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Chapter 1

TECHNICAL SPECIFICATION

Description

The 9480 Mainframe is housed in a 3U high, 19 inch rack mounting assembly with power supply, time and frequency management system, front panel display, and rear slots for up to eight distribution amplifier output cards.

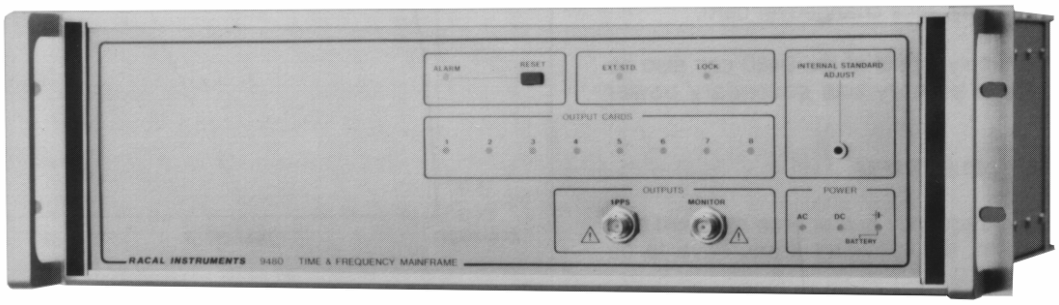

Figure 1-1, 9480

AC Power Supply Input

Line Frequency:	45 - 440 Hz
Voltage Ranges:	89.5- 110.5V (100V)
	103- 127 V (115V)
	192.5- 237.5V (215V)
	206- 254 V (230V)
AC Power Consumption	60 Watts maximum (after warm-up)

DC Power Supply Input

External 23.4 -30VDC, reverse polarity protection and fuse.

DC Current Consumption 1.5 A maximum (after warm-up)

Internal, rechargeable battery (option).

Mechanical Dimensions

Height:	136.3mm (3U)
Width:	425mm
Depth:	410mm
Weight:	12.5 kg (includes all options but excludes 1.3 kg battery pack)

Environmental Specification

Operating Temperature:	-10^0C to $+55^o$C
Storage Temperature:	-40^0C to $+70^o$C
Humidity:	95% RH at 40^oC

Electromagnetic Compatibility:

Designed to comply with MIL STD 461C Part 4 Navy Sections RE02 (to 1GHz), CE03, CS02, CS06, RS03. Unit remains operational in the presence of a 3 V/m interference from 14kHz to 1GHz and spikes of 1kV for 1μ duration and 500 V for 1m second duration.

Supply Requirements to IEC publications 348

Options

Sinewave Output Cards:

Available Frequencies:	13 MHz, 10 MHz, 5 MHz, 1 MHz and 100 KHz
Outputs per card:	Five
Frequencies per card:	One
Maximum number of cards:	Eight
Output Power:	+13 dBm ±2 dB
Output impedance:	50Ω
Output VSWR:	<1.3
Isolation:	>40 dB between Outputs
	>60 dB between Cards
Output Protection:	Indefinite Short Circuit
	<500 mW reverse power
	>30V applied DC
Harmonics:	<-30 dBc
Sub-harmonics:	<-70 dBc
Spurious:	<-70 dBc

TTL Output Cards:

Available Outputs:	2.048 MHz
Outputs per card:	Five
Output level:	TTL

Frequency Standard Options

External Frequency Standard

Frequency:	10 MHz or 13 MHz (see Note 1)
Signal Level:	100 mV or 1.2 Vrms (AC coupling)
Max Safe Level:	5 Vrms, 500 VDC blocking
Input Impedance:	500Ω (at 100 mV - 500 mV input level)

Frequency Multiplier (Option DIV)

A frequency multiplier option (factory fitted) enables the use of any external standard frequency that is 1 MHz or higher and a submultiple of 10 MHz. The frequency must be within $\pm$ 1 x 10^{-5} to ensure phase lock.

Note 1: 13 MHz external standard frequency is needed for 13 MHz outputs and must not be used with option DIV

Reference Changeover (Option RC0)

A (factory installed) reference changeover option is available. This card provides a changeover facility of frequency reference in systems requiring primary and back-up frequency sources.

Battery Back-Up (Option BBU)

The internal battery will supply standby power to the Frequency Standard for up to 1 hour. It is used with a Battery Control Board which is part of the battery back-up option (Option BBU).

Rubidium FRKL (H)

Frequency Drift:	4 x 10^{-11}/(1 x 10^{-11}) per month
Allan Variance:	3 x 10^{-12}/(1 x 10^{-12}) over 100 seconds
Warm-Up:	< 10 minutes to reach 2 x 10^{-10} at 25^{o}C ambient

Rubidium FRS-C

Frequency Drift:	5×10^{-11} per month; 5×10^{-10} per year
Allan Variance:	1×10^{-11} over 100 seconds
Warm-Up:	< 4 minutes to reach 2×10^{-9} at 25°C ambient

Quartz 04F

Aging:	2×10^{-10}/day, 3×10^{-8} /year
Allan Variance:	5×10^{-11} over 10 seconds
Phase Noise:	-145 dBc/Hz at 1 kHz offset
Warm-up:	Typically < 20 minutes to reach 1×10^{-8} at 25°C ambient

Quartz 04A

Aging:	3×10^{-9}/day
Warm-up:	< 6 minutes to reach 1×10^{-7}

PSU Service Option (Option PSO)

This option allows continuous operation of the 9480 while withdrawing and servicing the plug-in PSU. The option is comprised of an internally mounted assembly and a cable.

Chapter 2

GENERAL DESCRIPTION

Introduction

The 9480 Time and Frequency Distribution System is a modular frequency standard$_1$ time standard and distribution system. A Companion product the 9481 provides alarm and standby power supply facilities for large systems or systems that require very high availability.

These products offer a high degree of flexibility for designers of satellite systems, calibration systems, test systems and other applications requiring a frequency and/or a time standard.

The system provides a versatile means of generating and distributing a number of highly stable and accurate time signals and output frequencies derived from a self-contained, accurate atomic oscillator with a long term stability better than 10^{-9}/ year. High quality crystal standard options are also available.

The mainframe houses a Power Supply Unit, Distribution Board, Display Board and up to eight Output Cards. It can accept the following optional items: internal frequency standard, external reference board and battery back-up pack.

The system can operate as a simple five output distribution amplifier or a complex system time and frequency standard with multiple frequency outputs.

Up to 40 individual outputs at 1 V level, 50Ω impedance, can be provided, eight cards of five outputs each. A wide range of output frequency combinations can be configured.

The system may be operated as a slave and will switch over automatically when a suitable external input frequency is applied.

All options are retrofitable, enabling user to build up the system over a period of time without redundancy.

The unit operates from AC mains or an external DC, or from an internal battery back-up.

The unit is 136.3mm high (3U) and is suitable for standard 19

inch rack mounting.

9480 DESCRIPTION

The heart of the system is the time and frequency mainframe. This houses a power supply and the frequency and time management sub-system. The mainframe has the capacity for either an oven controlled crystal oscillator or rubidium frequency standard, a digital clock display, a battery back-up supply and up to eight, five-output, distribution amplifiers.

Distribution amplifier output cards are available in frequencies of 100 kHz, 1 MHz, 5 MHz, 10 MHz, 13 MHz and TTL output cards of 2.048 MHz and 13 MHz.

Applications

The 9480 is suited to requirements demanding a precision time reference, frequency reference and/or distribution system.

For satellite ground stations there are a range of options, including low noise frequency standards. For calibration laboratories, up to 40 outputs can be distributed from a single mainframe.

15 For UHF Quasi-Sync systems or Simulcast Systems, the flexible number of outputs and frequencies is ideal for phase-locking transmitter/receiver base stations. The FRS rubidium standard achieves the desired stability without the necessity of frequent oscillator calibration or expensive environmental controls.

THE 9480 SYSTEM

When selecting a suitable frequency and/or time standard and distribution system, consideration is given to:

(a) Frequency standard accuracy.

(b) Power supply requirements.

(c) Number and frequency of outputs.

Frequency Standards External

The 9480 can be used as a frequency distribution system, fed by an external standard. Under these circumstances, it may have a standard installed in the 9480 as a back-up. The 9480 will then switch automatically to its internal standard if the external input is lost or is not available.

Internal

The 9480 mainframe has a range of frequency standard options that include three (FRK-L, FRK-H, FRS-C) rubidium oscillators,

a high stability ovened crystal oscillator, a fast warm-up ovened crystal oscillator and a low phase noise, high stability, ovened crystal oscillator.

The choice of a frequency standard will depend on the application and consideration of Aging, Allan Variance, Phase Noise and Retrace Error.

Available Standards

FRK-L and FRK-H are ultra-stable, rubidium atomic oscillators with drift values of 4×10^{-11} and 1×10^{-11} respectively. For references which are later multiplied into the Gigahertz range a low phase noise option Is available.

FRS Is a lower cost, yet extremely stable atomic oscillator. It has a one month drift of 5×10^{-11} and warms-up in less than four minutes.

04F is a precision ovened crystal oscillator which combines 2×10^{-10}/day aging with very low phase noise.

04A is a fast warm-up, oven controlled crystal. oscillator. It has an aging characteristic of 3×10^{-9}/day and warms-up in less than 4 minutes.

Aging

Aging is the way in which an oscillator's frequency changes with time, stated as fractions of a Hertz per time period. Short term stability is stated for time periods of less than 100 seconds, whereas long term stability is stated for time periods of one day or more.

In general, aging occurs exponentially and is greatest during the first month of operation. Sometimes even high quality crystal oscillators may not be good enough for applications such as UHF quasi-sync or Simulcast systems, where accuracy's of 1×10^{-9} are required. Such accuracy can be achieved with a crystal but will require frequent adjustment and careful temperature control.

In contrast, a rubidium oscillator would only drift by 1×10^{-10} per year, but are more expensive than crystal oscillators.

Allan Variance

Allan Variance is used to characterize the long and short term stability of precision oscillators. It is a statistical method of presenting the average variance in frequency over a given time at a chosen sample interval. Mathematically it is expressed as:

Allan Variance

$$\sigma_y^2(\tau) = \frac{1}{2m}\sum_{k=1}^{m}(\bar{y}_{k+1} - \bar{y}_k)^2$$

where

$$y_k = \frac{\phi(t_k + \tau) - \phi(t_k)}{2\pi\nu_o\tau}$$

$\phi(t_k)$ is the phase at time t_k

ν_o is the frequency at which the phase measurement is made

m is the number of samples

Phase Noise

Phase Noise is a measure of the random fluctuations in frequency or phase due to noise. It is normally measured in a 1 Hz bandwidth at various frequency offsets from the fundamental frequency. Close-to-carrier noise is generated by the standard itself but at offsets of 1 MHz or more noise due to the frequency distribution system predominates. The 9480 uses low noise amplifiers throughout that have little effect on the quality of the standard. Figure 2-2 shows typical phase noise plots of the various standard option.

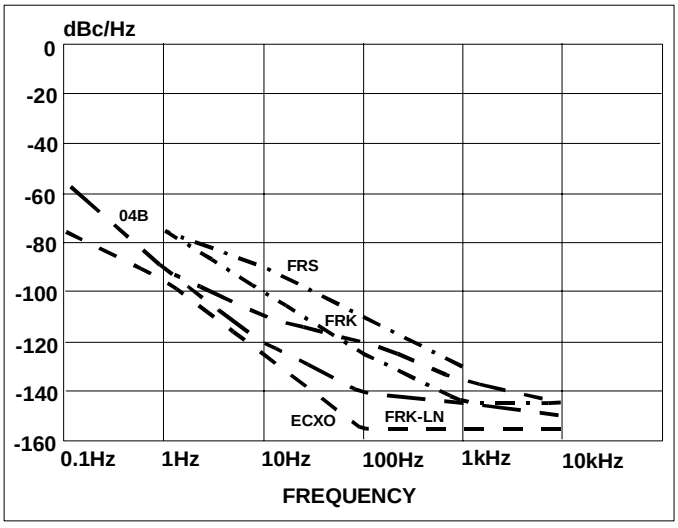

Figure 2-1, Phase Noise Performance Retrace

Retrace

Retrace is a particular problem of quartz crystal oscillators and is a shifted frequency offset caused by removing and re-applying power. Refer to Figure 2.3. In order to prevent retrace errors, the 9480 is available with an internal battery supply, which maintains supply to the oscillator in the event of loss of

primary power.

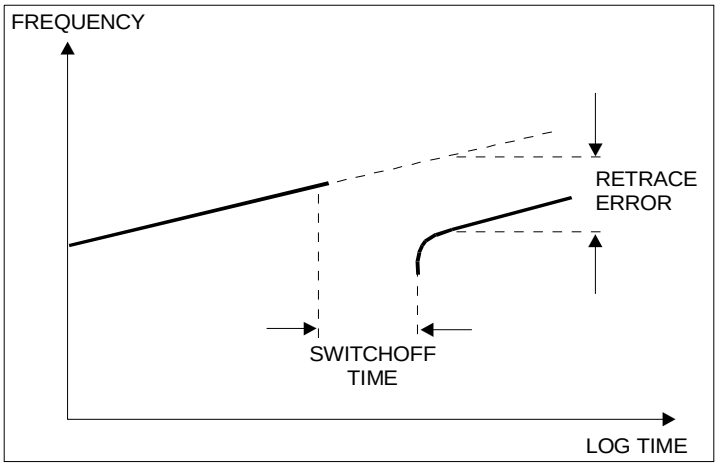

Figure 2-2, Retrace Errors

Power Supplies

The 9480 has a flexible power supply arrangement to ensure that supply to the frequency standard is maintained, thus eliminating retrace problems.

The power supply is a hierarchical system and features automatic switch over. The primary power is 89.5 to 254 Volts AC; if this is absent the unit automatically selects an externally applied 23.4-30 Volts DC and if this is absent the 9480 will select the optional internal rechargeable battery.

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Chapter 3

PREPARATION FOR USE

Introduction

To prepare the 9480 Mainframe for operational use, proceed as follows.

Unpacking

The Time and Frequency Mainframe 9480 is delivered from manufacturer to customer in a protective transit case packaging.

Carefully remove the unit from its sealed polythene bag and its protective package.

Examination

Visually inspect the unit for any damage caused by transit. Any defects should be noted on the appropriate form attached and reported to the Carrier and Company promptly.

Check for customer requested options and report any anomalies.

Output Card Description

At the rear of the 9480 Mainframe are slots for up to eight output cards. Each card has five buffered outputs available in frequencies of 13 MHz, 10 MHz, 5 MHz_1 1 MHz and 100 kHz.

A 2.048 MHz TTL output card can also be fitted.

A maximum of 40 outputs is available, five from each of the eight cards.

Future Expansion

For expansion to the time and frequency distribution system, additional output cards can be fitted to the mainframe at a future date.

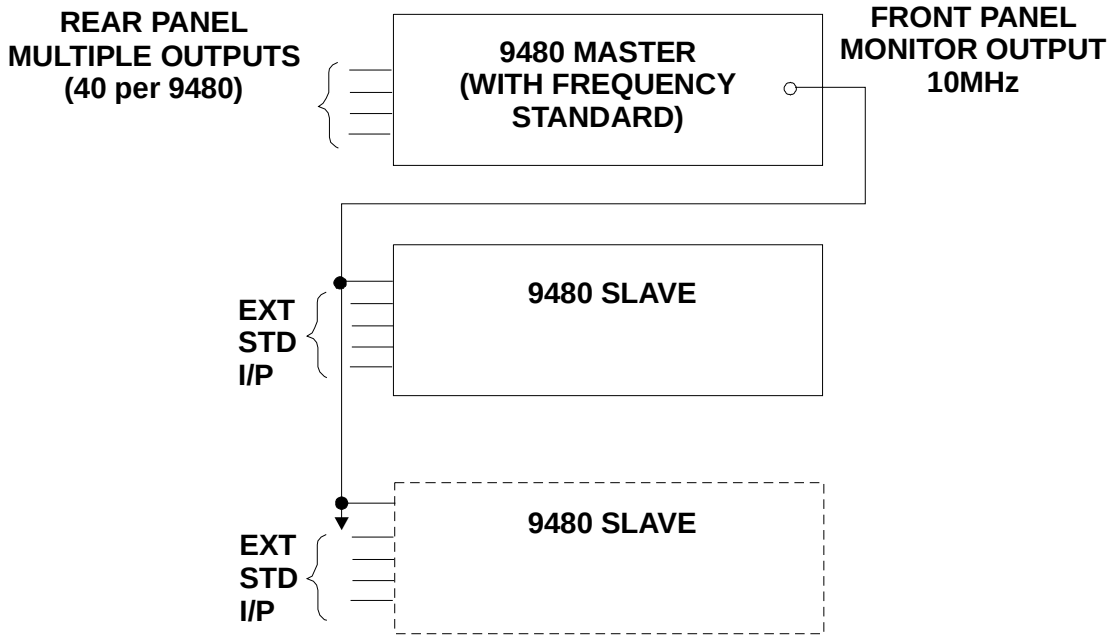
The quartz frequency standard can also be upgraded to a rubidium standard without the need to purchase a second mainframe.

External Standard

If an external frequency standard is available, this is to be connected to the card fitted in the left most slot, as viewed from the rear of the unit. An External Standard card Is factory fitted and can accept 10 MHz or 13 MHz signals. An External Multiplier option card accepts signal inputs of 1 MHz, 2 MHz, 5 MHz or 10MHz. A Reference Changeover option card accepts a 10 MHz signal only.

For large frequency distribution systems that require multiple outputs, the facility exists for 9480s to be daisy-chained together. In this configuration the Master 9480 is the one with the frequency standard and the front panel Monitor output is connected to the EXT STD I/P on the rear panel of the slave 9480s. See Figure 3-1 for connections.

Figure 3-1, 9480 Master/Slave System



Where the continuous availability of a frequency standard signal is of paramount importance, the 9480 units can be configured as shown in Figure 3.2. This arrangement ensures automatic changeover to a second frequency standard if the prime standard should fail. Standards are connected to a Reference Changeover card in a 9480 serving as a distribution unit.

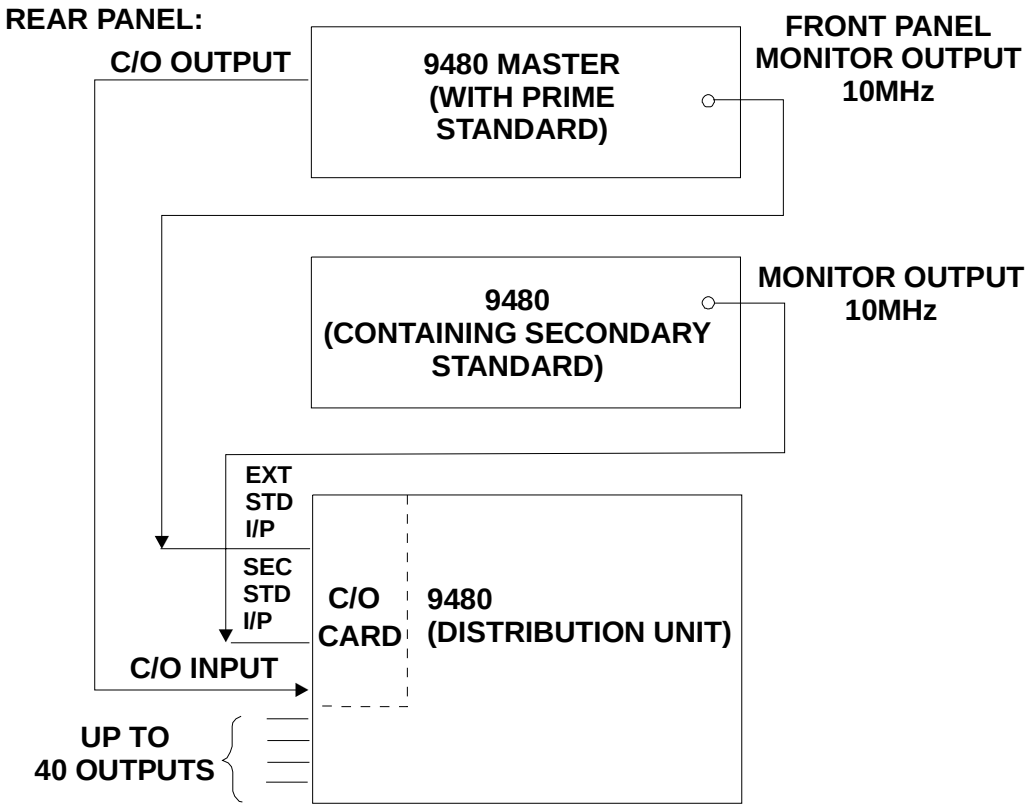


Figure 3-2, High Availability 9480 System

The two power inputs of the 9840 can also be utilized to provide a secondary power, back up, facility.

9481 Product Interfaces

A companion product, the 9481, is designed to provide standby power and alarm facilities for 9480 systems to ensure availability of standard signals. A 9481 unit provides the following services:-

(1) A Standby DC supply of +24 V from a mains power supply.

(2) A comprehensive local alarm facility for multiple 9480 system to allow quick and easy Interpretation of the fault.

(3) A remote alarm option for sending alarm information via an R5232C interface to a remote monitoring base.

Power Supply System

The 9480 mainframe has a hierarchical power supply system to ensure that the supply to the frequency standard is maintained.

The unit can be operated from mains AC power$_1$ external DC or from an internal battery for the reference standard. The unit features automatic switch over to the connected power supply.

Primary power is from an AC source in the 89.5-254 Volts AC range. If this is absent, the unit automatically selects an externally applied 23.4-30 Volts DC. In the absence of a DC source, the 9480 will select an internal rechargeable battery, if fitted.

AC/DC Lines

The AC and DC power lines are connected at the rear panel and are fused for circuit protection.

Check that the correct fuse rating is fitted for the available power supply. Refer to the rear panel label. Figure 3-3, for this information.

AC Line Select

Access to the AC input selection for setting one of the four voltage ranges is gained by releasing the plastic cover on the AC LINE input connector.

The correct voltage is set by rotating the drum.

The internal line fuse should be the correct one for the range as displayed on the panel.

Internal Battery

An internal battery pack, if fitted as an option, is designed to supply standard power to the Frequency Standard for a period of up to one hour. It is used in conjunction with a Battery Control Board that is supplied as part of the Battery Back-up option (BBU).

A Battery Control Board (if fitted) carries a BATTERY ENABLE switch. Use of this switch allows the battery to be temporarily disconnected. This facility allows the 9480 to be disconnected from external power supplies without activating the Battery Back-up facility.

If the top cover Is on the 9480, access to the battery switch is gained after removing a rubber plug in the cover.

The battery enabled position is when the switch lever is moved towards the heatsink. This is the normal position when operating from an external AC or DC source.

If the unit is non-operational for periods of time, the battery enable should be switched off to conserve energy.

Rack Mounting

Slide the unit into its rack position. It is recommended as a two-man operation.

Make the AC/DC power and any other connections at the rear.

Secure the unit to the rack.

Switch on the appropriate power button at the Rear Panel.

See Section Four for an interpretation of front panel indications.

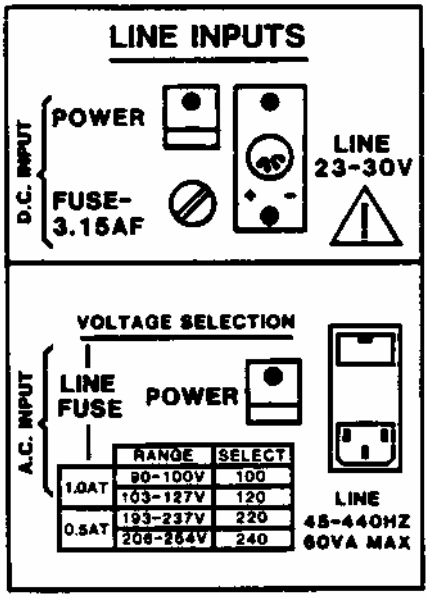


Figure 3-3, Rear Panel

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Chapter 4

OPERATING INSTRUCTIONS

Master Or Slave Operation

The 9480 unit may be used as a master for time and frequency signals or as a slave. In a slaved condition$_1$ it will automatically switch over when a suitable, external, signal frequency is applied to External Reference Card at the rear of the unit. This is usually a 10 MHz signal or a 13 MHz external signal for 13 MHz outputs, taken from the monitor output of the Master 9480.

Reference Changeover

A reference changeover option is available. This card provides an automatic changeover to a back-up (secondary) frequency standard if the prime standard should fail. The primary frequency generation (PFG) and the secondary frequency generation (SFG) inputs are to the same specification as the External frequency standard.

Operational Voltages

The unit can be set to operate from one of four AC line voltages (100, 120, 220 or 240 V ±10, 5%) in the 45 to 440 Hz frequency range. An external DC supply in the 23 to 30 V range can also be used as source or an internal battery, if fitted. The 9480 unit automatically switches from AC to DC or battery in its selection of power source.

Front Panel Features

The front panel has the following indications and controls (See the front panel in Figure 4-1):

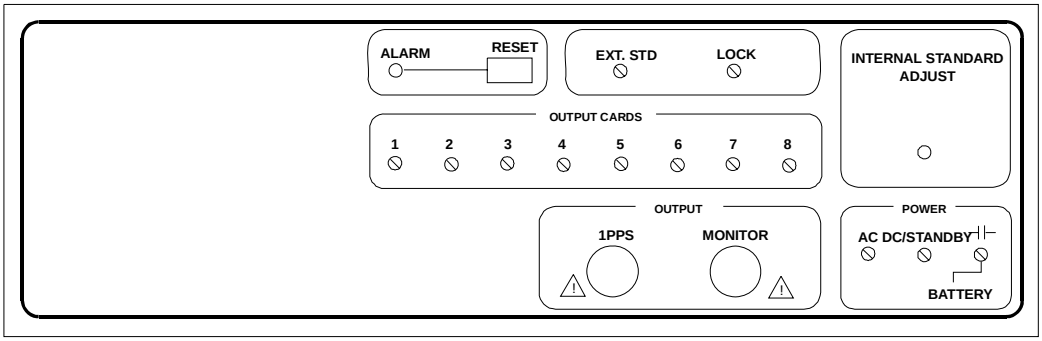

Figure 4-1, Front Panel

Output Failure (OUTPUT CARDS)

There are eight LED indicators, one for each OUTPUT CARD. An LED is lit when all five outputs from a card are functioning. An LED will flash if any of its outputs fails and extinguishes when a card is absent.

The LED will come back on when normal functioning is restored, but a failure triggers a flashing "General Alarm" and the alarm line remains activated until it is reset by the operator.

Frequency Lock (LOCK)

This indication is lit when the frequency standard is in LOCK. If the frequency multiplexer option from the external standard is fitted, that too must be in lock before the LED will light. An LED off denotes an unlocked condition.

External Frequency (EXT. STD.)

This indicator is lit when an external frequency standard is present at the rear panel giving rise to an automatic changeover from internal to external standard.

Power Source (POWER)

Three separate indicators for a choice of the power source, line AC, line DC or internal battery.

If both AC and DC power inputs are present, the 9480 automatically selects the AC input. If both AC and DC fail, the internal battery, if fitted and enabled, will power the internal frequency standard, but not the rest of the 9480 circuits.

ALARM and RESET

The ALARM LED will flash if any of the output LEDs has Indicated failure. It can be reset by depressing the RESET push button, provided the fault condition is no longer present.

OUTPUTS

Two BNC connectors are available on the front panel for output signal monitoring and the 1 pulse-per-second output.

A 0.3V ± 0.1V p-p, into a 50 ohm load, monitor output signal is available at the principal internal frequency (10 MHz or 13 MHz) or at 1 MHz. The waveform is substantially square wave and AC coupled.

A 0.3V ± 0.1V p-p (into a 50 ohm load, or TTL compatible into open circuit) square wave signal at 1 Hz is available at the 1 PPS socket. This signal is derived from the internal or external frequency standard and Is DC coupled.

INTERNAL STANDARD ADJUST

This is a recessed Vernier control for fine adjustment of frequency standard. Coarse adjustment of 04A and 04B options is through the top cover on its right hand side.

REAR PANEL

(See Figure 4-2 for the rear panel)

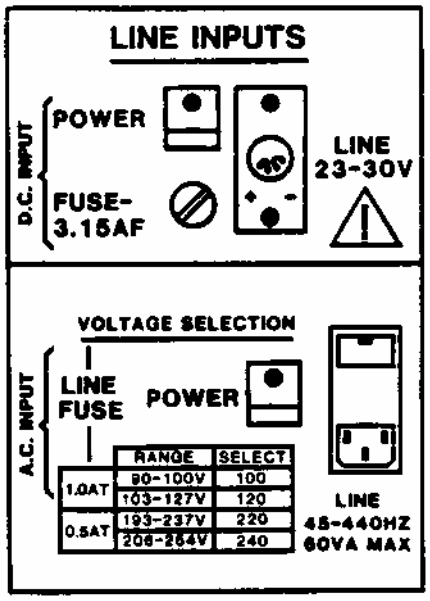

Figure 4-2, Rear Panel

Mains Input

This is a combined fuse and mains input socket and supply selection.

DC Input

This is a polarized, external DC input connector. See Figure 3.3 for the pin outs, the two pins on the left are commoned internally for the +ve supply, the two on the right for the -ve supply.

External PPS (Option)

This is the external input for 1 PPS signal.

10MHz Input

This is the plug-in card for external standard or option 9480-DIV. This is normally a 10 MHz, 100 mV to 1V rms, 50 ohm signal.

Diagnostic Connector

Lines in the connector are used to monitor the status on the frequency standard, Its battery supply and the Alarm line condition.

The pin out detail is as follows:

Pins	Functions
1	Alarm (Logic 1 = Alarm)
2	BATT. ON line (Logic 1 = BATT. ON)
3	External Reference line (Logic 1 = External Signal Present)
4	Rubidium oscillator control voltage
5	Oscillator in lock (Logic 1 = In Lock)
6	GND (System earth)
7	AC/DC* Input (Logic 1 = AC Input)
8	Master Reset* (Logic 0 input will reset the 9480 alarm)
9	Spare

Chapter 5
TECHNICAL DESCRIPTION

Introduction

This section provides the circuit descriptions for all the 9480 electronics boards and assemblies, including the output card options.

Distribution Board 19-3106

The circuit diagram is shown in Figure 1

The distribution board forms the hub of the 9480 system. It provides the interconnection between all the other boards that make up a system. It also carries the functions described below

Reference Selection

This circuit selects between internal and external frequency standards, when an internal oscillator is used, or PFG (primary frequency standard) and secondary frequency standard (SFG), when a reference change over board (19-3172) is used.

The SMC connector PL202 provides the signal from the internal standard. It is amplified and squared by the discrete long-tailed pair formed of Q201 and Q202. There is a transistor switch Q203 in the base that facilitates the switching off of this circuit.

The reference can also be supplied from the reference change over board via SK209 pins A3/B3.

Two reed relays, RL201 that is a normally closed type, and RL202 that is normally open effect the selection. Both are driven from the EXT signal line from the EXT REF slot connector SK209. When EXT is driven, RL202 connects in the external reference signal from SKl09, and the internal standard amplifier long tailed pair is switched off Otherwise RL201 connects in the internal standard signal from the long tailed pair.

The reference selection circuit can be bypassed when using the reference change over board and the reference supplied to U202/13 directly, from SK209 pins A5/B5.

Reference Distribution

The selected signal from the Reference selector is distributed to each of the slot connectors, and to the reference divider, by two hex inverter packages U202 and U203. It is arranged that one inverter, each of which has a passive pull-up on the output, buffers each slot. An additional chain of three inverters buffers the reference divider. The reference distribution circuit is separately screened.

Reference Divider

This chain of dividers takes the reference signal from the reference distribution and derives numerous signals.

The first stage is formed of a programmable synchronous binary counter U206 that is configurable via the link selector PL202 to divide by 10 or 13. The intention being to divide down to 1 MHz from either a 10 MHz or 13 MHz standard. A further link PL211 routes either the 10/13 MHz signal or the 1 MHz signal to the front panel monitor socket via the PL204. The link PL213 optionally disables this divider.

The next stage divides the 1 MHz by 100 to obtain the 10kHzINT signal, and is implemented with a ripple counter U208. This is made available on the PL206.

A further divide by 10, using another counter U209, derives a 1 kHz signal that is made available to the Battery Control Board via PL209.

The remaining part of U209 and U210 provide a further division of 1000, resulting in a signal of 1 Hz. This is used for the 1 pulse per second output available at PL205.

The entire reference divider chain is separately screened.

Alarms

Eight alarm signals from the eight slot connectors S~0l-8 are routed independently to the display board via PL203. Present FAULTS 1-8 are ORed together in U204 and set effectively an SR flip-flop U205 which takes the ALARM signal high. This signal is taken to the display board via PL203 and also to a BUZZER ALARM driven by an open collector transistor driver Q204 connected to PL218. A RESET signal from the display board, via the connector PL203, facilitates the resetting of the flip-flop and the clearing of the alarm.

Power Supplies

Two rails 4.9 V and 22.5 V are provided by the power supply via the connector SK210. These are filtered by a simple 2-pole LC network, supply the board circuits and are routed around the

various connectors as required.

The internal standard supply 'RRBF, available on PL201, originates from the battery control board via PL209 through an LC filter. If the battery option is not fitted, PL209 may take jumpers to select either 4.9 V or 22.5 V.

PSU ASSY 11-7074

The circuit diagram is shown in Figure 2.

This is in the form of a removable chassis. On the chassis is mounted a combined mains inlet socket and filter, mains on/off switch, transformer, bridge rectifier, socket and switch for DC input, 10 W resistor, fuse holders and Power Supply PCB. Connections on the chassis include AC and DC inputs, and power resistor, to the Power Supply PCB *(19-3105).*

Power Supply PCB 19-3105

The circuit diagram is shown in Figure 3

This circuit is based around a 5 volt reference D110. This is used via pot R124 to provide an adjustable reference for both the 4.9 V and 22.5 V circuits. The AC input from the PSU ASSY is smoothed, regulated by U102 to produce 23.1 V which is applied to D114. The DC input is processed by U101C, Q103 and Q104 to produce 22.9 V which is supplied to the other anode of D114.

If the AC input is present U101A and Q101 inhibit the DC supply by reducing the reference applied to U101. If the DC supply is present and the AC disconnected, D114 conducts to apply 22.5 V from the DC source. The 4.9 V supply is derived from the 22.5 V by U101B, Q105 and Q106. Q107, R134 and D111 provide overvoltage protection on the 4.9 V supply.

BATTERY CONTROL PCB 19-3109

The circuit diagram is shown in Figure 4.

This circuit contains:-

1) A battery charge/operate change over relay.
2) Two battery trickle/main charge circuits.
3) A battery enable/disable switch.
4) A low battery disable protection circuit.
5) A charging tinier circuit with reset.

This circuit co-ordinates the enabling and disabling of battery power and charging functions. It contains protection circuits that ensure the batteries are not overcharged or over-discharged.

There is a battery charge/operate change over relay RL501 which in the de-energized state supplies power from the batteries provided the battery enable/disable switch 5W501 is enabled. In this state 21 nickel cadmium cells are connected in series across TP502 and GND. Provided the initial voltage of the cells is greater than +25 V as sensed by U501, Q503 will be turned on to supply VRB at pins 2 and 4 of PL501.

Pin 8 of PL501 'BATT ON' will be approximately at +5 V. When the battery voltage falls below approximately +22 V, Q503 is turned off by Q502 and U501.

In the de-energized state of RL501 with SW501 enabled, the batteries are charged. There are 2 separate charging circuits, one for the 14 cell pack and one for the 7 cell pack. Both packs are charged at approx. 120 mA for 16 hours and then trickle charged at 14 mA thereafter. The main charge is started by a '1' on BATT* and the 1 kHz signal applied to U504B and C. This results in an incremental counting for 16 hours of counters U502 and U503 when U504A will switch off the main charge via *Q510.* The main charge for both battery packs is with Q510 switched on which results in Q507 switching on the main charging current of approx. 104 mA via R537, R538, R539 with the trickle current via R523 and R524 for the 7 cell pack. *Q506* is also enabled by Q510 to turn on the main charge for the 14 cell pack.

The constant current of approx. 102 mA flows via R519, R520, *Q506,* Q507 and the battery. The constant trickle current also flows via RS18, *Q505,* D507 and the battery.

Output Cards

A circuit diagram for all cards is shown in Figure 5.

The 9480 output cards consist of two types, a generic series of output cards offering buffered sinusoidal outputs, and a set of cards offering TTL outputs.

SINUSOIDAL OUTPUT CARDS

These consist of five cards offering different output frequencies. They are:

100kHz	19-3104
1 MHz	19-3103
5 MHz	19-3102
10MHz	19-3101
13 MHz	19-3100

The 13 MHz board requires a 13 MHz frequency standard present in the 9480 mainframe, the others all require a 10 MHz standard. The output cards are all built using the same PCBs, but use different components and link options (see Table on Figure 5) to determine the output frequency. The differences are described in later paragraphs.

The standard originates on the distribution board and, depending on the output frequency is divided down then buffered by U4B and U4C. The signal, that should now be a 1:1 square wave, is passed to a filter network, which has selected values for a specified frequency option. The output of the filter is buffered by the emitter follower stage Q11, and passed to one of five identical output stages.

Each output stage consists of two transistor drivers driving an inductively coupled output through T1 - T5. This allows for a floating output which, if required, can be tied to the system ground by inserting links 1-5. Each output transformer is tapped to provide a signal for the monitor lines. The monitor signal is rectified and smoothed to provide a mean DC level, which is attenuated and NANDed with the four other monitor signals in U1. Should an output fail, the output of U1 will go high, triggering the alarm circuit on the distribution board and appropriate LEDs on the front panel of the 9480 mainframe.

Differences between output cards are as follows.

100kHz 19-3104

This has U2 and U3 fitted. U2 is a presettable divide by 10 binary counter which is preset to 0, and gives a straight + 10 on

the 10 MHz standard. U3 is a presettable divide by 16 binary counter that is preset to 3 and resets at 13. This is done by NANDing the QC and QD outputs in U4A to provide a LOAD signal to U3/9. This provides another ÷ 10 stage to bring the frequency applied to the filter network down to 100 kHz. Selected components are used in the filter and output stage (see Figure 5).

1MHz 19-3103

This has U3 fitted, which in a similar manner to the 100 kHz board (above) provides a ÷ 10 stage to produce the output frequency from the 10 MHz standard. Selected components are used in the filter and output stage (see Figure 5).

5MHz 19-3102

This has U3 fitted (which is preset to 3). The LOAD signal is still taken from U4A, but the inputs to U4A are different to the previous boards (due to selectable links). Two inputs are taken high, the third is connected to the QC output of U3. This has the effect of taking the QC output, inverting it and applying it to the LOAD input of U3. When the Q outputs of U3 are preset to 3, QC is high, the next state (4) forces QC low which has the effect of applying a LOAD signal to U3 (via U4A) which the presets U3 Q outputs to 3 again. The QC output then goes high (the next state) again and the whole process is repeated. This has produced a ÷ 2 stage to obtain the required 5 MHz. Selected components are used in the filter and output stage (see Figure 5).

10MHz 19-3101

This board does not have U2 or U3 fitted. The 10 MHz standard is applied to U4A then U4B/U4C which all act as buffers. The signal is then filtered as in the other cards. Selected components are used in the filter and output stage (see Figure 5).

13MHz 19-3100

This board is identical to 19-3101 except for the selected filter and output stage components (see Figure 5). The 13 MHz output frequency is obtained by using a 13 MHz internal standard in the 9480 mainframe. Consequently 13 MHz output cards cannot be used with any other frequency options in the same mainframe and vice-versa.

TTL OUTPUT CARDS

2.048MHz 19-3125

See circuit diagram shown in Figure 6.

This card will only operate in a 9480 mainframe with a 10MHz frequency standard present. The circuit is a phase locked loop (PLL), which locks a divided down 10MHz with a divided down VCXO.

The 10MHz standard is buffered then applied to a 12 bit synchronous counter (U2, U3 and U4 paralleled) which is preset to $B1E_H$. This gives a division of $4E2_H$ (1250_{10}) resulting in an 8 kHz signal at U4/12. This signal is applied to the R (reference) input of U5 (U5/1). U5 is a digital phase detector. The other input, U5/3 is divided down from the VCXO and is 8 kHz when in lock. The error signal from the phase detector US is applied to the loop filter U6 (and associated components). The output of the filter, a mean DC level is applied to the VCXO, U7. The VCXO is a 16.384 MHz type. Its output is buffered and then divided down to 2.048MHz at U8/12. The 2.048MHz square wave is taken off to the output stages and also fed to dividers U9 and U10. U9 and U10 are configured as a synchronous ÷FFH ($\div 256_{10}$) counter to provide the signal to lock to the 8kHz derived from the 10MHz standard.

A small phase offset is introduced into the loop by R38, R40 and C26 to allow for any differences (within tolerance) in component values between different cards, that would cause notable changes in the steady state operating conditions between those cards.

The 2.048MHz square wave from U8/U12 is applied to output driver U13. Five outputs are taken from U13. Each output has a protection circuit. At the first output (SK1), R12/R29 provide short circuit protection and with D6/D7 also provide applied overvoltage protection. In the case of a DC voltage being applied to an output, D25, R41 and Q7 sink any extra current put onto the supply rail and prevent the rail being pulled up above approx. 5.6V. Each output is monitored and should an output fail then the FAULT line is pulled high by U14 and an alarm signal generated in the 9480 mainframe.

The 2.048MHz output card makes use of well decoupled supplies for separate parts of the circuit to reduce the overall noise present in the circuit. The 22.5V supply is brought down to above 7 volts by Q6 that in turn feeds Q2 – Q5. U6 is supplied from Q1.

EXTERNAL REFERENCE/MULTIPLIER BOARD 19-3108

The circuit diagram is shown in Figure 7.

The External Reference/Multiplier is a card physically compatible with the external reference slot of the 9480. The

AND 19-3139

board receives an external reference signal on a board mounted BNC connector that is accessible on the rear panel of the 9480. This signal is conditioned and fed to the Distribution Board. A detector signals to the Distribution Board, via the EXT line, the presence of an external reference signal.

The board is common to two variants: the 19-3108 takes a 10 MHz reference signal only, while the 19-3139 utilizes a PLL multiplier circuit to accept 1, 2, 5 and 10 MHz signals

Reference Input

The reference signal at SK301 is filtered by a three pole elliptic and clipped by a pair of reverse parallel signal diodes D301 and D302. The amplifier/limiter formed around the long tailed pair Q301, Q302 serves to normalize a wide input level range to a square wave compatible with TI" levels. This amplifier is switched off by a low on the EXT line of plug PL301.

The output is directed by the link choices at LK301 and LK302, either to the board connector PL301 in the case of the 19-3108, or around the multiplier circuit in the case of the 19-3139.

RF Detector

This circuit detects the presence of an input reference signal and drives the EXT line high when it exceeds a preset level. The signal is taken from clipping diodes D30 1 and D302 of the input circuit, and feeds a high sensitivity detector formed around the biased Schottky diode D305. A comparator U301, with a little hysteresis added, is used to compare the detector output with a reference chain that includes the preset R314, and another Schottky diode D307 for temperature compensation. This preset facilitates an adjustment of the detector threshold. The comparator drives a two transistor chain Q303 and Q304 which performs the EXT line switching.

Reference Frequency Multiplier

This is the 19-3139 version which utilizes a phase4ocked loop circuit to accept the submultiples of 10 MHz, which are 1, 2, 5 and 10 MHz signals. Links L301 and L302 on the board are selected to route the signal through the multiplier circuit. A pulse generator output is connected to a phase detector and forms a reference signal for the phase-locked loop.

Input Circuit and Pulse Generator

The waveform from the input amplifier is squared in U302A before the pulse generator, U302B and U302C. Negative-going pulses at U302C switch Q306, which drives the transmission line type transformer, T301. The transformer is used as a phase splitter, so that for the duration of each pulse from U302C, the sampling bridge of the phase detector is held forward-biased,

with the D309/D310 and D311/D312 junctions symmetrical about 0 V.

Phase-Locked Loop

The loop oscillator active element is Q309. The oscillator frequency is controlled by the crystal XL301 and the varacter diode D313. Trimming capacitor C328 can be adjusted manually to compensate for a range of crystal and varacter tolerances.

The oscillator output drives a unity gain cascade buffer Q307, Q308. Buffered RF from Q307 is the input to the phase detector bridge.

When the bridge of the phase detector is forward-biased by the pulses from T301, the D309, D311 junction adopts the same potential as the D310, D312 junction. At other times the junctions are isolated from each other by the high impedance of the non-conducting diodes. The bridge output is therefore a series of samples of the loop oscillator waveform, taken at the frequency of the external frequency standard.

The phase detector output depends upon the relative frequency of the oscillator and the frequency standard, and the phase of the oscillator waveform at the instant of sampling. If the standard frequency is 10 MHz, every cycle of the oscillator output is sampled. For sub-multiples of 10 MHz only every second, fourth, fifth and tenth cycle will be sampled. In every case, samples are of constant amplitude, if the standard frequency is an exact sub-multiple of the oscillator frequency. If the standard frequency is not an exact sub-multiple, output pulses will be amplitude modulated.

The amplitude of each phase detector output pulse depends on the instant value of the oscillator waveform at the time of sampling. Pulses are integrated in C323 that supplies the input to the loop amplifier U303. when the loop is in lock the voltage across C323 maintains the voltage at U303/6, and therefore across the varacter, at the level needed to maintain the oscillator at the lock frequency.

An output amplifier and a MULOCK control circuit are added to the output. The amplifier formed of Q310 and Q311 is identical to the input amplifier detailed above in the Reference Input paragraph. The MULOCK circuit, formed of D314 and Q312, is a simple signal detector which drives the MULOCK line low whilst EXTSTD is driven high, and a multiplier output is not present.

REFERENCE

The circuit diagram is shown in Figure 8.

CHANGEOVER BOARD 19-3172

The reference change over board fits in the same slot as the External Reference/Multiplier (19-3108/19-3139) boards. It essentially performs the function of choosing one of two different external 10 MHz frequency sources. One source is known as the primary frequency generator (PFG input, SK301), the other as the secondary standard input (SK302). The choice of the reference signal to be applied to the Distribution Board (19-3106) depends on varying conditions:

(1) If PFG is in 'LOCK', signal level OK, then the PFG is selected.

(2) If PFG out of 'LOCK' or signal level low, the secondary standard is selected.

(3) If SW1 set to 'BYPASS', the secondary standard is selected.

A typical system using the change over board would have a 9480 containing the primary standard, a 9480 containing the secondary standard and one or several 9480's containing output cards for the reference frequency distribution. See Figure 5.1.

Change Over Input

This enables a distribution 9480 to change between its PFG and secondary standard inputs. A logic '1' on this line would cause the PFG input to be active via PL301 A1/B1, and logic '0' chooses the secondary standard input via PL301 A3/B3. The input in connected to one of the three change over outputs on the 9480 primary standard unit's change over board. Note that when SW1 is set to 'BYPASS' the PFG input is inhibited regardless of the state of the change over input.

When used by the 9480 primary standard unit, the change over input is unused and must be pulled high by linking pins 2 and 3 of PL305. When used in reference frequency distribution 9480s, pins 1 and 2 must be linked.

Change Over Outputs

The change over outputs are used by the 9480 primary standard unit only. Three paralleled outputs are available, which are connected to the change over inputs on the reference frequency distribution 9480s, as previously mentioned. These outputs are used to indicate that the 9480 primary standard unit's internal oscillator has gone out of lock, and so force each reference frequency distribution 9480 to switch from primary standard to secondary standard operation. If the rubidium is out of lock PL301 pins A6/B6 ('RBLOCK') will go low, which turns Q315 and Q317 off and the change over output gets pulled low. when in lock, the 'RBLOCK' line goes high turning Q315 and Q317 on,

setting the change over output high.

Reference Input/RF Detector

The Reference Input/RF Detector for the 19-3172 is as described in previous paragraphs for the 19-3108/19-3139 boards. when the EXT line is driven high by Q304 the secondary standard input is inhibited and the PFG input amplifier active. Q304 can be turned off (and 'EXT' go low), irrespective of the PFG input level by a '0' on the change over input, (SK303), or SW1 set to 'BYPASS'.

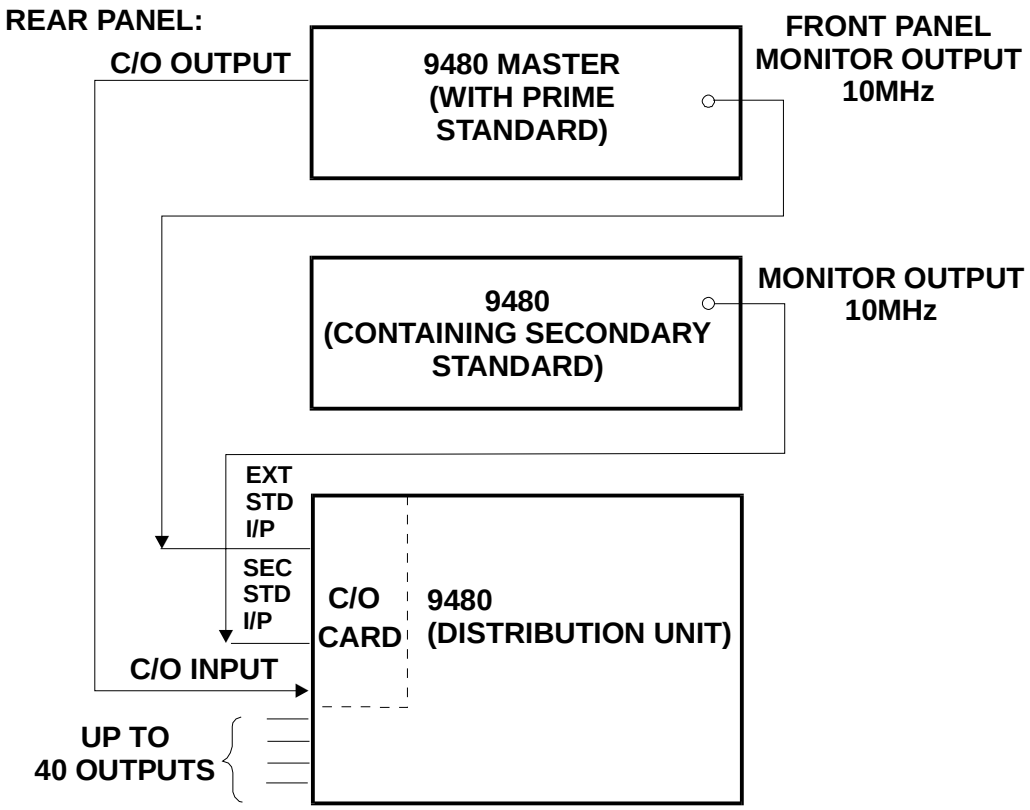

Figure 5-1, High Availability 9480 System

The 9480 primary standard unit's change over board is used to provide change over outputs via PL302-304.

The 9480's used for reference frequency distribution have signals PFG and secondary frequency standard applied to SK301 and SK302 together with the change over signal from the 9480 primary frequency standard.

The PFG signal connected to SK301 is usually derived from a high quality frequency standard, typically a rubidium oscillator. The secondary standard signal connected to SK302 is again usually a high quality standard and is used as a back up to the primary standard.

The change over board is intended to be used in systems that must have high availability of the reference frequency, the secondary frequency standard acts as redundancy in such a system.

One or more 9480s fitted with output cards (19-3100 - 19-3104) are used to distribute the appropriate source (PFG or secondary standard input) and are referred to as reference frequency distribution 9480s. when a reference change over board is used in PFG or secondary frequency standard 9480s, pins 2 and 3 of PL305 must be linked with a jumper, or else install the jumper to pins 1 and 2.

Note If an internal frequency standard is not supplied and a change over board is fitted to a 9480, a shorting link is fitted in position LK201 on the Distribution Board. If an internal standard is fitted, this connection is not made and the Berg header, used in linking, is located on pins 2 and 3 of PL208, connected to ground.

Secondary Frequency Standard Input

The reference signal from SK302 is amplified/buffered by the long tailed pair Q310 and Q311 in the same manner as the PFG reference input. The signal is then buffered further by U302 and passed to SW1A. The Normal/Bypass switch, SW1, allows the signal to be passed to either pins A3/B3 or A5/B5 of PL301. SW1 is used to enable the signal to bypass the switching circuits on the Distribution Board 19-3106, its usual operating position is with it set to 'Normal'. The amplifier is switched off by Q316 and a logic 1 on the EXT line. When used in a 9480 reference frequency distribution unit, the amplifier is switched off if,

(1) The primary frequency generator input is present (this sets EXT to '1').

or

(2) The change over input at SK303 is a '1'.

FRS BANDPASS FILTER BOARD 19-3124

The circuit diagram is shown in Figure 9.

The filter is used for suppression of unwanted spurious signals on the output of the Rubidium FRS-C and FRK-L frequency standards. It is a simple circuit built on a small PCB with input and output ports being provided by board mounted SMC connectors. The board is enclosed in a small Eddystone diecast box.

The filter is a 3 pole Butterworth design, transposed to a bandpass response on a center frequency of 10 MHz. A 56 ohm resistor terminates the output.

DISPLAY BOARD 19-3107

The display board provides the user interface of the 9480. It has LED indicators and operators push buttons together with associated electronics.

The circuit diagram is shown in Figure 10.

Alarms

Eight LED indicators, D401 to D408 labeled "1" to "8" respectively, indicate the individual slot status. For each, the configuration formed of a NAND gate and an open drain inverter around the LED is driven from the Lines FAULT1,8 and LD1,8 from the board connector SK401. While a board is installed and its fault line is low, the LED is lit continuously; if high, it flashes. The LED is extinguished when no card is installed.

Flashing occurs by gating a low rate square wave with one input of the NAND gate. This signal is generated by a multivibrator formed of the Schinift NAND U401A, and may be disabled by a low on the ALARM signal. The output is also used to flash the "ALARM" LED D409 via the buffer U401B.

Internal Standard Adjust

The multiturn pot R423 serves as a fine tuning adjustment for the internal standard. Its three connections are brought out on the board connector SK401.

Reset

The "RESET" push button SW401 is debounced by the circuit around the Schinitt NAND U401C and U401D. This drives the RESET* signal appearing on the board connector SK401.

Other Indicators

The LED indicators, D410, D411, D412 and D413 labeled "EXT STD", "LOCK", "AC" and "DC" respectively are driven by open drain buffers U405A, B, C and D from signals appearing of the board connector PLA01. The indicator D414 "BATTERY" is connected directly to PL401.

CRYSTAL OSCILLATOR ASSEMBLY 19-3141

The circuit diagram is shown in Figure 11.

The circuit produces a 10 MHz standard output from an input from a 5 MHz quartz crystal oscillator assembly, by a process of frequency doubling.

The 5 MHz signal is applied to a balanced transistor amplifier on Q1 and Q2. Differential outputs from the amplifier drive the base of Q3 via diodes D1 and D2. The result is a doubled frequency of 10 MHz at Q3.

The 10 MHz signal is amplified and filtered in the gain stages of Q3 and Q5, and fed to plug PL2 via the output buffer stages, Q6 and Q7. The tuned transformers T1 and T2 provide the first and second stages of filtering for the 10 MHz signal.

Q4 detects the output level. The output signal is returned by C6 to switch Q4 on, during positive peaks of signal. The gain of Q5 is controlled by the potential across capacitor C3 which changes via R12 and is discharged through Q4. If the output level increases, the time for which Q4 conducts increases dropping the mean potential across C3. The resulting decrease in gain of Q5 provides automatic level control (ALC).

Chapter 6
MAINTENANCE

Introduction

The 9480 chassis mainframe holds as standard a reference board, a distribution board, a display board and a power supply assembly. To meet customer specific requirements, options that can be installed are a choice of output cards, a Nickel Cadmium battery and battery control board and an internal reference oscillator.

Routine Maintenance

There is no routine maintenance associated with the 9480.

Test Equipment Required

The maintenance procedures will require the use of the test equipment of Table 6.1 or their equivalents.

Instructions are given on dismantling and reassembly into the frame of all boards and assemblies.

WARNING: LETHAL VOLTAGE
DANGEROUS AC VOLTAGES ARE EXPOSED IF THE INSTRUMENT COVERS ARE REMOVED WITH THE AC SUPPLY CONNECTED. SWITCH AC OFF AND DISCONNECT SUPPLY BEFORE WORKING ON INSTRUMENT.
LEAVE DC INPUT CONNECTED AND SWITCHED ON.

Much of the dismantling procedure can be performed with the aid of a PosiDriv screw driver set.

The first step is top cover removal to gain access to internal electronics and removal of the backplate is necessary to release the fitted output cards, the external reference card and PSU assembly.

Table 6-1, Test Equipment Required

Item	Description of Recommended Model	Required Parameters
1	Digital Multimeter, Racal 4005	AC voltage range 250V min. DC voltage range 30V mm. Accuracy ±2% or better.
2	RF Millivoltmeter, Racal 9301A	Frequency range 100kHz to 20MHz. Input level at least +15dBm. Accuracy ±2%.
3	Spectrum Analyzer, HP8568A	Frequency range 100kHz to 100MHz. Max. input level at least +15dBm. Dynamic range at least 80dB.
4	Oscilloscope, HP1740A	Bandwidth greater than 45MHz
5	Signal Generator, Racal 9081	Frequency range at least 1MHz to 13MHz max. Output level at least -7dBm.
6	Counter, Racal 1992	Frequency range at least 1 Hz to 13MHz with 50ohm signal input and external standard input.
7	Difference Meter Tracor 527A	Resolution range to at least 1 p in 10^{11}.
8	Frequency Standard	Better than 1 part in 10^{11}
9	DC Power Supply Unit, Farnell 30-5	Min. Output Range 0-30 V, Min. Output Range 0-3 A.
10	Monitor Test Jig, Racal Dana 190	-
11	BNC Shorting Plug	-
12	Two Wire Cable Terminated in 4 way latching DIN socket at one end.	-
13	Optional PSU service cable for use with PSU service option if fitted.	-

Removal And Replacement

The removal procedures are applicable to model serial numbers 1071 onwards.

Instrument Covers

Disconnect the AC power input line from the rear panel. In systems where maximum availability of the reference signals is required, leave any DC input connected and on, otherwise switch off and disconnect.

Remove the fifteen screws from the top cover.

Release the two screws in the top bezel of the front panel, but do not remove.

Move the top cover clear of chassis.

To replace the top cover, slide it under the front bezel and close down the two screws.

Replace and tighten the fifteen screws into the top cover.

Power Supply Assembly

The top cover should be removed first, as described above.

In cases where there has been an AC PSU failure and the frequency distribution system is provided with a 9481 and 9480 with PSU service option is installed, the DC input shall remain connected to the 9481 until the PSU maintenance cable has been installed after removal of the 9480 top cover.

Plug the PSU maintenance cable to the PSU service option board (if installed), this is located on the LHS of the unit when viewed from the front panel.

Remove the 10 screws of the metal plate securing the input/output cards, slide this plate back over the leads.

Take out the four screws through the upper chassis into the PSU Assembly.

Take out the four screws through the black snap bushes on the baseplate, underneath the chassis.

Carefully slide out the PSU Assembly from the rear of the chassis, so the mating connector on the Distribution Board PCB is not damaged.

AC and DC supply fuses are located on the PSU rear panel and can easily be replaced. The AC fuse is located behind the mains selector cover above the input socket.

To replace the PSU Assembly, carefully slide into the rear of the chassis so the connector on the Distribution Board is not

damaged.

Enter the four screws through the upper chassis, enter the four screws through the baseplate and tighten up.

Replace the input/output securing plate with its 10 screws.

Output Card(s)

Individual output cards are behind a metal plate that covers all cards installed and must be removed to give access to any card. The plate is held by 10 fixing screws.

On earlier versions of the 9480, output cards were each secured by two fixings per card and there was no overall cover plate.

The left hand slot is reserved for the external reference input cards.

Display Board

The Display/Indicator Board is easily removed if the front panel is dropped forward.

Release, but do not remove, two screws through the front panel bezel at the bottom of the chassis.

Remove the two large screws through the bottom plate near the front panel.

Lay the front panel forwards.

Remove the six screws through the stand-off pillars on the Display Board.

Disconnect the 34-way Ribbon Cable Assembly from PIAOI on the Display Board.

To replace the Display Board, first attach the Ribbon Cable and secure board with six screws through stand-off pillars to the front panel. Display LEDs should be carefully aligned with front panel holes to prevent damage to LEDs.

Restore the front panel to its normal position and tighten the two screws though the bottom bezel on the front panel.

Replace the two screws through the bottom plate and tighten.

If Display Board is changed, the oscillator must be set-up using resistor R43 according to the calibration procedure.

Oscillator

First remove thc instrument top cover as described in an earlier paragraph.

Free off the front panel as described earlier.

On the Distribution Board, release the multiway connector on the cable assembly from the Oscillator and the SMC connectors on the coaxial from the Band Pass Filter Assembly.

The Oscillator and Band Pass Filter are mounted on a plate to the inner chassis.

Take out the inner chassis by removing six side fixing screws and 10 screws through the bottom of the 9480.

Separate the plate from the inner chassis.

Remove the screws that hold the Oscillator to the plate.

To separate the Band Pass Filters from the baseplate, remove the four fixing screws through the bottom of the baseplate.

The removal procedure for the Oscillator and Band Pass Filter is essentially the same for all options that can be fitted, though positions of the monitoring plate on the chassis will vary between options.

It may also be necessary to separate Oscillator and BPF by removing the cable connection between units.

To replace, affix the Oscillator and Band Pass Filter to their baseplate and restore the wiring connection between them, if previously removed.

Mount the baseplate on the inner chassis and fix through the pillars with four screws. The inner chassis can be secured to the main chassis bottom by fixing the six side screws and the ten screws through the bottom of the 9480.

Restore the 2-wire multiway connector and the SMC connection on the large Distribution Board from the Oscillator and Band Pass Assembly.

Replace the front panel.

Battery Pack

NOTE:

A battery pack and Battery Control Board are fitted together *as* an option in a 9480 chassis.

To take out the battery pack, remove the seven screws that secure its baseplate to the inner chassis.

Unclip the 7-way connector from PL502 on the Battery Control Board.

Lift the battery pack out of the unit

To replace a battery pack, secure its baseplate to the inner chassis with seven fixing screws.

Make the connection to the multipin connector PL502 on the Battery Control Board.

Replace the front panel.

Battery Control Board

The battery pack should be removed as described in the previous paragraph before this board can easily be removed.

On the Control Board, remove the connector on PL501 from the Distribution Board or PSU Maintenance Board and remove the connection on PLS02 from the battery pack.

The 9-way ribbon cable underneath the board need not be released.

Remove the four long screws through the board and lift the board out.

Two Quick Blow fuses on the board can be replaced with the board in position in the chassis.

The Battery Control Board should be replaced before the Battery Pack.

Secure the board to the inner wall through the four pillars and make the connections *to* PL501 from the Distribution Board or PSU Maintenance Board and at PL502 from the Battery Pack.

The ENABLE/DISABLE switch on the Battery Control Board can be set to ENABLE by pointing the switch to the back of the unit. It can also be set after removing a protective grommet in the unit top cover. A label on the cover gives directions.

Distribution Board

Remove the instrument top cover and the backplate over the output cards as described earlier in removal of instrument covers.

Take out all the output cards and the external reference card.

Take out the Power Supply Assembly as described earlier.

Remove two screws through center of side wall retaining the inner wall end.

Free one side of unit by removing the three fixing screws behind the handle and by releasing the screw through the front panel top bezel on that side.

Take out the top inner chassis, after removing two small screws through both sides of unit into top chassis as well as the two screws holding the top chassis through stand-off pillars to the inner wall of the unit.

Remove the rear corner extrusion piece at the same time.

On the Distribution Board, disconnect the SMC type connectors PL202, 204, 205 and the ribbon cable connectors PL201, 203 and 207.

The connector PL209 should also be disconnected from the Battery Control Board, if installed.

Take out the seven remaining screws through stand-offs to the inner wall.

Remove the Distribution Board.

The screened boxes on the board are removed by desoldering to gain access to the logic ICs.

To replace the Distribution Board, attach it to the 9480 inner wall with seven small screws through stand-off pillars.

Secure the inner wall to one side of unit using two fixing screws.

Attach top chassis to side wall and through Distribution Board to the unit inner wall.

Replace the other side of unit and secure to handle, and front panel top bezel.

Secure the inner wall end with two screws to the unit side and top chassis to the side with two screws.

Make the electrical connections to the Distribution Board from the other boards.

Restore the Power Supply Assembly and secure in the chassis and restore all output cards that were removed, in their correct

positions.

Put all covers back on unit.

Diagnostic Connector

A 9-way connector on the rear frame is removed after taking out two screws and after releasing its connection to the Distribution Board.

Setting Up Procedures

Initial Checks

Set AC and DC mains switches to the OFF position, connect a nominal AC input and a +24 V 3 A source to DC input.

Verify that RF output sockets are at system earth by clipping on a resistance or continuity meter. Resistance should be less than 1Ω.

Apply 10 MHz sinewave at -7 dBm to input socket of external reference board. The individual harmonics of this signal must be lower than -26 dBc.

Unit Status Indication

Close DC power switch and verify that all status indicator LED's on front panel are in the status set out below.

ALARM – OFF If ALARM is flashing, press RESET.
If ALARM continues to flash, there is a fault.
Clear fault before proceeding.

EXT.STD.-ON

LOCK –ON If a rubidium (FRK-L, FRK-H or FRS) Internal Standard is fitted, wait for the LOCK to turn on. This may take several minutes. Otherwise LOCK should turn on instantly.

OUTPUT CARDS (1-8) ON, where the corresponding card is installed, otherwise OFF.

AC POWER - OFF

DC POWER - ON

BATTERY - OFF

Table 6-2, Limit Details of Internal Standard Options

Option	Section 1:	Section 2:

	Electrical Trim Range	Monitor Voltage @ Diag. Skt., Pin 4
04A	(N/A)	(N/A)
04B	>1 PARTS IN 10^7	1.6V to 3.2V
04E	>3 PARTS IN 10^7	0V to 10V
FRK-L	>2 PARTS IN 10^9	8V ±0.25V
FRK-H	>2 PARTS IN 10^9	8V ±0.25V
FRS	>1 PARTS IN 10^9	N/A
(Not Installed)		N/A

Front Panel Outputs

Check that output at MONITOR socket on FRONT PANEL is 10 MHz, 13 MHz or 1 MHz (according to option) squarewave, 0.3 V ±0.1 V p-p across 50Ω load.

Check that output at 1 PPS socket on FRONT PANEL is 1 Hz squarewave, 0.3 V ± 0.1 V p-p across 50Ω load.

External Reference/Multiplier Board Indication

Disconnect 10 MHz input from External Reference or Multiplier Board and verify that EXT STD LED on FRONT PANEL is OFF.

If MULTIPLIER board option is installed, apply 1 MHz/-7 dBm sinewave to input socket and momentarily depress RESET button. Verify that LED status is as stated in paragraph 86. Repeat with 2 MHz and 5 MHz inputs, note LED status and then disconnect.

Rubidium Internal Standard Indication

Open DC power switch for 10 seconds, close the switch and verify that the LOCK LED on FRONT PANEL remains OFF for between 3 and 60 seconds after switch on, and then turns ON. In some conditions, this period could extend to several minutes.

If a Rubidium standard is not installed, the LOCK LED will come ON instantly.

Battery Back-Up Indication

If this option is fitted, open DC power switch, remove rubber grommet from top cover of mainframe to expose "Battery Enable" toggle switch. Move switch lever to rear of mainframe, this enables battery.

Verify that “BATTERY” LED on FRONT PANEL is ON. If LED is OFF this could indicate a discharged battery. If LED is OFF go to AC check as stated in paragraph 96 and return to this checkout after completion of all other tests, when battery should have gained sufficient charge.

Return switch to original position and replace grommet.

AC Mains Indication

Turn on AC mains switch.

Connect 10 MHz input to External Reference Board and momentarily press RESET button on FRONT PANEL.

Verify LED status is as stated in paragraph 86 except AC POWER should be ON and DC POWER OFF.

Alarm Function

(This check applies only to Output Cards with sinusoidal RE outputs; 13 MHz, 10 MHz, 5 MHz, 1 MHz or 100 kHz).

Apply a short circuit to one RF output socket on each output card in turn, using the 50Ω BNC shorting plug.

Verify that, in each case, the corresponding output card indicator LED and the ALARM indicator LED on the FRONT PANEL flash alternately

Disconnect the short circuit, depress the RESET button and verify that the FRONT PANEL LED corresponding to each output card installed is lit continuously and the ALARM LED on the FRONT PANEL is now extinguished.

Output Card Function and Interaction

The following cheeks apply to each of the RE output card.

Verify for all outputs that:-

1) The signal level at all sockets is +13 dBm ±2 dB
2) Second and third harmonics are lower than -30 dBc.
3) Spurious signals are at levels no higher than -70 dBc.
4) At 1 MHz the spurious signal is lower than -70 dBc.

The following checks apply to TTL Output Cards. Using a BNC T-piece connected at the Signal Generator Output, connect the 10 MHz signal to the EXT.STD input on the counter. For each TTL output, verify that -

1) With card output connected to the 50Ω input of counter, the frequency is 2.048 000 MHz ±2 digits.

2) Using oscilloscope set to 50Ω coupling and 0.1 V/div, check the output amplitude is 0.38 V_{p-p}, ±100mV.

Disconnect EXT. STD. input on counter when checks have been performed.

Internal Standard Function And Adjustment

NOTE:

Adjustment of the Internal Standard is to be performed by Racal Instruments Ltd. Adjustment by unauthorized personnel will void any Warranty or Calibration guarantees.

Disconnect the 10 MHz input signal from the External Reference/Multiplier card and check that the EXT. STD. indicator LED on the FRONT PANEL is OFF.

For any RE Output Card installed, perform the output socket checks, as described earlier on one socket from each card.

If no RE Output Card is installed, perform the output checks for a TTL Output Card(s), but be sure that the EXT. STD. input on the counter is connected to the front panel MONITOR socket, instead of the Signal Generator output.

(The following checks do not apply to the 04A standard option.)

Leave the 9480 running on AC mains supply for at least 2 hours.

Using the Difference Meter with a 10 MHz Frequency Standard

(better than 1 part in 10^{11}) connected to the Reference Input, connect the MONITOR output on the FRONT PANEL to the Difference Meter input.

To verify the electrical trim range due to adjustment of INTERNAL STANDARD ADJUST on the FRONT PANEL, proceed:-

1) Rotate control fully counter-clockwise and record reading from Difference Meter.

2) Repeat with control fully clockwise.

3) Calculate and record the difference and verify this figure is equal to or greater than the trim range stated in Section 1 of Table 6.2, for the standard being checked.

Operate the 9480 for 15 hours at 22^{o}C $\pm$0.5^{o}C with its top cover on. After 15 hours, adjust the Internal Standard output frequency via the FRONT PANEL to better than 1 part in 10^{11}, using the Difference Meter set for this resolution.

Using the DMM, verify that the voltage at pin 4 of the diagnostic socket, on the rear part of the rnainframe, is within the limits specified in Section 2 of the Table 6.2 for the appropriate standard.

On completion of checks, switch off and remove the AC mains supply from the unit.

PSU Maintenance Option (PSO)

INTRODUCTION

This option, in conjunction with tile maintenance support cable 10-3058, allows tile user to remove the 9480 plug-in PSU 11-7074 for maintenance while keeping the rest of the 9480 operational. Where the 9480 is rack mounted, it is strongly recommended that rack sliders are used to assist with this operation.

Description

The option consists of a PCB and chassis mounted regulator assembly, together with connecting cables. The option is installed within tile 9480.

Using The Option

The following procedure should be used when it is required to remove the 9480 plug-in PSU for servicing, whilst maintaining 9480 operation.

Where the unit is rack mounted on sliders (recommended), release the front fixings securing the

9480 to the rack, and slide the unit out of the rack. Where the unit is in a fixed rack situation, it will be necessary to support the unit, after removal of the fixings, in a position that does not stress tile connecting leads at the back, while the maintenance procedures are carried out.

Connect a +24.5V ±0.5V, 3A DC standby supply (e.g. from Racal Instruments 9481) to the DC INPUT of the 9480 and set the 9480 DC power switch to ON. Set the AC power switch of the 9480 to OFF and disconnect the AC mains.

Follow the instructions in tile main body of the maintenance manual to remove tile 9480 top cover and rear screen plate.

Remove the protective insulator from PL3 on the 19-3180 PSU Maintenance Option PCB (left hand side panel viewed from the front).

Attach one end of tile maintenance support lead 10-3058 to PL3 on 19-3180 and the other end to a spare Standby DC Power output socket on the rear panel of tile 9481 (which must be switched on). Where a 9481 is not available, the user must connect a +24.5V +/-0.5V, 3A DC supply to tile 3 pin XLR connector on 10-3058 (+24V to pin 1, 0V to pin 3).

Set the plug-in PSU DC power switch to OFF and then follow the instructions for PSU removal in tile main body of the 9480 Maintenance Manual.

Before replacing the PSU, reconnect the +24.5V standby supply to the DC INPUT and set the DC power switch to ON. Carefully insert the plug-in into the main chassis and secure in accordance with the instructions in the main body of the Maintenance Manual.

Disconnect the maintenance support cable 10-3058 and replace the protective cover onto PL3.

Replace the top cover and rear screen plate.

Connect the AC mains supply to the PSU and set the AC power switch to ON.

if the DC input to the 9480 external DC socket is no longer required (i.e. for standby power), set the DC power switch to OFF

and disconnect the DC power cable.

Chapter 7

PARTS AND DIAGRAMS

PREFACE

The figure numbers (Fig 1 etc.) quoted at the top of the Parts List refer to the circuit diagram in the back of the Parts List.

A comprehensive Parts List is given for the Output Board options. The component values that make the different options possible are clearly distinguished in the parts listing against the board references.

The Multiplier and External Reference Assemblies are shown in a single listing with the items not installed in assembly 19-3108 indicated by a *.

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PARTS LIST

DISTRIBUTION ASSEMBLY 19-3106

(FIGURE 1)

Cct. Ref.	Value	Description	Rating	Tol.	Part Number
Resistors					
	Ohms		**W**		
R201	10k		0.25	5	20-2103
R202	100k		0.25	5	20-2104
R203	1k		0.25	5	20-2102
R204	100		0.25	5	20-2101
R205	2K2		0.25	5	20-2222
R206	390		0.25	5	20-2391
R207	3k9		0.25	5	20-2392
R208	22k		0.25	5	20-2223
R209	6k8		0.25	5	20-2682
R210	9x10k	Res SIL			20-5545
R211	1k1		0.25	5	20-2152
R212	1k1		0.25	5	20-2152
R213	1k1		0.25	5	20-2152
R214	1k1		0.25	5	20-2152
R215	100k		0.25	5	20-2104
R216	10k		0.25	5	20-2103
R217	9x22k	Res SIL			20-5547
R218	10k		0.25	5	20-2103
R219					
R220	22k		0.25	5	20-2223
R221	100		0.25	5	20-2101
R222	100		0.25	5	20-2101
R223	1k		0.25	5	20-2102
R224	1k		0.25	5	20-2102
Capacitors					
	F		**V**		
C201					
C202	100n	Ceramic	50	20	21-1708
C203	100n	Ceramic	50	20	21-1708
C204	100n	Ceramic	50	20	21-1708
C205	100n	Ceramic	50	20	21-1708
C206	10n	Ceramic	100	+80/-20	21-1709
C207	68µ	Aluminium Elec.	16	+50/-10	21-0625
C208	100n	Ceramic	50	20	21-1708
C209	10n	Ceramic	100	+80/-20	21-1709
C210	10n	Ceramic	100	+80/-20	21-1709
C21 I	10n	Ceramic	100	+80/-20	21-1709
C212	10n	Ceramic	100	+80/-20	21-1709
C213	10n	Ceramic	100	+80/-20	21-1709
C214	100n	Ceramic	50	20	21-1708
C215	100n	Ceramic	50	20	21-1708
C216	68µ	Alummium Elec	16	+50/-10	21-0625
C217	10n	Ceramic	100	+80/-20	21-1709
C218	100n	Ceramic	50	20	21-1708
C219	100n	Ceramic	50	20	21-1708
C220	100n	Ceramic	50	20	21-1708

C221	100n	Ceramic	50	20	21-1708
C222	100n	Ceramic	50	20	21-1708
C223	100n	Ceramic	50	20	21-1708
C224	27p		63	2	21-1685
C225	100n	Ceramic	50	20	21-1708
C226	100n	Ceramic	50	20	21-1708
C227	8x10n	Ceramic Array			21-7250
C228	8x10n	Ceramic Array			21-7250
C229	100n	Ceramic	50	20	21-1708
C230	100n	Ceramic	50	20	21-1708
C231	100n	Ceramic	50	20	21-1708
C232	100n	Ceramic	50	20	21-1708
C233	100n	Ceramic	50	20	21-1708

Diodes

D201		Diode SIL			22-1029
D202		Diode SIL			22-1029
D203		Diode SIL			22-1029
D204		Diode SIL			22-1029
D205		Diode SIL			22-1029
D206		Diode Zener 5.1 V			22-1808

Transistors

Q201		PNP 2N3906			22-6008
Q202		PNP 2N3906			22-6008
Q203		PNP 2N3906			22-6008

Integrated Circuits

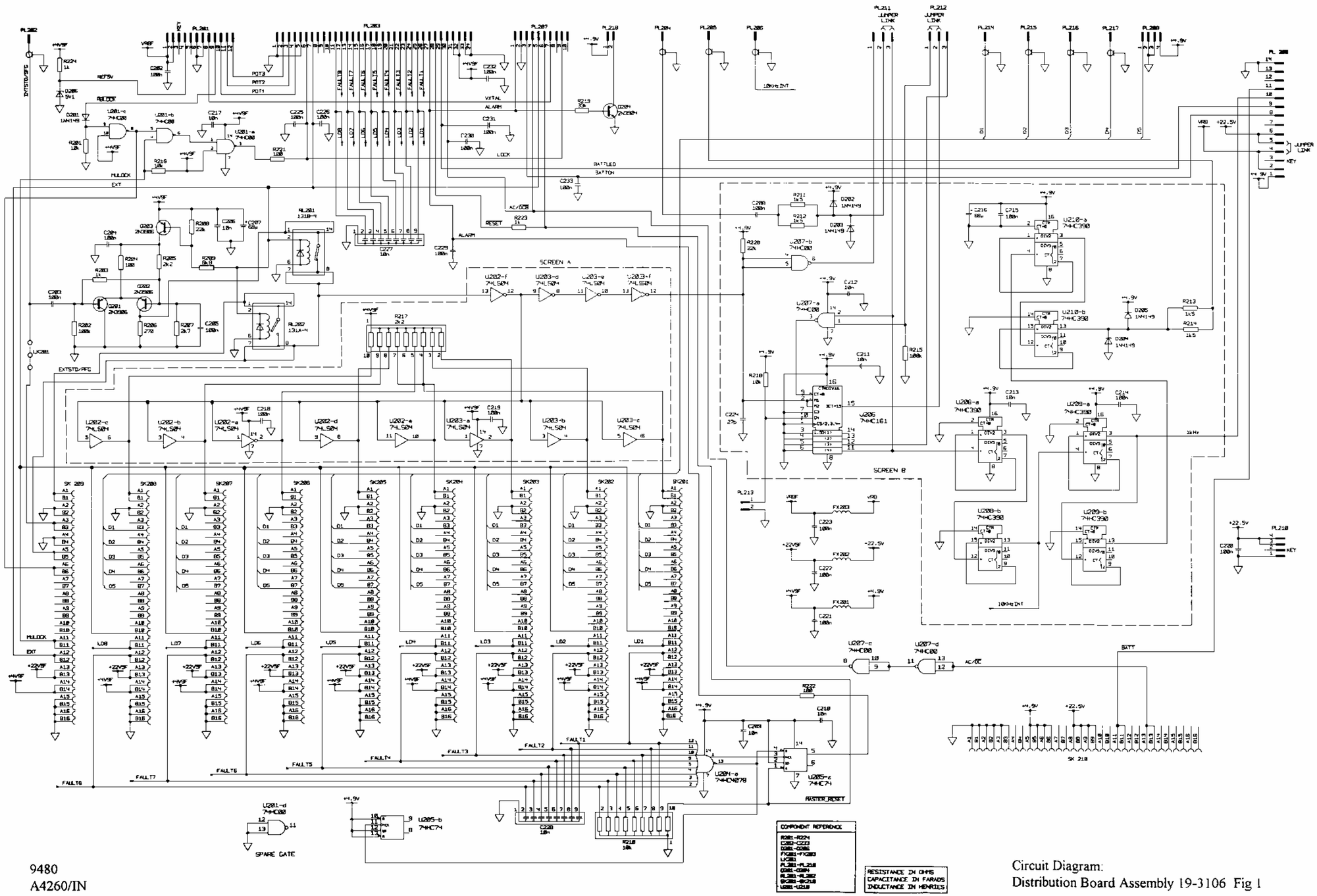
U201		DIL 74HC00			22-4775
U202		DIL 74LS04			22-4533
U203		DIL 74LS04			22-4533
U204		DIL 74HC4078			22-4855
U205		DIL 74HC74			22-4829
U206		BCD Decade Counter			22-4915
U207		DIL 74HC00			22-4775
U208		DIL Dual Decade Counter			22-4920
U209		DIL Dual Decade Counter			22-4920
U210		DIL Dual Decade Counter			22-4920

Coils

FX201		Coil Assembly			17-3166
FX202		Coil Assembly			17-3166
FX203		Coil Assembly			17-3166

Relays

RL201					23-7537
RL202					23-7517



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Circuit Diagram:
Distribution Board Assembly 19-3106 Fig 1

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PARTS LIST

POWER SUPPLY PEC ASSEMBLY 19-3105

(FIGURE 2)

Resistors

	Ohm		W		
R901	4.7		10		

Diodes

D901		Bridge			VH24B

Transformers

T901					CT3588

Switches

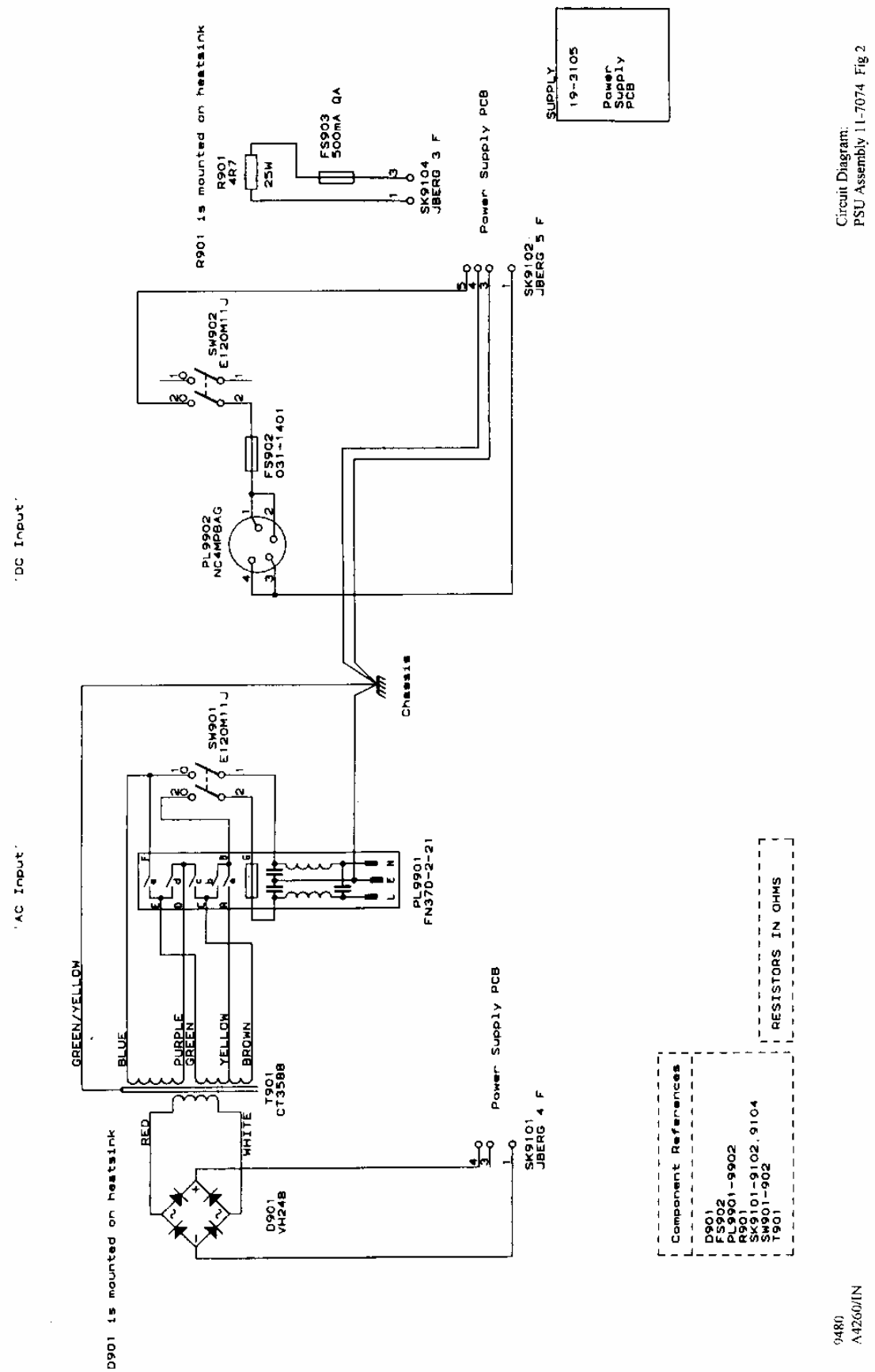
SW9011					E120M11J
SW902					E120M11J

Miscellaneous

FS902					031-1401

PCB

	Power Supply PCB				19-3105



Circuit Diagram:
PSU Assembly 11-7074 Fig 2

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PARTS LIST

POWER SUPPLY PEC ASSEMBLY 19-3105

(FIGURE 3)

Cct. Ref.	Value	Description	Rating	Tol.	Part Number
Resistors					
	Ohms		W		
R101	59k		0.25	0.1	20-7607
R102	20k		0.25	0.1	20-7606
R103	120k		0.25	5	20-2124
R104	10k		0.25	5	20-2103
R105	27k		0.25	5	20-2273
R106	10k		0.25	5	20-2103
R107	68k		0.25	5	20-2683
R108	866		0.25	0.1	20-7603
R109	100		0.25	0.1	20-7601
R110	12		0.5	5	20-3120
R111	12		0.5	5	20-3120
R112	12		0.5	5	20-3120
R113	12		0.5	5	20-3120
R114	1		0.25	5	20-2000
R115	1		0.25	5	20-2000
R116	68k		0.25	5	20-2683
R117	10k		0.25	5	20-2103
R118	71k5		0.25	0.1	20-7608
R119	20k		0.25	0.1	20-7606
R120	270		0.5	5	20-3271
R121	270		0.5	5	20-3271
R122	270		0.5	5	20-3271
R123	2k7		0.25	5	20-2272
R124	500	Potentiometer			20-7065
R125	15k		0.25	5	20-2153
R126	10k		0.25		20-2103
R127	15k		0.25	5	20-2153
R128					
R129	2k		0.25	0.1	20-7604
R130	27k		0.25	5	20-2273
R131	6k49		0.25	0.1	20-7610
R132	10		0.5	5	20-3100
R133	845		0.25	0.1	20-7602
R134	330		0.25	5	20-3331
R135	10k		0.25	5	20-2103
R136	330		0.25	5	20-3331
R137	3k9		0.25	5	20-2392
R138	8k2		0.25	5	20-2822

Capacitors

	F		V		
C101	6800µ	Electrolytic	63		21-0689
C102	6800µ	Electrolytic	63		21-0689
C103	1µ	Electrolytic	50		21-0779
C104	330µ	Electrolytic	40		21-0687
C105	330µ	Electrolytic	40		21-0687
C106	22µ	Electrolytic	40		21-0681
C107	100p	Ceramic	500		21-1520
C108	68µ	Electrolytic	16		21-0625
C109	100n	Ceramic	50		21-1708
C110	100n	Ceramic	50		21-1708
C111	330µ	Electrolytic	40		21-0687
C112	22µ	Electrolytic	40		21-0681

C113	100n	Ceramic	50		21-1708

Diodes

D101					
D102		Rectifier 3A	200		22-1619
D103		IN4149			22-1029
D104		Rectifier 3A	200		22-1619
D105					
D106		IN4149			22-1029
D107		IN4149			22-1029
D108		IN4149			22-1029
D109		Diode BZX79C10			22-1815
D110		Voltage Reference 5V			22-4265
D111		Zener Diode 5V1			22-1808
D112		IN4149			22-1029
D113		Diode BZX79C4V7			22-1807

Transistors

Q101		2N3904			22-6007
Q102		2N3904			22-6007
Q103		BDT91			22-6153
Q104		BD679			22-6262
Q105		BD679			22-6262
Q106		BD676			22-6263
Q107		BD676			22-6263

Integrated Circuits

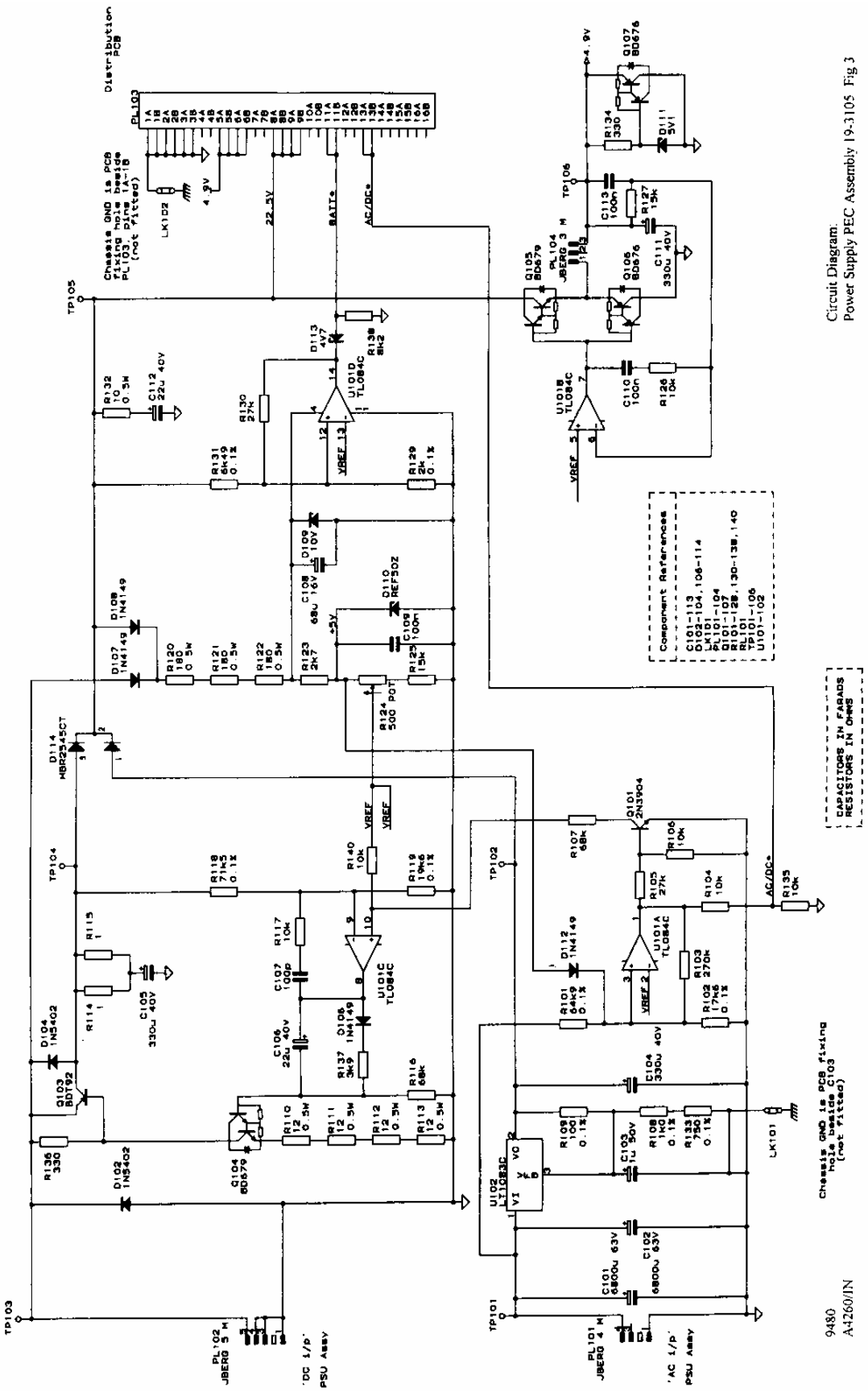
U101		TL084CN			224243
U102		LT1083CP			224312

Relays

RL101		JS1-24V			23-7534

Miscellaneous

PL101		Header Strip 16 Way			23-5606
PL102		Header Strip 16 Way			23-5606
PL103		Connector 32 Way			23-5689
PL104		Header Strip 16 Way			23-5606


Circuit Diagram:
Power Supply PEC Assembly 19-3105 Fig 3
Component References
C101-113
D103-104,106-114
LK101
PL101-104
Q101-107
R101-128,130-138,140
RL101
TP101-106
U101-102
CAPACITORS IN FARADS
RESISTORS IN OHMS
Distribution PCB
PL103
LK102
4.9V
22.5V
BATT+
AC/DC+
Chassis GND is PCB fixing hole beside PL103 (not fitted)
TP105
TP104
TP102
TP103
TP101
TP106
VREF
PL102 JBERG 5 M
'DC I/P' PSU Assy
PL101 JBERG 4 M
'AC I/P' PSU Assy
Chassis GND is PCB fixing hole beside C103 (not fitted)
9480
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PARTS LIST

BATTERY CONTROL PEC ASSEMBLY 19-3109

(FIGURE 4)

Cct. Ref.	Value	Description	Rating	Tol.	Part Number
Resistors					
	Ohms		**w**		
R501	2k2		0.25	5	20-2222
R502	4k7		025	5	20-2472
R503	33k		0.25	5	20-2333
R504	3k3		0.25	5	20-2332
R505	12k		0.25	5	20-2123
R506	100k		0.25	0.1	20-7609
R507	28k		0.25	0.1	20-7595
R508	220k		0.25	5	20-2224
R509	150k		0.25	5	20-2154
R510	15k		0.25	5	20-2153
R511	22k		0.25	5	20-2223
R512	100k		0.25	5	20-2104
R513	33k		0.25	5	20-2333
R514	10k		0.25	5	20-2103
R515	33k		0.25	5	20-2333
R516	1k		0.25	5	20-2102
R517	3k9		0.25	5	20-2392
R518	110		0.25	5	20-2111
R519	39	Wire-wound	2.5		20-5080
R520	39	Wire-wound	2.5		20-5080
R521	47k		0.25	5	20-2473
R522	3k3		0.25	5	20-2332
R523	1k5		0.25	5	20-3152
R524	1k5		0.25	5	20-3152
R525	10k		0.25	5	20-2103
R526	6k8		0.25	5	20-2682
R527	4k7		0.25	5	20-2472
R528					
R529	10k		0.25	5	20-2103
R530	2k2		0.25	5	20-2222
R531	10k		0.25	5	20-2103
R532	330k		0.25	5	20-2334
R533	47k		0.25	5	20-2473
R534	47k		0.25	5	20-2473
R535	3M3		0.25	5	20-2335
R536	22k		0.25	5	20-2223
R537	39	Wire-wound	2.5		20-5080
R538	39	Wire-wound	2.5		20-5080
R539	39	Wire-wound	2.5	-	20-5080
R540	100k		0.25	5	20-2104
R541	100k		0.25	5	20-2104
R542	100k		0.25	5	20-2104
R543	10k		0.25	5	20-2103

Capacitors

	F		**V**		
C501	100n		50	20	21-1708
C502	100n		50	20	21-1708
C503	100n		50	20	21-1708
C504	100n		50	20	21-1708
C505	100n		50	20	21-1708
C506	10n		25	20	21-1545
C507	1µ		100	20	21-5507

C508	47µ		25	20	21-0789

Diodes

D501		IN4149			22-1029
D502		Voltage Regulator 5V1			22-1808
D503		Diode REF50Z			22-4265
D504		IN4149			22-1029
D505		Voltage Regulator 12V			22-1817
D506		Voltage Regulator 8V2			22-1813
D507		IN4002			22-1602
D508		IN4002			22-1602
D509		IN4149			22-1029
D510		IN4149			22-1029
D511		Voltage Regulator 5V1			22-1808
D512		Voltage Regulator 2V7			22-1801
D513		Voltage Regulator 2V7			22-1801
D514		IN4149			22-1029
D515		OA91			22-0005

Transistors

Q501		2N3904			22-6007
Q502		2N3904			22-6007
Q503		RFP12P0B			22-6267
Q504		2N3904			22-6007
Q505		ZTX750			22-6185
Q506		BD438			22-6270
Q507		ZTX750			22-6185
Q508		2N3904			22-6007
Q509		2N3904			22-6007
Q510		2N3904			22-6007
Q511		J177			22-6264

Integrated Circuits

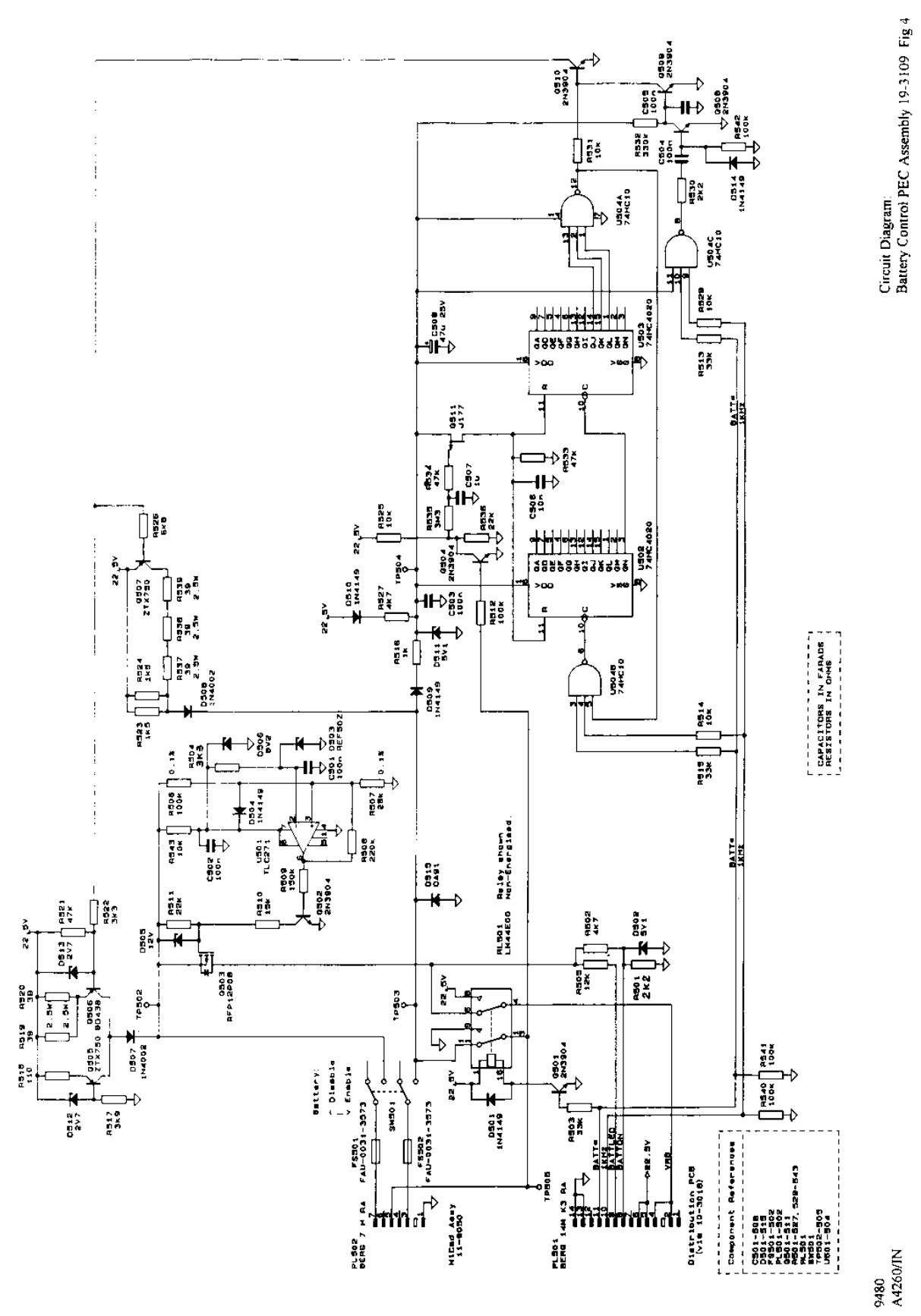
U501		TLC271			22-5118
U502		74HC4020			224919
U503		74HC4020			224919
U504		74HC10			224918

Relays

RL501		LM44EOO			22-7535

Miscellaneous

S501		Switch 2 Pole 2 Way			23-4127
FS501		Fuselink 5x20 mm			23-0009
FS502		Fuselink 5x20 mm			23-0009



Circuit Diagram
Battery Control PEC Assembly 19-3109 Fig 4

9480
A4260/IN

PARTS LIST
OUTPUT BOARD(S)
19-3100 (13 MHz), 19-3101(10 MHz), 19-3102 (5 MHz), 19-3103 (1 MHz), 19-3104 (100 kflz)

(FIGURE 5)

Cct. Ref.	Value	Description	Rating	Tol.	Part Number
Resistors					
	Ohms		W		
R1	6k8		0.25	5	20-2682
R2	2k7		0.25	5	20-2272
R3	100		0.25	5	20-2101
R4	1k2		0.25	5	20-2122
R5	1k5		0.25	5	20-2152
R6	470		0.25	5	20-2471
R7	10		0.25	5	20-2100
R8	82		0.25	5	20-2820
R9	10		0.25	5	20-2100
R10	100k		0.25	5	20-2104
R11	330k		0.25	5	20-2334
R12	330k		0.25	5	20-2334
R13	6k8		0.25	5	20-2682
R14	2k7		0.25	5	20-2272
R15	100		0.25	5	20-2101
R16	1k2		0.25	5	20-2122
R17	10		0.25	5	20-2100
R18	1k5		0.25	5	20-2152
R19	82		0.25	5	20-2820
R20	10		0.25	5	20-2100
R21	470		0.25	5	20-2471
R22	100k		0.25	5	20-2104
R23	330k		0.25	5	20-2334
R24	6k8		0.25	5	20-2682
R25	2k7		0.25	5	20-2272
R26	100		0.25	5	20-2101
R27	1k2		0.25	5	20-2122
R28	1k5		0.25	5	20-2152
R29	470		0.25	5	20-2471
R30	10		0.25	5	20-2100
R31	82		0.25	5	20-2820
R32	10		0.25	5	20-2100
R33	100k		0.25	5	20-2104
R34	330k		0.25	5	20-2334
R35					
19-3100	110		0.25	5	20-2111
19-3101	120		0.25	5	20-2121
19-3102	130		0.25	5	20-2131
19-3103	120		0.25	5	20-2121
19-3104	100		0.25	5	20-2101
R36	100		0.25	5	20-2101
R37	1k8		0.25	5	20-2182
R38	47		0.25	5	20-2470
R39	820		0.25	5	20-2821
R40	100		0.25	5	20-2101
R41	6k8		0.25	5	20-2682
R42	2k7		0.25	5	20-2272
R43	100		0.25	5	20-2101
R44	1k2		0.25	5	20-2122
R45	1k5		0.25	5	20-2152
R46	470		0.25	5	20-2471
R47	10		0.25	5	20-2100

R48	82		0.25	5	20-2820
R49	10		0.25	5	20-2100
R50	100k		0.25	5	20-2104
R51	330k		0.25	5	20-2334
R52	6k8		0.25	5	20-2682
R53	2k7		0.25	5	20-2272
R54	100		0.25	5	20-2101
R55	1k2		0.25	5	20-2122
R56	1k5		0.25	5	20-2152
R57	470		0.25	5	20-2471
R58	10		0.25	5	20-2100
R59	82		0.25	5	20-2820
R60	10		0.25	5	20-2100
R61	100k		0.25	5	20-2104
R62	330k		0.25	5	20-2334
R63	1k8		0.25	5	20-2182

Capacitors

	F		V		
C1	100n	Ceramic	50	20	21-1708
C2	100n	Ceramic	50	20	21-1708
C3	3.3µ	Aluminum Electrolytic	25	20	21-0762
C4	100n	Ceramic	50	20	21-1708
CS	100n	Ceramic	50	20	21-1708
C6	100n	Ceramic	50	20	21-1708
C7	47µ	Aluminum Electrolytic	25	20	21-0789
C8	10n	Ceramic	'00	+801-20	21-1709
C9	10n	Ceramic	100	+801-20	21-1709
C10	100n	Ceramic	50	20	21-1708
C11	22µ	Aluminum Electrolytic	40	20	21-0681
C12	100n	Ceramic	50	20	21-1708
C13	100n	Ceramic	50	20	21-1708
C14	10n	Ceramic	100	+801-20	21-1709
C15	3.3µ	Aluminum Electrolytic	25	20	21-0762
C16	100n	Ceramic	50	20	2i-l70~
C17	47µ	Aluminum Electrolytic	25	20	21-0789
C18	100n	Ceramic	50	20	21-1708
C19	100n	Ceramic	50	20	21-1708
C20	10n	Ceramic	100	+801-20	21-1709
C21	100n	Ceramic	50	20	21-1708
C22	100n	Ceramic	50	20	21-1708
C23	3.3µ	Aluminum Electrolytic	25	20	21-0762
C24	100n	Ceramic	50	20	21-1708
C25	100n	Ceramic	50	20	21-1708
C26	100n	Ceramic	50	20	21-1708
C27	47µ	Aluminum Electrolytic	25	20	21-0789

C28					
19-3100	68p	Polyester			21-2643
19-3101	100p	Silver Mica			21-3031
19-3102	180p	Silver Mica			21-3037
19-3103	1n5	Silver Mica			21-2917
19-3104	12n	Polyester			21-3577

C29					
19-3100	18p	Ceramic	63	2	21-1683
19-3101	22p	Ceramic	63	2	21-1684
19-3102	33p	Ceramic	63	2	21-1686
19-3103	274p	Silver Mica			21-2842
19-3104	3n4	Polyester			21-3851

C30					
19-3100	120p	Polyester			21-2645
19-3101	150p	Silver Mica			21-3035

19-3102	330p	Silver Mica			21-2659
19-3103	1n91	Silver Mica			21-2927
19-3104	12n	Polyester			21-3577

C31	100n	Ceramic	50	20	21-1708
C32	100n	Ceramic	50	20	21-1708
C33	47µ	Aluminum Electrolytic	25	20	21-0789
C34	10n	Ceramic	100	+801-20	21-1709
C35					
C36	100n	Ceramic	50	20	21-1708
C37	3.3µ	Aluminum Electrolytic	25	20	21-0762
C38	100n	Ceramic	50	20	21-1708
C39	100n	Ceramic	50	20	21-1708
C40	100n	Ceramic	50	20	21-1708
C41	47µ	Aluminum Electrolytic	25	20	21-0789
C42	100n	Ceramic	50	20	21-1708
C43	3.3µ	Aluminum Electrolytic	25	20	21-0762
C44	100n	Ceramic	50	20	21-1708
C45	100n	Ceramic	50	20	21-1708
C46	100n	Ceramic	50	20	21-1708
C47	100n	Ceramic	50	20	21-1708
C48	47µ	Aluminum Electrolytic	25	20	21-0789
C49	100n	Ceramic	50	20	21-1708
C50	100n	Ceramic	50	20	21-1708

C51					
19-3100	60p4	Polyester			21-2774
19-3101	86p6	Silver Mica			21-2790
19-3102	174p	Silver Mica			21-2823

C52					
19-3100	68p	Polyester			21-2643
19-3101	100p	Silver Mica			21-3031
19-3102	180p	Silver Mica			21-3037

Diodes

D1		Zener 6V2			22-1810
D2		Diode SIL IN4149			22-1029
D3		Diode SIL IN4149			22-1029
D4		Diode SIL IN4149			22-1029
D5		Diode SIL IN4149			22-1029
D6		Diode SIL IN4149			22-1029
D7		Diode SIL IN4149			22-1029
D8		Diode SIL IN4149			22-1029
D9		Diode SIL IN4149			22-1029
D10		Diode SIL IN4149			22-1029
D11		Diode SIL IN4149			22-1029

Inductors

SEL1-5					
19-3100	18µH	Inductor		±10	23-7207
19-3101	33µH	Inductor		±10	23-7163
19-3102	150µH	Inductor		±10	23-7165
19-3103	33pF	Capacitor, Ceramic 500V			21-1514
19-3104	1nF	Capacitor, Ceramic 500V			21-1532

L1	100µ	Inductor		10	23-7213
L2	10µ	Inductor		10	23-7155
L3	10µ	Inductor		10	23-7155
L4	100µ	Inductor		10	23-7213
L5	100µ	Inductor		10	23-7213

L6					
19-3100	1µ2			10	23-7193
19-3101	1µ5			10	23-7194
19-3102	3µ3			10	23-7198
19-3103	12µ			10	23-7205
19-3104	100µ			10	23-7213

L7	100µ	Inductor		10	23-7213

L8					
19-3100	680n			10	23-7190
19-3101	820n			10	23-7191
19-3102	1µ8			10	23-7195
19-3103		Wire Link Fitted		23-9124	
19-3104		Wire Link Fitted		23-9124	

L9	100µ	Inductor		10	23-7213

Transistors

Q1		N-Type 2N2219			22-6261
Q2		NPN 2N3904			22-6007
Q3		N-Type 2N2219			22-6261
Q4		NPN 2N3904			22-6007
QS		N-Type 2N2219			22-6261
Q6		NP N 2N3904			22-6007
Q7		N-Type 2N2219			22-6261
Q8		NPN 2N3904			22-6007
Q9		N-Type 2N2219			22-6261
Q10		NPN 2N3904			22-6007
Q11		NPN 2N3639			22-6017

Integrated Circuits

U1		DIL 74HC30			224828

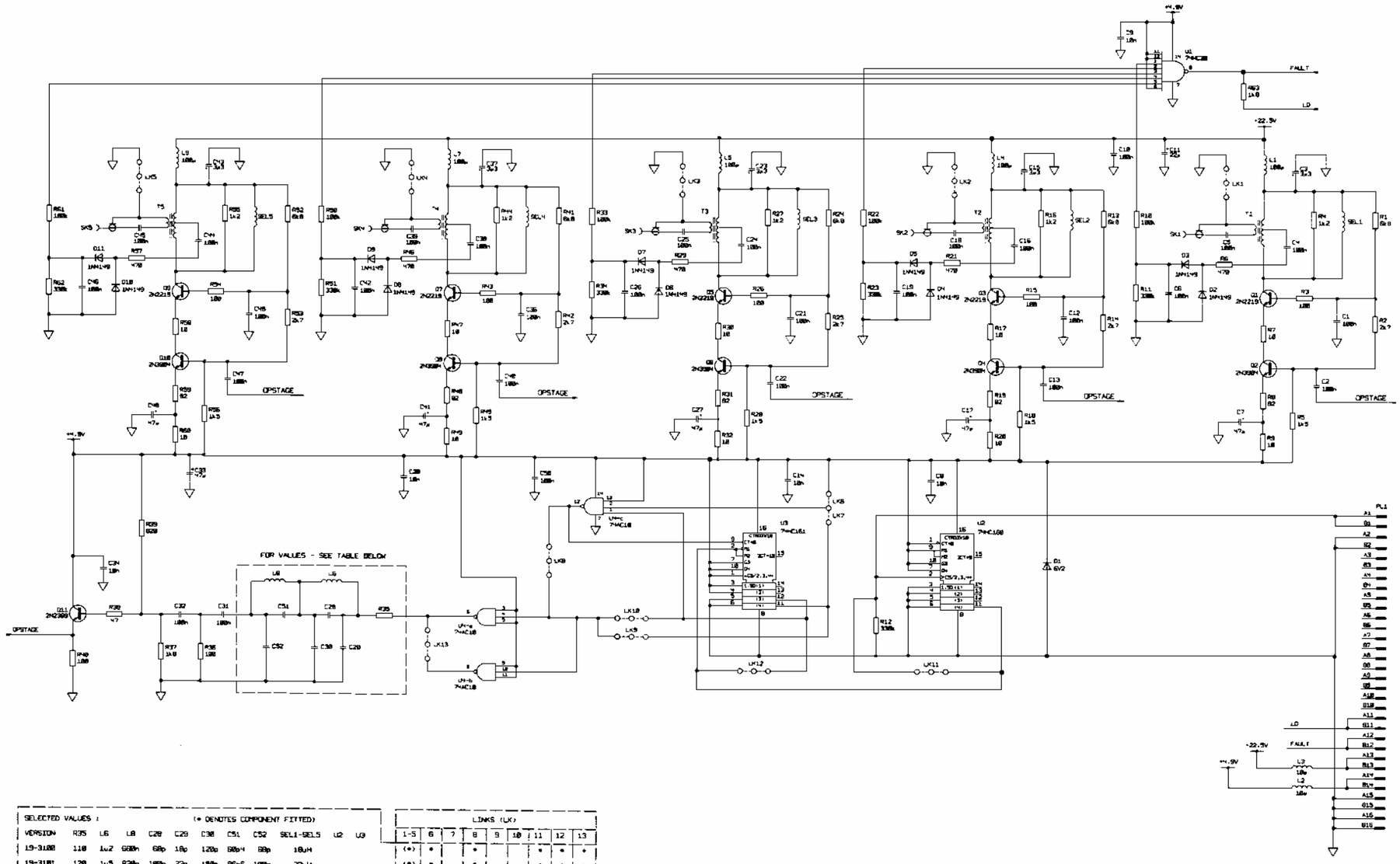
U2					
19-3104		DIL 74HC160			224914

U3					
19-3102		DIL 74HC161			224915
19-3103		DIL 74HC161			224915
19-3104		DIL 74HC161			224915

U4		Triple Input NAND 74AC 10			22-5111

Miscellaneous

LK (1-13) as fitted.		Link(s) BTC 0.56mm dia			25-0004



SELECTED VALUES :						(* DENOTES COMPONENT FITTED)							
VERSION	R35	L6	L8	C28	C29	C38	C51	C52	SEL1-SEL5	L2	L3
19-3100	11Ω	1u2	680n	68p	18p	120p	68pH	68p	18uH		
19-3101	12Ω	1u5	820n	100p	22p	150p	86pS	100p	33uH		
19-3102	13Ω	3u3	1u8	180p	33p	330p	174p	180p	150uH		*
19-3103	12Ω	12u	%	1n5	27*p	1n91			33pF		*
19-3104	10Ω	100u	%	12n	3n4	12n			1nF	*	*

X - WIRE LINK FITTED

LINKS (LK)								
1-5	6	7	8	9	10	11	12	13
(*)	*		*			*	*	*
(*)	*		*			*	*	*
(*)	*				*	*		*
(*)		*		*		*		*
(*)		*		*				*

(*) = * FOR NON-FLOATING COMPONETS

VERSION		FREQ.
	19-3100	13MHz
	19-3101	10MHz
	19-3102	5MHz
	19-3103	1MHz
	19-3104	100kHz

RESISTANCE IN OHMS
CAPACITANCE IN FARADS
INDUCTANCE IN HENRIES

COMPONENT REFERENCES
R1-R53
C1-C34,C38-C52
D1-D11
L1-L9
LK1-LK13
P.1
Q1-Q11
SEL1-SEL5
SK1-SK5
T1-T5
U1-U4

Circuit Diagram:
Output Board(s) 19-3100 to 3104 Fig 5

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PARTS LIST
2.048 MHz OUTPUT BOARD 19-3125
(FIGURE 6)

Cct. Ref.	Value	Description	Rating	Tol.	Part Number
Resistors					
	Ohms		**W**		
R1	680		0.25	5	20-2681
R2	1k		0.25	5	20-2102
R3	150		0.25	5	20-2151
R4	1k		0.25	5	20-2102
R5	1k		0.25	5	20-2102
R6	1M		0.25	5	20-2105
R7					
R8	1k		0.25	5	20-2102
R9					
R10	100		0.25	5	20-2101
R11	1k8		0.25	5	20-2182
R12	1k2		0.5	5	20-3122
R13	4k7		0.25	5	20-2472
R14	100k		0.25	5	20-2104
R15	1k2		0.5	5	20-3122
R16	4k7		0.25	5	20-2472
R17	100k		0.25	5	20-2104
R18	1k2		0.5	5	20-3122
R19	4k7		0.25	5	20-2472
R20	100k		0.25	5	20-2104
R21	1k2		0.5	5	20-3122
R22	4k7		0.25	5	20-2472
R23	100k		0.25	5	20-2104
R24	1k2		0.5	5	20-3122
R25	4k7		0.25	5	20-2472
R26	100k		0.25	5	20-2104
R27	470		0.25	5	20-2471
R28	10k		0.25	5	20-2103
R29	0.5		0.5	5	20-3122
R30	0.5		0.5	5	20-3122
R31	1k2		0.5	5	20-3122
R32	1k2		0.5	5	20-3122
R33	1k2		0.5	5	20-3122
R34	100		0.25	5	20-2101
R35	100		0.25	5	20-2101
R36	100		0.25	5	20-2101
R37	100		0.25	5	20-2101
R38	1M		0.25	5	20-2105
R39					
R40	10k		0.25	5	20-2103
R41	18		0.25	5	20-2180

Capacitors

	F		V		
C1	10n	Ceramic	100	+80/-20	21-1709
C2	10n	Ceramic	100	+80/-20	21-1709
C3	10n	Ceramic	100	+80/-20	21-1709
C4	10n	Ceramic	100	+80/-20	21-1709
C5	10n	Ceramic	100	+80/-20	21-1709
C6	10n	Ceramic	'00	+80/-20	21-1709
C7	10n	Ceramic	I 00	+80/-20	21-1709
C8	10n	Ceramic	'00	+80/-20	21-1709
C9	10n	Ceramic	100	+80/-20	21-1709
C10	10n	Ceramic	100	+80/-20	21-1709
C11					
C12					
C13	10n	Ceramic	100	+80/-20	21-1709
C14	33µ	Aluminum Electrolytic	40	20	21-0693
C15	100n	Ceramic	50	20	21-1708

C16	470n	Polyester	63	10	214568
C17	470n	Polyester	63	10	214568
C18	150n	Polycarbonate			21-5541
C19					
C20	100n	Ceramic	50	20	21-1708
C21	100n	Ceramic	50	20	21-1708
C22	100n	Ceramic	50	20	21-1708
C23	100n	Ceramic	50	20	21-1708
C24	100n	Ceramic	50	20	21-1708
C25	10n	Ceramic	100	+80/-20	21-1709
C26	10n	Ceramic	100	+80/-20	21-1709

Inductors

	H				
L1	10µ			10	23-7155
L2	10µ			10	23-7155

Diodes

D1		Zener 5V6			22-1809
D2					
D3					
D4		Zener 8V2			22-1813
D5					
D6		Diode SIL IN4149			22-1029
D7		Diode SIL IN4149			22-1029
D8		Diode SIL IN4149			22-1029
D9					
D10		Diode SIL IN4149			22-1029
D11		Diode SIL IN4149			22-1029
D12		Diode SIL IN4149			22-1029
D13					
D14		Diode SIL IN4149			22-1029
D15		Diode SIL IN4149			22-1029
D16		Diode SIL 1N4149			22-1029
D17					
D18		Diode SIL IN4149			22-1029
D19		Diode SIL IN4149			22-1 029
D20		Diode SIL IN4149			22-1029
D21					
D22		Diode SIL IN4149			22-1029
D23		Diode SIL IN4149			22-1029
D24		Diode SIL IN4149			22-1029
D25		Zener 5V1			22-1808
D26		Zener 13V			22-1818

Transistors

Q1		NPN ZTX450			22-6112
Q2		NPN ZTX450			22-6112
Q3		NPN ZTX450			22-6112
Q4		NPN ZTX450			22-6112
Q5		NPN ZTX450			22-6112
Q6		NPN BD135			22-6252
Q7		NPN ZTX450			22-6112

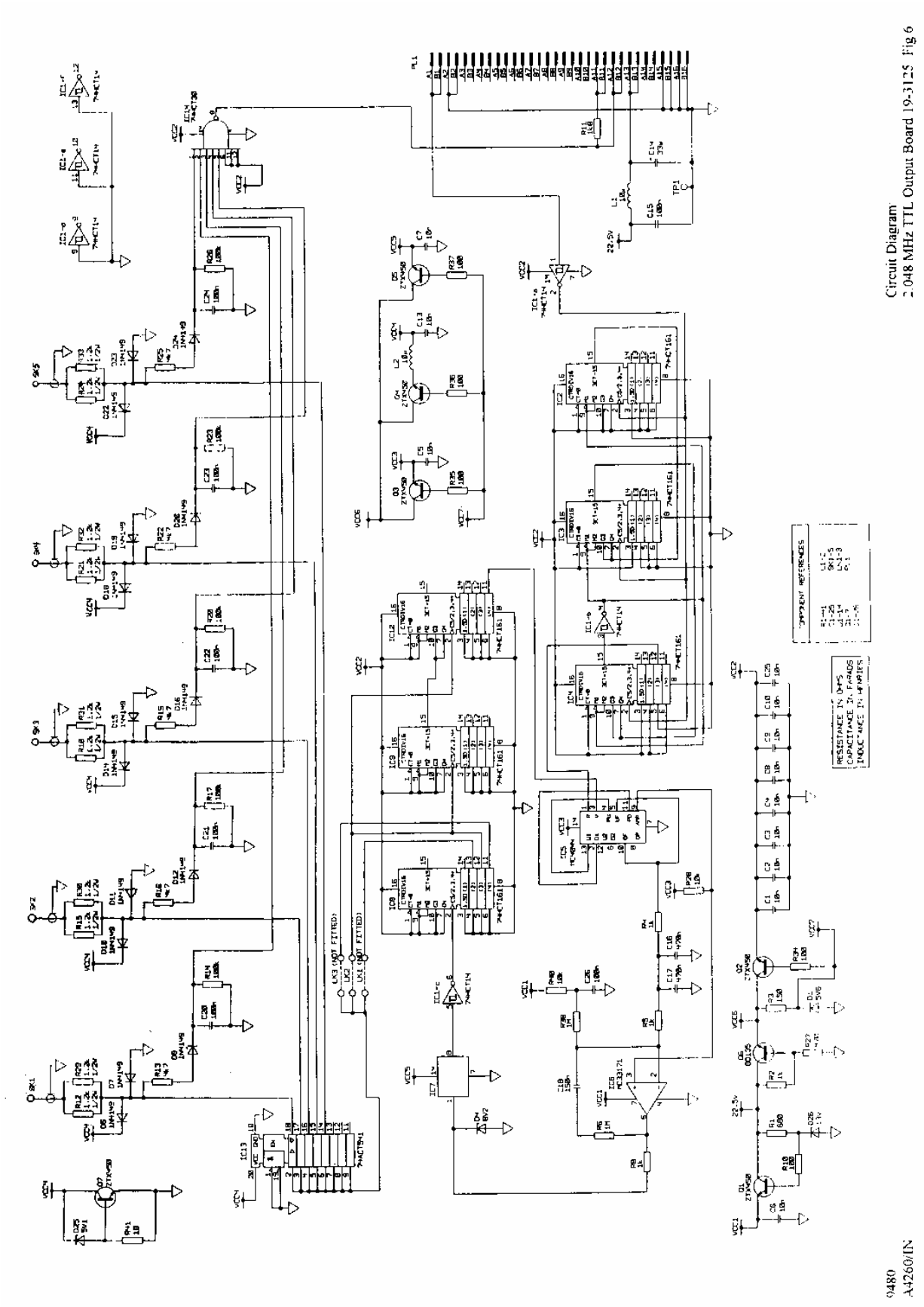
Integrated Circuits

U1		Hex Inverter 74HCT14			22-4925
U2		BCD Decade Counter 74HCT161			22-4924
U3		BCD Decade Counter 74HCT161			22-4924
U4		BCD Decade Counter 74HCT161			22-4924
U5		Phase Freq Detector MC4044			22-4200
U6		Op Amp MC33171			22-4351
U7		Crystal Oscillator 16.38 MHz			23-9208
U8		BCD Decade Counter 74HCT 161			22-4924
U9		BCD Decade Counter 74HCT161			22-4924
U10		BCD Decade Counter 74HCT161			22-4924

U11					
U12					
U13		Octal Buffer 74ACT541			22-5143
U14		8 Input NAND 74HC30			22-4819

Links

LK2		BTC 0.56mm dia			25-0004



Circuit Diagram
2.048 MHz TTL Output Board 19-3125 Fig 6

9480
A4260/IN

PARTS LIST
MULTIPLIER ASSEMBLY 19-3139 AND
EXTERNAL REFERENCE ASSEMBLY 19-3108
(FIGURE 7)

Note: These are similar assemblies. Components not fitted to assembly 19-3108 are indicated *.

Cct. Ref.	**Value**	Description	Rating	Tol. %	Part Number
Resistors					
	Ohms		W		
R301	56		0.25	5	20-2560
R302					
R303	56		0.25	5	20-2560
R304	220		0.25	5	20-2221
R305	2k2		0.25	5	20-2222
R306	3k9		0.25	5	20-2392
R307					
R308	47k		0.25	5	20-2473
R309	1k		0.25	5	20-2102
R310	10k		0.25	5	20-2103
R311	1k		0.25	5	20-2102
R312					
R313	47k		0.25	5	20-2473
R314	1k	Potentiometer			20-7112
R315	2k2		0.25	5	20-2222
R316	68k		0.25	5	20-2683
R317	47k		0.25	5	20-2473
R318	4k7		0.25	5	20-2472
R319	33k		0.25	5	20-2333
R320	33k		0.25	5	20-2333
R321	10k		0.25	5	20-2103
R322					
R323*	10k		0.25	5	20-2103
R324*	330		0.25	5	20-2331
R325*	56		0.25	5	20-2560
R326*	220		0.25	5	20-2221
R327*	220		0.25	5	20-2221
R328*	220		0.25	5	20-2221
R329*	220		0.25	5	20-2221
R330*					
R331*	10k		0.25	5	20-2103
R332*	10k		0.25	5	20-2103
R333*	220		0.25	5	20-2221
R334*	10k		0.25	5	20-2103
R335*	560k		0.25	5	20-2564
R336*	10k		0.25	5	20-2103
R337*	15k		0.25	5	20-2153
R338*	1k8		0.25	5	20-2182
R339*	100k		0.25	5	20-2104
R340*	150k		0.25	5	20-2154
R341*	100		0.25	5	20-2101
R342*	220		0.25	5	20-2221
R343*	390		0.25	5	20-2391
R344*	2k2		0.25	5	20-2222
R345*	3k9		0.25	5	20-2392
R346*	22k		0.25	5	20-2223

Capacitors

	F				
C301	100n	Ceramic	50	20	21-1708
C302	100n	Ceramic	50	20	21-1708
C303	220p	Ceramic	63	2	21-1696
C304	100n	Ceramic	50	20	21-1708
C305					

C306					
C307	100n	Ceramic	50	20	21-1708
C308	100n	Ceramic	50	20	21-1708
C309					
C310	100n	Ceramic	50	20	21-1708
C311		Aluminum Electrolytic	16	-10+50	21-0625
C3l2	2.7n	Ceramic		-20+40	21-1537
C313	100n	Ceramic	50	20	21-1708
C314	220p	Ceramic	63	2	21-1696
C315	39p	Ceramic	63	2	21-1687
C316					
C317*	100n	Ceramic	50	20	21-1708
C318*	10n	Ceramic	100	+80-20	21-1709
C319*	10n	Ceramic	100	+80-20	21-1709
C320*	100n	Ceramic	50	20	21-1708
C321*	10n	Ceramic	100	+80-20	21-1709
C322*	10n	Ceramic	100	+80-20	21-1709
C323*	10n	Ceramic	100	+80-20	21-1709
C324*	220p	Ceramic	63	2	21-1696
C325*	220p	Ceramic	63	2	21-1696
C326*	100n	Ceramic	50	20	21-1708
C327*	100n	Ceramic	50	20	21-1708
C328*	2-15p	Cap Trimmer			21-6043
C329*	100n	Ceramic	50	20	21-1708
C330*	10n	Ceramic	100	+80-20	21-1709
C331*	10n	Ceramic	100	+80-20	21-1709
C332*	10µ	Aluminum Electrolytic	40	20	21-0798
C333*	10n	Ceramic	50	20	21-1708
C334*	10n	Ceramic	I 00	+80-20	21-1709

Inductors

	H				
L301	1.2µ			10	23-7193
L302					
L303					
L304	33µ			10	23-7163
L305	33µ			10	23-7163
L306	1.2µ			10	23-7193
L307					
L308*	33µ			10	23-7163

Diodes

D301		SIL BAW62			22-1049
D302		SIL BAW62			22-1049
D303					
D304					
D305		Diode Schottkv 5082-2826			22-1073
D306					
D307		Diode Schottkv 5082-2X26			22-1073
D308					
D309*		SIL IN4149			22-1029
D310*		SIL IN4149			22-1029
D311*		SIL IN4149			22-1029
D312*		SIL IN4149			22-1029
D313*		MV1640			22-1097
D314*		SIL IN4149			22-1029

Transistors

Q301		PNP 2N3906			22-6008
Q302		PNP 2N3906			22-6008
Q303		NPN 2N3904			22-6007
Q304		PNP 2N3906			22-6008
Q305					

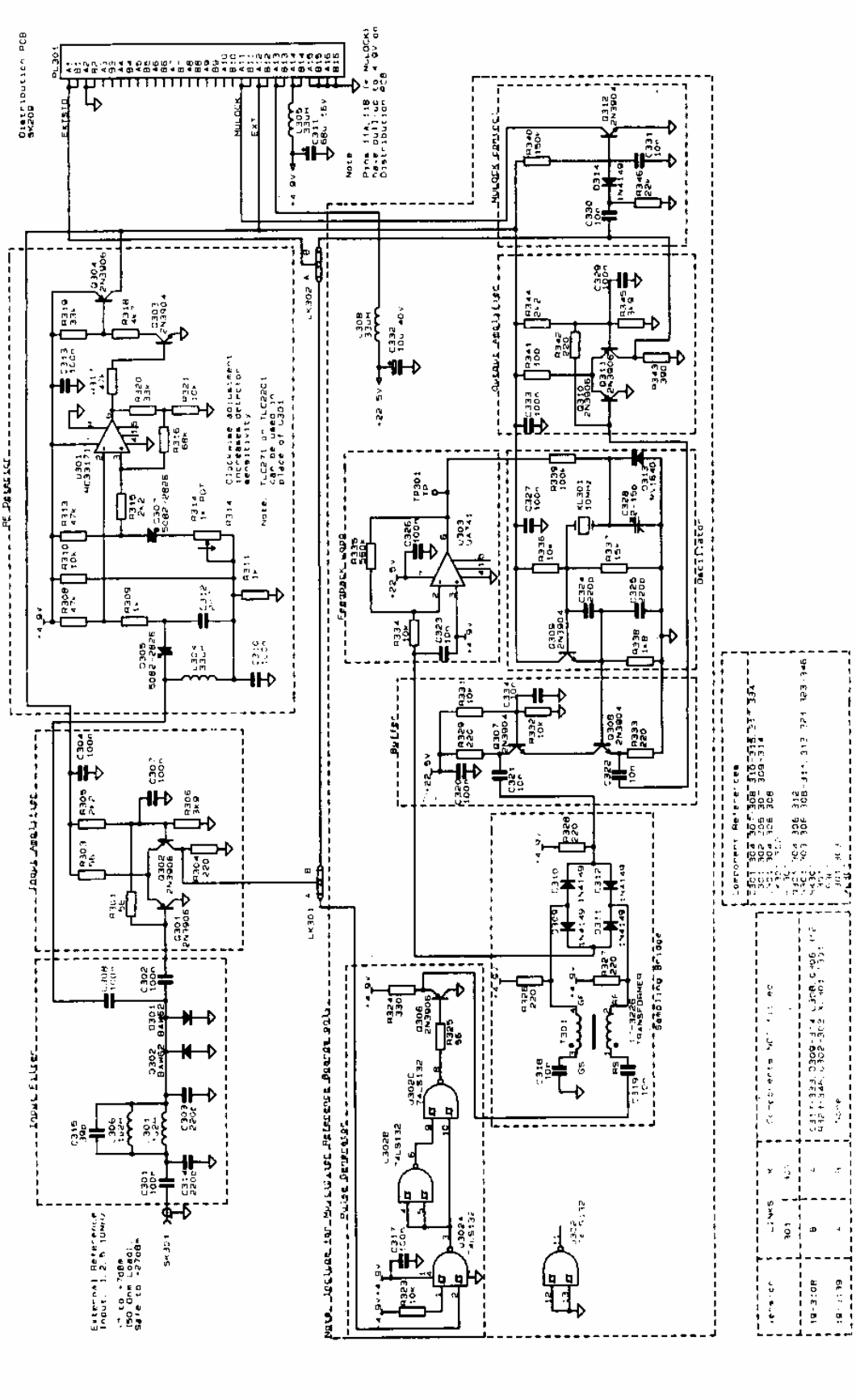
Q306*		PNP 2N3906			22-6008
Q307*		NPN 2N3904			22-6007
Q308*		NPN 2N3904			22-6007
Q309*		NPN 2N3904			22-6007
Q310*		PNP 2N3906			22-6008
Q311*		PNP 2N3906			22-6008
Q312*		NPN 2N3904			22-6007

Integrated Circuits

U301		Op-Amp MC33171			224351
U302*		DIL 74L5132			224582
U303*		DIL UA741			224111

Miscellaneous

XL301*		Crystal Osc 10 MHz			17-2114
T301*		Coil Assembly			17-3226
LK301		Link BTC 0.56 mm dia			25-0004
LK302		Link BTC 0.56 mm dia			25-0004



Circuit Diagram:
Multiplier Assy 19-3139/Reference Assy 19-3108 Fig 7

9480
A42560/IN

PARTS LIST
EFERENCE CIIANGE OVER BOARD
19-3172
(FIGURE 8)

Cct. Ref.	Value	Description	Rating	ToL	Part Numher
Resistors					
	Ohms	w			
R301	56		0.25	5	20-2560
R302					
R303	56		0.25	5	20-2560
R304	220		0.25	5	20-2221
R305			0.25	5	20-2222
R306	3k9		0.25	5	20-2392
R307					
R308	47"		0.25	5	20-2473
R309	1k		0.25	5	20-2102
R310	10k		0.25	5	20-2103
R311	1k		0.25	5	20-2102
R312					
R313	47k		0.25	5	20-2473
R314	1k	Potentiometer			20-7112
R315	2k2		0.25	5	20-2222
R316	68k		0.25	S	20-2683
R317	47"		0.25	5	20-2473
R318	4k7		0.25	5	20-2472
R319	33k		0.25	5	20-2333
R320	33k		0.25	5	20-2333
R321	10k		0.25	5	20-2103
R322					
R323					
R324					
R325					
R326					
R327					
R328					
R329					
R330					
R331		Resistors designated R322 to R340 are not installed.			
R332					
R333					
R334					
R335					
R336					
R337					
R338					
R339					
R340					
R341	56		0.25	5	20-2560
R342	56		0.25	5	20-2560
R343	220		0.25	5	20-2221
R344	2k2		0.25	S	20-2222
R345	3k9		0.25	5	20-2392
R346					
R347	1k		0.25	5	20-2102
R348	2k2		0.25	5	20-2222
R349					
R350	10k		0.25	5	20-2103
R351	10k		0.25	5	20-2103
R352	1k		0.25	5	20-2102
R353	10k		0.25	5	20-2103
R354	1k		0.25	5	20-2102
R355	1k		0.25	5	20-2102
R356	10k		0.25	5	20-2103
R357	10k		0.25	5	20-2103
R358	12k		0.25	5	20-2123

R359	220		0.25	5	20-2221

Capacitors

	F		V		
C301	100n	Ceramic	50	20	21-1708
C302	100n	Ceramic	50	20	21-1708
C303	220p	Ceramic	63	±2	21-1696
C304	100n	Ceramic	50	20	21-1708
C305					
C306					
C307	100n	Ceramic	50	20	21-1708
C308	100n	Ceramic	50	20	21-1708
C309					
C310	100n	Ceramic	50	20	21-1708
C311	68µ	Aluminum Elec	16	-10+50	21-0625
C312	2.7n	Ceramic		-20+40	21-1537
C313	100n	Ceramic	50	20	21-1708
C314	220p	Ceramic	63	±2	21-1696
C315					
C329	100n	Ceramic	50	20	21-1708
C330					
C331					
C332					
C333	100n	Ceramic	50	20	21-1708
C334					
C335	100n	Ceramic	50	20	21-1708
C336	100n	Ceramic	50	20	21-1708
C337	100n	Ceramic	so	20	21-1708
C338	100n	Ceramic	50	20	21-1708

Inductors

	H				
L301	1.2µ			±10	23-7193
L302					
L303					
L304	33µ			±10	23-7163
L305	33µ			±10	23-7163
L306	1.2µ			±10	23-7193

Diodes

D301		Diode SIL BAW62			22-1049
D302		Diode SIL BAW62			22-1049
D303					
D304					
D305		Schottky			22-1073
D306					
D307		Schotticy			22-1073

Transistors

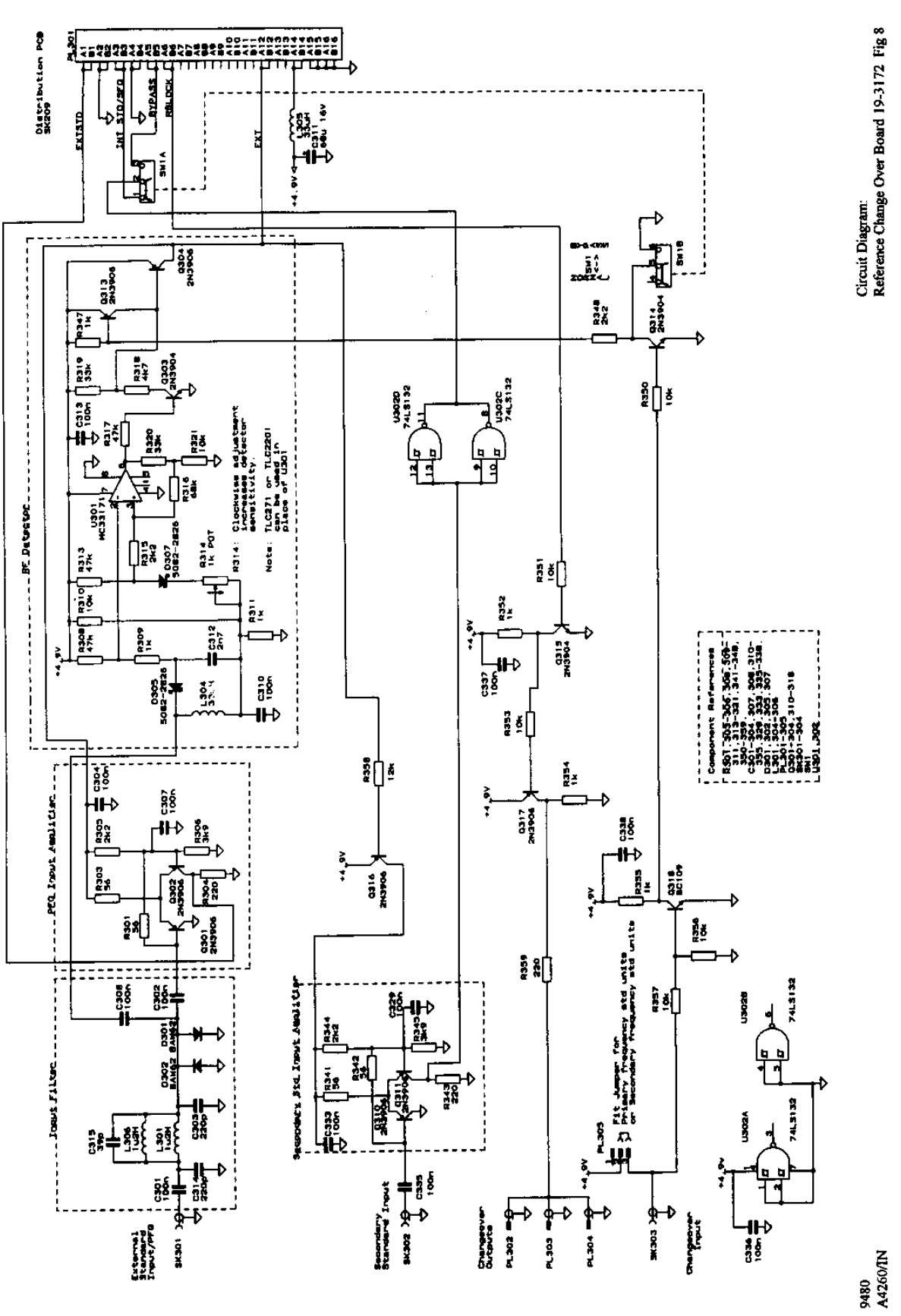
Q301		PNP 2N3906			22-6008
Q302		PNP 2N3906			22-6008
Q303		NPN 2N3904			22-6007
Q304		PNP 2N3906			22-6008
Q305					
Q310		PNP 2N3906			22-6008
Q311		PNP 2N3906			22-6008
Q312					
Q313		PNP 2N3906			22-6008
Q314		NPN 2N3904			22-6007
Q315		NPN 2N3904			22-6007
Q316		PNP 2N3906			22-6008
Q317		PNP 2N3906			22-6008
Q318		NPN BC109			22-6041

Integrated Circuits

U301		MC33171			224351
U302		DIL 74LS132			224582

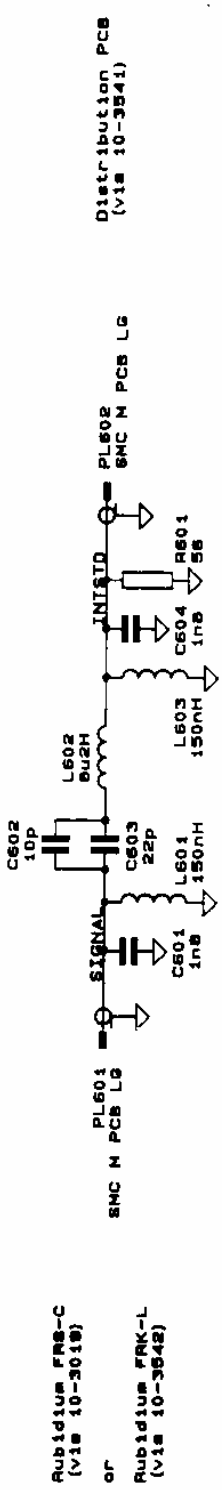
Switch

SW1		Ultra Miniature DPDT			234148


Circuit Diagram:
Reference Change Over Board 19-3172 Fig 8
9480
A4260/IN

PARTS LIST
FRS-BPF PEC ASSEMBLY 19-3124
(FIGURE 9)

Cct. Ref.	Value	Description	Rating	Tol.	Part Number
Resistors					
	Ohms	w			
R601	56		0.25	5	20-2560
Capacitors					
	F		V		
C601	1.8n				21-1920
C602	10p	Ceramic	63		21-1680
C603	22p	Ceramic	63		21-1684
C604	1.8n				21-1920
Inductors					
	H				
L601	150n	RF Inductor		10	23-7182
L602	8.2µ	RF Inductor		5	23-7250
L603	150n	RF Inductor		10	23-7182
Miscellaneous					
PL601		SMC Male Connector			23-3482
PL602		SMC Male Connector			23-3482



Circuit Diagram:
FRS BPF PEC Assembly 19-3124 Fig 9

9480
A4260/IN

PARTS LIST
DISPLAY PEC ASSEMBLY 19-3107
(FIGURE 10)

Cct. Ref.	Value	Description	Rating	Tol.	Part Number
Resistors					
	Ohms		**W**		
R401		Resistor Array 9x560k			20-5551
R402		Insulated Link			23-9124
R403	560k		0.25	5	20-2564
R404	560k		0.25	5	20-2564
R405	560k		0.25	5	20-2564
R406	1k5		0.25	5	20-2152
R407	470k		0.25	5	20-2474
R408	1k		0.25	5	20-2102
R409	1k		0.25	5	20-2102
R410	1k		0.25	5	20-2102
R411	1k		0.25	5	20-2102
R412	1k		0.25	5	20-2102
R413	1k		0.25	5	20-2102
R414	1k		0.25	5	20-2102
R415	1k		0.25	5	20-2102
R416	1k5		0.25	5	20-2152
R417	560k		0.25	5	20-2564
R418	1k5		0.25	5	20-2152
R419	1k5		0.25	5	20-2152
R420	560k		0.25	5	20-2564
R421	1k5		0.25	5	20-2152
R422	1k5		0.25	5	20-2152
R423	1k	Potentiometer			20-7066

Capacitors

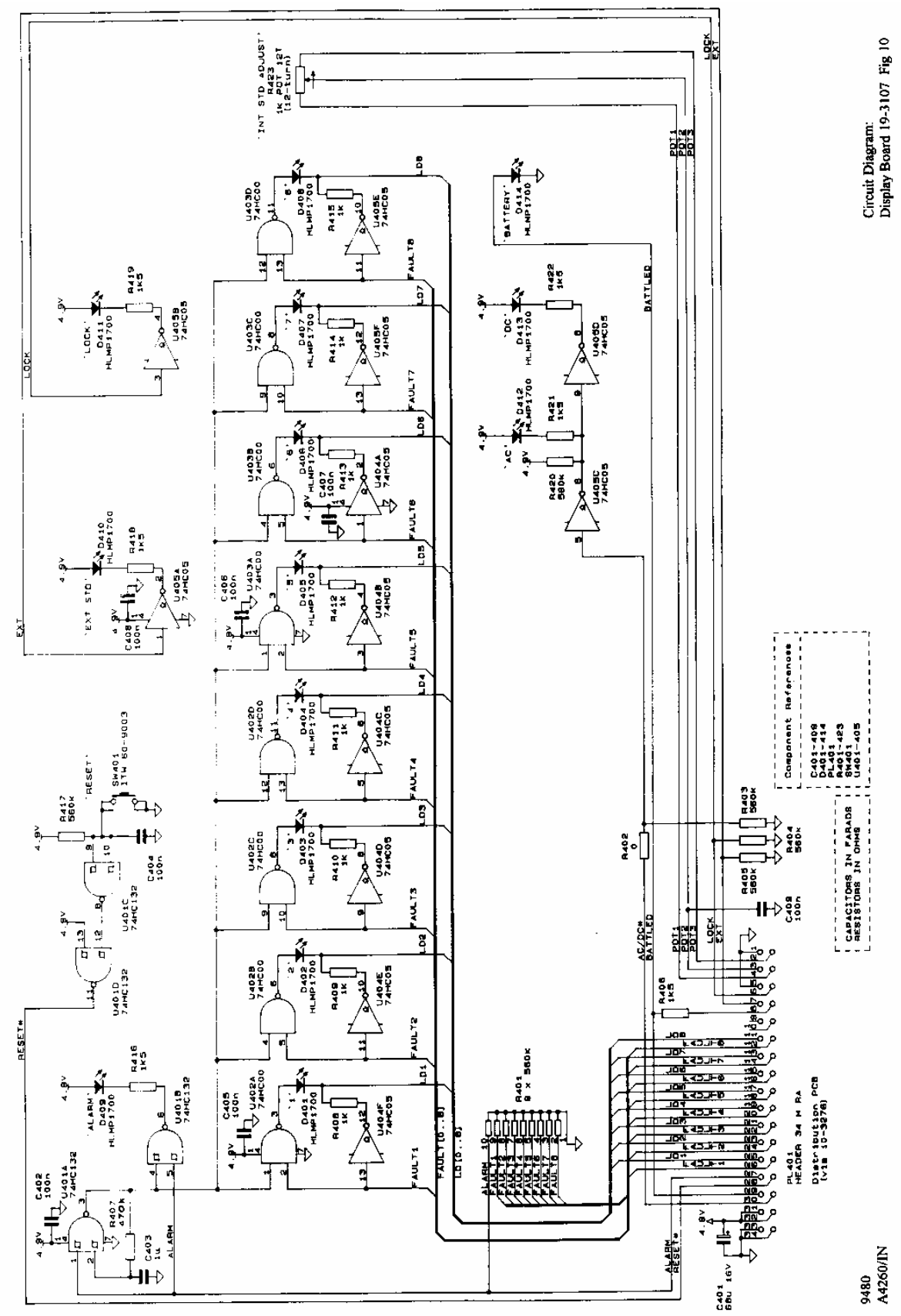
	F		**V**		
C401	68µ	Electrolytic	16		21-0625
C402	100n	Ceramic			21-1708
C403	100n	Tantulum	35		21-1041
C404	100n	Ceramic			21-1708
C405	100n	Ceramic			21-1708
C406	100n	Ceramic			21-1708
C407	100n	Ceramic			21-1708
C408	100n	Ceramic			21-1708
C409	100n	Ceramic			21-1708

Integrated Circuits

U401		74HC132			224813
U402		74HC00			224775
U403		74HC00			224775
U404		74HC05			224916
U405		74HC05			224916

Miscellaneous

S401		Pushbutton Switch			234123
P1401		34 Way Connector			23-3644
D401-414		Red LEDs, HLMP1700			26-5033


Circuit Diagram:
Display Board 19-3107 Fig 10
9480
A4260/IN
Component References
C401-409
D401-414
PL401
R401-423
SW401
U401-405
CAPACITORS IN FARADS
RESISTORS IN OHMS
PL401
HEADER 34 M RA
Distribution PCB
(Via 19-3278)
LOCK
EXT
BATTLED
AC/DCN
RESET*
ALARM
FAULT(0..8)
LD(0..8)
R401
8 x 560K
R402
0
R403
560K
R404
560K
R405
560K
R406
1K5
C409
100n
C401
68u 16V
'LOCK'
'EXT STD'
'ALARM'
'RESET'
'INT STD ADJUST'
R423
1K POT 12T
(12-turn)
'BATTERY'
'DC'
'AC'

PARTS LIST
QUARTZ STANDARD ASSEMBLY 04A AND 04B OPTION
19-3141
(FIGURE 11)

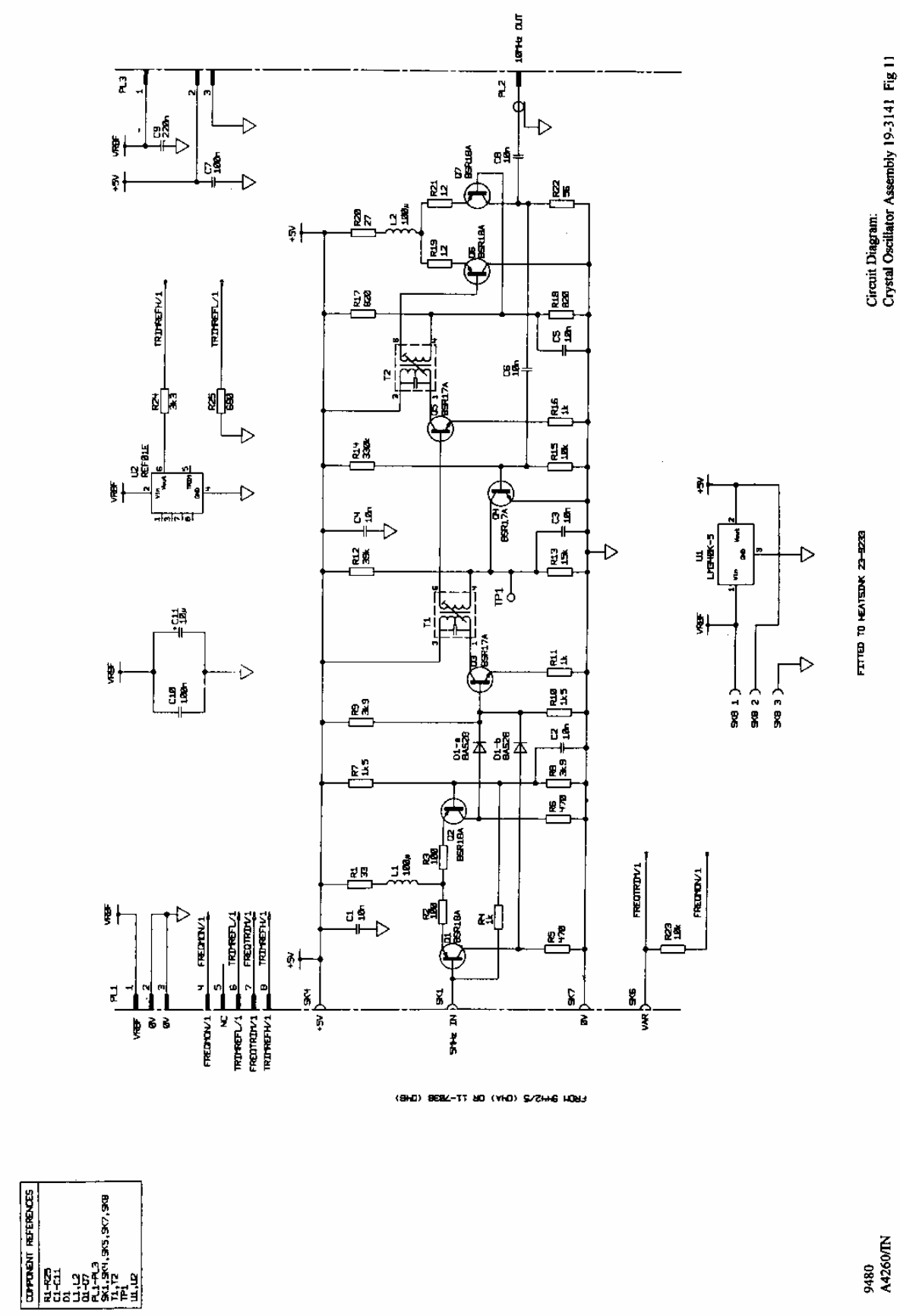
Cct. Ref.	Value	Description	Rating	Tol.	Part Number
Resistors					
	Ohms		W		
R1	33	Res Chip	0.125	5	20-5776
R2	100	Res Chip	0.125	5	20-5764
R3	100	Res Chip	0.125	5	20-5764
R4	1k	Res Chip	0.125	5	20-5792
R5	470	Res Chip	0.125	5	20-5765
R6	470	Res Chip	0.125	5	20-5765
R7	1k5	Res Chip	0.125	5	20-5794
R8	3k9	Res Chip	0.125	5	20-5798
R9	3k9	Res Chip	0.125	5	20-5798
R10	1k5	Res Chip	0.125	5	20-5794
R11	1k	Res Chip	0.125	5	20-5792
R12	39k	Res Chip	0.125	5	20-5808
R13	15k	Res Chip	0.125	5	20-5803
R14	330k	Res Chip	0.125	5	20-5816
R15	10k	Res Chip	0.125	5	20-5768
R16	1k	Res Chip	0.125	5	20-5792
R17	820	Res Chip	0.125	5	20-5791
R18	820	Res Chip	0.125	5	20-5791
R19	12	Res Chip	0.125	5	20-5772
R20	27	Res Chip	0.125	5	20-5775
R21	12	Res Chip	0.125	5	20-5772
R22	56	Res Chip	0.125	5	20-5779
R23	10k	Res Chip	0.125	5	20-5768
R24	3k3	Res Chip	0.125	5	20-5797
R25	680	Res Chip	0.125	5	20-5790
Capacitors					
	F	V			
C1	10n	Ceramic	50	10	21-1801
C2	10n	Ceramic	50	10	21-1801
C3	10n	Ceramic	So	10	21-1801
C4	10n	Ceramic	50	10	21-1801
C5	10n	Ceramic	50	10	21-1801
C6	10n	Ceramic	50	10	21-1801
C7	100n	Ceramic	50	20	21-1708
C8	10n	Ceramic	50	10	21-1801
C9	220n	Polyester	63	10	214566
C10	10n	Ceramic	50	20	21-1708
C11	10µ	Aluminum Electrolytic	63	20	21-0751
Inductors					
	H				
L1	100µ	Inductor Chip		10	23-7424
L2	100µ	Inductor Chip		10	23-7424
Diodes					
D1		Diode BAS28			22-1116
Transistors					
QI		PNP BSR18A			22-6199
Q2		PNP BSR18A			22-6199
Q3		NPN BSRI7A			22-6197
Q4		NPN BSRI7A			22-6197
Q5		NPN BSRI7A			22-6197
Q6		PNP BSR18A			22-6199
Q7		PNP BSRI8A			22-6199

Integrated Circuits

U2		+10 V Precision Reference REF01E			224361

Miscellaneous

T1		TOKO Detector Coil			23-7149
T2		TOKO Detector Coil			23-7149


Circuit Diagram:
Crystal Oscillator Assembly 19-3141 Fig 11
FITTED TO HEATSINK 23-8238
10MHz OUT
COMPONENT REFERENCES
R1-R25
C1-C11
D1
L1,L2
Q1-Q7
PL1-PL3
SK1,SK4,SK5,SK7,SK8
T1,T2
TP1
U1,U2
9480
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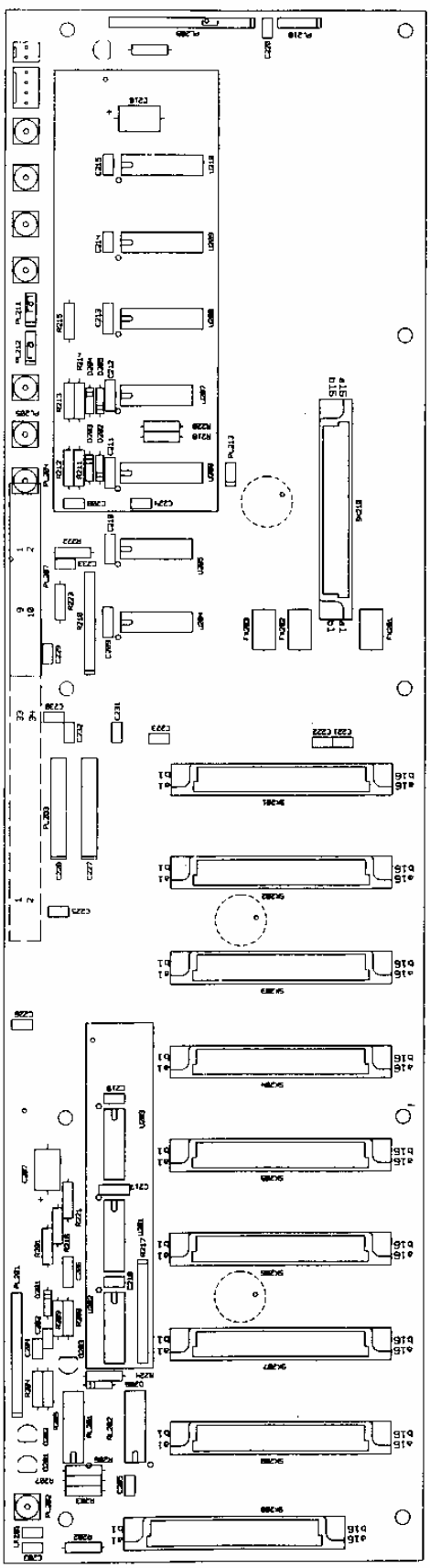

Component Layout:
Distribution Board Assembly 19-3106 Fig 12

9480
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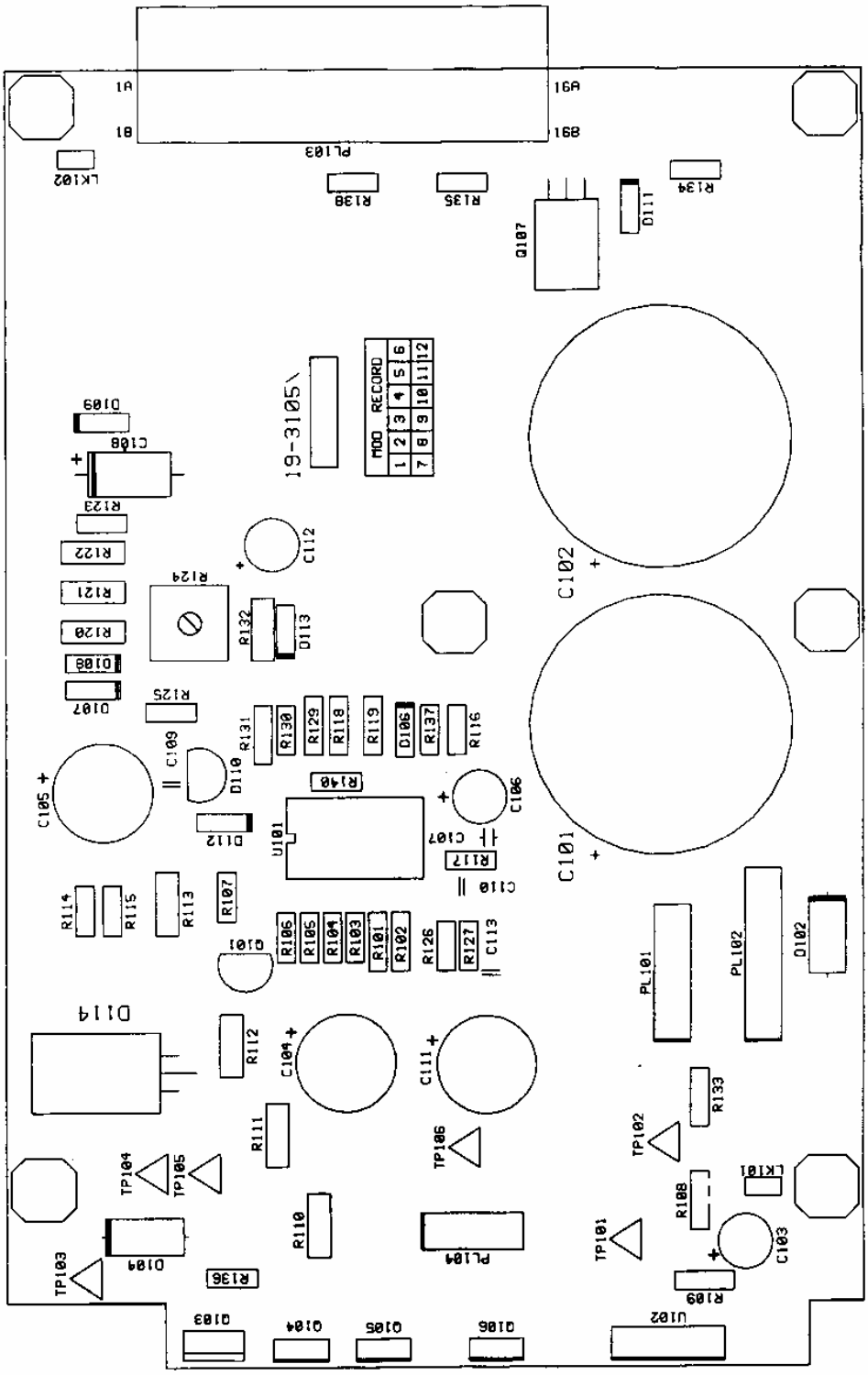
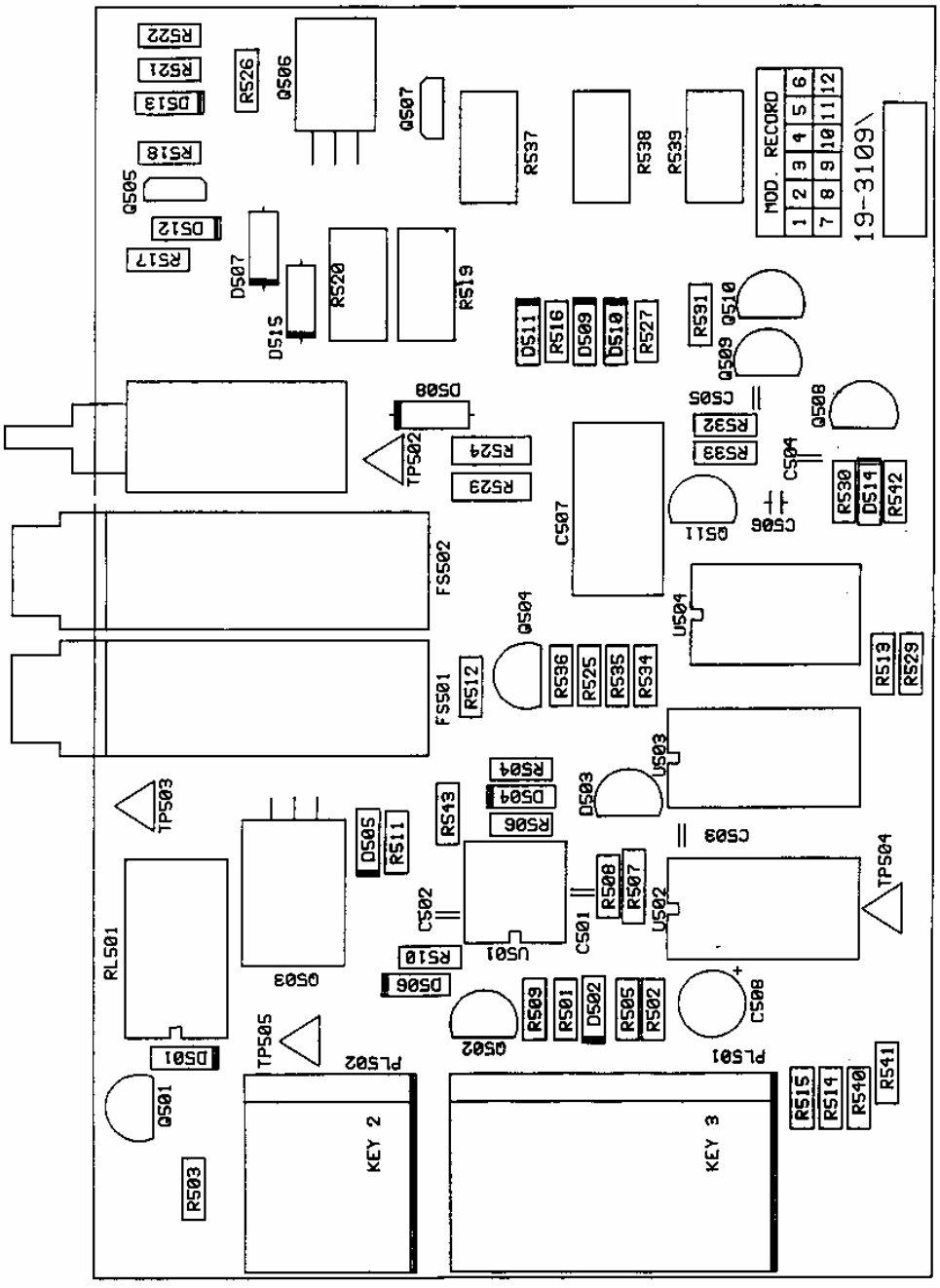
Component Layout:
PSU Assembly 11-7074 Fig 13



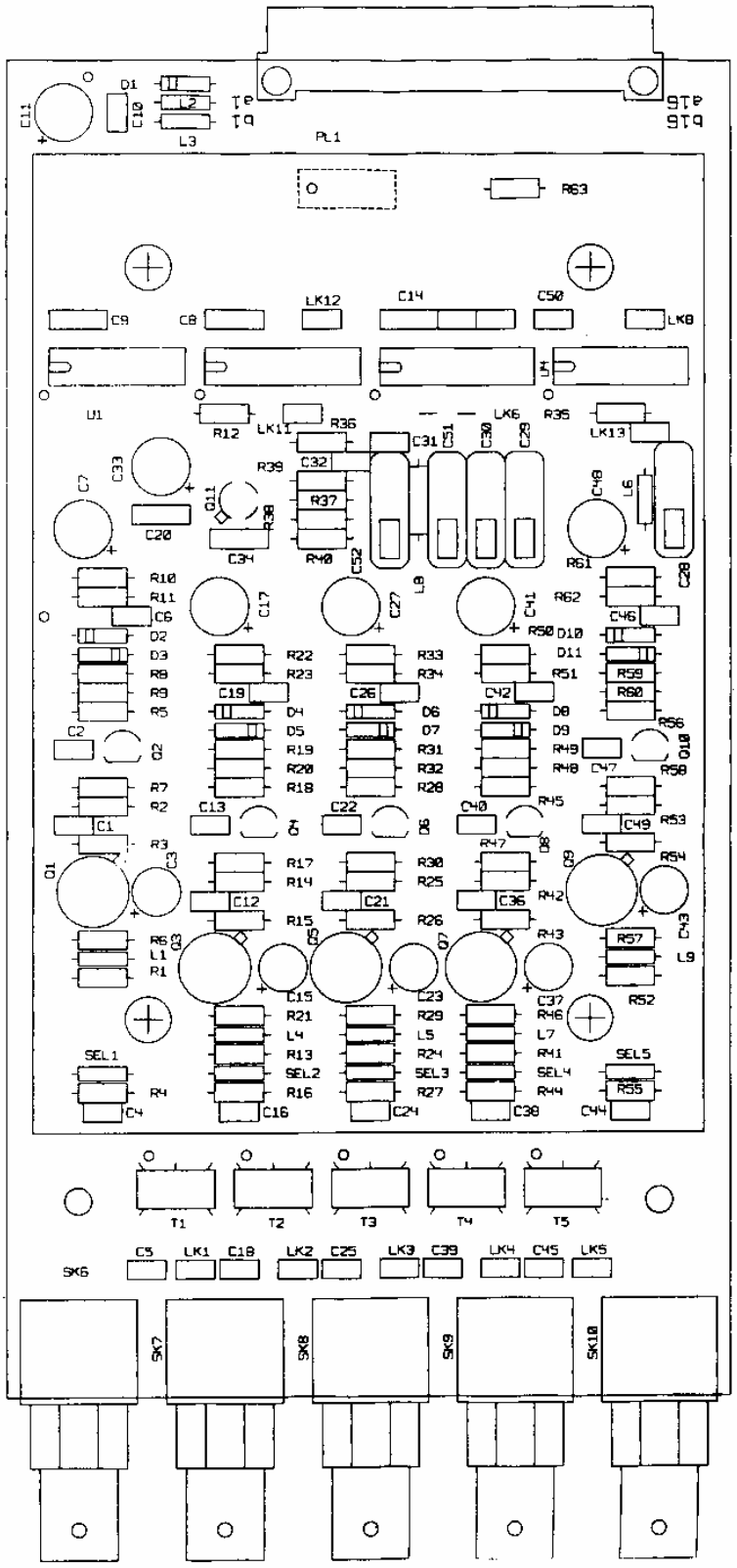
Component Layout:
Power Supply PEC Assembly 19-3105 Fig 14

9480
A4260/IN



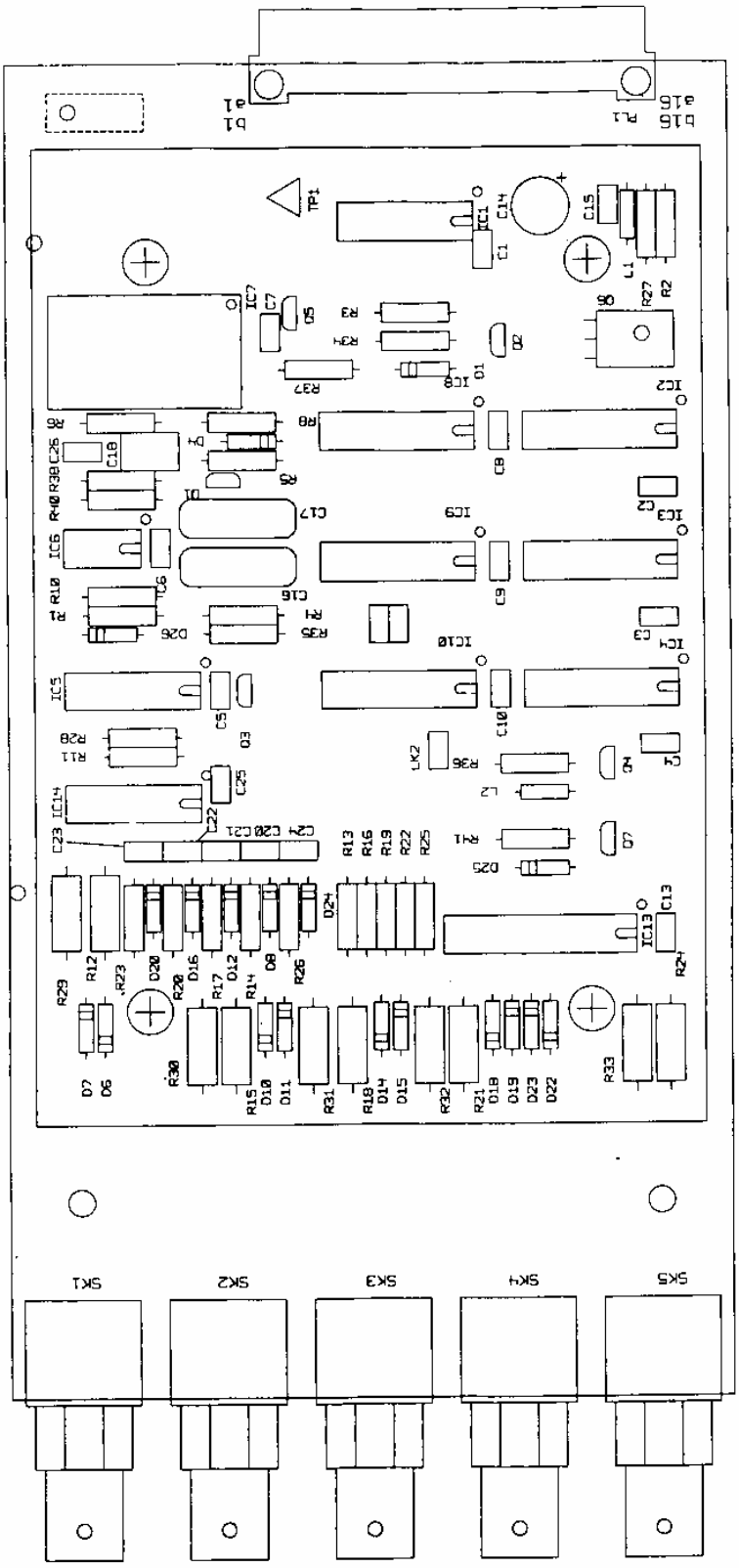
Component Layout:
Battery Control PEC Assembly 19-3109 Fig 15

9480
A4260/IN



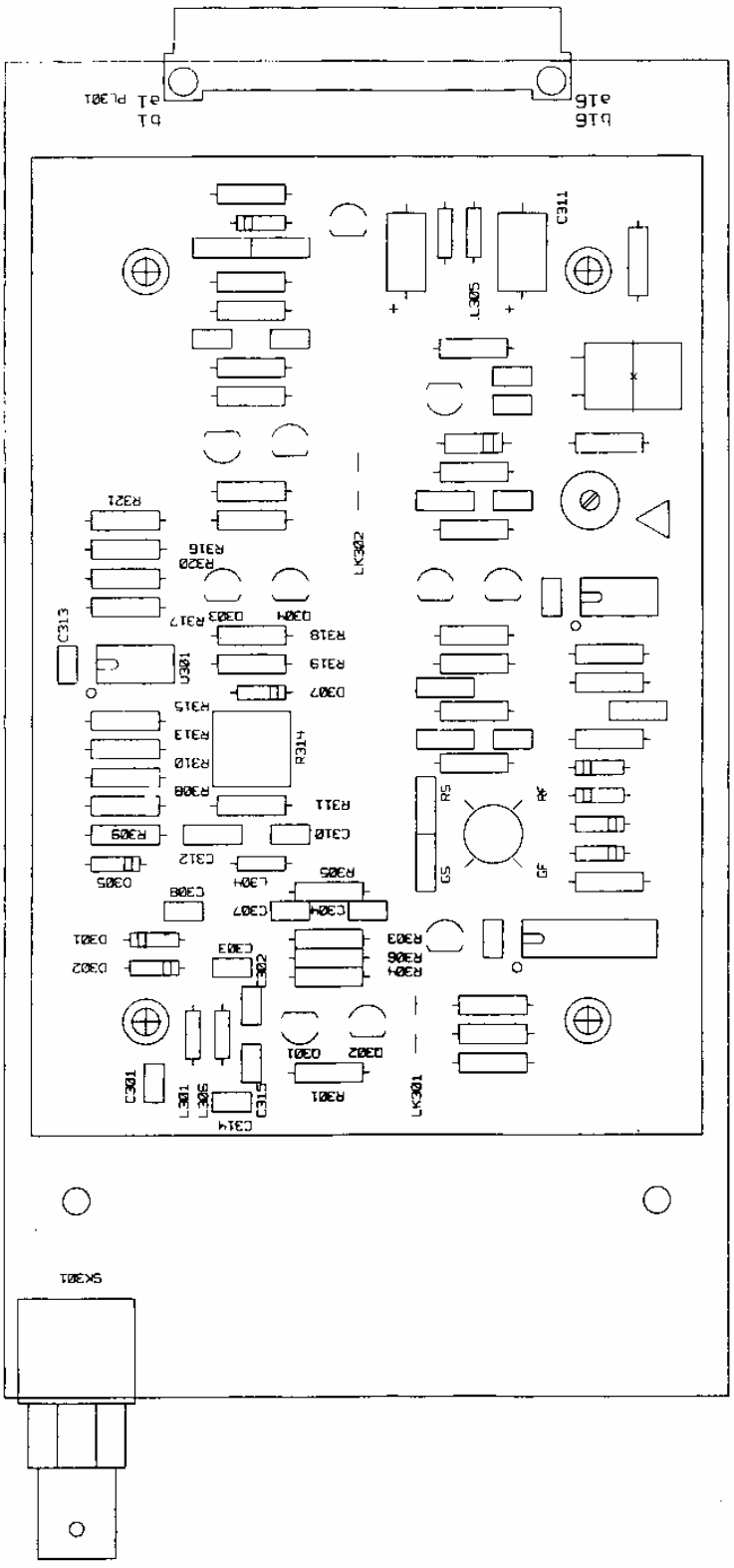
Component Layout:
Output Board(s) 19-3100 to 3104 Fig 16

9480
A4260/IN



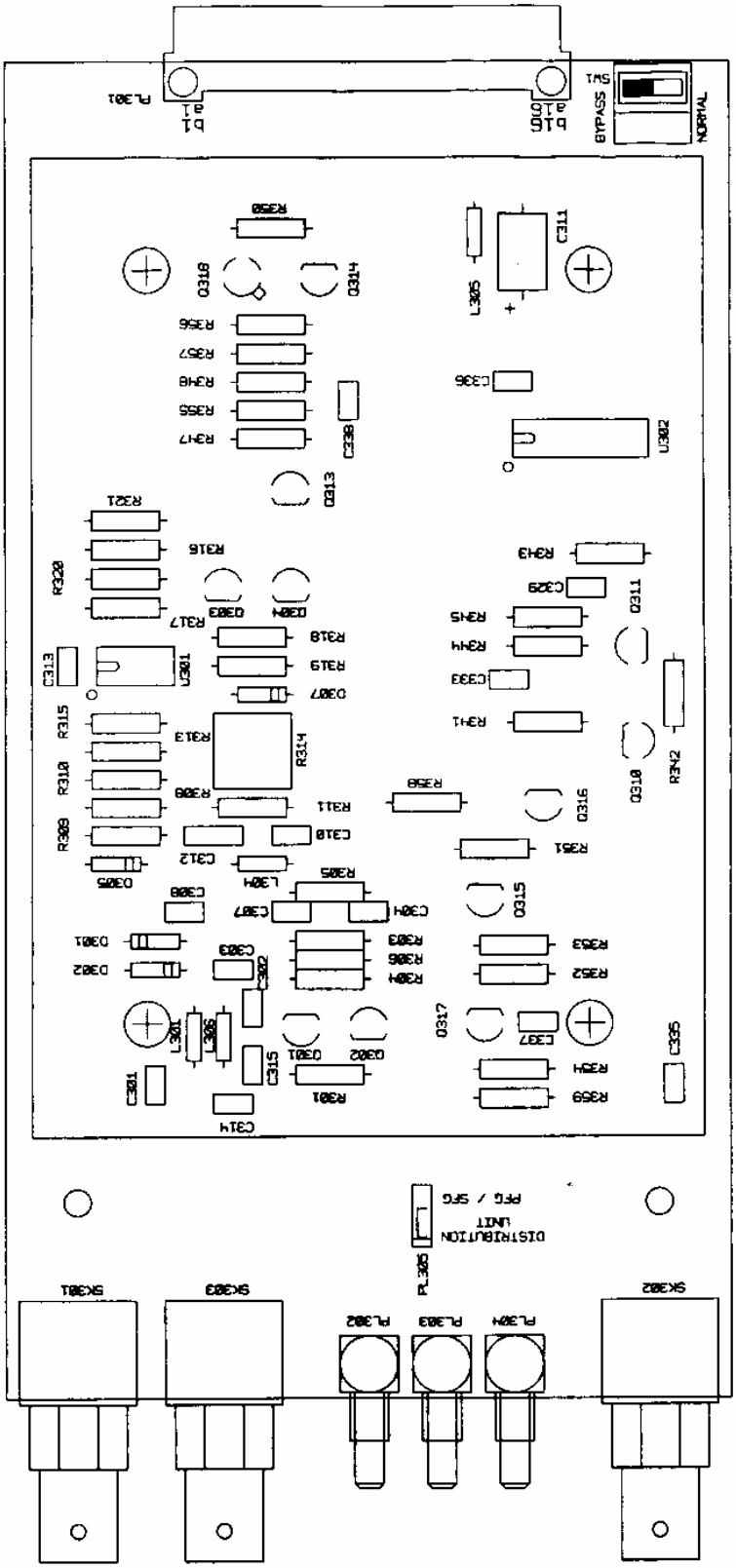
Component Layout:
2.048 MHz TTL Output Board 19-3125 Fig 17

9480
A4260/IN



Component Layout:
Multiplier Assy 19-3139/Reference Assy 19-3108 Fig 18

9480
A4260/IN



Component Layout:
Reference Change Over Board 19-3172 Fig 19

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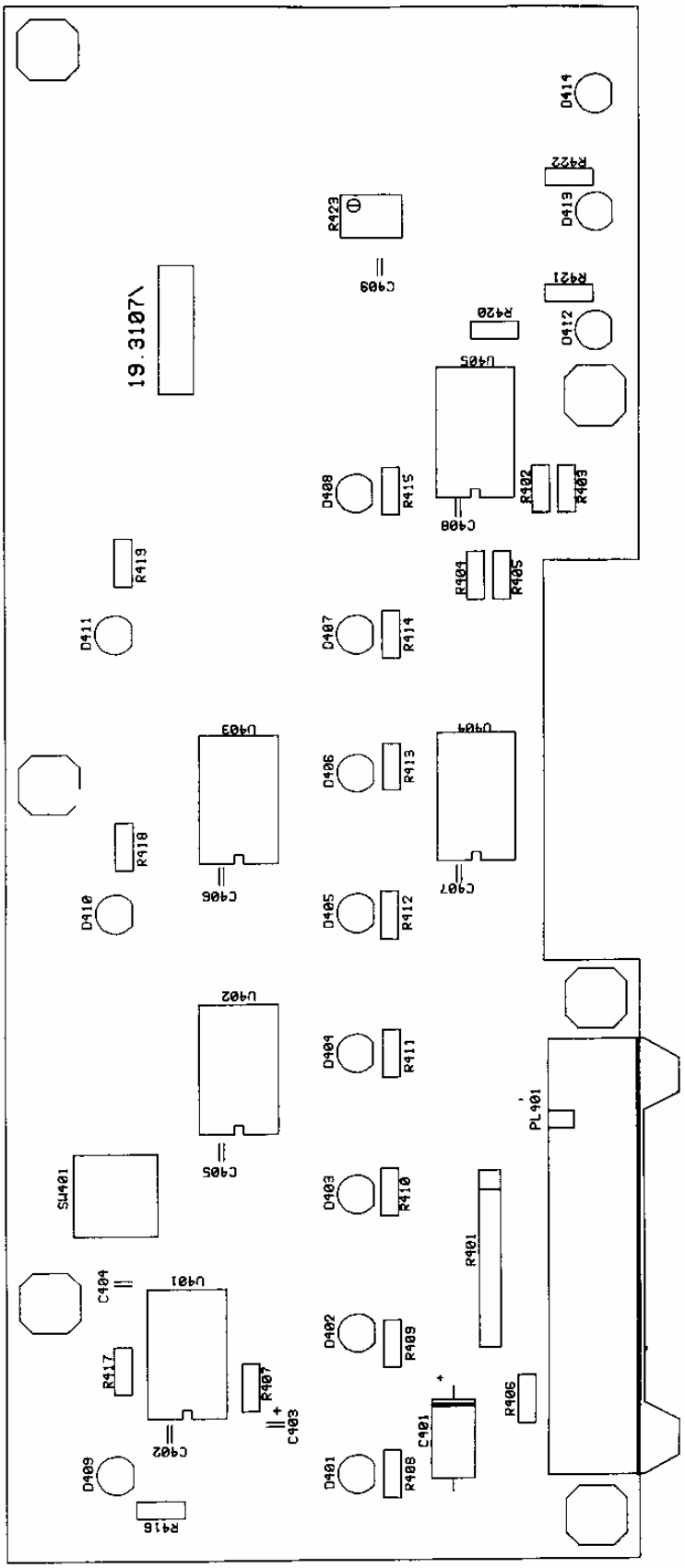
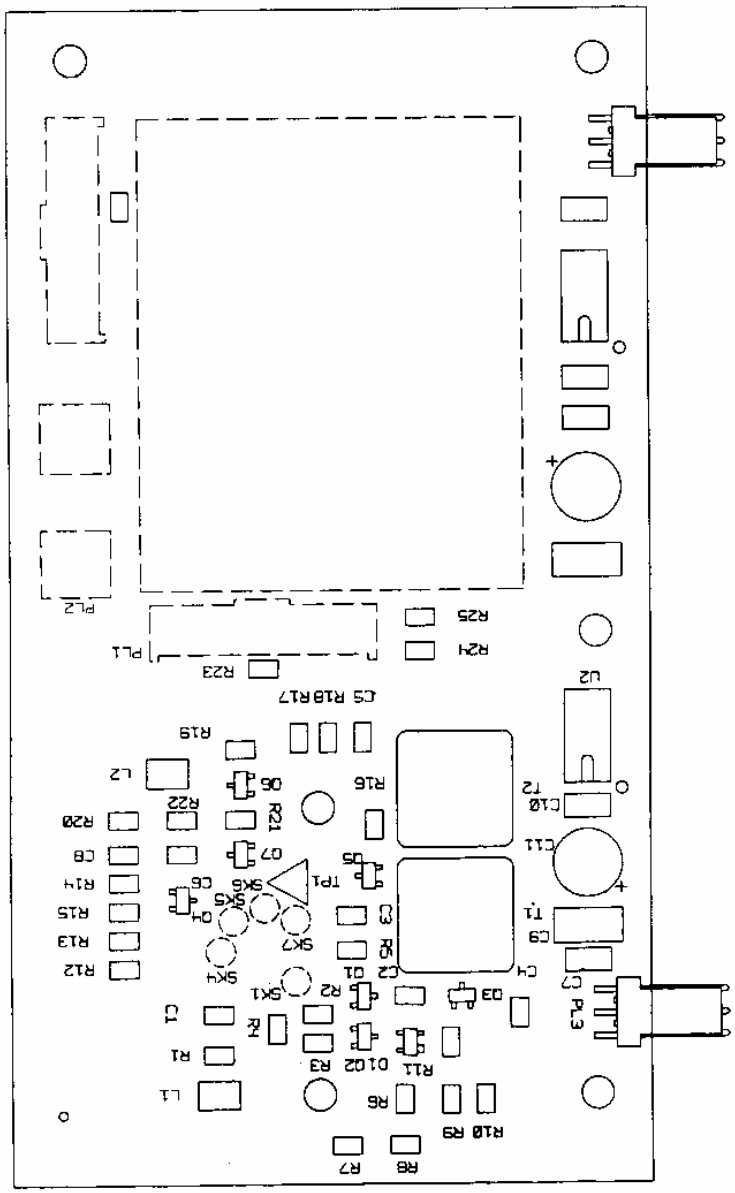
Component Layout:
FRS BPF PEC Assembly 19-3124 Fig 20



Component Layout:
Display Board 19-3107 Fig 21



Component Layout:
Crystal Oscillator Assembly 19-3141 Fig 22

9480
A4260/IN

Chapter 8
PRODUCT SUPPORT

Product Support

Racal Instruments has a complete Service and Parts Department. If you need technical assistance or should it be necessary to return your product for repair or calibration, call 1-800-722-3262. If parts are required to repair the product at your facility, call 1-949-859-8999 and ask for the Parts Department.

When sending your instrument in for repair, complete the form in the back of this manual.

For worldwide support and the office closes to your facility, refer to the Support Offices section on the following page.

Reshipment Instructions

Use the original packing material when returning the 9480 to Racal Instruments for calibration or servicing. The original shipping crate and associated packaging material will provide the necessary protection for safe reshipment.

If the original packing material is unavailable, contact Racal Instruments Customer Service for information.

Support Offices

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