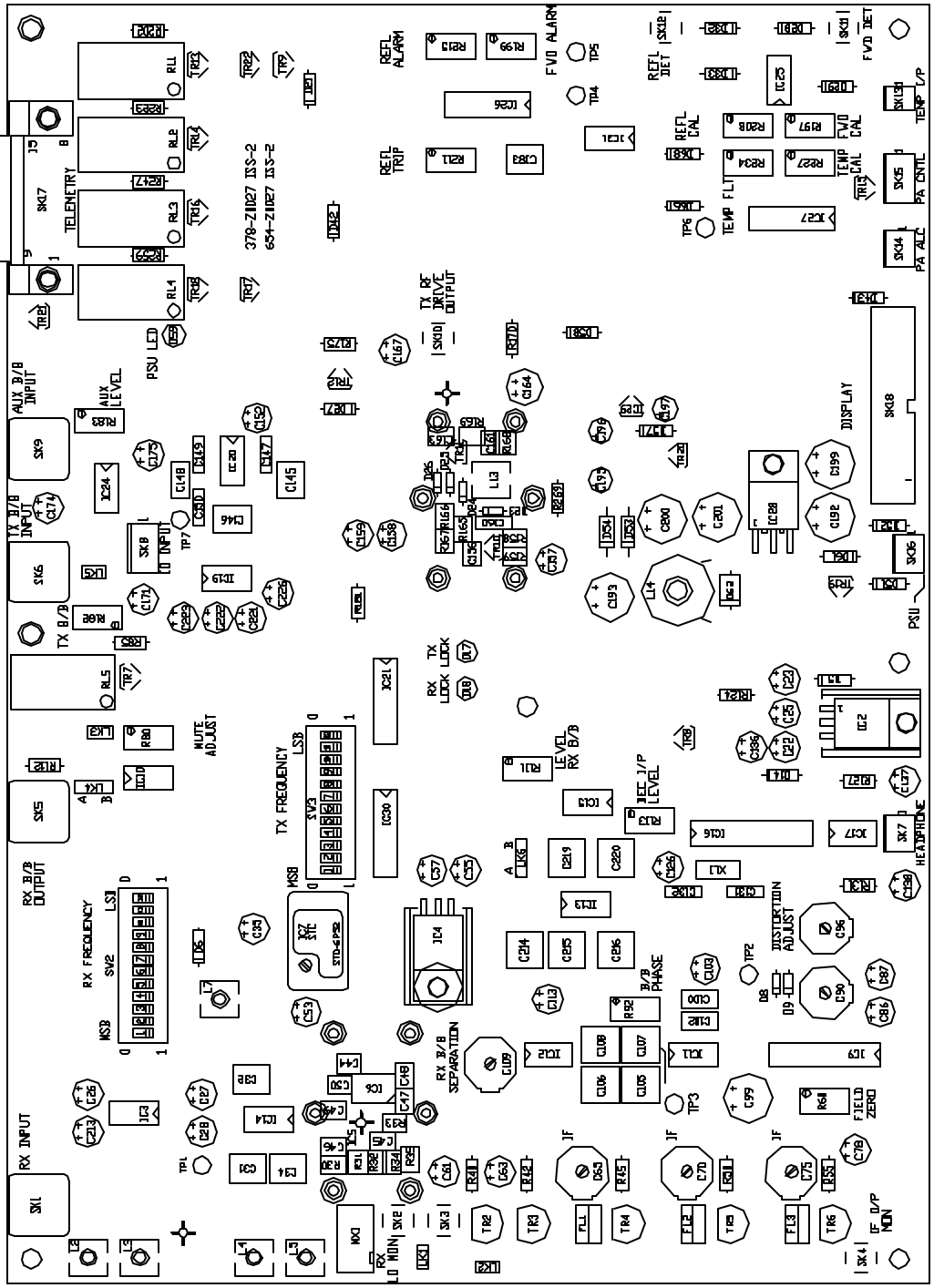
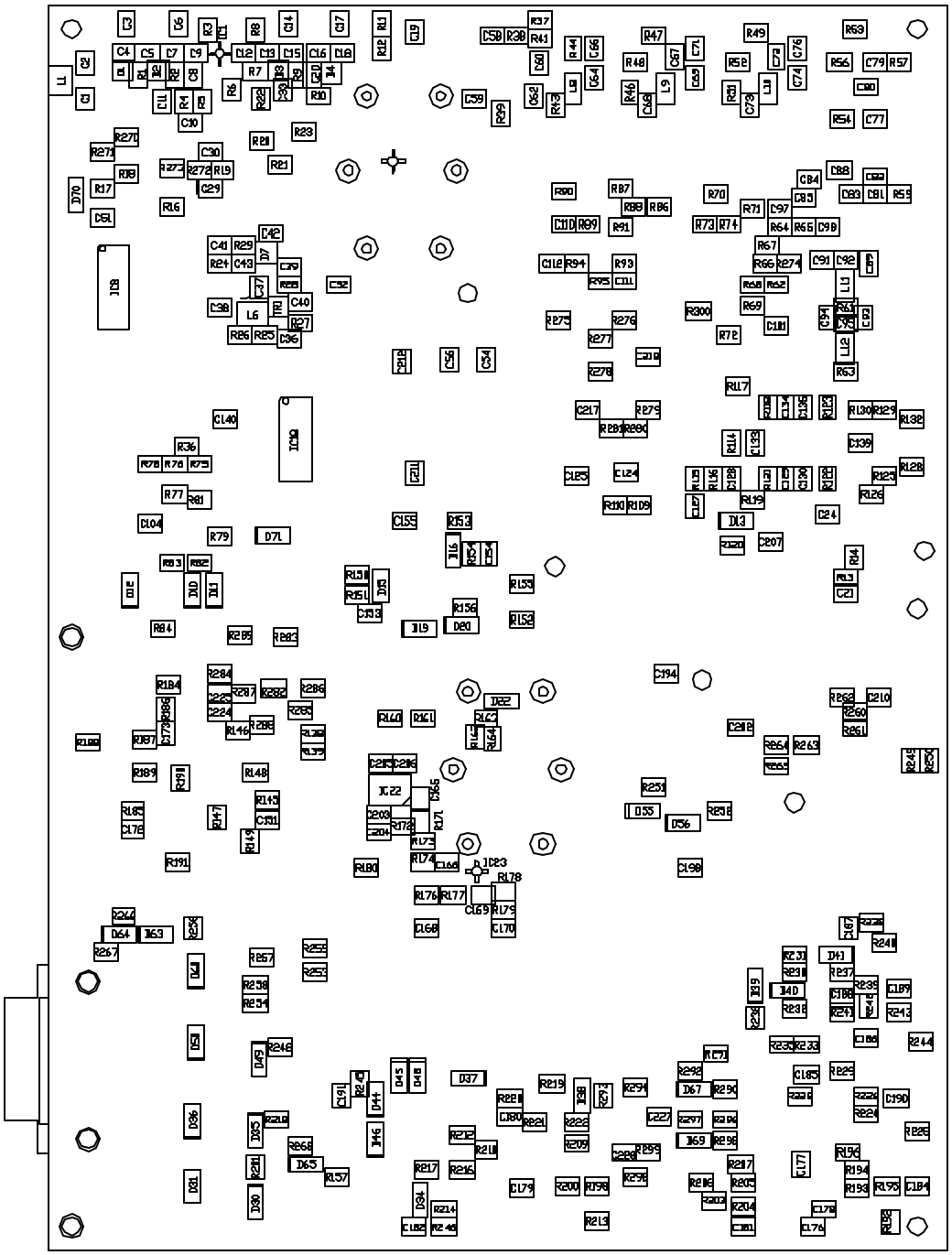
PCAD 5


654Z0027.DWG
COMPONENT SIDE
TELEMETRY
RX INPUT
RX B/B OUTPUT
TX B/B INPUT
AUX B/B INPUT
AUX LEVEL
PSU LED
TX RF DRIVE OUTPUT
REFL ALARM
REFL TRIP
FWD ALARM
REFL DET
REFL CAL
FWD CAL
TEMP CAL
TEMP FLT
TEMP I/P
PA CNTL
PA ALC
DISPLAY
PSU
HEADPHONE
MUTE ADJUST
TX FREQUENCY
RX FREQUENCY
TX LOCK
RX LOCK
LEVEL RX B/B
DEC I/P LEVEL
DISTORTION ADJUST
B/B PHASE
RX B/B SEPARATION
FIELD ZERO
IF O/P MON
RX LO MON



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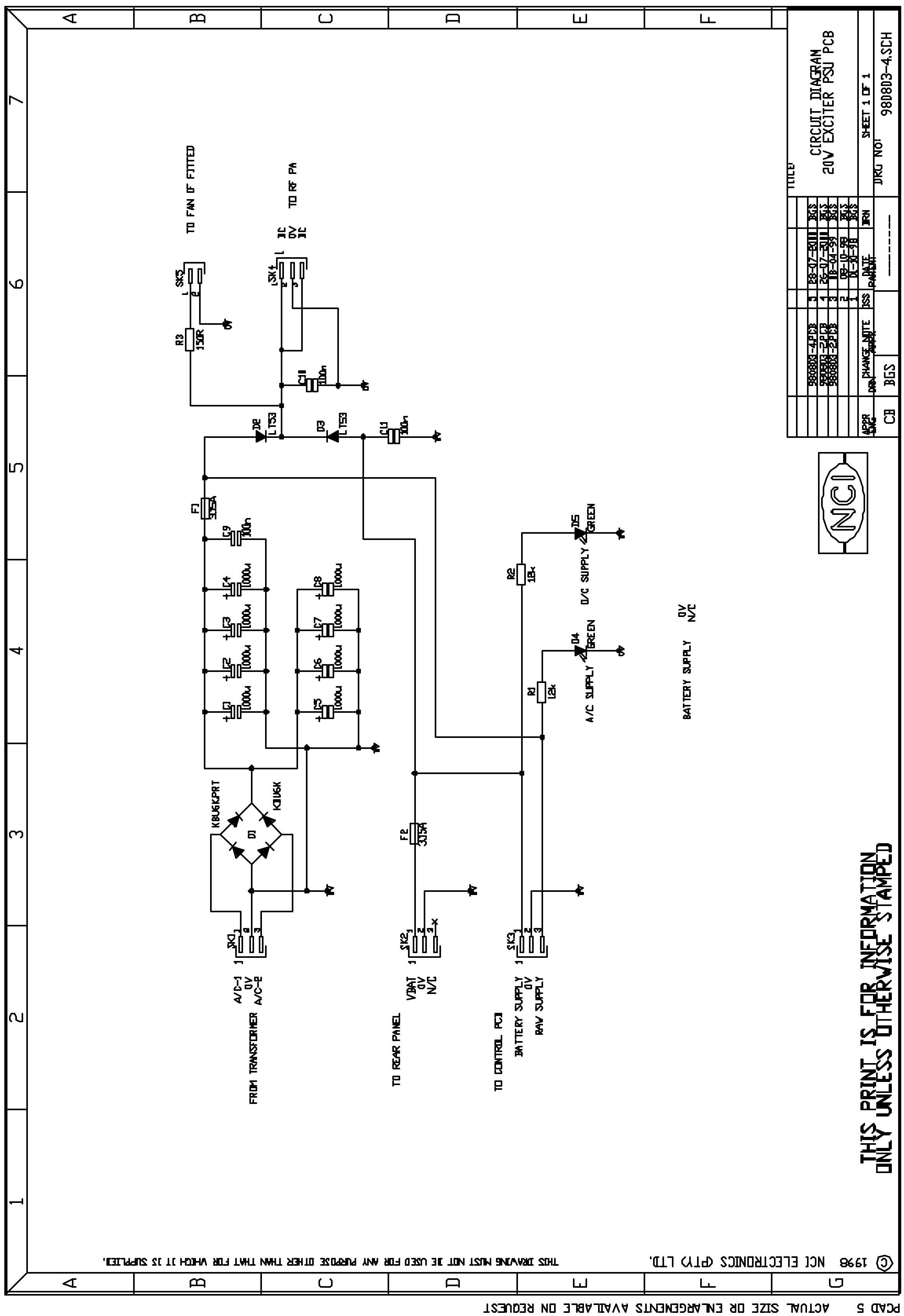
CIRCUIT DIAGRAM
20V EXCITER PSU PCB
SHEET 1 OF 1
980803-4.SCH
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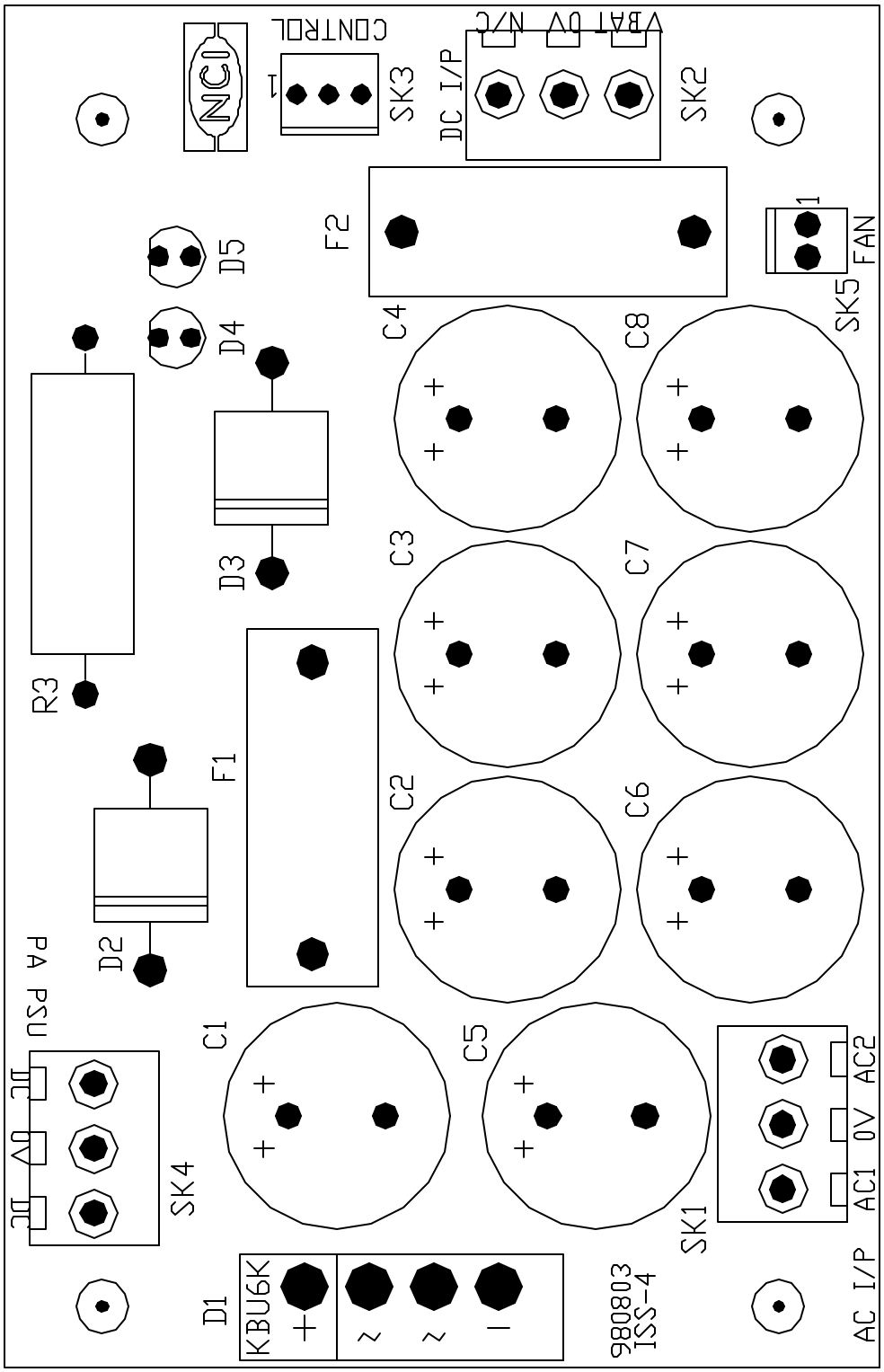
PCAD 5 ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
FROM TRANSFORMER
TO REAR PANEL
TO CONTROL PCB
TO FAN IF FITTED
TO RF PA
BATTERY SUPPLY
A/C SUPPLY
D/C SUPPLY

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



980803A4.DWG ASSEMBLY SHEET 1 OF 2

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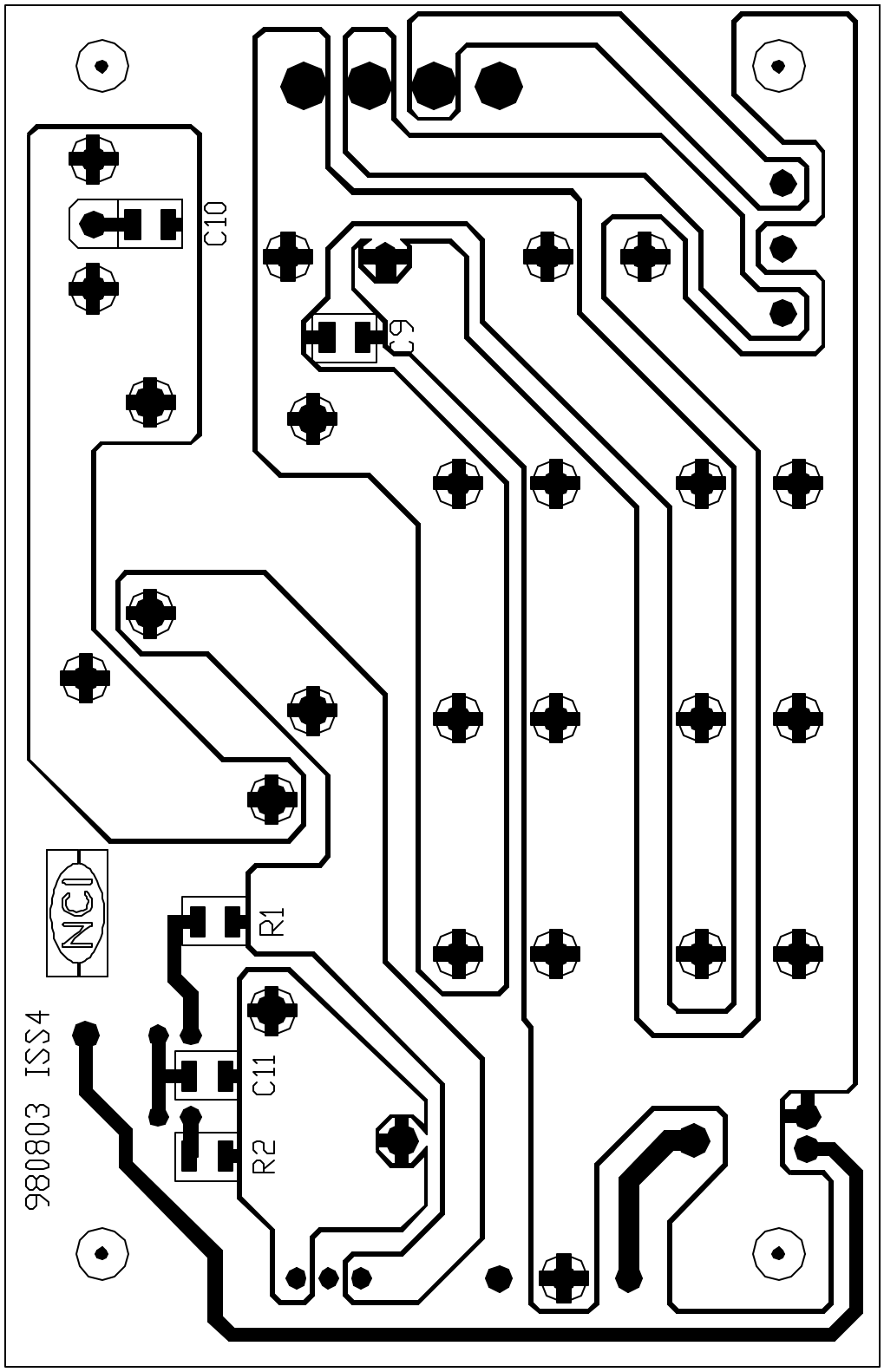
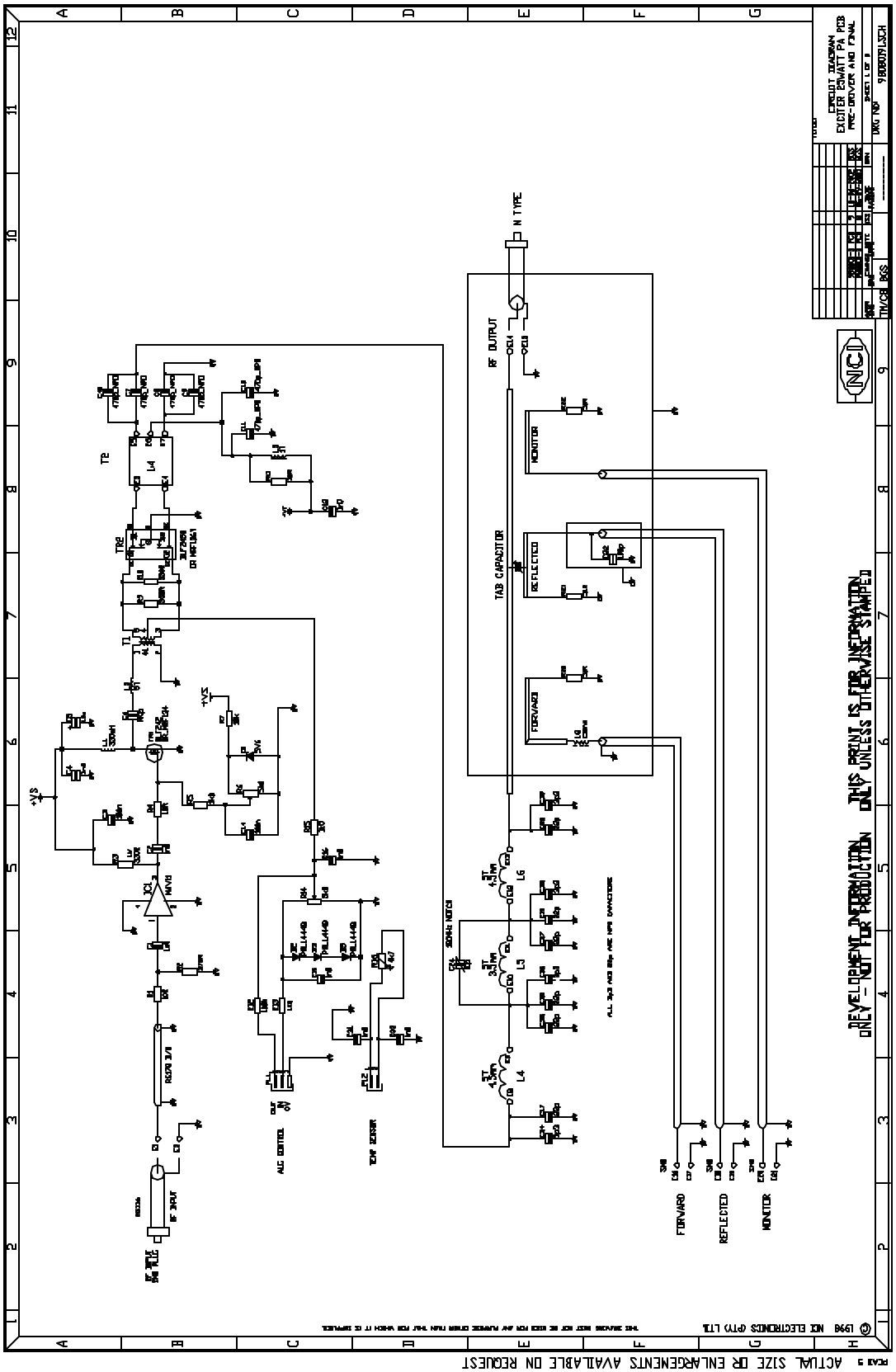


980803A4.DWG ASSEMBLY SHEET 2 OF 2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ACTUAL SIZE OR ENLARGEMENTS AVAILABLE ON REQUEST
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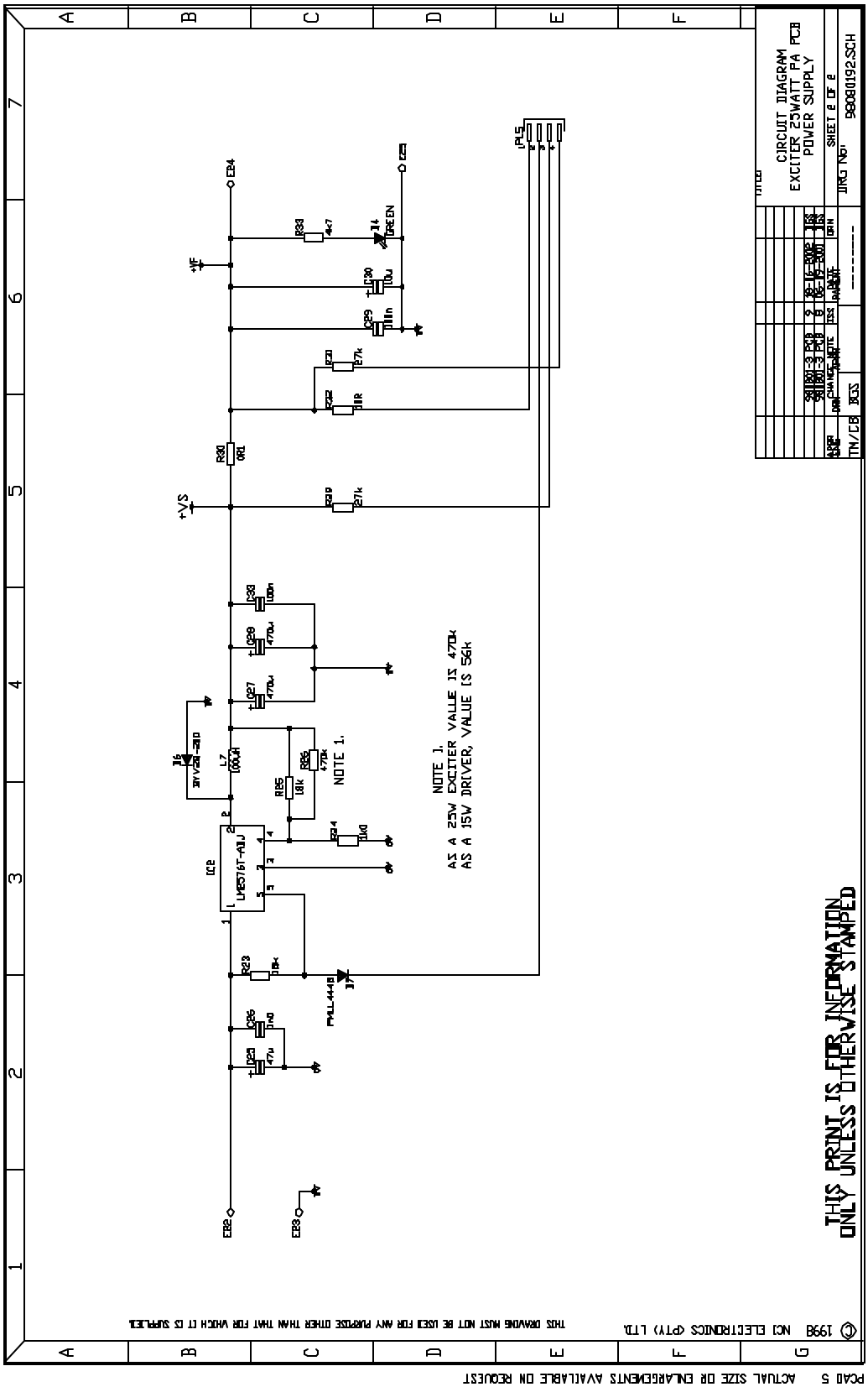
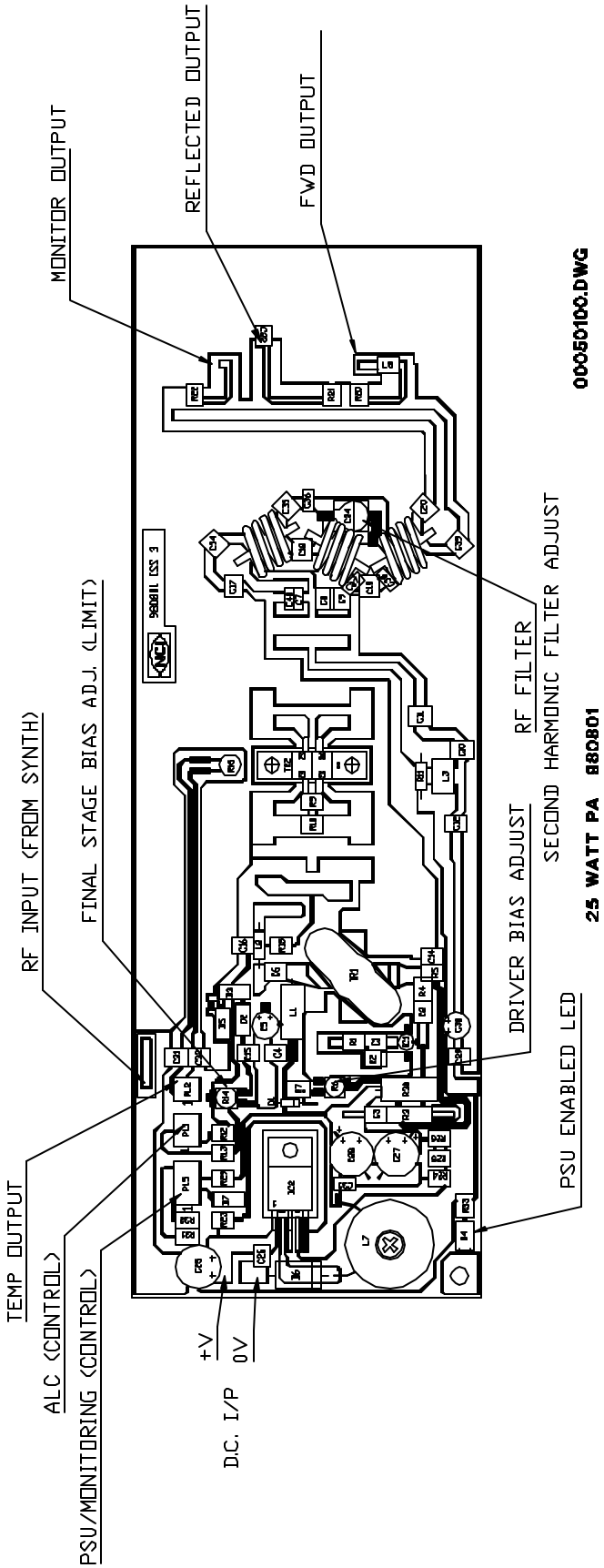
N TYPE
RF OUTPUT
TAB CAPACITOR
MONITOR
REFLECTED
FORWARD
RF INPUT
FORWARD
REFLECTED
MONITOR



00050100.DWG


MONITOR OUTPUT
REFLECTED OUTPUT
FWD OUTPUT
RF INPUT (FROM SYNTH)
FINAL STAGE BIAS ADJ. (LIMIT)
RF FILTER
DRIVER BIAS ADJUST
SECOND HARMONIC FILTER ADJUST
PSU ENABLED LED
TEMP OUTPUT
ALC (CONTROL)
PSU/MONITORING (CONTROL)
+V
0V
D.C. I/P
000550100.DWG
25 WATT PA 880801