

Distributed by
Raymarine

Any reference to Raytheon or RTN in this manual should be interpreted as Raymarine. The names Raytheon and RTN are owned by the Raytheon Company.

Apelco

FXL 400 Digital Color Flasher



INSTRUCTION MANUAL

TABLE OF CONTENTS

	Page
SECTION 1 INTRODUCTION	
1-1 General	1
1-2 Equipment Supplied	1
1-3 Specifications	2
SECTION 2 INSTALLATION	
2-1 Indicator Unit	4
2-2 Electrical Connections	4
2-3 Transducer	5
2-3-1 Mounting Considerations	5
2-3-2 Transom Mount	5
SECTION 3 OPERATION	
3-1 Operating Controls	7
3-1-1 Display Panel Controls	7
3-1-2 Alarm Operation	8
3-2 General Unit Operation	9
3-3 Interpretation of Results	9
3-3-1 Determining Bottom Conditions	9
3-3-2 Fish Location	10
3-3-3 Navigation	10
SECTION 4 THEORY OF OPERATION	
4-1 Control Circuit	11
4-2 TX Circuit	11
4-3 RX Circuit	11
4-4 Display Circuit	11
4-5 Alarm Circuit	12
4-6 Temperature Display Circuit	12
4-7 Power Supply Circuit	12
SECTION 5 MAINTENANCE	
5-1 Adjustment of Receiver Unit	13
5-1-1 Setting of FXL400 & Transducer	13
5-1-2 Adjustment of RF Unit	13
5-2 Temperature Adjustment	15
SECTION 6 Troubleshooting	

ILLUSTRATIONS AND TABLES

Figure	Page
FXL 400 Outline Drawing	4
Installation of M78650 Transducer	5
TABLE: Troubleshooting Chart	16
FXL 400 Assembly Drawing	19
FXL 400 Component Locations	20
FXL 400 Schematic Diagram	21

FXL 400 DIGITAL COLOR FLASHER

SECTION 1

INTRODUCTION

1-1 GENERAL:

Congratulations on the purchase of your new APELCO FXL 400 Digital Color Flasher. The FXL 400, with its small, light, and thin body can determine underwater depth and surface water temperature and display the information on a large Hi-visibility LCD display. In addition, a three color analog display provides an indication of the relative strength of the returned echos.

The FXL 400 is totally electronic. No motors, rotors, brushes, slip rings, or other mechanical parts are used in this instrument.

The depth values are displayed on both the LCD display and simultaneously on an analog display. The analog display is made up of a circle composed of 60 colored LED's to indicate the strengths of the echo returns. "Green" is used to indicate "weaker" returns such as bait fish, seaweed, plankton, etc. "Yellow" is reserved for indication of medium sized returns such as individual fish, schools of smaller fish, very soft bottom, etc. "Red" indicates very strong returns and usually represents the bottom structure.

A temperature sensor is built into the transducer assembly and simply by pressing a button, surface water temperature will be displayed in either C or F.

FXL 400 FEATURES:

DEPTH UNITS IN FEET, FATHOMS, OR METERS.

ADJUSTABLE DEPTH ALARM.

ADJUSTABLE TEMPERATURE ALARM.

SOLID STATE CIRCUITRY FOR LOW POWER CONSUMPTION.

1-2 EQUIPMENT SUPPLIED:

The FXL 400 color digital flasher is normally supplied with two-element sensor assembly (product code M78650) which is designed for transom mounting.

ADDITION: The unit is supplied with a power cable (Part No. G263113-2), a operation manual (Part No. G263113-1), and a warranty registration form (Part No. 983893 Rev).

1-3 SPECIFICATIONS:*

- 1) Range:

	Feet	Fathom	Meter
x1	0-20	0-20	0-20
x2	0-40	0-40	0-40
x3	0-60	0-60	0-60
x4	0-80	0-80	0-80
x5	0-99.8	0-99.9	0-99.9

- 2) Accuracy:
 - (1) 1.4 feet
 - (2) 0.2 fathom
 - (3) 0.4 m

- 3) Resolution:
 - (1) 0.2 feet
 - (2) 0.1 fathom
 - (3) 0.1 m

- 4) Operation Frequency: 200 kHz

- 5) Display: Electrical Display
 - 5.1 Analog display: 20 steps 3 color LEDs.
(green, yellow, red)
 - 5.2 Digital display: For depth/Water Temp.
 - (1) Depth: 3 digit LCD/5 range

Feet:	0.2 feet step
Fathom:	0.1 fathom step
Meter:	0.1 meter step
 - (2) Water temperature: 0° - 35.9° C
32.0° - 91.0° F

- 6) Depth Alarm Specifications:

Range	Feet
x1	2 - 20.0 (0.2 step)
x2	2 - 40.0 (0.2 step)
x3	2 - 60.0 (0.2 step)
x4	2 - 80.0 (0.2 step)
x5	2 - 99.8 (0.2 step)

Range	Fathom
x1	2 - 20.0 (0.1 step)
x2	2 - 40.0 (0.1 step)
x3	2 - 60.0 (0.1 step)
x4	2 - 80.0 (0.1 step)
x5	2 - 99.9 (0.1 step)

Range	Meter
x1	2 - 20.0 (0.1 step)
x2	2 - 40.0 (0.1 step)
x3	2 - 60.0 (0.1 step)
x4	2 - 80.0 (0.1 step)
x5	2 - 99.9 (0.1 step)

- 7) Water Temperature Specifications:
 $^{\circ}\text{C}$ 0.0 $^{\circ}\text{C}$ - 35.9 $^{\circ}\text{C}$ (0.1 $^{\circ}\text{C}$ step)
 $^{\circ}\text{F}$ 32.0 $^{\circ}\text{F}$ - 91.0 $^{\circ}\text{F}$ (0.1 $^{\circ}\text{F}$ step)
- 8) Input Voltage: 13.6 VDC (nominal) \pm 15%
- 9) Mechanical Description:
Dimensions: 200 mm x 140 mm x 80 mm
with Yoke Screws
Weight: about 800g

* Specifications are subject to change without notice.

SECTION 2

INSTALLATION

2-1 INDICATOR UNIT

The indicator unit should be mounted in a sheltered location on a table, shelf, or overhead, using the mounting yoke furnished. Select a convenient location suitable for easy viewing, but out of the direct rays of the sun if possible. Because the unit contains magnetic material it should be installed at least 30 inches (76 cm) from the magnetic compass. To mount the unit, unscrew the knobs on either side and attach the yoke to the mounting surface with screws.

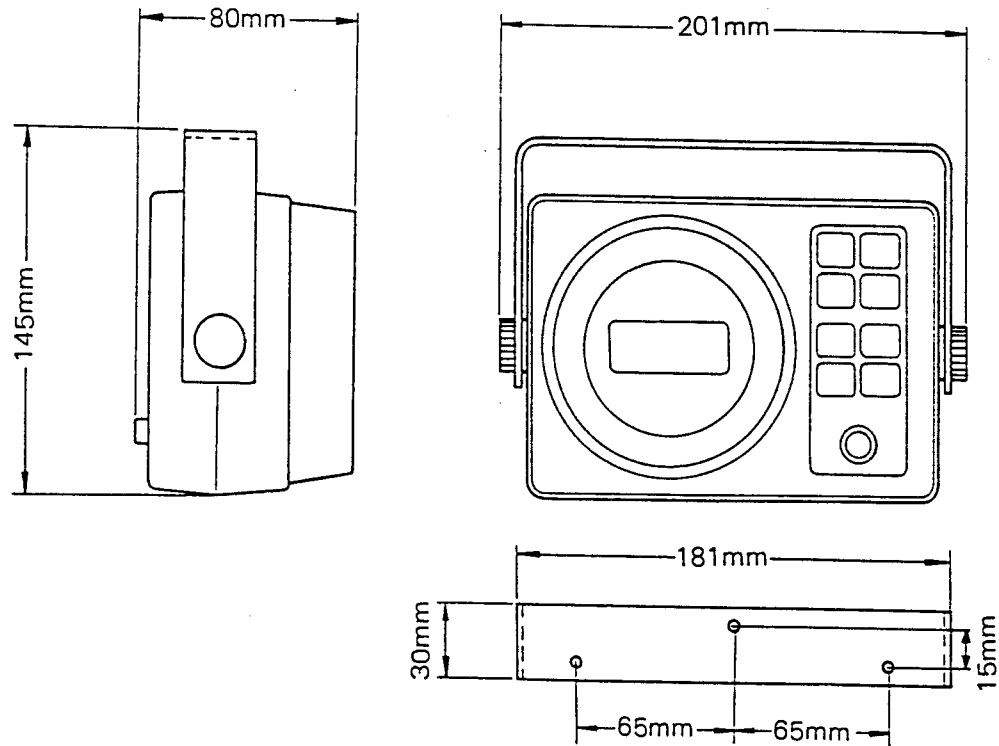


Fig. 2-1 Outline Drawing

2-2 ELECTRICAL CONNECTIONS

Connect the transducer and power cables to the matching rear panel connectors. Avoid routing the transducer cable parallel to or near the boat's electrical wiring to guard against noise pickup, which may introduce random flashes. Connect the power cable furnished to the 13.6-volt dc source capable of supplying 1.0 ampere.

The red wire of the power cable is positive; the black lead is negative. The power leads should be run directly to the battery (12 volts) or to the main power distribution panel on larger boats to minimize noise pickup. Leads should not be run to the engine control panel or to any intermediate point.

2-3 TRANSDUCERS

2-3-1 Mounting Considerations

The transducer/temperature assembly for this unit mount onto the transom with a universal bracket assembly.

A 25-foot length of connecting cable and connector are supplied with the transducer and should not be shortened or lengthened. If only a short distance is required for the table run, the extra cable should be coiled out of the way.

2-3-2 Transom Mount (Figure 2-2)

Transom mounting of the M78650 transducer using the mounting bracket supplied is illustrated in Figure 2-2. Ideally, the transducer would be mounted on the centerline of the boat. However, on boats with one motor, the mounting location will be at least 15 inches to either side of the centerline to minimize the effects of turbulence. The angle of the transducer face should parallel the sea bottom within 10° .

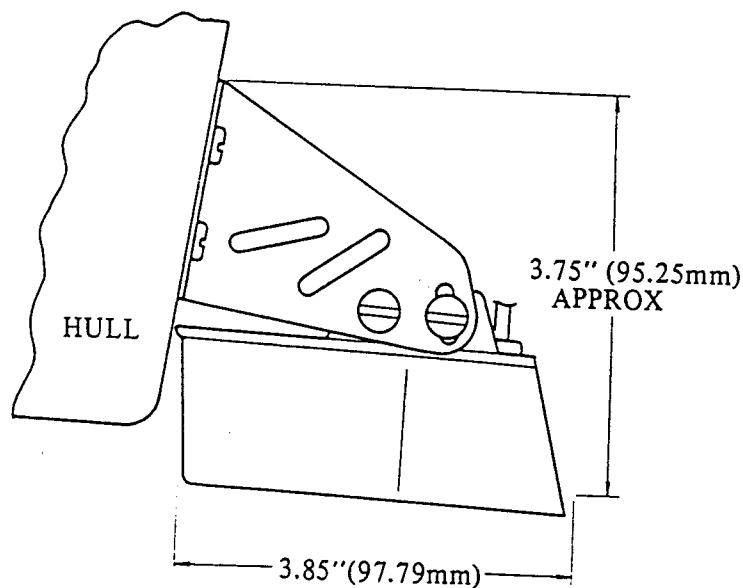


Fig. 2-2

The forward edge is designed to cut thru the water. So it should be extended below the hull bottom line. The after end of the transducer body should be tilted slightly downward for best water flow across transducer face.

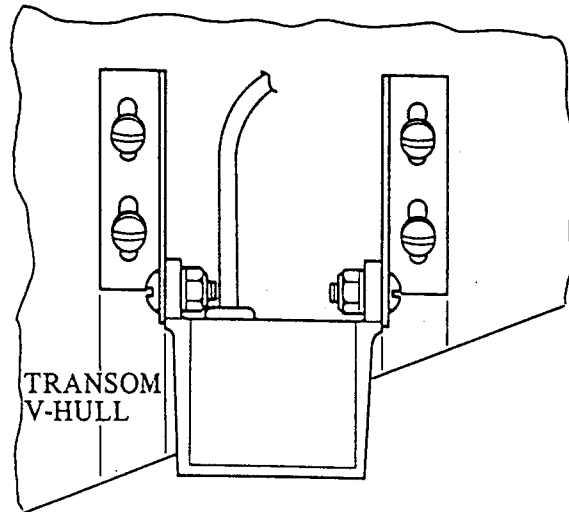


Fig. 2-3 The Deep V Installation

Notice that on the deep V hull, the transducer is orientated to maintain that parallel relationship to the sea bottom. (within 10°)

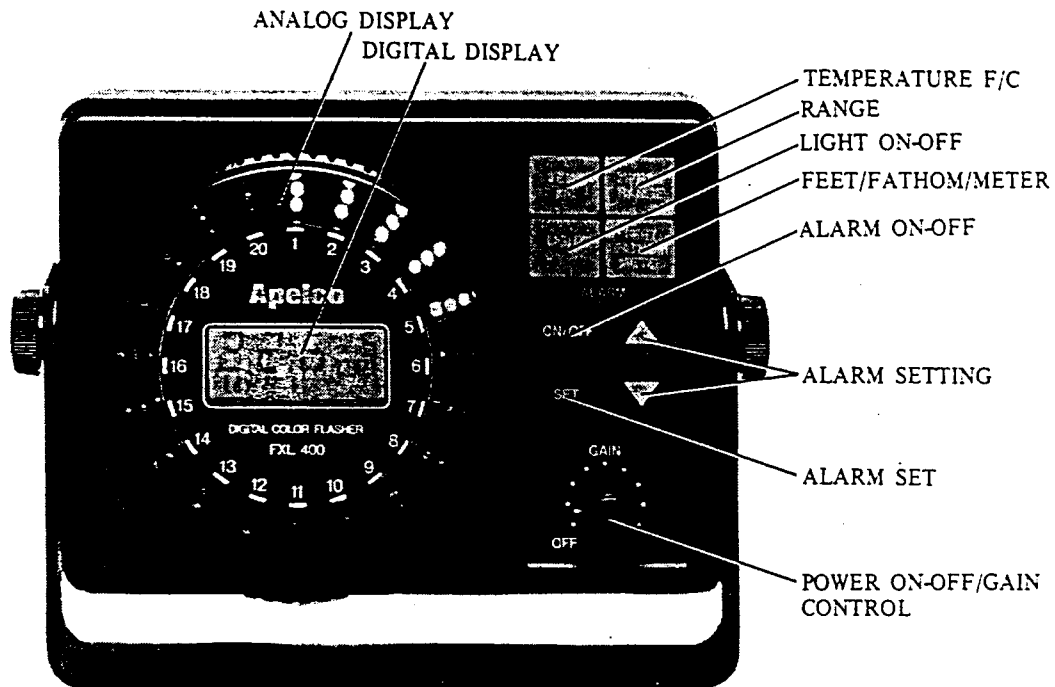
The transducer cable should be clamped against the transom as necessary to protect the cable from damage with a cable clamp.

If, upon first use of the FXL 400, abnormal operation is experienced, the following installation trouble shooting guide may help to determine the cause.

SECTION 3 OPERATION

3-1 OPERATING CONTROLS

All of the operating controls and indicators are shown below.



3-1-1 Display Panel Controls (Blue)

1. Rotate POWER ON/OFF and GAIN CONTROL clockwise until the depth value appears on both digital and analog display.

GENERAL OPERATION

When operating the unit in shallow water, choose a range scale which will make the best use of the analog dial. Thus if your in 20 feet of water use x1; under 40 feet use x2, under 60 feet use x3, under 80 feet use x4, and under 100 feet use x5.

For deeper water meters or fathoms depth units should be used.

1 meter = 3.28 feet

1 fathom = 6 feet

2. **Range** Key:
Select the multiplier range. When the power is on, range mode **x5** appears on the digital display. To change the multiplier range, press **Range** until the desired multiplier is indicated.

3. **FEET/FATHOM/METER** Key:
Select the depth function. When the power is on, **Feet** depth mode appears on the digital display. To change the depth unit function, press the **FEET/FATHOM/METER** until the desired unit is displayed.
4. **TEMP** (Temperature) Key:
Press the **TEMP**, water surface temperature in °C appears on the digital display.
To select the °F (Fahrenheit), press **TEMP** again.
5. **LIGHT** Key:
Turns on LCD backlight for night use.

3-1-2 Alarm Operation Controls (Red)

The FXL 400 has a built-in alarm system that will activate when the depth is shallower than a present point or the water temperature exceeds the preset value. The following procedure permits operation of the alarm functions.

1. To set the Depth Alarm
Unit must be displaying "Depth"
 - (1) Press Alarm **ON/OFF**, **2.0** appears on the digital display.
 - (2) To select the desired value between 2.0 – 99.8, press **△** or **▽**. In **FEET** mode, one push gives 0.2 step change, and in **FATHOM** and **METER** mode, it gives 0.1 step change.
 - (3) To fix the selected value, press **SET**. Digital value come to flashing and disappears. **ALM** appears on the digital display. Note: If **SET** is not pressed within 10 seconds the unit returns to "Normal" display.
 - (4) To confirm the fixed value, press **SET** again.
 - (5) To cancel the Alarm operation, press Alarm **ON/OFF**.
2. To set the Temperature Alarm
 - (1) Select temperature display.

(2) Press alarm ON/OFF.

Press or to desired temperature.

Press to activate alarm.

Note: Alarm can be set in °C or in °F. Press for °F display.

3-2 GENERAL UNIT OPERATION

Power is applied when the "SENSITIVITY" control is turned clockwise from the "OFF" position. Advance the "SENSITIVITY" control slowly clockwise until the red flash, indicating the depth of the water beneath the boat, appears.

Random flashes may appear on the depth scale when the boat is in turbulent water, such as when crossing the wake of another boat. These flashes are echoes from bubbles of air in the turbulent water. Since air bubbles are usually close to the surface, the random flashes will normally appear close to the zero flash on the depth scale.

3-3 INTERPRETATION OF RESULTS

The FXL 400 is one of the most useful pieces of equipment aboard a boat. In addition to indicating depths, it can indicate whether the bottom is hard or soft, and whether a hard bottom is smooth or irregular in contour. It can be a valuable navigational aid when used in conjunction with nautical charts.

3-3-1 Determining Bottom Conditions

To understand how bottom conditions affect echoes, consider the signal transmitted from the transducer as a cone-shaped beam of approximately 1 degrees. If the bottom were as hard and flat as a mirror, only the signal directly under the transducer would be reflected, and there would be a short, sharp, bright echo. Returns from an irregular bottom are reflected at varying angles and will appear on the indicator as a series of bright, closely spaced echoes. A muddy bottom produces a broad echo of lower intensity, caused by the dual reflection of the signal from the top of the mud and the hard bottom beneath the mud.

False echoes, which are a multiple of the actual depth, are most noticeable when sounding a very hard bottom in shallow water. These are caused by the signal bouncing back and forth between the bottom and the surface of the water. Normally they may be eliminated by reducing the sounder's sensitivity setting.

3-3-2 Fish Location

Echo returns from fish are generally very weak. Whether usable echo signals are obtained from fish depends on several things: the type of fish, the number and size of fish in a school, and their depth beneath the boat. These echoes appear intermittently on the indicator between the zero flash and the bottom flash. If the fish are too near the bottom it may be impossible to distinguish the fish echo from the bottom echo. When seeking fish with the depth indicator, observe the instrument constantly while maneuvering at a low speed, and use a higher than normal sensitivity setting.

3-3-3 Navigation

To use the depth sounder for navigation, several readings should be taken to develop a line of soundings for comparison with those on a chart of the area around an estimated position. When a sequence of depth markings is found on the chart which agrees or nearly agrees with the soundings, it may be possible to determine a position.

SECTION 4

THEORY OF OPERATION

4-1 CONTROL CIRCUIT

Control circuit comprises a microprocessor (IC-6). The microprocessor controls the entire circuitry:

1. Generates TX pulse and applies the pulse to TX power amplifier.
2. Converts amplified signal from receiver to depth and applies it to display.
3. Converts temperature signal from thermistor to temperature and applies it to display Via AD convertor.

4-2 TX CIRCUIT

The transmitter transmits 200 kHz pulse, which is one half of reference clock frequency (400 kHz) in CPU. Pulse interval is 500 mS regardless of unit of measurement and depth range. (Refer to specification for pulse width). TX power amplifier (Q6, Q9) amplifies signal from CPU to 320 pp-v.

4-3 RX CIRCUIT

The receiver comprises Q1, Q2, Q3. It amplifies reflected signal which is received by transducer. IC1 controls the gain of entire circuitry. The detected reflected signal are classified in three levels by level comparator (IC6). The level differs approximately 6 dB each. Data on depth and level strength of the reflected signal are applied to CPU.

4-4 DISPLAY CIRCUIT

Level and value of depth stored in RAM of CPU are displayed in both digital and analog. Full scale of each range has 1 ~ 20 steps. Data stored in RAM are classified into 1 ~ 20 steps, and LED displays the data in analog on the scale, and the level is displayed in three colors simultaneously. When sequential maximum values in RAM are equal, LCD displays it in three digits.

4-5 ALARM CIRCUIT

RAM in CPU accepts alarm setting. When the maximum value of reflected pulse equals to or below the setting, it generates 500 mS pulse, which applied to Q11 and blows buzzer and flickers ALM of LCD display.

4-6 TEMPERATURE DISPLAY CIRCUIT

A thermistor senses temperature. A resistance change of the thermistor is converted to a voltage change in the bridge circuit, and then amplified to DC 2V ~ 7V in DC amplifier (IC2A, IC2B). Selection of °C and °F is done in CPU. Amplified voltage signal is converted to digital signal in AD convertor, and applied to CPU to display as temperature.

4-7 POWER SUPPLY CIRCUIT

The ship's DC 13.6V battery is supplied to TX power amplifier and LED via line filter (T-5). And to all other circuitry via regulator circuit (IC4 9V, IC5 5V).

SECTION 5

MAINTENANCE

5-1 ADJUSTMENT OF RECEIVER UNIT

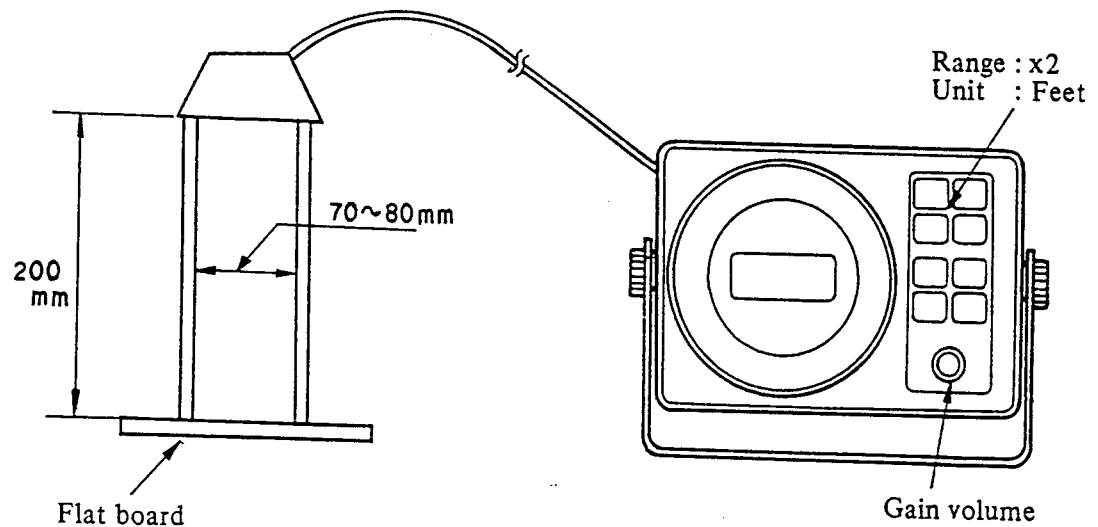


Fig. a Set FXL 400

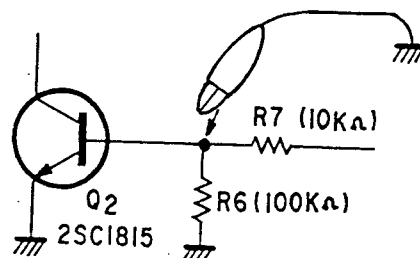
5-1-1 Setting of FXL 400 & Transducer

To adjust RF UNIT, set a transducer on the cylinder (200 mm height) as shown in Fig. a .

Set FXL 400 as : Depth Range x2
Depth Unit FEET

5-1-2 Adjustment of RF UNIT

- 1 Ground the base of gain control circuit Q2 with a clip cord.



- 2 Connect a synchroscope to R20 which is connected to detection circuit Q3. On these conditions, make echo signals from No. 1 to No. 4 or No. 5 appear on the CRT-tube. Then, adjust T-1, T-2 and T-3 as these echo signals become maximum.

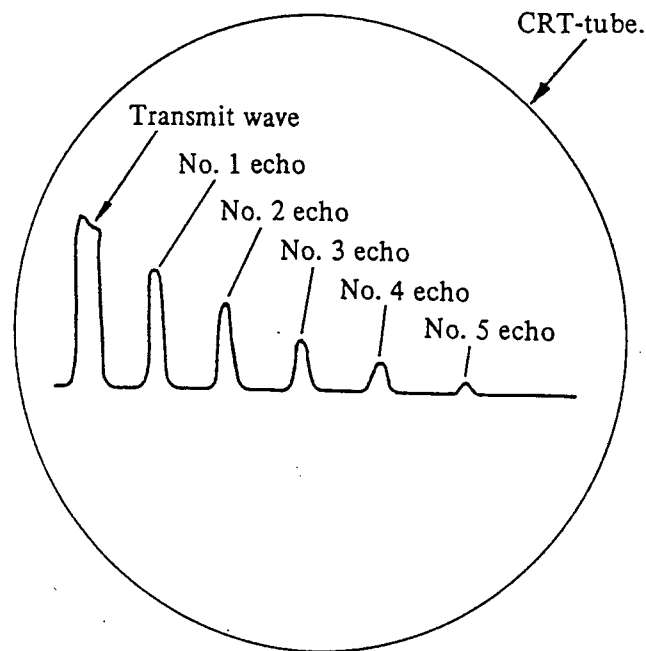
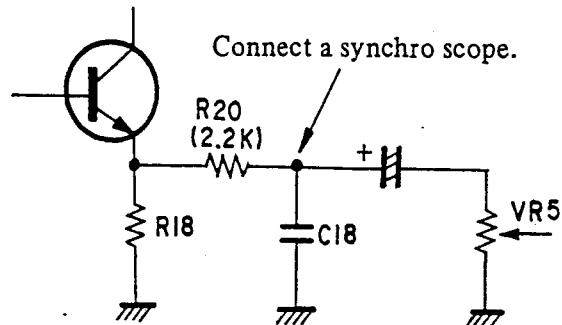


Fig. b CRT WAVE FORM

5-2 TEMPERATURE ADJUSTMENT

At °C:

1. Connect fixed resistor below across terminal (CN-2-2) 1 and 2 instead of the thermistor.

2° C	resistor 1	29.561 kohm
20° C	resistor 1	12.494 kohm
30° C	resistor 1	8.054 kohm

2. At 2° C, adjust VR3 so that LCD reads $2.0 \pm 0.5^{\circ}\text{C}$.
3. Change resistor for 30° C and adjust VR-2, so that LCD reads $30^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$.
4. Repeat 2 and 3 so that the setting falls within $\pm 0.5^{\circ}\text{C}$.

At °F:

Adjust VR1 and VR4 so that the setting falls within $\pm 0.9^{\circ}\text{F}$.

NOTE: $^{\circ}\text{F} = 1.8^{\circ}\text{C} + 32$

SECTION 6

TROUBLESHOOTING

For trouble shooting, refer to voltages and wave forms of each point each point printed on the schematic diagram.

The following table explains CPU port.

Port	I: Input O: Output	Usual port state	At operation	Content
P ₀₀	I	Lo	Hi	Key input (Key is in ON to Hi input at port.)
P ₀₁				
P ₀₂				
P ₀₃				
P ₁₀	I	Lo	Hi	At depth measurement. Strength of echo.
P ₁₁				
P ₁₂		Hi/Lo	Hi/Lo	4520 maximum bit Q _{1,3} (1280 μs)
P ₁₃				
P ₂₀	\bar{O}	Lo	Hi	Transmit
P ₂₁			Hi	LED segment (No. 11 ~ 20 Yellow)
P ₂₂				LED segment (No. 11 ~ 20 Red)
P ₃₀	\bar{O}	Lo	Hi	KEY SCAN (Q ₀ , Q ₁) LED Grid Data 0 : Q ₀ 1 : Q ₁ 9 : Q ₉
P ₃₁				
P ₃₂				
P ₃₃				
P ₄₀	\bar{O}	Hi	Lo	Temperature measurement (MC14443) CH (setting) Data 3 : CH0 Data 1 : CH2 2 : CH5 0 : CH7
P ₄₁				
P ₄₂		Lo	Hi	Temperature measurement (MC14443) RAMP START
P ₄₃	I			RANGE change Hi : YES Lo : NO
P ₅₀	I	Hi/Lo	Hi/Lo	4520 counter Q _{0,4} (80 μs)
P ₅₁				4520 counter Q _{1,1} (160 μs)
P ₅₂				4520 counter Q _{1,2} (320 μs)
P ₅₃				4520 counter Q _{1,3} (640 μs)
P ₆₀		Lo	Hi	RAMP ON : Hi OFF : Lo
P ₆₁		Hi	Lo	4520 counter RESET
P ₆₂		Lo	Hi	4520 counter STOP
P ₆₃		Lo	Hi/Lo	BUZZER ON : Hi OFF : Lo

FXL 400 PARTS LIST

Instruction Manual	G263113-1
D.C. Power Cable Assembly	G263113-2
Front Panel Assembly	G263113-3
Rear Cabinet Assembly	G263113-4
Display PCB Assembly	G263113-5
TX/RX PCB Assembly	G263113-6
Gain Control	G263113-7
Push Switch	G263113-8
LCD Display	G263113-9
Buzzer	G263113-10
Transducer Receptacle	G263113-11
DC Power Receptacle	G263113-12
Mounting Yoke	G263113-13
Knob, Yoke	G263113-14
Washer, Yoke	G263113-15
Spacers	G263113-16
Knob, Black	G263113-17
Washer, Rubber	G263113-18
Transducer Plug 5 Pin	G263109-3

I-6

ASSEMBLY DRAWING

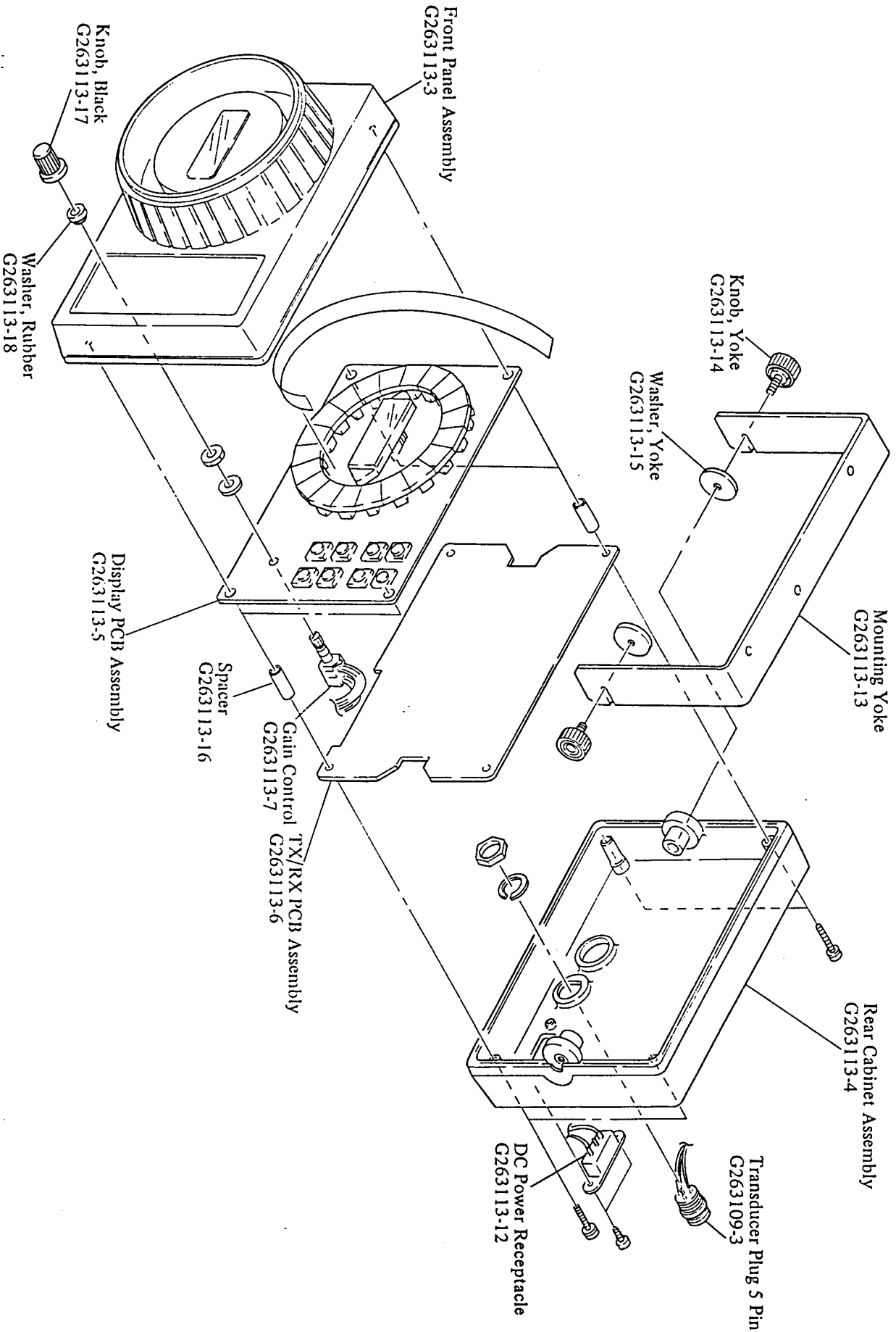
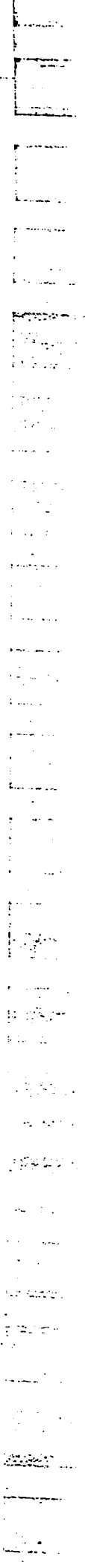


Figure FXL 400 Assembly Drawing



COMPONENT LOCATIONS

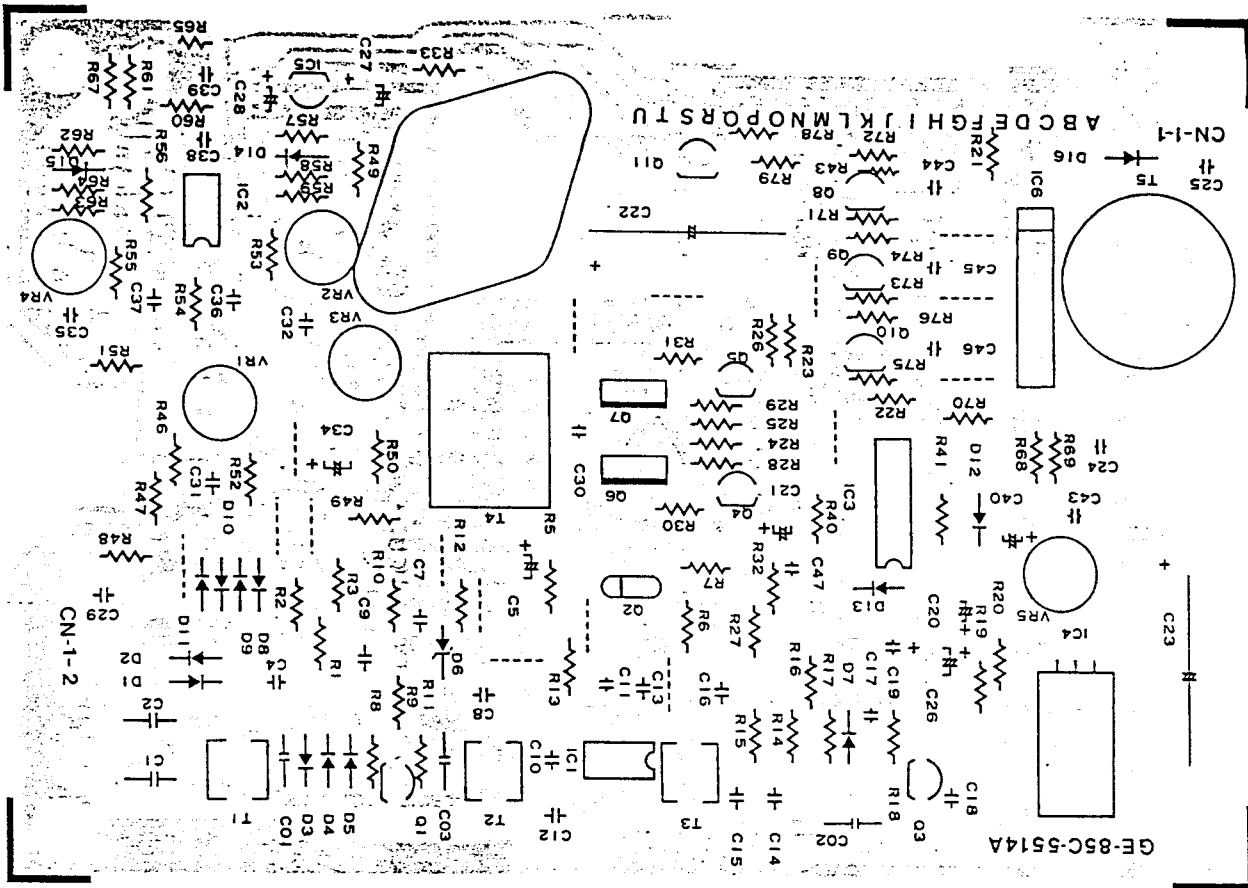


Figure FXL 400 TX/RX PCB Assembly

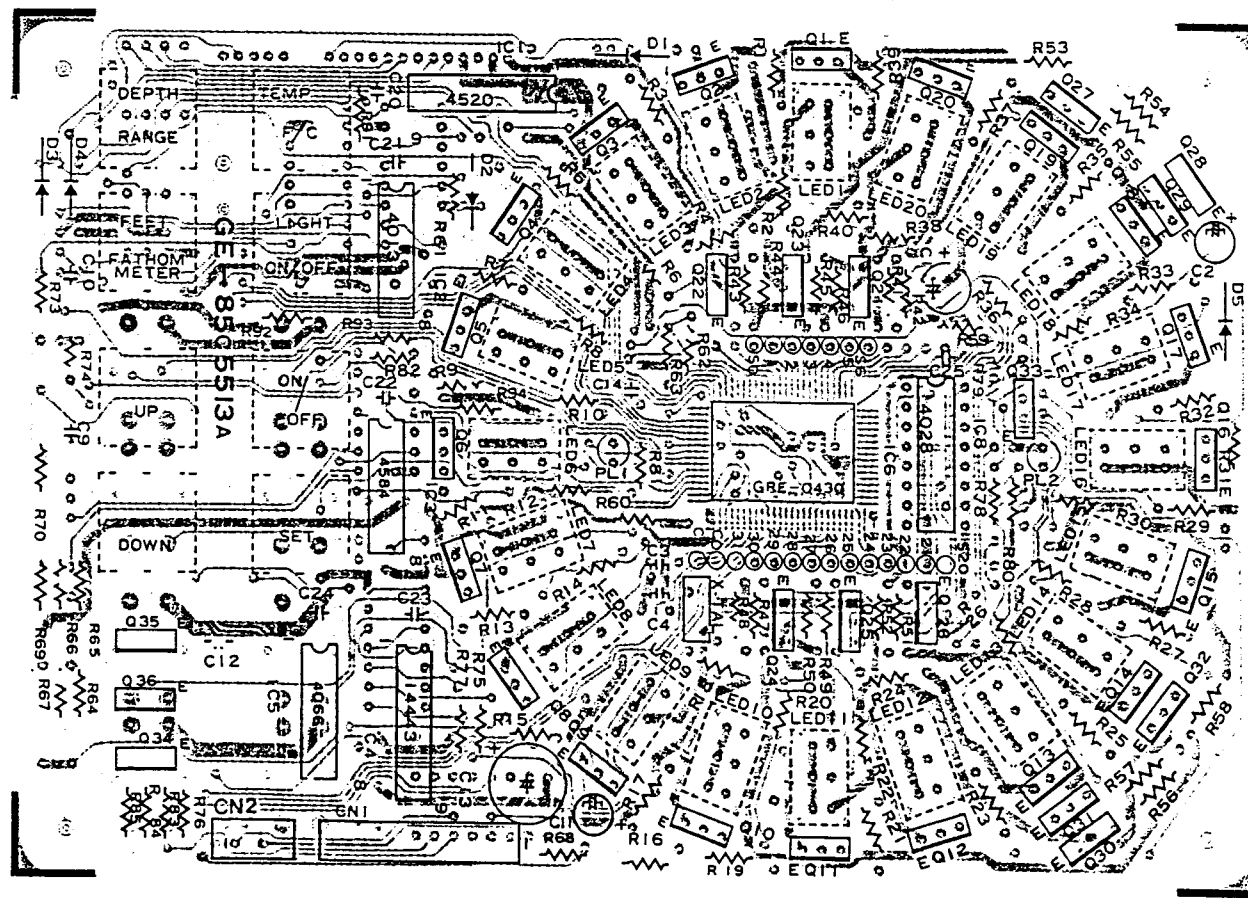
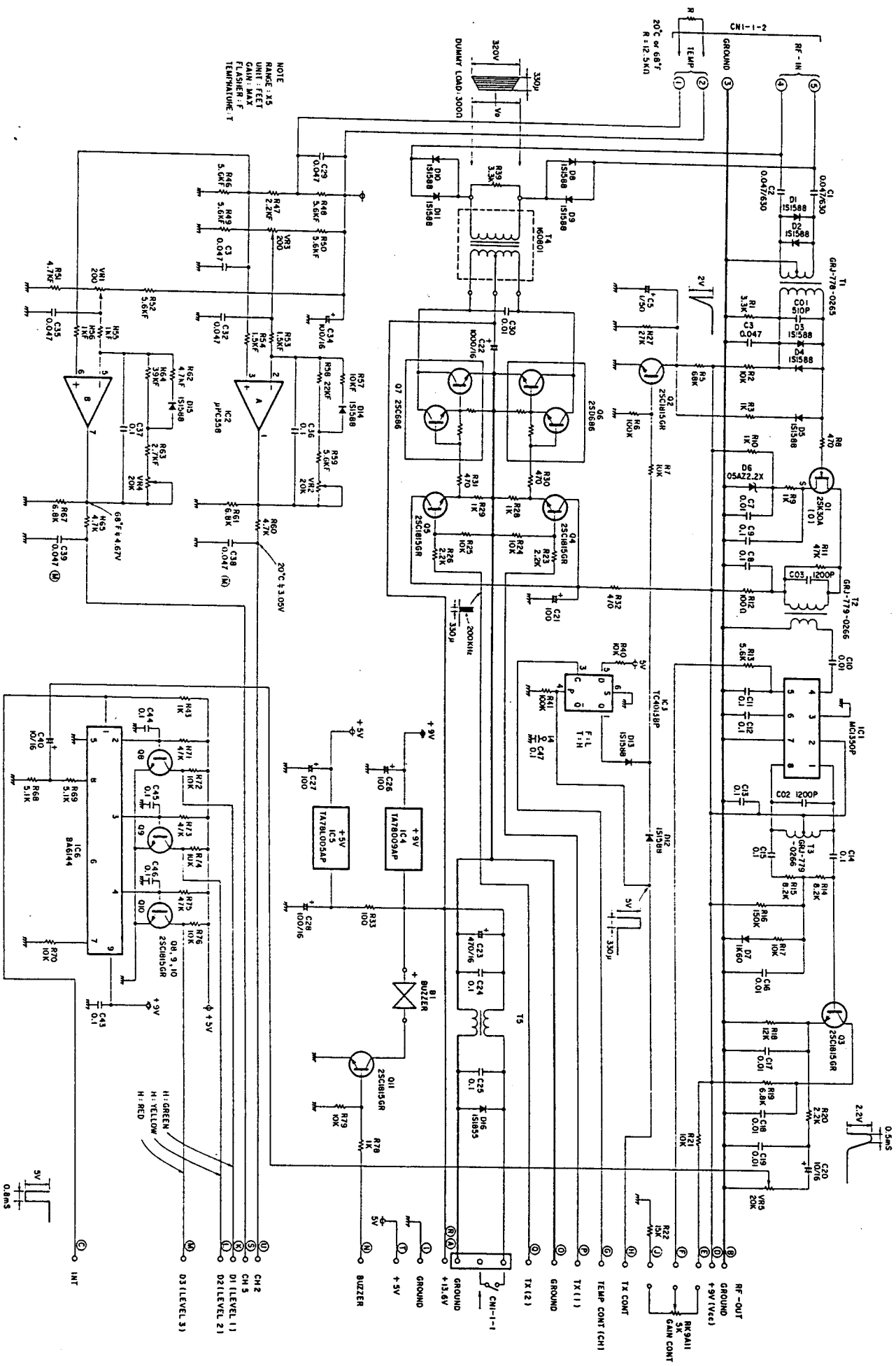


Figure FXL 400 Display PCB Assembly

TX/RX UNIT SCHEMATIC DIAGRAM



NOTE
 RANGE: X5
 UNIT: FEET
 GAIN: MAX
 FLASHER: F
 TEMPERATURE: T

Figure FXL 400 TX/RX Unit Schematic Diagram

